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Farmers's practices and attitudes towards artificial fed lambs and their mortality in meat systems

Xavier Boivin, Pauline Malarange, Anne Jarousse, Jean-Marc Gautier, Christophe Mallet, Frédéric Bouvier, Marie-Madeleine Mialon, Florence Kling-Eveillard, Laurence L.A. Guilloteau

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Proceedings of the 7th International Conference on the Assessment of Animal Welfare at Farm and Group level

Ede, The Netherlands
September 5-8, 2017

edited by:
Ingrid C. De Jong and Paul Koene



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Welcome to WAFL 2017!

The on-farm assessment of animal welfare is entering a new phase. For many years its application was limited mainly to scientific studies on the effects of various husbandry practices. But times are changing and animal welfare is increasingly considered to be an integral part of sustainable livestock production, and not just a legislative burden to agriculture in Europe. Initiatives such as the OIE Standards and the more recent ISO Specification on Animal Welfare Management aim to improve welfare at a global level, and food chains in many parts of the world are now considering and implementing animal friendlier ways of production. These developments require welfare to be assessed by the food business operators themselves, taking welfare assessment out of the laboratory, and putting it into farming practice.

The 7th international conference on Welfare Assessment at Farm and Group Level is organised by Wageningen University & Research, in collaboration with Van Hall Larenstein university of applied sciences. We consider it an honour to host WAFL 2017 in the Netherlands this year. We have made an effort to support the developments described above, by providing an opportunity for business and science to meet and work on innovative and practical ways to improve animal well-being.

There are many people who have contributed to this year's conference. You can find their names on the following pages. Without their help WAFL 2017 would not have been possible – thank you very, very much! We are also grateful for the professional support we received from Joke Scholte (ArtoFakt), Mike Jacobs (Wageningen Academic Publishers) and Oane de Hoop (OanEvents) who made our lives so much easier.

On behalf of the organising committee, we would like to welcome you to WAFL 2017 and wish you a stimulating and enjoyable conference.

Hans Spoolder

Bas Kemp

Acknowledgements

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Paul Koene
Kees van Reenen
Inonge Reimert
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Tuesday 5 September Innovation Day

9:00 – 9:30 Reception, coffee

9:30 – 9:45 Welcome and introduction

9:45 – 10:30 **Keynote** *Daniel M. Weary* (UBC Canada)

Innovations to improve animal welfare: what have we reached and what should we aim for?

10:30 – 12:00 **Pitch presentations welfare innovations**

Joep Driessen, Jan Hulsen and Wiebe Veenstra*

Keep cow and calf health and stress-free with cowsignals cuddle box

Elske N De Haas, Jerine A.J. Van Der Eijk, Lydia E. Nieuwe Weme, Bram Van Mil and T. Bas Rodenburg*

Phenolab: ultra-wide band tracking of individual group housed laying hens

Steen H. Møller, Britt I.F. Henriksen and Anna F. Marsbøll*

Full-scale implementation of WelFur-Mink in Europe – only certified pelts will be sold from 2020

Maikel Timmerman, Marion Kluivers-Poodt, Inonge Reimert, Herman Vermeer, Ruud Barth, Gert Kootstra, Johan Van Riel and Kees Lokhorst*

Creating Resilience in Pigs Through Artificial Intelligence (CuRly Pig TAIL)

Margit Dall Aaslyng, Helle Daugaard Larsen, Glenn Brink Nielsen and Per Black*

Measuring tail length and tail bites on pig carcasses

Anne Van Den Oever, Liebrechts Bas and van de Ven Lotte*

Q-perch helps fight poultry red mite

M.F. Mul, J.W. Van Riel, P.G.W. Groot Koerkamp, M. Dicke, G. Schoeber and D. Fetter*

The automated mite monitoring tool for advancing integrated pest management for *Dermanyssus gallinae*

Paul Jackson

Innovative concept building design using passive technology to improve resource efficiency

David Speller

OPTIFarm broiler management

Paul Koene

Adding social network information to automated dairy cow management

Elnaz Khatami

Improving animal health and welfare by on-line SCC monitoring instrument 'LUCI'

*M.A.W. Ruis, A. Mens, R. Zanders and J. Katoele**

Feeding live black soldier fly larvae and effects on health, welfare and production of laying hens

Carla Van Der Pol

HatchCare, the poultry incubator with feed, light, and water

12:00 – 12:30 Plenary discussion

12:30 – 13:30 Lunch

13:30 – 16:00 Innovation market

16:00 – 17:00 Plenary discussion and voting innovation award

17:00 – 22:00 Drinks and dinner, welcome reception WAFL congress

Wednesday 6 September 2017

7:30 – 8:30 Registration & coffee

8:30 – 9:00 Opening & welcome

Session: Sustainability and animal welfare

Chairperson: *Elsa Vasseur*

9:00 – 9:45 **Keynote** *Imke de Boer*

Future food systems: implications for animal welfare

9:45 – 10:00 *Carolina A. Munoz**, *Angus J.D. Campbell*, *Paul H. Hemsworth* and *Rebecca E. Doyle*

On-farm ewe welfare and its relationship with farmer management styles

10:00 – 10:15 *Luiza Toma*, *Marie J. Haskell**, *Andrew P. Barnes* and *Alistair W. Stott*

Relationship between animal welfare, production and environmental performance of dairy farms

10:15 – 10:45 Coffee break (& posters)

Session: Sustainability and animal welfare / Free papers

Chairperson: *Jan Tind Sørensen*

10:45 – 11:00 *Evelien De Olde**, *Eddie Bokkers* and *Imke De Boer*

The evaluation of animal welfare in sustainability assessment tools

11:00 – 11:15 *Lukas Tremetsberger*, *Jochen Kantelhardt* and *Christoph Winckler**

Animal health and welfare state and technical efficiency of dairy farms: possible synergies

11:15 – 11:30 *Sajeev Erangu Purath Mohankumar**, *Kian Mintz-Woo*, *Barbara Amo* and *Wilfried Winiwarter*

Ethical and agronomical considerations towards a sustainable pig housing system

11:30 – 11:45 *X. Boivin**, *P. Malarange*, *A. Jarousse*, *J.M. Gautier*, *C. Mallet*, *F. Bouvier*, *M.M. Mialon*, *F. Kling-Eveillard* and *L.A. Guilloteau*

Farmers' practices and attitudes towards artificial fed lambs and their mortality in meat systems

11:45 – 12:00 *Helena Telkanranta** and *Anna Valros*

Could pigs have unidentified behavioural needs that warrant inclusion in future welfare assessments?

12:00 – 13:30 Lunch

Session: Animal welfare in society

Chairperson: *Daniel Weary*

13:30 – 14:15 **Keynote** *Noelle Aarts*

The art of dialogue

14:15 – 14:30 *Katherine E. Koralesky** and *David Fraser*

Dairy industry stakeholder perceptions of British Columbia's emergency slaughter program

14:30 – 14:45 *Sarah Gauly*, *Marie Von Meyer-Höfe*, *Achim Spille* and *Gesa Busch**

Does the background matter – people's perception of pictures of pigs in different farm settings

- 14:45 – 15:00 *Lenka Van Riemsdijk**, *Paul T.M. Ingenbleek*, *Gerrita Van Der Veen* and *Hans C.M. Van Trijp*
Addressing the social dilemma in animal-friendly product choice with positioning strategies
- 15:00 – 15:15 *Karianne Muri**, *Per Arne Tufte* and *Randi Oppermann Moe*
Sheep farmers' behavioural attitudes are associated with intrinsic motivation and job satisfaction
- 15:15 – 15:30 *Manika Rödiger**, *Meike Janssen* and *Ulrich Hamm*
Multi-level animal welfare labels reflect consumer preferences: insights from a systematic review
- 15:30 – 16:30 Tea & posters
- 16:30 – 18:00 **Workshops**
- Workshop 1 *Hanneke Nijland*
Workshop animal farming and consumption
- Workshop 2 *Bas Engel* and *Bart Ampe*
Sensible statistics in animal welfare research
- Workshop 3 *Sophie de Graaf*, *Leonie Jacobs*, *Olga Szczodry* and *Frank Tuytens*
Towards a unified definition of animal welfare among animal welfare scientists
- Workshop 4 *Björn Forkman*
Welfare Quality: current state-of-the-art and a look into the future
- Workshop 5 *Paul Koene*, *Jose Kok* and *Jens Krause*
Zoo Animal Welfare: are we happy together?

Thursday 7 September 2017

Session: Social networks in animal welfare

Chairperson: *Janice Siegford*

8:30 – 9:15

Keynote *Jens Krause*

Social network analysis: opportunities and challenges for applications in wild and domestic animal populations

9:15 – 9:30

Yuzhi Li, Haifeng Zhang, Lee Johnston and Wayne Martin*

Understanding tail biting in pigs through social network analysis

9:30 – 9:45

Borbala Foris, Manuela Zebunke, Jan Langbein and Nina Melzer*

Relationship between personality and social behaviour in dairy cattle

9:45 – 10:00

Simone Foister, Andrea Doeschl-Wilson, Rainer Roehe, Laura Boyle and Simon Turner*

Can aggressive network structures at mixing be used to predict lesion outcomes in pigs?

10:00 – 10:15

Jen-Yun Chou, Emma M. Baxter and Lesley A. Smith*

Effect of environmental enrichment on the social contact patterns of group housed sows

10:15 – 10:45 Coffee break (& posters)

Session: Welfare assessment / Genetics and animal welfare

Chairperson: *Jim Webster*

10:45 – 11:00

Timothy Giles, Scott Hulme, Paul Barrow, Nathalie Le Floc'h, Anne-Marie Chaussé, Panagiotis Sakkas, Tommy Van Limbergen, Suso Mendez, Joaquín Morales and Neil Foster*

Identification of genes which are associated with production diseases in pigs and chickens

11:00 – 11:15

P.K. Mathur, R.H. Vogelzang, H.A. Mulder and E.F. Knol*

Genetic selection to enhance animal welfare using meat inspection data from slaughter plants

11:15 – 11:30

Juan P. Steibel, Rodolfo J.C. Cantet and Janice M. Siegford*

Modelling intensity of interaction to estimate direct and indirect genetic effects

11:30 – 11:45

Leonie Jacobs, Evelyne Delezie, Klara Goethals, Bart Ampe, Luc Duchateau and Frank Tuytens*

Development and application of a pre-slaughter welfare monitoring protocol for broilers

11:45 – 12:00

Nienke Van Staaveren, Bernadette Doyle, Edgar G. Manzanilla, Julia A. Calderón Díaz, Alison Hanlon and Laura A. Boyle*

Validation of lesions on the carcass as indicators of pig welfare on farm

12:00 – 14:00 Lunch & Posters

Parallel session 1: Welfare assessment		Parallel session 2: Welfare assessment		
Chair: Marie J. Haskell		Chair: Keelin O'Discroll		
14:00 – 14:30	Short keynote <i>Peter Sandøe*, Thomas Bøker Lund, Björn Forkman and Matt Denwood</i>	Should the contribution of one more lame cow depend on how many other cows on the farm are lame?	Short keynote <i>Fanny Pandolfi*, Ilias Kyriazakis, Katja Stoddart, Nina Wainwright and Sandra E. Edwards</i>	Welfare benchmarking for commercially farmed pigs in the UK
14:30 – 14:45	<i>Daniela Haager*, Christine Leeb and Christoph Winckler</i>	Validation of hock lesions as welfare indicator in dairy cows	<i>Gwendolyn Rudolph, Sabine Dippel, Davide Bochicchio, Sandra Edwards, Barbara Früh, Mirjam Holinger, Diane Holmes, Gudrun Illmann, Denise Knop, Armelle Prunier, Tine Rousing, Christoph Winckler and Christine Leeb*</i>	Does animal health and welfare of organic pigs differ between husbandry systems?
14:45 – 15:00	<i>Sabine Hartmann*, Verena Wesian, Christoph Winckler, Christine Berger, Marlene Berger, Edina Scherzer and Christine Leeb</i>	Implementation of animal-based measures within an animal-welfare labelling scheme for steers	<i>Tom Van Hertem*, Tomas Norton, Daniel Berckmans and Erik Vranken</i>	The relation between impaired gait and automated monitoring of broiler flock activity levels
15:00 – 15:15	<i>Marianne Villettaz Robichaud, Jeffrey Rushen, Anne Marie De Passillé, Elsa Vasseur*, Derek Haley, Karin Orsel and Doris Pellerin</i>	Association between animal welfare standards and farm profitability on Canadian freestall dairies	<i>Mona Franziska Giersberg*, Birgit Spindler and Nicole Kemper</i>	Assessment of plumage and integument condition in dual-purpose breeds and conventional layers
15:15 – 15:30	<i>Asja Ebinghaus*, Silvia Ivemeyer, Vanessa Lauks, Laura Santos, Kerstin Brügemann, Sven König and Ute Knierim</i>	How to measure dairy cows' responsiveness towards humans in breeding and welfare assessment?	<i>Stephanie Buijs*, Christine Nicol, Francesca Booth, Gemma Richards and John Tarlton</i>	Effects of automated monitoring equipment on laying hen behaviour

15:30 – 15:45	<i>Frida Lundmark*</i> , <i>Charlotte Berg and</i> <i>Helena Röcklinsberg</i>	Private animal welfare standards – opportunities and risks	<i>Lauren C. Dawson*</i> , <i>Cate E. Dewey,</i> <i>Elizabeth A. Stone,</i> <i>Michele T. Guerin</i> <i>and Lee Niel</i>	Development of an animal welfare assessment scheme for use in companion animal veterinary clinics
15:45 – 16:00	<i>Olga Szczodry*</i> , <i>Bart Ampe, Wouter Kraan,</i> <i>Emilie-Julie Bos, Annelies Van Nuffel and Frank Tuytens</i>	Using data from electronic sow feeders for investigating the effect of lameness on feeding behaviour	<i>Maud Bonato*</i> , <i>Tonny Muhvali, Anel Engelbrecht, Irek Malecki and Schalk Cloete</i>	Positive human-bird interactions improve welfare and production performance in the ostrich
16:00 – 16:15	<i>Hanne Kongsted*</i> <i>and Jan Tind Sørensen</i>	Abattoir data provide information on pig welfare at herd level in different production systems	<i>Yu Zhang*, Laureline Guinnefollau and Clive Phillips</i>	Effect of gaseous ammonia on eating and ruminating behaviour in sheep in simulated transport by sea
16:15 – 16:30	<i>Herman Vermeer*</i> <i>and Johan Van Riel</i>	Enforcement of ‘open standards’ for animal welfare – climate in pig houses	<i>Irena Czycholl*, Kathrin Büttner, Philipp Klingbeil, Michela Minero, Emanuela Dalla Costa, Francesca Dai and Joachim Krieter</i>	Evaluation of the AWIN welfare assessment protocol for horses regarding animal-based indicators

Friday 8 September 2017

Session: Avoiding bias in science

Chair: *Christoph Winckler*

9:00 – 9:45 **Keynote** *Jelte Wicherts*

The weak spots of contemporary science and how to strengthen it

9:45 – 10:00 *Nina Dam Otten**, *Tine Rousing* and *Björn Forkman*

Influence of professional affiliation on expert's views on animal welfare criteria

10:00 – 10:15 *L. Friedrich**, *I. Czycholl*, *N. Kemper* and *J. Krieter*

Reliability of the Welfare Quality® animal welfare assessment protocol for sows and piglets

10:15 – 10:45 Coffee break (& posters)

Session: Welfare assessment / Free papers

Chair: *Stephanie Buijs*

10:45 – 11:00 *Penny Lawlis** and *Tina Widowski*

Training outcomes for animal based measures

11:00 – 11:15 *Tine Rousing**, *Peter T. Thomsen* and *Jan Tind Sørensen*

Qualitative and quantitative animal behaviour measures in on-farm welfare assessments for pig herds

11:15 – 11:30 *Laura Boyle**, *John Mee* and *Joanna Marchewka*

Risks to welfare associated with changes in infrastructure and management in expanding dairy herds

11:30 – 11:45 *Kendy Teng**, *Brecht Devleesschauwer*, *Charline Maertens De Noordhout*, *Paul McGreevy*, *Peter Bennett*, *Jenny-Ann Toribio* and *Navneet Dhand*

Welfare-adjusted life years: combine welfare compromise and premature death to a whole

11:45 – 12:00 *Catalina Medrano-Galarza**, *Stephen Leblanc*, *Andria Jones-Bitton*, *Trevor Devries*, *Anne Marie De Passillé*, *Jeffrey Rushen*, *Marcia Endres* and *Derek Haley*

Interdependence of management and automated milk feeders to ensure dairy calf health

12:00 – 12:30 Closing session

12:30 – 13:30 Lunch (in a bag)

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Future food systems: implications for animal welfare*Imke De Boer**Wageningen University & Research, Animal Production Systems group, the Netherlands;
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The challenge to produce enough nutritious food for a growing and more prosperous population in a sustainable way is currently broadly acknowledged. It is now also largely undisputed that the animal sector uses a great deal of our natural resources, and contributes significantly to environmental issues. Furthermore, the way we keep our animals is debated in many countries across the world, because of concerns about among others the welfare of our production animals. My aim is to show different narratives about the future role of animals in an environmentally sustainable food system, as outlined in the scientific literature, and to discuss their implications for animal welfare. One dominant narrative is 'we need to produce more animal-source food (ASF) with less environmental impact'. Research that addresses this so-called production-narrative aims to improve the environmental efficiency of ASF production, and contributes to what is currently known as sustainable intensification of animal production. Solutions suggest, for example, a transition from grass-based to mixed feed-crop livestock systems, breeding of high yielding animals, use of growth stimulators and prevention of diseases. Although disease prevention is beneficial for animal welfare, the focus on increasing life-time productivity implies trade-offs with health and reproduction performance, and the possibility to express species specific behaviour. Another dominant narrative is 'we need to consume less or even no ASF, or ASF with a lower environmental impact'. Research that addresses this so-called consumption-narrative focuses on changing human consumption patterns by reducing or avoiding consumption of ASF, or shifting from ASF with a high impact, such as beef, to ASF with a lower impact, such as chicken, fish or insects. Although eating less ASF is beneficial from an overall welfare perspective (as welfare can be seen as the end-product of incidence (number of animals), severity (level of welfare), and the time animals are exposed to this level of welfare), the welfare of remaining animals is not addressed in this narrative. A relatively new narrative is 'animals are essential for resource-efficient food production, as they can convert biomass inedible for humans into nutritious ASF'. Research that addresses this so-called circular-narrative shows that natural resources are used most efficiently if animals are fed mainly on biomass inedible for humans, also referred to as leftovers. The amount of ASF that can be obtained from leftovers, however, depends on their type and availability (e.g. by-products food industry, food waste, crop residues, grass from marginal land), and their utilization potential by the animals. According to this circular narrative, low-yielding ruminants grazing marginal land can be more resource-use efficient than high-yielding ruminants fed grain and maize silage (best from the production narrative). Similarly, slow-growing chickens fed on insects or leftovers can be more resource-efficient than fast-growing chickens fed on grain. The circular narrative, therefore, offers most potential to produce in an environmentally-friendly and animal-friendly way. It however also implies that developed countries have to significantly reduce their consumption of ASF.

On-farm ewe welfare and its relationship with farmer management styles

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This study investigated the relationship between on-farm ewe welfare and farmer management styles in 25 sheep flocks in Victoria, Australia. One hundred ewes (aged 2-5) were assessed at each farm. Animals were managed extensively in a year-round outdoor system and farm visits were conducted after weaning (spring/summer 2016). The ewes were assessed by six valid animal-based measures: body condition score (BCS), fleece condition, skin lesions, tail length, dag score and lameness. Management-based measurements were collected through an interview with the farmers or farm managers. All measurements were collected by a single observer. To examine the relationship between ewe welfare and management, farmers were classified as having a 'passive' or 'proactive' management style. Farmers who do not measure the body condition of their ewes, do not maintain mortality records and do not scan for pregnancy, or scan but do not manage single and multiple ewes differently were classified as passive. Flock sizes ranged from 430 to 9,400 ($2,714 \pm 2,147$). Overall, 56% (n=14) of the farmers were classified as passive and 44% (n=11) as proactive. No differences were found in the average BCS of passive (2.9 ± 0.25) and proactive flocks (2.8 ± 0.19). However, a binomial generalized linear model showed that passive farmers had more ewes in inadequate BCS (too thin or too fat according to industry recommendations) ($P=0.004$), and more ewes needed further care in passive flocks (due to flystrike, severe lameness, etc.) compared to proactive flocks ($P=0.017$), indicating that farmers with passive management style have more ewes at risk of welfare compromise. This study constitutes the first investigation of sheep welfare and its relationship with management styles in Australia. These data will be further investigated to develop an intervention strategy to improve sheep welfare and productivity, with the ultimate goal of ensuring sustainability for the sheep industry.

Relationship between animal welfare, production and environmental performance of dairy farms

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Sustainability is thought of as consisting of three pillars: economic, social and environmental, and the concept can apply to farms as well as to societies. Farming systems are under pressure to reduce their environmental impact, but as they are businesses, farms must remain economically viable. Social concerns about animal welfare also influence the care and management of livestock. Little work has been done to investigate the relationship between production, environmental output and animal welfare outcomes of farms. In our study we visited 42 dairy farms across Scotland. The Welfare Quality® protocol was carried out on these farms. Data were collected on economic aspects, such as quantity of milk sold and labour, and on the environmental aspects required for a 'carbon footprint' estimation, which included fertiliser, land and fuel use. To simultaneously assess the welfare, environmental and productive performance of these farms, we developed Data Envelopment Analysis models. The models assess production efficiency (where high efficiency is defined as high production with low costs) while accounting for welfare and environmental impacts. The results provided a ranking of the farms based on their capacity to maximise welfare and production while minimising environmental footprint. Subsequently, the relationship between efficiency, welfare and environmental impacts was assessed by regressing the efficiency score for each farm against a number of variables such as no. of mastitis treatments, veterinarian visits and membership of biodiversity schemes using a Tobit approach. Significant differences were found between efficiency scores of farms by welfare score at principle level (good feeding, good housing, good health, appropriate behaviour) with scores ranging between 0.196 and 1. The results also indicate that animal health variables (mastitis treatments) and environmental characteristics (biodiversity schemes membership) have a significant effect on efficiency (all $P < 0.05$).

The evaluation of animal welfare in sustainability assessment tools

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A large number of sustainability assessment tools have been developed to gain insight into the sustainability performance of farms. The assessment results could be used by farmers to identify actions towards sustainable development in agriculture. An increase in research interest, market demand and changing consumer expectations has contributed to a rapid growth in the number of sustainability assessment tools. The tools vary, however, strongly in their scope (e.g. sector, geography, sustainability dimensions) and characteristics such as assessment time, data requirements, auditor, scoring and aggregation method. This diversity has resulted in concerns whether sustainability assessment tools provide valid and reliable conclusions on the sustainability performance of farms. In this study, we compared the approaches and assessment results of four sustainability assessment tools (RISE, SAFA, IDEA and PG) for the theme animal welfare. Our findings showed that each tool presents its own approach to assess animal welfare at farm level by using different indicators, auditors, and scoring and aggregation methods. Moreover, the comparison of assessment results revealed that the tools present different conclusions on the performance of a farm on animal welfare. This does not only cause confusion but also affects the trust in, and reliability of, sustainability assessments. The findings show the need to critically reflect on current approaches to assess animal welfare and sustainability at farm level. Increasing the validity and reliability of sustainability assessments is needed to use sustainability assessment tools for functions such as certification and benchmarking.

Animal health and welfare state and technical efficiency of dairy farms: possible synergies

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The present study investigated the association of animal health and welfare state as well as changes thereof with technical efficiency in a sample of 34 Austrian dairy farms. Health and welfare were assessed twice using the Welfare Quality® (WQ) assessment protocol for dairy cattle. Following a baseline welfare assessment, health and welfare planning was conducted on the farms. This included the identification, selection and implementation of measures in housing and management to improve health and welfare. One year after implementation, farms were reassessed to detect changes in the health and welfare state. Technical efficiency (TE), i.e. the degree to which farms combine inputs to produce outputs, was assessed using data envelopment analysis with herd size, annual labour and concentrate use as production factors and milk yield as output. This method formulates a best-practice frontier over all observed data points (farms). Efficient farms lie on the frontier and the other farms are radially measured against this frontier with TE scores ranging from 0 to 1 (fully efficient farms). For the analysis of efficiency changes after the one year implementation period, the Malmquist index was used. Regression analysis revealed that farms with a higher health state achieved significantly higher technical efficiencies (efficiency increase of 5 percentage points with increase in WQ principle score 'Good health' by 10; slope=0.00518; P=0.026). However, the implementation of measures increasing health and welfare states did not directly increase the farms' technical efficiency: across all farms, technical efficiency remained fairly stable and there were no significant associations in Malmquist indices and changes in the health and welfare state. Our study shows that data envelopment analysis is a valuable method for analysing the relationship between animal welfare and farm success and our results indicate substantial potential synergies between these two aspects.

Ethical and agronomical considerations towards a sustainable pig housing system

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Choices over different animal housing systems affect the welfare of animals, the environment and the economics of farming. In agronomic studies, animal welfare is usually measured in terms of biological functioning (reproductive fitness and lack of disease). We argue that biological functioning alone is insufficient to capture animal welfare, and extend the analysis to other forms of welfare such as hedonistic utility (pleasure and pain) and allowances for animal behaviour (playing and foraging). Moreover, there exist significant trade-offs on emissions (ammonia: NH₃ and greenhouse gases: GHGs) and costs from changing housing systems to improve animal welfare. An explicit consideration of the ethical aspects in pig housing systems along with its implications on emissions and costs are rare in current literature. The objective of this study is to critically explore and advance the discussion on animal welfare and apply that to pig housing in conjunction with analysing its repercussions on emissions and costs. We focus on the following pig housing systems: (1) fully or partially slatted; (2) deep-litter (provision of straw); and (3) a hybrid straw-flow system. Welfare, emission and cost changes associated with different housing systems are calculated based on a meta-analysis of published literature relative to a reference system. Results show that switching from a commonly employed slatted floor to a deep litter system improves pig welfare, but increases GHGs (by +172 g CO₂ e/pig/day), NH₃ (by +7 g NH₃/pig/day) and costs (by 4%). Hybrid housing systems such as straw flow which incorporate the natural behaviour of pigs in housing design can improve animal welfare while reducing both GHGs (by -333 g CO₂ e/pig/day) and NH₃ (by -5 g NH₃/pig/day) relative to a slatted floor system. The results presented here are relevant in light of a push towards improved animal welfare, and demonstrate that sustainable solutions are possible that satisfy issues concerning environmental protection, animal welfare and economic costs.

A vision for sustainable farm animal production*Melina Caroline Tensen**RSPCA Australia, Australia; mtensen@rspca.org.au*

In the debate about feeding a growing world population and in which livestock industries see an opportunity to increase the scale or the intensity of their operations rarely is consideration given to the effect this might have on farm animal welfare. Livestock farming practices can adversely impact welfare by failing to provide animals with their basic needs, such as adequate space and the freedom to express innate behaviours. If we are to raise animals for food or fibre, surely we can do so without compromising their welfare? What if we first address the glaring deficiencies in today's food supply chain? Up to 50% of all food produced for human consumption is wasted either at harvest, during storage and transport, or at the retail and consumer end of the supply chain. In addition to food wastage, the livestock industry's contribution to greenhouse gas emissions poses a challenge to the sector. Poor lifestyle and eating choices contribute to a significant public health concern affecting our population. So, are we going to produce ever more food with more animals and more resources and at any cost? Or, is it possible to consider an alternative food supply chain that truly encompasses the concept of sustainability? Is it possible to work together towards achieving a sustainable livestock production system that creates a high-value product reflective of the true cost of production and that sees no party disadvantaged – least of all the animals we farm for food?

Is compliance with animal welfare standards associated with improved profitability on dairy farms?

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Farmers are often concerned that meeting animal welfare standards may be costly, but there are good reasons to assume that improved welfare may increase profitability. We examined whether meeting Canadian animal welfare standards for tie-stall dairy farms was associated with changes in productive performance of cows. Tie-stall farms (n=100) were evaluated on whether they passed or failed the dairy industry animal welfare standards based on the recorded prevalence of leg and neck lesions, lameness, dirtiness, body condition score (BCS), and placement of the electric trainer. Recorded data was also obtained from each farm on farm profitability measures: average milk production, somatic cell count (SSC), calving interval, breedings per year, % culling, and % of cows in third lactation or higher. Univariate regression and multivariate regression was used to analyse the association between passing each welfare criterion and the indicators of farm profitability. Passing the criterion for lameness prevalence interacted with the % of primiparous cows on the farm to affect annual milk production ($P < 0.001$), which increased with a higher % of primiparous cows on farms that passed the criterion. When milk production genetic index and the % of primiparous cows was controlled for, farms passing the lameness criterion produced 289 kg less milk per year. SSC was higher on farms passing the criterion for neck lesions ($P = 0.02$) but lower on farms passing the criterion for flank dirtiness ($P = 0.05$), BCS ($P = 0.02$) and electric trainer placement ($P = 0.03$). Cow longevity was significantly associated with passing the criterion for electric trainer placement with farms passing having more cows in 3rd+ lactation ($P = 0.03$). Passing individual components of the welfare assessment tended to be associated with some indicators of improved profitability, but the relationships were complex suggesting that there is no simple relationship between animal welfare and farm profitability.

The effects of sensors and robots on human animal relationship on farm

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The digital revolution arrives on farm and leads to the development of the 'precision livestock farming' (PLF). Sensors collect data about the animals (milk quality, physical activity, etc.). These data are interpreted by computers and given back to the farmer through connected devices to help him to make decisions. Robots may be associated to the sensors. The aim of this study was to identify if PLF deteriorates the human-animal relationship and to analyse farmers' satisfaction with these tools. A survey was carried out in 25 farms in France: dairy farms with a milking robot or a heat detector, pig farms with an automatic feeder, poultry farms with a housing management system or an automated weighing system. Semi-directive interviews were conducted with the farmers to collect data on their initial motivation to adopt the equipment, the way it was introduced on farm, the changes that occurred in their work and in the contact with the animals, and the pros and cons. A qualitative content analysis was conducted. A typology mixing the type of farmer-animal relationship and the use of the precision tools was built, using a multiple correspondence analysis followed by a hierarchical clustering analysis. Most farmers mentioned that their job became more modern and that the work was easier with these tools. The digital data bring a different view on animals, focusing on problematic animals. Some pig and cattle farmers continued to spend time to observe their animals and used specific practices to tame the animals, with a view to facilitate the work and reduce animal stress. Others delegated all the decision or the task to the equipment, reducing the contact with the animals. Three profiles were identified showing a diversity of relations between the farmer and his animals. Finally, some farmers expressed limits regarding the place of new technologies on farm, such as the risk of losing their own autonomy or their ability to observe animals and detect problems.

Development of a monitoring tool for measuring and validating the sustainability of dairy farms

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Sustainability is gaining more and more importance in the production, processing and marketing of agricultural goods. This also applies to the German dairy industry. In the past, sustainability initiatives were focused mainly at the dairy factory level, but nowadays, dairy farms are also taken into account by food retailers, international food companies, society and consumers. Against this background an initial sector-specific concept for the sustainable development of dairy production in Germany was developed. Around 30 dairy factories are involved in the recently initiated (February 2017) pilot project as practice partners. The so-called 'Dairy Sustainability Tool' is a basic tool and a starting point to create awareness for a more sustainable development among a large number of dairy farms. It is a monitoring tool for dairy farms which measures and validates a broad range of sustainability criteria. Those criteria and their respective ratings were discussed and agreed transdisciplinarily upon with different stakeholders from the dairy business. The selected criteria, including their assessment, needed to be scientifically defined and validated in such a way that they can be measured and collected at a reasonable cost and time period by the farmers, using a written questionnaire. As a result, the questionnaire contains 60 sustainability-related criteria covering the areas of economics (10), ecology (17), social issues (9) and animal welfare (24). The overall objective of the pilot project is to promote a trustworthy and credible dialogue and process for the sustainable development of dairy farming. Therefore, the tool will be put in practice on a large scale for the first time; its feasibility and recognition at all stages of the value chain will be checked; and furthermore, the tool will be further developed based on the knowledge gained. The resulting dataset is unique as it provides detailed information about relevant sustainability aspects of a large number of dairy farms. The concept, focusing specifically on the animal welfare criteria, will be presented at the conference.

A sustainable option for tie-stalls: providing year-long exercise helps improve dairy cow welfare

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Exercise access offers potential health and welfare benefits and evidence suggests that dairy cows may have a preference for the outdoors even during winter. Providing exercise year-round could be a sustainable option for tie-stall farms, answering concerns surrounding restriction of movement, however, the benefits of year-round exercise for tie-stall cows are not well documented. The objectives of this study were to evaluate how year-round exercise (access to pasture and/or winter outdoor yard) and stall improvements (e.g.: tie-rail adjustment) affected outcome measures of welfare of lactating dairy cows housed in tie-stalls. Over 12 months, 20 cows/farm in 8 farms with year-round exercise and 4 without were visited and their welfare was assessed in each of the 4 visits. Visit 1 was conducted towards the end of the pasture season (Sept.), visit 2, 9-30 days after stall improvements were applied (Dec.), visit 3, at the end winter (April), and visit 4, 1 year after visit 1. Assessments of cow welfare consisted of animal and housing based measures. Farms were grouped based on whether they provided exercise or not and cows grouped on whether they were in modified or unmodified stalls. Differences in the outcome measures were analysed with a mixed linear model. On visit 1, there were 31 and 13% fewer cows with neck and knee injuries respectively in exercise farms ($P < 0.01$). During visit 2, we found 19% ($P < 0.05$) fewer cows with neck injuries in exercise farms. On visit 3, farms that provided exercise had 16 and 20% fewer cows with hock injuries and lameness, respectively ($P < 0.05$). During visit 4, access to exercise reduced the number of cows with hock injuries by 39% ($P < 0.05$). Our results showed that providing access to year-round exercise for cows kept in tie-stalls can improve the overall welfare of the animals by reducing body injuries and lameness prevalence.

Clipping the toenails of day-old ostrich chicks: beneficial or detrimental?

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The practice of clipping the toenails of day-old ostrich chicks has been adopted to decrease toenail-related injuries. Although the toenails regrow, clipping is presumed to be painful due to the presence of spongy bone tissue where the nail is clipped. The effect of clipping the toenails on welfare and production was therefore investigated in two trials to determine whether this practice was beneficial or detrimental. Toenails of day-old chicks were clipped with an electrical debeaker according to standardised methodology. Treatments were applied to groups of approximately 12 chicks each and replicated five times. Data were analysed according to a completely randomised design based on group means. In Trial 1, growth, survival and skin lesions were compared between control chicks with intact toenails, chicks with toenails clipped once (day-old) and chicks with toenails clipped twice (day-old and month-old). In Trial 2, the ratio of heterophils to lymphocytes (H/L) in bloodsmears was used to assess stress as a result of toenail clipping with and without the use of a non-steroidal anti-inflammatory drug (NSAID), as well as a topical anaesthetic, compared to control chicks. All the chicks which toenails were clipped had a withdrawal reaction directly after the toenails were clipped, despite the use of a NSAID, compared to control chicks subjected to a sham clipping, where no such reaction was noted. However, no differences in welfare as assessed with a welfare score based on movement and vocalisation were found 24 h after the procedure ($P > 0.05$). Growth and survival were also not influenced by treatment ($P > 0.05$), while the number of toenail-related lesions on skins was reduced in clipped birds in Trail 1 ($P < 0.05$). In Trial 2, no treatment differences were evident in H/L ratios, either with or without the use of analgesics ($P > 0.05$). Based on these results it seemed that clipping the toenails of day-old ostrich chicks did not compromise their long-term welfare and production.

Hidden animals: animal welfare indicators within assessments of sustainability

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Widespread integration of animal welfare requires alignment with sustainable practices, and integration of welfare indicators beyond marginal niche markets. A starting point would be broader recognition of welfare indicators connected to assessments of economics, environment, and social components of sustainable supply chains. While often labelled as an issue of socially acceptable farming practices, the biological process of food animal production indicates a connection to environment and economic factors. Examples from methods currently used in environmental and economic assessments highlights consistent use of welfare indicators that overlap with welfare assessment frameworks – namely mortality and morbidity. These indicators are used to evaluate effects of production practices on utilization of land, water, and feed resources, as well as outputs like manure and animal products (e.g. meat, milk, eggs). Inherently, these indicators may also represent negative welfare states of individuals in systems due to suffering from disease states, as well as potential indirect effects on the welfare of other animals, domestic and wild, that are dependent on shared ecosystem resources. Data on the effects of human and animal interactions connects positive welfare during handling of dairy cattle to improved worker safety and potential reduction of use of environmental resources. As understanding of positive welfare states continues to grow, it is important to also grow the understanding of connection to economic viability, environmental responsibility, and social accountability. Positive reinforcement of animal welfare as integral to sustainable food production can be achieved by supporting integration of welfare indicators in connection with more than just social acceptability, while reducing biases towards narrowly focused single-dimension evaluations of animal. Supporting the importance of these indicators, as well as comprehensive assessments of welfare solutions, will improve the ability for food businesses to safeguard good animal welfare in sustainable global food supply chains.

Monitoring body temperature and activity in sows using a sensor-based telemetric system

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Precision livestock farming technology can improve estrus detection accuracy and increase sow conception rates, leading to higher production efficiency and less labour. Furthermore, PLF technology can be used as early detection system for ill sows, improving animal health and welfare. Illness and estrus influence body temperature and activity of sows. Therefore a sensor-based telemetric system monitoring body temperature and activity was tested. First, Templant2 sensors (TeleMetronics Biomedical), containing a temperature sensor, 3D accelerometer, radio transmitter and battery, were validated under lab conditions for temperatures 35-45 °C, using a water basin with Julabo heater and validated P600 thermometer. Sow movements (walking, standing up, lying down) were simulated to validate activity measurements by attaching the sensor to a stick. Second, activity was recorded for 30 minutes with sensors attached to the neck and back of 3 sows, and activity for 3 days around estrus was recorded manually for 4 gilts and 4 other sows. Temperature results of sensors, heater and thermometer correlated highly in lab conditions (linear regression, $R^2=0.96$; slope 1.1). Simulated activities and sensor values corresponded consistently. In farm conditions, sow activity was measured reliably with the sensor attached externally. Sows showed more activity the day before insemination (manual observations, $P<0.05$ for standing up, lying down, sitting down and walking backward, increase 2.4 ± 2.6 , 4.6 ± 4.4 , 3.3 ± 3.7 and 4.7 ± 4.9 respectively), which makes this parameter a good predictor for estrus. In a follow-up study where the same sensors were used intra-vaginally in 12 gilts, temperature decreased (-0.26 °C) and activity increased (+38%) significantly at estrus, with both parameters measured reliably with the sensors. We conclude that monitoring activity and body temperature is a promising tool for estrus detection in sows and potentially in monitoring sow health and welfare.

The impact of health problems in dairy cows on greenhouse gas emissions: a case study with mastitis

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The dairy sector is responsible for 4.4% of global human-induced greenhouse gas (GHG) emissions. Climate change caused by GHG emissions and limited amount of resources, e.g. land and fossil energy, urge to produce food as efficient as possible. Health problems are expected to affect these emissions. Clinical mastitis (CM) in dairy cows, for example, is a major health and therefore welfare problem which has an average incidence of 27% in the Netherlands. CM results in inefficient production because of a decreased milk production and fertility, and an increased risk of culling. This study aimed to estimate the impact of health problems on GHG emissions using CM in the Dutch situation as a case study. A dynamic stochastic simulation model was developed and combined with life cycle assessment (LCA). Cows received a parity (1-5+), a potential milk production and a risk ratio for CM. Cows could get a maximum of 3 cases of CM in one lactation, which were caused by gram positive or gram negative bacteria, or other pathogens. Based on the number of cases of CM and pathogen combination, cows had a reduced daily milk yield, discarded milk if treated with antibiotics, a prolonged calving interval, and an increased risk of culling. Subsequently, LCA was used to quantify the impact of CM on GHG emissions per ton fat-and-protein-corrected milk (kg CO₂e/t FPCM) from cradle to farm gate. Preliminary results indicate that per case of CM, GHG emissions increased by 6.2% (55.5 kg CO₂e/t FPCM) on average. Emissions increased by >34% (>300 kg CO₂e/t FPCM) for cows that died on the farm because of CM. Reducing health problems, such as CM, is effective to diminish GHG emissions from milk production. Moreover, cow welfare and farmer's income will improve. Therefore, reducing health problems contribute to sustainable development of dairy production.

Occurrence of lameness during a 6-month period in four Danish dairy herds*Karina B. Glerup¹, Hans Houe², Björn Forkman², Mette S. Herskin³ and Peter T. Thomsen³**¹University of Copenhagen, Department of Veterinary Clinical Sciences, Denmark, ²University of Copenhagen, Department of Veterinary and Animal Sciences, Denmark, ³Aarhus University, Department of Animal Science, Denmark; kgb@sund.ku.dk*

Despite negative consequences on animal welfare and economy, not much is known about the frequency of cows repeatedly showing lameness in dairy herds. The objective of this study was to describe the occurrence of lameness during a 6-month period in four Danish dairy herds (sampled by convenience). Lameness was evaluated over a period of 26 weeks. In each herd (224-338 Danish Holstein cows in loose housing systems with cubicles), all lactating cows were lameness scored on a 5-point scale every second week. In each herd, all observations were made by the same observer (one observer in herd A, another observer in herds B, C and D). Not all cows could be located on every visit, and only cows (n=898) with at least 10 out of 13 observations were included in the analysis. In the four herds, A: 2%, B: 43%, C: 30% and D: 40% of the cows were never observed lame (i.e. scored 1 or 2) during the study, while A: 94%, B: 37%, C: 56% and D: 40% of the cows were observed lame (i.e. scored 4 or 5) at least once during the six months period. The proportion of cows that were observed lame during at least 7 of the 10-13 observations was A: 24%, B: 1%, C: 11% and D: 3%, respectively. Most cases of lameness are caused by hoof disorders, many of which are painful. In this study we found that some cows were observed lame on more than half of the visits and although substantial variation was found between herds, the large proportion of lame cows and many individual cows being lame at many scorings, constitute a welfare problem.

Effects of some factors on calves' viability and growth

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The aim of this study was to analyse the effects of dam size, type of birth, calving ease, calf sex and season on calf viability and body weight. Study was carried out on 397 Romanian Spotted cows and their 407 calves from the Research and Development Station for Bovine Arad, Romania. Two multifactorial regression models were employed. The first one was to evaluate the influence of cows' body size (body weight, rump length, width at hips and at pins) on calf viability (viable, morbid, non-viable), type of birth (single, twin) and calving ease (eutocic, dystocic). The second was to assess the effect of calf sex (male, female), calving season (summer, winter), calving ease, and type of birth on calf viability and body weight. Cows having larger rump size produced more viable calves (285 viable vs 88 morbid vs 34 non-viable), and more eutocic calvings (310 eutocic vs 97 dystocic) than cows with smaller rump ($P \leq 0.05$). Rump size was significantly higher in cows producing twins compared to those calving singles (55.2 vs 54.1 cm length, 57.8 vs 56.2 cm width at hips, and 37.1 vs 36.1 cm width at ischia, $P \leq 0.05$). Cow body weight had no significant effect on calving, calf viability and type of birth ($P > 0.05$). Calf weight at birth was higher in summer than in winter (36.8 vs 35.4 kg, $P \leq 0.001$), in males than in females (38 vs 33.8 kg, $P \leq 0.001$), in singles than in twins (36.7 vs 32.8 kg, $P \leq 0.001$), and in eutocic than in dystocic calvings (35.7 vs 36.3 kg, $P \leq 0.05$). Dystocia at calving increased the morbidity and mortality rates of calves ($P < 0.05$). Higher incidence of morbidity and mortality was recorded in twins vs singles ($P < 0.01$). Calf viability and body weight could be assessed based on dam rump size, type of birth, calving ease, calf sex and season of calving. This enable farmer to take a decision regarding calf welfare at an early age and act appropriately.

Economic and environmental impact of dry period length in dairy cows

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Shortening or omitting the dry period of dairy cows can improve cow welfare through fewer management changes and improved metabolic health in early lactation, at the cost of milk production. Part of the milk losses are compensated by additional milk before calving. The aim of this study was to model how a transition to a dry period of 28 or 0 days vs a dry period of 56 days affects net financial flows at herd level and greenhouse gas emissions per unit of milk. The evaluation included financial flows from milk, meat, calves, feed, and youngstock, and greenhouse gas emissions from feed production, enteric fermentation, and manure storage. In the stochastic model in R, dry period length affected milk yield, calving interval, and the risk of culling for fertility. Values for these parameters were derived from data from commercial dairy farms that shorten or omit the dry period since 2010/2011. Other parameters were based on literature. Herds of 100 cows were simulated at cow level for 5 years following the change in dry period length (n=40 herds per scenario). Total herd milk yield in the first year was not different among different dry period lengths (ANOVA, $P>0.05$), whereas a dry period of 28 days on average reduced yield by 2.9% from the second year onwards ($P<0.05$); and no dry period reduced yield by 7.0% in the second year ($P<0.05$), and by 3.7% from the third year onwards ($P<0.05$). At herd level, dry periods of 28 and 0 days in comparison with 56 days reduced net financial flows by €949 and €1,680 per year and resulted in similar greenhouse gas emissions per unit milk.

Relation between the prevalence of claw lesions in Flemish dairies and the perception of the farmers

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Claw lesions are an important reason for compromised animal welfare and culling and cause major financial losses in Flemish dairies. Farmers aren't always aware of the prevalence and impact of claw problems on their dairy. The aim of this study was to address the prevalence of claw lesions in lactating cows in Flanders. Therefore farmers were asked to complete a survey involving the management and housing practices they apply. Next they were asked to estimate the prevalence of the following claw problems among lactating animals on their farm: interdigital dermatitis (ID), digital dermatitis (DD), sole haemorrhages (SoH), white line disease (WLD), sole ulcer (SU), interdigital phlegmon (IP), swollen heels (SH) and footrot (FR). Forty dairies (16.4%) were selected to be visited to assess the claw health. The selection was based on access to pasture, number of lactating cows, estimate of ID and DD and herd production level. These 40 dairies are representative for all respondents of the survey. On each farm at least 15 (fixed number) animals were examined. Selection was based on parity, lactation stage and milk production corrected for age, season of calving and lactation stage. ID was scored according to Döpfer *et al.*, while other lesions were scored on a 4-point scale. Mobility, body condition, leg condition, hygiene, claw hook and length etc. were also determined. About 33.0 (+14.6)% of the selected animals were clinically lame. There was a significant ($P < 0.05$) correlation between estimated and determined prevalence of SH ($r^2 = 0.42$; $P < 0.05$), acute DD lesions (M1, M2 and M4.1; $r^2 = 0.40$; $P < 0.05$) and IP ($r^2 = 0.73$; $P < 0.001$) in contrast to ID, overall DD lesions, SoH, WLD, SU and FR. These results show that farmers could estimate the obviously visible lesions, but had difficulties estimating lesions for which detailed inspection of the claw was necessary.

Comparison of AW indicators & body weight of beef cattle in a silvopastoral system and natural grass

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Animal production systems that combine trees and pasture are considered silvopastoral systems (SPS). Studies performed mainly in Central America and with *Bos taurus indicus* breeds, concluded that SPS have the potential to improve animal welfare and productivity of livestock farms while contributing to the sustainability of these systems. SPS are of recent implementation in temperate weather countries like Uruguay, where *Bos taurus taurus* breeds are predominant and the main landscape, where the beef cattle are kept, is the natural grassland (NG). SPS produces, besides the beef, obtained wood from the tree plantations. The objective of this preliminary study was to determine if these benefits also apply in temperate regions. The study was conducted on two extensive beef farms in the southern part of Uruguay. In each farm, two groups of Hereford steers (n=20) were allocated randomly to SPS (*Eucaliptus globulus* plantation) and NG without tillage, adjacent paddocks (20 hectares each), in summer time from October 2015 to May 2016. Both farms were visited every 45 days to compare welfare and health indicators as well as body weight. Welfare indicators were individually recorded according to the Welfare Quality® protocol for cattle in the farm facilities prior to the entrance on the scale where each animal was weighed. A mixed model was used to analyse weight as response variable. Categorical variables were compared with Fisher's exact test. Preliminary results indicate that in both SPS and NG the welfare of the cattle is at a high level, showing no significant differences ($P < 0.05$) between groups. Further research is needed to determine if SPS could improve even more the welfare of beef cattle, considering findings in other countries. Having this and the additional profit from wood production, SPS becomes an interesting complement to the sustainable beef production.

Manipulation and slaughter of American bison (*Bison bison*) in European farms*Hilde Vervaecke**Odisee University College, Agro- and Biotechnology, Belgium; hilde.vervaecke@odisee.be*

Approximately 6,000 American bison are bred on ranches in Europe for meat. Bison are wild non-domesticated animals that are kept extensively year-round but that require regular handling in order to comply with sanitary regulations. We surveyed the methods of manipulation and slaughter and the incidence of reported meat quality problems. The survey includes data on 18 ranches, in France (n=11), Belgium (n=3), Switzerland (n=2), the UK (n=1) and Poland (n=1). On average, each breeder had 72 adult bison (range=21-182) and slaughtered on average 16 bison per year (SD=10.47), 75% males and 25% females, at an average age of 30 months (20-42 months). All breeders had manipulation cages and corrals. Half of the breeders transported the bison dead after shooting and subsequent bleeding on the farm, either in the corral, in the field or in the trailer; the other half transported the animals live (average distance of 48 km) to the slaughterhouse, where they were either killed by firearm in the trailer or otherwise in the slaughter facilities. 53% of the breeders had their animals killed by fire-arm, 26% of the breeders had their animals killed by cutting after captive-bolt stunning and one fifth of the breeders (21%) has allowed for un-stunned cutting in the past. The latter was used in slaughterhouses where previous attempts to stun had been unsuccessful. Breeders that had used a captive-bolt noted that up to 40% of the animals needed re-stunning due to the thickness of the skull. There was no link between reported meat-quality and killing method. Some farmers developed very efficient stress-reducing practices for handling and killing bison. Bison on-farm killing by shooting was the most humane method with the highest instant success rate and no transport stress. Slaughterers and veterinarians need more information on effective stunning techniques for bison.

