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# The dietary fibres: definition and analysis in animal feeding, and their role in rabbit nutrition and health

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European Society of Veterinary and Comparative Nutrition

## The dietary fibres: definition and analysis in animal feeding, and their role in rabbit nutrition and health.

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19th ESVCN congress  
Toulouse : september 17-19

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- ❖ Recalls: effects of fibres on rabbit ingestion and digestion
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- ❖ Fibres requirements and European tables
- ❖ Conclusions & perspectives

## 1. Context

### Digestive health in the growing rabbit

\* Digestive troubles **after weaning** = 10 - 15% mortality  
=> preventive **antibiotherapy**



\* **Digestive health / troubles** = ??

diarrhoea, caecal impaction, mucus +

+ intake troubles, weak growth, behaviour troubles (caecotrophy ...)

#### Origins :

• infectious : coccidiosis, colibacillosis, REE

• non-infectious risk factors:

\* stress, environnement (ventilation, heating),

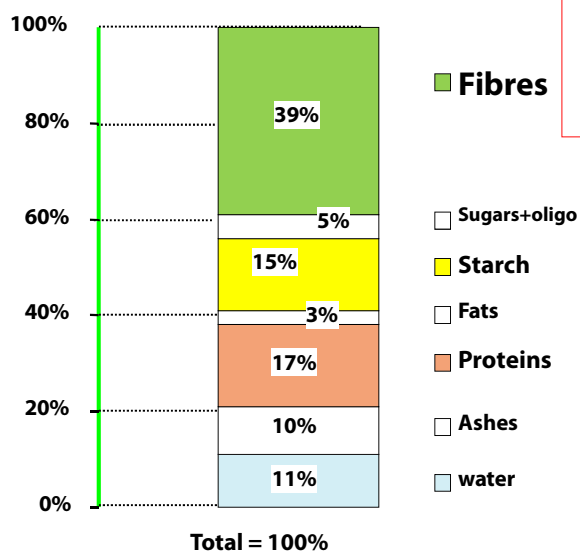
\* **unbalanced feeds**

**impact of nutrition on rabbit digestive health => YES**

The rabbit is **herbivorous** : **unsufficient fibres intake** =>

**higher RISK** of digestive trouble after weaning

### Main nutrients in a feed for a growing rabbit



**Fibres intake =  
51 g / day  
+ 11 g/d  
from soft faeces**



### Previous studies :

relationship among crude fibre and "mortality by diarrhoea"

#### Results : requirements in CRUDE FIBRE ??

very variable / unprecise .... 6 to 14% !

<i>Niehaus 1968 :</i>	6 - 14 %
<i>Morand Fehr 1970 :</i>	12 - 17 %
<i>Heckmann &amp; Menner 1970 :</i>	8 - 9 %
<i>Martina 1974 :</i>	6 - 8,4 %
<i>Lebas 1975, 1984 :</i>	13 - 14 %
<i>Colin 1976 :</i>	12 %
<i>NRC 1977 :</i>	10 - 12 %
<i>Lang 1981 :</i>	12-14 %
<i>Maertens 1992 :</i>	> 14,5 %

