INTRAMUSCULAR FAT CONTENT DEPENDING ON THE MUSCLE, THE LIVE WEIGHT AND THE SEX OF THE PIG

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Abstract – Intramuscular fat (IMF) is of interest for the meat industry, breeding and nutrition companies because it affects at the palatability of pork. The objective of this study was to examine the variation of IMF content among muscles and different locations of the same muscle, live weight and sex of the pigs. For this purpose 92 pigs of the same genotype but different sex (surgically castrated, entire male, female and immunocastrated male) and live weight (30, 70, 100 and 120 kg) were slaughtered. Samples of the loin at 3 different anatomical positions and 3 muscles of the ham were obtained and IMF determined. Results show differences in IMF content between sexes, being this higher in surgically castrated pigs, independently of its weight and muscle. Regarding muscles, important differences in IMF content were found, as well as between different locations of the same muscle. These differences are linked with the weight of the pig, indicating deposition of IMF during growth is not the same in all the muscles.

Key Words – intramuscular fat, pig sex, weight, muscle

I. INTRODUCTION

Intramuscular fat content (IMF) is the fat deposited between fascial or muscle fibre bundles. IMF varied across breed, sex, diet and weight at slaughter [1,2,3,4]. Some works show positive relationship between IMF and consumer acceptability of the pork meat [5,6,7], probably due to the lubrication during chewing [8]. Because of the influence of IMF in the palatability of the meat, it is an important parameter for the different stakeholders of the pig industry. It is of interest to know differences in IMF content depending on the muscle or the location of the muscle. Also it is of interest, mainly for breeding and nutritional purposes, to know the deposition of IMF at the different muscles during the growth of the pig and see if it is affected by its sex.

The objective of this study was to examine the variation of IMF content among muscles and different locations of the same muscle, live weight and sex of the pigs.

II. MATERIALS AND METHODS

A total of 92 Pietrain x (Landrace x Duroc) pigs from for sexes (CM: surgically castrated male; FE: female; IM: immunocastrated males; EM: entire male) were used in the present study. Immunocastration was performed by the administration of two doses of the vaccine Improvac® (Zoetis, Spain) at 12 weeks of age and 5 weeks before slaughter. When animals reached their target body weight (TBW) of 30, 70, 100 or 120 kg, they were slaughtered at IRTA's experimental abattoir.

Table 1 Number of animals according to their target body weight (TBW) and sex (CM: surgically castrated male; FE: female; IM: immunocastrated males; EM: entire male)

TBW (kg)	CM	FE	IM	EM	*Total*
30	4	4	0	4	*12*
70	4	4	4	4	*16*
100	4	4	4	5	*17*
120	12	12	12	11	*47*
Total	*24*	*24*	*20*	*24*	*92*

At 24 h *post mortem* loin samples were taken at 3 anatomical locations: between the 3rd and 4th last rib (34LR), between the 8th and 9th last rib (89LR) and between the 3rd and 4th *lumbar vertebrae* (34VL) levels. Samples of three muscles of the ham were also removed: *biceps femoris* (BF), *gluteus medius* (GM) and *semimembranosus* (SM). Meat samples were frozen at -20ºC until being processed.

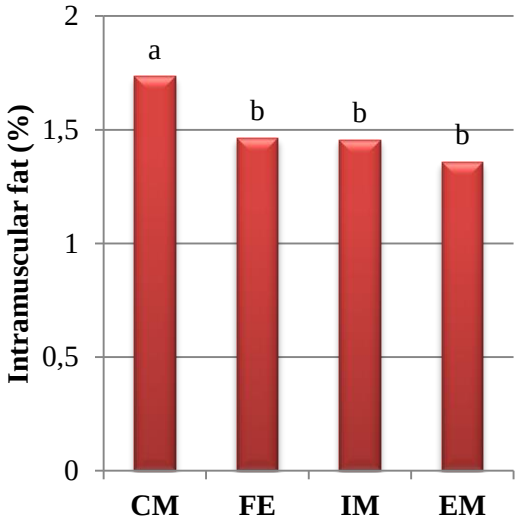
Intramuscular fat content was determined in the minced loin (fascia excluded) by means of the FoodScan equipment (Foss Analytical, Denmark) at wavelengths between 850 and 1050 nm.

Statistical analysis was performed with SAS (SAS Institute Inc., Cary, NC, US). The model included TBW, muscle and sex as fixed effects. Double and triple interactions were also included in the model if significant. Significant differences between least squared means were obtained after apply Tukey test.