Inclusion of poplar trees in pasture-based pig systems to reduce the heat load of lactating sows dur

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Inclusion of poplar trees in pasture-based pig systems to reduce the heat load of lactating sows during hot periods. On a global scale, the demand for organic pork is increasing. Organic pig production is associated with positive aspects such as animals being able to perform species-specific behaviour, and a low use of antimicrobics. However, the current Danish organic production system with sows on grass-clover pastures poses animal welfare challenges during the hot season as indicated by a recent pilot study we did where 85% of sows were severely sunburned on ears. In the pasture-based system, the farrowing huts are the only possibility for sows to seek protection from the sun. Studies indicate that during hot days, the huts may reach temperatures exceeding the level of sow thermal comfort zone and there is a need for providing sows with alternative shading possibilities. The aim of this study was to investigate whether access to poplar trees could reduce the heat load of lactating sows. We investigated two different pasture-based systems in which each sow had access to an area with either no trees or 32 trees. Sow sunburn was assessed on different body parts as: (1) no sunburn; (2) visible redness of skin; (3) severe redness of skin; (4) visible wounds or flaking skin. In addition, sow respiration frequency was recorded on day two prior to expected farrowing until day seven post farrowing. Fifty-eight sows were observed during summer 2015 and 20 sows during winter until autumn 2017. Preliminary results show that during the summer 2015, sow respiration rate was lower in the area with poplar trees compared to the farrowing hut (30 and 46 breaths per 60 seconds, respectively). However, of sows with access to poplar trees 44.4% had visible wounds and flaking skin on ears and 14.1% severe redness of ears. We suggest that inclusion of trees in pasture-based systems represents an area with reduced heat load but the amount and/or location of trees were not able to prevent severe sunburn.

Smothering in UK free-range laying hens: research from the McDonald's sustainable egg supply group

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Since 2008, McDonald's Restaurants UK has collaborated with FAI Farms and their two egg suppliers to form a sustainable egg supply group (SESG). SESG tackle sustainability challenges under a 3Es framework of ethics, environment and economics. Smothering occurs when birds group together, resulting in death from suffocation. Smothering presents an ethical and economic concern. Responding to this concern, and recognising that little published research was available, SESG initiated research to further understand smothering. A preliminary study supported anecdotal evidence that smothers cause significant mortality and established three categories of smothering: panic smothers (PS), nestbox smothers (NBS), and recurring smothers (RS). PS are caused by sudden disturbances, they're isolated incidences involving large numbers (>20) of birds. NBS occur when multiple birds visit a nestbox simultaneously. RS recur throughout lay, involving small (1-10) numbers of birds per incidence. A SESG questionnaire based study was the first to determine incidence of smothering in commercial UK laying hen flocks and to explore associations with housing and management practices. Questionnaires were sent to farm managers from McDonald's two free-range egg suppliers, representing 35% of the UK free-range egg industry. A 50% and 100% response rate was achieved (n=206). Smothering was found to be common with 61.2% of farm managers reported smothering in their last flock. Mortality due to smothering was reported at 1.6%. Smothering was confirmed to be unpredictable with no clear effective reduction strategies in use. GLM procedures found breed (P=0.008) and nestbox manufacturer (P=0.014) to predict NBS. Nestbox manufacturer (P=0.009), feeding oyster, grit or grain on the litter (P<0.001) and range use on a sunny day (P<0.001) predicted the combined category, PSRS. Smothering illustrates the delicate balance of breed, housing and management for free-range laying hens. We hope that this research will stimulate further work exploring solutions to smothering.

Comparison of loose housing and individual housing of sows in early gestation within 4 sow herds*Theo Geudeke**GD Animal Health, Deventer, The Netherlands, Pig Health, the Netherlands;**t.geudeke@gdanimalhealth.com*

In the Netherlands group housing of pregnant sows is mandatory from four days after insemination. Group housing allows sows to show a more natural and social behaviour with positive implications for animal welfare. However, the pig industry is reluctant to house sows in groups in early gestation. Group housing might result in poor reproductive performance and impaired welfare due to stress related to hierarchy fighting, food competition and (limited) space allowance. In this respect, research so far never compared group housing and individual housing of sows in early gestation under field conditions within farms. Four well managed sow herds with good reproductive results were selected. The farms had a housing system with lockable free access stalls. Within each farm 10 to 14 groups of sows that were inseminated within the same week, were divided into paired groups of 10 to 25 sows that were either loose housed or housed individually during the first four weeks after insemination. Paired groups (n=60) were equally divided in terms of age and body condition and housed in adjacent groups. In all groups information was recorded and analysed on pregnancy rate and litter size. Pregnancy rates (at day 35) did not differ significantly between loose housed sows (93.1%) and individually confined sows (93.3%). Also litter size did not differ (15.80 vs 15.75 total born). Within the four farms in this study no differences were seen between group housing and individual housing of sows. As suggested by other investigations, stockmanship and animal handling are likely more important than housing system when it comes to animal welfare and reproductive performance in sow herds. This study was approved by an authorized Animal Experiment Commission and financed by the Dutch pig industry.

First results: are there links between Welfare Quality® and sustainability indicators of dairying?

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Parameters of animal health and welfare and environmental performance of farms are possibly correlated. This study's aim is to illustrate those relationships as they became apparent from initial farm analyses for 9 of 38 dairy farms of a German farm network (www.pilotbetriebe.de). We assessed the status of dairy cow welfare using the Welfare Quality® Assessment protocol for cattle and completed it with medical treatment data. Farm management was analysed with the model REPRO e.g. with focus on N loss and greenhouse gas (GHG) emissions. Scores (*in italics*) were assigned to the results. For example, a conventional farm of the network (48 dehorned cows, cubicles with rubber mats, slatted floor, no outdoor access, 1.6 livestock units/ha, ration based on maize and grass silage, farm-grown concentrates and imported soybeans) had an overall welfare score of acceptable. At criteria level, absence of prolonged hunger (59.3) pointed out a link between welfare and sustainability: Despite feed import, milk yield was rather low (7,250 kg ECM/cow/a, 0.59) and GHG emissions were high (1,269 g CO₂/kg ECM, 0.26). Reason was that feed quality produced on farm was low although energy input into plant production was high (15.4 GJ/ha, 0.46) at high energy efficiency (12.8, 0.88). Humus balance was negative (-226 kg C/ha, 0). Results of such status-quo analyses were discussed in farmer-advisor-scientist workshops within the frame of the farmer's objectives to find improvement measures. Those were put into scenarios for REPRO. We expect to see a high potential for the conjunct improvement of animal health and welfare and environmental performance for individual farms.

Preliminary results on the practice of tail docking in Merino Fine Wool sheep in South Africa

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The tails of most South African sheep breeds are docked routinely. Arguments for docking are: appearance (mainly based on human preference), an improved reproduction; reduced faecal contamination of the breech region; greater marketability; improved weight gain and ease of shearing. Tail docking is also performed in wool sheep to avoid welfare problems associated with breech blowfly strike. However, tail docking is a key welfare issue, shown to cause pain and distress, regardless of the technique used or the age of the lamb. This study assessed the impact of tail docking in 173 fine wool Merinos at Tygerhoek research farm during the 2016 lambing season. The tails of lambs in the control group were left intact while the tails of lambs in the docked group were docked with a hot iron at the third palpable joint at roughly 3 weeks of age. Lambs were randomly allocated to either treatment within sexes. The docked and control groups did not differ for mean birth weight, indicating no bias on size due to sampling. Survival from docking to weaning at 16 weeks of age, weaning weights and breech blowfly strikes were recorded. Proportions were assessed with either χ^2 methods or the Fisher's exact probability test (FET) in the case of low frequencies. Weaning weights were analysed with least-squares procedures. Weaning weights (respectively 26.9 ± 0.6 and 26.9 ± 0.5 kg for the docked and control groups) and lamb survival (respectively 92.0 and 91.8%) did not differ between the experimental groups. The percentages of ram lambs that were struck were 8.3 and 6.0% for the docked and the control groups respectively (FET=0.69). Corresponding percentages for ewe lambs were 2.6 and 6.3% (FET=0.62). The overall frequencies of lambs suffering from breech strike across sexes did not differ between groups (5.3 vs 6.1%; $\chi^2=0.014$; $P=0.91$). Preliminary results suggest that tail docking had no evident advantage in any of the traits measured.

On-farm assessment of welfare in dairy farming and its impacts on measures of sustainability

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A welfare assessment tool for dairy farms was developed as an extension of an already existing analytical programme based on scientific principles ('REPRO') mainly used for the evaluation of process sustainability in arable farming. Our approach was to link on-farm animal welfare indicators to ecological implications. Twenty three German dairy farms (of which 5 were organic) of various regions were analysed for nutrient flow and emission sources relative to specific housing and management conditions. The assessment of animal welfare was based primarily on already existing valid and practicable methodologies such as WQ*, 'Cows and More' as well as other benchmarking tools based on critical control points. In detail, evaluation was based on four weighted indicator groups, listed in increasing order: housing environment (resource/management based), yield (management/animal based), health (management/animal based), body condition and behaviour (animal based). In addition, a mix of at least eleven indicators was used for each group. Ecological sustainability analysis revealed a highly variable greenhouse gas (GHG) balance ranging from 0.74 to 1.34 CO₂-eq per kg ECM (energy corrected milk). Culling rate (ranging from 19% to 43% among our 23 farms), as a cumulated indicator for several welfare problems, would improve sustainability balance by 0.7 to 10.3% when standardised to a target value of 23%. Diseases such as mastitis, milk fever, ketosis and lameness that result into reduced feed intake, milk production and eventually to a reduced longevity add to an increase in GHG balance in a range of 1.5 to 11.6%. The results indicate that animal health and welfare substantially impacts production efficiency and sustainability.

Development of furnished cages reusing conventional cages for laying hens*Tsuyoshi Shimmura¹, Naoko Maekawa², Satoshi Hirahara³ and Toshio Tanaka²**¹Tokyo University of Agriculture and Technology, Department of Biological Production, Japan,**²Azabu University, School of Veterinary Medicine, Japan, ³Kanagawa Agricultural Technology Center, Japan; shimmura@go.tuat.ac.jp*

Various alternative housing systems for laying hens have been developed. Furnished cages have advantages, i.e. improving on some behavioural problems and keeping high productivity. However, the high cost to introduce them into farms have remained unresolved. To decrease the introduction cost, we developed furnished cages by reusing conventional cages. We made the furnished cages by adding the resources (plastic sheet and artificial turf for nest area, and wooden perch) to conventional cages. The average cost to make them was \$ 2.1, and the average construction time by the farmer was ten minutes per cage. We prepared the total six nest designs by combining two floor designs (artificial turf floor or cage floor) and three surrounding designs (all side surrounding, one side surrounding, or no surrounding). We obtained six replicates by assigning a total 144 hens into each design (four hens/cage; 630 cm²/hen). We measured behaviour, physical condition, production and egg quality. The data were analysed using repeated measure ANOVA followed by Tukey-Kramer test. When compared the floor designs in nest, dust-bathing and litter-exploring were observed only in cages with artificial turf floor. The plumage damage and the proportion of eggs laid outside nest were also lower in cages with artificial turf floor than cage floor ($P < 0.05$). Next when compared the surrounding designs in nest, dust-bathing, litter-exploring and active behaviour were observed more frequently in cage with one side surrounding than all side surrounding ($P < 0.05$). The plumage damage was lower in cages with one and all side surrounding than no surrounding ($P < 0.05$). These results suggested that the cage with artificial turf floor and one side surrounding may be effective when develop the furnished cages with low introduction cost.

Dominance effects on grazing patterns in horses in nature reserves*Hilde Vervaecke¹, Johan Miechielsens¹, Jan Van Uytvanck² and Maurice Hoffmann²**¹Odisee University College, Agro- and Biotechnology, Belgium, ²INBO Research Institute for Nature and Forest, Belgium; hilde.vervaecke@odisee.be*

Nature reserve managers aim to evaluate the spatial position and presumed behaviour of a group of introduced large herbivores by using telemetric data of one randomly selected individual. We hypothesized that dominance effects can cause variations in grazing patterns. A group of five Konik horses was observed during summer in a Belgian coastal dune reserve Westhoek-Zuid of 60 ha. All agonistic interactions were scored and the hierarchy was analysed. For each horse 25 focals of 15 minutes were conducted to score behaviour and position with 90 seconds intervals. The horses stayed predominantly in dune grassland (34.10%), in woody areas (25.30%), rough scrub areas (14.20%) and in rough grassland vegetation (11.60%). The horses foraged during 59.85% of their time, rested (standing and lying) during 36.80% and moved during 3.35% of their time. The horses diet was composed for 87.73% of grasses, i.e. 66.90% long grasses (average count: 96, SD=39.35) and 33.10% short grasses (average count: 47.8, SD=13.44). Short grasses were rarer but most preferred and were consumed relatively more by higher ranking horses (rank-short grass intake: $rs=-0.98$), whereas long grass was consumed more by low ranking horses (rank-long grass intake: $rs=0.94$). This implies rank related monopolization of better quality grass when groups move in patchy grasslands. Often the poorer long-grassed vegetation types are targeted by nature managers, although these are least preferred by the animals. The choice of an adequate group size should be such that the low ranking animals are forced into eating the suboptimal vegetation, without harming their nutritional welfare. The selection of both the lowest and highest ranking individual will give a better view on the group grazing behaviour than the selection of a random animal.

Assessing sustainability of welfare improvement in working equids in Petra, Jordan

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Brooke is an international charity aiming to sustainably improve working equine welfare. Having achieved welfare improvement and established local healthcare systems, Brooke reduced intervention activities in Petra, Jordan from 2011; this study aimed to assess the extent to which welfare was subsequently sustained. Welfare data were collected using Brooke's Standardised Equine-Based Welfare Assessment Tool (SEBWAT) in December 2010, February 2013 and December 2016 from a purposive sample of 136, 108, 110 donkeys/mules (DM); 128, 97, 67 riding horses (RH); and 26, 27, 27 (all) carriage horses (CH). Data were collected by the same observer at the same sites under similar climatic conditions. The following indicators showed sustained improvement over 2010, 2013 and 2016, respectively. Proportion of underweight equids remained stable following improvement in DM (73%, 62%, 60%) and CH (42%, 15%, 19%), and continued improvement in RH (25%, 17%, 3%). Forelimb hoof shape abnormalities continued improvement in DM (18%, 5%, 1%), RH (37%, 28%, 4%) and CH (38%, 30%, 4%), and for hindlimbs remained stable following improvement in DM (12%, 2%, 3%), RH (14%, 8%, 6%) and CH (8%, 4%, 4%). Severe lameness reduced to negligible in RH (8%, 9%, 2%) and improved since prior assessment in CH (15%, 33%, 7%). For positive behaviour, improvement continued in RH (89%, 92%, 97%), and since prior assessment in CH (92%, 78%, 85%); DM remained stable (82%, 82%, 81%). Cessation of intervention activities coincided with severely diminished tourist numbers in Jordan following the 'Arab Spring' in 2011, negatively impacting animal owners' income. However, these results indicate that neither factor resulted in deterioration of welfare status, suggesting the potential for welfare deficit due to diminished owner income may be offset by benefits from reduced workload, and that welfare improvements can be sustained beyond Brooke presence.

Association of transition health with early culling in dairy cows under pasture-based systems

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High rates of involuntary culling and diseases in early lactation are signs of poor animal welfare. The aim of this preliminary study was to evaluate the influence of illness after calving on the culling rate in early lactation grazing dairy cows. Data were collected during the late autumn and spring calving season from April to November of 2016 on seven dairy farms in the southern Chile, including 1,801 cows that calved during this time. Average herd size was 326 ± 91 (\pm SD) with milk production averaging $7,260 \pm 920$ kg/lactation (\pm SD). Disease and culling data (slaughter/death) were extracted from on-farm computer herd management software. Only postcalving diseases that were consistently recorded across herds were considered, including retained placenta, mastitis, metritis and milk fever. Data were exported to SAS version 9.1 (SAS Institute Inc., Cary, NC) for statistical analysis. The effect of illness after calving on the number of cows culled (slaughter/death) was tested using a Chi-squared test. Overall, 17% of the cows studied developed at least one clinical disease during the first month after calving and the average culling rate was 7.9%. Mean and median number of lactations of cows at culling was 3.5 ± 1.8 (\pm SD) and 4 lactations, respectively. Considering the time interval after last calving to culling, 64.3% were culled in the first 100 days in milk compared with 35.6% after 100 days. Cows that developed at least one clinical health event after calving were more likely to be culled in the first 100 days in milk than the no clinical event cows (8.39 vs 4.43%, respectively; $P=0.004$). The decision to cull was likely driven by a combination of ill health and low production in the first weeks of lactation. Our preliminary results are the first to show the effect of transition diseases on cull status in cows under pasture-based Chilean farms. These results are part of a bigger project that includes 40 farms which are still under evaluation.

Implicit presence of animal welfare features in agricultural economic policy assessment models*Bouda Vosough Ahmadi**SRUC, Land Economy, Environment and Society Research Group, United Kingdom;
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Quantitative economic models are commonly used for ex ante assessment of various agricultural policies such as the common agricultural policy (CAP) and its reforms in Europe. In recent years, these policies are not only used to support producers in form of direct payment as income support but also they contribute to providing basic public good such as environmental protection and promoting biodiversity. In spite of the fact that majority of these models inherently incorporate various animal welfare features, but quite often these aspects are either not considered as first priority or are not explicitly mentioned as important consequences of proposed policy changes. For example ensuring nutritional requirements and feed demands of various species of farm animals, their demand for both simple and skilled labour and management forces, their optimum production levels, as well as their optimum space requirements and stocking densities are among important features that overall determine the state of farm animal welfare. Under the current CAP, safeguarding animal welfare is only guaranteed by a set of regulations known as cross-compliance that make farmers who do not comply with certain requirements subject to reductions of or exclusion from direct support. The aims of this paper are two folds: first, to describe and discuss the four mentioned important animal welfare features that are implicitly included in the commonly used economic policy assessment models and second, to propose alternatives for some aspects of the current cross-compliance system by explicitly including a set of well-defined and established animal welfare requirements in the policy assessment models that can be explicitly quantified and assessed by the models.

Restraint of sows during lactation is a risk for preweaning mortality and increased hair cortisol

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Improving lactating sows' welfare can potentially enhance swine farms economics by maximizing piglet survival and health. The objective of the current study was to examine production and welfare parameters of sows and their piglets during lactation, when free crates system is used after variable restraint periods in conventional crates. Sows (n=80) were housed in conventional crates but confinement bars were opened after different periods, from 3 days after farrowing to full restraint. For certain analyses sows were grouped into short restraint group (SR; 3-9 days after farrowing) and long restraint group (LR; 14-21 days). Chronic stress was evaluated by hair cortisol assay at the end of lactation. Multiple linear regression revealed that for any additional day in restraint, piglets weaning rate (% weaned) significantly decreases by 0.4% (P<0.05); furthermore, when litter size increases by one piglet, weaning rate significantly decreases by 3.4% (P<0.01). Advanced mixed effects model also showed that litter size and restraint were risks for pre-weaning mortality, with lower mortality in the SR as compared to LR (2.7±0.3 vs 3±0.4 dead piglets/ litter, respectively). Total number of weaned piglets per litter was significantly higher in SR as compared to LR (10.3±0.3 vs 9.7±0.3; P<0.05), while there were no differences in litter size parameters after farrowing. Total litter weight on weaning day was 68.8±2.2 kg in SR and 64.9±1.8 kg LR (P=0.12). Hair Cortisol was significantly lower in sows in SR (36.3±4.1 vs 42.4±2.4 pg/mg; P<0.05). Medical treatments during lactation (e.g. antibiotics; NSAID) tended to be less common in SR, in sows (21.9 vs 40%; P=0.1219) and in piglets (12.4 vs 17.1%; P=0.0609). Results from the current study support the conclusion that shortening restraint period during lactation can improve welfare, decrease chronic stress and maximize piglet survival, health and production.

The art of dialogue*Noelle Aarts**Wageningen University and Research, Department of Social Sciences, the Netherlands;
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When faced with complex and contested issues, in which many stakeholders are involved with different backgrounds and interests, it is nowadays common to call for a dialogue. That also applies to the assessment of animal welfare in livestock production. However, research shows that it is extremely difficult to get engaged in a conversation that deserves to be called a dialogue in the sense that nobody tries to win and that participants are open to co-develop new common perspectives. How should we understand this complex and complicated landscape of differing perspectives, interests, values and emotions? How can we engage in meaningful and constructive dialogue about animal welfare in livestock breeding, across conflicting and conflictive views, in order to find solutions, while valuing both feelings and facts? How can we transform disagreements and different perspectives into a productive conversation that addresses relevant issues and their potential solutions? In this keynote, mechanisms will be identified that help to understand why conversations develop as they do, why it is so difficult to achieve a dialogue and what could be done to improve the quality of our conversations. The starting point is not the individual skills or shortcomings of participants in the conversation. Instead we focus on understanding the interaction, on how utterances of people are being interpreted by others, on the mechanisms that are at play and how this affects the course of the conversation.

Dairy industry stakeholder perceptions of British Columbia's emergency slaughter program

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When dealing with acutely injured or non-ambulatory dairy cows, producers must decide whether to treat, ship, euthanize, or (where permitted) use on-farm emergency slaughter. The emergency slaughter program (ESP) is available to producers in British Columbia if a cow cannot be transported humanely but is fit for human consumption. Cows must first pass an ante-mortem inspection performed by a veterinarian, and are then killed on farm and transported to a slaughterhouse within 2 h. To understand how dairy industry stakeholders perceive the ESP, we conducted a qualitative study involving 25 interviews and 3 focus groups with 40 dairy producers, veterinarians, government employees, transporters, and auction market staff. Transcribed interviews were analysed in NVivo 11 software using thematic analysis to assist data coding and interpretation. Participants had similar perceptions of the ESP, but underlying values guided whether they used the program. First, regarding cow welfare, some felt the ESP offered an incentive to hasten death for injured animals, while others believed the ESP delayed the death of animals that should be euthanized immediately. Second, regarding the reputation of the dairy sector, some saw the ESP as preventing transport of compromised cows to public auction, while others were opposed to seeking financial gain from injured cows. Third, while some regarded veterinary oversight as increasing the legitimacy of the program, others saw potential for a conflict of interest in veterinarian/producer relationships. Despite these differences, shared recommendations for the program include: (1) extending abattoir hours for emergency slaughter animals; (2) additional transporter availability; (3) stricter rules on when the ESP can occur; and (4) producer education about proactive decision-making for compromised cows. This insight can encourage discussions within the sector about improving the ESP for stakeholders. This research provides a case study in using stakeholder perceptions to help guide policy and program development.

Does the background matter? People's perception of pictures of pigs in different farm settings

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Public discussions about animal welfare in livestock farming involve the increased use of pictures in the media. Such pictures can be composed very differently ranging from airbrushed pictures for marketing purposes up to shocking pictures about grievances in farming. The perception of such pictures may be influenced by both, the animals' appearance as well as the environment in which it is depicted. The aim of this study is to analyse the effects of picture composition (pig and pen) on peoples' perception of pig welfare and pen evaluation. To achieve this aim, 1,019 German residents took part in an online survey in June/July 2016. Using a 2×2 factorial design, four modified pictures showing a pig ('happy' or 'unhappy'-looking) in a pen (slatted floor or straw bedding) were evaluated by respondents regarding perceived pig welfare and pen characteristics. 5-point semantic differential scales from -2 to 0 to +2 were used. A General Linear Model and t-tests were calculated with IBM SPSS Statistics to analyse effects on picture evaluation. Overall, the effect of the pen was the largest on picture evaluation ($\eta^2=0.392$, $P\leq 0.001$) followed by the effect of the pig ($\eta^2=0.099$, $P\leq 0.001$). The welfare of both, the 'happy' and 'unhappy' pig, was always rated lower in the slatted floor setting than in the straw setting and the 'unhappy pig' on straw achieved better welfare-values compared to the 'happy pig' on slatted floor (e.g. evaluation of health: 'happy' pig $\mu_{\text{straw}}=0.87$ and $\mu_{\text{slatted}}=0.22$; 'unhappy' pig $\mu_{\text{straw}}=0.49$ and $\mu_{\text{slatted}}=-0.16$; $P\leq 0.001$). The straw pen was rated more positive compared to the slatted floor pen and the evaluation only slightly differed depending on pigs' expression (e.g. evaluation of species-appropriateness: straw pen $\mu_{\text{happy}}=0.56$ and $\mu_{\text{unhappy}}=0.48$; slatted floor pen $\mu_{\text{happy}}=-1.08$ and $\mu_{\text{unhappy}}=-1.16$, $P\leq 0.001$). The results show that public perceptions of a contentious husbandry system (pen with slatted floor) is not altered by showing positive appearing animals whereas a more positive perceived system (pen with straw) enhances the welfare perception of the animal on pictures.

Addressing the social dilemma in animal-friendly product choice with positioning strategies

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Despite the continuing attention for animal welfare in society, consumer product choices remain an important barrier for animal-friendly improvements in animal-based production systems. This paper aims to address this issue by viewing animal-friendly product choice as a social dilemma between maximizing the buyer's self-interest and the collective interest, which presents a main challenge of marketing animal-friendly products. To address the social dilemma, this study proposes positioning strategies that reinforce the animal welfare label with different types of complementary consumption values, namely the functional, emotional, social and epistemic value. As consumers differ in their behaviour in social dilemmas, this study also measures the impact of a motivational conflict, which refers to individual differences in the relative importance of collective interest and self-interest, on animal-friendly product choice. The strategies were empirically tested in a choice experiment conducted with 575 Dutch meat shoppers. The results showed that two strategies – emotional and epistemic – are effective in increasing consumer perceptions of the respective consumption values, both with a small, yet significant effect ($P=0.04$ and 0.03 respectively, calculated with Dunnett one-way t-tests). These insights imply that animal welfare labels that call on consumer feelings or provoke curiosity may be particularly effective in driving consumers towards a more animal-friendly food choice. Logistic regression showed that while consumers with high motivational conflict are more likely to choose animal-friendly products (odds ratio=2.25, $P<0.001$), they do so less often if the total perceived value of such products increases than consumers with low motivational conflict (odds ratio=0.54, $P=0.001$). This result shows new opportunities for marketing animal-friendly products, as it suggests that positioning strategies emphasizing the 'what's in it for me' can even drive those consumers who don't care about animals towards animal-friendly product choices.

Sheep farmers' behavioural attitudes are associated with intrinsic motivation and job satisfaction

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A number of studies have provided evidence for a relationship between stockpeople's attitudes and behaviour, and the subsequent behavioural response and performance of the animals. The work environment is known to affect work motivation and job satisfaction, and in turn, these factors could affect the farmers' attitudes to handling their livestock, and thus the quality and quantity of human-animal interactions. In Norway, where sheep generally are housed throughout the cold season (mean flock size: 71.5 ewes), there is an increasing interest in more simple and less costly building solutions. In the SheepHouse project, we developed and distributed a web-based questionnaire (using QuestBack™) to 3,764 Norwegian sheep farmers (response rate 32%) to explore the effects of different housing solutions on both sheep and farmer well-being. The aim of this part of the study is to identify the most important predictors of the sheep farmers' attitudes towards handling sheep. Multi-item rating scales measuring attitudes, job satisfaction and work motivation were analysed using principal-component factor analysis. New index variables were created for use in regression analyses. Preliminary regression models indicate that the farmers' attitudes to positive handling of their sheep are significantly and positively associated with intrinsic work motivation (i.e. valuing animal welfare, a meaningful job and the lifestyle of farming) ($P < 0.001$) and affective job satisfaction ($P < 0.001$), explaining 22% of the variance. Extrinsic work motivation (e.g. valuing high salary) was not significantly associated with attitudes, nor was the type of farm building. The results show that farmers who are internally motivated and have a high level of job satisfaction also have more positive attitudes towards sheep handling. This suggest that recruiting stockpeople with a strong intrinsic work motivation and focusing on factors that can enhance their job satisfaction may be of importance in improving sheep welfare.

Multi-level animal welfare labels reflect consumer preferences: insights from a systematic review

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The objectives of this study were to analyse consumer preferences for animal welfare-friendly husbandry systems, especially the preferences for outdoor access of farm animals, and to assess the relative size of consumer segments which place a high importance on animal welfare-friendly husbandry systems. The analysis was based on a systematic review of empirical journal articles with a focus on meat and milk producing farm animals. In total, 32 studies were analysed, 25 on consumer preferences and 15 on segmentation (eight studies reported both). All 25 studies on consumer preferences tested outdoor access for animals as one among other product attributes and revealed its significant positive and strong influence on consumer preferences for meat and milk. The studies further showed that consumers were willing to pay a premium for outdoor access of farm animals. All 15 studies on consumer segmentation identified at least one segment which gave the animal welfare-friendliness of the husbandry system the highest priority (with a size of 9 to 54% of the respective sample). The majority of segmentation studies identified one or more additional consumer segments for which other attributes were more important, however animal welfare was still ranked high in importance. Currently, in some EU countries consumers only have the choice between products sold as organic or as conventional (i.e. according to the minimum legal requirements). Organic husbandry systems, which require amongst others outdoor access for farm animals, are highly valued by small consumer segments in EU countries. Our review showed, however, that there is a multi-level market for products from in between organic and conventional standards, which offers opportunities for price differentiation according to animal husbandry systems.

Antibiotic use: balancing consumer concerns and animal welfare*Fiona Gwendolen Roberts¹, John Kirkpatrick² and Gerald Crown¹**¹NSF International, Hanborough Business Park, Long Hanborough, Oxon OX29 8SJ, United Kingdom, ²Tesco Stores (UK) Ltd, Progress House, The Boulevard Shire Park, Welwyn Garden City, Herts AL7 1 RZ, United Kingdom; fiona@foodsecure.co.uk*

In recognition that the emergence of antimicrobial resistance and the potential link to antibiotic use in livestock are a consumer concern, Tesco (UK) places the responsible use of medicines as a core element to the Agricultural Requirements in all livestock supply chains. This is supported by an associated programme of independent on-farm inspections and monthly submitted Outcome Measure data, addressing key welfare indicators. Farm inspection and subsequent data management and analysis is undertaken by Integra Food Secure Ltd, an independent UKAS accredited inspection body No.111; with global expertise in the assessment of farm animal welfare. A key aim is to support the supply chain in strategies to reduce antibiotic usage and to evidence that this is achievable without compromising animal welfare. To evaluate the impact of reduction strategies, data has been collated across the global broiler supply chain over the last 18 months; focussing on antibiotic usage (mg/kg), mortality (%), hockburn (%) and pododermatitis (%). Results indicate that antibiotic usage in the supply chain follows a binomial distribution with discrete 'low' (4.5 ± 4.2 mg/kg) and 'high' (21.7 ± 7.2 mg/kg) user populations. Key welfare indices, such as levels of pododermatitis are positively correlated (0.49) with antibiotic use. A 62% reduction in use ($P < 0.05$) has been achieved across UK broiler integrations; and importantly this is without significantly increasing on-farm mortality. There is no statistically significant seasonal effect but there does appear to be a threshold of approx. 3 mg/kg below which sustained reduction is challenging. The work demonstrates the value of a supported process of data collection and analysis to drive improvement in a supply chain, evidence good practice and support a consumer facing retail position.

Supply chain's lack of response to emerging needs for clenbuterol-free meat: a case study in Mexico*Miriam Elizabeth Perez-Luna**Wageningen University and Research, Marketing and Consumer Behaviour Group, the Netherlands; miriam.perezluna@wur.nl*

The supply of bovine meat in the emerging market of Mexico involves both public health risk and animal welfare concerns due to the illegal involvement of clenbuterol hydrochloride in the fattening of the cattle. Previous studies have shown expressed and latent needs of end consumers for clenbuterol-free meat in Texcoco, Mexico, yet little is known, from a supply chain perspective, about the moderators intervening the response to these needs. This case study is constituted by qualitative face-to-face semi-structured interviews to members of the supply chain with the aim to explore the reasons behind the lack of supply of clenbuterol-free bovine meat. A unique case of an online submission of an interviewer's questionnaire to a slaughterhouse due to availability constraints during the data collection is included as well. Five farmers, two middlemen, three slaughterhouses, and four butchers, under condition of anonymity, provided insights of the current situation of the supply chain in regards of the use of the beta agonist. The choice of the units of analysis was based on their role within the supply chain and its access was through snowball sampling technique. Coding and analysis of the respondents' answers was aided by the software *ATLAS.ti* v7. A consensus was reached by all the respondents with the expressed needs of their customers for lean meat produced with clenbuterol, and no expressed needs for clenbuterol-free meat. Likewise, they all maintained an emphasis on production efficiency-related benefits of clenbuterol, lack of entrepreneurship for proactive differentiation and innovation of their offer, and mentioned the violability of the law against handling, possessing, and using this substance. Since this supply chain showed to be customer-led, there is a call for latent needs for clenbuterol-free meat to be expressed and thus fulfilled. Furthermore, this study discloses the urge for the incorporation of animal welfare and human health safeguarding concerns in the consumers' demands and thus, the supply chain members activities. It also proposes marketing-related interventions for promoting the supply of clenbuterol-free meat which can gradually disassociate the members of the supply chain from illegal and unhealthy practices.

Role of agricultural colleges in framing future farmers' perception of animal welfare*Inger Anneberg¹, Peter Sandøe² and Jesper Lassen³**¹Aarhus University, Department of Animal Science, Denmark, ²University of Copenhagen, Department of Large Animal Sciences, Denmark, ³University of Copenhagen, Department of Food and Resource Economics, Denmark; inger.anneberg@anis.au.dk*

The welfare of farm animals depends on development in production systems, economic drivers and regulation, but also human factors such as management strategies, communication, training and knowledge sharing play a role. Since the years spent at agricultural colleges are likely to influence the coming farmers and their perception of animal welfare, the aim of this paper is to examine the role agricultural colleges have in forming future farmers' knowledge and understanding of animal welfare. The study used a qualitative approach and included observations from the classrooms as well as nine interviews with teachers at four agricultural colleges in Denmark. The data (transcripts of the interviews and notes from observations) was subsequently coded and analysed using systematic text condensation. The study showed how the animal welfare had an important role in the teaching at Danish agricultural colleges. It is a cross-cutting subject that should be and is included in the curriculum when relevant. Differences in teachers' perception of and experience with animal welfare resulted in dilemmas. Our study also showed how teachers face challenges in getting access to diverse knowledge about animal welfare. Finally, our study pointed towards a conflict over the role and importance of animal welfare as a theme during the extended periods of vocational training at farms, which is an important part of the education, and during classroom teaching at the colleges. Typically, teacher's experience that the students consider working on farms as a more relevant basis for discussing animal welfare than the more academic knowledge presented by the teachers. Based on this we will discuss how well colleges equip coming farmers to work with and discuss different understandings of animal welfare.

Citizens perceive broiler welfare differently from poultry farmers and poultry veterinarians

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In society, questions have been raised about broiler welfare and about how broilers should be kept. Insight into perceptions of broiler welfare from different stakeholder groups could provide input how to deal with these public concerns. Therefore, a survey by means of a questionnaire was done to study broiler welfare perceptions by Dutch citizens (n=2,259), poultry farmers (n=100) and poultry veterinarians (n=41) in March and April 2014. A randomly selected panel of Dutch citizens, representative for the Netherlands, was invited to participate (CentERdata, the Netherlands). Farmers and veterinarians were invited by an email from their professional organisations. Respondents scored on five-point Likert scales (1) the welfare of broilers in a conventional, conventional plus, free-range and organic system (1=poor welfare, 5=excellent welfare), and (2) the influence of various welfare aspects on animal welfare (1=absolutely no influence, 5=absolutely does influence). Differences among mean scores of the stakeholder groups were analysed with ANOVA and the post-hoc Games-Howell test. Citizens perceived the welfare of broilers kept in the conventional (mean±SE: 2.40±0.023) and conventional plus (3.19±0.020) systems lower (P<0.001) than did farmers (3.90±0.119; 4.18±0.110) and veterinarians (3.85±0.129; 4.37±0.115). However, farmers (2.82±0.153) and veterinarians (3.12±0.213) perceived broiler welfare in organic systems lower (P<0.001) than did citizens (4.33±0.018). These differences in welfare scores could be explained by different perceptions of aspects of animal welfare. Compared to professionals, citizens perceived the influence on animal welfare of aspects related to natural behaviour – space to move around freely, natural needs, outdoor access, *ad libitum* feed and water, scratching and dust bathing opportunities, and enrichment – higher (P<0.05) and the influence of the aspects pain and anxiety or stress, lower (P<0.05). The biggest difference in scores between the stakeholder groups regarded the aspect outdoor access. These different perceptions of stakeholder groups may have consequences for the future of broiler husbandry.

Ambition and reality of the EU animal welfare legislation on long distance animal transport*Julia Havenstein**Animals' Angels e. V., Germany; kontakt@animals-angels.de*

The EU offers a broad range of animal welfare rules dealing with major welfare concerns regarding rearing, transport and slaughter offering good enforcement tools. With the introduction of Article 13 TFEU, the EU goes even further by recognizing animals as sentient beings, requiring that full regard shall be paid to their welfare when formulating and implementing EU policies. This reflects the concern of the EU citizens for animals and their ethical values. They want animal suffering to be avoided and they rely on EU institutions, official member state bodies and the European farming industry to comply with EU legislation. However, practice too often paints a different picture: farm animal welfare rules are ignored, even systematically. Enforcement bodies are powerless or overwhelmed by other priorities. When it comes to decisions between animal welfare and economic interests, economics win while the animals lose out. The examples are manifold and concern all species, industry sectors and production processes. We identify this inconsistency on the example of long distance transports of live animals destined for slaughter, showing how reality looks like for these animals. For example, in 2016, during several large-scale investigations at the Turkish-Bulgarian border, our organization inspected 330 animal transports out of which 100% were in violation of Council Regulation (EC) No 01/2005. We thus come to the result that reality lingers behind the ambitions of the EU animal welfare laws and that authorities too often fail to properly implement animal welfare legislation. Animal welfare is not just window dressing. The EU has to stick to its own values setting clear limits to purely economic interests. The aim of the EU and its institutions cannot only be market optimization, but in the first place the defence of its values and of the ethical demands of its citizens.

A framework for review of private animal health and welfare standards in QA programmes

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In recent years, 'private standards' (PS) in animal health and welfare (AHW) are increasingly common. These are voluntary standards developed by non-governmental organisations, used for the certification and labelling of animal products under quality assurance (QA) schemes. PS may not be scrutinised to the same degree as public standards. Therefore the aim was to develop a framework to facilitate the review of PS in AHW. We conducted a theoretical study in which we considered benefits and concerns about the use of AHW standards in QA programmes and evaluated the process of developing public standards, particularly by the OIE. Benefits of PS in AHW are that they provide opportunities for product differentiation and being more easily developed and implemented are more responsive to change than public standards. PS may also bring financial benefit to farmers from real improvements to AHW provided that they incorporate a continuous improvement approach. Concerns include lack of harmonisation and inefficiencies whereby QA programme may not work synergistically with existing international/national/regional/sector-level efforts towards improved AHW (e.g. on-farm auditing requirements, AW research findings). Others include costs of compliance, and the credibility of associated claims. The framework seeks: (1) to clarify the primary programme goal(s), the measureable outputs relevant to AHW, and the primary programme beneficiaries; and (2) to evaluate programme effectiveness, efficiency and transparency. It represents a theoretical tool which can assist during the development or subsequent evaluation of PS and thereby contribute to their refinement such that the concerns raised above can be addressed and ultimately improvements achieved in AHW. We will use this tool to critique dairy cow welfare QA schemes in four EU countries.

Animal welfare in traditional mountain dairy cattle farms: how do consumers perceive complexity?

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This qualitative study aims at shedding light on perceptions regarding animal welfare in mountain dairy cheese production systems by investigating: (1) consumer knowledge of traditional mountain husbandry systems; (2) consumer understanding of animal welfare attributes currently employed in dairy cow welfare assessment; and (3) consumers' preference for mountain cheese labels with welfare claims. Focus group discussions targeted the three main consumer groups that purchase mountain cheese in the eastern Italian Alps, namely local communities living in the mountains, and Italian and German-speaking tourists living in urban lowlands. Focus groups consisted of 6-8 people recruited on a voluntary basis with the only criterion being that they were cheese purchasers. Participants from the local community were recruited through project advertisement at the local cheese shop. Italian and German-speaking tourists were recruited through the Slow-Food networks. A moderator guided the discussions, following a structured topic list composed of four steps. The introductory section aimed to introduce participants to each other in terms of outdoor activities, favourite foods and relationship with animals. In the second section, the topics of mountain environment and agriculture were investigated through a drawing exercise. The third section focused on dairy cows and welfare aspects using pictures from different mountain farms. The fourth section investigated cheese quality attributes and interest for animal welfare labels. Results were analysed and coded with NVivo software for qualitative research. Despite the overall positive attributes linked to mountain farming and mountain products that emerged in all groups, participants from lowland urban communities (mean elevation 270 m a.s.l.; mean inhabitants 97,270) and participants from the mountain community (mean elevation 570 m a.s.l.; mean inhabitants 1,330) emphasized different themes regarding mountain farming, animal welfare and cheese labels. Findings from this study will inform the development of quantitative research targeting consumers' view on animal welfare in mountain farms.

Farmer apprentices' learning on animal welfare during farm practice is influenced by host farmers*Mette Vaarst and Inger Anneberg**Aarhus University, Animal Science, Denmark; mette.vaarst@anis.au.dk*

Background: In Denmark, farmers are educated at farmer colleges (up to 4 years 3 months). The education includes periods of practice on farms. Previous studies focused on farmer colleges' curriculum and teaching material on animal welfare suggested that the periods of on-farm practice influenced the apprentices' perceptions of animal welfare and their practical handling of animals. This study therefore aimed to investigate factors influencing the apprentices' learning about farm animal welfare in practice. Methods: Conduct of three focus group interviews with farmer apprentices (three agricultural colleges, in total 24 students) and 15 qualitative phone-interviews with host farmers, using semi-structured interview guides. The two samples of qualitative interviews were analysed using systematic text condensation. Results: Two major themes were found among hosts, viewing the apprentice as 'a young person going through a learning process including animal welfare' vs 'relatively cheap labour on the farm'. A dominant result among the apprentices was that some hosts, e.g. by not being present in daily work, did not acknowledge their learning process and need for dialogue about animal welfare. Both host farmers and apprentices gave examples how this could affect animal welfare, meaning spending less or almost no time on dialogue and articulating e.g. common observations and common considerations on appropriate actions and reactions regarding the management of animals. In such cases learning on animal welfare seemed to be mostly 'copying what the permanent farm staff did' without discussing or explaining it. Secondly, the contact between agricultural colleges and host farmers ranged between 'very close' to 'almost non-existing'. In cases where learning at the college seemed completely disconnected to the on-farm learning, the host farmer could risk to lose interest in the learning process of his/her apprentices, and the apprentice found that on-farm learning remained un-reflected and un-related to the topics taught in the college.

Do villagers trigger farmers' perceptions of animal welfare standards?*Nina Purwins¹, Tim Viergutz¹ and Birgit Schulze-Ehlers^{1,2}**¹University of Goettingen, Germany, ²Lincoln University, New Zealand;**nina.purwins@agr.uni-goettingen.de*

While there is a wide consensus among politicians, researchers, and sector experts alike that farm animal welfare needs to be increased, farmers' willingness to implement certain animal welfare standards so far seems limited. In this respect, farmers' perceptions of the usefulness of animal welfare standards is key. This research examines the factors which determine farmers' perceptions of the usefulness of various animal welfare measures based on a quantitative questionnaire among pig producers in Germany (n=62, to be extended; we use 7-point-Likert-type scales, principal component analysis, and multiple regression analysis). The novelty of our approach lies in a particular focus on the impact of farmers' social networks and geographical localizations. Controlling for general attitudes towards animal welfare and the perceived ease of implementation, we find that the attitudes of people important to the farmers are the main drivers of the farmers' perceived usefulness of animal welfare standards ($R^2=0.53$). Hence, if a farmer's social network demands the implementation of animal welfare standards, the farmer perceives the standards as useful to increase animal welfare. Additionally, the farmers' perceived attitudes in the social network are decomposed into the farmers' valuations of different groups of social relationships, i.e. family, friends, colleagues, and villagers. We detect that the impact of the villagers on the farmer is crucial ($P=0.01$). If the farmers value the attitudes of the villagers, they are likely to be confronted with a milieu which demands the implementation of animal welfare standards. Given these findings, we relate farmers' valuations of villagers to farmers' contact rates with different groups as well as indicators based on the respondents' geographic localizations. These findings may furthermore help to assess the social pressure a farmer is facing based on the geographic localizations and consequentially help to develop appropriate communication strategies for animal welfare endeavours.

Brazilian citizens: expectations for dairy cattle welfare and awareness of contentious practices

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We surveyed a representative sample of Brazilian urban citizens (n=300) with the aim to explore their knowledge and expectations on how farmers should care for their dairy cattle. Participants were invited to answer an open-ended question, describing how they imagined a dairy farm that cares about the welfare of their animals. Respondents were then asked, in closed questions, whether they were aware of (yes/no) and their position (support/indifferent/oppose) regarding four practices commonly used in dairy farms. The quality of care given to the animals on the farm was the main animal welfare issue raised by participants, followed by aspects related to feeding, cows' health, hygiene and quality of the facilities. Participants highlighted concerns related to use of chemical additives in the cows' feed or residues in milk, and associated this with milk quality. Participants also placed value on the ability of the cows to graze and to have lots of space to move around. Few respondents were aware of the specific management practices: early cow-calf separation, 35%; zero-grazing, 32%; culling the newborn male calf, 21%; and dehorning/disbudding without pain control, 11%. Although no participants raised these or any other specific management practices in response to the open-ended question, the majority was opposed to the practices (cow-calf separation, 89%; zero-grazing, 85%; culling the male calf, 90%, and dehorning/disbudding without pain control, 79%) when directly asked. This study confirms previous research showing that urban Brazilian citizens are largely unaware of livestock production practices and systems, but do have expectations regarding animal welfare.

Social network analysis: opportunities and challenges for applications in wild and domestic animal populations*Jens Krause**University of Leeds, Faculty of Biological Sciences, United Kingdom; j.krause@leeds.ac.uk*

The field of social network analysis has rapidly developed in recent years. In most major taxonomic groups substantial progress has been made thanks to the tools and conceptual advances offered by social network analysis. In particular the arrival of reality mining (i.e. machine-collected data) has made it possible that huge datasets on the spatial and social dynamics of animals can be collected using standardized methods based on objective criteria. Nevertheless this opportunity has also created new challenges some of which I will discuss in this talk. In addition I will present a new approach to social networks using Markov chains which allows us to model the fission-fusion dynamics of populations.

Understanding tail biting in pigs through social network analysis*Yuzhi Li¹, Haifeng Zhang¹, Lee Johnston¹ and Wayne Martin²**¹University of Minnesota, West Central Research and Outreach Center, USA, ²University of Minnesota Extension, USA; yuzhili@umn.edu*

The objective of this study was to investigate the association of social structure and incidence of tail biting in pigs. Pigs ($n=144$, initial weight= 7.2 ± 1.57 kg, 4 weeks of age) were grouped based on their litter origin: littermates (all pen-mates were born and nursed by the same sow), non-littermates (no pen-mates were born or nursed by the same sow), and half-littermates (half of the pen-mates were born and nursed by one of two sows). Six pens (8 pigs of mixed sex/pen) of each litter origin were studied for 6 weeks. Incidence of tail damage and growth performance were monitored. Behaviour of pigs was video-recorded for 6 h during daytime at 6 and 8 weeks of age, respectively. Videos were scanned at 10-min intervals to register pigs that were lying together (1) or not (0) in binary matrices. Pigs that were lying together were considered to be socially connected. Social network analysis was performed using the UCINET software. Non-littermates had greater network centralities (0.95 vs 0.65, SE=0.02 for degree centrality (DC); 0.86 vs 0.44, SE=0.03 for closeness centrality (CC); and 0.99 vs 0.45, SE=0.05 for betweenness centrality (BC); $P<0.05$ for all centralities), density (4.91 vs 3.27, SE=0.36; $P<0.05$), and clustering coefficient (4.87 vs 3.18, SE=0.39; $P<0.05$) than littermates indicating that non-littermates were more socially connected. 2% of non-littermates had their tails damaged, compared to 15% of half-littermates and 27% of littermates with damaged tails ($P<0.001$). Pigs with damaged tails had lower centralities (0.69 \pm 0.02 vs 0.84 \pm 0.01 for DC, 0.47 \pm 0.03 vs 0.70 \pm 0.01 for CC, 0.46 \pm 0.05 vs 0.78 \pm 0.02 for BC; all $P<0.01$) than other pigs indicating that victimized pigs were less socially connected with their pen-mates. These preliminary results suggest that littermates were less socially connected among themselves compared with non-littermates. Less social connection with pen-mates may predispose pigs to being a victim of tail biting.

Relationship between personality and social behaviour in dairy cattle

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We investigated the relationship between personality traits and the social behaviour within a group using socio-negative (displacement) as well as socio-positive (grooming) interactions. In a group of 14 lactating Holstein-Friesian cows (no mother-daughter relations), we determined displacement (n=403) and grooming (n=63) events from a 2-day continuous video footage. Using these interactions, we created weighted and directed socio-positive/-negative networks and calculated the IN-/OUT-degree (No. of partners) and IN-/OUT-strength (No. of interactions) via social network analysis. We assessed personality in the month of the observation based on an arena test; we transformed seven selected parameters into personality traits (*activity*, *alertness*, *boldness*) via principal component analysis (trait stability was proved via repeated test). Linear regression was applied to test the relations between a personality trait and a network measure. The slope of the regression line provides the direction and magnitude of the relation, P-values were calculated via permutation test (n=1000). Contrary to our hypothesis, *activity* showed a positive relation with IN-degree and IN-strength of displacements and a negative relation with IN-degree of grooming. This indicates that more active cows are displaced more often and receive grooming from fewer group companions; which may correspond to avoidance behaviour. *Alertness* (may reflecting anxiety) tended to show a positive association with IN-/OUT-strength of grooming, suggesting that alert cows give and get more grooming, which might support the hypothesis that grooming has a stress reducing function. *Boldness* was positively related to OUT-degree and showed a negative relation to IN-degree of displacements. Moreover, *boldness* and Lamprecht dominance index showed a positive correlation ($R_s=0.63$, $P_{raw}=0.016$). This supports our hypothesis that bold animals are more dominant, displace more cows and they are displaced by fewer. Results indicate that personality may affect the social behaviour and thus could be a relevant factor for the assessment of social welfare in groups.

Can aggressive network structures at mixing be used to predict lesion outcomes in pigs?

