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AVERAGE MUSCLE FIBRE CROSS SECTIONAL AREA VARIES CONSIDERABLY IN PORK LOINS

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Introduction

Porcine *M. longissimus dorsi* contains about 80 per cent of glycolytic type IIB fibres calculated based on the fibre number and about 90 per cent calculated based on the fibre area (Oksbjerg et al. 1995, Ruusunen et al. 1996). Therefore, the size of these fibres has a great effect on the average muscle fibre cross sectional area in this muscle. When a muscle grows, the diameter of type IIB fibres increases faster than that of type I. In a newborn pig the sizes of all muscle fibres are the same, but at the slaughter weight, the size of type IIB fibres are twice as large as the size of type I and type IIA fibres (Bader 1983). Chrystall and coworkers (1969) found that muscle fibre diameter increased 100% from birth to 25 days, whereas from 100 to 125 days of age, muscle fibre diameter increased only 10 per cent. The rate of the muscle fibre growth in porcine longissimus dorsi after 150 days of age is very slow.

When a muscle grows both the cross sectional area and the length of the fibres increase. Muscle size can also increase by satellite cell proliferation but this is not a very important way. Carcass fat content affects muscle fibre size so that in fat carcasses the muscle fibre size is smaller than in lean carcasses (Seideman et al. (1989).

Objectives

The aim of the present study was to investigate how much does the average muscle fibre cross sectional area range in pork loins at the live weight of 95-100 kg.

Methodology

The study consisted of 27 Finnish Landrace and 28 Yorkshire pigs slaughtered at the live weight of 95-100 kg. Average muscle fibre cross sectional area in *M. longissimus dorsi* was measured with Image Analyzer from sections stained with myosin ATPase method (Brooke and Kaiser, 1970). Pork loin cross sectional area was measured one day after slaughter.

Results & Discussion

Gilts had a larger loin area ($p<0.05$) and a larger average muscle fibre cross sectional area ($p<0.05$) than the barrows. Karlsson et al. (1994), Ruusunen et al. (1996) and Nürnberg and Ender (1990) have also shown that both the muscle fibre cross sectional area and the loin area are larger in gilts than in barrows. The differences in the loin area and in the average fibre cross sectional area between the breeds were not significant ($p>0.05$) (Table 1).

According to Chrystall and coworkers (1969), the growth of muscle fibres in *M. longissimus dorsi* is most rapid early in life declining later to a near stationary level. One reason for this is that the fat starts to accumulate in the carcass at that stage. Carcass fat content affects muscle fibre size so that in fat carcasses the average muscle fibre cross sectional area is smaller than in lean carcasses (Seideman et al. (1989). Therefore, it is important to take both the live weight of the pig and carcass lean fat/content into account when studying muscle fibre cross sectional area. In Figures 1 and 2, the average fibre cross sectional area is presented in relation to the cross sectional area of pork loin at the live weight of 95-100 kg. The average muscle fibre cross sectional area varies considerably in pork loin with the same cross sectional area regardless of breed or sex. The pork loin area ranged from 30 to 35 cm^2 in three pigs, from 35.1 to 40 cm^2 in 18 pigs, from 40.1 to 45 cm^2 in 22 pigs and from 45.1 to 50 cm^2 in 12 pigs. The relationships between the largest average and the smallest average muscle fibre cross sectional area in these groups were 1.5, 1.4, 1.7 and 1.7, respectively.

Muscle fibres are oxidative at the early stages of growth due to the dense capillarization and the small cross sectional area of muscle fibres, but when the fibres grow, they become more anaerobic. Thus, selection based on small fibre cross sectional area could result in pigs with more oxidative muscle. It has been found that the more oxidative the muscles are, the better the sensory quality of meat is (Essen-Gustavsson and Fjelkner-Modig, 1985).