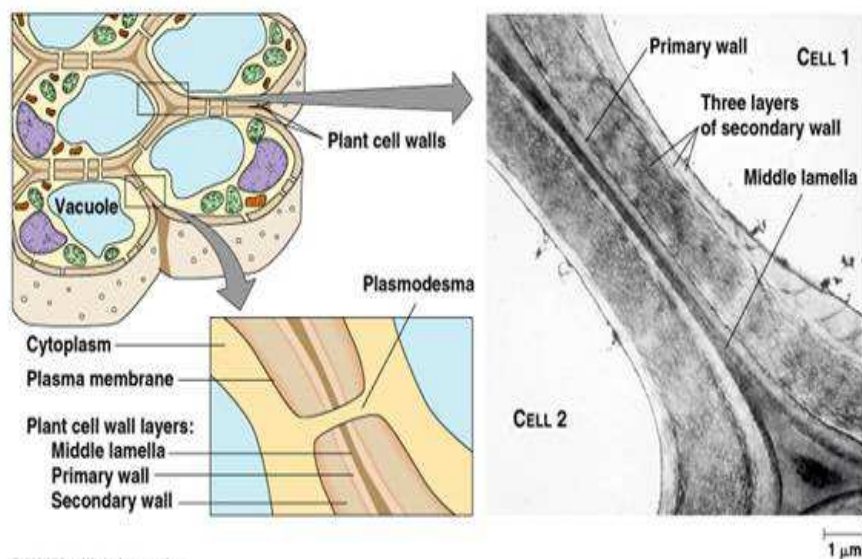


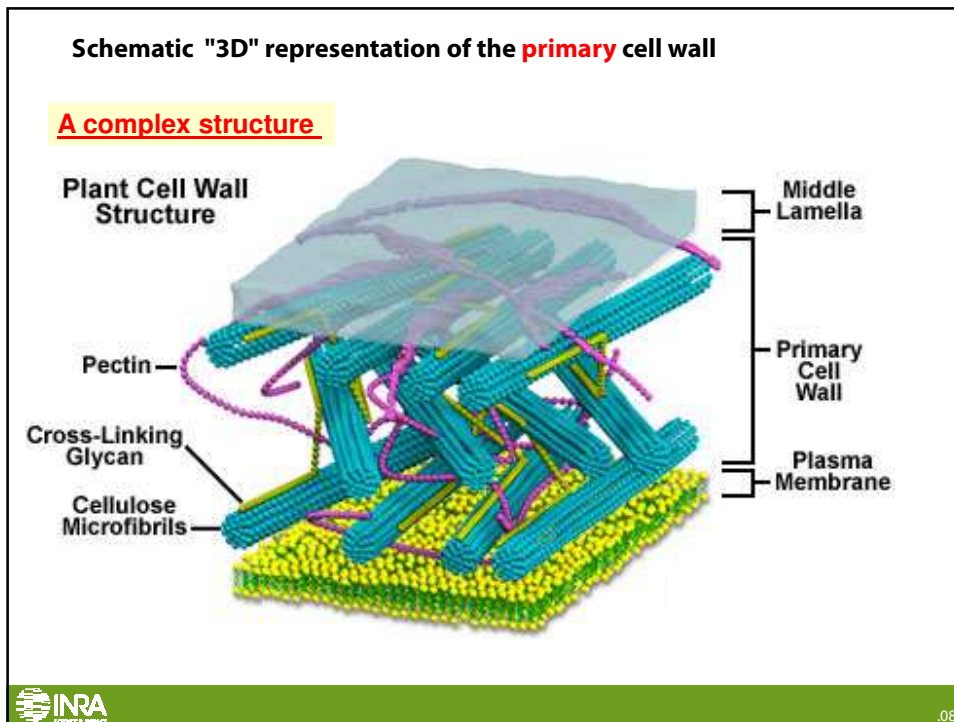
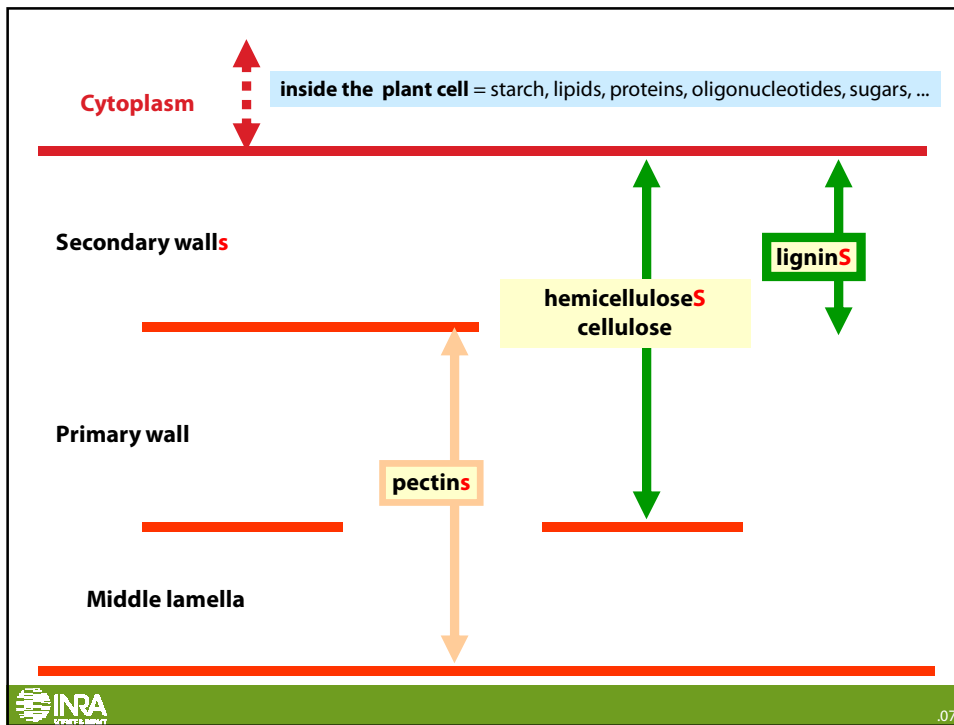
How to improve the precision of these requirements ?

**Other criteria to be studied ?**

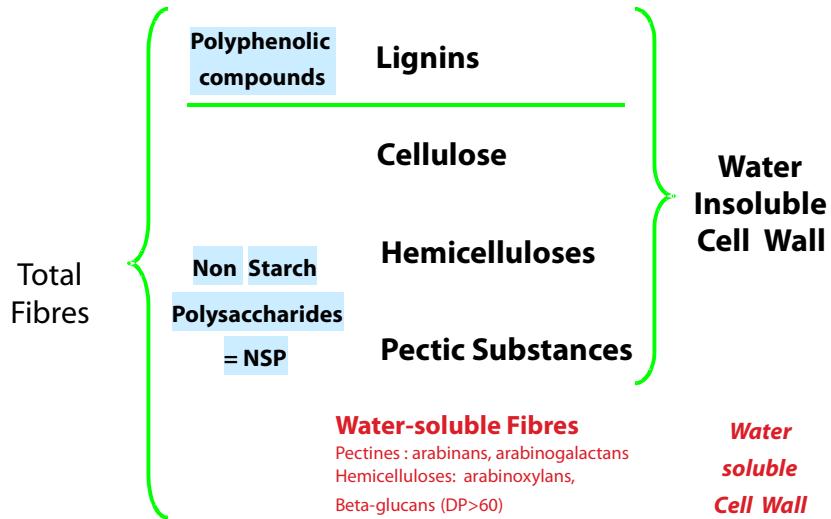
## 2. Recalls on fibres : origin, structure, methods

### Standard plant cell walls

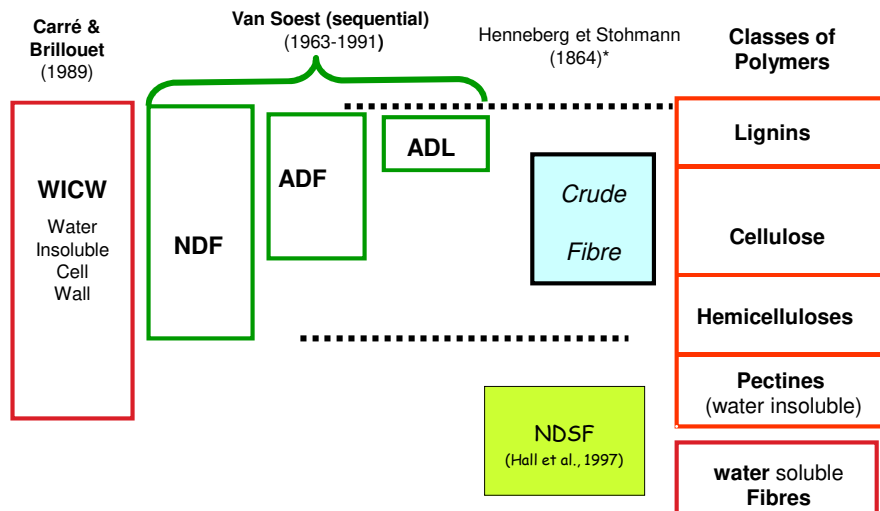




## Simple CLASSIFICATION OF DIETARY FIBRES



## MAIN GRAVIMETRIC METHODS FOR DETERMINATION OF DIETARY FIBRES IN ANIMAL FEEDS

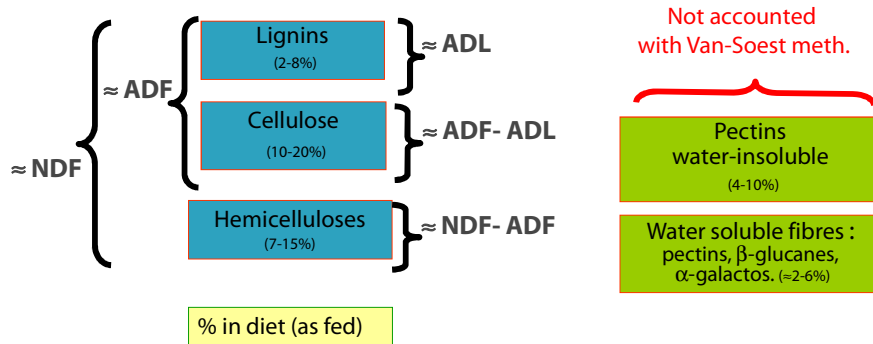


\* Crude fibre: method from the Weende agronomy unit.