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Post-mixing aggression following regrouping is an on-going welfare problem in the pig industry that management approaches have failed to resolve. To date, research on aggressive behaviour has focused on isolated dyadic interactions and the summation of these into dominance hierarchies, which have not managed to fully explain the variation in skin lesion outcomes. Pigs are housed in social groups in which dyadic interactions occur as components of a larger complex of potentially non-independent interactions. Quantitatively characterising the full network of interactions in a social group could allow a more precise understanding of group-level lesion outcomes. In this study the aggressive social networks of 78 pens of 15 grower pigs following mixing were analysed. Animals were weighed and where possible similar weighted pigs were grouped together to reduce variation in weight. The network characteristics of two distinct aggressive behaviours were investigated (reciprocated (RA) and non-reciprocated (NRA) aggression) to discover whether the centralisation and structure of these networks offer new insight into the injuries from aggression at mixing and thereafter in stable social groups 3 weeks post-mixing. The effect of pen level centralisation was analysed using a REML mixed model with experimental batch as a random effect; sex, breed, and mean weight as fixed effects, and pen level lesion scores as the response variate. The findings revealed structural differences in networks comprised of NRA and RA behaviours. NRA networks had higher levels of centralisation than RA networks but RA network centralisation offered the most predictive value in terms of lesion scores. Networks with high eigenvector ($P=0.024$) and betweenness centralisation ($P=0.021$) were associated with lower numbers of lesions at mixing and more lesions in stable groups (eigenvector; $P=0.035$, betweenness; $P=0.031$). Whereas networks with a higher clustering coefficient had more lesions at mixing ($P=0.001$) and fewer lesions in stable groups ($P=0.019$). This suggests that low centralisation and even distribution of aggressive interactions between pigs contribute to long term social stability of the group as a whole.

Effect of environmental enrichment on the social contact patterns of group housed sows

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Optimising group housing for pregnant sows is a crucial issue following the global trend of phasing out sow stalls. Providing suitable enrichment could further benefit sow welfare. This study aims to evaluate a scratching brush enrichment device for group-housed sows and determine the impact of its inclusion on social contact patterns. 6 groups (4-6 per group) of sows were observed in 3 phases of equal duration: Phase 1, control period; Phase 2, enrichment period and; Phase 3, post enrichment period. Social dominance hierarchy of each group was determined via food competition tests (DT) at the start of the trial and the end of each phase. Lesion scores (LS) were also taken. Scan sampling recorded sow-to-sow contact behaviour and sow-enrichment contact. Social network analysis (SNA) using UCINET calculated weighted *degree* (an indicator of gregariousness). Spearman's ranked correlation tests determined the relationship between sow hierarchy (DT and LS) and enrichment use. Phase effects on *degree* were analysed by GLMMs, with Phase as the fixed effect and sow nested in group as the random effect. There was a strong positive association between dominance test across all phases ($P < 0.05$) and dominance status did not affect enrichment use. However, sows with a higher lesion score in Phase 1 and 2 showed increased use of the enrichment device ($P < 0.05$), which may have been due to a greater itch sensation from the lesions. There was a significant reduction in *degree* during enrichment and post-enrichment phases relative to the pre-enrichment phase ($P < 0.001$). In conclusion, the addition of the enrichment did not impact the stability of dominance within the group and sows with more lesions may use the brush to alleviate the itch sensation as lesions heal. However, the enrichment had an effect on sow social dynamics, with a reduction in contact that persisted into the post-enrichment phase.

Access to an outdoor run in dairy goats: effects on activity and social behaviour*Nina M Keil¹, Joanna Stachowicz^{1,2}, Lorenz Gygax¹, Beat Wechsler¹ and Edna Hillmann²**¹Centre for proper housing of ruminants and pigs, Swiss Federal Food Safety and Veterinary Office FSVO, Switzerland, ²Ethology and Animal Welfare Unit, ETH Zürich Department of Environmental Systems Science, Switzerland; nina.keil@agroscope.admin.ch*

An outdoor run provides additional space and enrichment for dairy goats in loose housing and could be beneficial for goats' welfare. The aim of this study was to determine the effect of an outdoor run on activity and social behaviour of dairy goats. The study was conducted on six dairy farms with 10 groups of adult females in total. Groups differed in size (30 to 100 animals), breed and horn status. Within groups, the age structure was heterogeneous. We observed each group indoors in the lying and activity area on two days for 2 h in the morning after the feeding/milking, i.e. peak hours of outdoor run use. The outdoor run was open on one day and closed on the other day in randomized order. Weather conditions were comparable between days and farms (moderate temperatures, cloudy, no rain). Every 10 minutes the number of goats indoors and the number of goats lying and standing in the lying and activity area were noted. Agonistic interactions with physical contact (head butts, displacements of lying or staying goats, chasing, fights) occurring in the lying and activity area were recorded continuously. Linear mixed-effects models were used to test the effect of outdoor run accessibility on goats' behaviour. As expected, fewer goats were indoors when the outdoor run was open (median difference=-8; $F_{1,17}=33.01$, $P<0.0001$) but also a smaller % of goats were lying indoors (median difference=-18%; $F_{1,17}=41.56$, $P<0.0001$). No consistent effect of the outdoor run was found on social behaviour. With access to the outdoor run, there was a strong increase in the number of agonistic interactions in three groups. In seven groups, however, goats showed less agonistic behaviour. Possibly, goats going outdoors and coming back indoors also pose a risk for social conflicts due to more overall activity and potential confrontations between individuals.

Social networks in dairy cattle: potential implications for the transmission of *Leptospira* spp.

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This study aims to analyse the contact structure of dairy cattle that may lead to transmission of *Leptospira* spp., a bacterium responsible of a worldwide zoonosis of high prevalence in cattle herds. For that purpose, we examined the social networks of a group of dairy cows (n=100) and calves (n=33), in a pasture-based system. We focused on three contact behaviours that may lead to transmission of *Leptospira* spp.: sniffing, licking and rubbing face on the genital area of another animal. Direct observations were conducted during four weeks, four hours per day and three days per week. Behaviour sampling method with all-occurrences recording was used to register these behaviours. We created the networks and used exponential random graph models to model the probability of contact between cows based on their calving number, age and reproductive status, and between calves based on their sex and age. Cows were less likely to interact with cows of different calving number, than with cows of similar calving number (OR=0.8). Individuals that were in heat during the observation period were involved in significantly more interactions than individuals that were gestating (OR=1.5). It was more likely for a cow to interact with a cow that had already sniffed/licked/rub her (OR=4.2), than with cows that didn't interact previously with her. Cows that had calved 4 or less times, were less likely to perform the behaviours than cows with higher parity (OR=0.8). Male calves were more frequently the ones initiating the interaction (OR=7.8), and less frequently the receptors of the interaction (OR=0.4). Calves were less likely to interact with calves of different age, than with calves of similar age (OR=0.9). Structural attributes were also key to capture the clustering of the network providing an overall better fit. More detail of the analysis and results will be presented at the congress.

Real-time location system to uncover the contact structure of group-housed sows

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Real-time location systems (RTLS) help to uncover contact structures of sows. By this, ethological, welfare, and epidemiological issues can be answered. Here, 200 sows in a gestation unit (dynamic group with weekly rehousing) were equipped with ear tags (Smartbow GmbH, 36×52 mm, 35 g) of a RTLS transmitting one position per second. The stable was divided in predefined areas (approx. 20 m²). Over one week, daily networks were constructed, i.e. all contacts between two animals in the same predefined area were aggregated over one day to a single one maintaining the frequency of contacts as edge weights. Social network analysis delivered results for existent contacts (unweighted) and their frequency (weighted). Degree specifies the number of contacts of a sow. Betweenness indicates to which extent a sow lies on the shortest paths between all others. Thereby, weighted calculations include the frequency of contacts. Over one day, sows had contact to all other sows (unweighted degree). The average contact length was 55 min with a maximum of 2 h (weighted degree). The low Spearman-Rank-Correlation (0.16, P=0.02) between weighted and unweighted degree suggests that sows had intensive contact with only few others. Further, it was found that 45% of the newly integrated sows showed highly weighted degrees because they have to find their place in the social hierarchy. This effect decreased after day 3. Moreover, individual sows seemed to connect different groups within the stable indicated by a high weighted betweenness (0.70-0.98). However, these sows did not have a high weighted degree, suggesting that group-housed sows form clusters (small subgroups) which should be further evaluated. Due to the coarse raster of predefined areas and the chosen time period of one day only little variance could be obtained. Refinement of these parameters can lead to a better resolution. To conclude, network analysis gives new insights in contact structures of group-housed sows which help to e.g. investigate disease transmission.

Social network analysis of high- and low-productive dairy cows*Paul Koene, Pieter Hogewerf and Bert Ipema**Wageningen University & Research, Animal Welfare, Wageningen Livestock Research, the Netherlands; paul.koene@wur.nl*

Dairy cows may graze more efficiently when allowed grazing in predefined areas with predictable sward height and grass quality. According to literature separating High- and Low yielding (HY and LY) dairy cows may have advantages for efficient grassland use, by allowing HY-animals to graze on a new grass strip first. In the control group 8 cHY and 8 cLY cows were grazing on a fixed area with every day a new strip of grass. In the experimental group 8 eHY- cows (matched with cHY) were also free to graze in the same fixed area, but 8 eLY cows (matched with cLY) were potentially stopped at a virtual fence and reduced the grazing area with possible social, welfare and production consequences. The virtual fence consisted of underground wires signalling a boundary that was received in the cow collar, producing a warning signal to the cow when approaching the boundary and a correction signal when crossing the boundary. All individual cows' positions were recorded using GPS during day and night in the pasture and their locomotion and nearest neighbour were determined. The cows were moved to a milking parlour twice a day; individual milk production was recorded (liter per day). Data were recorded in three periods, i.e. P1 (learning), P2 (basis) and P3 (cross-over, i.e. experimental and control group were switched). The virtual fence was successful in preventing eLY-cows to reach the fresh grass. A reduction in their locomotion was found that might be related to a reduced welfare. However, no effect of the virtual fence and the restriction of the LY experimental group on milk production was found, Preliminary analysis of the Social Network showed a strong separation between eHY- and eLY-cows induced by the virtual fence. In the cross-over this separation initially remained, but extinguished in 3 days.

The weak spots of contemporary science and how to strengthen it*Jelte Wicherts**Tilburg University, Department of Methodology and Statistics, the Netherlands;**j.m.wicherts@uvt.nl*

Several fraud cases, widespread failure to replicate or reproduce seminal findings, and pervasive error in the scientific literature have led to a crisis of confidence in the biomedical, behavioural, and social sciences. In this keynote, Jelte Wicherts will discuss some of the core findings that point at weak spots in contemporary science and considers the structural and human factors that underlie them. He will delve into the human tendencies that create errors and biases in data collection, analyses, and reporting of research results. He will present several solutions to deal with observer bias, publication bias, researcher's tendency to exploit degrees of freedom in their analysis of data, low statistical power, and errors in the reporting of results, with a focus on the specific challenges in animal welfare research.

Influence of professional affiliation on expert's views on animal welfare criteria*Nina Dam Otten¹, Tine Rousing² and Björn Forkman¹**¹University of Copenhagen, Dept. of Veterinary and Animal Sciences, Denmark, ²Aarhus University, Dept. of Animal Science, Denmark; nio@sund.ku.dk*

The aggregation procedures of most comprehensive animal welfare assessment protocols do highly rely on the weightings derived from expert opinion. However, experts are often gathered from different backgrounds with very differing approaches to animal welfare (AW). Therefore, the present study investigated, whether the affiliation of experts within the four interest groups: research, veterinarians, production advice and animal welfare control (AWC) influenced the weightings of animal welfare criteria. Data were obtained from four separate expert panel studies (in 2011 and 2016) both asking experts to weigh different welfare measures and criteria for dairy cattle and sow welfare assessment. A total of 54 cattle experts participated represented by dairy production consultancy (22%), official AWC (28%), bovine practitioners (35%) and AW researchers (15%). The 34 swine experts were representing production consultancy (35%); official AWC (41%) and AW research (24%). Experts were asked to assign relative weights to the overall welfare criteria: *thirst*, *hunger*, *resting comfort*, *ease of movement*, *injuries*, *disease* and *emotional state*. Between group differences in weights were assessed by ANOVA analyses (with Bonferroni correction). Expert groups disagreed on the ranking of criteria among both species. However, using median weights experts agreed upon *thirst*>*hunger*>*resting comfort* and *injuries*>*disease*>*emotional state*. Cattle consultancy and AWC differed consistently across criteria, but only with significance within the criteria *hunger* ($P=0.04$), and tendencies towards significance within the criteria *thirst* ($P=0.06$). Researchers and AWC prioritized *thirst* (median weight=1.6) while veterinarians and consultants prioritized *disease* (median weight=1.2). Among swine experts no significant between group differences were found and *hunger* and *thirst* were ranked highest (median weight=1.2). The results highlight the challenges of using expert weightings in aggregated welfare assessment models, as the choice of expert affiliation may play a confounding role in the final aggregation due to different prioritization of criteria.

Reliability of the Welfare Quality® animal welfare assessment protocol for sows and piglets

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The Welfare Quality® animal welfare assessment protocols are animal-based on-farm assessment tools for animal welfare. Aim of the project was to test the Welfare Quality® protocol applied to sows and piglets for its interobserver reliability (IRR). The protocol consists of a Qualitative Behaviour Assessment (QBA), direct behavioural observations (BO) by instantaneous scan sampling, a human-animal relationship test (HAR), scans for stereotypies (ST) and scans for different individual parameters, e.g. metritis and shoulder sores. The study took place on twelve farms in Schleswig-Holstein, Germany. Two trained observers assessed the same animals at the same time, but completely independent from each other in 20 joint visits. IRR was calculated using Spearman's rank correlation coefficient (RS), intraclass correlation coefficient (ICC) and smallest detectable change (SDC). Preliminary results showed that there was no agreement for the QBA (ICC 0.00, RS 0.07, SDC 86.70). These results were confirmed by principal component analysis. The BO showed good agreement, e.g. investigation of the pen (ICC 0.60, RS 0.49, SDC 0.19). Overall, ST were of acceptable agreement, e.g. bar biting (ICC 0.99, RS 0.63, SDC 0.06). Only poor agreement was observed for the HAR (ICC 0.20, RS 0.08, SDC 0.25), which can be explained by the fact that the definition is somewhat uncertain. In most cases, individual measures had acceptable to good agreement, e.g. metritis (ICC 0.90, RS 0.77, SDC 0.10). However, the IRR was poor for the parameter shoulder sores (ICC 0.00, RS 0.00, SDC 0.60), which can be explained by difficulties in differentiation between category 0 (no lesions) and 1 (scar tissue, healing injury, reddening of the area) if it is too dark in the stables. In conclusion, the IRR was good for BO, ST and most individual parameters, but not for the QBA, the HAR and for the parameter shoulder sores.

Training outcomes for animal based measures

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Reliable measures are required for animal welfare audits to ensure consistent and valid results. There are 3 types of measures that can be used to measure any standard – resource-based, management-based or animal-based measures – although animal based measures (ABM's) are preferred since they are a direct measure of animal welfare. Over a six-year period, groups of 12-19 graduate students (n=98) were provided with similar in-class training in several dairy cattle ABM's including body condition scoring (BCS), lameness as well as hock, knee and neck lesion scoring. In each year, students and an expert independently assessed approximately 50 cows (n=303) at either an auction or at a dairy farm. Scoring systems varied across cohorts, with some years' students scoring using two categories (i.e. acceptable or unacceptable) while in other years students compared a five point BSC and lameness systems to the 3-point scoring systems included in the Welfare Quality© program. Overall, interobserver reliability (IOR) was typically 70% between students and the expert with IOR improving with fewer categories. In 2016, students were intentionally given limited training prior to the on-farm assessment to test the strength of protocols developed using five point BCS and lameness scoring systems and an injury scoring system with four categories. Results were better for hock injuries (72% agreement) and neck scores (97% agreement) but unacceptable for BCS (38%) and lameness (33%). This suggest that injuries may be easier to classify, compared to BCS or lameness, or it may be that gaps in the protocols contributed to unacceptable IOR. Assessors can be taught to reliably use ABM's for dairy cattle in agreement with an 'expert' provided that training on ABM's involves the use of clearly worded guidelines. This should be considered when selecting ABM's for an animal care assessment program.

Qualitative and quantitative animal behaviour measures in on-farm welfare assessments for pig herds

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Qualitative behaviour assessment (QBA) is a qualitative animal welfare indicator included in the WQ[®] animal welfare assessment protocols for cattle, swine and poultry. The WQ[®] protocols includes also quantitative welfare indicators for social behaviour. This study explores the potential association between QBA and the quantitative measures for social behaviour in slaughter pigs. During 2015-2016, four observers scored QBA and quantitative social behaviour – both as described in the WQ[®] protocol – for a total of 3,669 group housed slaughter pigs from 25 Danish slaughter pig herds. Quantitative social behaviour measures were edited to mean herd prevalences. Based on this, two variables on quantitative measures for social behaviour were included in the analyses – one on the positive (QUANPOS) and one on the negative (QUANNEG) interactions. Multiple Spearman rank correlations were used to evaluate the potential association between: (1) QUANNEG and the negative loaded WQ[®]-QBA terms: Fearful, Agitated, Frustrated, Bored, Irritable, Calmless, Apathetic and Distressed; and (2) QUANPOS and the positive loaded WQ[®]-QBA terms: Relaxed, Calm, Content, Friendly, Playful, Positively Occupied, Lively, Inquisitive, Sociable and Happy. Statistical significance level was set to $P < 0.001$. QUANNEG did – apart from one negative QBA-measure ‘Agitated’ (correlation coefficient -0.69 , $P = 0.0001$) – not correlate to the negative QBA-measures, and QUANPOS did not correlate to any of the positive QBA-measures. The results indicate that quantitative and qualitative measures do not replace each other but rather supplement each other in an on-farm multidimensional welfare assessment.

Recording behaviour directly vs from video during on-farm behaviour tests*Christina Veit, Marie Albers and Sabine Dippel**Friedrich-Loeffler-Institut, Institute of Animal Welfare and Animal Husbandry, Germany;
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Direct and video observation of animal behaviour differ regarding practicability and bias of observers. We compared the results of behaviour tests on a farm where behaviour was recorded directly and from video. A total of 18 groups (35-40 pigs each) were tested in their pens on 12 days during late rearing and early fattening (n=169). In each group, voluntary human approach test (VHAT), novel object test (NOT) and a modified novel object test where the object was thrown (mNOT) were performed and video recorded using a head camera. The performing person recorded seconds till APPROACH within half a pig length, seconds till first CONTACT and proportion of group within one pig length of person/object (INTEREST) at two time points (t) live as well as from video afterwards. APPROACH and CONTACT were collapsed into binary variables and positive and negative agreement calculated. For INTEREST we subtracted video from direct observation results. Influence of observation method (video vs direct) on results was analysed for each test in linear or logistic mixed models with random factor group. Positive and negative agreement [P_{pos} | P_{neg}] were weak to strong (APPROACH: NOT [0.61|0.95], mNOT [0.62|0.95] and VHAT [0.88|0.97]; CONTACT: NOT [0.94|0.81], mNOT [0.97|0.38] and VHAT [0.92|0.96]). Differences for INTEREST for VHAT [t_{30} ; t_{60}] were higher [mean % \pm std = -2.6 \pm 7.4; -1.7 \pm 5.4] than for NOT [1.3 \pm 9.2; 0.7 \pm 7.7] and mNOT [0.2 \pm 6.2; 0.2 \pm 7.0]. Significantly more pigs were INTERESTed during VHAT when assessed from video compared to direct observation (lsmeans INTEREST_{30s} = 32.9 vs 30.3%, respectively; SE=0.8, P<0.001; INTEREST_{60s} = 31.4 vs 29.7%, respectively; SE=0.8, P=0.014). No other significant differences were found. In conclusion, when animals can be seen clearly (as during VHAT) video observations yield more reliable scan sampling results than direct observations. If the view is less clear, variation of observations obscures differences between methods.

Development and application of a pre-slaughter welfare monitoring protocol for broilers

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To assess the impact of the pre-slaughter phase on broiler chicken welfare, a practical monitoring protocol is warranted. We developed such a user-friendly integrated welfare score (IWS) based on expert opinion. An initial list of 15 potential animal-based welfare measures to be assessed at the slaughter plant was based on literature. For each measure the impact of various stages within the pre-slaughter phase (baseline pre-catching, catching/loading, transportation, lairage) was tested for 81 commercially transported Belgian flocks. Measures were on birds individually ($n=132\pm 3$ birds/flock), in-crate ($n=88$ crates/flock) or at the slaughter line ($n=1,785\pm 33$ birds/flock). Six measures were removed, as they received low relative weights from poultry experts ($n=9$) during a workshop or because they were insufficiently affected by any of the pre-slaughter stages. Thus, the protocol consisted of 9 measures (fractures, bruising, panting/huddling, splay-legged birds, crowding, supine birds, stuck body parts, mortality, carcass rejections) which together take circa 1 h/flock to assess. Although inter-observer reliability could not be tested for mortality, carcass rejection data and for measures at the slaughter line, it was reasonably good for the remaining 5 measures ($\geq 68\%$ agreement). The IWS is based on the sum of all measure scores (0-100), multiplied by their relative weights (0-1), as based on a digital survey among 19 poultry researchers. The IWS is corrected with a customized compensation reduction strategy to give more weight to low measure scores. Indeed, when giving overall welfare scores to fictitious transports, experts allocated more weight to bad measure scores than good scores. Application of the integration on 63 transports showed a good spread on IWS and good sensitivity to important measures and to extremely low scores. The IWS can be used for auditing and quality assurance schemes, comparing slaughter plants and transportation companies. Individual measure scores can identify problematic pre-slaughter stages and opportunities for remedial actions.

Validation of lesions on the carcass as indicators of pig welfare on farm

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This study aimed to validate the recording of carcass skin (SL) and tail lesions (TL) at meat inspection as indicators of pig health and welfare (HW) on farm. Thirty-one integrated pig farms were assessed using an adapted version of the Welfare Quality® protocol to allow inspection of six randomly selected pens of pigs in the first weaner (S1), second weaner (S2) and finisher stage (S3). Hereafter, one batch of pigs was observed at slaughter for each farm where SL due to agonistic interactions (0-3) and TL due to tail biting (0-4) were scored once according to severity for each carcass. Linear regression models were developed to predict the prevalence of each HW outcome in each stage based on the prevalence of the carcass lesion outcomes. The HW outcomes that were best predicted by carcass SL and TL were poor body condition (S1, $R^2=0.30$), bursitis (S2, $R^2=0.28$), huddling (S1, $R^2=0.30$), severe tail lesions (S3, $R^2=0.31$) and coughing (S2, $R^2=0.45$). Receiver operating curves (ROC) were plotted to evaluate the potential of carcass lesions as monitoring tools to identify problem farms. Problem farms were defined as those above the 75th percentile value for each HW outcome and the area under the curve (AUC), sensitivity (Se) and specificity (Sp) were calculated. The prevalence of carcass lesions could moderately accurately predict problem farms with poor body condition (AUC: 0.80, Se: 75%, Sp: 87%), bursitis (AUC: 0.82, Se: 100%, Sp: 75%) and severe tail lesions (AUC: 0.81, Se: 88%, Sp: 74%) with high levels of Se and Sp at the optimal cut-off value of the predictive carcass lesion. Hence, carcass lesions reflect certain pig HW problems on farm and could play a role in the monitoring of pig welfare at meat inspection.

Should the contribution of one more lame cow depend on how many other cows on the farm are lame?

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Welfare states apply to individual animals. Therefore, group welfare in our view should be aggregated as a linear function of the proportion of affected animals, so that for example doubling the number of lame cows on a farm leads to a doubling of the welfare effect of lameness. In contrast, the Welfare Quality protocol considers the total welfare score to be a highly non-linear function of the proportion of animals on the farm that are suffering. The weight that each additional affected animal has on the total welfare score depends heavily on the proportion of animals that are already affected, so that the impact of an additional affected cow is reduced as the number of animals with problems increases. This is a result of the application of expert weighting of different levels of welfare problems on a scale which as its anchor points include the terms 'acceptable' and 'unacceptable'. We support our view by two arguments: (1) It is conceptually problematic to mix the size of welfare problems and the evaluation of acceptability thresholds within one measure – partly because acceptability may be viewed as a non-linear function of the size of the welfare problems found a farm level. (2) What experts view as an acceptable level of animal welfare is more a matter of individual ethical judgement than of expertise. We asked 166 animal welfare experts to score the welfare effects of various prevalences of four conditions in cattle on an 11-point Likert scale with 'acceptable' and 'unacceptable' as anchor points. Linear mixed effects models with respondent as a random effect showed that the standard deviation for respondent (between 1.5-1.8) was between 30 and 80% higher than the residual standard deviation (between 1.0-1.2) for each outcome. This indicates a disproportionately large effect of respondent on the score.

Validation of hock lesions as welfare indicator in dairy cows*Daniela Haager, Christine Leeb and Christoph Winckler**Livestock Sciences, Sustainable Agricultural Systems, Austria; daniela.haager@boku.ac.at*

Hock lesions are a common welfare problem in dairy cows. However, empirical data linking hock lesions to e.g. inflammatory reactions or painfulness are limited. To address this, we examined signs of inflammation, especially hyperthermia and the presence of inflammatory cells, in different types of hock lesions and hypothesised that already mild hock lesions, indicated by hair loss, are relevant for the cow's welfare. 172 dairy cows were assessed visually at the lateral hock (H) and the lateral point of the hock (PH) and were categorised as no hair loss (control), hair 'curly' (mild), hair loss ≤ 2.5 cm (moderate), or hair loss > 2.5 cm (severe). Ulcerations were additionally recorded as absent or present. Skin temperature (ST) was measured at both H and PH using an infrared camera (FLIR T440). Control animals were shaved before thermal imaging and animals with mild hair loss were excluded for this part of the study. In the second part, at an abattoir 25 H and 26 PH were assessed visually for hair loss, and skin samples taken post mortem histologically examined for tissue alterations and inflammatory processes. Maximum skin temperature at H and PH with moderate hair loss (H: 37.7 °C; PH: 37.3 °C) and with severe hair loss (H: 37.8 °C; PH: 37.4 °C) was significantly higher than in control animals (H: 36.5 °C; PH: 36.2 °C) (Kruskal-Wallis, $P \leq 0.001$ and $P = 0.004$, respectively). Additionally, ST of H with severe hair loss and ulceration (38.1 °C) differed significantly from H without ulceration (37.7 °C; Wilcoxon, $P = 0.001$). The degree of severity of hair loss was significantly associated with the degree of severity of tissue alteration, as well as infiltration of inflammatory cells at both H and PH (Fisher's exact test, $P = 0.002$ and $P = 0.031$, respectively). The consistent signs of inflammation support our hypothesis that already mild hock lesions are relevant for the cow's welfare.

Implementation of animal-based measures within an animal-welfare labelling scheme for steers

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Animal-based measures (ABM) are used to indicate animal welfare (AW) and reflect the outcome of resources. ABM have been implemented in Austria for the first time within the AW label 'Tierschutz-kontrolliert' applied to 'ALMO*' steers kept in loose housing systems with pasture access. The goal of this on-farm study was to describe the implementation of ABM during auditing, to evaluate the prevalence of ABM and potential correlations with resource-based measures (RBM). Four inspectors trained to sufficient agreement in assessing 15 selected ABM, audited 190 farms regarding both RBM and ABM. For this study 120 audits (1,784 steers) were analysed. The median prevalence (%) of each ABM was 0.0. The most common parameters found were: 'dirtiness' (Q3: 15.0%; Max: 64.2%), 'ocular discharge' (Q3: 4.7%; Max: 35.7%) and 'loose faeces' (Q3: 2.8%; Max: 50.0%). Additionally, on several farms the following parameters had highest maximum values: 'hairless spots on front leg' (Q3: 0.0%; Max: 40.0%), 'overgrown claws' (Q3: 0.0%; Max: 33.3%) and 'hairless spots on head, neck, shoulder or back' (Q3: 0.0%; Max: 31.3%). 'Hairless spots on front legs' were significantly higher in cubicles with rubber mats (Q3: 2.63%; Max: 40%; n=24), than in straw systems, where they were never observed (deep litter: P=0.004; n=31; straw flow system: P=0.015; n=21). Space allowance correlated negatively with 'dirtiness' (-0.356; P=0.007) as well as 'hairless spots on the hind leg' (-0.349; P=0.008). The negative correlation found between certain RBM and ABM suggests the need to address and ultimately adjust those RBM (e.g. replacing rubber mat systems with straw systems). Furthermore, the fact that some ABM do not correlate with RBM but nevertheless vary between similar housing systems, reiterates the necessity to include ABM in any auditing for quality seals.

Association between animal welfare standards and farm profitability on Canadian freestall dairies

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Improving animal welfare on dairy farms is often thought as a cost more than a potential financial gain for the farmer. The aim of this study was to examine if improvements in farm profitability and productivity indicators were associated with meeting the new Canadian proAction animal welfare standards for freestall farms. A total of 130 freestall farms (mean \pm SD: 148 \pm 90 cows) were evaluated on whether or not they passed the proAction animal welfare standards for prevalence of leg and neck lesions, lameness, dirtiness, body condition score (BCS), and stocking density. The farms' profitability indicators retrieved from the dairy herd improvement program were: average milk production, calving interval, % of culling, and % of cows in third or more lactations. Univariable and multivariable linear regressions were used to analyse the associations between reaching welfare criterion and the farms' profitability indicators. Attaining the criterion for lameness prevalence interacted with the average days in milk (DIM) at first breeding to affect milk production, which increased with increasing DIM at first breeding in farms that passed the criterion ($\beta=41.49$ kg/DIM; $P=0.032$). Reaching the criterion for BCS interacted with the number of milking cows on the farms to affect the farm's yearly % of culling. The % of culling increased with increasing number of cows for farms that passed the criterion ($\beta=0.12\%/cow$; $P=0.004$). The criteria for hock lesions interacted with the criteria for knee lesions to affect the % of cows in their third lactation or more leading to the highest % of mature cows found on farms that passed the hock lesions criterion and failed the knee lesions one and the lowest % of mature cows on farms that passed both criterion (42 vs 35%; $P=0.005$). The relationship between reaching the proAction components and farm profitability indicators are complex but the results suggests that meeting the animal welfare criterion could be financially beneficial for dairy farms.

How to measure dairy cows' responsiveness towards humans in breeding and welfare assessment?

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In dairy cattle breeding and animal welfare science uncertainties exist regarding the quality of measures of cows' responsiveness towards humans. This study investigated criterion validity of four behavioural measures applied in the barn – avoidance distance (AD), tolerance to tactile interaction (TTI), release behaviour (RB), and qualitative behaviour assessment (QBA) in a handling situation: (1) in comparison with the existing behavioural breeding trait of milking temperament (MT) at animal level; and (2) in comparison with cows' behaviour during milking at herd level. On 33 farms we collected data on AD, TTI, RB, QBA, as well as MT that is routinely scored by the farmer, and recorded the number of steps and kicks per cow during milking. Inter-test associations on animal and herd level were investigated by Spearman rank correlation analysis. While at animal level AD and TTI correlated weakly ($r_s=0.28$, $P<0.01$, $n=1,890$), among the other behavioural measures moderate to strong correlations were found ($r_s=0.46-0.74$, $P<0.01$, $n=582-1,890$). Between MT and any other measure no significant correlation was found. At herd level, medians of AD and QBA, means of steps and kicks, and percentages of cows scored nervous regarding TTI, RB, and MT were calculated. Significant correlations were found between AD, TTI, RB, and QBA, in general higher than at animal level, and between steps and kicks ($r_s=0.80$, $P<0.01$, $n=24$). But neither steps and kicks correlated with AD, TTI, RB, QBA or MT nor MT with AD, TTI, RB or QBA. Associations of different strengths between AD, TTI, RB, and QBA suggest that the measures partly reflect different aspects of cows' responsiveness towards humans, e.g. depending on the location and setting of testing. The absence of correlations with the behaviour during milking underline methodological problems with MT, but also question the relation between behaviour in the milking parlour and responsiveness in the barn.

Private animal welfare standards – opportunities and risks

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In Europe various types of voluntary animal welfare standards are often regarded a key to improved farm animal welfare. Our project aimed at analysing the consequences of having both official EU and national legislation and various private animal welfare standards or programmes. Results from EconWelfare (www.econwelfare.eu) were used for an overview, followed by thorough systematic text analyses regarding the values, structure and content of in total 14 European regulations from Germany UK, Spain and Sweden. Seven focus areas were identified: intentions with the legislation/standard, the concept of animal welfare, the five freedoms animal welfare concept, unnecessary suffering, natural behaviour, stock-keeper's role and killing of animals. In a second study inspection protocols from on-farm inspections (2010-2013) of 328 Swedish farms were analysed. Above the official control farms were affiliated to either of the private standards Arla, KRAV (Sweden's organic standard) or Seal of Quality. Private standards are often perceived as more flexible and less restrictive than legislation. By linking to sanctions, including expulsion from a marketing label, they can also be efficient in achieving improved animal welfare, and may enable premium payment to the producers. However, many private standards are not really voluntary, as affiliation is a prerequisite for market access, and it can be difficult for the farmers – and the consumers – to understand the differences between different standards, not least due to lack of transparency as to what is actually required in terms of animal welfare provisions in some private standards. Our study revealed that depending on how compliance is measured, e.g. individual or flock level, the outcome will vary considerably even if the requirements in the regulations are similar. Animal welfare problems identified within a given regulation risk reflecting the focus of that particular regulation rather than insufficient welfare from a biological or ethological point of view.

Using data from electronic sow feeders for investigating the effect of lameness on feeding behaviour

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Lameness is a major cause for economic losses in the pig sector and an animal welfare problem in breeding sows. Numerous farms use electronic sow feeders (ESF) which notify the farmer when a sow fails to eat. ESF collects also extra data that is currently not exploited although it may yield information on feeding behaviour. Since there is evidence that lameness status affects feeding behaviour, this study aimed to derive feeding-related variables from ESF-data and to investigate their association with lameness status. Eleven variables relating to feeding behaviour were derived from raw ESF-data and matched with the corresponding sows' gait score, which was assessed using a 150 mm tagged visual analogue scale. Data were analysed with generalized linear mixed models using R 3.3.0, 2016. Increased lameness was associated with less time spent in the ESF (57.56 vs 72.52 min for lame and non-lame respectively, $P=0.026$), particularly for the unrewarded (i.e. no food delivered) ESF-visits (29.50 vs 43.81 min, $P=0.022$). The minimum, median and maximum durations between ESF-visits were higher with increased lameness ($P=0.003$, 0.020 and 0.015 , respectively). Finally, there was a tendency for the feeding rank to differ between lame (11.8 ± 0.74 SEM) and non-lame (9.8 ± 0.61) sows ($P=0.072$). These results indicate that lame sows shorten their visits to the ESF, which suggests that they are less willing or able to stand for prolonged periods. Additionally, lame sows seem to have longer intervals between visits, which may indicate a reluctance to walk, reside or compete for access to the ESF. This study demonstrates that lameness status influences several aspects of feeding behaviour that can be derived routinely from ESF data. Further research is ongoing to integrate ESF data in a lameness monitoring system.

Abattoir data provide information on pig welfare at herd level in different production systems*Hanne Kongsted and Jan Tind Sørensen**Aarhus University, Department of Animal Science, Denmark; hanne.kongsted@anis.au.dk*

Our aim was to evaluate whether lesions related to animal welfare (housing and behaviour) recorded at routine meat inspection were associated with production system (conventional indoor (CI), conventional free-range (CF) or organic free-range (OF)). We evaluated meat inspection data from 1,096,756 pigs (from 78 CI herds (533,765 pigs), 25 CF herds (269,933 pigs) and 37 OF herds (293,058 pigs) slaughtered at one Danish abattoir during 2013-2015. Generalized linear mixed model with production type, year and quarter of slaughter as fixed effects and herd as random effect were constructed. Pigs raised in CI systems exhibited minor variations in the prevalence of lesions through quarter 1-4 of each year. Across the study period, the within-herd prevalence of leg swellings, hoof abscesses, skin lesions and tail lesion was 3% [1%; 7%], 1% [1%; 2%], 1% [1%; 13%] and 1% [0.1%; 9%]. In CF and OF herds, we saw the same pattern of variation in the prevalence of skin and tail lesions through the quarters of each year. Skin lesions were most prevalent in quarter 3. The prevalence of tail lesions was highest in quarter 1 and 4. In CF and OF herds the within-herd prevalence of leg swellings, hoof abscesses, skin lesions and tail lesions was 1.5% [0.6%; 3%], 0.7% [0.1%; 2%], 3% [0.3%; 21%] and 2.5% [0%; 9%]. Odds for skin and tail lesions were approximately 3 times higher in CF and OF pigs compared to conventional pigs ($P < 0.001$). Odds for leg swellings and hoof abscesses were approximately 1.5 times higher in CI pigs compared to CF and OF pigs ($P < 0.001$). Large herd effects (ICC 21-24%) on the occurrence of skin and tail lesions suggested possibilities for herd-specific interventions. Data on lesions obtained by routine meat inspection can provide useful information for assessing welfare at herd level when retrieved from one abattoir.

Enforcement of 'open standards' for animal welfare – climate in pig houses*Herman Vermeer and Johan Van Riel**Wageningen Livestock Research, the Netherlands; herman.vermeer@wur.nl*

According to the Dutch Animal Welfare Act the indoor climate in pig houses shouldn't be harmful to the animals. This is a so called 'open standard' which enables pig farmers to reach welfare goals with self-chosen measures. However inspection is difficult because strict limits are not available. The aim of the project was to determine measures to assess climate in pig houses. This creates the possibility to enforce open standards on pig farms. In total 32 farms with finishing pigs and 64 farms with rearing piglets were assessed by the Dutch inspection service. On these farms a set of climate related measures was collected in six pens according to a newly developed protocol. The measures were animal and resource based measures and air quality. A simple assessment of the reliability, variation and correlation between measures reduced the dataset from 22 to 12 measures. With principal components analysis five of the measures within this set appeared to be the major measures and could be regarded as warning signals. Piglets and finishing pigs had CO₂ and NH₃ levels, eye and tail scores as warning signals in common. Number five for piglets was ear score and for finishing pigs animal soiling. Based on the Welfare Quality® Pig Protocol and other references limits were defined for all measures. The number of times a measure exceeded these limits per farm was calculated. This total number for the set of 12 and the set of 5 measures were highly correlated ($r=0.81$ and $r=0.95$ for piglets and finishers respectively). These five measures were sufficient to sorting farms on the risk of climate problems. It can be concluded that shortcomings in indoor climate for pigs can be assessed by a limited set of 12 measures and the first signs can be easily detected by measuring only five measures.

Welfare benchmarking for commercially farmed pigs in the UK

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The 'Real Welfare' scheme has collected animal-based measures to assess on-farm pig welfare in the UK since April 2013. The assessment involved five main measures (percentage of pigs requiring hospitalization, percentage of lame pigs, percentage of pigs with severe tail lesions, percentage of pigs with severe body marks and enrichment use ratio) and data about housing and management. The objective is to report the prevalence of five main welfare outcomes for the mainstream finisher pig herd (excluding hospital pens) in the UK and changes over three calendar years. Fisher and χ^2 tests were conducted to assess associations between different environmental variables and production practices. Generalized linear models were used to assess changes over time in enrichment provision, tail docking and welfare outcomes. Correlations between welfare outcomes were also assessed. Substrates (in 69% of farms and for 62% of the pigs) were more common as enrichment than objects. The type of enrichment and tail docking practice were associated with measures related to the environment ($P < 0.05$). Over time, there was a significant increase of pens with undocked-tail pigs ($P < 0.05$) and pens with substrates ($P < 0.05$) and a significant decrease of the proportion of lame pigs, pigs requiring hospitalization and pigs with severe body lesions ($P < 0.05$). At farm level, an average of 0.07% pigs required hospitalization, 0.18% were lame, 0.14% had severe tail lesions and 0.26% had severe body marks. The percentage of pigs requiring hospitalization and lame pigs were correlated ($P < 0.05$, $R > 0.3$). The results from the first three years of the scheme demonstrate a reduction in the prevalence of most animal-based measures. Further research is needed to understand if this is attributable to better management of sick pigs or increased attention to animal welfare.

Does animal health and welfare of organic pigs differ between husbandry systems?

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During the CoreOrganicII ProPIG, animal health & welfare (AHW) of organic pigs in 3 husbandry systems (8 countries) was compared: indoor with outside run (IN: n=34 farms), outdoor on pasture (OUT: n=12) and partly outdoor with at least one age group on pasture (POUT: n=28). The hypothesis was that all systems can deliver good welfare when well managed. 7 trained observers assessed pregnant sows (SO), weaners (WE) and fatteners (FA) using animal-based parameters. Non-parametric Kruskal-Wallis tests were used, if $P < 0.05$ pairwise testing (Wilcoxon rank sum; Bonferroni corrected) was performed with $P < 0.05$. Across systems, the median prevalence of several AHW areas was 0% (shoulder lesions SO; ectoparasites SO, FA; tail lesions, lameness WE; runts FA). No differences between husbandry systems in the prevalence of vulva deformation in SO (10.7%, 3.0%, 8.7%); short tails in WE (0%, 0.5%, 2.2%) or FA (1.8%, 2.3%, 6.5%) were found. OUT had lower prevalence of respiratory problems in WE and FA (both 0% OUT, >60% POUT, IN). Signs of diarrhoea in WE were less frequent in OUT (0%) than in IN (25.0%) and diarrhoea in FA was less frequent in OUT than in POUT and IN (0%, 0%, 8.3%). OUT had fewer lame SO than POUT and IN (0%, 3.4%, 7.1%). Across systems, prevalences of most AHW areas but respiratory problems in IN and POUT and diarrhoea in IN were low. Beyond that, OUT appeared to be beneficial with regard to several areas of AHW, which could be explained by the environmental conditions, e.g. respiratory problems (air quality), diarrhoea (exposure to faeces) and lameness (flooring). POUT farms in most cases kept SO outdoors and WE and FA similar to IN farms, and this was reflected in the results. It can be concluded, that systems do differ regarding AHW and development of organic husbandry systems across Europe should take this into account.

The relation between impaired gait and automated monitoring of broiler flock activity levels

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Leg deformities and lameness cause a major welfare concern in the European poultry industry. In this study, the aim was focused on the relation between bird activity, measured from camera images, and broiler gait score. Within the EUPLF-project, broiler gait was manually assessed on a discrete [0-5]-scale according to the Welfare Quality Protocol by trained local human experts in five commercial broiler farms spread over four European countries. Assessments (n=88) on 129±37 birds were done in week 3, 4 and 5 of the rearing period. Flock Gait Score (FGS) was calculated as the mean gait score value of the flock during the assessment. Bird activity was automatically monitored with a Precision Livestock Farming tool, four cameras of the eYeNamic™ system mounted at the ridge of the house in top-down perspective. Flock activity level was calculated from the difference between the two consecutive (697±120 millisecon. interval) snapshot images of the floor space below. Flock activity level (ACT) was calculated as the mean value of all daily measured activity samples. Data analysis showed a significant Spearman correlation ($r=-0.76$; $P<0.001$) between FGS and ACT, and we may conclude that there is a significant negative correlation between activity level and gait score in broiler flocks. The significant linear regression equation $FGS = 2.85 - 0.21 \times ACT$ was found ($F_{(1,86)}=104.59$, $P<0.001$), with an R^2 of 0.55. Higher activity levels are associated with lower gait scores, i.e. better animal gait. The linear trend is clear in all farms ($R^2=[0.53-0.74]$). Both the activity level and gait score are influenced by the age of the birds. The Bland-Altman plot showed that both measurements were unbiased with a mean difference of 0.00 ± 0.42 . The 95% lower limit of agreement is -0.83, and the higher limit of agreement is 0.83. This might indicate that the activity level of the flock is a rather weak single predictor for flock gait score. These results suggest that there is potential for the continuous automated assessment of gait scoring through the fully automated and continuous measurement of flock activity levels in the broiler house.

Assessment of plumage and integument condition in dual-purpose breeds and conventional layers

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Feather pecking and cannibalism are major challenges in laying hen husbandry. The assessment of plumage and integument condition provides useful information about the occurrence of these behavioural disorders. The aim was to evaluate the behaviour of dual-purpose breeds (Lohmann Dual, LD) and conventional layer hybrids (Lohmann Brown plus, LB+), and to compare two scoring methods, i.e. a mere visual scoring (VSc) and a scoring with handling of individual animals (HSc). 1,800 untrimmed hens per genetic strain were housed conventionally in four compartments of an aviary system. During weekly (20th-71st week of life) VSc, the hens' plumage and integument condition were scored on five body parts (head/neck, back, tail, wing, breast/belly) using a five or four point scale. HSc was carried out on seven study days applying the same scoring scale as for VSc. In LB+ hens, minor plumage damage started at the age of 25 weeks and increased to the 71st week, resulting in 22.5% (wing) and 99.5% (back) of the LB+ hens showing feather losses. In contrast, only 2% of the LD hens showed minor feather losses (head/neck, breast/belly) remaining constant throughout the laying period. Integument damage occurred in 0.5% of the LB+ hens in week 46, with 6% affected hens in week 66, and 2.5% at the end of the study. No injuries were found in LD hens. Spearman's rho for the comparison of plumage scores given in VSc and HSc was >0.90 and significant ($P < 0.01$) for all body regions, except for breast/belly (0.45-0.50). However, VSc and HSc were equally valid for detecting skin injuries of all body regions ($r_s > 0.86$, $P < 0.01$). In conclusion, feather pecking and cannibalism only occurred in the LB+ flocks, though both genetic strains were kept under the same conditions. The visual scoring method was suitable for detecting both plumage damages and skin injuries.

Effects of automated monitoring equipment on laying hen behaviour*Stephanie Buijs, Christine Nicol, Francesca Booth, Gemma Richards and John Tarlton**University of Bristol, School of veterinary sciences, United Kingdom; stephanie.buijs@bristol.ac.uk*

Precision livestock farming often requires the attachment of sensors to animals. However, such equipment can alter behaviour, invalidating the data collected. For instance, laying hens often respond aggressively to flock members with minor alterations in appearance, causing equipped hens to flee, fight or hide. We evaluated how 50 g 'backpacks' affected hen behaviour using direct observation. These 'backpacks' contained three monitoring devices (a light sensor, an accelerometer and a location device). The equipment was wrapped in brown tape and fitted to the hen's back using elastic loops around the wing base. We equipped 14 hens within a flock of 2,000 housed on a commercial free-range farm (British Blacktails, 45 weeks old). Behaviour of equipped and non-equipped hens was observed 2, 3 and 7 days after equipping (continuous focal observation, 5 min/hen/day, alternating between equipped and non-equipped) and compared using Wilcoxon rank-sum tests. None of the equipped hens was ever observed to flee or fight. Although equipment tended to increase the frequency of pecks received on day 2 and 3 ($P=0.08$ and 0.05 , respectively) compared to non-equipped birds, median values were 0 for both groups and differences in interquartile range were small (0-0 vs 0-0.3 and 0-0 vs 0-0.6 pecks/minute, respectively). Equipped hens generally did not react to these pecks (which included all types except severe feather pecks). Equipped and non-equipped hens were not found to differ significantly in the % of time spent eating/drinking, foraging, perching, preening, sitting, standing, walking or in the nestbox, or in their frequency of bodyshaking and pecking others (all P -values >0.05 for each day). Although further evaluation is required as sample size was modest, numerical differences between the treatments were either very small ($<3\%$) and/or inconsistent over days, suggesting that it is unlikely that such behaviours were not found to differ simply due to lack of power. The exception was foraging, which was numerically lower in equipped birds on day 2 (31%) and 3 (10%), though not on day 7. Overall, this system seems to have only a minor impact on behaviour, suggesting its suitability for collecting automated behavioural data.

Development of an animal welfare assessment scheme for use in companion animal veterinary clinics

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Veterinary care is important for ensuring animal health, but can also negatively impact patient welfare. To encourage optimal canine and feline welfare related to veterinary care, we aimed to develop a welfare assessment scheme for the clinic environment, similar to those that exist for agricultural species. To identify factors to be included, a variety of stakeholders, including animal welfare researchers and veterinarians, were consulted in a multi-stage survey. Through thematic analysis, pain management, behavioural health, and veterinarian-client communication emerged as overarching themes, each encompassing several assessable factors (e.g. pre-emptive analgesia for surgery, use of low-stress handling techniques, provision of training advice). These factors formed the basis of a draft assessment tool, incorporating questionnaires, interviews, and video observation of veterinary appointments. Through assessments in 30 veterinary clinics, reliability, validity, and feasibility were evaluated. This process revealed unique challenges, such as conducting a point assessment with little control over the patient's home life or previous experiences, making animal-based measures more complicated than in on-farm assessments. Intra-observer reliability was high throughout ($K_w \geq 0.80$), inter-observer reliability was highest for interviews ($K_w = 0.83, 0.73$ for pain; $0.82, 0.81$ for behavioural health; $0.40, 0.44$ for communication), and feasibility was high for interviews and questionnaires; however, responses given through interviews and questionnaires were often inconsistent with data from appointment observation, suggesting low validity. Overall, a mix of measurement types is required to achieve an optimal balance between reliability, feasibility, and validity. Further evaluation of alternative assessment techniques (e.g. veterinarian evaluation of staged encounters, real-time evaluation of analgesic protocols) is warranted to attempt improvements in validity.

Positive human-bird interactions improve welfare and production performance in the ostrich

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Poorly defined husbandry practices and inappropriate stockmanship has been suggested to contribute to unsatisfactory production results, still constraining ostrich farming worldwide (i.e. low chick survival, suboptimal egg and chick production). We thus investigated the effect of two different husbandry practices on ostrich chicks from hatch to 12 weeks of age. 272 chicks were randomly assigned to two groups, namely: standard husbandry practices (S), and additional human presence (as compared to S), involving regular physical contact, audio and visual stimuli (I). Immune responses were evaluated by performing a Hemagglutination-Inhibition (HI) test following Newcastle disease vaccine injection at 5 months old, while stress responses were assessed by measuring the heterophil/lymphocyte ratio (H/L) before (T0) and 3 days after (T3) harvesting feathers at 8 months. Finally, egg production of these birds was recorded over a 7-month breeding season at 2-years-old. The HI test revealed that a lower dilution rate was needed to cause complete inhibition of antigens in I chicks as compared to S chicks (I: 18.78 ± 3.0 ; S: 23.37 ± 2.34 ; $P < 0.05$), suggesting a stronger immune response in I chicks. While the H/L ratio did not differ before and after the harvesting of feathers in I chicks (T0: 7.41 ± 0.66 ; T3: 7.21 ± 0.89 , $P > 0.05$), S chicks showed a higher ratio after the harvesting of the feathers (T0: 7.03 ± 0.71 ; T3: 12.06 ± 2.09 , $P < 0.05$), indicating an improved ability of I chicks to handle potential stressful events. Furthermore, I birds produced significantly more eggs than S birds (I: 60.71 ± 4.96 ; S: 35 ± 8.17 ; $P = 0.02$). Clearly, additional human presence and interaction seemed to have worthwhile beneficial effects not only on the welfare of the birds but also on their reproductive performance under farming conditions and should thus be studied further.