III. RESULTS AND DISCUSSION

Only the interaction between muscle and TBW was significant. This indicates that sex effect in the IMF levels is not dependent on the muscle nor on the TBW.
Results of the IMF content by sex are presented in Figure 1.

Figure 1. Intramuscular fat content by sex (CM: surgically castrated male; FE: female; IM: immunocastrated male; EM: entire male) considering all the muscles and live pigs weights (Different letter indicate significant differences, P<0.05).



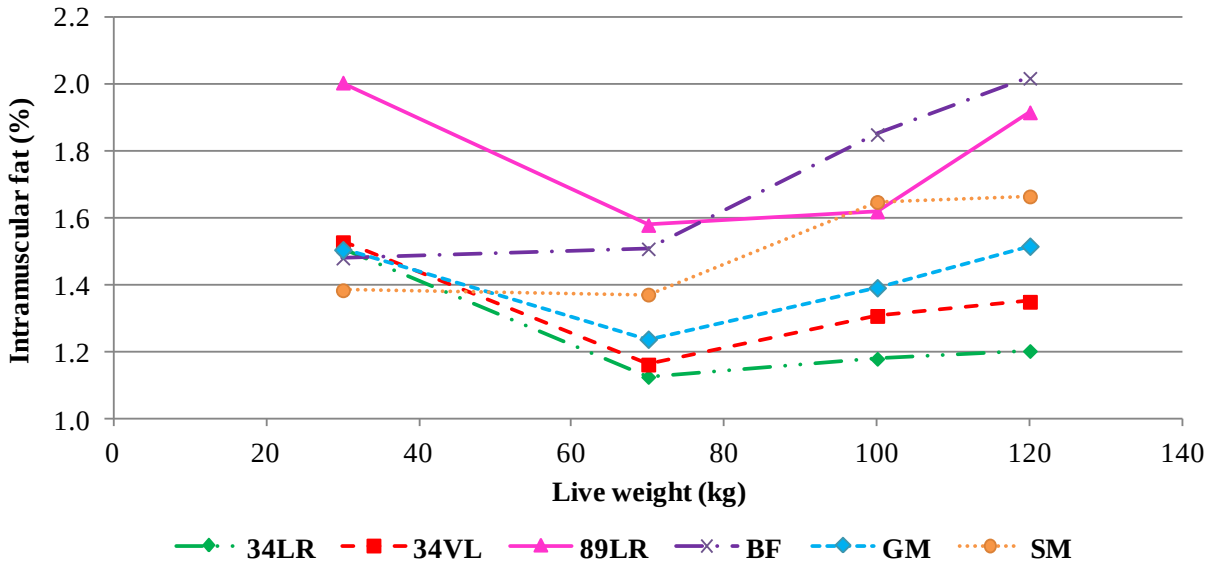
CM presented significantly (P<0.05) higher IMF content than the other sexes evaluated. In a meta-analysis performed by Trefan et al. [9], IMF was higher in CM than EM and FE while in IM was in between CM and FE. In SM muscle, Gispert et al. [10] evaluated IMF in pigs of the same crossbred as in the present work and slaughtered between 100 and 120 kg, fiunding higher IMF values in CM compared with EM and FE, being IM in between. No differences in IMF content in GM muscle of CM, FE and IM were found by Font-i-Furnols et al. [11] in Duroc pigs of more than 130 kg. Differences between works can be due to differences in genotypes, weight and feeding of the pigs.

Regarding the interaction between TBW and muscle, results are presented in Figure 2.
Significant interaction indicates that IMF deposition during pig growth differs between the muscles of the ham and anatomical regions of the loin. In some muscles IMF content was higher at 30 kg than at the other weights studied and this result is surprising because IMF is the last tissue to be deposited during growth [12]. At 30 kg TBW, IMF content was higher at 89LR level of the loin than the other locations evaluated. These differences diminished at 70 kg TBW where IMF was higher at 89LR level of the loin and BF muscle than at 34LR and 34VL levels of the loin. At 100 kg, IMF was lower at 34LR than at 89LR levels of the loin, BF and SM muscles. At 120 kg TBW, which is a weight close to commercial, BF muscle of the ham presented higher IMF than GM and SM muscles. BF muscle also had higher IMF than 34LR and 34VL levels but similar to 89LR level of the loin. Regarding the loin, the most cranial part (89LR level) had higher IMF content than the most caudal parts at all the TBW studied. Differences in IMF content at different levels of the loin were also reported by Faucitano et al. [13] and are in agreement with the results of the present work.