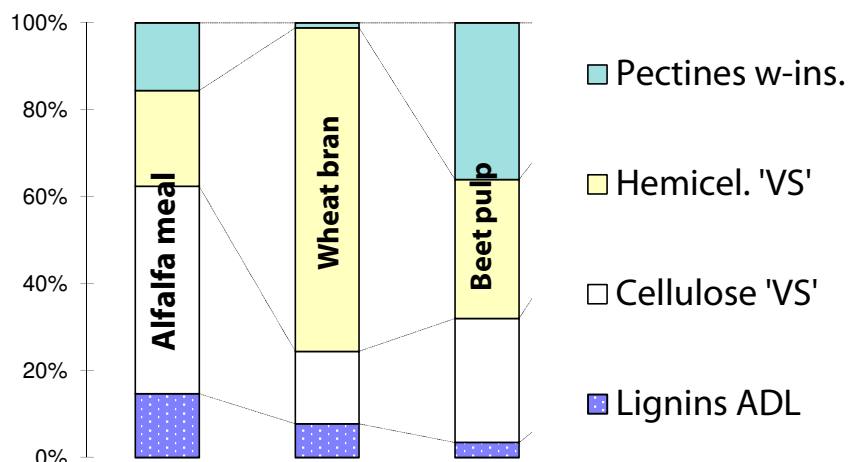
NDSF : sum of pectines (water-solubles & insolubles) +  $\beta$ -glucanes + fructanes + oligosaccharides [DP>15]

## Importance of the different fibres fractions in diet for growing rabbit

Interest of "Van-Soest" criteria:  
allow to assess the quality of fibre  
**"routine" method**



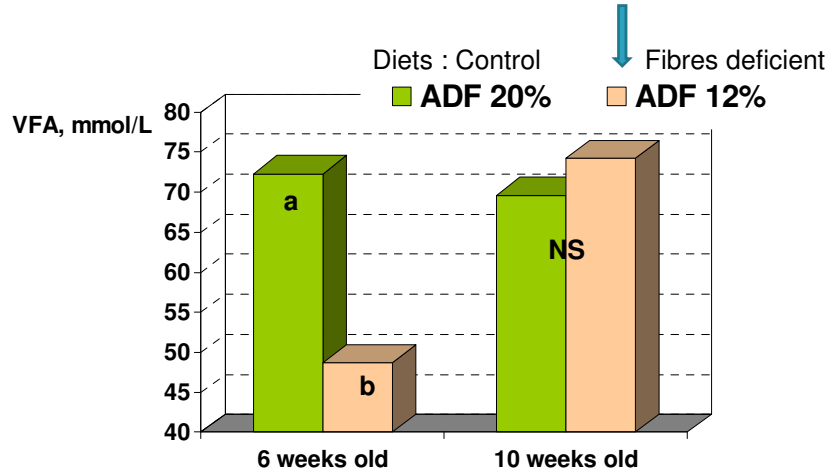
## Fibres composition of some raw materials



### 3. Fibres : effects on rabbit digestion

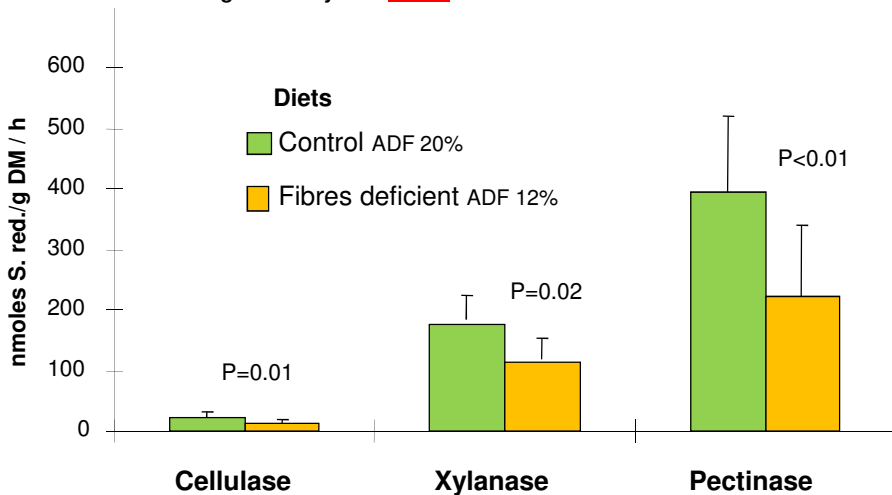
#### 3.1 Microbial activity in the caecum

VFA concentrations : interaction Age and dietary fibre level



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#### Fibrolytic activity of caecal bacteria according to dietary fibre level