Effect of gaseous ammonia on eating and ruminating behaviour in sheep in simulated transport by seaYu Zhang¹, Laureline Guinnefollau² and Clive Phillips¹¹Centre for Animal Welfare and Ethics, School of Veterinary Science, The University of Queensland, Australia, ²Universite Francois Rabelais, Tours France, France; yu.zhang2014@gmail.com

Ammonia accumulation in sheep accommodation during live export is a major welfare problem. Ammonia is an irritant to mucosal surfaces, including the buccal cavity, which may be linked to previously observed reductions in feed intake. We investigated the mechanisms for this by studying eating and ruminating rates in sheep under simulated live export conditions. Twelve 6 months old lambs (mean 24.5±2 kg) were randomly assigned to control or 30 ppm ammonia treatment (a validated maximum for livestock in live export) for three 14 day periods (a typical journey duration from Australia to the Middle East) in a change-over design. In each period, ruminating behaviour was recorded for ten periods of 60 seconds from 14:00 to 19:00 pm on day 7 and day 8. Rumination was recorded in chews/min and the time interval between swallowing and regurgitation. Sheep were fed 400 g TMR pellets and long-chopped lucerne hay *ad libitum* daily. Ammonia decreased hay intake (1.03 vs 1.10 kg/d, SEM=0.014, P=0.002). Ruminating chewing rate decreased with ammonia (85.68 vs 88.10 chewing bites/min, SEM=0.60, P=0.014) and the time between swallowing and regurgitation increased (6.75 vs 5.83 seconds, SEM=0.18, P=0.002). Palatability of a hard lucerne pellet and soft sorghum chaff was measured during a short (6 min) eating test. Ammonia reduced the rate of masticating lucerne pellets (2.20 vs 2.28 chews per second, SEM=0.012, P<0.001) but not sorghum chaff (2.26 vs 2.28 chews per second, SEM=0.018, P=0.47). Thus ammonia reduced feed intake and slowed chewing and swallowing, maybe due to an irritated buccal cavity. If proven, this would indicate reduced welfare of the very large numbers of sheep that are transported from Australia to the Middle East.

Evaluation of the AWIN welfare assessment protocol for horses regarding animal-based indicators

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Based on Welfare Quality®, the AWIN Welfare Assessment Protocol for Horses was developed as welfare assessment tool in the equine sector. Thereby, mainly animal-based indicators are used which are collected in two assessment approaches: first and second level. Whereas the first level enables a fast overview with nearly no direct animal contact, the second level represents a comprehensive and thus time-consuming data collection. The aim of this study was to test the agreement of first and second level to prove whether the first level is sufficiently sensitive. Altogether, one trained observer will perform 140 protocol assessments on 14 stables in Germany, in this preliminary analysis, 23 assessments on 9 stables were included. Spearman Rank correlation coefficients (RS), intraclass correlation coefficients (ICC), smallest detectable changes (SDC) and limits of agreement (LoA) were calculated for each indicator. The results of the behavioural tests, the horse grimace scale and the stereotypes demonstrated insufficient agreement. Of the disease indicators eye discharges (RS: 0.58, ICC: 0.54, SDC: 0.06, LoA: -0.06-0.07) and coughing (RS: 0.66, ICC: 0.64, SDC: 0.07, LoA: -0.07-0.08) revealed good agreement, for the others, significant differences were detected. Also most integument alterations showed a poor match between first and second level with the exception of skin changes at the muzzle in general (RS: 0.58, ICC: 0.50, SDC: 0.07, LoA: -0.09-0.06) and at the back regarding skin lesions (RS: 0.84, ICC: 0.6, SDC: 0.06, LoA: -0.07-0.06) and swellings (RS: 0.80, ICC: 0.79, SDC: 0.02, LoA: -0.03-0.02). Body condition score of category 2 was scored in an agreeing manner (RS: 0.85, ICC: 0.79, SDC: 0.04, LoA: -0.03-0.05) whereas differences were revealed for category 3 and 4. In summary, only some indicators showed a good agreement. This is probably due to low prevalences and too detailed categorisation. Thus, an adaption of the protocol is needed.

Impact of following recommendations for tie stall configuration on outcome-based measures of welfare

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To evaluate how well Canadian dairy farms with tie stalls complied with recommendations for stall dimensions, and the effect of compliance on cow welfare, we assessed lactating Holstein cows (n=3,485) on 100 tie stall dairy farms for neck and leg lesions, lameness, and cleanliness, and measured time spent lying down. Data on the width and length of the stall were recorded for each cow. The majority of cows were housed in stalls that are smaller than recommended. The prevalence of lesions and lameness was high (neck=33%; knee=44%; hock=58%, lameness=25%) and the prevalence of dirtiness was low (udder=4%; flank=11%; legs=4%). Mixed models (GLIMMIX) were used to examine how the risk of each outcome changed as the stall dimensions deviated from the recommendations. Meeting the recommendation for stall width reduced the risk of neck injuries (odds ratio OR=0.89; SE=0.05 P<0.01) and lameness (OR=0.85; SE=0.04; P<0.01) and increased the daily duration of lying time, (P<0.01) but increased the risk of a dirty flank (OR=1.21; SE=0.06; P<0.01) and dirty legs (OR=1.17; SE=0.08; P=0.04). Meeting the recommendation for stall length tended to reduce the risk of knee lesions (OR=0.90; SE=0.06; P=0.08) and increased lying bout frequency (P<0.01) but increased the risk of a dirty udder (OR=1.36; SE=0.13; P=0.02). Compliance with recommendations for stall dimensions, especially stall width, is associated with signs of better cow welfare. There is a trade-off between the prevalence of lesions and lameness and prevalence of cleanliness: stalls of recommended size reduce the risk of lesions and lameness but increase dirtiness, but the prevalence of dirty cows remains very low.

Refinement of broiler chicken welfare outcomes using Delphi methodology*Ana Paula Oliveira Souza and Carla Forte Maiolino Molento**Federal University of Paraná, Animal Welfare Laboratory, Brazil; anapaulasouza@ufpr.br*

Recent studies about broiler chicken welfare assessment suggest the need for refinement in some animal welfare indicators. This study aimed to refine three broiler chicken welfare indicators: bird cleanliness (BC), carcass scratches (CS), breast and abdomen contact dermatitis (CD). We built a questionnaire with pictures of birds with different levels of the target indicators to be classified as absent, low, moderate or severe. Following Delphi methodology, the questionnaire was sent to 146 experts invited for the first round (R1). In the second round (R2), 88 participants who answered R1 were asked about the relationship between feathering and BC; to quantify maximum accepted levels of CS according to age, depth and length of lesion; and, based on justification given in R1 for each level of CD, to select between two scales including erythema. Interquartile deviation was calculated to verify consensus among respondents. In R1, there was 56.8% (83/146) complete and relevant responses for BC, 56.1% (82/146) for CS and 55.5% (81/146) for CD. In R2, 73.5% (61/88) of specialists participated, 68.7% (57/88) completed the questionnaire. In R1, consensus was achieved for 8/10 pictures of BC, and in R2 results suggested the need to include feathering condition assessment during BC analysis. Considering CS, consensus was achieved for 5/8 pictures in R1. In R2, 98.2% (56/57) of respondents considered that old scratches must be assessed as animal welfare indicator. For CD, consensus was achieved in 2/10 pictures in R1, being them the extreme cases, absence and severe CD. Additionally, erythema was recognized as an unhealthy condition of the skin by 96.4% (80/83) of respondents in R1. In R2, 64.9% (37/57) of respondents chose a more detailed scale to assess CD. After R2, we built a visual and descriptive scale for the assessment of BC and CD on farm, and CS at the slaughterhouse.

Broiler chicken meat inspection data in Southern Brazil: an animal welfare approach

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The Federal Inspection Service (SIF) of the Brazilian Ministry of Agriculture, Livestock and Supply (MAPA) undertakes meat inspection at slaughterhouses, but outcomes have not been used for animal welfare surveillance. We assessed condemnation data from broiler chicken slaughterhouses in Southern Brazil to evaluate their potential use as animal welfare indicators (AWI). Data from January 2010 to December 2015 in the states of Paraná (PR), Santa Catarina (SC) and Rio Grande do Sul (RS) were used. Correlation of AWI was tested using Spearman rank correlation test. Principal Component Analysis (PCA) was used to explore variance and covariance structures of AWI. Fractures and bruising were recorded together, and they represent the most prevalent welfare problem (PR, 22.1%; SC, 16.6%; RS, 23.7%), followed by skin lesion or inflammation (PR, 14.8%; SC, 9.1%; RS, 9.1%). Footpad dermatitis is not officially controlled since affected feet might be accepted as lower grade product. In PR, progressive increase on injury, arthritis, ineffective bleeding, and airsacculitis may reveal important welfare aspects. High correlation between AWI within PR was more commonly observed than in RS and SC, perhaps because of earlier implementation of local SIF standardization. PCA showed changes on condemnation data pattern in PR after standardization, pointing injury and *Escherichia coli* problems as main causes for condemnation related to animal welfare. They were strongly related to component 1, representing 39.4% of data variability. It seems crucial to update and standardize data collection to set a routine that allows risk analysis regarding both food safety and animal welfare. There is considerable potential to improve animal welfare assessment using SIF structure that is already in place for food safety purposes. In this regard, cooperative work between SIF and companies seems an interesting approach to promote transparency of production process, which would benefit society and animals.

Behavioural traits of undocked heavy pigs receiving different enrichment tools*Eleonora Nannoni, Luca Sardi, Marika Vitali and Giovanna Martelli**Alma Mater Studiorum, University of Bologna, Department of Veterinary Medical Sciences, Italy; eleonora.nannoni2@unibo.it*

The aim of the present work was to investigate the effects of innovative enrichment devices on the behavioural traits of undocked Italian heavy pigs kept on slatted floor in the body weight range 25-160 kg. Two separate and independent trials (n=40 pigs each, 5 pigs/pen) were carried out. In Trial 1, 20 pigs received a hanging metal chain (C1, positive control) as environmental enrichment, and 20 received wood logs (WL) placed inside a metal rack allowing snout and biting manipulation. In Trial 2, 20 pigs received a metal chain (C2, positive control) whereas 20 received a specifically formulated vegetable edible block (EB) placed inside the same metal rack. The manipulable materials were always available to animals. Pigs were videotaped every 2 weeks and behaviour was analysed by the same trained observer (scan-sampling for general behaviour and all-occurrences sampling on three selected days for the number and the duration of the interactions with the devices). Data were submitted to one-way ANOVA (using the pig as the experimental unit and the environmental enrichment as the main effect). Kruskal-Wallis test was used for non-parametric data. General behaviour was only marginally affected by all enrichment tools, although EB pigs spent less time in (aimless) rooting/exploring the pen floor (13.39 vs 15.90% of the observed behaviours, $P < 0.01$) than C2. In Trial 1, WL pigs interacted with the enrichment tool less than C1 pigs (0.64 vs 1.84%, $P < 0.01$). In Trial 2, EB pigs interacted more with the enrichment (2.85 vs 1.12%, $P < 0.001$) if compared to C2 group. These data were confirmed by in-continuous observations. In conclusion, our results show that edible blocks (EB) but not wood logs (WL) were more attractive for pigs than hanging metal chains (C1 and C2). The research was funded by Progetto AGER, grant no. 2011-0280.

A model to induce cannibalism outbreak on pigs based on frustration of exploratory behaviour

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A model of cannibalism in pigs was built from the frustration of investigation, generated in two trials by the withdrawal from the fifth day of fattening period (FP) of the pen enrichment supplied during the post weaning period (PW). Three levels of enrichment were applied: in Trial 1 (T1): slatted floors and progressive supply of chain-plastic pipe or cord (E-) vs no object (A) (12 pens/treatment: A vs E-); Trial 2 (T2): straw bedding (E+) vs slatted floor with progressive supply of objects (E-) (12 pens/treatment: E- vs E+). During the first four days of the FP, piglets had cords and plastic pipes (P) vs no material (A) (6 pens per treatment: T1: A/A, A/P, E/A, and E-/P; T2: E-/A, E-/ P, E+/A, and E+/P). Behaviour was video recorded every 2 weeks during PW, then daily during the first four days and finally at Day 7 of the fattening period. The social interactions, tail biting, pen and object investigation performed in pens for two hours were submitted to variance analysis (Proc Mixed SAS). Tails and ears injuries were scored three times in PW and daily for the two first weeks in FP (χ^2 test). During PW, enrichment promoted interest towards object (T1: 2% total scan for E- vs 0 for A; $P < 0.05$), and more straw investigation compared to objects ones (T2: 23.2 for E+ vs 3.5% total scan for E-, $P < 0.05$). No severe tail and ears lesions were observed in both trials. At Day 4 of FP, the withdrawal of objects did not strongly affected the behaviour, except in T2 showing more positive social interactions (33 for E-/A vs 23% total items for E-/P; $P < 0.05$). Cannibalism outbreak was only limited to three pens in T2 (E+/A, E-/A, E-/P), and any case at Day 7, highlighting multifactorial causes of cannibalism.

Developing a Japanese animal welfare certification system for dairy cows*Tetsuya Seo and Mika Kitamura**Obihiro University of Agriculture and Veterinary Medicine, Japan; seo@obihiro.ac.jp*

In recent years, animal welfare concerns have been increasing among Japanese consumers. However, Japan has no third-party farm animal welfare certification system. We are striving to produce animal welfare assessment standards for certification in dairy cows, and have established the Japanese farm animal welfare association for certifying the farms. Based on a literature review, objective assessment standards were developed for each item simply by judging the results with a circle ('yes') and an X ('no') to denote whether the standards are met. The welfare standards are based on three categories: facilities, management, and animals as follows. In all, 52 items are assessed. The farm can be certified if it receives a score of 80% or more in each category. Facility-based assessment: Indicators are used to assess proper rearing facilities and to assess the barn and outdoor areas for defects that might adversely affect animals. Assessment items include the feed trough size, water trough size, temperature control, calving pens, and cow trainers. Management-based assessment: Indicators are used to assess proper performance of daily rearing management. Assessment items include feed and water trough cleanliness, and bed softness. Animal-based assessment: If animals are diseased, injured or undernourished, then animal welfare is regarded as poor. Assessment items include the hock condition, abnormal behaviour, and body condition. To acquire certification, the farm would be inspected twice per year during the first year. The inspectors visit a farm to assess whether the farm complies with certification requirements, and subsequently report the assessment results. After the association certifies a farm, the farmer can display the association label when selling dairy products. Such certified products will be sold in 2017.

Salivary CgA as a new biomarker of stress in pigs

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Saliva sampling has the advantage of being non-invasive as it causes minimal stress during collection, thus making it an ideal tool for evaluating stress in animals. Chromogranin A (CgA) is the major protein found at the core of catecholamine's storage vesicles of the adrenal medulla and sympathetic nerves chromaffin cells, from which it is co-released with epinephrine and norepinephrine. In human, salivary CgA (sCgA) is considered as a sensitive and reliable quantitative tool for monitoring the sympathoadrenal medullary (SAM) activity. However, it is still not widely used in pigs. The objective of this abstract would be to provide evidence of the use of sCgA as a marker of stress in pigs and stress the advantages that this protein can have in comparison with other biomarkers used traditionally. For this purpose the following aspects have been addressed: (1) the development and validation of a sensitive assay for sCgA in pigs. (2) The behaviour of sCgA on different acute stress models such as: restriction with nose-snare, transport and accommodation in the slaughterhouse or isolation and regrouping in a farm. (3) The possibility of use sCgA to detect stress associated with factors of chronic exposure. (4) The advantages in comparison with other salivary biomarkers of stress such as the existence of no circadian pattern and the lack of variations due to gender and/or age. It is expected that this data can help to promote the use of this innovative salivary stress biomarker as a practical and non-invasive tool to stress response of pigs.

Welfare risk assessment plans – identification and characterization of potential risks and benefits

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From an ethical and legal point of view, ensuring animal welfare is imperative and a distinct scientific and societal goal. We are in need of science-based, objective frameworks to address animal welfare issues and to enable appropriate welfare management. 'Risk assessments' comprise the identification and characterization of potential risks and benefits for the welfare of animals. Risk assessment plans (RAPs) might be used as guidelines to address and improve circumstances, procedures and/or management strategies. Risks to welfare are identified based on the 'dynamic concept of animal welfare', which requires animals to be mentally and physiologically capable/able to react adequately to environmental challenges. Adequate reactions are seen as elements of an animal's natural behavioural repertoire. The capability/ability to display normal behavioural patterns allows the animal to adapt to the demands of the prevailing environmental circumstances and enables it to reach a state that it appraises as positive (modified and extended from Ohl and Van der Staay). A RAP characterizes the exposure of a defined target population to the potential risk factors and possible consequences thereof for the welfare of the population, using literature research and on site data collection. The potential impact of the identified risk factors is weighted by classification into four categories, each comprising four sources: (1) generalization (which part of the target population is exposed to potential risks); (2) duration of exposure to potential risks; (3) intensity of exposure to potential risks (ranging from mild to terminal); (4) probability of exposure to potential risks. Here we present the implementation of animal welfare risk assessment, using the example of a dog population housed in a research kennel. Even though this kennel fulfils all legal requirements for a research facility (including welfare-related requirements), we were able to identify (potential) risks to the welfare of the kept dogs, related to e.g. housing and management. We will highlight the advantages and challenges of a RAP while aiming at objectively assessing risks to welfare.

A co-elaborative tool to assess growing pigs welfare

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Animal welfare assessment systems are mainly used by external auditors. Better commitment could be achieved if farmers could assess the welfare of their pigs themselves and act to improve it. A project was designed to build an animal welfare assessment tool with farmers from three different French regions. An exhaustive list of criteria was established at three co-design workshops involving farmers, their advisers and animal welfare experts. Farmers indicated how they evaluated whether their animals were doing well, either spontaneously in a brainstorming discussion, or by answering to questions from a naïve visitor. Then representatives of the groups gathered, prioritized and selected the criteria according to four dimensions: housing (cleanliness, moisture, resting posture), behaviour (fear of human, use of enrichment material), health (diarrhoea, coughing, lameness, severe body/tail lesions, physical appearance) and feeding (trough/drinker cleanliness, low body weight). They proposed rapid measurement methods (observation at group level from the corridor and individually in the pen) and stages to use them: two rooms in the post weaning period (PW) and two rooms in the growing-finishing period (G). A prototype tool was built on these bases. Farmers and advisers scored their animals twice, after the training session and six months later (spring 2017). The first series of evaluation indicated that lameness frequency was lower in PW than in G (0.27 vs 0.41% of pigs) and ranged from 0 to 1.7% (PW) and 3.6% (G). Exploratory behaviour was scored when entering the room and 10 minutes later. The percentage of pens with enrichment investigation was higher after 10 minutes presence, higher in PW period than in G period (34.5 vs 23.1%) and ranged from 0 to 100% of pens. The feedback of both sessions will allow to assess the feasibility of this tool in different type of farms, the difficulties encountered in the implementation by the farmers and to finalize with them a list of relevant measures.

Barren environments increase 'wakeful' inactivity in veal calves

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Inactivity is a vastly understudied behavioural category, which may reflect both positive and negative affective states, or a lack thereof, in domesticated, captive animals. Increased inactivity in barren-housed animals, in combination with an increased interest in stimuli, was previously suggested as an indicator of boredom in captive mink. The aim of this study was to further our understanding of inactive behaviours and associated affective states in intensively raised calves fed different diets. Holstein-Friesian veal calves (n=200) were housed in enriched or barren environments: (1) imposed/restricted diet vs free choice (*experiment [EXP] 1*); (2) no additional straw vs *ad libitum* straw (*EXP2*); (3) low vs high solid feed (*EXP2*); (4) bucket vs automated dispenser for milk replacer feeding (*EXP2*). Inactive behaviours (*EXP1*: lie, idle, sleep; *EXP2*: lie idle, stand idle, sleep) and stereotyped behaviours (tongue playing, object manipulation) were recorded at two ages (*EXP1*: 12 and 26 wk; *EXP2*: 15 and 24 wk) using instantaneous scan sampling. In *EXP2*, latency to touch a novel object was recorded at 15 and 24 wk. Calves in all enriched environments showed less stereotyped behaviours ($P<0.05$). No differences in inactivity were found between calves with a restricted or free choice diet (% total scans for idle: 34.8 vs 33.4), however, calves from the other barren environments, showed more lying idle at 24 wk of age ($P<0.05$) (% total scans; straw: 31.4 vs 23.1; solid feed: 33.0 vs 23.8; milk replacer method: 30.7 vs 23.2). No differences in latency to touch the novel object were found. Therefore, although barren environments were generally associated with more stereotyped behaviour and 'wakeful' inactivity (sleep was not different), suggesting worse welfare, we were unable to conclude that this inactivity was potentially an indicator of boredom, or any other affective state for that matter.

Welfare and quality check – customized system for monitoring animal welfare

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Documentation of animal welfare in the entire production chain is an increasing demand from many customers of fresh meat. A systemized registration system makes it possible to turn these demands into advantages. Welfare and Quality Check (WQC) is a system for monitoring animal welfare of pigs at the slaughterhouse. Animal welfare can be monitored and documented by different animal-based measurements but also more indirectly by resource-based measurements as recently reviewed by Brandt and Aaslyng. WQC is a science-based tool founded in the ethical audits. The WQC protocol contains a well-defined setup of questions and observation points that combines management related issues with practical arrangements (e.g. reflections, shadows or disturbing light; hit by box gate), animal-based measures (e.g. positioning of sticking knife, noise level) and meat quality. WQC includes observations and graduation of 6 to 13 indicators within each of the four important areas: (1) the unloading area, (2) the lairage area, (3) the stunning/sticking process and (4) the meat quality performed on the cut floor. The check provides the slaughterhouse with an overview of the status at hand. The concurrent training of slaughterhouse employees ensures implementation of the WQC system and ongoing focus on animal welfare. Furthermore, the design allows for inclusion of specific customer demands related to animal welfare, providing the slaughterhouse with a customized protocol. Good animal welfare is also good business. Quality defects seen in the meat cuts as e.g. haemorrhages can lead to loss of income. However, by monitoring the occurrence of haemorrhages, followed by identification of the problem area and implementation of the necessary adjustments, the problem can be reduced. In this way, WQC is an effective tool when identifying and registering potential problems related to the handling of animals on the day of slaughter. Monitoring animal welfare parameters provides the possibility of changing these inappropriate procedures and operations.

Nesting behaviour of broiler breeders

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Broilers have been selected for growth related characteristics, which are negatively correlated to reproductive traits. This genetic background creates challenges in broiler breeders, as the hens do not make optimal use of the nests provided. This project aims to investigate what factors determine where a broiler breeder hen prefers to lay her egg, in which nesting behaviour probably plays a crucial role. Factors such as genetic background, social interactions, physical characteristics of the nest and climate might interfere with the natural nesting behaviour of the hen. Also fundamental trade-offs between different motivations, such as hunger, comfort and safety, might influence nesting behaviour. Behaviour and use of space will be measured in experimental set-ups in order to gain insight in the importance of different system components. This knowledge will be used to optimise housing conditions and develop strategies that stimulate the hen to lay her egg in the nest. The performance of this improved system will be tested in field experiments to investigate the transferability of results from experimental to field conditions.

assessing animal welfare in costa rican dairy herds based on the Welfare Quality® protocols

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Animal welfare is an important issue in farming, and welfare assessment is vital to improve the welfare of farm animals. Since the welfare status of dairy farms in Costa Rica was not known, the Welfare Quality® protocol (2009) was applied in 60 dairy herds around the country. The aim of this study was to evaluate the applicability of this protocol in Costa Rica. The farms were all from the biggest dairy producers' cooperative in the country. The protocol assesses the welfare in four areas: feeding, housing, health and behaviour. Most of the farms were scored as 'enhanced' (55%) or 'acceptable' (37%), the rest were 'not acceptable'. The protocol was applied in a wide variety of farms: extensive, semi-intensive and intensive farming systems, equatorial to tropical savanna climate, etc. Since in this protocol most of the measurements are taken directly on the animals and not on the infrastructure, the protocol was easily applied on the farms of Costa Rica. Nevertheless, some adjustments are necessary for a more accurate use of the protocol in the country, mainly regarding housing-dependent measurements like the evaluation of the drinkers and the avoidance distance. In 92% of the farms cows were kept on the pasture at least half of the day, in these cases, the drinkers on the pasture were different from those in the stable, which made the scoring of the drinkers difficult. Also, around 20% of them had feeding troughs that limited the vision of the cow, making the avoidance distance test inaccurate. Moreover, it is important to create a method to evaluate heat stress, a key parameter in tropical countries, since for example in Costa Rica the average temperature is 24 °C and the average humidity is of 81%, which gives an average temperature-humidity index of 73, which has been categorized as mild heat stress for cattle. It was concluded that since the protocol mainly consists of animal based measures, it can be easily adapted to the different management methods and environmental conditions in Costa Rica.

Is the reticular temperature a useful indicator of heat stress in dairy cattle?*Stefanie Ammer¹, Christian Lambertz² and Matthias Gauly²**¹Research Institute of Organic Agriculture, Department of Livestock Science, Switzerland, ²Free University of Bolzano, Faculty of Science and Technology, Italy; stefanie.ammer@fibl.org*

The predicted climate change may intensify heat stress (HS) effects for dairy cattle which impair performance, health and welfare. The use of automatic systems for continuously monitoring body temperature might be a useful method to detect HS. The objectives were to investigate the reticular temperature (RT) as HS indicator taking performance and water intake (WI) into consideration. Therefore RT of 28 Holstein-Friesian dairy cows was recorded continuously and milk yield daily (classified as <30 kg, 30-35 kg, 35-40 kg, and \geq 40 kg) between March and December. Barn climate records (air temperature, relative humidity) were used to calculate the daily temperature-humidity-index (THI; classified as <60, 60-65, 65-70, and \geq 70.). Additionally, the individual WI of 10 cows during 100 days was recorded. A mixed model and Pearson correlation coefficients were calculated with SAS 9.3 to estimate the effects on daily median RT. Up to a THI of 65, RT remained at 39.2 °C. Above this threshold, RT increased to 39.3 °C and further to 39.4 °C when $\text{THI} \geq 70$ ($P < 0.001$). The correlation between $\text{THI} \geq 70$ and RT was 0.22, while there was no relation when $\text{THI} < 70$ ($P < 0.001$). The RT was greater, when dairy cows yielded ≥ 30 kg/d and $\text{THI} \geq 70$ (39.5 °C) compared with <30 kg and $\text{THI} < 70$ (39.3 °C) ($P < 0.001$). WI caused a mean decrease in RT of 3.2 °C (± 1.5). It was influenced by the amount of WI ($r = 0.60$; $P < 0.001$). After WI, it took up to 2 h until RT reached the level before drinking. In conclusion, RT increased markedly when $\text{THI} \geq 70$ so that it could be used as an indicator for HS. Nevertheless, the effects of WI and performance have to be considered carefully when RT is used to detect hyperthermia in dairy cattle.

Training observers in the use of an equine welfare assessment tool: benefits of hands-on experience

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Previous research has documented the success of a variety of methods to teach observers how to repeatably and reliably score a single animal-based measure. Whether these same training methods can be applied to multiple animal-based measures in a single training program is less documented, but equally important, given the rise in comprehensive welfare assessment tools. The objective, of this research was to determine the levels of inter-observer reliability when trainee assessors were taught a combination of animal-based welfare measures to assess horses in a range of conditions in Ontario. As part of a larger project examining the use of an equine on-farm welfare assessment in Canada, three assessors were trained by a 'gold standard' assessor in the use of six animal-based measures (ocular and nasal discharge, injury, hoof status, body condition, and lameness scores) incorporated into an on-farm welfare assessment tool. Training took place over three days and involved in-class (two days) and hands-on (one day) experience. Trainee assessors achieved over 70% agreement with the trainer for all measures and improved agreement when provided with hands-on experience for all measures except injury scoring. Subsequently, the trainer was accompanied by one trainee to horse farms ($n_{\text{TraineeA}}=9$, $n_{\text{TraineeB}}=16$) where horses ($n_{\text{total}}=308$) were scored using the six measures. Injury scoring achieved the lowest percentage agreement (78%), lameness scoring the highest (97%). Kappa scores differed substantially between the two trainees attending on-farm assessments. Overall percentage agreement and κ scores were comparable or higher than those seen in existing literature, likely due to the simplification of the scoring systems and the relative scarcity of welfare-threatening conditions (e.g. severe lameness). Results suggest that trainees are capable of learning how to reliably score multiple animal-based measures and benefit from the addition of hands-on training when applying the scoring systems to a diverse population of horses.

Selection of meat inspection data for animal welfare index*Søren Saxmose Nielsen, Matthew James Denwood and Hans Houe**University of Copenhagen, Department of Veterinary and Animal Sciences, Denmark;
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National welfare indices of cattle and pig production are being established in Denmark, and register data from abattoirs may contribute to such indices. The objective of this study was to select potentially welfare-relevant abattoir recordings and to assess the sources of variation within these recordings with a view towards inclusion in a national welfare index. Slaughter codes from the largest sow (n=3), slaughter pig (n=9) and cattle (n=8) abattoirs covering 92% of slaughtered animals in Denmark during 2012 were pre-selected based on expert judgment of having animal welfare relevance. This resulted in 22 individual codes and 8 code combinations for pigs, and 20 individual codes and 9 code combinations for cattle. Random effects logistic regression was used for each code/combination to determine the magnitude of variation derived at the level of the farm or abattoir, of which farm variation might be associated with welfare, whereas abattoir variation is most likely caused by differences in recording practices. Codes/combinations were excluded for use in the national welfare index based on poor model fit, or a relatively large abattoir effect. Ultimately, there was a large abattoir effect for most of the codes modelled. Among the pre-selected codes, the following number of codes or combinations were found to be potentially useful for a welfare index: 8 for slaughter pigs, 15 for sows, 5 for cattle <18 months of age, and 6 for older cattle. The majority of codes were considered to be not appropriate to be carried forward to the welfare index. It should also be noted that the accuracy of each code/combination was not assessed, only the observed variation between farms and abattoirs. In order to improve the possibility of using meat inspection data in animal welfare assessment, it is highly needed to identify the reasons for the large variation between abattoirs.

Assessment of injuries of laying hens at slaughter and its informative value concerning cannibalism

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Detection of cannibalism is essential for the improvement of hens' welfare in subsequent laying periods. The validity of the assessment of skin injuries at slaughter compared to on farm was evaluated in hens, being non-beak trimmed (20 flocks), beak trimmed (10 flocks) or 'mixed' (1 flock). 438 hens each from 31 flocks (flock size 1,500-5,900) of 11 farms (farm size 6,000-58,000 hens) were examined at the evisceration line after a previous on farm examination by the same observer (30 hens/flock). Time intervals between 'on farm' and 'at slaughter' assessments varied from 1 to 22 weeks. On average 6.5% of the laying hens had skin injuries, non-beak trimmed hens more (8.0%) than beak trimmed hens (4.2%, $P < 0.001$, χ^2 -test). The time interval of assessment did not seem to affect the prevalence of injuries. Setting a limit for the definition of cannibalism at 10% of injured hens, 6 flocks were affected by cannibalism. A correlation between the assessment results of skin injuries at slaughter with on farm results was found (Kendall's-Tau, 0.609; $P < 0.001$). The difference of assessed skin injuries between the two assessment methods was 25.0% (31.6% of hens affected on farm, 6.5% at slaughter). A large variation of frequency of injuries is demonstrated by the coefficient of variation for repeated measurements of 131.3%. After transforming the data into a binary form of either 'cannibalism' or 'no cannibalism', a ROC-Curve analysis determined the accuracy of estimating the prevalence of cannibalism on farm via examinations at slaughter. Using a threshold of 1.4% of hens with injuries at slaughter, presence of cannibalism as defined above was detected with a sensitivity of 92.3% and a specificity of 72.4%. In conclusion, the detection of preceding cannibalism is possible, whereby the detection limit to diagnose cannibalism from injuries on farm is much lower than at slaughter.

Comparing welfare assessment results from Welfare Quality and a Finnish healthcare scheme for cattle

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We studied whether Naseva, a national healthcare scheme for cattle in Finland, could be used as a reliable on-farm welfare assessment tool. Naseva's welfare section (NWS) includes 23 measures (12 animal based (ABM) and 11 other) based on the principles and criteria of Welfare Quality (WQ). Each measure can score 1 (good), 2 (acceptable) or 3 (needs improvement). We compared NWS and WQ-assessment on both criteria and measure level to examine whether the evaluation of the welfare status was overlapping. Forty-three free-stall dairy farms from Eastern Finland were Naseva-evaluated by their contract veterinarian. One of three trained assessors conducted the full WQ assessment within two weeks from this. A linear mixed model with the veterinarian as a confounding factor was formulated to predict the WQ-criteria score with the NWS measures that best correspond to the measures within each WQ-criteria. Spearman rank correlation was used to study connection between individual NWS and WQ measurements. There was an association between NWS and WQ only in the criteria 'Absence of prolonged hunger' ($P=0.04$) and 'Expression of other behaviour' ($P<0.001$). Most correlations between WQ and NWS measurements were weak ($|r_s|<0.4$). Moderate to strong correlations ($|r_s|>0.4$) were found between lesions (NWS) and mild and severe integument alterations (WQ) ($r_s=-0.52$ and 0.53 , respectively), outdoor access (NWS) and days in outdoor loafing area (OLA) per year and hours in OLA/day (WQ) ($r_s=-0.51$ for both), and grazing (NWS) and days on pasture/year and hours on pasture/day (WQ) ($r_s=-0.75$ and -0.70). In general NWS was not in agreement with WQ. Naseva and WQ had different assessors, which might explain part of the differences in the results. Also, NWS does not have a fixed sample size for the ABMs. According to our results, Naseva needs further development if it is to be used as a welfare assessment tool.

Risk factors associated with skin and vulva lesions in Danish loose-housed gestating sows and gilts

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This cross-sectional study investigated risk factors associated with the pen-level prevalence of skin and vulva lesions in loose-housed gestating sows and gilts in Denmark. Twenty-one conventional herds with more than 200 sows were visited from April to December 2015. Herds were chosen by convenience sampling and pens and animals were selected according to the Welfare Quality protocol. Associations between the proportion of animals in a pen with skin or vulva lesions and selected pen characteristics were analysed using univariable generalised linear mixed models with a negative binomial response and herd and pen as random effects. A multivariable model was not used due to moderately high confounding between pen characteristics. Of the 657 sampled animals from 121 pens, 210 (32%) had skin lesions, whereas 63 (10%) had vulva lesions. Skin and vulva lesions occurred with a corresponding frequency in the same animal ($n=20$, 3%), as expected if occurring independently. The risk of skin lesions was higher in pens with: electronic feeding compared to individual feeding stalls with rear gates (OR=3.0, 95% CI: 1.5-6.2), groups of >60 animals compared to groups of 8-20 animals (OR=2.7, 95% CI: 1.3-6.2), and recently mixed stable groups compared to stable groups (OR=2.2, 95% CI: 1.1-4.1). The risk was lower in pens with gilts compared to mixed groups (OR=0.2, 95% CI: 0.0-0.7) and tended to be lower in pens with maximally two handfuls of straw compared to no rooting material (OR=0.4, 95% CI: 0.1-1.0). The risk of vulva lesions was higher in pens with >60 animals compared to 8-20 animals (OR=4.4, 95% CI: 1.2-19.0). The results suggest that occurrence of skin and vulva lesions may have different aetiologies. Further research is needed to uncover the effects of pen design, feeding system, rooting material, group dynamics and size on skin and vulva lesions.

BOVIWELL: an easy-to-use tool to evaluate on-farm welfare of cattle*Nicolas Nocture and Mathieu Pissot**Moy Park Beef Orléans, France; mathieu.pissot@moypark.com*

On-farm animal welfare monitoring has made an important move forward since the publication of the Welfare Quality system in 2009. Articulated around the Five Freedoms of Animal Welfare, BoviWell is a cattle welfare evaluation tool inspired of Welfare Quality protocol and methodology (sample, aggregation, scoring) and aimed to be carried out within a maximum of 2 h on farm. The tool was built thanks to several working sessions with scientific experts, technical experts, institutions, NGOs, and tests in farms. Target was to identify the most relevant and feasible indicators to allow a scoring repeatable and comparable to the one obtained with Welfare Quality full assessment. Boviwell starts with a questionnaire on farm profile, farming practices (dehorning, castration, time spent in pasture, etc.) and technical indicators (animal health, calving conditions, etc.). Then, size of sample to be observed (in barn only) is calculated for each cattle category. Measures are mainly animal-based (body scoring, cleanliness, appropriate lying down, injures, approach test, etc.) and completed by housing conditions observations (watering and area per animal). Results are converted into scores through compliance to references or decision tree methods, with higher weight given to weaker performances (correlated to Choquet integrals). Finally, scores are classified within the Five Freedoms and aggregated into cattle category. To date, 100 diagnosis have been performed and show that 11% are in 'Excellent' grade; 77% 'Superior', 12% 'Acceptable' and none 'not-classified'. Each diagnosis helps enrich the database and refine references and grading scale. In conclusion, BoviWell gives an accurate evaluation of animal welfare, comparable to Welfare Quality full evaluation, within only few hours. Identification of best practices and/or potential ways of improvement linked to technical indicators facilitates discussion and involvement of farmers. BoviWell is currently spread out in 1,600 farms in France.

Use of routinely collected herd data to classify dairy herds for claw health associated welfare

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Claw health is an important indicator for dairy cattle welfare. The claw health status of a herd can be assessed by clinical observation of individual cows, which is time consuming and a challenge to obtain uniformity between observers. The objective of the study was to develop an empirical model on routinely collected herd data that could classify herds with a below or above average claw health. Two hundred dairy herds were visited to determine the proportion of lame cows, cows with visible hock or knee lesions and an overall grade for claw health. Routinely collected herd data were converted into cattle health parameters. Principal component analysis was used to combine claw health parameters into an observed claw health score. The dataset was randomly divided in a test group of 150 herds to develop a predictive model and a group of 50 herds for validation. Multivariable linear regression with a backward elimination procedure was carried out on routine herd data of the test group to find the best predictive model for the observed claw health score. With the final predictive model, the claw health status of the 50 validation herds was estimated. Herds were classified as below or above average for claw health. Agreement between the predicted relative to observed claw health score was obtained and sensitivity and specificity of the model were determined using the veterinary observations during the herd visits as golden standard. The final model explained 27% of the variance in the observed claw health score. The model correctly classified claw health for 72% of the validation herds with a sensitivity of 77% (95% CI 46-95%) and specificity of 76% (95% CI 57-90%). The study showed that routinely collected data can be used to classify herds for claw health, but was not sensitive enough to achieve multilevel classification.

Use of indicators of dairy cow welfare in the EU*Terence Cassidy and Patrick Caruana**European Commission, Directorate-General for Health & Food Safety (Unit F2 Animals), Ireland;
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Dairy farming is widespread in the EU with milk the number one single product sector; in value 15% of agricultural output. EU animal welfare legislation provides general requirements for dairy cows and Member State implement this by checking the resources provided to dairy cows and whether these are sufficient to prevent animal suffering. Although not defined in legislation animal based indicators are now frequently used in farm assessments. At national level there is little data on how farms perform based on indicators and there is no overview of dairy cow welfare. Somatic cell count is the only indicator widely used as it is a mandatory requirement. Its use has brought about huge improvements in milk quality in the last decades and dairy cow welfare has also benefited from low levels of mastitis. Other milk parameters used by farmers to improve cow welfare include those for acidosis and ketosis, but have not been used as part of wider schemes. Lameness and body condition score are used during farm assessments but systems have not been set up to monitor farms on the basis of these indicators. Although several Member States have set intervention levels for official investigation, e.g. 20% lameness, they do not have an overview of lameness in dairy cows. Breeders' associations use ease of calving to improve cow survivability, reduce injury at calving and improve reproductive performance. Several Member States have promoted certain cow types for certain farm conditions. Data is not available on the uptake of either of either of these initiatives by farmers. Animal indicators are effective for identifying problems on farm; however they have not been utilised to establish benchmarks for farms. By using existing data more systematically, farmers can be clear on the standards they achieve and Government and industry can provide assurances that animal welfare is respected. In order to achieve this, indicators need to be further standardised, with data defined for collection and analysis and intervention levels established.

Pre-weaning environment affects adult pigs' emotional state*Oceane Schmitt^{1,2}, Keelin O'Driscoll², Laura Boyle² and Emma M. Baxter¹**¹SRUC, Animal Behaviour and Welfare, Animal and Veterinary Science Research Group, United Kingdom, ²Teagasc, Pig Development Department, Ireland; oceane.schmitt@teagasc.ie*

Artificial rearing (i.e. rearing piglets away from the sow) is used when large litters (>14 piglets) are prevalent. Qualitative Behaviour Assessment (QBA) was used by observers of different backgrounds to assess the effect of pre-weaning environment on adult pigs' emotional state. Pigs were sow-reared (SR) or artificially-reared (AR) with milk replacer from 7 days-old until weaning. At the finisher stage of production (134±5.9 days-old) one group of SR pigs (n=13) and one group of AR pigs (n=16) (mixed sex, from different litters) were videoed in the home pen for 20 min. Five 1-min clips were randomly selected from each video (n=10) and watched by observers blinded to treatment (n=22). They were experienced or inexperienced with pigs (EP; EP+: n=14, EP-: n=8) and with behavioural observations (EO, EO+: n=14, EO-: n=8). Clips were scored by placing a vertical mark on a 125-mm visual analogue scale for 20 QBA descriptors. QBA score was calculated using all descriptors' scores. Wilcoxon-rank test analysed differences due to treatment, pig and behaviour experiences. Kendall's coefficient of concordance (W) assessed inter-observers reliability. Principal Component Analysis (PCA) processed descriptors scores. SR QBA was higher than AR (39.13±3.04 vs 30.36±2.90, $X^2=4.08$, $P<0.05$). Pigs were perceived along two axes: feelings (PC1, 42% variance explained) and physical activity (PC2, 18% variance explained). SR pigs experienced more positive feelings (e.g. happy, content, relaxed) and less negative feelings (e.g. tense, frustrated, aimless), but were less physically active (e.g. playful, agitated, active) than AR pigs. The inter-observer reliability was significant but weak ($W=0.09$, $P<0.05$). QBA score was similar between observers with different experience with behavioural observations (EO+: 36.28±2.61, EO-: 32.06±3.61, $X^2=0.65$, $P>0.05$) or with pigs (EP+: 35.81±2.70, EP-: 32.88±3.40, $X^2=0.21$, $P>0.05$). Pre-weaning environment affected the emotional state of adult pigs: SR pigs were perceived as being in a better emotional state than AR pigs.

Impact of grazing on dairy cow welfare – first results of the Welfare Quality® protocol

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Studies targeting the impact of grazing on the animal welfare status overall are scarce in Germany. Previous studies aimed mostly at impacts on health parameters or selected diseases. The aim of the present study was to examine the effects of grazing on welfare of dairy cows in organic and conventional farms based on the Welfare Quality® protocol for dairy cattle. Therefore, we applied the Welfare Quality® protocol on 32 (14 zero grazing, ZG; 18 summer grazing, SG) dairy farms twice to assess the status of animal welfare during the winter and summer period. For the summer assessment we recorded some indicators of the protocol on pasture for the SG farms (e.g. lying comfort). For statistical analyses we used the Wilcoxon signed-rank test. The first results indicate a higher score in most welfare principles (mean \pm SEM; good housing ZG: 53 \pm 4, SG: 70 \pm 3, P=0.001; good health ZG: 44 \pm 3, SG: 52 \pm 3, P=0.048; appropriate behaviour ZG: 32 \pm 2, SG: 67 \pm 3, P<0.001) during the summer months for dairy cows with summer grazing, except for the welfare principle 'good feeding' (ZG: 44 \pm 8, SG: 23 \pm 4, P=0.029). This worse rating for SG farms was predominantly related to insufficient supply of drinking water on pasture (usually too few drinking places) compared to ZG farms. Better scoring of SG farms in the other welfare principles might be explained by improvements of lying surfaces on pasture, thereby reducing injuries (integument alterations, lameness), and in space allowance which might be helpful to prevent agonistic behaviours. In contrast, the welfare situation between ZG farms and SG farms did not differ during winter (all principles, P>0.05). In conclusion, grazing offers a great potential to enhance welfare of dairy cows during the summer period, while the beneficial effects of grazing are not guaranteed when management does not satisfy the animals' needs.

An app assessing animal welfare through animal-based measures

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TIBENA (Terrena animal-based welfare measures for a New Agriculture) is an innovative tool supporting farmers in their animal welfare improvement process. This diagnostic tool, based on the 5 Freedoms, helps identify good practices and possible improvements, through 37 to 80 animal-based welfare indicators (depending on the species). The results are used to discuss many aspects of flock (or herd) management and welfare with the farmer: water and nutrition, comfort, health, stress level and animal behaviour. Construction of the tool began with an exhaustive consultation process: literature review (mainly Welfare Quality) and interviews with scientists and professionals. Then, the trial app was assessed in the field including 20 to 30 commercial farms per species and with an expert committee, until the tool was considered reliable and robust enough to be used on a large commercial scale. Reproducibility inter-observers was tested: the results' similarity correlation is 92.74% (3 observers and 2 farms) in pigs, and 98.1% (4 observers and 3 farms) in broilers. Reproducibility inter-farms is ensured: for each species, farms selected for testing were as different as possible regarding infrastructures and production methods. Technical feasibility was tested by different operators, and scientific validity was monitored until the end with bibliography and experts. By spending about one to three hours observing the animals, TIBENA gives an objective picture of the welfare state at the herd or flock level. Thanks to the clear and illustrated instructions, and the convenience of a smartphone app, anyone can use the tool and obtain a valid result. The app contains recommendations for welfare improvement. The app currently exists for pigs, broilers, rabbits and cattle, and is being developed for other farm species. During the period October 2015-December 2016, the TIBENA app was used on 54 Terrena farms to assess welfare and provide recommendations for improvement. The longer-term goal is to make the app available to the whole industry.

Evaluation of an automated monitoring system to assess laying hens' use of the outdoor range

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Automated monitoring allows collection of continuous sets of behavioural data on multiple animals simultaneously, which is nearly impossible by direct observation. We assessed the accuracy of a novel light-based monitoring system that records range use in laying hens. We compared the system's output to direct continuous focal observation of hen location. Fourteen hens from a commercial free-range flock (British Blacktails, 45 weeks old, total flock size 2,000) were equipped with a device that recorded light levels each minute. Aiming to equip hens that would differ in how much they used the range, 7 hens were caught outside and 7 inside the house. Data were collected 2-7 days after equipping. Hen location ('in' or 'out') was determined by comparing the hen's sensor to four ambient light sensors placed in the brightest areas of the shed (where sunlight came in through the popholes or ventilation slits). When the reading of a hen-mounted sensor exceeded that of all inside ambient sensors, the hen was considered to be outside at that moment. To avoid collecting data when inside and outside levels were too similar, two additional ambient light sensors were placed outside, and data were discarded when $\min(\text{out}) < 1.1 \times \max(\text{in})$. This resulted in daily data collection starting between 07.11 and 07.45 and ending between 16.20 and 16.35, corresponding with sunrise and sunset for that time of year (November). Additionally, 0-30 minutes/day when the sun shone directly through the popholes (around 08:00 or 14:30) had to be discarded. The system's accuracy was evaluated by direct observation of the equipped hens (206 minutes in total). Monitoring and observations were in agreement 92% of the time, i.e. the hen's position ('in' or 'out') as determined by the system was confirmed by our observations. The monitoring system indicated that hens originally caught outside spent a much greater percentage of the monitored time on the range (median (Q1-Q3): 42% (40-51)) than those caught inside (6% (3-17), $P < 0.001$, Wilcoxon rank-sum test). We conclude that the system shows great promise as a tool to monitor range use.

Date of assessment affects the WelFur-assessment of mink in the winter- and growth period

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In the on-farm welfare assessment system WelFur-Mink, a range of animal- and resource-based measurements are taken on a sample of mink in each production season and aggregated into an overall assessment at farm level. Mink follow a strictly synchronised annual cycle. In order to limit the variation in welfare with stage of life, each assessment period lasts only six to eight weeks. However, the prevalence of welfare problems may still vary with date of assessment, as previously shown in the nursing period. The aim of this study is to explore if there is a change in the prevalence of welfare problems in the winter- and growth periods. Eight private Danish mink farms were included. Each farm was assessed four times during the growth period in 2014 and three times during the winter period in 2015 according to the WelFur-Mink protocol. The same set of cages was assessed repeatedly on each farm within each period. They consisted of 120 cages with one mink per cage in the winter period and 90 cages with one to four mink per cage in the growth period. Initial analysis using logistic binomial mixed models showed a change with assessment date. In the winter period, the prevalence of 'too thin mink' ($\chi^2=134$, $df=1$, $P<0.001$) decreased and the prevalence of 'mink with fur chewing' ($\chi^2=24$, $df=1$, $P<0.001$) increased. In the growth period, the prevalence of 'mink with injuries' ($\chi^2=8$, $df=1$, $P=0.004$), 'cages with diarrhoea' ($\chi^2=9$, $df=1$, $P=0.003$), and 'exploratory mink' ($\chi^2=15$, $df=1$, $P<0.001$) increased. Some changes with date of assessment are negative in regards to animal welfare, e.g. the prevalence of 'mink with fur chewing', 'mink with injuries', and 'cages with diarrhoea' increased, while others are positive, e.g. the prevalence of 'too thin mink' decreased and the prevalence of 'exploratory mink' increased. If these changes affect the aggregated welfare assessment, this must be controlled in order to ensure that the WelFur assessment of mink is independent of assessment date.

US pork producer perceptions of issues affecting the management, performance, and well-being of pigs

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An online survey of US pork producers investigated their perception and use of behaviour in managing pigs. Questions included: 'when you conduct health checks, what signs are you looking for that tell you everything is well or not well' (wellness); 'what do you consider the top three most important issues affecting the management, performance, and well-being of breeding pigs' (sow issues); and 'market hogs' (hog issues). A qualitative analysis of text identified themes. All listed wellness terms and all three sow and hog issue were placed in a general then specific category. Chi-square tests of homogeneity compared frequencies between groups. In total, 277 respondents listed 949 wellness terms. Of these, 69% were clinical signs, most mentioned were coughing (27%), looking at the manure (23%), and lameness (17%). Behavioural signs were mentioned by 66%, including movement (21%), and the ability to get up (18%). Other general categories included looking at parts of the pig (21%), posture (11%), demeanor (17%), and surrounding environment (10%). Additionally, 18% mentioned affective states, including lethargic/listless (10%), comfortable (3%), playful (1.4%), and happy (1.4%). Respondents mentioning affective states tended to be female ($P=0.06$). Hog and sow issues were categorized as 'human-based', 'pig-based', or 'environment-based', and frequencies differed between sows and hogs ($P<0.001$). Pig-based issues were mentioned more for sows (57%) than hogs (45%), environment-based for hogs (29%) than sows (15%), and human-based were similar (sows: 28%, hogs: 26%). The highest specific issues for both were health (hogs: 17%, sows: 12%) and nutrition (hogs: 16%, sows: 15%). Environment-based air quality (6% hogs vs 1.5% of all mentions for sows) and space (hogs: 6%, sows: 0.7%) were mentioned more for hogs, and pig-based performance more for sows (hogs: 3%, sows: 11%). This information can be used to drive future outreach education, and research.