A high number of muscle fibres with small fibre cross sectional area per loin area permits more growth potential to the muscle without a decrease of the oxidativity (Ashmore and Vigneron 1988). Miller et al., (1975) and Søholm Petersen et al., (1999) found that carcass meat content can be increased by choosing animals with the biggest number of muscle fibres although Staun (1963), Seideman et al. (1989) and Larzul et al. (1997) have shown the opposite that the muscle fibre thickness correlates positively with lean meat content. It is, however, not yet known which muscle fibre cross sectional area at a certain live weight leads to (i) a fast growth, (ii) oxidative muscles, (iii) pigs whose carcasses contain a lot of lean meat and (iv) also meat with good technological and sensory quality.

Conclusions

The muscle fibre cross sectional area can vary considerably in pork loin with the same cross sectional area at the live weight of 95-100 kg regardless of breed or sex.

Table 1. Live weight (kg), loin area (cm^2) and average muscle fibre cross sectional area of *M. longissimus dorsi* (μm^2).

	Barrows (N=28)	Gilts (N=27)	p	Landrace (N=27)	Yorkshire (N=28)	p
Live weight (kg)	98.2	97.7	0.310	98.3	97.6	0.125
Loin area (cm^2)	40.4	43.1	0.0087	42.7	40.8	0.072
Muscle fibre area x 10^3 (μm^2)	3.9	4.5	0.0012	4.2	4.1	0.464