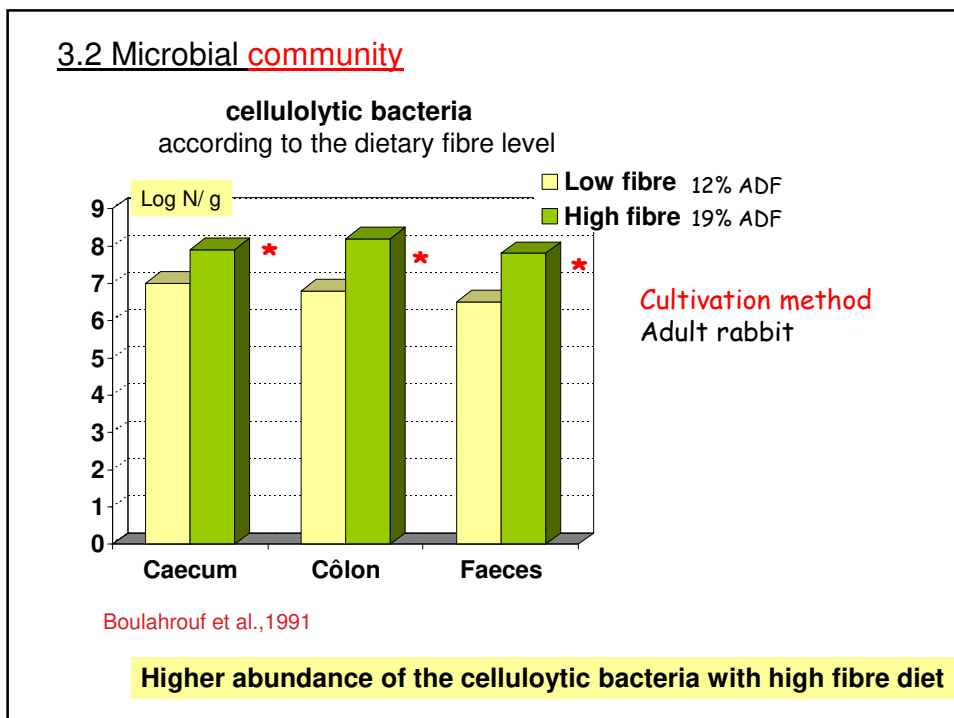
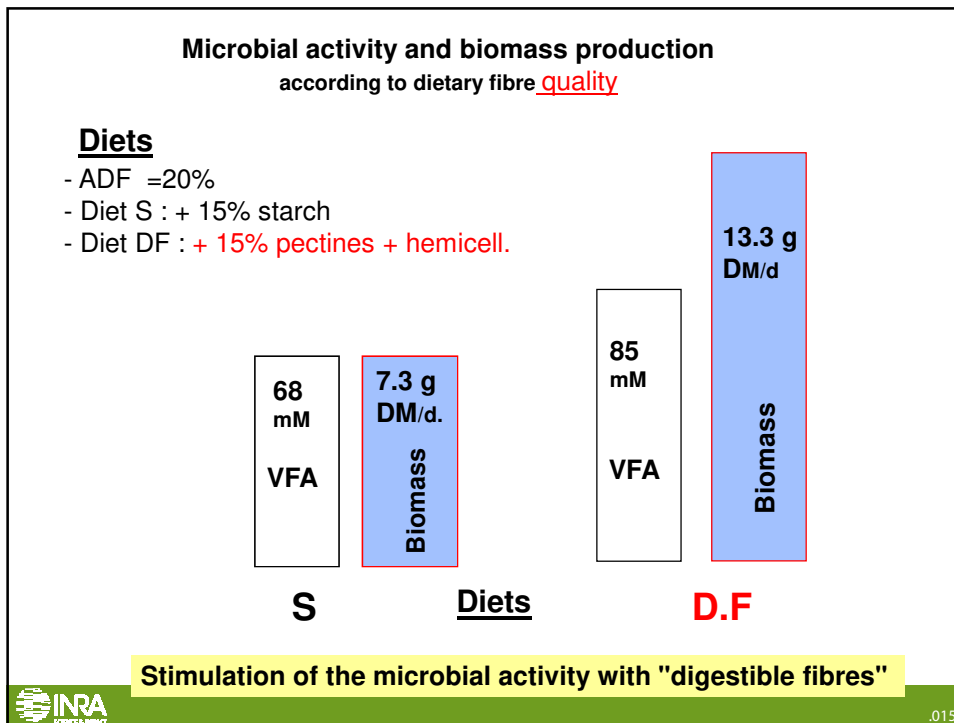


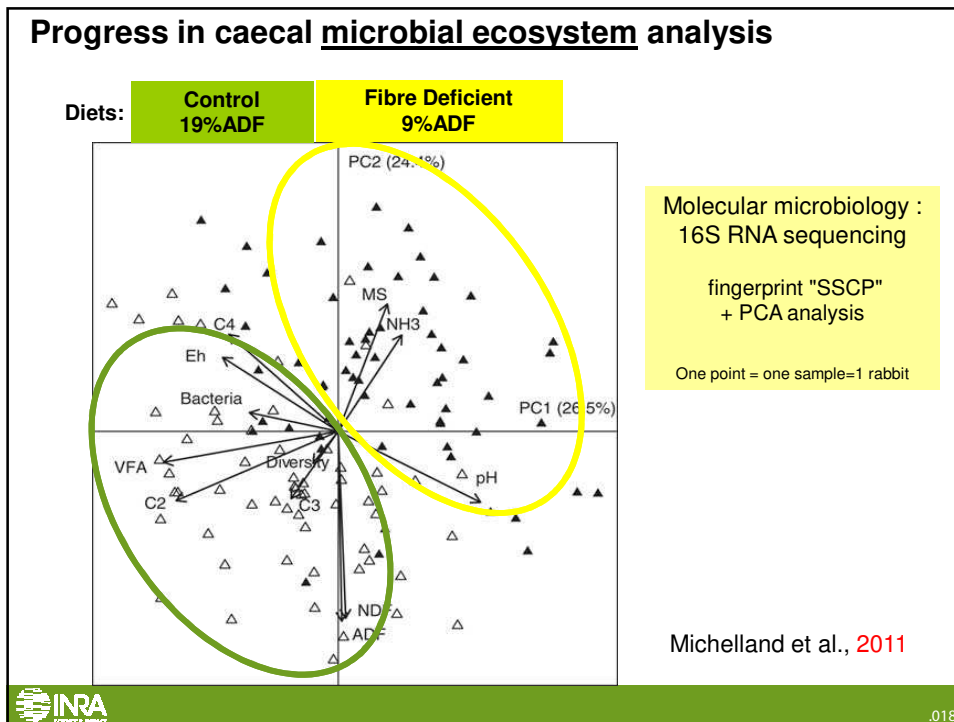
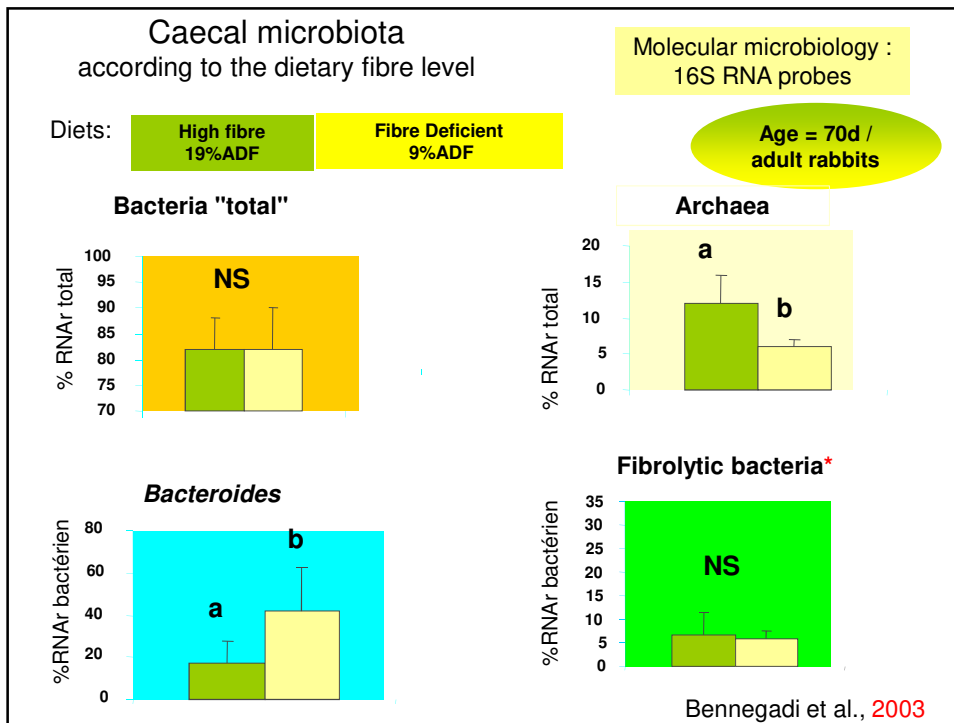
(Gidenne et al., 2000)