NSAIDs do not mitigate piglet castration pain based on behavioural and activity monitoring

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Each year, millions of boar piglets in North America and the EU are surgically castrated to minimize boar taint and aggression. While this procedure is known to be painful, and legislation mandates that piglets be provided with appropriate analgesia to control post-procedural pain, many piglets are not given pain relief. This has a potentially significant impact on piglet welfare. The objective of this study was to assess the efficacy of meloxicam (0.4 and 1.0 mg/kg) and ketoprofen (6.0 mg/kg) in reducing pain in castrated piglets, using validated behavioural scoring techniques and a novel Piglet Grimace Scale (PGS). Fifteen litters of 5 day old piglets (n=80) were used and boar piglets within a litter were randomly assigned to one of eight possible treatments: 0.4 mg/kg meloxicam-castrated, 0.4 mg/kg meloxicam-uncastrated, 1.0 mg/kg meloxicam-castrated, 1.0 mg/kg meloxicam-uncastrated, 6.0 mg/kg ketoprofen-castrated, 6.0 mg/kg ketoprofen-uncastrated, saline-castrated, or sham-castrated (n=10 piglets/treatment group). Injections were given intramuscularly 20 mins prior to surgical castration. Piglets were video recorded for 1 h pre-procedure, immediately post-castration for 8 h and for another 1 h, 24 h post-procedure (10 h total). Twenty-one behaviours and postures were scored continuously for the first 15 mins of every hour by four observers blinded as to experimental time and piglet treatment using Observer software. Data was analysed using a mixed model ANOVA with repeated measures and a post-hoc Tukey test. Castrated piglets were significantly less active 3 and 4 h post-castration ($P=0.0007$ and $P<0.0001$, respectively) while uncastrated piglets had unvarying levels of activity throughout the observation period. Castrated piglets also displayed significantly more tail wagging and pain-related behaviours (e.g. spasms, rump rubbing, trembling, stiffness) than uncastrated piglets ($P<0.0001$). The use of meloxicam or ketoprofen was not associated with a reduction in pain behaviours or postures. Our findings indicate that the use of NSAIDs at recommended doses does not sufficiently alleviate castration-associated pain in neonatal pigs.

Benchmarking in a Swedish welfare assessment system for dairy cattle

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'Ask the Cow' is an advisory animal welfare service performed by trained assessors. The service includes objective assessments of animal-based welfare measures. In a benchmarking system, the results from the assessments are compared with a reference group of randomly selected Swedish dairy herds. An action plan, in combination with the benchmarking system, guides the owner towards measures to improve animal welfare. The aim of the study was to estimate body condition, cleanliness and prevalence of lesions, lameness, long or asymmetric claws and abnormal rising behaviour. Ask the Cow assessments were performed on 1,750 cows, 1,676 heifers and 1,623 calves at fifty randomly selected Swedish farms. The prevalences of remarks were estimated at individual and herd level per animal category. Herd level estimates will be used to update the benchmarking system. The highest prevalence was found for lesions in cows followed by cows standing in cubicles, cows with asymmetric claws, lameness in cows, dirty cows and dirty heifers. In comparison to the current limits in the benchmarking system, statistically significant differences were found. Prevalence of dirty and lean animals and animals with lesions have decreased in all age groups. Dirty cows have decreased from 24 to 10%, heifers from 28.8 to 9.7% and calves from 15.5 to 4.7%. Lean cows have decreased from 6.2 to 1.6%, heifers from 4.1 to 0.7% and calves from 7.1 to 3.8%. Lesions in cows have almost halved, from 30.5 to 17.3% and decreased in heifers from 3 to 1.6% and calves from 4.1 to 0.9%. Animals with high body condition scores have become more common, from 3.1 to 6.3% in cows and from 2 to 7.6% in heifers. In cows, lameness have increased from 8.9 to 12.9%. The development towards larger herds and loose-housed systems probably have an impact on the changes.

Does giving access to grass silage improve health of growing-fattening pigs in organic farms?

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Despite the enriched environment and straw availability prescribed in organic pig fattening, health problems like tail and skin lesions as well as gastric ulcers may occur that are related to a lack of palatable roughages. We therefore investigated the effect of grass silage availability in addition to straw and concentrate feed on six commercial organic farms. On each farm, there were two groups offered grass silage (GS) and two control groups without silage (C). Tail and skin lesions, and tear staining, as a potential indicator of chronic stress, were scored individually four times during the fattening period. At slaughter, the status of the gastric mucosa of the *pars oesophagea* was assessed. We used generalized linear mixed effect models with pig in group in farm as nested random effect and likelihood-ratio tests for data analysis. From 1,394 observations on 368 animals we diagnosed tail lesions in 26 cases (on 25 animals), of which 11 originated from the first observation after regrouping and were thus not yet related to the treatment. From the remaining 15 cases of tail lesions, only one was found in a GS group and the other 14 in six C groups. Skin lesions did not differ between treatments ($\chi^2(1)=1.58$; $P=0.21$) but changed during the fattening period ($\chi^2(1)=102.31$; $P<0.001$) with the highest scores for scratches at the beginning. There was no treatment effect on tear staining ($\chi^2(1)=0.09$; $P=0.77$), but tear staining considerably increased during the fattening period ($\chi^2(1)=110.20$; $P<0.001$). Severe changes in the gastric mucosa and gastric ulcers were found in stomachs of pigs from three out of the six farms. On these farms C pigs had more severe changes than GS pigs (8.5 vs 2.7%; $\chi^2(1)=4.0$; $P=0.04$). Grass silage thus seems to potentially reduce tail lesions and gastric ulcers especially on farms with high incidence of such ulcers.

Validation of a scoring system for footpad dermatitis in broiler chickens*Sophia Heitmann¹, Jenny Stracke¹, Henning Petersen², Birgit Spindler¹ and Nicole Kemper¹**¹Institute for Animal Hygiene, Animal Welfare and Farm Animal Behaviour, University of Veterinary Medicine Hannover, Foundation, Germany, ²Clinic for Poultry, University of Veterinary Medicine Hannover, Foundation, Germany; sophia.heitmann@tiho-hannover.de*

Measuring the severity of footpad dermatitis, as an important indicator of animal welfare in poultry industry, is an accepted tool monitoring the quality of animal husbandry. Different scoring schemes are used, most of them based on a visual evaluation. A standardization of the existing systems could be beneficial, not only to compare different studies, but to provide an objective tool in poultry welfare surveillance. In this study we present a validation of a visual scoring system, widely used in German production systems, adding information of histological parameters. Therefore, feet of broiler chicken (ROSS 308) were scored at the abattoir (4-point scale: 0; 1; 2a; 2b). Ten feet per score class (n=40) were sampled and analysed macroscopically and microscopically, measuring size and depth of the lesions and thickness of the different cutaneous layers. For a classification of these histological parameters, a cluster analysis was performed. Using the glimmix procedure in SAS, visual and histological classification were found to differ significantly ($F=5.49$; $P<0.05$). Furthermore, using the Kendall tau correlation coefficient, a positive correlation of the size of a lesion with the depth of the ulcer was found. In conclusion, in this study we showed that the size of the lesion might be a good indicator of the depth. Whereas histological findings coincided well with the less severe visual scores (0; 1), the differentiation between the severe scores (2a; 2b) seemed to be less valid. We therefore recommend keeping visual scoring systems as simple as possible, referring to the size of the lesions as indirect parameter for the depth.

Welfare assessment in beef cattle: a multidisciplinary approach

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The purposes of this study were to evaluate beef cattle welfare with a multidisciplinary approach as housing conditions and management practice change and to investigate the correlations between the parameters used and their applicability. A total of 15 Piemontese bulls reared in a tied stall housing system (farm A), 15 Piemontese and 15 Blonde d'Aquitaine reared in pen for groups (farm B and C, respectively) and 15 Irish cross-breed reared in paddock (for the first 40 days) and pen for groups (for the next 6 months) were considered. The 'RIBECA' scoring system (a welfare protocol formulated by CRPA; Centro Ricerche Produzioni Animali) was used for the assessment of animal- (e.g. BCS, ocular/nasal discharge, avoidance distance) and resource-based (e.g. pen features, animal crowding) measures. Hair 20 β -dihydrocortisol, complete blood and serum profile and dROMs (Reactive Oxygen metabolites) were also analysed. Observations and blood samples were performed 2 times: 3 weeks after the arrival of the animals on the farm (T0) and after 5 months (T1). Data were analysed by One-way ANOVA, Kruskal-Wallis test, Student's t and Wilcoxon tests. Animal-based score was not significantly different between the farms, while total welfare score (animal- and resource-based measures) was 'poor' for farm A, 'fair' for farms B and D and 'very good' for farm C. Farm D animals were the most fearful; blood findings suggest that this group showed the worst adaptation: WBC, neutrophils, N/L, albumin, CK, glucose, creatinine and LDH increased at T1; $P < 0.01$. Farm C animals were well adapted: WBC, monocytes, eosinophils and basophils decreased at T1; $P < 0.01$, 20 β -dihydrocortisol and dROMs were lower in this group; $P < 0.01$. Farm A and B animals did not show significant differences. These results suggest that the parallel use of total welfare scores and laboratory stress indicators allows a better assessment of animal welfare.

Brief sensorial restriction lamb-ewe and behaviour in young

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In sheep it is common that brief periods of separation ewe-lamb are performed in farms, reducing the sensorial exchange between ewe and lamb. Aim of this study was to determine the behaviour of lambs of different ages during short periods of additive sensory isolation of their ewes. Sixty ewe-lamb were randomly assigned to one of five treatments: lambs remained with their mothers (C), sensory restriction from second to fourth treatment: auditory (A), auditory and visual (A + V), auditory, visual and tactile (A+V+T), and auditory, visual, tactile and olfactory restriction (A+V+T+O). In A and V treatments, devices were put over ears and eyes of lambs, respectively in order to reduce the sensorial interaction. Only in A+V+T and A+V+T+O lamb and ewes were physically separated by wall. Treatments were repeated in the same animals at three different ages: at 3 (G3), 10 (G10) and 20 (G20) days of age, during 15 minutes. Behaviours were recorded (vocalizations, micturitions, defecations, sniffing of objects, sniffing of conspecific, escape attempts, walking and lying down). No animal suffered any injury or temporary or permanent damage due to research. Data were analysed using a covariance analysis to determine differences for repeated measurements. It was found that in A+V+T and A+V+T+O restrictions, lambs showed an increase in the average of number of vocalizations ($P<0.0001$), exploration of conspecific ($P<0.001$), walking ($P<0.0001$) and lying down ($P\leq 0.02$). In G3, offspring showed differences ($P=0.006$) in the mean of urination; however G10 ($P=0.05$) and G20 lambs ($P<0.0001$) showed an increase in the average of escape attempts. It is concluded that: (1) the behavioural signs evaluated increased, particularly when limiting the physical contact and olfactory sense from the mother; and (2) the older lambs showed more reactivity in the 'fight or flight' behaviours to the sensorial restriction.

Simulating pigs to understand their feeding behaviour and to improve their welfare*Iris J.M.M. Boumans¹, Imke J.M. De Boer¹, Gert Jan Hofstede² and Eddie A.M. Bokkers¹**¹Wageningen University, Animal Production Systems group, the Netherlands, ²Wageningen University, Information Technology group, the Netherlands; iris.boumans@wur.nl*

The causation of feeding behaviour is known to be a complex interaction among many internal (e.g. metabolism, pig characteristics) and external factors (e.g. feeding system, social interactions). This interaction, however, is not well understood. The aim of this study was to gain deeper understanding of mechanisms and essential factors underlying feeding behaviour of growing pigs under intensive housing conditions. We developed an agent-based model in which feeding and interaction behaviour of individually and group-housed pigs with a single feeder emerged over the day (per minute) and during the growth period (120 days). We tested the effect of internal factors (e.g. metabolism, circadian rhythms, behavioural strategies) and external factors (e.g. social dynamics and diet characteristics) on emerging feeding and interaction patterns, such as feed intake, meal frequency, feeding rate and displacement attempts. These patterns were validated by comparing them to those observed in empirical studies with conventionally housed growing pigs in various group sizes. Model results show that hormonal circadian rhythms of melatonin and cortisol interact with metabolism and explain feeding patterns of individually housed pigs over the day. An interaction between pig (e.g. maximum feeding rate) and diet characteristics (e.g. energy level) and group size affects competition between pigs and conflicts around the feeder. Competition level at a certain threshold caused a turning point in behavioural patterns, after which behavioural strategies of pigs (e.g. avoid and approach decisions) explained the direction of change, especially in meal-based (e.g. meal frequency and size) and interaction patterns (e.g. avoidance and displacements). Social facilitation had a limited effect on patterns in the model. The model helps to better understand mechanisms underlying feeding behaviour in growing pigs and can be used as a tool in further research to understand how housing and management practices, pig characteristics and group dynamics can affect pig behaviour and welfare over time.

Effects of holding time before milking on behaviour of dairy cows and milk hygiene quality

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Cows that wait longer to be milked have fewer opportunities to express their natural behaviour and could experience more stress; these factors might be associated with increased somatic cell counts (SCC) and bacteria counts (BC) in milk. The aim of the study was to evaluate the effect of holding time (HT) on the behaviour of cows during milking, SCC, and BC in milk. One hundred cows were enrolled from 10 pasture-based dairy farms in the plains of Bogota, Colombia, balanced by milking type (5 farms fixed-parlour, n=50 cows; 5 farms mobile-parlour, n=50 cows). Farms were visited 3 times (1 morning- and 2 afternoon-milking) between April and September 2014. Cows were recorded during milking process to determine HT and frequency of restless behaviours (i.e. step, lift, kick). Videos were analysed using the software Cowlog 2.0. Individual milk samples were taken to determine SCC, mesophilic, *Escherichia coli*, and total coliform counts. HT was dichotomized: HT1 (≤ 35 min) and HT2 (> 35 min). Data were analysed using factorial ANCOVA in SPSS 20. HT (mean \pm SD) was significantly ($P < 0.05$) shorter for cows milked in fixed-parlour (28 ± 25.4 min) compared to mobile (42 ± 28 min); and HT was significantly longer during afternoon-milking (44 ± 33 min) compared to morning-milking (30 ± 23 min). SCC and *E. coli* counts were significantly lower in the HT1 group (SCC: 552.028 ± 88.985 cells/ml; *E. coli*: 4.9 ± 38.5 cfu/ml) compared to HT2 group (SCC: 625.447 ± 105.443 cells/ml; *E. coli*: 11.2 ± 82.8 cfu/ml) in mobile-parlour. The frequency of stepping was in the HT1 group (0.4 ± 0.5 steps/min) compared to cows in the HT2 group (0.3 ± 0.4 steps/min) ($P > 0.05$). This study suggests that having short holding times (≤ 35 min) when mobile-parlour is using could help improve milk quality.

A shared and practical method for welfare assessment in poultry and rabbit: EBENE

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Farmers are concerned by the welfare of their animals. Recent regulatory and international welfare texts have increasingly focused on outcomes and stakeholder empowerment (animal welfare training, good practice guidelines, etc.). To help the poultry and rabbit sectors achieve this, the EBENE (Evaluation du BiEN-Etre animal) project is developing a practical and shared method for assessing welfare. The first step was to agree on a methodological framework with a group of professionals. The second involved proposing indicators and measurement methods specific to each sector within five working groups: meat sector (chickens, turkeys, ducks, guinea fowl, and quails), laying hens, ducks for foie gras, breeder flock and rabbits. A third stage aimed at taking into account the views of other stakeholders. From the beginning of the process, NGOs (CIWF, Welfarm) and relevant scientists (INRA, ANSES, ISA Lille, Oniris) were consulted to develop welfare assessment methods for chickens / turkeys and laying hens in cages. Meetings between representatives from the poultry and rabbit industries and other civil society stakeholders (NGOs, scientists, competent authorities, distribution) led to consensus on the method to be used. This method integrates all the components of welfare and is based on the principles and criterion grid established in the Welfare Quality® project. It represents a tool for improvement that farmers, technicians and / or veterinarians can use. Currently, indicators and associated measures are available for broilers, turkeys, rabbits and laying hens, but there is still need to validate or simplify some of them. Subsequently, the method will be adapted to free-range systems and to other species. Throughout 2017, it will be improved through scientific validation, and feedback from users and the various stakeholders. Work will then continue to compile the results, and to develop a smartphone application to facilitate use.

Development and pilot study of a welfare assessment protocol for dairy calves*John Barry¹, Emer Kennedy¹, Riona Sayers¹, Imke De Boer² and Eddie Bokkers²**¹Teagasc Moorepark, Animal and Grassland Research and Innovation Centre, Ireland, ²Wageningen University, Animal Production Systems Group, the Netherlands; John.Barry@teagasc.ie*

As agricultural systems continue to develop and become more refined, so too must protocols used to assess the welfare of animals experiencing them. The aim of this research was to develop a welfare assessment protocol for pre-weaned dairy calves (<12 weeks old), and investigate, and improve, its reliability and feasibility through an on-farm pilot study. Using existing protocols, literature and expert consultation, animal based indicators were selected to assess welfare of dairy calves. Measurements include behavioural observations from 60 minute video recordings, health scoring, heart girths, and blood and faecal sample analyses. To successfully estimate welfare at farm level a representative sample of calves must be taken (i.e. male and female, from different age groups). To be able to identify risk factors and improvement options for calf welfare, management practises (e.g. colostrum management, post-colostrum feeding, weaning, hygiene, and health), are assessed by interviewing the farmer, and husbandry conditions are assessed using measurements such as temperature, wind-speed, space allowance, bedding quality, availability of fresh drinking water, concentrates, and forage, air ammonia concentration, and feeding equipment hygiene. Subsequent to protocol development, a pilot study was carried out on five commercial Irish dairy farms to evaluate its reliability and feasibility. Strengths and weaknesses of the protocol were identified during the pilot and modifications made accordingly. Further questions were included and a number of existing questions restructured to enhance clarity. Additional measurements, such as bedding depth and total air capacity, were included to provide more environmental information. Through the combined use of animal, management and environmental information, we are confident in having developed and piloted a reliable and feasible on-farm dairy calf welfare protocol. This protocol can be used for large scale on-farm dairy calf welfare assessments.

Health and welfare status of pregnant dairy goats according to the farming system in France

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Chronic stress in farm animals during pregnancy alters health and welfare both in females and their offspring but few data exist from field studies. An epidemiological survey has been performed in dairy goat farms to investigate the effects of the farming systems on the welfare and health of adult females and their offspring. We here report data collected during the dry (non-milking) period of goats in 62 French farms selected to embrace the diversity of existing production systems: 26 big farms (>400 goats) without grazing area (system 1); 18 smaller farms (<400 goats) without grazing area (system 2); and 18 farms with grazing areas (<400 goats, system 3). For each farm, welfare and health have been assessed, applying the AWIN[®] protocol on a representative sample of animals. Regarding welfare, the human/animal relationship indicator (latency for first contact during the avoidance distance test) did not show difference between farming systems, what may be due to the high variability of the results between farms (min = 0 vs >180 s). Regarding health indicators: (1) for body condition, there were less thin goats in system 1 (4%) than in systems 2 (10%) and 3 (16%) (P=0.0001) and more fat goats in system 2 (21%) than in system 3 (7%) (P=0.008), (2) pregnant goats reared in system 2 had more claws in poor condition (62%) than the ones reared in system 3 (36%) (P=0.0578) and (3) there were less abscesses in system 3 (10%) than in systems 1 (21%) and 2 (21%) (P=0.0188). The first analysis of available data shows that health seems to be less optimal in the smaller (<400 goats) farms without grazing area, whereas no significant difference could be found for the welfare indicators up to now. These preliminary results will be completed in the poster by further analyses allowing to have a more comprehensive picture of the goats and kids health and welfare in dairy farms, and to assess the influence of housing and management characteristics on those.

A method to develop an effective animal welfare protocol: laboratory mice*Ivone Campos-Luna¹, Amy Miller¹, Andrew Beard¹, Françoise Wemelsfelder² and Matthew Leach¹**¹Newcastle University, School of Agriculture, Food, and Rural Development, United Kingdom,**²Scotland's Rural College, Animal and Veterinary Sciences Group, United Kingdom;
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In animal welfare, effective protocols are designed to assess all components of welfare including physical and psychological states as well as the environment that houses the animal. The aim of this study was to create a laboratory mouse welfare protocol that includes all aspects of welfare. The construction of this protocol comprised 3 phases: (1) input of experts through a Delphi consultation, (2) validation of Qualitative Behavioural Assessment (QBA) for assessing the behavioural expressions (emotional states). This validation forms part of a project exploring the utility of the QBA in laboratory animals for the first time. It used free choice profiling, fixed expression validation approach and cross-validation with other welfare measures. Finally, in phase (3) the indicators derived from the Delphi consultation and QBA were aggregated into a single protocol and its reliability and practicability were assessed in different laboratory facilities. A total of 98 participants completed the final round in the Delphi study with a consensus of 72% being reached. Hunch posture, coat condition, exhibition of normal and abnormal behaviour and usage of nesting material were chosen, irrespective of the nature of the assessment being carry out (daily assessment or welfare audit). The Free Choice Profiling data for the QBA was analysed with General Procrustes Analysis (GPA). The results show a significant agreement between participants in their assessment ($P < 0.001$). The GPA found two main dimensions that accounted for the 78% of the variation observed. Dimension 1 was characterised as 'inquisitive'/'alert' vs 'in pain'/'lethargic' and dimension 2 as 'calm'/'content' vs 'agitated'/'stressed'. The 3-phase process used to construct the final protocol better guarantees the validity of the indicators it contains, as it encompasses all aspects of mouse laboratory welfare including a novel method of assessing psychological welfare (QBA).

On-farm self-monitoring of animal welfare in poultry flocks

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German animal welfare legislation requires since 2014 all livestock owners to perform on-farm self-assessments of animal welfare, mainly with animal based indicators. While this novel approach may contribute to improved welfare, both extent and methods of the welfare assessment are under debate, as training and available time of farmers are limited. Based on group discussions with 14 experts (scientists, farm advisors, farmers, and representatives from administration and organisations), a proposal on the selection of relevant welfare indicators and easily applicable methods for laying hens and pullets, broilers and turkeys is presented. Indicator choice was based on the most important animal welfare concerns, depending on species and production type: feather pecking, cannibalism, injuries, dermatitis at feet, hocks or breast, lameness, high morbidity, keel bone damage, insufficient water availability, poor body condition, high mortality, mutilations as well as pain or injury due to catching and transport. Taking into account literature information on validity, reliability and feasibility of corresponding indicators and practical experience, assessment methods were chosen, described and illustrated in a farmers' booklet. Three categories of measures were included: (1) summary assessments of routinely and regularly recorded data such as animal losses, water consumption, use of pharmaceuticals, laying performance and egg quality; (2) slaughter records regarding dead birds on arrival, condemnation causes, foot pad, breast or skin dermatitis; and (3) measures for which a sample of birds needs to be scored at certain intervals, e.g. on lameness, extent of beak trimming, weight uniformity, plumage condition, skin wounds, dermatitis or keel bone damage. The assessment protocols are the basis for ongoing work on the feasibility and efficiency of animal welfare self-assessments on-farm.

Dairy cattle welfare assessment in Israel*Gilad Faktor**Hachaklait Veterinary services Israel, Israel; faktor@hachaklait.co.il*

The objective of this presentation is to introduce a new audit for assessing dairy cattle welfare in Israel. The audit was created on the basis of the European Welfare Quality assessment protocol for cattle, the Bristol Welfare Assurance Programme (BWAP) and the American Dairy welfare evaluation guide. As these protocols are not totally suitable for Israeli Dairy farms, we created an Israeli tailored audit. Promoting animal welfare is one of chief duties of veterinarians. 'Hachaklait', a group practice of 46 bovine practitioners in Israel attends approximately 90% of dairy farms in Israel (some 100,000 milking cows). Therefore we developed an advisory welfare audit for our clients. The special conditions in our dairy farms and our hot and humid climate require unique welfare issues to be examined. For example, lameness is a minor issue in Israel (around 6% annual occurrence) as our farms are comprised of open pens with soft matter and cows spend little time on concrete floors (compared to high rates of lameness in stall systems due to excessive walking and standing on concrete floors). On the other hand, cooling the cows on farm (water sprinklers and ventilation) is a big welfare issue. Our audit is based on our herd health department data (resource based) and on animal based data from farm visit. As most of our farms are highly computerized we have a large data base on many topics (morbidity, mortality, fertility milk yield, body condition score, lameness and more). On the basis of this data we are able to pinpoint potential welfare issues prior to farm visit. The audit is comprised of five topics: husbandry and living conditions, animal health, painful procedures, human-animal relationship (including animal behaviour) and summary. Each topic is evaluated numerically, for example, when evaluating ventilation we will give the following scores: no ventilation=2, partial ventilation=1, full ventilation=0. When summarising, a total score is presented for both resource and animal based data. As we have only started using this audit, we only have preliminary results. After auditing a large number of farms we will create welfare benchmarks. These benchmarks will be presented to our clients as welfare issues that don't meet the standard and require improvement.

Validation of the EBENE method's measures for laying hens housed in cages

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The objective of the welfare project EBENE (Evaluation du BiEN-Etre animal) is to provide the French poultry and rabbit industries with a shared and practical method to assess animal welfare. This study aimed to validate the practicability (simple and fast – less than 1 h) and the scientific reliability of the indicators and their measures for the cage laying hen production system. The study involved nine laying hen cage farms. Two assessors first carried out the measures on the same population sample together and then repeated the assessment less than 3 days later. After collecting general information about the flock, observations were conducted on 12 cages per flock. First, behavioural measures at a cage scale were collected (e.g. proportion of foraging or dustbathing hens). Then, sanitary measures at an individual scale (five to eight animals per cage) were conducted (e.g. the proportion of hens with a featherless area). The total duration of the assessment was calculated and correlation tests were run to evaluate the repeatability of the measured indicators in order to validate the reliability of the method. The practicability of the method was not entirely validated because the time required was too long (54±10 min for behavioural data and 26±8 min for sanitary data). Inter- and intra- assessor repeatability were validated for 14 and 15 of the 19 indicators respectively. Correlations between indicators (e.g. aggression and severe feather pecking) or modifying observation technics could enable the measures to be simplified and shortened. Work will continue to compile results. Following validation, a smartphone application will be developed to facilitate use of the methods.

Validation of the EBENE method's measures for standard broiler

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The objective of the welfare project EBENE (Evaluation du BiEN-Etre animal) is to provide the French poultry and rabbit industries with a shared and practical method to assess animal welfare. This study aimed to validate the practicability (simple and fast – under 1 h) and the scientific reliability of the indicators and their measures for the indoor broiler production system. Two assessors carried out the measures on seven broiler farms, initially together on the same population sample and then a second time the following day. After collecting general information about the flock, behavioural measures (e.g. proportion of walking or foraging birds) were conducted on two areas of the building (4 m²/area). Then sanitary measures (e.g. proportion of lame or small birds) were assessed on three transects, allowing observation of 3/5 of the birds as birds are assumed to be homogeneously distributed in the building along five predefined transects. The total duration of the assessment was calculated and correlation tests were run to evaluate the repeatability of the measured indicators in order to validate the reliability of the method. A lower total duration than required in the objectives (26±5 min for the collection of behavioural data and 24±5 min for the collection of sanitary data) confirmed the practicability of the method. Intra assessor repeatability was validated except for the 'head injuries' indicator, rarely observed in our sample. Inter assessor repeatability was validated except for 'head injuries' and 'stretching' indicators. Calculated correlations between the indicators observed in farms and data collected at slaughterhouse is a first step to confirm the accuracy of our indicators. Work will continue to compile results. Following validation, a smartphone application will be developed to facilitate use of the methods.

Housing lame dairy cows in hospital pens – do they benefit from the stay?

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For animal welfare reasons, Danish legislation states that dairy farmers must, if necessary, house lame cows in hospital pens with a soft and dry flooring and increased surveillance. Lameness can lead to behavioural changes, indicative of altered motivations and potentially other needs than in healthy herd mates. However, there is a lack of scientific knowledge on the gain from housing lame cows in hospital pens: does such a stay benefit the animal welfare, the productivity or other? In this ongoing project, we seek to examine whether lame cows benefit from a stay in a hospital pen in terms of: (1) speed of recovery and risk of relapse; (2) medicine use and veterinary treatments in the time period following lameness; (3) milk production and reproduction; and (4) behavioural measures of animal welfare. Data are recorded in commercial Danish dairy herds during a 1½-year period, and are currently ongoing. During this period, lactating cows are lameness scored and included in the study on a weekly basis. Based on a paired study design, half of the obviously lame cows (lameness score of 4, on a 1 (non-lame) – 5 (severe) point scale) are housed in hospital pens complying Danish legislation (lower competition, deep bedding) for a maximum of 4 weeks (or until lameness score 2). The other half of the lame cows are kept with the healthy herd mates in the group of lactating cows. An ethical permit was obtained to allow housing of lame cows together with the healthy herd mates. All cows, irrespective of experimental treatment, receive hoof treatment according to farm practices. For all cows in the study, weekly lameness scoring is performed for 4 weeks after study inclusion. Behavioural measures of activity, including lying time and lying bouts are obtained by use of data loggers during the first week after inclusion of each cow into the study. For the remaining part of the current lactation, information about milk yield, reproduction, veterinary treatment and culling is gathered.

Examining the reliability of a horse hoof condition score

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Whilst it is widely recognised that inadequate hoof condition is a major welfare concern in domestic horses, no universal hoof assessment scale exists. The Horse Welfare Assessment Tool (HWAT) was developed to enable horse owners to measure and benchmark their horses' welfare over time, in order to improve their horse management knowledge and awareness of their horses' welfare state. The HWAT consists of a range of animal-based measures including a Hoof Condition Score (HCS) developed during this study. The HCS measures a range of hoof factors including hoof balance, wall length and the presence of cracks or distortions. In order to ensure that the HCS is a valid measure of hoof condition when applied by owners, the inter- and intra-observer reliability of the indice was examined in the field using a test-retest assessment. Participants were recruited via Riding Clubs and data was collected during two on-site visits with horse owners and their horses. The HCS assessments were performed by both the horse owner and the researcher at each visit in a blind manner. Data were analysed using Spearman's rho (ρ) and Kappa statistics (κ). The results suggest that HCS did not have acceptable levels of inter- and intra-observer reliability ($\rho < 0.50$ and $\kappa < 0.60$) for most elements. Poor inter- and intra-observer reliability were found in elements that were novel to owners such as medio-lateral heel balance (e.g. visit 1 inter-observer $\rho = -0.043$ and $\kappa = 0.234$ on near fore). More acceptable levels of reliability were found in elements already familiar to owners, such as varus or valgus limb confirmation (e.g. visit 1 inter-observer $\rho = 0.443$ $\kappa = 0.426$ on near fore). These results suggest horse owners have difficulty evaluating the condition of their horses' feet using the HCS, however the effectiveness of the HCS may improve with increased exposure or improved instructions.

Heart rate measures in goats affected by small ruminant lentivirus (SRLV): a pilot study

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Small ruminants lentivirus (SRLV) provokes caprine arthritis-encephalitis (CAE) which manifests with joint and udder soreness and, at final stages, emaciation and death. However, the illness can develop sub-clinically for several years, provoking no obvious symptoms. It is not known if affected goats without clinical symptoms of CAE do not experience pain when milked. Twenty dairy goats (10 infection-free, 10 SRLV-positive), without clinical symptoms of CAE, were subjected to daily milking. Heart rate (HR) was measured with HR monitor (Polar 810i, Finland) 10 minutes before (Phase 1), during (Phase 2) and after (Phase 3) morning and evening milking. HR files were corrected with moderate error correction filter in Polar Pro-trainer software. Only files containing less than 10% of errors were retained for the analysis, due to higher than recommended number of artefacts, HRV analysis was omitted. Mean HR and HRmax were submitted to multi-factorial ANOVA with random animal effect. The models included goat's health status (healthy vs infected), time of day (morning vs evening), phase (Phases 1 – 3) and their interactions as fixed effects. HR measures did not differ between healthy and infected goats ($P > 0.05$ for both HR and HRmax). Milking increased the HR (Phase 1, LSM=114.2±2.88 bpm vs Phase 2, LSM=124.3±2.88 bpm; $P=0.01$ and Phase 2 vs Phase 3, LSM=117.7±2.88 bpm; $P < 0.01$) and HRmax (Phase 1, LSM=134.5±3.85 bpm vs Phase 2, LSM=153.8±3.85 bpm; $P < 0.01$ and Phase 2 vs Phase 3, LSM=139.2±3.85 bpm; $P < 0.01$). Also, during evening milking both cardiac measures were higher than during morning milking (HR, morning, LSM=111.7±2.69 vs evening, LSM=125.8±3.04, $P < 0.01$; HRmax, morning, LSM=138.6±3.48 vs evening, LSM=146.4±4.08, $P=0.04$) which can be explained by greater relaxation of goats in morning hours. Although health status was not detectable, other effects (e.g. husbandry procedures), resulting in emotional or locomotor responses could be monitored by HR measurement for welfare assessment in goats. All procedures were accepted by the Commission for Ethics in Animal Experimentation.

Evaluating 'Animal Welfare Payments' of the EUs Common Agricultural Policy*Angela Bergschmidt¹, Jan Brinkmann², Christine Renziehausen¹ and Solveig March²**¹Thünen-Institute of Farm Economics, Germany, ²Thünen-Institute of Organic Farming, Germany; angela.bergschmidt@thuenen.de*

In the EUs Common Agricultural Policy, one measure is specifically targeted at supporting farm animal welfare: the 'Animal Welfare Payments'. Farms participating in this voluntary measure commit themselves to requirements such as access to pasture or the provision of straw bedding. We evaluated if the measure achieves its goal of supporting farms with a 'good' animal welfare status. To this aim we implemented the Welfare Quality® protocols, a resource-oriented assessment tool and a set of 10 health indicators. The data collection was carried out in 2013/2014 on a sample of 112 dairy farms participating in the support measure in Germany. The data were primarily analysed using descriptive statistics. To identify relationships between particular indicators and indicator systems, correlation coefficients (Spearman) were calculated. Differences between farming systems and sub-measures were analysed by means of non-parametric tests. The Welfare Quality® assessment showed a good situation with respect to the principles of 'good housing' (Ø 66.7 | 37.0-100) and 'appropriate behaviour' (Ø 57.7 | 17.0-90.8) and neutral values for 'good feeding' (Ø 49.0 | 4.2-100) and 'good health' (Ø 49.3 | 30.0-78.8). The resource-oriented assessment confirms problems with access to water and points out other critical aspects such as poor conditions for calving and resting. The health indicator analysis showed relevant prevalence of lameness (Ø 15% | 0-69) and mastitis (Ø 15% | 3-31 >400 SCC). While the methods used for evaluation might not be able to detect subtle but significant improvements, results indicate that there are still significant animal welfare problems on the subsidised farms. To improve the effectiveness of the policy measure, modifications should be introduced: The resource-oriented requirements can be adapted to provide for a better access to water, adequate cubicles and calving pens. Additionally, result oriented elements need to be implemented to address issues of animal health.

Mountain summer pasturing improves behavioural measures of welfare of dairy cows

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With the aim to assess the effect of mountain summer pasture (MSP) on dairy cows' welfare we compared a set of behavioural measures in the valley farms 2-4 weeks before and 2-6 weeks after MSP. For this purpose, a modified assessment protocol developed by EFSA for use in small-scale dairy farms including mainly animal-based measures of cow welfare was applied on 67 family farms. The inclusion criteria were location in the alpine region of Slovenia, Italy or Austria, dual purpose breeds and a minimum period of two months spent on MSP. Measures assessed were avoidance distance towards an approaching unknown person, cows lying outside the lying area, a rising movement score (the lower the score the easier the rising movement) and qualitative behaviour assessment (QBA). In the statistical analysis, assessment (before and after MSP) was used as fixed effect while farm within country was included as random effect when applicable. The avoidance distance and the percentage of cows lying outside the lying area were similar across the assessments ($P=0.06$), while cows had lower rising scores after MSP compared to before (1.84 vs 2.07; $\chi^2=16.26$, $P=0.001$). Dimension scores obtained from QBA showed that cows were assessed in a more positive valence after MSP (-0.21 vs 0.10; $F\text{-value}=9.23$; $P=0.003$) and a lower level of arousal was observed (-0.22 vs 0.04; $F\text{-value}=4.87$; $P=0.029$). Our results in small dairy farms imply that access to mountain summer pasturing can promote easier rising movements and that cows were assessed to be in a more positive emotional state, while – contrary to previous studies – it does not increase the level of fearfulness of the animals.

Assessment of aggressive behaviour when mixing rabbit does after parturition – preliminary results

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Individual housing in wire cages, the predominant system for rabbit does, allows indirect interactions but it prevents direct social contact between the does. A way of improving these aspects is group or semi-group housing, but these systems may lead to aggressive behaviour, mainly during the first days after grouping familiar or unfamiliar conspecifics in these systems. Thus, the objective of this work was to study the aggressive behaviour of breeding does when first contacting familiar or unfamiliar conspecifics in semi-group housing (consisting in 4 adjacent individual cages connected, consequently mixing the does), at 14 days post-partum, in order to take measures to diminish the problems caused by aggressiveness. A total of 24 nulliparous does of fertile age were used in this experiment. Does were housed individually until day 14 after giving birth. Then, a collective cage was formed by removing one wall of four adjacent cages, and the rabbits' aggressive behaviour was recorded for 30 minutes for later assessment. Statistical analysis were performed throughout Statgraphics Centurion®. The preliminary results showed that all the studied events had some kind of confrontational behaviour, being the most frequent floor kicking (24.01%), attacking (22.05%), chasing (12.99%), and fighting (11.22%). The average duration of a fight was of 8.04 ± 7.75 s, with a latency to the first fight of 191.63 ± 166.45 s. In most cases, there were one (37.5% of encounters) or two dominant does (62.5% of encounters) that initiated aggressive behaviour towards the others to establish dominance ($\chi^2=0.0032$) and started between 35 and 94% of all the aggressive events observed. Conclusively, the moment of remixing rabbit does has to be accurately studied and solutions may have to be sought in order to avoid aggressiveness problems.

Productive parameters in rabbit does housed individually and in semi-group systems: first results

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In order to assess and compare different commercial rearing conditions for rabbit does, it is essential to perform an objective evaluation of welfare conditions. Behavioural, physiological, pathological and productive indicators may be used to measure welfare conditions in rabbits. The main objective of this work was the search for a housing system in which rabbits' welfare is enhanced without an unacceptable economic impairment, in terms of production. To do this, two types of enriched cages (with a tunnel or with a hay dispenser), and a semi-group housing prototype were tested from a multifactorial point of view by using productivity measurements. The existing cage system served as a control. Seventy nulliparous does of fertile age were used for this experiment. Milk production was studied in first and second births through controlled nursing, and productive parameters (feed intake, body weight, and weight of the litter at birth and at weaning) were studied in first to fourth births. Feed consumption was significantly higher in collective cages in weeks 1 and 2, whereas there were no significant differences in weeks 3 and 4. This did not correlate with milk production, which was significantly lower in collective housing than control and tunnel housing, while no significant differences were found with the hay dispenser cages. On the other hand, doe weight and litter weight had no significant differences in all four groups, although litter weight was slightly higher in individual cages, regardless they were enriched or not. Thus, as feed intake was lower, litter weight remained the same, and although there were no significant differences in the Conversion Index ($P=0.0889$), it was lower in enriched individual cages than in semi-group cages (3.57 and 3.65 vs 3.98), it can be concluded that productive results in individual cages seem to be better than in semi-group.

Seasonal effects on animal welfare assessment in dairy cattle*Daniel Gieseke¹, Lisa Dierkes¹, Susanna Montag¹, Christian Lambertz² and Matthias Gauly²**¹Georg-August-University of Göttingen, Department of Animal Science, Germany, ²Free University of Bozen-Bolzano, Faculty of Science and Technology, Italy; dgieseke1@gwdg.de*

In Europe, dairy cows are commonly kept in loose-housing systems under outdoor climatic conditions. Seasonal variations of the climate thus directly affect performance, behaviour, health and consequently welfare of the animals. Still, it is unknown whether results of welfare assessments are influenced by the time of the year they are conducted. Therefore, the aim of this study was to assess 20 dairy cattle farms in four different seasons using the Welfare Quality protocol (WQP). Additionally, barns climate was recorded continuously by data loggers. The daily average temperature-humidity-index was calculated following the formula of National Research Council [winter: 50 ± 5 ; spring: 51 ± 7 ; summer: 70 ± 5 ; autumn: 55 ± 4]. A linear mixed model and pairwise Pearson chi-squared tests were performed to estimate differences between the four seasons. In terms of animal-based indicators, the prevalence of mild lameness was higher in spring (32%) and summer (35%) compared with winter (25%) [$P < 0.05$], whereas diarrhoea was determined more often in winter (21%), summer (22%) and autumn (19%) than in spring (12%) [$P < 0.05$]. Mild integument alterations were rated lower in winter (39%) and spring (36%) than in autumn (47%) [$P < 0.05$]. Mastitis was found less often in winter (21%) and spring (26%) than in autumn (47%) [$P < 0.05$]. The emotional state – evaluated with the qualitative behaviour assessment approach – was scored (range 0 to 100 pts) lower in summer (65 pts) compared with winter (79 pts) and spring (74 pts) [$P < 0.05$]. In contrast, the percentage of lean cows was higher in winter (7%) than in summer (5%) and autumn (3%) [$P < 0.05$]. For the remaining welfare indicators (e.g. nasal discharge, coughing, agonistic behaviour) no seasonal effects were observed [$P > 0.05$]. The WQP overall classification ('enhanced' 44%; 'acceptable' 56%) also did not differ between seasons [$P > 0.05$]. In conclusion, the results demonstrate the independence of the WQP overall classification results from seasonal effects, while single indicators are related. Consequently, the time of year welfare is assessed should be considered whenever studies are compared for single indicators.

Ad libitum feeding of lactating mink or access to additional water for kits did not improve welfare

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The aim of the study was to evaluate the effect of (1) *ad libitum* feeding of female mink from the first day of lactation and (2) additional water nipples for mink kits at the nest box opening, on two animal based welfare indicators and potential changes in the WelFur score at farm level. The indicators were measured according to the WelFur-Mink protocol. We hypothesized that (1) *ad libitum* feeding from the first day of lactation will reduce the prevalence of very thin females by the end of lactation, and that (2) an additional water nipple for mink kits positioned at the nest box opening will decrease the prevalence of kits with injuries by the end of the nursing period. Three private farms with 1,387 dams with kits were included in the study. Of these 917 (316, 307, 294: farm 1, 2 and 3) dams were fed *ad libitum*, and 698 cages with 4,175 kits (1,437, 1,344, 1,394: farm 1, 2 and 3) had access to additional water. 'Injuries' and 'Lean animals' were measured around seven weeks of lactation. The prevalence of cages with injuries and lean animals were analysed with logistic binomial models, taking farm, kits at seven weeks and dams' age into account. No significant effects of *ad libitum* feeding of lactating females on the prevalence of lean animals, or on additional water nipples for mink kits on the prevalence of injuries were found when looking at all the farms. Cages without *ad libitum* feeding had significantly lower prevalence of injuries ($P < 0.05$). One farm had significantly lower prevalence of lean animals in cages with *ad libitum* feeding ($P < 0.001$). Individual feed allowances per litter per day have been collected in order to analyse the effects in more detail, including simulated WelFur scores at farm level.

On-line benchmarking of welfare assessments on dairy farms to help producers to improve welfare

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Hock lesions and lameness were assessed on 4,652 Holstein cows from 80 farms, within the Maritime Provinces of Canada. These farms consisted of 34 tie-stall and 46 free-stall facilities. All assessors in this study were trained and reached a target agreement ($\kappa \geq 0.6$) prior to conducting assessments on-farm. Lameness was determined using gait scores or tie-stall lameness scores, which assessed foot placement and weight distribution. Hock lesions were scored on a 4 point scale (0-3) based on amount of hair loss, swelling and presence of broken skin. These outcomes, along with facility and management factors required or recommended in the Canadian Welfare Code of Practice for Dairy Cattle, were used to determine scores for 12 critical areas of cow welfare, for example hoof health and stall management. Scores were calculated using equal weighting of specific targets within each critical area, based on a welfare assessment developed by Vasseur *et al.* The within herd prevalence of hock lesions ranged from 0-83% and the within herd prevalence of lameness ranged from 0-52%. These results indicate that a low prevalence of lameness and hock lesions on dairy herds is achievable. The critical area scores, along with the prevalence of hock lesions and lameness within the herd, were reported to the producers through an online benchmarking system (www.benchmarkcowcomfort.com). This website is being used to track which producers access the website and the amount of time the participants spend online. Benchmarking welfare assessments can motivate producers to make improvements to reduce injuries and lameness in their herds. To assess the effect of benchmarking, after a 6-month interval, the animal-based outcomes will be re-evaluated on the participating farms during spring 2017. It is hypothesized that the within herd prevalence of injuries and lameness will be reduced in comparison to the initial assessments.

Do my pigs have welfare problems: a proposal for an on-farm self-monitoring

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To comply with the German animal welfare legislation all livestock owners have to assess the welfare of their animals using animal based indicators (ABI). In order to specify this requirement a total of 17 scientists, farm advisors, farmers and representatives from administration and NGOs were invited to develop an on-farm self-monitoring scheme. In a first step of this transdisciplinary process, important welfare concerns in sows, piglets, weaners and fattening pigs were identified. These include health status, lesions, productive life span, mortality, tail length, heat stress, lying comfort, water supply, agonistic interactions, and possibilities to perform particular behaviours. In a second step, based on existing schemes indicators were selected covering these welfare concerns. In addition, the validity, reliability and feasibility of indicators were taken into account. In a third step, a smaller group of six experts developed a booklet for farmers. In this booklet for each indicator the relevance, methods for recordings and definitions (including illustrations) are described. Indicators are selected for relevance for each production phase and (1) are already available on farms (e.g. use of antibiotics, daily weight gain, mortality, and fertility data); (2) had to be assessed on-farm (e.g. stereotypies, cleanliness, body lesions, tail length, body condition, lameness, swellings of legs, claw condition, ectoparasites, water supply, nesting material); and (3) can be obtained from slaughter records (e.g. lung scores). As a result, a comprehensive ABI scheme is developed in a multi-stakeholder approach which can be used by farmers to perform a systematic monitoring of ABI as a basis for improvements. Within an ongoing project protocols will be tested, teaching material for their application will be developed, different training methods will be tested, and a framework to evaluate the welfare outcomes (e.g. thresholds) will be developed.

Development of a customer-specific broiler welfare assessment programme*Ingrid De Jong¹, Gerben Hofstra² and Jan Jaap Hamming³**¹Wageningen Livestock Research, Animal Welfare, the Netherlands, ²HAS University of Applied Sciences, the Netherlands, ³Heijs Food Products, the Netherlands; ingrid.dejong@wur.nl*

In order to guarantee production according to a defined welfare standard, and to increase the transparency to customers, Heijs Food Products BV is currently developing a broiler welfare assessment programme specific for its own production chain. Previously developed welfare assessment protocols are available, e.g. from Welfare Quality, but these are relatively time consuming and therefore difficult to implement in practice. On broiler farms and at the slaughter plant many data are routinely collected and can possibly be integrated in a modified welfare assessment programme. The aim therefore was to develop a specific welfare assessment programme that can be incorporated into the routine procedures of the producer, and that consists of valid, reliable and feasible measures of broiler welfare. The framework was based on Welfare Quality and animal-based measures were preferred over resource-based measures. Four stages in the development process could be identified: (1) define a list of potential measures using the five principles of Welfare Quality; (2) selection of indicators, based on validity, reliability and feasibility; (3) define a classification and an impact score to calculate a measure score; (4) graphical representation of the scores per flock. In stage (1) and (2) eleven measures of on-farm welfare were selected. These included similar measures as in Welfare Quality, such as foot pad dermatitis, but also new measures that are collected routinely, such as the daily dose of antibiotic treatments. For each of these measures either a scoring was developed or an existing scoring was used, and the measure score was calculated by calculating $\text{score} \times \text{impact}$. The scores for the individual measures are presented in a spider web. The prototype is currently tested using existing farm data and the model will be extended with measures indicative of the welfare during the end-of-life process.

Indicators for on-farm self-monitoring of animal welfare – a proposal for implementation in cattle

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Since 2014 the German Animal Welfare Act requires livestock keepers to monitor appropriate animal-based indicators in order to safeguard that the animals are kept and cared according to their needs. However, no detailed provisions regarding content, scope and implementation of the self-monitoring have been given. For self-monitoring of cattle welfare, in a first step 16 experts selected robust and feasible indicators which address the most important animal welfare problems in cattle. In a second step, detailed protocols for the implementation of self-monitoring in cattle farms were elaborated by a smaller expert group. Indicators consider already existing data (e.g. milk recording, cattle database) or should be assessed on-farm in defined intervals. The following sets of indicators have been recommended. Dairy cattle: productive life span, somatic cell count (alternatively: mastitis treatment incidence), milk fat-protein ratio, body condition, lameness, integument alterations, cleanliness, claw condition, animal losses, dystocia incidence, adequate use of lying places, rising behaviour, avoidance distance, water availability. Beef cattle: integument alterations (including tail tip alterations), lameness, body condition, cleanliness, claw condition, nasal discharge, animal losses, tongue rolling, space allowance, water availability. Calves: body condition, cleanliness, animal losses, treatment incidences of enteric and respiratory diseases, complications after dehorning, inter-sucking, nesting score. For each of these measures clear definitions, suggestions for sample sizes and, if applicable, illustrations are given and a recording schedule is proposed. In a recently started project, the self-monitoring of welfare will be implemented and subsequently evaluated. This will also address the type and extent of farmer training regarding reliable application of the monitoring protocols as well as an assessment framework regarding the welfare outcomes (target & threshold values, benchmarking).

Indicators for a result-oriented approach for animal welfare policies and organic farming

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The objective of the project was to integrate result-oriented approaches into agricultural policy support measures and organic farming. This was done exemplarily for dairy cows. To this aim, problem-oriented indicators were selected by scientists and practitioners and tested in an on farm survey on 115 dairy farms. The results were compared with the Welfare Quality® assessment and a resource based system. A normative and a status quo oriented approach were tested to define benchmarks and targets for the indicators as a basis for a remuneration scheme. The following recommendations were formulated: Suitable indicators for the result oriented approach are (1) lameness, (2) carpus/ tarsus alterations, (3) body condition, (4) integument alterations, (5) broken tails, (6) cleanliness, (7) somatic cell-count >400.000 /ml, (8) fat-protein quotient ≥ 1.5 , (9) fat-protein quotient <1.0 and (10) mortality. As these indicators only address the health dimension of animal welfare, resource and management provisions such as specifications for pasture, access to water, cow/cubicle relation, animal-feeding place ratio and the use of anaesthesia and analgesics for dehorning are necessary to address all aspects of animal welfare. A status quo based benchmarking should be applied, where a farm receives a premium for an indicator if achieving the value of the 25% best farms, will not receive a premium but remains in the support measure, if its value is that of the 50% medium farms, is excluded from the measure when more than one indicator value is among the 25% worst farms. The indicators are equally applicable for the use in organic farming. The benchmarking system would have to be applied with sanctions here: a farm with problematic indicator values could be obliged to follow a consultation or be excluded from using the label of the organic association for its dairy products.

