Histochemical properties and meat quality traits of porcine muscles during growth:

Effect of feed restriction in pigs slaughtered at the same weight and varying age

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Introduction

In pigs the number of muscle fibers is determined at birth (*Stickland and Goldspink,* 1973). Thus, during postnatal growth increase in skeletal muscle mass is mainly a result of an increase in muscle fiber size (hypertrophic growth). At birth, all fibers are oxidative and an intense conversion towards glycolytic fibers is observed up to 4 months of age. Thereafter, the proportion of glycolytic fibers keeps on increasing but at a much slower rate (*Lefaucheur and Vigneron,* 1986).

Postnatal nutrition is one of the determinant factors influencing muscle development through their effects on growth rate and body composition. *Harrison et al.* (1996) reported significantly reduced muscle fibers size and concomitantly higher proportions of slow oxidative fibers (**SO**) in 2 month old pigs after sever dietary energy restriction (50% of ad libitum). However, the reduction in fiber size was accompanied by a reduction in body weight. When muscle fiber size is compared at a similar BW (100 or 130 kg), muscle fiber type distribution was not affected and only SO fibers tended to be smaller in pigs with restricted (70% of voluntary feed intake) compared to ad libitum feed allowance (*Čandek-Potokar et al.*, 1999). By contrast, in younger and lighter pigs (50 kg BW at slaughter) *Solomon et al.* (1988) reported smaller SO and smaller fast glycolytic fibers (**FG**) as well as higher proportions of fast oxidative-glycolytic fibers (**FOG**) and lower proportions of FG fibers in restrictively fed pigs compared to pigs with ad libitum access to the diet.

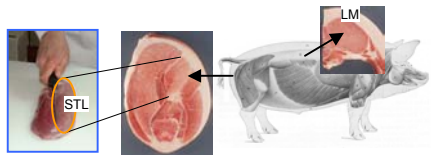
Objectives

The purpose of this experiment was to compare the histochemical properties of myofibers and meat quality traits in two glycolytic muscles (LM and light portion of the semitendinosus muscle [**STL**]) in pigs with restricted (80% of voluntary feed intake) or ad libitum access to feed. Pigs were slaughtered either at the end of the growing or finishing period at the same BW but different age. The BW at slaughter was chosen based on the results obtained by *Lefaucheur and Vigneron* (1986), who showed that the rate of conversion from oxidative towards glycolytic metabolism is slowed down after 60 kg BW (< 4 months of age).

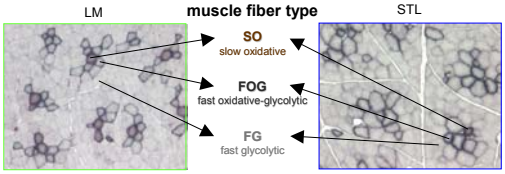
Material and Methods

Animals and Treatments Twenty-four Swiss Large White barrows from six litters were selected and had either restricted (**R**) or ad libitum (**A**) or access to a standard growing (20 – 60 kg BW) and finishing (60 – 100 kg BW) diet. Two littermates from two dietary treatments were slaughtered at 61.3 ± 0.99 kg (**A60**; n = 6 and **R60**; n = 6) or 101.3 ± 1.48 kg BW (**A100**; n = 6 and **R100**; n = 6).

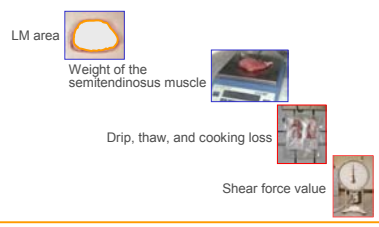
Tissue sampling at slaughter Muscle samples were collected within 40 min postmortem

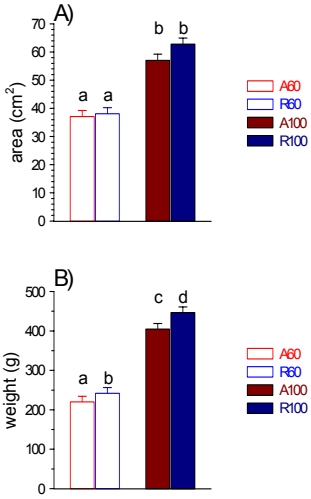


Histochemical Analysis Muscle sections were treated with the combination of succinic dehydrogenase and acid myofibrillar ATPase according to the multiple staining procedure of *Solomon and Dunn* (1988).