.014

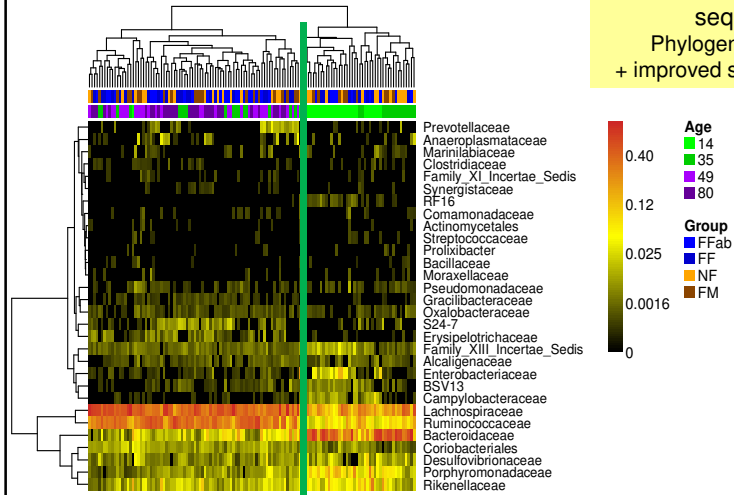






## Further progress in caecal microbiota characterisation

Molecular microbiology :  
16S RNA high throughput  
sequencing  
Phylogenetic affiliation  
+ improved statistical analysis



## 3.2 Effect of fibre on digestion

<u>Class of dietary fibres</u>		<u>Mean, %</u>	<u>Range</u>
Lignins (ADL)	} poorly digestible fibres	-10 +15	-13 to +50
Cellulose (ADF – ADL)		15 - 18	5 to 40
Hemicelluloses (NDF – ADF)	} digestible fibres	25 - 35	10 to 60
Pectins (total uronic acids)		70 - 76	30 to 85
Soluble fibre (TDF-NDF)	} Rapidly fermentable fibres	70-90	??

### Digestion of other nutrients

Starch	90 - 100%
Proteins	70 - 75
Lipids	70 - 80

**Conclusion**  
fibres => reduction of diet digestibility

#### 4. Fibres and digestive health of the growing rabbit

For a *pure nutritionist*, any **reduction** of fibre level will induce a **reduction** of nutritional costs

Thus: the **BEST FIBRE LEVEL** Should be **THE LOWEST....?**

**BUT** "breeders" and "pathologists" have observed :


**low dietary fibres** levels are associated with a **higher risk of digestive troubles** and mortality, after weaning


Thus, 2 questions :

- 1 - How to estimate the **sanitary risk** for digestive troubles ?
- 2 - Which **type of fibre to reduce the risk**, and at **which level**?

#### 4.1 Question 1 : estimating the sanitary risk for digestive troubles, after weaning

##### Criteria to assess the sanitary status

Classical criterion = **Mortality**  **Yes/No criterion**

  
**17%**  
Mortality  
weaning-slaughter  
(30-70d old)

**Example:**  
fibre deficiency and digestive health  
(Bennegadi *et al.*, 2001)  
(N= 80 rabbits)

**New criterion to refine** the estimation of the health status of a group of rabbits



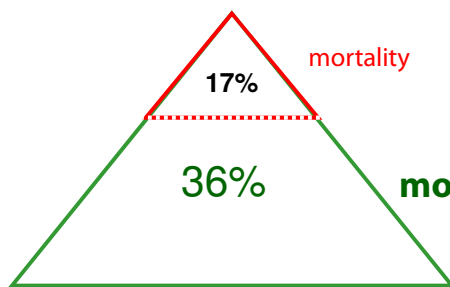
**MORBIDITY =**

- low growth (DWG +/- 2 S.D.), punctual loss of weight
- transitory diarrhoea
- intake troubles