Assessing the behavioural response of dogs to humans in a household environment*Megan Hayes and Lauren Hemsworth**Animal Welfare Science Centre, University of Melbourne, Australia;**lauren.hemsworth@unimelb.edu.au*

The effects of the human-animal relationship (HAR) on livestock demonstrate the potential influence of the HAR on the welfare of companion dogs. The present study is part of a project to develop a behavioural test to assess fear of humans in dogs in household settings. The validity of an approach-avoidance test of dogs in an arena to a stationary human ('AAT') was examined by comparing it to a previously-published human avoidance test ('HAT') in which a human approached kennelled dogs from outside the kennel. Twenty-seven dogs were tested in the AAT and HAT (test order randomly imposed on individual dogs). Principal component (PCA) analysis was conducted to identify a set of components for each test that represents underlying relationships between the test's behavioural variables (transcribed from video footage). For the AAT, two components were identified that provided an appropriate summary of the data (51.9 and 27.1 variance accounted, respectively), and for the HAT three components were identified (42.3, 19.8 and 16.3 variance accounted, respectively). Spearman rank correlations examined the relationships between the AAT and HAT components and a moderate significant correlation was found between the AAT_{Component1} and HAT_{Component2} scores ($\rho=0.418$, $P=0.034$); the reduced proximity of the dog to a stationary experimenter in the AAT was correlated with a greater avoidance of the experimenter at the front of the kennel by the dog in the HAT. Intra- and inter-observer reliability for the AAT were high with intraclass correlation coefficients (ICC) above 0.990 ($P<0.001$). While the relationship between the tests was moderate, the HAT has not been validated and thus further research examining the validity of the AAT is required. For example, evidence of behavioural and physiological correlates in a test as well as handling treatments designed to differentially affect an animal's fear of humans, producing the expected variations in the behaviour.

Determining cattle learning and behavioural response to a virtual fence*Sabrina Lomax and Cameron Clark**The University of Sydney, School of Life and Environmental Sciences, Australia; sabrina.lomax@sydney.edu.au*

Virtual fencing (VF) has the potential to revolutionise control of livestock movement. Cattle can associate an audio cue with a mild electrical shock. This study investigates individual animal learning with VF collars, and if training time can be reduced using a visual cue (VC). The experiment utilised dog training collars fitted in Moo Monitors. 8 non-lactating dairy cows were subjected to one of 2 treatments: (1) Virtual Fence (VF) only; (2) visual cue with VF (VC). Habituation to the laneway, pellets and manual collars occurred 2× per day for 4 days prior to testing. Testing was performed in a laneway twice daily. A VF line was set halfway down the laneway with a feed trough containing pellets at the end of the laneway. Cows received an audio cue for 2 sec at the VF line. If they kept moving forward they received a mildly aversive electric shock. After 3 days the VC was removed and test repeated for 3 days. Animal behaviour, and number of cues received was recorded. The visual cue reduced the number of times cows tested the fence line, with VC cows receiving less cues (mean 2.13) than VF cows (mean 4) overall ($P=0.007$). The number of cues reduced with each test ($P<0.001$), however the cows were less likely to test the VF once they had received a shock. Cues increased with removal of the VC, with cows receiving the most cues when the VC was removed ($P<0.001$). Results indicate that there is variation in learning VF cues, and a visual cue does not improve learning in the laneway test. Positive reinforcement using a reward in the laneway is necessary between tests for future studies.

Qualitative behavioural assessment of *Bos indicus* bulls following castration

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Australian rangeland cattle are commonly castrated at first muster without analgesia. This study tested whether observers could distinguish between the behaviour of 42 six-eight month old *Bos indicus* cattle subject to four treatments: surgical castration (C, n=12), C with pre-operative sub-cutaneous meloxicam (CM, n=12), C with pre-operative sub-cutaneous and intratesticular lignocaine (CL, n=12), or uncastrated animals (NC, n=6). Bulls were anaesthetised for the procedure using halothane and their behaviour recorded in a recovery yard (day 0) and home paddock (days -1 to 13). Using fixed lists of 20 descriptive terms and a Qualitative Behavioural Assessment (QBA) protocol, 19 observers scored the video clips against visual analogue scales and their scores analysed by Principal Component Analysis (PCA). Observer scores showed a significant treatment effect for QBA dimension 1 (31.8% of variation) at 2 h post handling in the recovery yard (one way ANOVA $F_{3,20}=21.72$ $P<0.001$). Pairwise comparisons for these data showed CM bulls were described as more relaxed, content and calm (low end of axis) than NC ($F_{1,27}=54$ $P<0.001$), C ($F_{1,48}=66$ $P<0.001$) and CL ($F_{1,27}=54$ $P<0.001$) treatment groups, which were described as more irritated, agitated and uncomfortable (high end of axis). Bull behaviour using a quantitative ethogram was analysed by PCA and compared with the QBA scores. Ethogram scores for restless behaviour, such as self-grooming, tail swishing, and head shaking were correlated at the high end of QBA dimension 1 ($P<0.05$). Thus, QBA reflected the ethogram data in cattle, and results suggest meloxicam, but not lignocaine, benefitted cattle post-surgery.

Margin of error of the WelFur fox good health score in the current semi-random sampling method

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The welfare principle Good health in the WelFur on-farm welfare assessment protocol for foxes includes ten measures within the three welfare criteria: (1) absence of injuries: moving difficulties and skin lesions; (2) absence of diseases: bent feet, ocular inflammation, impaired mouth and teeth health, diarrhoea, urinary tract infection, obviously sick fox and mortality; and (3) absence of pain induced by management procedures; killing method. The margins of error (MOE) can be easily calculated for the individual measures for estimating an adequate sample size. The combined effect of these MOEs on the MOE of the Good health principle score is more obscure, because it is aggregated from the measures via several steps and using varying non-linear methods (warning and alarm thresholds, decision tree, l-spline functions and/or Choquet integrals). Our aim is to demonstrate the MOE for the principle score in 22 samples of 120 foxes (the sample size in the current protocol) from a data collected from all 3,697 foxes of one farm. The semi-random sampling method of the protocol was used to take 20 samples. In addition, extreme samples were formed out of the 120 best and worst foxes of the farm. The principle score based on the full farm data was 52, indicating acceptable category (score 20-55), whereas the scores for the 20 semi-random samples ranged from 46 to 73 (mean 54), with six samples in category good (55-80). The score for the best possible scenario, i.e. 100, belonged to the best category (80-100) and the worst scenario, i.e. 28, was above unacceptable level (20). Our demonstration shows that the current semi-random sampling method may lead to a misclassification of a farm in principle Good health. The MOE could probably be narrowed by further developing the sampling method, increasing the sample size or modifying the WelFur score calculation.

Seeking alone time: do cows seek isolation at and after calving?*Gosia Zobel¹, Frances Huddart¹, Jim Webster¹ and Kathryn Proudfoot²**¹AgResearch Ltd., Animal Welfare Team, New Zealand, ²The Ohio State University, USA;
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Cows are social animals, but may naturally distance themselves from the herd at calving. The strength of this behaviour is unknown in modern New Zealand dairy cow genetics and in pasture-based systems using 'standoff' pads overnight. Our study aimed to determine if Kiwi cross dairy cows seek isolation around calving. Two standoff pads (17×70 m; typically utilized for pasture management during wet periods) were each equipped with 19 l-shaped 'hides' (2 heavy-duty gates covered with plywood and rubber matting). To randomize the chance cows had access to hides, and to minimize side bias, hides were accessible on each pad on alternating days with cows manually allocated to a pad in alternating order. Cows were kept on the pads overnight (16:00-08:00) at a stocking density of 50 cows/pad, and spent the daytime as a group of 100 on pasture. New cows were introduced into the group to replace those that calved. Weight and previous pad exposure were covariates in binomial tests of difference of observed proportions from 50%. Of 186 calvings, 42% (78 cows) occurred on pasture and 58% (108 cows) occurred on the pads. About half of the latter calved while hides were accessible, and 18% of these cows moved into a hide at calving (9/49 cows, 3 unknown, CI:7-29%). Of the cows that did not calve in the hides, 73% moved into a hide with their calf 2.5±1.7 h after calving (29/40 cows, CI:59-87%); previous pad experience tended to shorten this latency (P=0.1). Weight had no effect. Only a small proportion of cows sought isolation during calving, however, the majority eventually went in a hide with their calves. It is possible that cows familiar with large, pasture-based grouping either do not have a strong drive for isolation, or that it is actually the calf that seeks out a hiding place.

Assessment of animal welfare during the collection process of depopulation for end of lay hens

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Depopulations of Swiss commercial laying hens from aviaries were investigated hypothesizing that injury rates and stress levels are higher in depopulated hens compared to baseline values collected prior to depopulation. We collected two subgroups for each farm (n=14) and assessed either cloacal and comb temperature as well as hematocrit (n=153; 6-15 hens) or breathing rate and tonic immobility (TI; # inductions required (max=3), latency to first head movement (LAT1) and standing upright (LATSU)) (n=166; 10-17 hens). Hens were haphazardly selected from entire crates which were collected in a stratified manner (packing station and time). As a control we assessed measures in the same fashion as described using 3-11 hens per subgroup (n=256) collected 2 h prior to depopulation from different barn locations. Variation in number of examined individuals arose due to differences in depopulation schedules and durations. Linear mixed models with a nested design (individuals within farms) were used to test for differences between control and depopulated hens. The number of inductions (TI) was analysed using a multinomial logistic regression. During depopulation, cloacal temperature was 0.5 °C (P<0.05) higher whereas the comb was 3 °C lower (P<0.05), and chest movements decreased by 5 per minute (P<0.05) compared to the control. TI in the control hens was more likely to require three inductions (P=0.03, z=2.12) or fail (P=0.02, z=2.3). We found no differences between control and depopulation for hematocrit (P=0.22, mean ± SE=31.6±0.2%), or LAT1 (P=0.46, mean ± SE=74.5±5.4 s) and LATSU (P=0.5, mean ± SE=117.1±8.4 s) of hens were TI induction was successful. On average, depopulations took 101 min (±6.6 min) with a speed of 2.9 hens/min (±0.26). Increased respiration rate and temperature changes indicate that hens were challenged by depopulation. Whether these responses reflect severe stress will be investigated further including assessment of injuries in future work.

Correlation between criterion scores of WelFur fox assessment and Qualitative Behaviour Assessment

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In the WelFur on-farm welfare assessment protocol assessment of foxes' 'Positive emotional state' is based on a temperament test performed to individual animals and management information of transportation of foxes. However, Qualitative Behaviour Assessment (QBA) for foxes is under development. We studied the correlation between the 12 welfare criterion scores and QBA results. WelFur assessments were carried out in winter, summer and autumn on 77 Finnish farms by 12 assessors. At the end of each assessment visit, the assessor evaluated the general appearance of the animals on the farm with a visual analogue scale for 24 QBA attributes. The attributes were combined season-wise to three Principal Components (PC). The interpretation of the PCs for the winter and autumn was: PC1 = 'Positiveness' (high loadings from e.g. 'happy'), PC2 = 'Fearfulness' (e.g. 'fearful') and PC3 = 'Apathy' (e.g. 'bored'). PC analysis extracted 'Positiveness' (PC1) and 'Fearfulness' (PC3) also for the summer, whereas PC2 was more contradictory (e.g. positive loadings from 'sad' and 'happy'). Correlation between the PCs and welfare criteria was weak: r ranged from -0.34 to +0.34, and only ten out of the 108 correlations were significant ($P < 0.05$, $n = 74-77$). The weak correlation could be interpreted to indicate that QBA adds to the protocol something that the other measurements do not cover, putatively a measure of positive emotional state. On the other hand, nine of the significant correlations were quite logical: for example, 'Positiveness' correlated positively with the 'Expression of other behaviour', 'Absence of injuries' and 'Absence of disease' scores. This may reflect overlap of QBA with the measurements in the current protocol. Also variance arising from the subjective nature of the QBA and the variation between the assessors might partially explain the low correlation. Thus, QBA was not probably independent of the measurements in the current protocol.

Effect of colostrum and group housing management on diarrhoea in milk fed organic dairy calves*Mari Reiten, Tine Rousing and Jan Tind Sørensen**Aarhus University, Animal Science, Denmark; mari.reiten@anis.au.dk*

Calf diarrhoea is one of the most important welfare problems in organic dairy herds. An experimental design was conducted in six large organic dairy herds to identify the best diarrhoea prevention strategy for milk fed calves (0-6 weeks of age), focusing on colostrum feeding. All calves were clinically examined weekly for signs of diarrhoea. Diarrhoea was defined as presence of at least two out of five indicators (faecal smear under tail, diverging faecal colour, liquid faeces, dehydration and fever ($>39\text{ }^{\circ}\text{C}$)) at least once during the 6-weeks study period. Calves – being with the dam for 24 h – were randomly allocated to one of two treatments; suckling the dam or manual feeding with pre-frozen colostrum of known quality from the herd's colostrum bank. From 1-6 weeks of age, calves were housed in groups of up to four calves. Colostrum quality for both treatments was measured with a brix refractometer. A brix-value $\geq 22\%$ (IgG=50 g/l) was considered good colostrum quality. Differences in colostrum quality between 'dam' and 'bank' were analysed using a generalized linear mixed model, while effects of colostrum management (dam/bank) and colostrum quality on diarrhoea were analysed using logistic regression models. No significant difference was found in colostrum brix value from bank (avg. 23.1%, 133 calves) and dam (avg. 22.3%, 176 calves) ($P=0.87$), or risk of diarrhoea for calves having received colostrum from dam or bank ($P=0.21$). The odds of diarrhoea tend to be higher for calves receiving colostrum of lower brix value (OR=1.55 for brix $<22\%$ (107 calves) vs brix $\geq 22\%$ (202 calves)) ($P=0.07$). A major reason for not finding any difference between colostrum management strategies may be insignificant difference in colostrum quality between the two treatments (bank vs dam). Factors such as time from birth to first colostrum intake will be further investigated.

Assessment of the welfare of carriage horses in Yogyakarta Province, Indonesia

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Horse drawn carriage is still widely used as transportation and leisure in Yogyakarta Province. This study was aimed to assess the level of animal welfare of carriage horses in Yogyakarta, Indonesia. We assessed the welfare of 225 heads of carriage horses, belong to 65 owners in Yogyakarta Indonesia. From various sources of literatures and management practices on regular basis, 25 indicators which describe the attribute of 5 freedoms, were selected. The individual assessment was defined as directly observable and objective verifiable (e.g. body condition score and presence of skin lesion and wounds, diseases and discomfort by use). Data on farm level were related to feeding, housing and health care management, exercise, training methods, and human-animal interactions. The data were analysed descriptively and compared to some existing welfare assessment, due to absence of particular welfare assessment protocols for developing countries. The results showed that 29, 20.3 and 50.7% of carriage horses had relatively good, moderate and bad welfare respectively. Health and human-animal interaction aspects obtained the worst score. In conclusion, most of horses used for carriage are handled poorly. Welfare assessment based on objective parameters can be used as first step to improve horse welfare in Indonesia, but needs continuous improvement. The animal welfare needs to be strongly and continually promoted in developing country such as Indonesia. Welfare assessment protocol for horses is needed in developing countries.

Evaluation of EEG to procedural pain of tail docking with and without analgesic intervention*Charissa Harris, Peter White and Sabrina Lomax**University of Sydney, Australia; char2922@uni.sydney.edu.au*

Electroencephalography (EEG) offers a practical way of measuring the pain response and efficacy of analgesia in livestock. This study aims to evaluate the EEG response of tail docking in conscious sheep with and without the administration of analgesic intervention with the purpose of validating this method for future studies. Six lambs were sourced from The University of Sydney teaching flock. Tri-solfen® was administered to all treatment groups upon completion of the experiment. Animals were randomly allocated into treatment groups; surgical hot iron tail docking (HIT) (n=4), or rubber ring tail docking (n=2). For HIT one of the following analgesic interventions was applied; Lignocaine administered to the tail at docking site, Tri-solfen applied post-surgically to the wound site, tri-solfen and Lignocaine, or no analgesic intervention (as per standard industry practice). Rubber ring lambs were given lignocaine administered to the tail at docking site or no analgesic intervention. Baseline EEG data was recorded for 5 minutes prior to treatment, during the procedure and 5 minutes post-procedure. Data was manually scanned and movement and noise artefacts rejected from analysis. 10 second epochs were used to calculate total power (F_{Tot}) in mV^2 using specially written software in Matlab (Mathworks®). Significant interactions between treatment and time ($P < 0.001$) were observed in all bandwidths for all treatments. There was a significant difference ($P < 0.001$) between HIT and rubber ring tail docking post-procedure regardless of analgesic intervention. Preliminary results show a difference between tail docking methods, likely due to the nature of differing pain pathways. Differences between analgesics treatments indicates potential for this method to determine the efficacy of pain management methods. Further replication of analgesic treatment groups is required. Preliminary results suggest there is potential for the use of EEG in differentiating analgesic use for tail docking lambs.

Evaluation of the AWIN assessment protocol for horses in experimental conditions and in farms

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Considering the place of Equid's welfare in societal concerns, it is necessary to have available protocols to assess welfare in a reliable and easy manner. This study aimed to test validity, feasibility and reliability of the AWIN Horse protocol, in two phases: (1) experimental and (2) in different type of farms. The phase (1) used two groups of 13 pony mares placed in different welfare conditions for 26 days. One group was kept at pasture with natural shelters (P) and the other was housed in individual boxes with food, spatial and social restrictions (B). Welfare was assessed with the AWIN horse protocol, simultaneously with scan sampling and physiological indicators. Intra and inter-groups comparisons (phase 1) and inter-observer reliability (phases 1 and 2) were performed with non-parametrical tests with $P < 0.05$; a PCA was used to analyse Qualitative Behaviour Assessment in the B group (only a global QBA was performed in the P group). Impairments of welfare during the phase (1) were highlighted in the B group by scan sampling and physiological indicators (increase in cortisol and decrease in blood platelets). Simultaneously AWIN environmental indicators showed that space, exercise and social relationships were not sufficient in the B group compared to the P group. AWIN behavioural indicators revealed that more ponies presented abnormal behaviour in the B group (7/13 vs 0/13). However for the QBA, the scores of the animals in the B group on axis F1 of the PCA increased from the 1st to the 4th week, suggesting an adaptation to the restricted conditions (more relaxed and at ease; and less annoyed and uneasy). In conclusion, both environmental and animal indicators are necessary to evaluate welfare. Inter-observer reliability of these indicators was good or very good ($\kappa > 0.6$ or 0.8) and the protocol was globally easy to use in farms.

Behavioural measures for commercial broiler production

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In order to effectively manage and improve farm animal welfare, it must be measured. Measurement allows for the identification of best and worst practice across a supply chain. Information from measurements can be used to drive improvements in animal welfare, then demonstrate where improvements have or haven't been made. Retailers, food producers and industry bodies are regularly making public commitments to animal welfare standards. Consumers are beginning to embrace their roles as citizens and purchasing habits are shifting towards more 'ethical foods'. The need of all stakeholders, for robust, meaningful, and understandable measures of animal welfare for commercial production is therefore greater than ever. Current welfare measure portfolios for commercial broilers tend to focus on health alongside environmental and resource inputs. A direct measure of behaviour is lacking. FAI Farms Ltd provide sustainable sourcing solutions, including advice and research in animal welfare, across the food supply chain. Three major food businesses have approached FAI to explore the practical assessment of broiler behaviour. We have reviewed currently available behaviour measures and trialled measures for use in research and accreditation contexts, focusing in particular on signs of positive welfare. These measures include qualitative behavioural assessment (QBA) as well as scored observations of specific behaviours. Whilst there are still challenges to overcome, the inclusion of practical, positive behavioural outcomes to complete the commercial welfare measure portfolio is a real opportunity to quickly drive improvements in commercial broiler welfare.

The development of a welfare assessment tool for the Australian Fur Seals at Melbourne Zoo

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A practical, informative and ongoing welfare assessment tool is required to enable staff to monitor the welfare of animals kept in zoos. Keepers have an intimate knowledge of individual animals in their care and are best positioned to notice even minor changes in individual animals that may be indicative of welfare concerns. Using literature and consultation with keepers a tool was developed to monitor the four Australian Fur Seals in the Wild Sea exhibit at Melbourne Zoo, Australia. The developed tool highlights critical areas of welfare and enables seal keepers to note when changes occur, emphasise when welfare may be jeopardised, or when welfare improves. Indicators include resource-based (weather and water quality) and outcome-based measures (health status (weight, feed consumption and ocular condition), behaviour (sociability and demeanour) during and outside training and repetitive behaviour). The welfare assessment tool utilises the traffic light system with colours working to enhance the rapid visibility of issues of concern. The colours act as a scale to grade the severity of welfare issues for individual animals, with green indicating no issue and therefore no action. Amber indicates a noted, but mild or medium severity issue that requires monitoring and/or ongoing action (e.g. ongoing medication), but that is controlled. Red indicates a serious concern of either an existing issue that has worsened in severity or a new serious issue that has arisen and requires an immediate response (e.g. eye infection). Assessors are able to add comments in order to clarify and justify traffic light scores, as well as add any important additional information. The chosen indicators were based on actual welfare concerns of seals within the exhibit, but were limited by practical constraints. The tool is developed for use in Excel, but once refined and evaluated will be based on a more user-friendly computer-based software platform.

Reflections on AssureWel: utilising welfare outcome assessment to improve farm animal welfare

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The AssureWel project developed welfare outcome assessments (WOA) for six livestock species, utilising existing research to develop practical, scientifically robust assessment protocols to facilitate dynamic welfare management systems for farm assurance schemes. Stakeholder reflections on learnings and challenges associated with implementing protocols have been categorised into six main themes: (1) Developing protocols: measures were identified and selected by a process of literature review, expert opinion, practical experience and utilising established and accepted protocols. The most successful protocols for application and data quality contained a small number of measures, which had clear, objective scoring systems. Exclusion of some measures and compromises in scoring sensitivity were necessary to ensure protocols were practical for use within farm assurance scheme assessments. (2) Industry engagement: Key industry stakeholders were included in the WOA development process and informed of plans and progress. Industry input facilitated successful WOA development. (3) Training: Extensive training was developed for assessors which incorporated elements of classroom theory, field practice, discussion and on-going learning and re-standardisation in scoring using an online web tool. (4) Utilising WOA data to improve on-farm welfare: Behaviour change theory informed assessors how to communicate with producers on making changes to farm management based on WOA results. Easy to understand feedback forms were developed to assist producer's understanding of their WOA results and their relevance by benchmarking them against their peers. Ensuring sufficient information and advice was available to support changes without compromising the independent role of assessors in the audit process was challenging but considered key to driving change. (5) Utilising data at scheme level: WOA data was used to review current performance, set targets and inform improvement strategies to achieve continuous improvement. (6) Dissemination: AssureWel is committed to openly sharing knowledge and expertise in WOA.

Animal welfare in Danish pig herds

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It is reasonable to assume that animal welfare varies not only between herds but also between different ages of an animal. The objective of the study was to use an animal welfare assessment protocol to identify areas of animal welfare concern in Danish pigs of different ages. This study involved visiting Danish pig farms and assessing the welfare of piglets, (n=57), farrowing sows, (n=57), sows and gilts (n=57), and weaners/fatteners (n=57), using a newly developed animal welfare assessment protocol. The protocol used had many of the same measures as Welfare Quality[®], and covered 8 of the 12 Welfare Quality[®] criteria for piglets, 9 for farrowing sows, 9 for weaners/fatteners and 8 for sows and gilts. The welfare outcome of the score for each measure was weighted by the average score given by scientists (n=6), consultants (n=4) and official veterinarians (n=16) working with animal welfare. The possible scores ranged from 0 (poor welfare) to 100 (perfect welfare). The overall welfare pertaining to that measure was then calculated as the prevalence of the scores included. For piglets, the routines around tail docking and castration were the major welfare concerns (use of pain killers or not; welfare scores = 30 ± 9 and 37 ± 3 ; mean \pm SD). For farrowing sows, it was the farrowing space and system (28 ± 15 and 34 ± 0), as well as the ability to perform nestbuilding behaviour (36 ± 25). For sows and gilts, the major concern was the time spent crated in the insemination unit (37 ± 16). For weaners and fatteners it was the levels of mortality (37 ± 12), the floor type in the hospital pens (37 ± 16), floorage in the resting area (38 ± 14) and access to water (39 ± 19). Although the farms were not a random sample, the results can be used to identify issues that are likely to represent major animal welfare concerns in the Danish pig sector.

A Kinect based 3D cow scanner for the evaluation of body characteristics

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Decreases in health, fertility, and longevity and also modified behaviour are side effects of the breeding for high yielding cows, indicating a decrease in animal welfare. As efforts exist to include health and welfare traits in breeding objectives, the necessity is given to objectively evaluate e.g. udder, feet and legs, rump angle or body condition. Therefore, a 3D cow scanner is presented to assess body characteristics using computer vision. The recording unit comprises six Microsoft Kinect cameras collecting 3D data from both sides of the cow. 19 Holstein-Friesian dairy cows walked through the scanner ten times. The durations of these runs (run time) were determined. Averaged run times significantly differed between cows and ranged from 8.5 s to 51.6 s (mean: 17.2 ± 9.4 s). Additionally, it was counted how often the animals stopped during the run. This ranged from 0 to 11 (mean: 1.3 ± 1.6) depending on the individual. Indifference towards the scanner was observed after averagely five runs. Using 3D object recognition, body parts were specified in the 3D data. The vertical distance from udder bottom to floor (UD) and rear leg angle (RL) were calculated. UD and RL ranged from 42.4 to 61.2 cm (mean: 49.8 ± 5.3 cm) and 136.9 to 154.8° (mean: $146.0 \pm 4.6^\circ$), respectively. Spearman rank correlations to conformation recording scores were 0.63, respectively, 0.67. Both traits were significantly influenced by lactation stage and number, milk yield, time since last milking, and height. Results suggest that additionally to measuring linear traits, the scanner could display body characteristic changes over time and, thus, address welfare issues. Furthermore, measurement precision significantly depended on run time and number of stops. In a future setting the scanner should be installed permanently, so that animals get adapted and effects of animal behaviour on the measurements are avoided.

Evaluation of an online training tool for animal-based measures of cattle welfare*Josef Schenkenfelder, Christoph Winckler and Christine Leeb**University of Natural Resources and Life Sciences, Vienna, Department of Sustainable Agricultural Systems, Division of Livestock Sciences, Austria; josef@schenkenfelder.co.at*

In 2016, 'BIO AUSTRIA' introduced guidelines for the self-assessment of animal welfare at farm-level aimed at assessing and benchmarking the animal welfare state on Austrian organic farms. It contains predominantly animal-based parameters, which allow for a more valid estimation of the welfare state than resource-based parameters. However, the robustness of data from such a self-assessment largely depends on the inter-observer reliability (IOR) of the persons carrying out the measurement. In the course of the present study, an online training-tool for the assessment of 10 animal-based parameters of dairy cattle welfare was established. This tool included online a description of the measures as well as quizzes containing pictures or video clips of selected animal-based parameters which had to be assessed by the test persons. IOR as compared to a gold standard (calculated as Cohen's κ) was investigated. Furthermore, it was of interest whether a set of factors related to the test persons' background would influence IOR and, whether practice in terms of repeated trials leads to improvement. In total, 938 κ values from 111 users were obtained from the 10 different quizzes. When taking the quizzes for the first time, the percentage of test persons ($n=58-100$ users depending on quiz) achieving $\kappa \geq 0.40$ ranged from 49% (hairless spots) to 100% (cleanliness). For all parameters but hairless spots and body condition (76%), more than 80% of the test persons at least reached $\kappa \geq 0.40$. Retaking the quizzes (round 2, $n=14-24$) led to significant improvement of agreement for all parameters, except for hairless patches and lameness (delta $\kappa=0.00-0.15$). Significant effects on the level of agreement was found for the factors age, level of education and knowledge of animal-based parameters, respectively (e.g. lower or maximum equal performance of users aged <20 years compared to 20-29 years and 30+ years). In conclusion, the results of this study are promising as regards the intended use of the training tool. However, its potential to improve reliability of live on-farm assessments needs to be further investigated.

EBENE: a new welfare assessment method co-built with stakeholders tested in free-range laying hen

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As requested from the poultry industry a shared and practical method of commercial poultry and rabbit welfare assessment was developed: EBENE method. It should easily be implemented by the farmer and so its application has to be simple and fast (one hour). Here, the work for free-range laying hens is presented. The assessment indicators were defined using both Welfare quality[®] and several meetings with different stakeholders (scientists, customers, NGO, farmers). Indicators were collected indirectly through a questionnaire submitted to farmers and directly without handling the hens using behavioural observations/tests and a sanitary condition assessment. Two sampling methods were tested to collect indicators from behavioural observations/tests: 9 small areas (= MET1, 2×1.5 m) vs 3 large areas (= MET2, 2×3 m). Seventeen farms were included in this study. The feasibility (duration+ practicability of the assessment) and indicator repeatability (intra and inter-observer) were tested. For intra observer repeatability, 9/10 behavioural indicators (gentle pecking = GP, severe pecking = SP, preening = P, dustbathing = D, stretching = S, walk =W, exploration of environment = EE, panting = PA and huddling = H) with MET1 and 7/10 (GP, SP, D, S, W, PA and H) with MET 2 were correlated at least moderately ($\rho \geq 0.5$, $P < 0.05$). For inter observer repeatability, 9/10 indicators (GP, SP, P, D, S, W, EE, PA and H), with MET1 and 3/10 (SP, W and H) with MET 2 were correlated at least moderately ($\rho \geq 0.4$, $P < 0.05$). All indicators assessing sanitary condition showed at least a moderate correlation $\rho \geq 0.5$, $P < 0.05$ or a high percentage of similarity for inter and intra observer repeatability. The total average duration of direct animal assessment was longer than the defined goal: 90.95 ± 18.77 min with MET1 vs 57.51 ± 8.80 min with MET2. Even though assessment with MET 2 was shorter than with MET 1, the results suggest the use of assessment with MET1 because both inter- and intra- observer repeatability were better than with MET2. In order to know if a decrease of duration can be considered a bootstrap analysis has to be performed.

Practical and affordable implementation of Equine Welfare Quality type protocol in riding-schools*Machteld Van Dierendonck*^{1,2}¹*Veterinary Faculties, Ghent University & Antwerp University, Belgium,* ²*Utrecht University, the Netherlands, Equine Clinic, the Netherlands; m.vandierendonck@uu.nl*

The assessment and improvement of Equine Welfare at yard level is still a challenge, despite the Dutch equine Welfare Quality® assessment protocol (WMP, 2011) and the AWIN horse-protocol (2015). The main problem for implementation is that WQ protocols take too long and are too expensive to do at regular basis, combined with resistances to change. The goal of this study was to design and test a successful implementation of the WMP. For the WMP 150 yards were visited and 2,956 horses assessed: the health aspects and their related risk assessment were presented in Visser *et al.* This study was used to determine the most discriminating factors to use in the final implementation: 12 global and 63 individual factors remained in the assessment. Of these, 3 global and 46 individual factors are included in the pass-fail decision which uses 5 distinct rules. The main innovation was to split the execution of the assessment in three stages: firstly, the yard owner provides basic information like feeding schedules etc. and a ground-plan (to distribute the random sample optimally). Second, the environmental based risk-factors are assessed by specially trained and independent ‘inspectors’. When a yard does not pass this stage: the further assessment stops, thus their costs stop. Finally, when a yard passes, the animal based factors are assessed by specially trained certified equine veterinarians. Twenty-three yards have been (voluntarily) assessed to test the implementation protocol; three yards, including a large riding school with highest rating on a national scheme, did not pass. The Dutch equine industry has expressed their will to make this protocol obligatory for all Dutch riding schools and training yards. The most important innovations and adaptations as well as an evaluation of the human behaviour change techniques used to overcome the resistance to change, will be discussed.

The use of pain faces for real-time assessment of pain in *Bos indicus* bull calves after castration

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Pain assessment in *Bos indicus* is challenging as they are not habituated to human contact and therefore is evaluated from the distance. The aim of this study was to investigate the applicability of using the Cow Pain Face for real-time assessment of pain following castration. Forty-two *B. indicus* bulls underwent halothane-anaesthesia allocated to four groups: one non-surgical group (n=5), and three castration treatment groups: intra-testicular and subcutaneous lidocaine (n=12), subcutaneous meloxicam (n=12) and no analgesia (n=12). The animals were observed from a distance through binoculars before (days -1 and day 0 morning) and after castration (day 0 and day 1) by the same observer who was trained to evaluate the Cow Pain Face in *Bos taurus*. The observer was blinded to treatment but not to +/- castration as this was obvious on direct observation. No pain faces were observed before castration. On the day of surgery and on day 1, all animals displayed facial expressions of pain following castration but not following anaesthesia alone. The facial expression of *B. indicus* following castration can be summarized by: (1) tension of the facial cutaneous and the caninus muscles; (2) ears backwards, facing downwards; (3) tension of the orbicularis oculi and frontalis muscles; (4) tension around and above the nostrils; and (5) tension of the orbicularis oris muscle. As expected, none of the analgesia protocols completely attenuated pain following castration. The pain face of the *B. taurus* is differs slightly due to different anatomy but could be applied to *B. indicus* and the direct evaluation was useful for detecting pain from the distance. Evaluating facial expressions in one animal took approximately one minute but was impeded by factors such as black coat colour (difficult to distinguish mimic) and feeding (chewing action more distinct than mimic) and fear of observers (fear overriding pain).

Welfare assessment on 40 dairy goat farms in Germany

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Dairy goat farming is a booming branch of animal husbandry in Germany. Due to the market expansion there was a growing demand for special advice on health, feeding and housing of dairy goats. Thus, a project was initiated in 2014 to integrate innovative farmer-to-farmer study groups, welfare assessment and evaluation of housing systems. Welfare assessment and resource-based indicators should be recorded three times on 40 dairy goat farms in Germany. Between the welfare assessments farmers discussed in study groups health and welfare problems using assessment results as benchmarks. One major goal of the project was to apply standardised animal-based indicators to assess the welfare of dairy goats in Germany. The welfare assessment protocol was established according to literature sources. The AWIN-protocol for goats was not available at that time. Data acquisition was facilitated by programming an assessment tool using a relational database. On-farm assessment took a full workday including recording of animal-based and resource-based indicators, housing and gas concentration. Data analysis was performed using SAS 9.4 to calculate prevalences for all indicators on farm level and for the reference population. The first assessment started in spring 2015 with 1,876 individually assessed lactating goats on 40 farms. The assessed goats were chosen as a representative sample according to Cochran from all herds using the milking order. Ten animal-based indicators out of 24 in total showed a prevalence higher than 5%: moderate (47.6%) and severe claw overgrowth (5.2%), moderate udder asymmetry (5.1%), mild udder lesions (7.8%), small udder scars (8.9%), head lesions (15.1%), hairless patches of body (9.5%) and neck (15.5%), swellings (5.6%). 59.3% of goats avoided the approach of an unfamiliar person. In contrast to a moderate claw overgrowth in 47.6% of goats only 1.6% showed mild lameness. As a conclusion of the first application of a welfare assessment protocol for dairy goats, the welfare status of the 40 farms was considered to be high compared to similar studies in other countries. Only four indicators had a higher prevalence than 15%. On farm and study group level, animal-based indicators directed to specific welfare problems and supported discussions about improvement strategies.

CowsAndMore a new decision support system to enhance the animal welfare status of their cows

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The aim of the project 'CowsAndMore' is to develop a decision support system for dairy farmers which increases the welfare situation of their cows in the barns. The advising tool is based on three steps: (1) On farm registration of different characteristics (husbandry and management related) to describe the status quo; (2) Data analysis to compare the registered situation with target values (and other farms – bench mark); (3) Derive of advising recommendations to increase the welfare status. A new methodical aspect is the use of touchpads as tool for the 'on farm registration' of characteristics. All information is collected in a dynamic data pool which is used to describe the population (averages and deviations of the characteristics). To derive realistic target values the 'best practice level' can be calculated e.g. of the top 10% farms. The result of step 1 and 2 is the identification of weaknesses in the welfare situation of the individual farm. Basis is the objective and systematic collection of criteria and indicators in relation to behaviour, disposition and appearance of dairy cows and a standardised root-cause analysis. Also step 3 is supported by the new tool because some identified weaknesses leads to proven advises. During the final consultation with the farmer possible solutions are discussed and directly incorporated into an action plan (fixed in a printed out 'protocol'). Actually farm data from 138 dairy farms with over 10,00 cows are the basis of the decision support system (DDS). In different accompanying scientific thesis the work criteria's and indicator's reliability were tested. For example the interrater-correlation-coefficient of the used hygiene scoring method was very high ($r=0.89-0.92$). The usability of the DDS CowsAndMore and it's on farm effects were also validated. After the recommended changings in the bedding management in an investigated dairy farm we registered strong improvements in animal-based indicators (percentage of standing and lying animals in the cubice).

Feeding acidified milk to Holstein calves: assessment of calf behaviour and welfare

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Feeding acidified milk to dairy calves is a popular method to reduce bacterial contamination in milk and promote *ad libitum* feeding; however, assessing calf welfare in these systems is difficult. This study investigated calf drinking behaviour when offered acidified milk vs non-acidified milk. Ten one-day-old Holstein heifer calves were randomly assigned to one of two treatments: (1) offered acidified milk on Day 1; or (2) offered non-acidified milk on Day 1. The type of milk each calf received alternated every day until weaning at six weeks of age. Calves were offered 4 l of milk daily at 5:30 and 14:00. The amount of milk refusals were recorded 30 minutes after milk was first offered at every feeding for each calf. Calf behaviour was recorded during each feeding using video cameras and body weights were recorded every seven days. Video footage was analysed for the amount of time required to finish drinking and the number of breakaways (calf stopped drinking, remained in the feeding area, and then proceeded to drink) for each calf. Pearson's correlations were used to detect significant relationships. Data were analysed as a randomized complete block design with repeated measures using SAS. The type of milk offered during the first day did not affect overall average daily gain ($P=0.77$). A positive relationship was detected between the amount of milk a calf refused and the number of breakaways a calf exhibited ($P=0.002$). When offered acidified milk, calves refused, on average, 2.50 ± 0.12 l more milk ($P<0.0001$) than on days offered non-acidified milk and demonstrated 0.45 ± 0.11 more breakaways ($P<0.0001$) than when offered non-acidified milk. As calves aged, they refused less milk ($P<0.0001$) and demonstrated fewer breakaways during feedings ($P<0.0001$). The results from this study showed that Holstein calves exhibited more aversive behaviour towards acidified milk than non-acidified, unpasteurized milk; however, the frequency of aversive behaviour decreased as calves aged. Based on the significant relationship between milk refusals and breakaways, calf breakaway behaviour may be a useful tool during on-farm welfare assessments of group-housed dairy calves (especially mob-fed calves).

Comparison of behaviours and vocal signals of alpacas during handling and painful stimuli

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Alpacas are domestic camelids native of South America. They are raised in farms in Chile, Argentina, Peru and Bolivia, however recently they are also being bred in several European countries, New Zealand and the USA. Despite the marked interest for this type of livestock, the knowledge of their welfare is scarce and behavioural signals are not well understood. Alpacas communicate emotions through body postures and a wide variety of vocalizations; nevertheless, it is not clear whether they are related to stress or pain response. The aim of this study was to compare body postures, behaviours and vocalizations of alpacas between handling procedures and during the administration of two injections, as part of a veterinary program. This study was conducted in a farm and 32 alpacas were included. During handling, each alpaca was separated from its group and taken to a management pen (MP). The study was in three stages: (1) HANDLING, from the time each alpaca was in the MP until they were physically restrained; (2) PAIN STIMULI, when they were injected; (3) POST PAIN STIMULI, when they were released in MP and before they were returned to their groups. The frequency of spitting and tail-up were recorded as behaviour and posture; the frequency of humming, grumbling and screaming were recorded as vocalizations. Acoustic parameters were recorded with a microphone Sennheiser® ME-66/K6, connected to a digital recorder Tascam DR-100 MKII®. The audio files were analysed using the software Raven Pro® 1.4. We measured duration and time to maximum amplitude (s) and spectral characteristics of acoustic signal, dominant frequency (Hz) and number of harmonics of acoustic signals. Friedman test was applied to compare behaviours between the three stages, and ANOVA was conducted to compare bioacoustics parameters. We found that only the frequency of humming was higher during handling than during painful stimuli ($\chi^2=12.25$, $P=0.02$). The frequency of grumbling, screaming, tail up and spitting was not affected by the painful stimuli ($P>0.05$). The same was found regarding the bioacoustics parameters ($P>0.05$). We can conclude that, in the handling context, humming is a indicator of stress and the remaining parameters do not allow to distinguish between stress and pain response.

Results of qualitative behaviour assessment reflect social tension in dairy goats*Susanne Waiblinger¹, Dorit Mersmann¹ and Francoise Wemelsfelder²*¹*University of Veterinary Medicine, Vienna, Institute of Animal Husbandry and Welfare, Austria,*²*SRUC, Roslin Institute Building, United Kingdom; Susanne.Waiblinger@vetmeduni.ac.at*

Reliable, quantitative observations of social interaction for evaluation of social tension and stress on farms require relatively long observation time. Qualitative behaviour assessment (QBA) might provide similar information already after shorter observation time due to a more holistic evaluation of behaviour. The aim of the study was to assess the associations of QBA with quantitative observations of social interactions, injuries and other health parameters in dairy goat herds. 45 dairy goat farms (herd size 78-620, 170 ± 116) were visited for two days each. QBA was assessed with a fixed term scale with 29 terms by one observer for 12-22 min starting approximately 3 h prior to evening milking of the first day. Afterwards, social interactions were observed directly (totally 6 h in 3x2 h session). A randomized subsample of goats (38-332 goats) was examined with respect to injuries, general health signs and body condition. Tests assessing the goats' fear of humans were performed at the second day. PCA of QBA revealed two main components explaining 50% of variation. Component1 (29.8%) ranged from bored/apathetic to aggressive/frightened, thus related to the level of arousal or fear. Component2 (20.3%) ranged from uneasy/annoyed to positively occupied/friendly, rather representing valence. Component1 correlated positively with the prevalence of udder injuries ($r_s=0.45$, $P=0.002$) and with the distance goats kept to an experimenter in the pen ($r_s=0.39$, $P=0.02$), but also negatively with the proportion of animals with swollen shoulder lymph nodes ($r_s=-0.35$, $P=0.02$); goats with caseous lymphadenitis might be less active. In contrast, Component2 correlated negatively with agonistic interactions ($r_s=-0.33$, $P=0.03$) in the pen and positively with affiliative interactions ($r_s=0.35$, $P=0.02$). The results suggest that short observations of QBA are suitable to assess the level of social tension (assessed by frequency of social interactions and injuries) in dairy goat herds but also reflect other aspects of welfare.

The influence of male pigs on animal welfare on the day of slaughter

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In Denmark, the majority of male piglets are castrated. However, there may be an ongoing trend towards fewer castrations in the future. Increasing the male pig population may have a negative effect on the welfare during lairage at the abattoir. The aim of the study was to examine how the presence of male pigs influenced the animal welfare during lairage at the abattoir. A total of 408 pigs, 148 boars, 200 sows, and 60 castrates from 9 different producers (5 with, 4 without males) were included in the study. Mixing of the two 'males only' deliveries with sows and castrates according to abattoir procedures will be described on the poster. Fourteen individually numbered pigs were housed together in each of five pens per delivery for one hour before slaughter. All incidents of sexual or aggressive behaviour were evaluated from video recordings. Pigs that have been fasted, mixed, transported, and maybe mixed again in an unknown environment at abattoir generally prefers to rest when offered the opportunity. Therefore, a reduced possibility to rest was used as a general indicator of the stress-level during lairage. A resting index was calculated as the percentage of pigs lying down between the 5th and 55th minutes of the lairage period, counting the number of pigs standing, sitting and lying down at 5 minute intervals (11 counts). Resting-index = (no. of observations of pigs lying down / total no. of counted postures) × 100 The resting index for pens with male pigs was very variable (12 to 96%). For pens without male pigs, the resting index varied from 73 to 94%. All sexual behaviour and the majority of aggressive behaviour was displayed by males. Sows and castrates housed with males displayed or participated in more aggressive behaviour than when not housed with males. The results indicate that the overall stress level is generally, but not necessarily, higher when male pigs are present during lairage at the abattoir.

Assessment of the multi-criteria evaluation system of the Welfare Quality® protocol for growing pigs

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This study aims to assess the multi-criteria evaluation system of the Welfare Quality® protocol for growing pigs regarding reliability and the importance of indicators on the overall assessment. Therefore, 198 protocol assessments were carried out on 24 farms in Germany by two trained observers. To test the interobserver reliability, the same animals were observed simultaneously; test-retest reliability was assessed by repeated assessments through the same observer. Data was aggregated with the online calculator of Welfare Quality®. For criteria, principles and the overall score different reliability and agreement parameters were calculated: Spearman rank correlation coefficients (RS), intraclass correlation coefficient (ICC), smallest detectable change (SDC) and limits of agreement (LoA). Interobserver reliability was insufficient for the criteria comfort around resting (RS: 0.18, ICC: 0.56, SDC: 21.56, LoA: -29.06-17.02), expression of social behaviours (RS: 0.60, ICC: 0.47, SDC: 32.68, LoA: -16.63-46.61), expression of other behaviours (RS: 0.29, ICC: 0.00, SDC: 29.42, LoA: -21.03-20.59), good human animal relationship (RS: 0.26, ICC: 0.75, SDC: 20.74, LoA: -24.65-34.39) and positive emotional state (RS: 0.64, ICC: 0.70, SDC: 19.22, LoA: -29.91-19.64) as well as for the principles good housing (RS: 0.64, ICC: 0.63, SDC: 14.82, LoA: -21.42-13.04) and appropriate behaviour (RS: 0.37, ICC: 0.53, SDC: 11.99, LoA: -15.97-11.32). This is probably due to insufficiently reliable indicators. Test-retest reliability was mainly insufficient due to a low variability among farms. By partial least squares modelling, the influence of indicators was estimated with variable importance for projection (VIP) scores. VIP scores revealed some unexpected influences since the Welfare Quality® aggregation system aimed to avoid interferences and double-counting. The results propose that feasibility is enhanced by deletion and weighting of indicators according to the revealed importance. Thus, the study contributes essentially to the further development of the aggregation of welfare indicators.

Identification of areas with poor welfare in Danish dairy herds

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Animal welfare varies considerably between herds and within certain welfare areas e.g. housing, feeding or health aspects. The objective of this study was to describe the distribution of animal welfare scores for selected animal welfare measures and herd level scores using an animal centred approach for assessing animal welfare to derive at scores on measure, criteria and herd levels. The present study assessed a total of 28 measures (12 resource- and 16 animal-based measures) describing eight criteria within housing, feeding, health and behaviour aspects of dairy cow welfare. Data were collected during 2015 in 60 Danish dairy herds. For the animal-based measures, cows were sampled according to the Welfare Quality protocol, while resource measures were assessed across all cows. An index model was created using weighted and aggregated herd means of the graded measures adjusted for herd size. The model provided scores ranging from poor to excellent welfare (score 0-100) with a score below 50 indicating unacceptable welfare for each level. Overall herd scores ranged from 71.5-88.6 (SD=3.9) with a mean score of 80.4, and thus an overall acceptable welfare for study herds according to the present protocol. Identification of individual measure scores <50 were used to identify areas giving rise to welfare concerns. Results showed: 75% of the herds had unacceptable water supply; total floorage was unacceptable for 56% of the herds; the number of animals lying outside the lying area was unacceptable in 38% of the herds. In addition, 57% of herds had unacceptable levels of integument alterations (i.e. lesions and swellings) and 70% of the herds did not have an acceptable number of cow brushes. Problem areas were primarily found in relation to resource measures. In conclusion, improved welfare for Danish dairy cows could potentially be achieved by focussing on water supply, stocking density and cow brushes.

Alternatives to castration and their long-term effects on salivary cortisol concentrations in piglet

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Piglet castration is a major animal welfare problem while the procedure is usually done without anaesthesia or analgesia. However, administration of pain medication or anaesthesia for young piglets should be considered carefully. We investigated the long-term effect of five different castration protocols on salivary cortisol concentrations of piglets when they were exposed to noise or housed with new mates. Five days old crossbred (Y × L) piglets (total n=181, from 29 litters) were allocated to five separate castration protocols: (1) TC: traditional castration without medication; (2) PK: meloxicam injection 0.4 mg/kg i.m.; (3) LA: local anaesthesia with lidocaine (2%); (4) GA: general inhalation anaesthesia with isoflurane (1.5%) and meloxicam injection 0.4 mg/kg i.m.; and (5) NC: no castration. Piglets were weaned at 36 days of average age (hereafter D36). The weaner piglets subjected to the novel stressor, i.e. thunderstorm sound at 07:40 on D84, and they were moved to the fattening unit with new pen mates at 20:20 on D85. Four salivary cortisol samples were collected on synthetic swabs at the same time each day, i.e. approximately 08:00, 12:00, 16:00 and 20:00 on D83, D84, D85 and D86, respectively. The data were analysed using repeated measures with a nested design. Irrespective of the treatments, the cortisol concentrations of the piglets did not respond to the thunderstorm sound, but increased after grouping with new mates in fattening units ($P < 0.01$). After grouping, the cortisol levels of the piglets in PK group were higher than in NC and TC ($P < 0.05$, for both), and tended to be higher than in GA group ($P = 0.07$). In conclusion, moving weaner pigs to new environments and grouping them with new mates seems more stressful probably due to fighting than exposing them to thunderstorm noise in terms of cortisol status. The higher cortisol levels seen in castrated pigs with pain medication can be speculated to be due to increased sensitivity to the pain caused by the wound after fighting.

a method for cleaning electroencephalography data in conscious sheep*Charissa Harris, Peter White and Sabrina Lomax**University of Sydney, Australia; char2922@uni.sydney.edu.au*

The use of electroencephalography (EEG) offers potential as an effective and practical way of measuring pain response and efficacy of analgesia in livestock. A preliminary trial was conducted to identify muscle artefacts impacting EEG signal quality in conscious sheep. The trial was conducted using six hogget wethers sourced from the University of Sydney teaching flock, Cobbitty NSW. Lignocaine (1 ml) was administered to electrode placement sites to minimise discomfort. Subdermal 12 mm, monopolar needle electrodes (29 gauge) made from surgical steel (ADInstruments, Ltd.) were placed in a three-electrode montage adapted from Murrell and Johnson. EEG was recorded using Powerlab® and LabChart® software (ADInstruments Ltd). Initial traces were bandpass filtered between 0.5-40 Hz to obtain improved signals. Simultaneous video recording was used (Video Capture add on, LabChart ADInstruments) to identify artefacts caused by muscle movement, including blinking and head turns. Preliminary results for this trial show distinct artefact patterns for head movement to the right, left, eye blinks, and chewing. Further analysis in Matlab (Mathworks®) is being used to characterise these artefacts for removal from recordings. Data cleaning will allow accurate detection of changes in EEG output, such as differentiating muscle movements from treatment responses. These results will enable more accurate recording of EEG in conscious sheep, allowing the progression of this method for use as a means of pain detection in conscious sheep during husbandry procedures.

