WITHIN LITTER VARIATION IN FIBRE CHARACTERISTICS, PRODUCTION AND MEAT QUALITY TRAITS OF PIGS FROM SOWS FED DIFFERENTLY DURING GESTATION.

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Background

It is well documented, that muscle fibres are developed prenatally in pigs and are fixed at birth. In pigs two types of fibres develop prenatally. Primary fibres develop from d 25 to d 50 of gestation. Secondary fibres develop thereafter with numbers being fixed around day 80 of gestation (Christensen et al., 2000).
It is also known that the number of muscle fibres influences postnatal muscle growth (Rehfeldt et al., 2000). An extreme case is double-muscling in cattle, where the animals have a very high number of muscle fibres leading to extreme muscling postnatally.
Dwyer et al. (1994) have shown, that feeding pregnant sows different levels of feed in early and mid-gestation can lead to increased number of muscle fibres in the offspring with a positive effect on postnatal muscle growth. This effect of increased maternal feeding is found only in small pigs with the smallest number of muscle fibres leading to a narrower distribution of fibre numbers within litter. The increase in muscle fibre number is only seen in the secondary fibre population as primary fibres are not affected by maternal nutrition within litter (Dwyer & Stickland, 1991).

Objective

The objective of this experiment was to study how different feeding levels in early and mid-gestation and within litter variation in size (slaughter weight) of offspring influence muscle fibre characteristics (number, types and area), production traits (daily gain, slaughter weight and meat percentage) and meat quality traits (ultimate pH, drip loss, Minolta colour and pigment) in pigs.

Methods

39 Danish Landrace*Yorkshire halothan negative sows were used in this study. The sows were randomly assigned to one of three treatments. Treatment 1 sows (control) were fed restrictively with 2.0 FUp from day 0-70, treatment 2 sows were fed restrictively until day 24 and from day 51-70 and *ad libitum* from day 25-50, and treatment 3 sows were fed restrictively until day 24 and *ad libitum* from day 25-70. All sows were fed 2.0 FUp from day 71-110 and thereafter 3.1 FUp until farrowing. Offspring from all sows were treated equally and slaughtered at a litter average weight of approximately 100 kg. *M. Semitendinosus* was analysed for muscle fibre characteristics, production traits were collected throughout the experiment and *M. Longissimus dorsi* was analysed for meat quality traits.

Results and discussion

We found no significant effects of maternal feeding level on any fibre characteristics or production and meat quality traits and no maternal feeding*size by litter interactions (data not shown). On this background, data from all treatment groups is included in the analysis of effects of size within litter. Results are shown in Table 1.
There was a significant variation in total fibre number, P-fibre number, and S-fibre number between pigs of different size within litter. The heaviest pigs had a larger fibre number, than the light and middle weight pigs, and this effect was seen both in P- and S-fibre number. The S:P-ratio was also significant ($P<0.01$). There was also a significant variation in mean fibre area (MFA) between pigs of different size. The lightest pigs have a smaller MFA than middle and heavy weight pigs. As would be expected, there was a significant variation in daily gain ($P<0.001$) and slaughter weight ($P<0.001$) between pigs of different size within litter, but we found no variation in meat percentage.
These results show that the size differences within litter and consequently the daily gain to some extent can be explained by variation in fibre number and/or MFA. The size difference between light and middle weight pigs can be associated with the MFA, but not the number of fibres, while the size difference between middle and heavy weight pigs was associated with the number of fibres, but not the MFA. The within litter variation in P-fibre number between pigs of different size shown in this study is in contrast to results obtained by Dwyer & Stickland (1991), who found no variation in P-fibre number within litter. Handel & Stickland (1987) suggest that the difference between small and large littermates can be explained by a lower S:P-ratio in the smaller littermates. Results from this study show that the S:P-ratio decreased with increasing weight of the pig.
There was a significant effect of size on b*-value and pigment content and a tendency to an effect on L*-value. The heaviest pigs had more pale and yellow meat than light and middle weight pigs. The pigment content was highest in middle and heavy weight pigs. The differences in size within litter also cause some variation in colour of the meat. There might be an association between the pigment content of the meat and the MFA. The pigment content of the meat decreased with decreasing MFA. However, the pigment content increased with body weight. Thus, if the pigs of different size were compared at the same weight it is likely that the difference in pigment content is abolished.

Conclusions

Feeding the pregnant sow different levels of feed in early to mid-gestation did not influence the muscle fibre characteristics, production or meat quality traits of the offspring in the present study. The within litter variation in size and also the growth rate of the pigs can partly be explained by variation in muscle fibre number and MFA. The variation in muscle fibre number is both in the P- and S-fibre population, and the S:P-ratio decreases with increasing weight of the pig. The colour of the meat also shows some variation due to size of the pigs.

Pertinent literature

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Table 1. Effect of size within litter on fibre characteristics, production- and meat quality traits of pigs.

	Size within litter (slaughter weight)			
Parameter	Lightest	Middle	Heaviest	P-value
Number of pigs	73	69	73	
Days at slaughter	156	156	156	
Fibre characteristics:				
Fibre number	617,357	608,186	664,918	<0.01
P-fibre (number)	25,039	26,651	29,844	<0.001
S-fibre (number)	590,383	579,901	637,434	<0.01
S:P-ratio	24.3	22.3	21.4	<0.01
MFA, μm^2	5267	5873	5858	<0.001
Production traits:				
Daily gain, g/day	810	935	1038	<0.001
Slaughter weight, kg	71.0	80.9	89.4	<0.001
Meat percentage	59.9	60.0	59.5	NS
Meat quality traits:				
Ultimate pH	5.58	5.58	5.57	NS
Drip loss, %	5.2	5.3	5.8	NS
L*	53.6	53.1	54.1	=0.10
a*	7.5	7.5	7.6	NS
b*	6.2	6.3	6.7	<0.05
Pigment, mg/g	0.70	0.76	0.74	<0.01