**Importance of the frequency of the measure**

**e.g. : daily** measure for Bennegadi et al. (2001).

Measure of the health status



+

**Example:**  
fibre deficiency and digestive health  
(Bennegadi et al., 2000)

Health risk index, HRi

= 53%

**IMPORTANT**

**necessary to measure those criteria on large groups of animal**

10% mortality = ? 1 dead/10, **very different** from 100 deads/1000

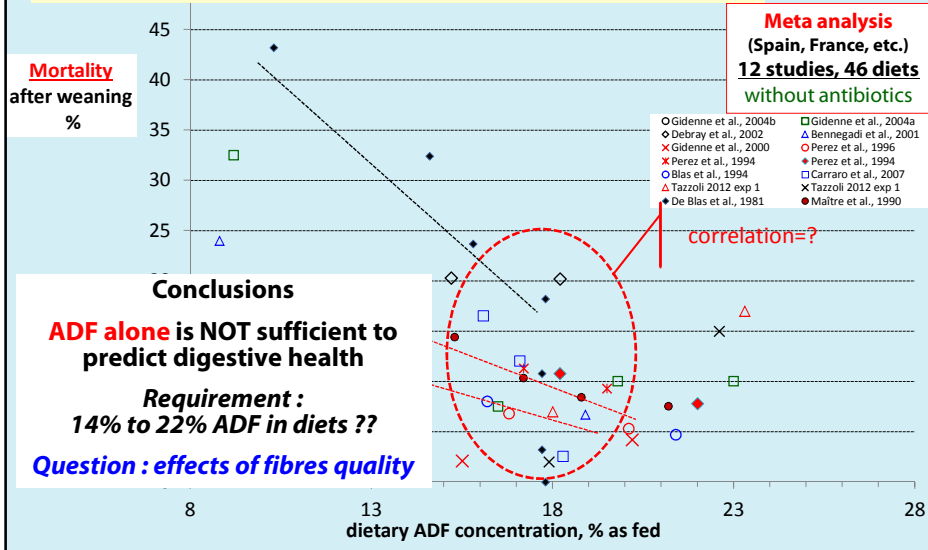
**NEED : large experimental design,**

**e.g. network of experimental units (french network GEC: 6 units)**

## 4.2 Fibres and digestive health of the growing rabbit

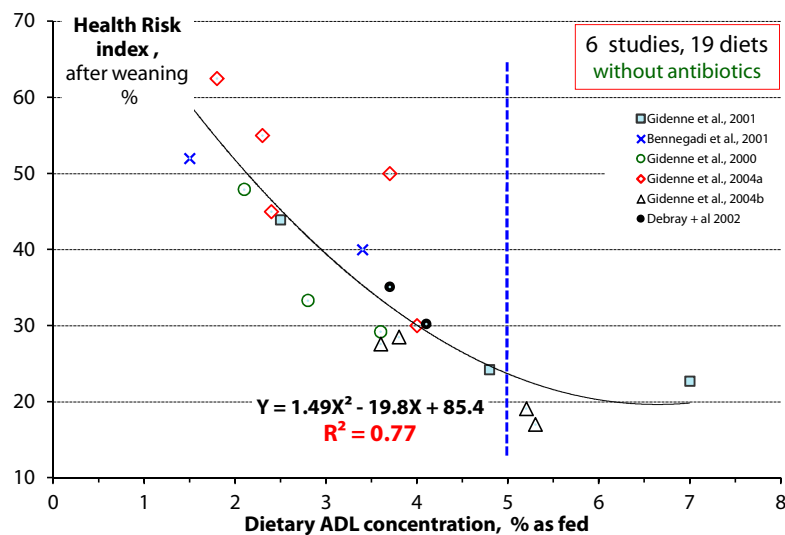
Question : only one fibre criterion for mortality prediction ?

Poorly digested fibres "ADF" and mortality from digestive troubles = ?



25

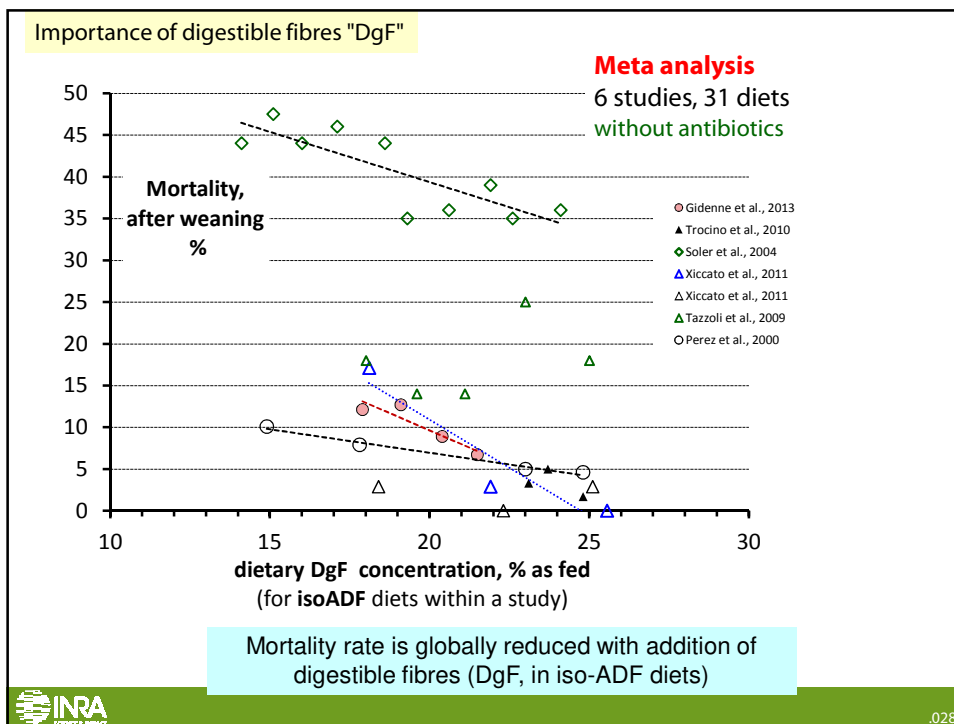
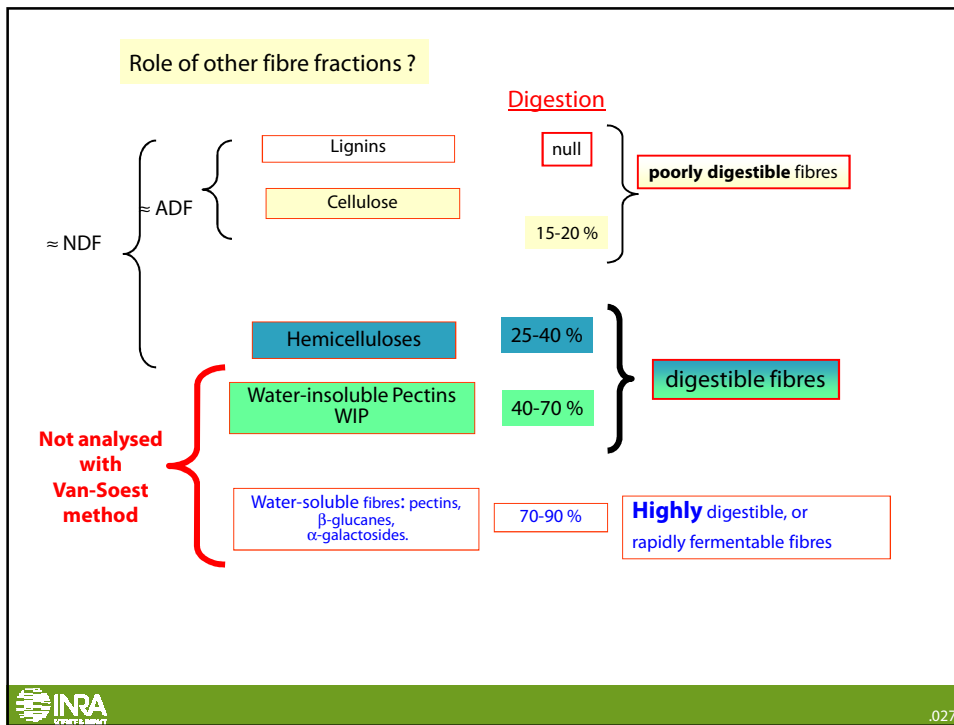
Effects of lignins on rabbit digestive health ??

