Effect of immunocastration in combination with addition of fat to diet on quantitative oxidation of nutrients and fat retention in male pigs

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Introduction

Immunocastration (IC) has been studied as one of the possible replacements for surgical castration of male pigs to block reproductive function and eliminate boar taint. It has a positive effect on performance (Batorek *et al.*, 2012) but after IC, increased feed intake (FI) and fat deposition indicate changes at the metabolic level. The objective of the study was to determine the effects of IC and increase of dietary fat on energy (E) metabolism and relationships between digested nutrients and their final outputs for catabolic and metabolic process in fattening pigs.

Material and methods

Digestibility and N and E balance in respiration chambers were determined during 8-9 days in 2 subsequent stages prior and after IC with Improvac® (mean body weight BW: 85 and 135 kg) in 4 replicates (2 groups of 2 littermates each). Pigs were fed at 90% of predicted *ad libitum* ME intake and were allocated to one of 2 groups: Group 1 was fed low fat diet (LF; standard diet with addition of 0.5% of rapeseed oil; 2.5% DM of fat) during stage 1 and 2 and group 2 was fed LF during stage 1 and high fat diet (HF; diet enriched in fat by addition of corn and linseed oils to balance the C18:3:C18:2 fatty acids (FA) ratio between diets; 8.9% DM of fat) during stage 2. Additionally, pigs received a test-meal containing ^{13}C18:2 n-6 FA and $^{13}CO_2$ production was measured (on 0, 1, 5 and 6-7 days after ingestion) in order to calculate the rate of oxidation of this FA. The 7th day was a fasting day with feed deprivation. Heat production (HP) and respiratory quotient (RQ) were calculated according to Brouwer (1965) and components of HP (Van Milgen *et al.* 1997) were used to calculate heat increment (HI) as the sum of HP due to physical activity and thermic effect of feeding. Oxidation of nutrients and their contribution to fat retention (RF) were calculated according to Chwalibog *et al.* (1992). Effect of treatment group, stage and their interaction was tested by the GLM procedure (SAS Inc., Cary, NC, USA).

Results and discussion

To mimic the increase in voluntary FI seen in IM after V2, the ME intake was increased between stages (P<0.01; Table 1). Total RE increased with stage (P<0.01) and was mainly retained as fat (P<0.01) in accordance with increased lipogenesis during stage 2 (P<0.01). RF synthesized from carbohydrates (RF(CHO)) increased with stage (P<0.01; Figure 1), but on HF diet the proportion of RF originating from dietary fat increased at the expense of RF(CHO) (P<0.01). This explains the decreased HP (P<0.01; Table 1) and increased RE and RE as fat (P<0.01) on HF diet, because the utilization of ME originating from lipids instead of carbohydrates is energetically more efficient and results in lower HP (Van Milgen *et al.*, 2001). Nevertheless, the decrease in HI (% ME intake) with HF during stage 2 was only numerical (Table 1). The RQ was always above 1 and it increased with stage (P<0.01; Table 1), but it was lower on HF diet (P<0.01), indicating that there was more oxidation and less synthesis of lipids on HF diet in stage 2. In contrary, production of $^{13}CO_2$ because of oxidation of dietary ^{13}C18:2 n-6 FA increased with stage, but was higher on LF diet from day 2 onwards (Figure 2), indicating that dietary provision of this essential FA was insufficient for pigs on LF diet to satisfy their minimal oxidation rate.

Table 1. Results of energy balance (kJ/kg of $BW^{0.60}$ per day) and respiratory quotient in growing immunocastrated pigs before (stage 1) and after (stage 2) successful immunocastration.

	Stage 1		Stage 2		r.s.d	*P*-value[1]		
Group	1	2	1	2		S	G	S × G
Diet	LF	LF	LF	HF				
Energy balance (kJ/kg of $BW^{0.60}$ per day)								
ME intake	$2,270^{a}$	$2,277^{a}$	$2,449^{b}$	$2,492^{b}$	19	<0.01	0.32	0.10
Heat production	$1,346^{ab}$	$1,370^{b}$	$1,371^{ab}$	$1,327^{a}$	17	0.33	0.77	<0.01
Retained energy as fat	648^{a}	600^{a}	806^{b}	914^{c}	30	<0.01	0.48	<0.01
Total retained energy	924^{a}	907^{a}	$1,078^{b}$	1165^{c}	20	<0.01	0.36	<0.01
Lipogenesis	559^{a}	513^{a}	746^{b}	681^{b}	38	<0.01	0.26	0.63
Heat increment (% of ME)	23.3	23.8	27.5	24.7	2.9	0.13	0.59	0.30
Respiratory quotient	1.10^{a}	1.09^{a}	1.14^{b}	1.07^{a}	0.01	0.14	0.04	<0.01

r.s.d.=residual standard deviation; ME = metabolizable energy; LF = low fat diet; HF = high fat diet.

[1] Tested for effects of stage (S), group (G) and their interaction (S×G).

a-c Least squares means within a row with different superscripts differ ($P<0.05$).

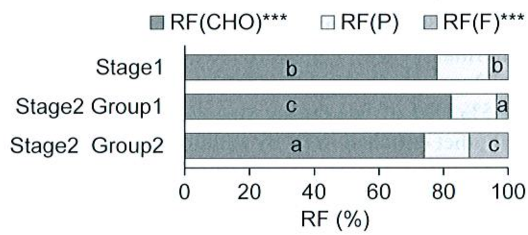

*Figure 1. Percentage of total retained fat (RF) originating from dietary carbohydrates (RF(CHO)), proteins (RF(P)) and fat (RF(F)); *** P<0.01.*

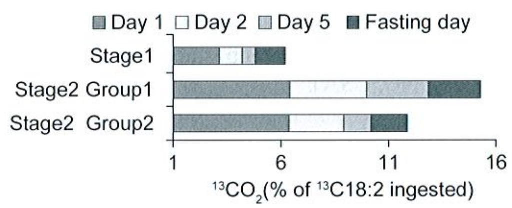

Figure 2. Excreted $^{13}CO_2$ as percentage of consumed ^{13}C18:3 during the 1st, 2nd, 5th and fasting day in respiration chamber.

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