Evaluation of the welfare of dual purpose cattle in Michoacán, Mexico

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Consumers exert more pressure on animal products with welfare. However, there is little information on animal welfare (AW) in extensive production systems. It is assumed that the animal has the freedom of natural behaviour and better well-being. Other schools of thought question psychological and physiological well-being that may be compromised by natural factors, environment, predators, and malnutrition, among others. With the objective of evaluating the welfare of dual purpose cattle in the Southeast of the state of Michoacán, Mexico; first, information was obtained on productive, technical and economic aspects from a sample of 93 production units (PU) of the 1,800 registered, by simple random sampling with 95% confidence level and a 10% error, to classify groups of producers. The data obtained was analysed with principle components (PCA) and cluster (CA). Three subsystems were obtained: subsistence production system (51 PU), family production system (36 PU) and business production system (6 PU). Afterwards, a random sample of animals was obtained, with 95% confidence level and a 10% error, from four PU of each group. The animals were evaluated with an evaluation index of AW (ANI 35 L) that ranks each criterion from 0 to 4.0 points. The sum of all the points gives a maximum total of 147. The subsistence and family subsystems had a greater animal welfare index. The indices of human-animal relationship and health decrease when the herds are larger and when hired labor is available.

Effects of a virtual fence on individual and social behaviour and welfare of dairy cows*Paul Koene, Pieter Hogewerf and Bert Ipema**Wageningen University & Research, Animal Welfare, Wageningen Livestock Research, the Netherlands; paul.koene@wur.nl*

Dairy cows may graze more efficiently when allowed grazing in predefined areas with predictable sward height and grass quality. Moving the animals daily or preferably more frequently is needed. Using traditional fencing such as strip grazing causes high labour requirements. Undesirable effects of electric fencing might be prevented by the use of virtual fencing. A warning signal could be given to the cow when approaching the boundary and a correction signal when crossing the boundary. Questions are whether the virtual fence works as expected and what the impact of the signals is on the behaviour and welfare. Dairy cows – grazing in a group of four – in the virtual fenced area were compared with cows in the electric fenced area. This was replicated once with two other groups (n=16). During 12 days the groups were compared in several aspects. One of the aspects was grazing on a single strip (80×10 m) compared to a double strip (80×20 m). The behaviour, position and activity were monitored during 5 h per day. During the 12 day period cows stayed in the strips with only few temporary boundary crossings. In a 1-strip area the virtual fence cows showed more were standing (34 vs 8.5%; $P<0.001$) and less lying (4 vs 14%; $P<0.01$). The cows in the virtual fence system showed lower nearest neighbour distances than the cows in the electric fence system ($P<0.01$). The behavioural synchronization of the group in the virtual fence condition – measured during standing (8.5 vs 13%) and lying (25 vs 25%) – was weaker ($P<0.001$) in the 2-strip area. Our conclusion is that a virtual fence is effective but has some effects on the social and individual behaviour and welfare of cows.

Calf management extension programme to improve calf welfare on British dairy farms*Jenny Gibbons and Andrew Dodd**AHDB Dairy, United Kingdom; jenny.gibbons@ahdb.org.uk*

Studies on commercial British farms inform us that between 5.22% and 8% of heifer and bull calves are either stillborn or die within the first 24 h. A further 14% of heifers born alive and tagged do not calve down for the first time and enter the milking herd. Youngstock are the future dairy producers and it is paramount that they get the best possible start to life in terms of nutrition, health and welfare. In 2016, a calf management extension programme (Calf to Calving) of resources, tools and training for both dairy farmers and their advisers was rolled out in Britain. The objective of calf to calving is to enable dairy farmers to make measured improvements in youngstock survival and growth rate and increase the percentage of high quality heifer calves making it into the milking herd by 24 months of age. The programme involves 12 farms monitoring survival and growth rate of ten heifer calves from birth through to first calving and hosting quarterly open meetings on their farm. Calf to calving facilitates farmer to farmer learning so farmers are better able to assess calf performance, identify areas for improvement, determine their options for change and implement their chosen changes. In addition, best practice messages and the latest science on calf rearing is delivered by technical experts and veterinarians. In the first year of the programme, 43 meetings were delivered with an average of 25 attendees, 93% of which intend to make changes on farm as a result of attending a meeting. An overview of the findings and a perspective on the impact of the extension programme on calf management and welfare will be shared and discussed.

EuroDairy: sharing experiences and best practice of dairy cattle welfare assessment across Europe

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In 2016, a EuroDairy network funded through the EU Horizon 2020 programme was convened. One objective is to improve animal welfare, specifically to share experiences on the use of practical outcome-based welfare measures. A survey was conducted to identify innovative activities in practical welfare assessment. A total of 11 organisations from 9 countries responded to the survey including The Netherlands (NL), United Kingdom (UK), Sweden (SE), Denmark (DK), Spain (ES), Italy (IT), Finland (FI), Slovenia (SI) and France (FR). The common welfare priorities were prevention of production diseases, better on-farm recording of health and welfare data, improving housing conditions both indoor and outdoor and pain prevention during management procedures such as disbudding. There are a number of welfare assessment initiatives including AssureWel (UK), Ask the Cow (SE) and those based on Welfare Quality® (FI, IT). Only two countries (DK, NL) set targets, for example mortality rates for cows (14%) and calves (20%). There were some similarities in the top 3 non-compliances across member states: Udder health, cleanliness, space allowance, herd health review with vet and water provision. Planned welfare activities comprise Cow Compass Beta (NL), positive welfare (UK), welfare index for cows and calves (DK), design and use of welfare pen (DK), comparing Naseva health care visit to Welfare Quality (FI), improve welfare in Parmigiano Reggiano cheese supply chain (IT). On-farm innovations include alternative housing, flooring and bedding, claw health registration programmes and adoption of smart precision technologies. Priorities identified for the EuroDairy network were: (1) exchange best practice; (2) practical, less time consuming and more uniform welfare assessments; (3) build innovations to enhance welfare; (4) behaviour and welfare needs of cattle; (5) better use of existing recorded data; and (6) mastitis and lameness interventions. The next stages include convening several webinars, workshops and farmer exchange visits to share knowledge, experiences and practical solutions.

Identification of genes which are associated with production diseases in pigs and chickens

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Production disease in pigs and chickens is caused by a variety of different pathogens, mainly enteric and respiratory, which may result in significant economic losses. Other factors such as stress, poor husbandry and nutrition can also contribute to an animal's susceptibility to disease. Molecular biomarkers of production disease could be of value by improving diagnosis and risk analysis to determine best practice with an impact on increased economic output and animal welfare. Over 480 chicken tissue samples from countries including Belgium, Spain and the UK, and over 115 pig samples from Belgium, Spain, France and Ireland were available. Samples included lung, intestine, mesenteric and tracheobronchic lymph node, bone, cartilage and sciatic nerve. Two types of software were used to analyse the microarray data; Genespring was used for statistical analysis and visualisation of transcriptomic data and Cytoscape was used to visualise molecular interaction networks between genes. Results indicated that panels of genes may identify a broad spectrum of infectious disease in chickens, whereas combinations of upregulated genes may be used as biomarkers of specific pathogens such as *Escherichia coli* or *Eimeria*. Pigs from two lines (RFI high and low) were kept in dirty environments which had the same bedding and clean environments which had fresh bedding. A greater difference was observed in the number of genes differentially expressed in the RFI high pigs than RFI low pigs. Pathway analysis from both chicken and pig experiments indicated that many networks were affected including those involved in regulating the immune-system. Whilst a large number of studies have been carried out in human medicine, further work is needed to identify molecular biomarkers in veterinary medicine and in particular those associated with production disease in the pig and poultry livestock industry.

Genetic selection to enhance animal welfare using meat inspection data from slaughter plants

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Animal health and welfare are monitored during meat inspection in many slaughter houses around the world. Carcasses are examined by meat inspectors and remarks are made with respect to different diseases, injuries and other abnormalities. This is a valuable data resource for disease prevention and enhancing animal welfare but it is hardly used for this purpose. Records on 69 carcass condemnations on over 147,000 finisher pigs were analysed to answer questions including: (1) what are the most common carcass condemnations; (2) are there differences between sexes; (3) are there differences between farms; (4) do fast growing pigs have more welfare related remarks; and (5) what can genetics do to enhance animal welfare. The most frequent carcass condemnation remarks were pneumonia (15.5%), joint disorders (9.4%), pleuritis (4.8%), liver lesions (2.5%) and pericarditis (2.3%). Joint disorders occurred more often in boars than in gilts. There were also significant differences between farms depending upon their housing and management. Pedigree records were available for 142,324 pigs from 14 farms and were used for genetic analysis. The heritability estimates for joint disorders, pneumonia, pleuritis, pericarditis, and liver lesions were 0.10, 0.09, 0.14, 0.24 and 0.17, respectively, on liability scale, suggesting existence of substantial genetic variation. The genetic correlations between these carcass condemnations and finishing traits were small but mostly negative, suggesting the possibility of enhancing pig health and welfare simultaneously with genetic improvement in finishing traits. Further analysis also revealed that selection of the top 25% boars to be used as terminal sires can substantially reduce the incidence of these traits in finishers. A Topigs Norsvin Welfare index (TWI) was developed based on the breeding values for these traits and their economic values for farmers and slaughter plants. This index is used to enhance animal welfare in pig farms.

Modelling intensity of interaction to estimate direct and indirect genetic effects*Juan P. Steibel¹, Rodolfo J.C. Cantet² and Janice M. Siegford¹**¹Michigan State University, USA, ²University of Buenos Aires, Argentina; steibelj@msu.edu*

Selecting for social genetic effects has been proposed for improving welfare of group-housed livestock. In classical social genetic effects, the social effects are modelled assuming uniform intensity of social interaction among all group members. Such models may lead to confounding of the social effect incidence matrix with the pen or group incidence matrix. The confounding is generally avoided by using multiple mixings, where each animal is grouped with different animals in each mixing. But even if re-mixing is performed, the underlying assumption is that intensity of interaction within group is uniform among all possible pairs of individuals. Exploiting estimates of intensity of competition between all pairs of individuals has been proposed in the context of forest tree breeding, but it has not been attempted with animals. In this work, we show how dyadic social interactions estimated from decoded video observations of group-housed pigs could be used to parameterize social genetic effects models. We show that this approach allows estimation of social genetic effects separately from other group-specific effects without having to re-mix animals. We also illustrate how to build social interaction matrices to obtain variance estimates that are comparable to estimates of direct genetic variance and environmental variance components. Furthermore, we propose alternative metrics for the incidence matrix of social interactions by using frequency or duration of different types of interactions and suggest a framework for model comparison, including cross validation in the presence of successive mixings. Finally, we present equations to use the proposed models to perform genome-wide association of indirect genetic effects in addition to predicting animal-specific indirect breeding values. We conclude that in the presence of pairwise-behaviour observations, indirect genetic effects models could be parametrized to account for such information, and they could lead to an increased amount of phenotypic variance that is explained by genetic effects.

Metabolites as new genetic selection tools to enhance behaviour in pigs*Lisette E. Van Der Zande¹, Inonge Reimert², Pramod K. Mathur¹ and Egbert F. Knol¹**¹Topigs Norsvin BV, the Netherlands, ²Wageningen University & Research, Adaptation Physiology Group, the Netherlands; lisette.van.der.zande@topignorsvin.com*

Favourable social behaviour between pigs is important and desirable for animal welfare, economic benefits to farmers, and human society. Already shown to be effective is genetic selection using social breeding values (SBVs). SBVs is the genetic effect based on the growth and behaviour of an individual on its pen mates. Pigs with high SBV have desirable behaviour and cause less tail damage to their pen mates. It is further desirable to have a more clear understanding of the biological mechanisms behind animal behaviour. It is known that metabolites such as serotonin, influence behaviour. However, the relationship between behaviour and metabolites is not yet well understood in pigs. If metabolites are heritable in pigs, combining the knowledge genomics and metabolites might result in more accurate prediction of behaviour. Therefore, this study contributes to the knowledge on genetics of behaviour in pigs. Six metabolites were measured on 480 genotyped animals housed in equal numbers in barren and enriched housing. Behaviour was measured through video recordings. Among the six metabolites, the concentration of haptoglobin and IgG were affected by the housing systems. In addition, SBV was significantly associated with haptoglobin and lymphocytes. The heritability estimates using genomic information for haptoglobin, leukocytes, lymphocytes, serotonin, IgG, and IgM were 0.15, 0.26, 0.14, 0.21, 0.27, 0.41, respectively, which implies that these metabolites have a good genetic basis. There was a significant effect of SBV, haptoglobin, and IgM on tail damage as victim of undesirable behaviour. However, there was no significant correlation between the six metabolites and tail biting behaviour as perpetrator. Further data analysis is underway to investigate the usefulness of over 100 metabolites to reduce the risk of some undesirable behaviours like tail biting and for overall enhancement of pig behaviour and welfare.

Genetic correlations between skin lesions and growth traits in group housed pigs

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Pigs housed in groups are remixed with unfamiliar individuals which can trigger aggressive interactions compromising the welfare of these individuals. Skin lesions are a reliable indicator trait of aggression and are moderately heritable, suggesting that aggression may be reduced through selective breeding. However, a common concern is the relationship between skin lesions and traits related to growth and carcass composition. To investigate this concern, 1,079 purebred Yorkshire pigs were strategically remixed into new groups of familiar and unfamiliar animals at 3 life stages (weaning, grow-finish, mature gilts). Skin lesions (fresh bright red cuts) were counted immediately prior to mixing and 24 h post mixing across 3 body regions: front, middle, and rear. Body weights were recorded prior to each mixing event. Prior to slaughter, backfat thickness and loin muscle area were determined by ultrasound. Bivariate analysis was performed using a genomic best linear unbiased prediction model with fixed effects of sex, replicate, observer, weight and pre-mix lesions as covariates, and random effects of pen and genetic additive effect. The response variables were post-mix lesions with either weight gain (per life stage), back fat thickness, or loin muscle area. The genetic relationship matrix was constructed using genotypes from 52,925 SNPs. Genetic correlations between weight gain and lesions were close to zero and not significant. Backfat and lesions were slightly positively but not significantly correlated (0.08 to 0.28). A moderate negative correlation was found between loin muscle area and lesions (-0.43 to -0.62) and these genetic correlations were deemed significant for grow-finish pigs middle and rear lesions ($P < 0.003$ and $P < 9.73 \times 10^{-5}$, respectively) but not for front lesions. These results are promising for the industry because they suggest pigs can be selected for reduced lesions, thus reducing aggression, without negatively affecting growth. In addition, selection for reduced lesions may contribute to increased loin muscle area.

Which genes are best indicators for lesion age determination on the pig carcass – a preliminary study

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Assessing the age of lesions on the carcass may help determine the time of their infliction and identify the causes. This study aimed at identifying which genes are the best indicators of lesion age on the pig carcass. Five identical lesions were inflicted at the same time on the shoulders of 10 pigs (100±20 kg) using a piglet's lower jaw. Five biopsies on each pig were performed at 1, 4, 8, 24 and 48 h after injury (1 biopsy per lesion). Intact skin was the control. Local anaesthetic and analgesics were used to reduce pain. To assess the effect of slaughter and carcass treatment on gene expression, 5 of the 10 pigs were slaughtered 24 h after the infliction of two lesions in the hams. Biopsies were taken before and after slaughter (BS and AS, respectively), and after carcass singeing. The qPCR method was used to quantify the expression of 98 genes involved in wound healing, using the $2^{-\Delta\Delta CT}$ method. Since carcass handling induced a degradation of the RNA, only samples taken before carcass dehairing were used. Genes that were not differently expressed between BS and AS were first tested on 5 pigs in all lesion age categories. Fourteen selected genes were then tested on all pigs. Statistical analyses were performed using the PROC MIXED procedure of SAS. Eight genes (CCL2, COX2, IL2, IL6, IL8, MMP1, SERPINE1, TIMP1) presented different expression patterns by the age of the lesion ($P < 0.05$). In particular, COX2 appears to be a useful indicator of lesions of 1h (1h=6.2 [3.2-12.1], 4h=1.4 [0.7-2.6], 8h=1.7 [0.9-3.4], 24h=1.6 [0.8-3.1], 48h=1.1 [0.6-2.2]; $P < 0.01$), and MMP1 of 4-8h (1h=1.9 [0.7-5.5], 4h=35.6 [12.4-102.3], 8h=19.2 [6.7-55.3], 24h=4.0 [1.4-11.4], 48h=1.3 [0.4-3.6]; $P < 0.001$). Based on their different expression by age of lesion, the identified genes may be used in larger-scale studies to validate on-field methods for this assessment.

Farmers' practices and attitudes towards artificial fed lambs and their mortality in meat systems

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Artificial rearing is a common practice in French sheep farming particularly for raising supernumerary lambs in prolific breeds. Mortality rates can reach more than 50% suggesting possible animal welfare and health issues. This prospective study aims to investigate a range of variable rearing conditions, practices, and farmer attitudes towards animals, contact with animals and working in this system, relating this diversity to declared mortality rates. This study was based on semi-directive interviews and questionnaires. As no database exists to identify farms with artificial feeding systems, a convenient sample of farms was built through a snowball process with the help of professional organisation networks in the central area of France. Thirty-five farms (737±396 ewes) were surveyed with a particular focus on technical aspects (milk powder quality, feeding system, milk temperature, etc.). Factor analyses were performed on farm characteristics and on attitude scales. The relationship between these variables and the declared mortality rates were analysed through single and multiple regression analyses with selection processes. Our results show varying practices and farmer attitudes. 61% of farmers agreed on the profitability of these rearing practices. From the farmers' point of view, the most important elements are: for 58% of the farmers the early separation from the dam, 54% choosing the stronger lamb, 58% giving the colostrum within 6 h after birth. Declared lamb mortality varied strongly from farm to farm (15.7±13.6%: range 1-50%). Multiple regression analysis (with missing data regarding sanitary breaks) showed that three factors explained 59% of this variability (log transformed, F_{3,13}=6.24, P<0.01): Farm size (β =+0.51), duration of the sanitary break (β =-0.27) and agreement that sheep are sensitive to petting (β =-0.84). Our results suggest that a large diversity in farmer attitudes and practices in artificial rearing systems exist in France making possible a strong scope of improvements concerning welfare and health, and reducing lamb mortality.

Could pigs have unidentified behavioural needs that warrant inclusion in future welfare assessments?

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A growing body of research suggests that in addition to pigs' known behavioural needs, some other behaviours may also be innately motivated, and thwarting them may cause frustration. Here, we review the literature on potential candidates for 'new' behavioural needs and present our findings. One candidate is wallowing, which may have emotional significance beyond thermoregulation. Pigs spend time in water even at optimal temperatures and work to gain access to wallowing, suggesting potential similarity to dustbathing in poultry. We also discuss literature on potential significance of novelty, olfaction and nest-oriented behaviours. The latter have been observed in sows building farrowing nests, piglets burrowing in these nests and pigs of both sexes building resting nests, but their welfare-relevance has only been studied in sows before farrowing. We have collected descriptive data on pre-rest behaviours by using videos from other experiments on intensively farmed pigs with no bedding. In Experiment 1, we observed 167 gilts for 2 h, finding that 92% of events of settling to recumbency started with oral-nasal contact, mainly at the floor (52%) or another pig (31%). Experiment 2 involved pigs provided with objects for manipulation: 128 finishing pigs had pieces of wood and 51 suckling piglets had sisal ropes as material for manipulation. We observed each animal once until recumbent and immobile, presumably asleep. Of the finishing pigs, 14% placed the head or body under wood for 2 to 19 seconds before lying down; 3% remained under and in contact with it when immobile. Of the piglets, 16% placed the head or body under rope for 3 to 25 seconds before lying down; 14% remained under and in contact when immobile. We conclude the interaction with floor and objects may have been caused by a pre-sleep motivation to manipulate nest materials. Further research is needed on the welfare-relevance of these behaviours and whether they require inclusion in welfare assessments of the future.

Risks to welfare associated with changes in infrastructure and management in expanding dairy herds

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Herd size increased following quota abolition in Irish pasture based dairy farms. However, investment in farm infrastructure and appropriate changes in farm management may not have occurred concurrently and have potential implications for cow welfare. This study aimed to establish the changes in and opinions about such issues on Irish dairy farms in the past 3 years (2012-2015). The survey was conducted with farmers (F; n=115) at 2 national farming events and cattle vets (V; n=60) at a national conference using a questionnaire by interview. Teagasc dairy advisors were asked to complete the questionnaire themselves (A; n=48) at a training event. Results are expressed as % of group surveyed. Data were analysed in SAS using logistic and mixed procedures. The majority (77%) of F increased herd size. More F who increased herd size invested in the milking parlour (93.5%) than those that did not expand (6.5%) ($X^2=8.3$; $P=0.004$). However, these two groups did not differ in terms of investment in housing or roadways ($P>0.05$). There was good agreement between V (90.0±3.9%) and A (87.5±4.82%) that the best way to herd cows is on foot ($P<0.05$). However, more than 30% of F reported using a vehicle. On those farms, herds were larger than where cows were herded on foot (152.7±15.9 vs 99.0±6.1 cows; $P<0.001$). We did not investigate whether F only began to employ a vehicle for herding following expansion. The distance to the furthest pasture (884.4±45.2 m) was positively correlated with herd size ($r=0.26$, $P=0.01$). Investment in milking parlours involved increased capacity, indicating that cow welfare is not likely to be adversely affected by inefficiencies in the milking process in expanded herds. However, the lack of investment in roadways combined with potential for faster herding and longer walking distances in such herds poses risks to cow welfare, particularly lameness. Furthermore, given that cows are housed for on average 3.6 months p.a. the lack of investment in housing in expanded herds poses risks of overcrowding and social stress.

Welfare-adjusted life years: combine welfare compromise and premature death to a whole

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This paper aims to demonstrate a novel metric, welfare-adjusted life years (WALYs), which allows quantification of welfare compromise caused by diseases in companion animals and integrates it with another perspective of disease impact, premature death, as a whole. The welfare compromise component, years lived with compromised welfare, is calculated by multiplying the number of cases, the average duration of the disease until remission or death, and the welfare compromise weights (WCWs); the premature death component is named years of life lost, estimated by multiplying the number of deaths due to the disease and the standard life expectancy at the age of death (i.e. years of lost). WALY is the sum of the two components: larger the WALY of a disease, greater the negative impact caused by the disease. WALY value can be calculated for all diseases if their essential epidemiological data are available and if WCWs for their welfare states (each disease has several welfare states, depending on the clinical signs and disease sequela) are present. WCWs can be generated by conducting a survey including paired comparison and anchoring questions. Using paired comparison questions, respondents are asked to consider two hypothetical dogs with different welfare states and specify which dog they deemed having better welfare than the other. This creates a list of welfare states ordered in the magnitude of welfare compromise, and anchoring methods, such as visual analogue scale, time trade-off or people trade-off, can assign each welfare state a WCW between 0 (perfect welfare) and 1 (worst welfare). To demonstrate WALY metric, 35 welfare states for 10 inheritable diseases of dogs were selected and their WCWs were generated, and the results of different anchoring methods were compared.

Interdependence of management and automated milk feeders to ensure dairy calf health

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Dairy cattle welfare assessment schemes have traditionally been focused primarily on mature cows. We have examined data on management practices with automated milk feeders (AMF) to identify factors associated with calf health problems, that ultimately impact welfare, and which could be measured in calf welfare assessment schemes. Seventeen dairy farms with AMF in Ontario (Canada) were visited 4 times, seasonally, over 1 year. All calves (n=1,488) in pens (n=35) with AMF were health scored to identify number of calves with diarrhoea (CD) and bovine respiratory disease (BRD). Data on calf, feeder, and pen management practices were analysed using mixed-effects negative binomial regression models. Overall calf-level prevalence of CD and BRD were 23% and 17%, respectively. Median (IQR) within-pen prevalence of CD and BRD was 17% (7-37) and 11% (0-28), respectively. Predictors associated with reduced within-pen prevalence of CD were the feeding of probiotics (risk ratio [RR]=0.5, P<0.01), cleaning AMF hoses daily compared to weekly (RR=0.53, P<0.03), and individual-housing (vs group-housing) before introduction to the AMF pen (RR=0.6, P=0.07). In contrast, use of maternity pens other than for calving tended to be a risk factor (RR=1.6, P=0.07). Predictors associated with reduced within-pen prevalence of BRD were increased total solids in milk replacer (RR=0.93, P=0.04), and dry top bedding over a wet bedding pack no deeper than 5 cm (RR=0.6, P=0.04). Predictors associated with increased within-pen prevalence of BRD were sharing air with cattle up to 5-8 months old (RR=3.4, P=0.01) or older (RR=2.0, P=0.07), and introduction to the AMF pen after 9 d old compared to <3 d (RR=2.1, P=0.04) or 3 to 6 d (RR 2.0, P=0.02). To conclude, risk factors for disease and reduced calf welfare in group-housed calves fed with an AMF are commingling with older animals and infrequent cleaning of the feeder.

Effect of lactation system and floor type on aggressive behaviour of rabbit does housed in groups

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The aim of this work was to evaluate the effect of the lactation system and the floor type on the aggressive behaviour of rabbit does reared in a part-time group housing system. Thirty-two crossbred pregnant rabbit does were housed in groups of four from 8 d until 2 d before kindling and from 2 d until 33 d after kindling in collective pens (n=8). Half of the pens had wire net floor covered with mats (W), and half plastic slatted floor (P). During the controlled lactation (from 2 d to 18 d after kindling), in half pens (2 W and 2 P) each doe always nursed its own litter (fixed lactation; F), whereas in the remaining half (2 W and 2 P) each doe nursed whatever litter of the group (random lactation; R). The number and duration of the aggressive interactions in each pen were video-recorded for 30-min intervals every hour for 24 h at three days, i.e. 8 d before kindling, and 2 d and 18 d after kindling. Data were analysed using hour, day, lactation system and floor type as fixed effects and pen as random effect (PROC GLIMMIX, SAS). Does showed higher durations of aggressive interactions (16.6 ± 1.59 vs 12.4 ± 1.20 sec/pen/interval) and mount attempts (14.1 ± 2.40 vs 7.4 ± 1.28 sec/pen/interval) in F than R pens ($P < 0.05$). They exhibited more (0.47 ± 3.56 vs 0.32 ± 2.43 events/pen/interval) and longer (17.1 ± 1.64 vs 11.9 ± 1.16 sec/pen/interval) aggressive interactions in W than P pens besides more chasing (0.08 ± 3.22 vs 0.04 ± 1.69 events/pen/interval) and mount attempts duration (14.1 ± 2.41 vs 7.4 ± 1.27 sec/pen/interval) ($P < 0.05$). In conclusion, lactation system and pen floor influenced aggressiveness. Further studies are necessary to elucidate the reasons and the mechanisms for the different aggressiveness observed with the two lactation systems, and to confirm differences between does kept on wire net compared to does on plastic floor.

The motivation-based calving facility*Maria Vilain Rørvang, Mette S. Herskin and Margit Bak Jensen**Aarhus University, Department of Animal Science, Denmark; maria.vilainrorvang@anis.au.dk*

To ease calving and safeguard animal welfare, cows are moved to individual calving pens (ICP) when calving is due. However, cows may be moved too late and disturbed, which prolongs calving and challenges welfare. Development of calving systems based on dairy cows' pre-calving motivation to seek isolation may facilitate the use of ICPs. This study examined whether such system, facilitates the use of ICPs. Danish Holstein cows (n=66) were housed in groups of six in a 9×9 m area connected to six individual and secluded calving pens (4.5×3 m). Cows were trained to use one of two isolation opportunities i.e. ICPs with functional gates (n=34) allowing only one cow access at a time, or ICPs with permanently open gates allowing free cow traffic (n=32). Response variables were location of calving, social and calving behaviour. Factors influencing the use of the isolation opportunities were identified by logistic regression (R-software) and are presented as odds ratios and 95% confidence intervals. Contrary to the hypothesis, functional gates did not increase the use of ICPs (21 cows with open gates vs 13 cows with functional gates: OR: 51.41 [1.83-72.97]; P=0.068). Across all cows, dominant cows (determined using displacement events) had the highest odds of calving inside an ICP (OR: 1.14 [1.07-1.30]; P=0.0035). If an alien calf was present during the last 8 h pre-calving, cows were less likely to calve inside an ICP (OR: 0.46 [0.011-1.25]; P=0.069). Cows that had their first rhythmical contractions in an ICP had higher odds of calving in the pen (OR 54.05 [2.89-162.82]; P=0.036). Taken together, functional gates did not facilitate isolation seeking and the cows may have perceived the mechanical gate as an obstacle rather than an advantage when choosing calving site. It is possible that the cows were not able to combine the learnt response with the innate motivation. Social factors had a strong influence on seeking isolation. In order to develop a successful motivation-based calving system, where ICPs are used appropriately, future studies should focus on easing entry to ICPs, explore options to increase the isolation motivation and reduce competition for ICPs.

The relationship between response to humans and social aggression in pigs

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Mixing unfamiliar pigs is common in modern production, resulting in intense fighting that can lead to injury and stress. To address this concern we need to understand how aggression is related to other behavioural traits. Responses in human approach tests (HAT) and handling tests were compared with skin lesions to assess the relationship between aggression and human-response for 257 grow-finish stage barrows across 20 pens. Pigs were mixed at 10 wk. Skin lesions (fresh, red marks), a reliable proxy of social aggression, were counted pre-mixing, 24 h post-mixing, and 3 wk post-mixing (stable) by body location (front, middle, and rear) because of research showing differences in fighting strategy based on location. Behaviour tests were conducted at 14 wk. For HAT, frequency and intensity (low/moderate or extreme force) of oronasal contact with observer was recorded every 30 s for 9 min. For handling tests, activity and reactivity while entering, in, and leaving a weigh crate were recorded. General linear mixed models compared HAT responses and skin lesions. For analysis in stable groups, the response variable was lesions by body location; fixed effects were human approach response, repetition, lesion observer, pen as random effect, and weight at mixing as covariate. No effect was found for stable score lesions and interaction with observer ($P>0.05$). For analysis of 24 h post-mix, pre-mix lesions added as a fixed effect. We found that pigs bullied after mixing (high rear lesions) interacted more intensely in HAT ($P=0.026$). The same models were used for handling scores. Pigs bullied in stable groups were less active in the weigh crate ($P=0.021$). Results suggest that social aggression is related to human-related behaviour, but more research is needed. This study is part of a larger study comparing video-recorded affiliative and aggressive behaviours, lesion scores, and genotypes ($n=1,070$ pigs) for further understanding of pig sociality.

Effect of heat stress on piglet welfare – application of a non-invasive gut permeability marker

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Climate change impacts the sustainability of livestock production. Due to increasing temperatures, animals are more frequently exposed to episodes of heat stress. Consequently, welfare of food-producing animals is impaired by disturbances in their energy metabolism, hormonal status, immune system or gut integrity. Here, we evaluate the influence of heat stress on gut permeability of piglets by employing a non-invasive dual sugar assay. At nine weeks of age, eight piglets were placed pairwise in metabolic cages. After an adaption period of four days, pigs were kept for 24 h under thermoneutral conditions (28 °C, day 1). On days 2-4, all piglets were exposed to periods of heat stress (35 °C for 6 h per day; 18 h at 32 °C). On day 1 and 3, agar containing lactulose (500 mg/kg b.w.) and rhamnose (100 mg/kg b.w.) was fed to the piglets. Urine was collected on day 1 as well as 2, 4 and 6 h after sugar application day 3, and analysed for lactulose and rhamnose by HPLC-MS/MS. All procedures were performed according to Austrian law (LF1-TVG-39/012-2014) and the European Guidelines for the Care and Use of Animals for Research Purpose. Obtained mean values were analysed with a nonparametric test. No significant differences between the cumulative lactulose and rhamnose excretions on day 1 and day 3 were observed. However, the urinary lactulose/rhamnose was significantly increased ($P=0.0286$) when piglets were exposed to heat stress. In contrast to previous studies, we demonstrated the impact of heat stress on gut integrity by using a non-invasive method. Although this assay is often used to assess human gut integrity, its application in animals is still limited. Thus, we highlighted the negative effects of elevated temperatures on gut health and, hence, animal welfare.

Using sensors to monitor behaviour at the dairy farm

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Sensors can measure various types of behaviour automatically in a dairy herd. They can, therefore, be used to monitor a herd and the computer can detect deviations of normal behaviour and give an attention to the farmer. In order to do so, normal baseline values are needed. Since these may vary due to parity and housing conditions, the aim of this study was to investigate the effects of parity and freestall bedding (cow mattress vs deep litter) on daily lying time, locomotion, standing and eating time from 42d a.p. – 28d p.p. Sixteen Dutch dairy farms (3,158 cows) were used in this study and the number of steps per day, time of standing and lying (in sec/2 h period) and time eating (in sec/2 h) were collected by means of Nedap smart tags (Groenlo, the Netherlands). Furthermore, in the first two weeks post-partum blood samples were collected to measure BHB levels. T-tests and timeseries were used for comparison. The results of locomotion revealed that primiparous cows made 833 (SD 132; $P < 0.001$) more steps on daily basis in comparison with multiparous cows. Animals housed on cow mattresses made on daily basis on average 621 (SD 30; $P < 0.001$) more steps vs animals in stalls with deep litter bedding. Primiparous cows spent daily on average 64 minutes (SD 4.8; $P < 0.001$) less time lying down and animals on farms with cow mattresses lie on daily basis around 30 (SD 17.3; $P < 0.001$) minutes less when compared with animals housed on farms with deep litter bedding. The number of lying bouts increased from 6 to 9 per day 1 day before calving and decreased to 7 per day after calving. The time lying per day decreased before calving. And the average lying time increases again in the first week post-partum. Cows that had a subclinical ketosis post-partum were eating half an hour less during the dry period. Already 42 days before calving this difference could be observed. It became clear that with sensors differences in behaviour during the dry period can be detected that could lead to managerial interventions to reduce the risk for diseases post-partum. This study is ongoing and more data will be obtained.

Intratesticular alfaxalone and lidocaine for induction of anaesthesia during castration in piglets

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The objective was to determine whether intratesticular (IT) injection of an alfaxalone-lidocaine drug combination can induce anaesthesia and provide a rapid recovery in piglets undergoing surgical castration. Thirty piglets 2-10 days old were randomly divided into three alfaxalone + lidocaine dose groups: low [LD (4 mg/kg + 1.5 mg/kg)], medium [MD (6 mg/kg + 2 mg/kg)], and high [HD (8 mg/kg + 2.5 mg/kg)]. Induction times (i.e. time from IT injection to lateral recumbency) and recovery times (i.e. time from IT injection to standing recovery) were recorded, as well as movement and vocalization. Heart rate, oxygen saturation, respiratory rate, temperature, blood pressure, and end tidal carbon dioxide were recorded over time. Continuous data were analysed using a two-way ANOVA for repeated measures, induction and recovery times were compared using a one-way ANOVA, and categorical data were analysed using a Chi-squared test. Induction time did not differ between groups ($P=0.19$) with a mean time of 2:11 min, 3:17 min, and 3:44 min for HD, MD and LD, respectively. Recovery time was significantly faster in LD, compared to MD and HD ($P=0.005$) with a mean recovery time of 34:06 min, 31:37 min, 29:34 min for HD, MD, and LD, respectively. Incidence of movement and vocalization was decreased in MD and HD compared to the LD group, but did not show statistical significance. Physiologic data revealed no differences across the three groups. All parameters were stable over time except for heart rate, which decreased in all three groups ($P<0.05$) and respiratory rate, which increased in the LD and MD groups ($P<0.05$). The alfaxalone-lidocaine combinations investigated in this study induced a deep sedation in all piglets. Physiologic data remained within clinically acceptable ranges, suggesting that this drug combination works well for intratesticular injection prior to castration in neonatal piglets.

Immune response of suckled beef calves to dam vaccination against bovine respiratory disease

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Peak incidence of pneumonia occurs in young calves less than 3 months of age. The objectives were: (1) characterise the development of immunocompetence in beef suckler calves from birth to 3 months of age; and (2) trace glycoprotein E (gE)-negative bovine herpesvirus type 1 (BoHV-1) antibodies from vaccinated dams to calf sera and investigate the calves' response to live BoHV-1 at 2 weeks of age. The study consisted of thirty multiparous (MP) beef suckler, spring-calving cows: Limousin × Friesian (LF; n=15) and Charolais × Limousin (CL; n=15). Cows were immunised against BoHV-1 at day(d) -84 and -56 pre-partum. Calves were immunized at 2 weeks of age against Parainfluenza type 3 virus (PI-3 virus), bovine respiratory Syncytial virus (BRSV) and *Mannheimia (Pasteurella) haemolytica*. All calves were also immunized against BoHV-1 at 6 weeks of age, using 1 dose of a live commercial vaccine; this was administered intra-nasally at 6 weeks of age. Cows were blood sampled by jugular venipuncture at d -84, d -56, d -28 (pre-calving), d 0 (calving), and at d 14 post-calving. Blood samples were collected from the calves (n=30) via jugular venipuncture at birth, prior to colostrum feeding (0 h), at 12 h, 24 h, 72 h and 168 h after the initial feeding of colostrum, and at d 7, 14, 28, 42, 56 and 84 post birth. The mean concentration of gE negative antibodies circulating in the dam's blood pre-partum proved negative to gE ab (S/N≥0.70). The CL and LF cows proved negative to gE-antibodies. Total circulating BoHV-1 antibody levels peaked (85%) at 12 h post birth in calves and declined thereafter, as the maternal antibodies decayed. There was no difference (P>0.05) in BoHV-1 and BRSV antibody levels in calves post vaccination at 2 weeks of age or after the booster BRSV vaccine. Further research is warranted to improve vaccine effectiveness against pneumonia in calves with maternally derived antibodies.

Illumina MiSeq 16S amplicon sequence analysis of bovine respiratory disease associated bacteria

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Currently used culture and molecular methods for identification of bacteria associated with fatal cases of the bovine respiratory disease (BRDC) will not identify unknown or unculturable pathogens. The study objective was to develop a single universal assay, based on high throughput phylogenetic (16S ribosomal RNA (rRNA) gene) PCR amplicon sequencing, with potential to accurately identify and differentiate bacteria in post-mortem lung and lymph node tissue samples harvested from fatal BRDC cases. Thirty-eight lung (cranial lobe) and 32 corresponding mediastinal lymph node post-mortem tissue samples were collected from beef and dairy calves and confirmed as BRD cases by veterinary laboratory pathologists. To serve as a comparison, 20 lung (cranial lobe) and 20 corresponding mediastinal lymph node tissue samples were also sourced from healthy Holstein-Friesian calves. DNA extracted from the tissue samples was used to prepare 16S rRNA gene amplicon libraries were sequenced on an Illumina MiSeq. Quantitative insights into microbial ecology (QIIME) was used to determine the operational taxonomic unit (OTU) which corresponded to the 16S rRNA gene sequences. Calves had unique lung and lymph node microbiomes. Bacterial OTUs were identified within the post-mortem tissue samples from both healthy calves and calves which died from the BRDC. *Leptotrichiaceae*, *Pasteurellaceae*, and *Fusobacterium* were the most abundant OTUs identified within the lungs and lymph nodes of the calves which died from BRD. *Leptotrichiaceae*, *Fusobacterium*, and *Mycoplasma* had greater relative abundances in post-mortem lung samples collected from dairy calves which died from BRD compared with healthy calves. *Leptotrichiaceae* and *Pasteurellaceae* showed higher relative abundances in post-mortem lymph node samples collected from fatal BRDC dairy calf cases, compared with healthy, lung lesion free, Holstein-Friesian calves. In conclusion, we have shown that a single universal bacterial 16S rRNA gene amplicon sequencing assay can detect the bacteria present in a BRDC tissue sample. Using this assay, we have identified a novel bacterial species which appears to be associated with BRD.

Commercialising an automated GPS-based virtual fencing system for livestock*Dana Campbell¹, Jim Lea¹, William Farrer², Sally Haynes² and Caroline Lee¹**¹CSIRO, Agriculture and Food, Australia, ²Agersens, Australia; dana.campbell@csiro.au*

Managing grazing cattle, particularly in extensive pasture-based systems is challenging due to the limited farmer contact with animals and this may result in welfare issues. Vast farm areas can restrict construction of physical fences that enable better control over animal monitoring. Thus virtual fences (VF) – boundaries with no physical barrier – have the potential to enable remote monitoring of animal location and movement patterns, reduce handling during herding and keep animals away from hazardous environments. Consequently, VF represent a sustainable fencing solution in complex land areas for improved welfare. The Commonwealth Scientific and Industrial Research Organisation (CSIRO) has partnered with Agersens, Australia to commercialise patented VF collar technology for cattle. The VF algorithm tracks the animals' location through GPS and emits an audio tone as the animal approaches the VF boundary. If the animal stops or turns away no electrical stimulus is applied, but if the animal continues forward an aversive electrical stimulus is applied. Animal location and collar activity can be monitored online. The automated collar prototypes were tested on a group of 6 Angus heifers located in a 6.2 ha experimental paddock. Cattle were first given access to 100% of the paddock for 4 days to acclimate and then a VF was set to restrict animals to 40% of the paddock. Excluding the first 24 h period of learning the VF boundary, across approximately 1 week, on average, animals spent 90.52% (SE 2.30%) of their time in the 40% inclusion zone. On average, 79.72% (SE 1.20%) of the signals emitted by the collar were audio cues, indicating animals were avoiding the VF based on audio signals alone. These initial tests show the automated collars represent a potential tool for remote control and monitoring of grazing cattle for improved welfare management. This project is supported by funding from the Australian Government Department of Agriculture and Water Resources as part of its Rural R&D for Profit programme.

Management of cull dairy cows: consensus of an expert consultation in Canada*Jane Stojkov and David Fraser**The University of British Columbia, Faculty of Land and Food Systems, Animal Welfare Program, Canada; j.stojkov@alumni.ubc.ca*

Management of cull dairy cows is a significant animal welfare challenge that has received little systematic attention in practice, policy and research. Dairy cows are continually removed from dairy herds and many are culled because of health issues. Because the market for these animals is specialized, cows with compromised health may be transported significant distances to slaughter and loaded and unloaded several times. The objectives of this study were to describe the diverse management of cull dairy cows in Canada and develop consensus for future actions, policy and research. Lacking quantitative research, a qualitative methodology was used. A two-day expert consultation was convened, involving farmers, veterinarians, regulators, animal transport, livestock auction and slaughter sectors. Participants (n=15) were recruited through 'key informants', and discussed provincial management practices of cull cattle, related risk factors, animal welfare problems and recommendations. The meeting was audio-recorded and used to extract descriptive data on cull cattle management and identify points of agreement. The results indicated significant differences in management practices between provinces, long transport distances in some cases (Newfoundland to Ontario – roughly 3,000 km), multiple handling events at livestock auctions, and dealer networks involved in multiple sales which increased the time from farm to slaughter (7-10 days). Nine consensus points were reached: (1) to gather information on travel times from farm to slaughter; (2) to increase awareness among producers and herd veterinarians of potential travel distances and delays; (3) to promote proactive culling; (4) to improve the ability of personnel to assess animals' condition and fitness for transport; (5) to identify local options for slaughter; (6) to investigate different management options such as on-farm slaughter; (7) to ensure that farms and auctions have personnel trained and equipped for euthanasia; (8) to promote cooperation among enforcement agencies; and (9) to eliminate certain forms of unnecessary handling.

Long distance transport of unweaned calves in practice: welfare concerns*Cecilia Pedernera¹, Iris Baumgärtner¹, Sabrina Gurtner¹ and Lesley Moffat²**¹Animal Welfare Foundation, Germany, ²Eyes on Animals, the Netherlands;**c.pedernera@animal-welfare-foundation.org*

To be reared for veal or beef, thousands of calves born on dairy farms are collected at just several weeks of age to be transported on long-journeys to farms in countries such as the Netherlands, Italy or Spain from countries as far away as Lithuania, Poland and Ireland. It is not possible to give milk to unweaned calves on board the vehicle. As a consequence the unweaned calves suffer from hunger, stress and increasing weakness during long-distance journeys. Some of them cannot cope with transport and arrive dead at their final destination. Between 2014 and 2016 our teams documented ten consignments of unweaned calves and gathered evidence of poor enforcement of Council Regulation (EC) 1/2005. By inspecting the trucks during the stops or at arrival, the types of drinkers were identified and animals drinking as well as number of weak or dead animals were assessed. Behaviours related to hunger were registered as present or absent. Results: during our inspections, not one of the vehicles was equipped with drinking devices other than metal nipples which are not appropriate for calves and can only be used to offer water. None of the calves was supplied with liquid after 9 h. Calves showed indicators of hunger such as vocalizations, licking the walls of the truck and redirected suckling behaviours. We observed three dead animals at arrival to destination, one unfit animal was reloaded after the stop in a Control Post. Three years evidence, shows that the binding requirement of supplying animals with specie- and -age- appropriate feed on board during long-distance journeys of more than 8 h is not a common practice, no improvement was registered. Long distance transport of unweaned calves is not possible without exposing these animals to conditions that are causing undue suffering to them and the subsequent welfare problems.

Restlessness of dairy cows before calving

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Careful monitoring of cows helps to minimize pain and distress during calving, and knowledge of the time of birth is important to ensure timely and adequate uptake of colostrum. However, direct visual observation is time consuming and continuous presence of an observer during stage two of calving can disturb cows; therefore, to predict precisely the calving time, various methods have been proposed to automatically and remotely measure physiological (body temperature; blood level of oestrone-sulphate, 17 beta oestradiol and progesterone; electrolytes in mammary secretion), physical (relaxation of pelvic ligaments; physical separation of the vulva lips) and behavioural indicators. Restlessness is one key behavioural change occurring when calving is approaching. Video cameras or accelerometers recording behaviour of cows can be integrated in systems using image analysis or locomotive activity to alert the farmer when calving is approaching; however, alerting systems require input of benchmark information about behaviours and changes in behaviours which can be predictive of the time of calving. Eight cows in a calving barn were continuously video-monitored. The recordings of the 24 h before calving were analysed to identify the routine behaviours associated with an imminent birth. In our conditions, the only behaviour that was significantly influenced by the distance from calving was frequency of lying bouts; the average number of lying bouts started to increase ($P < 0.0001$) at 3 h before calving reaching the greatest ($P < 0.0001$) value during the last two hours before calving. Increase in the frequency of lying bouts may be an indicator of restlessness useful to predict approaching calving, but further studies are needed to input benchmark values in automated alerting systems.

A farmer survey report on calf mortality rates Southern Brazil

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Calf survival is a crucial indicator of welfare level in a herd, one with a direct impact on farm and dairy industry economy and sustainability. Recognition of calf mortality is the first step to understanding how husbandry strategies in a heterogeneous dairy farming community affect calf survival. Brazil, the world's fifth milk producer, has no updated data of calf mortality rates or husbandry and breeding practices that act as on farm risk factors. This study is the first within a larger project investigating calf mortality risk factors at herd level, and farmers' attitudes towards calf rearing in the southern state of Rio Grande do Sul, where 95% of the milk is produced in smallholding family farms. Trained technicians applied a closed question survey when farmers visited their local agriculture development office. Questions related to demographic information, general dairy herd description, estimated number of heifer calves born and dead in the previous 12 months, cause of death, calf husbandry, feeding and neonatal management practices. A total of 1,460 valid responses across 307 out of 497 state municipalities were obtained, representing all 7 state regions. Herds had ≤ 20 cows and average milk production of 6,000 l/month. Farmers' reported mortality rate was 8.5% (21% stillbirths and 79% live births) out of 10,721 calves born in the previous 12 months. Pre-weaning mortality was concentrated in 39.9% of the farms: up to 2 calves died in 32.6%, and ≥ 3 calves in 7.3% of the farms. The main reported causes of death were diarrhoea (44.3%), unknown causes (38.3%), and pneumonia (5.5%). The fact that farmers struggled to identify the cause of death highlights the lack of knowledge of signs that could aid them to tackle disease on time and apply preventive care measures. Our study provides the first report on dairy heifer calf mortality rates in smallholding dairy farms in Brazil.

Nasal wipes: a welfare refinement for sampling influenza virus in pigs

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Influenza infection is an important veterinary and public health issue. Nasal swabs are the current gold standard for sampling influenza virus in pigs. Taking nasal swabs is a regulated procedure in the UK requiring restraint. This causes stress to the pig and others nearby when they vocalise. Restraining large strong animals is time consuming, associated with health and safety concerns and requires at least three trained technicians when sampling. In comparison, nasal wipes are a non-invasive, unregulated procedure which can be performed quickly without restraining the animal, representing a valuable welfare refinement. The aim of the study was to assess the suitability of nasal wipes for sampling influenza virus in pigs. Nasal swabs were compared to cotton and nylon nasal wipes by obtaining viral shedding profiles of four pigs intra-nasally infected with swine influenza virus. The pigs used in this study were the unvaccinated control group from a larger influenza study, and were sampled daily for 7 days post infection (DPI). All samples were stored at -80 °C before the virus was re-suspended in medium and viral RNA extracted and quantified using Real Time RT-PCR. Both nylon and cotton nasal wipes were effective at detecting viral shedding and the profiles agreed well with swab data based on ANOVA performed in R statistical program. However, cotton wipes were less effective 3 DPI, with a relative equivalent unit (REU) titre of 2.05 log₁₀ TCID₅₀/ml (SD 0.95) compared to 2.89 REU (SD 0.53) for swabs (P=0.03). On 5 DPI swabs 2.09 (SD 0.34) REU were significantly better at detecting viral shedding than both cotton 0.23 (SD 0.22) REU P≤0.000 and nylon 0.03 (SD 0.06) REU P≤0.000 wipes. Nasal wipes were effective for sampling influenza virus in this study, but were less sensitive than swabs when virus shedding occurred at low levels. Wipe sampling could be applied on farms or at agricultural shows to provide samples for qualitative assessment of influenza virus infection while causing minimal distress to pigs.