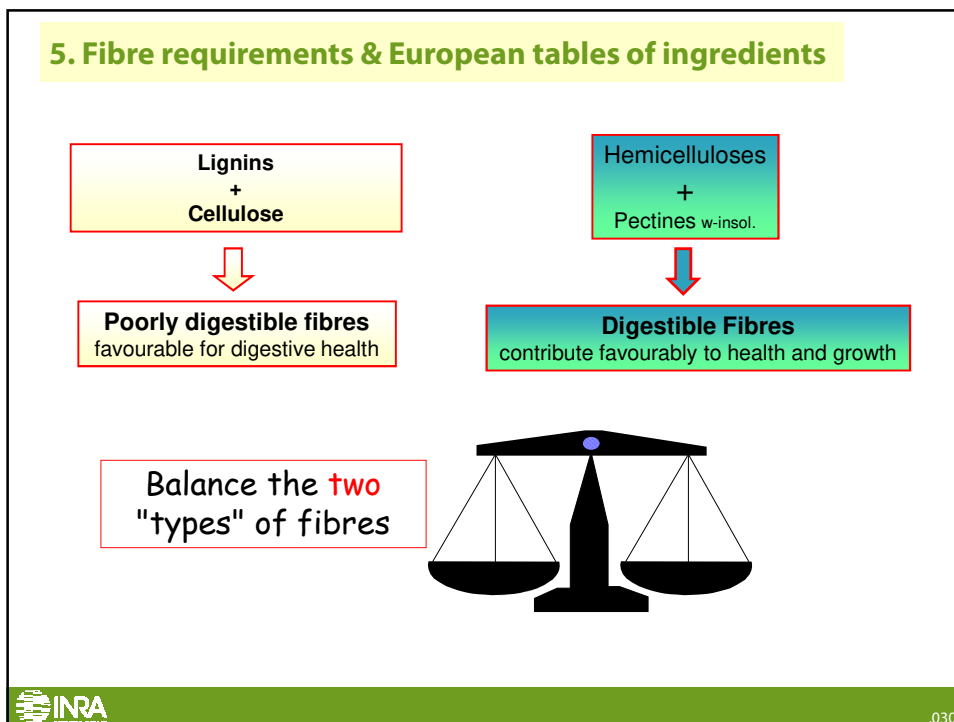
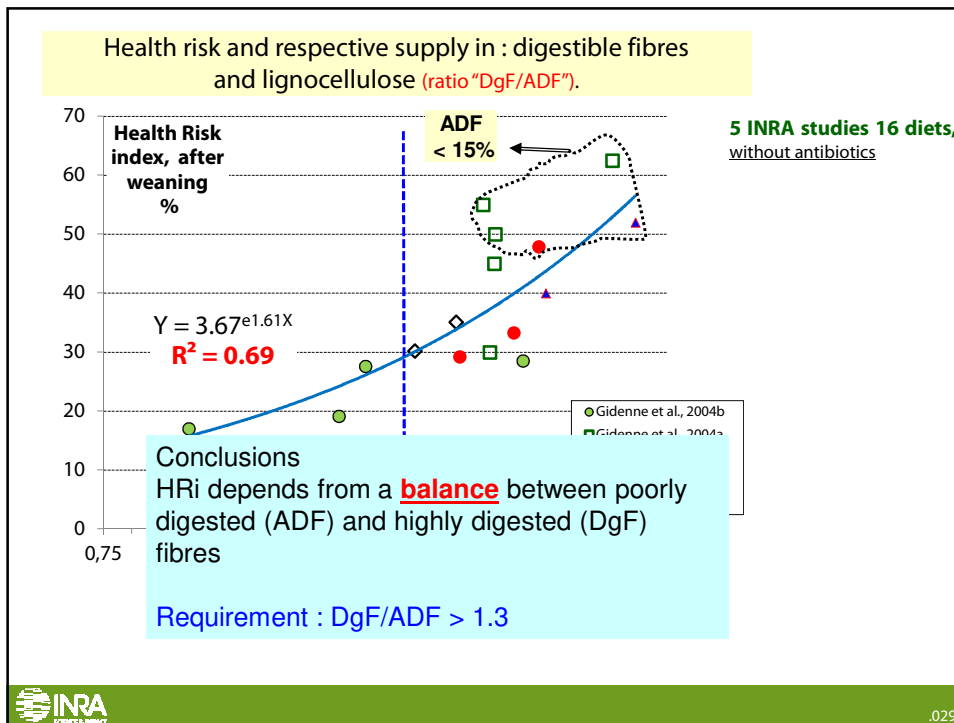


**Requirement : minimum 5% ADL**  
**Beware : ADL is not true lignin ...**  
 (overestimation in some cases (tannins-> grape marc, ...))



.026







**Fibres requirements** to prevent digestive troubles  
in the young and growing rabbit

3 key points

Unit :g/kg as fed *	Post weaning (28-42d old)	End of fattening (42-70d old)
Lignocellulose "ADF <sub>om</sub> " *	≥190	≥170
Lignins "ADL" *	≥55	≥50
DgF/ADF <sub>om</sub>	≤1.3	≤1.3
Cellulose "ADF-ADL" *	≥130	≥110
Ratio Lignins/ Cellulose	>0.40	>0.40
Hemicelluloses "NDF-ADF" *	>120	>100



.031

**European "EGRAN" feedstuffs tables** (Maertens *et al.*, 2002)

**Table 4** : Proximate fibre composition of some raw materials (90% DM) used in rabbit feeds, and with criteria used in fibre recommendations for the growing rabbit.