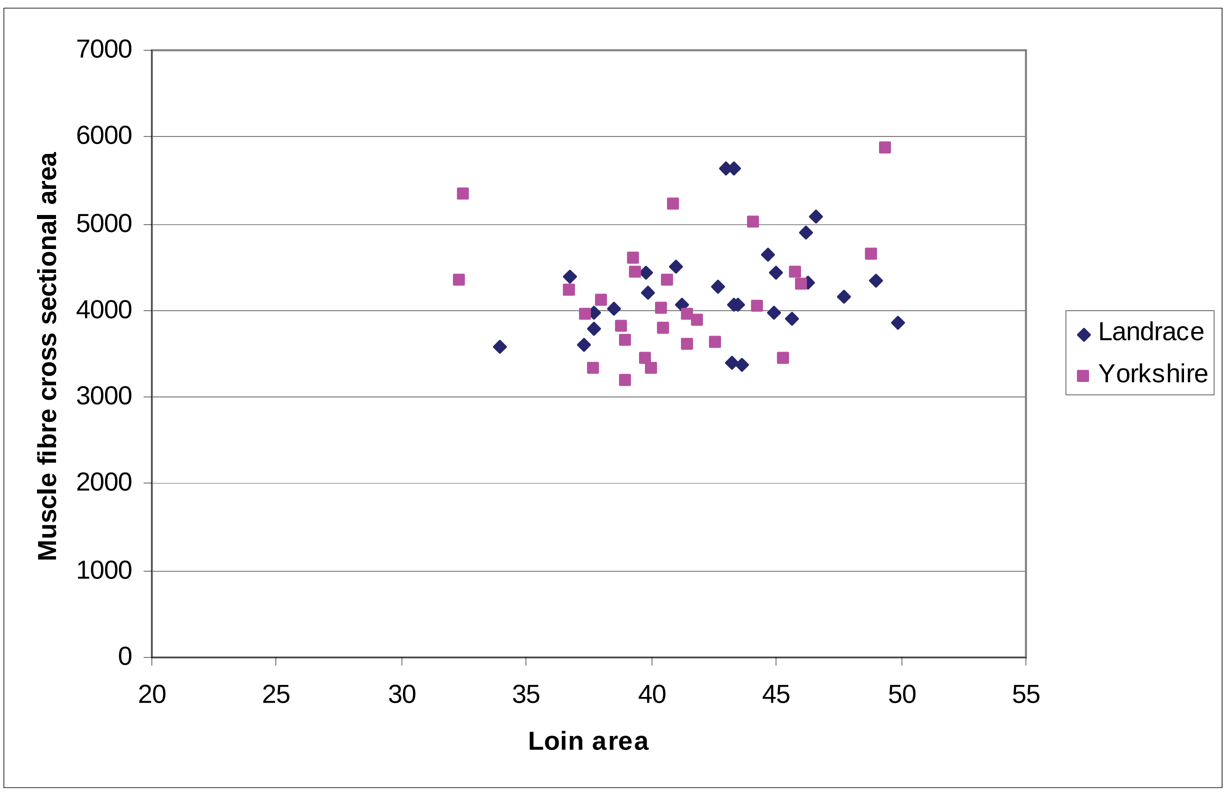

Figure 1. Average muscle fibre cross sectional area (μm^2) of *M. longissimus dorsi* in relation to loin area (cm^2) in Landrace and Yorkshire pigs.

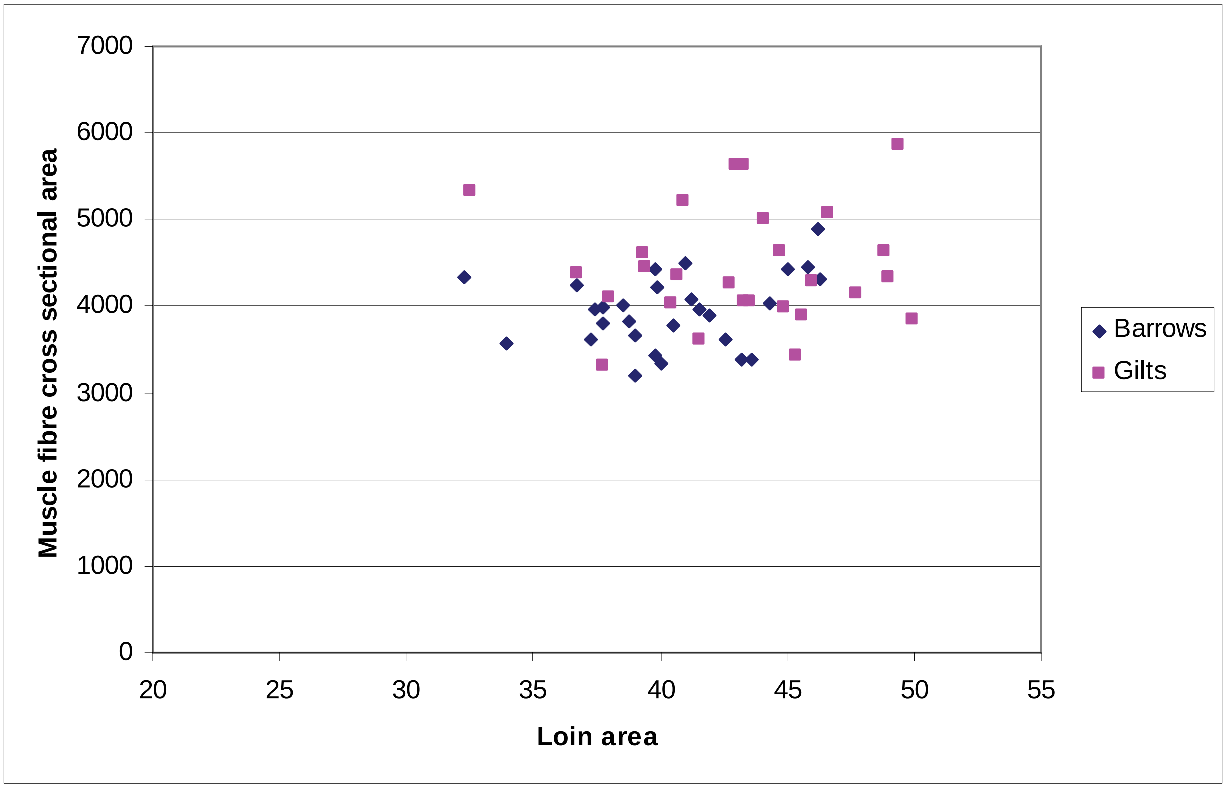

Figure 2. Average muscle fibre cross sectional area (μm^2) of *M. longissimus dorsi* in relation to loin area (cm^2) in barrows and gilts.

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