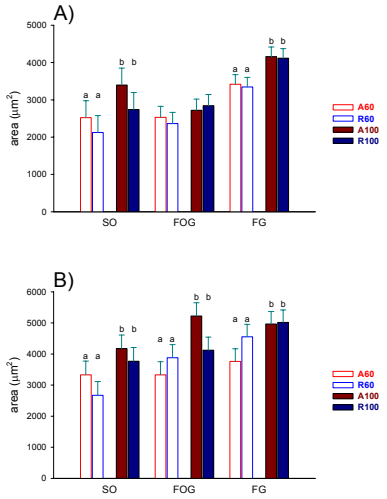


Morphometric Muscle Measurements and Meat Quality Traits

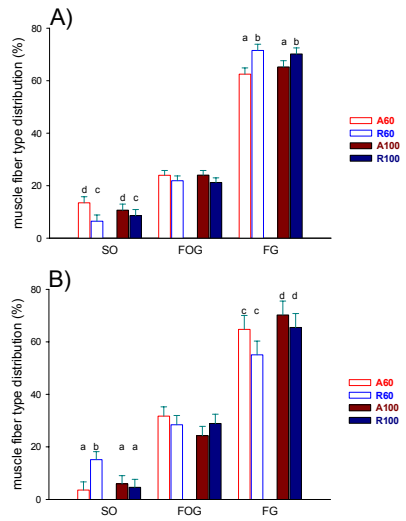




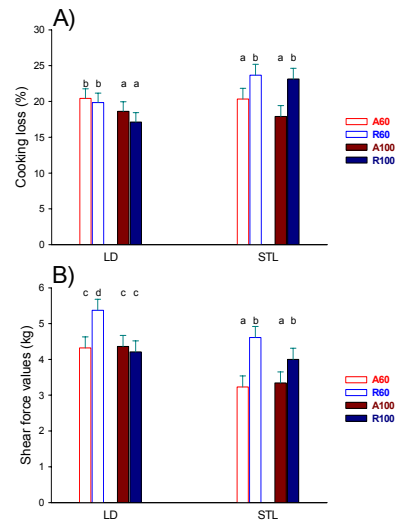
Effect of feed intake on loin area (A) and weight of the semitendinosus muscle (B) of pigs slaughtered at 61 kg (**A60** and **R60**) or 101 kg BW (**A100** and **R100**). Different superscripts denote differences between treatment groups ($P < 0.05$).



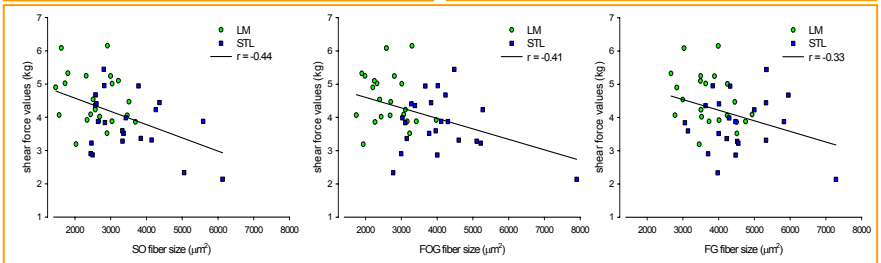
Effect of feed intake on muscle fiber size of the LM (A) and STL (B) of pigs slaughtered at 61 kg (**A60** and **R60**) or 101 kg BW (**A100** and **R100**). Different superscripts denote differences between treatment groups within each fiber type (^{a,b}; $P < 0.05$). SO = slow oxidative; FOG = fast oxidative-glycolytic; FG = fast glycolytic.



Effect of feed intake on muscle fiber type distribution of the LM (A) and STL (B) of pigs slaughtered at 61 kg (**A60** and **R60**) or 101 kg BW (**A100** and **R100**). Different superscripts denote differences between treatment groups within each fiber type (^{a,b}; $P < 0.05$; ^{c,d}; $P < 0.10$). SO = slow oxidative; FOG = fast oxidative-glycolytic; FG = fast glycolytic.



Effect of feed intake on cooking loss (A) and shear force values determined in the LM and STL of pigs slaughtered at 61 kg (**A60** and **R60**) or 101 kg BW (**A100** and **R100**). Different superscripts denote differences between treatment groups within each muscle (^{a,b}; $P < 0.05$; ^{c,d}; $P < 0.10$).



Relationship between the size of SO (slow oxidative), FOG (fast oxidative-glycolytic), and FG (fast glycolytic) fibers and the shear force values determined in the LM and light portion of the semitendinosus muscle.

Conclusions

Feed restriction (effect of age at a given weight) had no effect on myofiber size of the LM and STL. Compared to the ad libitum group, the LM but not the STL of pigs with restricted feed allowance had more FG and fewer SO fibers. This finding suggests a greater maturation rate of this muscle with increasing age. Although the number of FG fibers increased from 60 to 100 kg BW in the STL, age (at the same BW) seemed not to affect STL maturation. This might be explained by the lower allometric growth rate of the semitendinosus muscle compared to the LM.

The STL of pigs in the restricted group displayed higher cooking losses and was less tender compared to the STL of pigs in the ad libitum group. Furthermore, with increasing size of SO, FOG, and FG fibers shear force values decreased. This relationship resulted mainly from the higher shear force values and smaller myofibers observed in pigs at 60 kg BW than in pigs at 100 kg BW.

References

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