<i>g/kg on as fed basis</i>	NDF	ADF	ADL	WIP	UAI	DgF	CF	CP
Alfalfa meal 17	418	326	73	68	55	160	261	153
Wheat bran	428	128	35	30	14	330	102	158
Wheat straw	750	474	80	22	20	298	95	36
Sugarbeet pulp	428	212	78	250	190	466	80	90
Citrus pulp	220	155	16	120	80	185	33	59
Soyabean husks	588	426	21	92	60	254	55	122
Sunflower husks	693	562	202	100	75	231	68	54
Cocoa husk	390	300	140	30	20	120	83	164
Palm cake	520	317	90	30	10	233	150	185
Soyabean meal 48	104	65	5	55	24	94	50	468
<i>Whole seeds</i>								
Soya	117	73	8	60	25	104	56	369
Barley	175	55	9	6	3	126	46	108
Maize	100	25	5	7	5	82	19	92

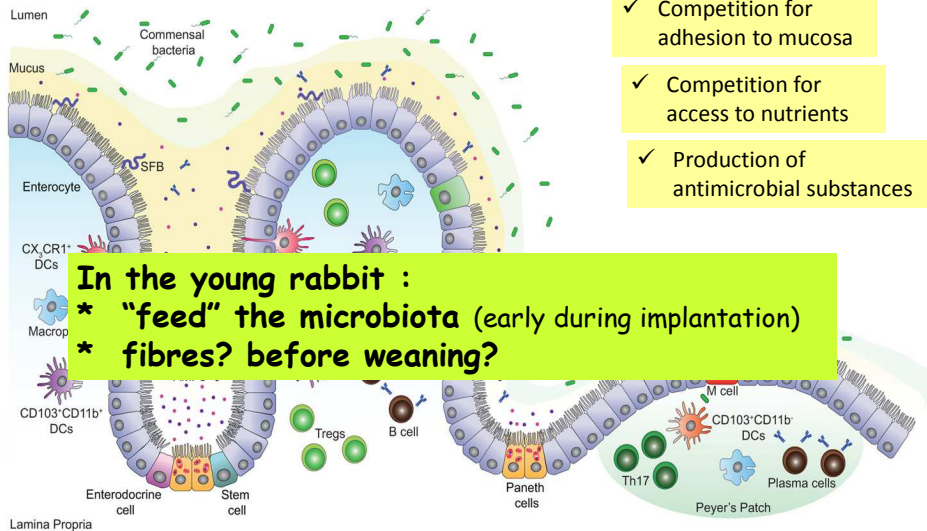


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## 6. Perspectives

further understanding of fibre effects on health?

Fibre – microbiota – immunity in the young rabbit



**GenPhySE**  
Génétique, Physiologie et Systèmes d'Élevage

**INRA**  
SCIENCE & IMPACT

**Rabbit research team**

- Sylvie Combes
- Laurence Lamothe
- Corine Bayourthe  
Agronomy highschool
- Thierry Gidenne
- + 2 PhD students  
Teyha READ  
Héloïse LEGENDRE
- Davi Savietto
- Francis Enjalbert
- + technical staff
- Olivier Zemb
- Annabelle Meynadier
- Muriel Segura
- Béatrice Gabinaud
- Laurent Cauquil
- Carole Bannelier

**INP ENSAT**

**INP TOULOUSE**  
ÉCOLE NATIONALE VÉTÉRAIRE

**Veterinary highschool**

Thanks for your attention

**INRA**  
INRAE

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**Question 2 : how to differentiate the effect of fibres from that of starch?**

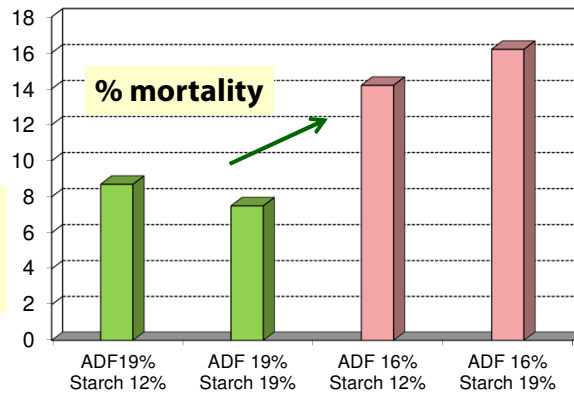
**Answer 1:**

factorial design **2 X 2** with: 2 **starch** (12 vs 19%) X 2 **ADF** (19 vs 16%) levels (4 diets)

Large scale study  
n=507 rab./diet,  
6 sites  
weaning -slaughter

Effect of **ADF: 7 vs 15%**  
P<0.05

Effect of **starch = NS**



**Conclusions:**

**No effect of starch on mortality**

**ADF reduces the mortality**



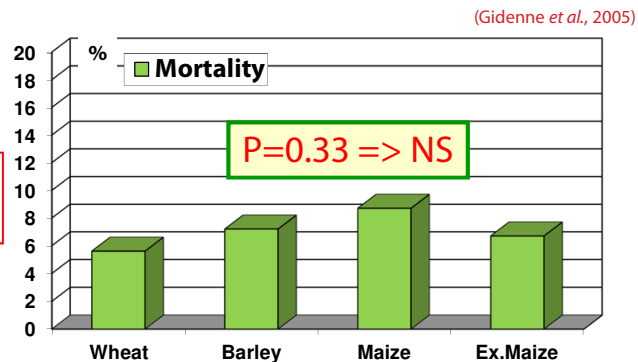
.035

**Answer 2 :**

**isoADF diets** but variations in **starch quality** : maize, wheat, barley, extruded maize

Diet with some "risks" : ADF < 18% and starch ≈ 20%

n=446 rab./diet  
5 sites  
period : weaning -slaughter



(Gidenne et al., 2005)

P=0.33 => NS

starch level at ileum (50d) % DM: 6<sup>b</sup> 5<sup>b</sup> 11<sup>a</sup> 2<sup>c</sup>

Conclusion : **NO** correlation among **ileal starch** and **mortality**,  
NO starch overload



.036