Animal welfare in free-roaming Konik polski horses

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Konik horses are increasingly maintained in forest sanctuaries either as a native, primitive breed that contributes to conservation of genetic resources or as semi-feral populations maintained for landscape cultivation and/or for protection of biodiversity in wastelands. It is believed that free-roaming animals, living in habitats that enable the full repertoire of natural behaviours, have generally higher welfare than those kept in stables. Present overview, based on long term observations that were conducted on a basis of daily inspections of free-roaming Konik herds over 8 to 60 years in six forest sanctuaries in Poland, has more general than experimental character. Welfare of Koniks was assessed on the base of body condition, health status, injuries, reproduction performance and species-typical behaviour. The observations confirmed that Koniks are not exposed to malnutrition or suffering and their physiological and behavioural needs are fulfilled. At densities of 9-44 ha per 1 adult horse, as calculated on a basis of acreage available for horses and population sizes in particular sanctuaries, apart from insect harassment in summer, sporadic welfare issues are related to accidental drownings in marsh in winter due to falling through ice, immobilization in grooves during wallowing and skin lesions as results of combat between stallions. Our experience shows that appropriate welfare of free-roaming horses can be assured by the selecting areas with sufficient feeding resources and with natural shelter (trees and/or bushes). Human interventions can be limited to supplying hay during periods of thick snow cover whilst overstocking must be avoided by controlling the population growth.

Effects of space allowance on the stepping responses of sheep to motions simulating sea transport*Grisel Navarro and Clive Phillips**Univeristy of Queensland, Centre for Animal Welfare and Ethics, Australia;**grisel.navarro@uq.net.au*

Adequate space is important to allow transported animals to spread their limbs in different directions during their attempts to maintain balance by stepping when the vessel or vehicle moves. We tested whether space allowance and type of motion impact on stepping behaviour. Nine sheep were exposed in a factorial design to combinations of two treatment sets: low (0.78 m²/sheep), medium (0.92 m²/sheep) and high (1.04 m²/sheep) space allowances, and Regular (programmed roll movements), Irregular (a random sequence of pitch and roll movements) or no floor movements. During each treatment application 3 sheep were exposed for 1 h to one of the 9 treatments in a cage of variable dimensions, using a Latin square design. The behaviours were recorded by video cameras and analysed using behaviour software. Values were converted to log₁₀ steps/hour to achieve normal residual distribution. The most common directions of the movements were foreleg and hindleg forward/backward and the least common movement was foot returning to the same place (4.17, 2.81, 1.09 steps/h, respectively, P<0.001). Sheep stepped more in the Low than Medium and High space allowances (1.57, 1.41, 1.45 steps/h, respectively, P<0.001), and more in the Regular than Irregular and Control (0.25, 0.12, 0.13 steps/h, P<0.001), which corresponded to increased aggression. There was evidence that sheep partially adapted to Regular but not Irregular movement over time (P<0.001). There was no evidence that space allowance affected the direction of stepping movements (P=0.40). However, regular movement increased frequency of feet returning to the same place, compared with the control (Regular 1.19, Control 1.07, P<0.001), suggesting that sheep were using predictable stepping movements in response to the rolling motion. We conclude that low space allowance and regular ship-like movement increased sheep stepping responses, which may reduce their welfare.

The effect of straw bales on foot pad dermatitis in broilers*Ida J. Pedersen¹, Fernanda M. Tahamtani², Anja B. Riber² and Björn Forkman¹**¹University of Copenhagen, Department of Veterinary and Animal Sciences, Denmark, ²Aarhus University, Department of Animal Science, Denmark; ida.jp@sund.ku.dk*

A major animal welfare issue in broiler production is leg and foot pad health. One of the proposed strategies for improving leg health in broilers is to increase their activity, and a way of doing this is providing straw bales. However, previous studies show that straw as bedding material is a risk factor for foot pad dermatitis. In the current study we investigate the effect of giving access to straw bales on foot pad dermatitis. Pens (9.5×3 m) with 500 broilers in each (Ross 308, mixed sex), corresponding to a stocking density of 40 kg/m² were used. The litter material was wood shavings, commercial feed was used and the birds were slaughtered at day 35. In three of the pens 3 bales of straw/pen were placed, evenly distributed in the pens. The bales were not replaced during the experiment. The fourth pen functioned as a control pen. Sixty randomly chosen birds, at 34 days of age, from each pen were scored for foot pad dermatitis using a 3-point scale. Left and right foot pad scores were merged to a combined score (0, 1, 2, 3 and 4). The distributions of scores 0, 1, 2, 3, 4 in percent were 41, 11, 39, 5, 4 (median:1, min: 0, max:4) and 55, 13, 8, 12, 12 (median:0, min: 0, max:4) in the bale treatment and control, respectively. A significant difference was found between the treatment and control (P=0.00547, χ^2), with a lower percentage of severe foot pad scores (score 3 and 4) in the straw bale treatment. The study is on-going and more replicates will be included to strengthen the statistical conclusion. The preliminary results indicate that, unlike straw bedding, straw bales are not a risk factor for foot pad dermatitis, possibly due to increased activity levels. This research was funded by the EU FP7 Prohealth project (no. 613574).

BeTi – Berger Tierwohl: implementing animal health and welfare planning on commercial pig farms

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To monitor and improve animal health and welfare (AHW) on its supplying pig fattening farms an Austrian abattoir and meat processing company approached university to launch a joint project on AHW planning (AHWP). For this purpose, AHW was assessed on 11 farms (270 – 1,408 fattening places, fully-slatted floor systems) in 2016 using a management questionnaire (farm characteristics, herd and disease management, hygiene, feeding; 16 questions), animal based measures (productivity, treatment records, slaughterhouse findings, clinical scoring, behavioural observation; 32 measures) and pen equipment (6 items). Subsequently, a written report was created for each farm including benchmarking of animal based measures. One to three goals and specific measures to achieve them were developed and added to the report during an individual advisory visit together with the farmer(s). The most common goals and measures (n) were: (a) reduction of tail and ear biting (6) by improving quality of environmental enrichment (6) and other management strategies (3) such as separating the biter from the group, docking tails equally long, regular maintenance of drinkers; (b) reduction of respiratory diseases and/or diarrhoea (5) by identification of relevant pathogens (5) and adaption of treatment strategies (1); (c) parasite control (5) by adapting deworming strategies (5) and improving pen hygiene (2); (d) increasing daily weight gain (3) by improving feeding ration (3); and (e) reducing fly pressure (2) in the pens by introducing slurry flies (2). The focus of farmers on environmental enrichment and diagnosis of disease reflects the most relevant findings (e.g. median prevalence of tail lesions 9.3% or pneumonia 31.9%) and the willingness to address behavioural needs of pigs. To evaluate the impact of agreed and implemented measures on AHW, all farms will be visited one year after the initial visit. AHWP may be a suitable tool for farm management as well as quality assurance for abattoirs and retailers.

Salivary HSP70 as a putative biomarker of heat stress in high yielding dairy cows

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Molecular chaperones of the HSP70 family provide protection for cells against environmental stress. HSP70 levels in blood reportedly increase during heat stress in livestock. HSP70 has been reported to be present in saliva of humans but, to our knowledge, it has yet not been described in cattle. The aim of the present study was to determine whether HSP70 was detectable in saliva of dairy cows. Eight high-yielding (305 D milk production: 11,367±1,006 kg) and eight lower-yielding (305 D milk production 8,002±643 kg) Holstein Frisian cows (lactation: 2.3±0.5 and 2.1±0.4; DIM: 115.8±47.4 and 112.0±46.3, respectively) from a dairy farm in the Alentejo region, Portugal were involved in the study. Saliva samples were collected from the cows in summer and winter (average environmental temperatures in summer and winter: 32.8 and 11.5 °C, respectively). Salivette cotton rolls (Sarstedt GmbH, Germany) were used, and centrifuged samples were stored at -20 °C until quantification by ELISA (SEA873Mi, Cloud-Clone Corp, USA). Samples were run in duplicate. Data were analysed by One-way ANOVA and Tukey-Hsu test. Salivary HSP70 concentrations ranged from 0.524 to 12.174 ng/ml. For high producing cows, salivary HSP70 concentrations were higher in summer than in winter (7.34±2.03 vs 2.54±0.26, respectively; P=0.033). No differences among periods were observed for low producing cows (2.34±0.6 vs 2.27±0.2, respectively). To our knowledge, this is the first time that HSP70 is reported to be present in cattle saliva. This preliminary study highlights that salivary HSP70 as a non-invasive biomarker may be a potential tool in further studies on thermal adaptation in cows. Acknowledgements: Viktor Jurkovich: DairyCare COST STSM; Bolyai János Research Fellowship of Hungarian Academy of Sciences. Elsa Lamy: National Funds through FCT, Project UID/AGR/00115/2013; Investigator FCT contract IF/01778/2013.

Changes in tail posture, a possible early warning sign of tail biting

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Damaging tail biting behaviour is very difficult for farmers to predict, due to the many risk factors associated with the behaviour. A previous study finds that tail damages more often appear on hanging or tucked tails compared to curly tails. If such changes in tail posture can be spotted before tail damages occurs, then changes in tail posture could be an early warning sign of a tail biting outbreak. In the present study, we investigated if pre-injurious tail directed behaviour (TDB) affected tail posture and the response of receiving pigs at a commercial farm. The individual pig's response to TDB and the effect of TDB on tail posture were recorded in 24 pens (743 pigs with intact tails from 7-30 kg, 31 pigs per pen, +/- 1.25 s.d) using video recordings. TDB (tail interest, tail-in-mouth and tail bite), the response of the receiver (+/- reaction) and the immediate change in tail posture were recorded during a 2-hour period the day before a tail biting outbreak. In total, 1,544 incidences of TDB were logged (18.1% tail bites) leading to a response from the receiving pigs in 87.4% of the cases. The type of TDB affected the response, with more pigs reacting to tail bite compared to tail-in-mouth ($\chi^2=41.6$; DF=2; $P<0.001$) and tail-interest ($P<0.001$), while no difference was observed between tail-in-mouth and tail interest. TDB affected tail posture ($\chi^2=323$; DF=2), with fewer curly tails or tails on the floor of lying pigs (41.9 to 8.4%; $P<0.001$) and more tucked (13.0 to 38.4%; $P<0.001$) and hanging tails (45.1 to 53.2%; $P<0.001$) after TDB. In conclusion, supposed TDB is a predictor of injurious tail biting, then changes in tail posture and the high rate of responding to TDB, indicate that it might be possible to predict a tail biting outbreak.

Platform use in lactating dairy goats relates to production and behavioural responses to noveltyGosia Zobel¹, Heather Neave² and Jim Webster¹¹AgResearch Ltd., Animal Welfare Team, New Zealand, ²University of British Columbia, Animal Welfare Program, Canada; gosia.zobel@agresearch.co.nz

Goats are natural climbers but it is unknown whether lactating dairy goats naïve to climbing opportunities would express this behaviour. This study quantified platform use and related it to production and tests that evaluate how goats respond to novelty. A group of twelve multiparous Saanen cross goats was provided with a platform (4×1×0.7 m, 35° ramp/each end) on rubber mats adjacent to a bedded area (wood shavings). Goats had *ad libitum* water, fresh-cut pasture, silage (delivered twice daily), and a maize-based supplement at milking (600 g/d). Daily milk production was recorded. Two 48-h periods (excluding 2.7 h/d for milking) were video-recorded to determine platform use (lying/standing on and under platform) of each goat. Before and after observation, goats were weighed, and human approach and novel object tests (5-min each) were conducted. Eight behaviours (exploring, escape attempt, walking, tail raise, vocalizations, looking at human/object, touching human/object, latency to approach human/object) were recorded, and averaged across tests. All goats used the platform but interacted with it in different ways, spending 1.9±0.8 h/d on the platform, and 0.9±0.8 h/d under the platform. A principal components analysis found 4 Factors accounted for 88% of the variability in platform use: Factor1: exploring, touching human/object (highly positive), latency to touch human/object (highly negative); Factor2: vocalizations, walking (highly positive), Factor3: escape attempt, tail raising (highly positive), and Factor4: looking at human/object (highly positive), vocalizations (moderately negative). Regression analysis showed that goats with lower Factor1 loadings ($P<0.05$), higher milk production ($P=0.01$), and lower weight ($P<0.05$) spent more time on the platform. Goats with higher Factor3 loadings spent more time under the platform ($P<0.001$). In summary, lactating goats readily use platforms, but this behaviour relates in part to individual behavioural and production traits; further analysis is examining how platform usage is affected by the relationships between individual goats.

Synchronisation of behaviour of bulls on pasture and in pens*Jaakko Mononen, Leena Tuomisto and Arto Huuskonen**Natural Resources Institute Finland, Green Technology, Finland; jaakko.mononen@luke.fi*

High synchronisation of behaviour in cattle has been proposed to indicate the animals' freedom to express their natural social behaviour. Hence, synchronisation is also a putative on-farm welfare measure in cattle. We compared behavioural synchrony of bulls on pasture and in pens. Fifteen Finnish Ayrshire and four Holstein-Friesian bulls (Year 1) and 29 Hereford bulls (Year 2) were allotted semi-randomly to two treatments. PAS treatment animals (n=5 groups of 4 or 5 animals) were housed in winter in group pens in an uninsulated barn but kept on pasture from early June to late August. PEN treatment animals (n=5 groups of 4 or 5 animals) were kept in group pens in the uninsulated barn in winter and summer. The groups of animals remained the same throughout the study. The behaviour of the bulls was recorded for 24 h with instantaneous sampling (6 min sampling interval) in June and July, i.e. when the animals were 14-15 and 15-16 months old, respectively. Three mutually exclusive categories of behaviour were used: grazing or eating, lying and standing. Kappa co-efficient was calculated as an index of behavioural synchrony for each group and day from the 240 (=1,440/6) sampling points per day. The data for the two years were pooled and the Kappa co-efficients were compared between the treatment groups with the Mann-Whitney Test separately for June and July. The PAS bulls showed markedly higher synchronisation of behaviour than the PEN bulls both in June (0.63 ± 0.029 vs 0.29 ± 0.050 ; mean \pm SD; $P=0.008$, $n=5$ per treatment) and July (0.63 ± 0.043 vs 0.32 ± 0.042 ; $P=0.008$, $n=5$ per treatment). Our bull results are in accordance with earlier findings in dairy cows: larger space with more behavioural freedom increases behavioural synchrony in cattle.

Natural extracts in weaned piglets nutritionGrazia Pastorelli¹, Mario Pellacini² and Barbara Pizzi²¹University of Milano, Department of Veterinary Medicine, Italy, ²Ferrero Mangimi spa, Italy; grazia.pastorelli@unimi.it

Weaning is a crucial period for piglets, during which they undergo severe stress that can affect feed intake, the development of gastrointestinal tract and absorption of nutrients. Meanwhile, the level of antioxidants declines, increasing morbidity and mortality. In the post-weaning period, to minimize complications the piglets' diet can be integrated with natural extracts with antioxidant and anti-inflammatory effects. Moreover the response to oxidative stress is considered as an effective parameter for assessing pig's welfare. The aim of this study is to evaluate the effect of dietary supplementation of natural extracts on piglets performance and total antioxidant activity. KRL test evaluated the total antioxidant activity of whole blood and red blood cell (RBC) by measuring the time required to haemolyse 50% of the RBC exposed to a controlled free radical attack. A total of 160 piglets were assigned to 4 dietary treatments: Control diet (CTR) (Ferrero Mangimi, spa), and CTR diet supplemented with *Boswellia* (500) (BOS), *Uncaria* (200) and *Tanacetum* (50) (U+T) and antioxidant mixture (AM) (*Verbenaceae*, *Liliaceae*, *Labiatae*) (225) mg/kg of diet. Blood samples were collected on day 0, 18 and 28 to assess the KRL test, at the same time recording the pigs' body weight and feed consumption. The KRL value measured on d0 was used as covariate. No effect on growth performance was detected. The KRL test on whole blood did not show any significant difference among experimental groups and over time. The highest value (126.3 min) was found in BOS group on d 28. Red blood cell showed a treatment effect ($P=0.05$) and a time \times treatment effect ($P=0.005$); least square means found were 67.51, 64.98, 64.11 and 74.41 minutes in AOX, BOS, CON and U+T group respectively. The current results suggest a positive effect of U+T and BOS extracts to be further investigated.

Cross-sucking and intersucking in dairy buffaloes

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We assessed the incidence and the potential risk factors for cross-sucking in calves and intersucking in lactating cows in 33 buffalo farms. Three female trained assessors collected the data through a questionnaire including resource and management measures, which were directly taken and asked to the farmer, respectively. The incidences of cross-sucking and intersucking were also asked to the farmer while mortality was collected from farm recordings. The farm was used as experimental unit. For each categorical risk factor an ANOVA was performed to assess the association with outcome variables, whereas for continuous risk factors the association was tested using Pearson correlation coefficients. Cross-sucking and intersucking were observed in 90% and 42% of the farms, respectively; their mean incidences were 20.4 ± 25.7 and 1.8 ± 1.2 (mean \pm SD), respectively. Surprisingly, cross-sucking tended to be positively correlated with the age of separation from the mother ($n=20$, $r=0.39$, $P=0.08$). It also tended to be negatively associated with space allowance ($n=20$, $r=-0.38$, $P=0.11$). In addition, a positive correlation between cross-sucking and calf mortality was observed ($n=20$, $r=0.45$, $P=0.06$). The incidence of intersucking was positively correlated with the number of buffalo cows on the farm ($n=33$, $r=0.45$, $P=0.01$) and the number of dry animals per pen ($n=33$, $r=0.36$, $P=0.04$). The presence of cross-sucking in the categories of weaned calves and heifers induced a higher incidence of intersucking ($F_{1,31}=3.3$, $P=0.08$ and $F_{1,31}=12.2$, $P=0.01$, respectively). We conclude that appropriate management strategies should be implemented in order to reduce the incidence of cross-sucking and intersucking. In addition, the onset of cross-sucking in young stock, such as weaned calves and heifers, may favour the development of intersucking in lactating buffaloes.

Rumen mucosa alterations in intensively finished fattening cattle

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In intensive fattening cattle production systems animals may not always be fed diets with appropriate chemical and physical properties. This study aimed therefore at assessing post-mortem the prevalence and histology of rumen mucosa alterations in intensively finished fattening cattle in a wider perspective to investigate potential associations between specific problems and characteristics of the fed diets. The study was carried out in two slaughterhouses in North-Eastern Italy during spring and autumn 2016. One experienced assessor observed 15 rumens per batch after their emptying, without interfering with the regular procedures and schedule of the slaughterhouses. Occurrence of signs of ruminitis (absent, rarified or immature papillae with numerous whitish or reddish nodules of 2-3 mm), hyperkeratosis (hardened rumen papillae), and star scars were recorded as binary. Results of this preliminary study regard 1,465 rumens (944 bulls, 521 heifers) from 105 batches slaughtered in 21 days. Herd level prevalence were calculated and submitted to descriptive statistics. Prevalence of rumens with signs of ruminitis were $25.9 \pm 22.4\%$ (average \pm SD), with hyperkeratosis was $52.6 \pm 23.4\%$, and with one or more star scars was $19.2 \pm 20.2\%$. Histological findings defined ruminitis as a diffuse hypoplasia of the rumen papillae and multifocal squamous metaplasia with formation of keratin cysts in the proper submucosa with diffuse infiltration of eosinophil granulocytes and lymphoplasma cells; hyperkeratosis as formation of hyperparakeratotic rumen papillae with epithelial squamous cells developing epithelium and infiltration of eosinophils and lymphohistiocytes. Results of this study pointed out a need for further investigations on rumen mucosa alterations and on the potential predisposing causes occurring on-farm with particular attention towards the role of the intensive finishing diets on rumen health

Salivary alfa-amylase in horses with simple colonic obstruction: a pilot study

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This study aimed to evaluate salivary alfa-amylase (sAA), a biomarker of the sympathetic activation, in horses with acute abdomen syndrome in order to assess the relationship of sAA with pain behaviour. For this purpose, a prospective observational study including 19 horses that showed acute abdomen syndrome was performed, where specific pain behaviour scale (Equine acute abdominal pain scale-version 1, EAAPS-1, 5 point score) was used and salivary samples were collected. All horses with acute abdomen syndrome were finally diagnosed as simple colonic obstructions (simple impaction of the pelvic flexure, simple left dorsal colon displacement, simple left colon displacement or simple right colon displacement) by rectal examination, nasogastric intubation, clinicopathology and ultrasonography. In addition, 11 healthy horses with no evidence of clinical signs at physical examination and no changes at complete blood count and basic biochemistry were employed as controls. An unpaired Student's t-test (2-tailed) was applied to compare sAA values between healthy and diseased horses. Spearman correlation among sAA (UI/l) and EAAPS-1 in diseased horses was also performed. sAA activity in diseased horses (median=61.3, max=706.7, min=3.3) was significantly higher ($P<0.0001$) than control cases (median=2.5, max=8.0, min=0.1). EAAPS-1 (median=4, max=5, min=1) was significantly correlated ($r=0.78$, $P<0.001$) with sAA activity. This preliminary study indicates that sAA activity could be an indicator of pain in horses with acute abdomen syndrome. Further studies should be undertaken to elucidate sAA possible use in the prognostic or monitoring of treatment of this disease.

Abnormal behaviour and posture amongst horses transported long distances across the EU for slaughter*Hannah Westen**World Horse Welfare, United Kingdom; hannahwesten@worldhorsewelfare.org*

Welfare problems in horses transported long distances across the EU for slaughter have been well documented by NGOs. Over the past decades evidence suggests that the incidence of severe injuries and disease has reduced considerably on the main route across Europe. However, field observations undertaken at rest stops have, for many years, recorded behavioural and postural abnormalities amongst these horses, posing significant challenges with regards to welfare assessment. Although the literature suggests that many of these behaviours or postures are indicative of pain, discomfort or stress (e.g. weight-shifting, pointing), there are others as yet unrecognised in the scientific literature, whose relevance or value as animal-based welfare measures are not known. Where behaviours or postures have been identified as being indicative of a problem, assessment is largely subjective. Development of tools such as the facial grimace scale for horses (HGS), have helped lend a degree of objectivity to assessments, allowing collection of quantitative data, but the reliability of such tools in different pain scenarios, particularly chronic pain, is still under investigation. Determination of aetiological factors and subsequent steps to mitigate is complicated not only by a lack of understanding of the behaviours and postures observed but also by the high degree of heterogeneity seen in the sample population and transport conditions. Furthermore, perceptions, attitudes and behaviours of personnel working in the trade are likely to be influenced by previous experiences, which may be particularly relevant when considering the relative subtlety of some behavioural or postural indicators when compared to more overt welfare problems, such as broken limbs, seen more commonly in the past. Further multi-disciplinary research is required to identify, describe and quantify relevant behavioural and postural indicators, ascertain potential causes or contributing factors and devise feasible solutions that will lead to widespread welfare improvements.

Encouraging farmers to improve animal welfare – the possible role of behavioural economics

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Farmers play an important role to raise the animal welfare standards on their farms. It is often assumed that they act purely on an economic basis. However, changing insights have shown that psychological and sociological drivers reported in literature should also be acknowledged. This is the field of behavioural economics. Is it possible to use behavioural economics to understand decision-making of farmers? This was tested in December 2016 in a study focussing on dairy farmers' decision making concerning participation in an imaginary programme for prevention of bovine virus diarrhoea (BVD). Such a programme is important to raise both animal welfare and health standards on dairy farms. Of the farmers participating in the study, 82 already had a BVD-free status on their farms and 48 had not. When comparing these two groups, farmers with a BVD-free status perceived less problems with BVD, had a more positive attitude to the BVD prevention programme and were more convinced that joining the programme should benefit their cows' health. The 48 farmers who did not have a BVD free status yet were asked whether they would consider joining the BVD prevention programme if they were offered a reward of €3 per calf sold if their farm should appear to be free of BVD, or a fine of €30 per calf contaminated by BVD if their farm should appear not to be free of BVD. Of these farmers, 38 (79%) choose to join the programme. Comparing the testers and non-testers showed that testers had a more positive attitude to the prevention programme, were more convinced that it should benefit their cows' health and tended to be more ambiguity-averse. This shows that decision-making of farmers is not only affected by price incentives but that other factors such as attitude and ambiguity aversion play a role as well.

A novel use of rumination behaviour to monitor oestrus in dairy cows on pastureAna Carolina Strappini¹, Fernanda Araneda² and Gustavo Monti³

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Behavioural expression of oestrus is a welfare characteristic, however its occurrence has declined in dairy cows increasing the need to identify alternate means for oestrus detection. Changes on rumination time (RT) has been linked to oestrous events for free-stalled cows but no studies have been reported in cows on pasture under Chilean conditions. Our aim was to investigate whether RT is related to oestrous events in dairy cows permanently kept on pasture. The study was conducted at Agricultural Research Station of Universidad Austral de Chile, Valdivia. Rumination data from 30 Holstein-Black Friesian dairy cows was automatically recorded using a microphone-based sensor (Heatime® SCR HR- Pro-LD) during 40 days. We observed oestrus behaviour (focal sampling) for 60 minutes two times a day (9:00-10:00 am and 7:00-8:00 pm). The day of oestrus (day 0) was defined by visual observation according the score of Van Eerdenburg *et al.* and confirmed with plasma progesterone concentration (≤ 1.5 ng/ml). Thirty seven oestrus episodes were confirmed for 24 cows (average 1.5 episodes/animal). We estimated a reference period for RT (mean of RT 3 days before and 3 days after day 0) of 604.29 ± 64.01 min. Mean RT on day 0 was 535.84 ± 64.57 min/day. We observed a drop of 68.45 min, 11.33% lower than the reference period. We used a generalized nested linear mixed model (GLMM) to model the association between RT and cow's factors (parity, age, body condition score, mean milk yield (l/day), oestrus score, and days in milk at the moment of oestrus, confirmed ovulation after oestrus episode, plasma progesterone levels and size of the follicle). We performed multifactorial GLM procedures including a forward stepwise method to build a model of best fit for variables affecting RT. In conclusion, RT is affected by the day of oestrus in dairy cows on pasture. Ethical Committee for the use of Experimental Animals, UACH (99/2013S9-2014).

Systematic review on animal welfare indicators in dairy cattle to identify those of highest validity

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The rising interest of society in animal protection and animal welfare regarding livestock, broaden the discussion on how to define and assess animal welfare. The interpretation range of this term as well as the involvement of different stakeholders, result in a variety of indicators that are mainly resource- and management-based. Until now, little systematic investigations regarding the evidence of scientific studies and the validity of animal welfare indicators in dairy cattle exist. Therefore, it is the objective of the project to review literature on animal welfare indicators systematically, to assess its quality and to identify especially animal-based welfare indicators of highest validity. First, we outlined the complexity of the terms 'animal welfare' and 'Tierwohl' by wide search, focusing on the different meanings in political, societal and scientific background, to better understand and classify existing animal welfare indicators. In a first glance on European and German animal welfare assessment protocols regarding dairy cattle and their indicators, we hardly found animal-based indicators that are not only health-oriented but include aspects beyond that. For the Systematic Review we searched within five databases (CAB Direct, Google Scholar, Livivo, PubMed, Scopus) for peer-reviewed and non-indexed literature, using a strict protocol with English and German search terms. The outcome was limited to publications of the last five years, to dairy cattle as the species of interest and geographically to Europe, regarding the content of the studies. After the removal of all duplicates, we are now confronted with the abstract-screening and categorizing of 1,727 publications, separating peer-reviewed publications from Guidelines, Recommendations, Reviews and others. The following full-text-screening and discussion of original scientific studies (increased list of search terms) shall list empiric verified animal welfare indicators and identify those of highest validity.

Communicating animal welfare in agriculture: public and private information and dialogue*Diane Ryland**University of Lincoln, Law School, United Kingdom; dryland@lincoln.ac.uk*

Increasingly, the ethical consumer is interested in animal welfare enhanced agri-produce, but is not informed adequately as to the welfare needs of farm animals, nor of the standards of animal welfare practised in the food supply chain. Public farm animal welfare standards are not comprehensive and can be said to be minimum, consensus standards which are based on science. A requirement to signal the animal welfare credentials of meat does not exist in law beyond that applicable to quality produce meeting good agricultural practice promoted as organic in a 'niche' market. Purportedly higher private animal welfare farm assurance standards and certification schemes have evolved, with the tendency for a business to business certificate of conformity to operate in a business context, from which the consumer is distanced. This paper will examine the potential for the public and private sectors to communicate indicators and standards of animal welfare promoted for food producing animals. Its methodology is desk-based doctrinal research. It will, for example, extract information from the website of GLOBALG.A.P. It will suggest soft law tools of governance to increase the sources and flow of private, *prima facie* voluntary, credible, transparent and verifiable information on animal welfare. It will propose an industry-led business to consumer animal welfare label and private animal welfare platform with which to educate and inform on the level of animal welfare practised in agricultural produce certified for supply in the global food chain. It will also explore the significance of opening up animal welfare dialogue between the public and private spheres. It will, further, evaluate the roles for market standardisation to act as a communicative tool and to incentivise added value animal welfare practices, strengthened by public and private collaboration.

Development of a sampling scheme to measure ammonia, temperature and humidity in sheep export by sea

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Ammonia, high temperature and high humidity have adverse effects on animals during long distance livestock export from Australia to the Middle East, but none of these is effectively measured currently. On the basis of data maps obtained on two voyages of live sheep export, this study determined sampling strategies for ammonia, temperature and humidity measurement on the vessel. The difference between predicted high and low ammonia sites on the shipment could be detected with approximately 5 measurement sites of each. Margins of error were determined, which suggested that dry bulb temperature could be measured with 6-8 measurement sites, but even 20 measurement sites were not sufficient to measure relative humidity. For the vessel recorded, considerably more ammonia measurement sites are required on closed decks than on open decks, with less variation for temperature measurement. The number of pens measured contributed more to the variance of ammonia and temperature measurement than the number of sampling locations within each pen on open decks. This study highlights the importance of a suitable sampling strategy to measure ammonia, temperature and relative humidity on board ship during live export.

Positive reinforcement training in pigs; methodology and cost effectiveness analysis*Kate Mala Ellen¹, Amanda Nevel¹ and Ute Weyer²**¹The Royal Veterinary College, United Kingdom, ²The Animal Plant and Health Agency, United Kingdom; kellen4@rvc.ac.uk*

Positive reinforcement training (PRT) is a tool used to refine and facilitate animal handling. Pigs demonstrate cognitive capacity and can be trained. The purpose of the study was to establish PRT within a herd of pigs at a research institute in the United Kingdom. Training was carried out to ultimately reduce the stress of the animals and stockmen during weighing. A total of thirteen piglets were recruited. A standard method was followed to teach the piglets to associate a ball with a treat. Training occurred three times a week for eight weeks. The piglets followed the ball and entered the weigh crate, without the need for restraint or force. All thirteen piglets were trained within the eight weeks; assessed by entering the crate and allowing the doors to be closed. Cost-effectiveness analysis of weighing trained piglets, against untrained pigs, demonstrated PRT to be advisable when weighing four or more pigs. Weighing eight trained piglets compared to eight untrained, resulted in a net staff-time of 1.75 h. The impact of PRT on the animals and staff were considered greater than monetary effects. Training was reduced once the piglets were trained; the piglets still voluntarily entered the weigh crate four weeks, after having had no further training. A record of training was kept and alterations were made to the standard method. It is possible that the results are biased as stockmen were informed of the study and may have inadvertently elongated or shortened weighing times. However with allowance for the bias, the benefits of PRT are still apparent. This study elicits the scope of using PRT in research. Further study should focus on measuring the reduction in stress levels of the pigs, the effects of altering training frequency, and the long term job satisfaction of staff, when PRT is used.

Abstracts Innovation Day

(these abstracts have not been reviewed)

Innovation in animal welfare science*Daniel M. Weary**University of British Columbia, Animal Welfare Program, Canada; dan.weary@ubc.ca*

Animal Welfare Science is a new field, rich in innovation. In this presentation I will review three main areas of innovation: conceptual, methodological and technological. Our field has required conceptual innovation, in part because the science is mandated by the underlying societal concerns, requiring not just good science, but also science that responds to these concerns. Initial conceptions of welfare were often focused on health and production, but more modern work has focused on affective states that are often key to public concerns. More work is now required to integrate concerns about natural living and animal care into animal welfare science, and more generally, how to integrate research on what is important to human stakeholders with what is important to the animal. Methodological innovation has also been required, especially to address the special demand of assessing affective states in animals. Innovations have included the development of motivational tests, cognitive bias tests and qualitative behavioural assessments, to name a few. New work is required to assess particularly relevant affective states, for example, to distinguish between pain and suffering in animals. Recent and future progress will also rely heavily on technological innovations, taking advantage of the rapid development of on-farm data collection and control technologies. Some of these technologies specifically address welfare-relevant issues (such as automated methods to detect lame cows); in other cases existing technologies (such as robotic calf feeders) will need to be creatively co-opted (e.g. by measuring non-nutritive visits, indicative of hunger) to provide real-time welfare assessments. A special area of promise is in the harvesting of such data from many farms, allowing for the development of routine benchmarking as well as machine-learning algorithms designed to detect welfare problems at both the farm and individual animal levels. I conclude by calling for the development of a culture that celebrates such innovations, ensuring that our field remains scientifically and societally relevant in the years to come.

Keep cow and calf health and stress-free with cowsignals cuddle box*Joep Driessen, Jan Hulsen and Wiebe Veenstra**CowSignals Training Company, the Netherlands; hulsen@vetvice.nl*

The aim of the cuddle box is to keep cow and calf healthy and stress-free, and let the farmer work safely. Start by letting the cow give birth quietly in the calving pen. Move the calf immediately after birth into the Cuddle Box: a bed of good quality hay (or silage) just outside the calving pen, clean and hygienic. Here the mother can lick her calf dry. Put a half open box around the calf so it can't walk away and is protected from cold winds. Give 20 litres of lukewarm water to the mother, to re-hydrate her and to stimulate feed intake. The cow will easily go to her calf. Now you can move the swing gate against the mother and lock her in with a chain, to work safe under the udder. Milk the cow out completely, on the spot, while she is licking her calf. Feed immediately at least two litres of fresh & warm colostrum to the calf. The more colostrum the baby calf takes in now, the better! Store the rest of the colostrum in the fridge after putting the number of the calf on it, to feed it to the same calf 6-12 h later. Number the calf and register her. Move the calf to an individual pen after she is dry. When the calf is gone, the cow will start looking around. She will start sniffing for her baby and will end up eating the hay or silage where the calf was lying. We recommend one to two hours of contact between calf and cow. Much longer likely has more disadvantages than advantages. The cow will not eat quick enough after calving, resulting to more ketosis and other diseases. Research shows that cows experienced the least parting stress when the calf is taken away immediately.

Phenolab: ultra-wide band tracking of individual group housed laying hens

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Farm animals are generally kept in groups of varying sizes. It is challenging to monitor the behaviour of individual animals when they are housed in a group. To aid to this need, we have tested an innovative new automatic sensor technology which can track individuals in a group. With the use of this ultra-wide band tracking device and recording beacons, we were able to track individual laying hens in an equipped arena (project PhenoLab). Hens had an active sending tag in a backpack. Every 30 s location of each tag was recorded. TrackLab software provided distance moved and movement patterns based on location data. With this set-up, we tested if we could detect differences between birds who feather peck and victims of the behaviour. We used a White Leghorn line selected on high feather pecking for 11 generations. Prior to tracking, home pen observations were made to record who was the feather pecker and who was the victim based on giving or receiving more than 2 severe FP per 0.5 h summed over observation times. FP data was obtained weekly from a 15 min video-recording from at 28 and 29 weeks of age. Independent t-test was performed for comparison. At 37 weeks of age hens were tested inside a 8×7 m empty test-room with their pen-mates for 15 minutes. Feather peckers tended to walk a greater distance ($t_{15}=1.89$, $P=0.07$; $9,286\pm 1,660$ vs $5,251\pm 1,361$ cm) and had a higher average speed when moving ($t_{15}=2.62$, $P=0.02$; 9.5 ± 1 vs 5.5 ± 1.1 m/s²) than victims. These results indicate that with automatic locomotor data differences in behavioural traits of individual birds can be detected, which affect welfare on a group level. Moreover, the system could be used to predict changes in activity patterns and detect individuals that have or will perform damaging behaviour.

Full-scale implementation of WelFur-Mink in Europe – only certified pelts will be sold from 2020

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Since 2009, researchers from Aarhus and 5 other European universities have been working on the development of a welfare assessment protocol for mink and foxes after the concept developed in Welfare Quality®. The WelFur-Mink protocol is based on a critical evaluation of validity, reliability and feasibility at measure level. The protocol has been repeatedly tested in 12 European countries and developed to handle all conditions found in each of the three seasons that covers the strict annual cycle of mink production. The assessment results from the 22 welfare indicators are aggregated across the 3 seasons into 12 welfare criteria and 4 welfare principles, from which each farm is classified as either 'best', 'good', 'acceptable' or 'unacceptable' current practice. The European Fur Breeders Associations have decided to implement WelFur in Europe on a voluntary basis. As all fur auctions have decided only to sell European pelts that are classified 'Acceptable' or better from 2020, all 4,000 European fur farms are expected to join WelFur. A private audit company started the assessments in January 2017, after all assessors completed a WelFur training course. A tool for taking unbiased and representative samples on a mink farm, and an application for on-farm registration of the assessment and exporting the results have been developed. In order to secure that farmers can react and improve the welfare of the animals, all assessment results are reported back to the farmer after each assessment and advisors from each country are taught how to interpret the WelFur results and how to help farmers improve housing or management when needed. Despite all potential stumbling blocks and obstacles, WelFur seems to be the first example of a full scale implementation of a science based welfare assessment in an entire animal sector.

Creating Resilience in Pigs Through Artificial Intelligence (CuRly Pig TAIL)

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The pig provides a huge amount of health and welfare information by its behaviour and appearance (e.g. lying, eating, skin colour, eye colour, hair coat and tail-posture). By careful observation of this body language we believe it is possible to identify (early) signals of discomfort, upcoming disease and undesired behaviour. By early detection of these signals interventions can be carried out in an earlier stage than currently is done to restore health and welfare of the pig herd. Good health and welfare is the foundation of high resilience in animals, which makes them less vulnerable for disturbances (e.g. infections). For a farmer it is, however, impossible to continuously monitor the body language and behaviour of every pig on his or her farm. By using a combination of non-invasive techniques to collect signals from the pigs and their housing environment (e.g. a camera and a water meter) the pigs can be observed 24/7. By combining computer vision and pig knowledge using machine and deep learning techniques, a non-invasive monitoring system can be designed. Deep learning is the current state-of-the-art machine learning approach for computer vision that is especially powerful in recognising and localising image content, e.g. the location of the body parts or visible abnormalities thereof. Deep learning is based on large convolutional neural networks and require a large amount of manually annotated training (image) data. Ultimately with this approach the robustness of pig husbandry systems is increased due to better health and welfare conditions for the animals. Additionally, our approach could even lead to a new design of pig housing systems. Furthermore, it increases the job satisfaction of the farmer. Our ambition is to develop advanced monitoring systems that allow to stop tail docking all together, so the curly pig tail becomes once again a common phenomenon on pig farms. To achieve this ambition, we will explore, co-develop and test non-invasive monitoring technologies for pig husbandry.

Measuring tail length and tail bites on pig carcasses

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Tail biting can be a problem in the pig production, and tail docking is therefore widely used. However, this is also a painful and time-consuming extra handling of the piglets. However, a ban on tail docking will demand extra focus from the farmers in order to avoid tail bites, as longer tails are more attractive for biting. Feedback to the farmers from the slaughterhouses concerning tail bites can be a way to ensure a continuous focus on the problem. The aim of the project is therefore to develop a vision-based system for on-line measuring of tail length and tail bites on the pig carcasses. Furthermore, the project aims to evaluate the effect of the feedback to the farmer on the level of tail bites in the herd. A vision-based system at the slaughter line can collect information about tail length and tail bites. The system takes two pictures of the tail – one with 3D information and one with colour information. From these pictures, the tail length and width are measured, and the area with tail bites is calculated. The tail length and width can estimate the frequency of older tail bites while the colour differences represent bites that are more recent. The frequency of tail bites observed in a given herd can be determined and given as feedback to the farmer. The vision system is under development at the Danish Meat Research Institute and will be tested ultimo 2017.

Q-perch helps fight poultry red mite

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Poultry red mite is a parasite that is present on an average of 83% European poultry farms. Poultry red mite causes anaemia, weight loss and agitation in chickens and also facilitates the spread of bacterial and viral pathogens. This leads to additional mortality, a higher feed conversion, decreased egg quality and production. Thus, the economic importance of fighting this parasite is vital for poultry farmers. Traditionally red mite was controlled by pesticides, which aim to minimise population size on short term basis. Vencomatic Group launches a mechanic solution to control red mite in poultry houses by continuously keeping the population size in an acceptable range. Based on the knowledge that red mite predominantly parasitize on its host during the dark, the focus is on the perches that chickens roost on. The revolutionary Q-perch is a patented perch containing two isolators, that kill the red mite on their journey towards the chicken. A small electrical current running through the isolators is harmless for the chickens, but lethal for the red mite. The mushroom shape of the Q-perch is studied to be the most comfortable shape for the chickens, as it offers stability and grip. Therefore the Q-perch is beneficial for animal health and welfare, which in turn benefits the farmer as the chickens perform better.

The automated mite monitoring tool for advancing integrated pest management for *Dermanyssus gallinae*

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The poultry red mite (PRM), *Dermanyssus gallinae*, is the most common ectoparasite of egg laying hens in many parts of the world, though this haematophagous mite may feed upon a range of other hosts, including humans. High infestation rates of PRM in egg-laying facilities may cause anaemia in hens, and in extreme cases even hen mortality. Other negative effects of infestations include reduced animal welfare, reduced egg production and egg quality, increased feed and water intake and lower bird weight. Control of PRM is difficult. The mites' reclusive and nocturnal lifestyle makes this pest hard to target using available conventional acaricides. Increasingly stringent pesticide legislation in many parts of the world, as well as the tendency of PRM to rapidly develop resistance, further exacerbate this issue. Consequently, there is an urgent need for alternative control strategies. Integrated pest management (IPM) is a multi-disciplinary approach that aims to control pests and diseases whilst minimising any negative environmental and economic effects associated with pest management. Monitoring of pest populations is a critical component of IPM programmes that can be used to inform treatment timings and evaluate applied treatments according to the eight general principles of IPM laid down in Directive 2009/128/EC. To contribute to more advanced IPM programmes, Wageningen Livestock Research developed and validated (1) an automated mite counter; (2) a population dynamics model; (3) an economic model; and (4) an advise algorithm to forecast and advise on timing of treatments when economic or welfare thresholds are exceeded. This so called automated mite monitoring tool is tested on one egg producing farm and will be made available for egg laying hen producers in the near future. Hotraco, a globally operating supplier of innovative computerized systems for use in the pig and poultry houses will commercialise this automated mite monitoring tool. A prototype will be presented during the innovation day.

Innovative concept building design using passive technology to improve resource efficiency*Paul Jackson**Newcastle University, AFRD, United Kingdom; p.jackson4@newcastle.ac.uk*

In conventional finishing pig buildings, extreme hot and cold weather conditions have a direct negative effect on feed conversion efficiency and animal welfare. The design of typical UK fan ventilated finishing pig buildings has remained largely unaltered since their first introduction in the 1930s and is generally based on minimum external temperature to ensure the internal environment does not fall below the specified lowest temperature required for the pigs. This approach can have a detrimental effect on the quality of the internal air, due to the overriding factor for the ventilation system controller being the minimum temperature set point. The SPATHE (Solar, PAssive, Thermal, Heat Exchange) concept building takes account of historic, current and future building technology to provide an optimum enclosed environment for pigs to thrive. The building is designed in such a way as to reduce the solar heat gains entering the space in summer, whilst capturing solar rays in winter to take advantage of free heating. Further passive design elements include the integration of thermal labyrinths to deliver heat exchange to the incoming fresh air, thus providing free cooling in summer and free heating in winter, as well as promoting better winter air quality and reducing the peak summer and winter internal temperatures. The SPATHE is a modular building designed to house 250 pigs in each room. The building has the option for easy integration of sustainable technologies such as Solar PV & thermal and rainwater harvesting to further reduce utility bills. The SPATHE concept specification was used to create a dynamic thermal model which was directly compared to the previous model of a standard fully slatted finisher building, to explore how this innovate approach to building design can improve resource efficiency and welfare of pigs.

OPTIFarm broiler management*David Speller**Applied Group, United Kingdom; david.speller@appliedgroup.org.uk*

As an intensive broiler farming business it has been very clear that improvements in animal welfare and improvements in farm profitability can go together provided the welfare improvement is of genuine benefit to the birds housed. The ever complicating world of computer programmes and sensor technology is not one that sits comfortably with most stockman for whom the personal interaction with the animals is key. It's not about what the data is telling them it is more about what they see, hear, smell and ultimately feel when in a broiler house with the birds. This is where OPTIFarm was born. Initially for our own farming needs and now offered globally as a remote optimisation and monitoring service. Using specialist trained individuals (mainly ex broiler farm managers) OPTIFarm monitors the birds and their environment 365 days per year, 24 h a day. From the monitoring and data captured OPTIFarm can translate findings into the farmer's language through either a phone call, sending him a text or an e mail. The data gathered can suggest what feed, lighting, environment, water, etc. the birds are desiring at that moment allowing for rapid decision making and improved welfare. As well as advising, OPTIFarm is also able to actively remote manage the shed controls systems to optimise the environment remotely whilst the farmer is sleeping. It is very often noticed that farm environments are stable in the daylight hours with stable external climate conditions but can go wrong overnight as temperatures drop outside and cooler air enters the building. Likewise managing heat stress requires accurate controls settings and an understanding of temperature, humidity and wind chill factors felt by the birds. OPTIFarm can do it all 24 h a day 7 days a week globally.

Adding social network information to automated dairy cow management*Paul Koene**Wageningen University & Research, Wageningen Livestock Research, the Netherlands;**paul.koene@wur.nl*

Dairy cow management systems are based on traditional and sensor information concerning individual parameters. Future management should include also social information, because Social Network Analysis adds crucial information and precision and consequently increases welfare and reduces costs. In dairy cow management focus lies mainly on individual performance and measurements despite the fact that social information is shown to be important in managing introductions and removals, oestrus, lameness, cow traffic with respect to feeding (fence) and milking (robot). Social influence can be both positive and negative. Relevant behavioural information are interactions, rank order, nearest neighbours, furthest neighbours, friends, approaches, avoidances, time spend together and many social behavioural elements, such as vocalizations. Many of the interactions and associations can be automatically measured using sensor technology. Using the social information in the pasture or barn will improve actual management by more precise interpretation of performance measurements and the opportunity to guide the behaviour in cows, bulls and calves. Furthermore, assessments of individual and group welfare are possible, facilitating benchmarking. The integration of individual and social information is based on analysis of cow positions allowing for on social network assessment. During further development of the management system new monitoring and sensing parameters can be added and used after or during the needed validation and standardization.

Improving animal health and welfare by on-line SCC monitoring instrument 'LUCI'*Elnaz Khatami**Mastiline, the Netherlands; e.khatami@mastiline.com*

Healthy cows are essential for a dairy farm. A healthy cow produces more and better quality milk and uses less medicine, like antibiotics. One of the most obvious health indicators for dairy cows is the somatic cell count (SCC) in milk. High numbers will lead to mastitis, which is an inflammation of the udder and negatively affects the health of the cow and consequently the production of milk. Mastiline has developed a detection system for early stage monitoring of cell count for each individual cow. With a detection limit of 50K cells/ml it has outstanding performance compared to other technology in the market. The aim is to improve animal health to reduce the overall cell count of a herd, to increase milk production and to reduce costs. Research has shown that cows with lower SCC produce more and better milk. Estimation of WUR research indicates a revenue potential of 82 – 220 (€/cow/year). Mastiline has developed an analytical instrument (sensor) named LUCI for automated on-line monitoring of somatic cell count (SCC) which can be easily integrated in the automatic milking system (AMS). The measuring instrument consists a sampling unit, reaction chamber and detection module. The method is based on ATP analysis. The ATP method is scientifically proven to have good correlation with the gold standard. Milk samples are tested with LUCI and compared with the Fossomatic results, which currently remains the gold standard in somatic cell counting.

Feeding live black soldier fly larvae and effects on health, welfare and production of laying hens

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Insects are proposed as a high quality and efficient protein source in animal feed, e.g. for poultry and pigs. Protein from insects can replace soybean products from Latin America, making it a more sustainable feed ingredient as it can be produced locally. The inclusion of insects in animal feed seems feasible in the near future. Current legislation allows feeding insects alive or as fat or hydrolysed protein extracts. In poultry, first experiences are obtained with feeding live larvae of the black soldier fly (BSF, *Hermetica illucens*). Small-scale experiments with laying hens indicate that production can be guaranteed when 20% of the pelleted ration is replaced by BSF larvae of the BSF. However, continued trials have to show what the real potential is of live insects as feed for poultry, in relation to health, welfare and production. The aim of Wadudu Insect Centre is to contribute to welfare and production of laying hens, by introducing BSF larvae in innovative housing and chain concepts, thereby looking for and finding separate niche sales channels for the eggs. In cooperation with two universities of applied sciences, applied research has started (April 2017 – December 2018) in a research facility in Dronten to investigate the potential of BSF larvae in laying hen feed. The main question to be answered is what will be an (cost)effective and practical way to introduce the larvae: how to provide them, and could they utilize litter/manure in the hen house for development, thereby decreasing environmental impact of hen farming? Besides studying the effects on health and production, ways to optimize feeding BSF larvae as foraging enrichment are evaluated. It is expected that prolonged searching and pecking for larvae reduces redirected foraging behaviour that could lead to undesirable behaviour such as feather pecking. This is interesting in view of the upcoming ban on beak trimming from September 1st, 2018.

HatchCare, the poultry incubator with feed, light, and water*Carla Van Der Pol**HatchTech B.V., Veenendaal, the Netherlands; cvdpol@hatchtech.nl*

Traditionally, commercially kept chicks hatch from their eggs in a dark incubator without feed and water. Once all chicks in a batch have hatched, they are removed from the incubator, processed, and transported to the poultry farm. Because of biological variation in the moment of hatch between chicks, and because of the length of processing and transportation times, chicks may spend between 24 and 72 h off feed and water before they receive their first meal at the farm. While chicks can survive this fasting period because they still have a residual yolk, they become increasingly hungry and thirsty, and their health and welfare are compromised. HatchTech has developed a hatcher, called HatchCare, that provides feed, water, and light immediately after hatch, allowing each chick to start feed and water intake whenever they so desire. What's more, the fact that the climate and conditions inside HatchCare can be controlled closely allows implementation of new ideas and innovations, such as cooler incubation in the hatching phase, lower CO₂ levels, and lighting schedules to stimulate chicken health before and after hatching.

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