IV. CONCLUSION

In the conditions of the present work it can be concluded that intramuscular fat content varied with the muscle, the level of the loin, the live weight and the sex of the pig. Surgically castrated pigs had higher intramuscular content than the other sexes studied. In general the most caudal part of the loin presents higher intramuscular fat content than the most cranial part and in the ham the highest content can be found in the *biceps femoris* muscle compared with *semimembranosus* and *gluteus medius*.

Figure 2. Intramuscular fat content of pigs of several sexes depending on the muscle (34LR: loin at 3rd-4th last rib level, 34VL: loin at 3rd-4th lumbar vertebra level, 89LR: loin at 8th-9th last rib level, BF: *biceps femoris*, GM: *gluteus medius*, SM: *semimembranosus*) and target body weight (30, 70, 100 and 120 kg).



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REFERENCES

1. Tous, N., Lizardo, R., Vilà, B., Gispert, M., Font-i-Furnols, M. & Esteve-Garcia, E. (2013) Effect of high dose of CLA in finishing pigs on fat deposition and FA composition in intramuscular fat and other fat depots. Meat Science 93: 517-524.
2. Cilla, I., Altarriba, J., Guerrero, L., Gispert, M., Martinez, L., Moreno, C., Beltrán, J.A., Guàrdia, M.D., Diestre, A., Arnau, J. & Roncalés, P. (2006). Effect of different Duroc line sires on carcass composition, meat quality and dry-cured ham acceptability. Meat Science 72: 252–260
3. D'Souza, D. N., Pethick, D. W., Dunshea, F. R., Pluske, J. R. & Mullan, B. P. (2003). Nutritional manipulation increases intramuscular fat levels in the Longissimus muscle of female finisher pigs. Australian Journal of Agricultural Research 54: 745–749.
4. Gou, P., Guerrero, L., & Arnau, J. (1995). Sex and crossbred effects on the characteristics of dry-cured ham. Meat Science 40: 21–31.
5. Bejerholm, C. & Barton-Gade, P. A. (1986). Effect of intramuscular fat level on eating quality of pig meat. In Proceedings of the 32nd European Meeting of Meat Research Workers (pp. 389–391).
6. Fortin, A., Robertson, W. M. & Tong, A. K. W. (2005). The eating quality of Canadian pork and its relationship with intramuscular fat. Meat Science 69: 297–305.
7. Font-i-Furnols, M., Tous, N., Esteve-Garcia, E. & Gispert, M. (2012). Do all the consumers accept the marbling in the same way? The relation beetween visual and sensory acceptability of pork. Meat Science 91: 448-453.
8. Johnson, P.L., Drevjani, L.A., Allen, O.B. & Reasbeck, L.M. (1988). Supplementation of

skim milk fed to veal calves: carcass characteristics, chemical, instrumental, and sensory parameters. Canadian Journal of Animal Science 68: 1069-1077.
9. Trefan, L., Doeschl-Wilson, A., Rooke, J.A., Terlouw, C. & Bünger, L. (2013). Meta-analysis of effects of gender in combination with carcass weight and breed on pork quality. Journal of Animal Science 91: 1480-1492.
10. Gispert, M., Oliver, M.A., Velarde, A., Suarez, P., Perez, J. & Font i Furnols, M. (2010). Carcass and meat quality characteristics of immunocastrated male, surgically castrated male, entire male and female pigs. Meat Science 85: 664-670 .
11. Font-i-Furnols, M., Gispert, M., Soler, J., Diaz, M., Garcia-Regueiro, J.A., Diaz, I. & Pearce, M.C. (2012) Effect of vaccination against gonadotrophin-releasing factor on growth performance, carcass, meat and fat quality of male Duroc pigs for dry cured ham production. Meat Science 91: 148-154.
12. Pethick, D.W., Harper, G.S. & Oddy, V.H. (2004). Growth, development and nutritional manipulation of marbling in cattle: A review. Australian Journal of Experimental Agriculture 44: 705-715.
13. Faucitano, L., Rivest, J., Daigle, J. P., Lévesque, J. & Gariepy, C. (2004). Distribution of intramuscular fat content and marbling within the longissimus muscle of pigs. Canadian Journal of Animal Science 84: 57–61.