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in

De Pedro E.J. (ed.), Cabezas A.B. (ed.).
7th International Symposium on the Mediterranean Pig

Zaragoza : CIHEAM
Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 101

2012
pages 335-339

Effect of sex and slaughter weight on carcass traits measured *in vivo* with ultrasound and *post-mortem* in the carcass in Iberian pigs

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Abstract. Carcass composition of Iberian pigs is very important because it influences the quality of their cured products. Therefore, the objective of this study was to determine the effects of sex and slaughter weight on carcass traits measured *in vivo* with ultrasound and subsequently in the carcass. One hundred and sixty five castrate males and females with a weight ranging from 130 to 175 kg were ultrasound-scanned before slaughter with a 12-cm long, 3,5 Mhz probe. Two images were collected across the *Longissimus dorsi* muscle, one between the 10th and 11th ribs and another after the last rib. After slaughtering, carcass, hams, shoulders and loins were weighted, and the same measurements performed for the ultrasound images were also done in the carcass as follows: loin area, and fat thickness (external, middle, internal, external + middle layers and total). Sex effects were significant for shoulder traits, for ultrasound fat thickness measurements taken between 10th and 11th ribs, and also for some other traits at the last rib level. Slaughtering pigs over 165 kg did not improve carcass or cut yields.

Keywords. Iberian pig – Carcass traits – Backfat – Slaughter weight – Ultrasound.

Effet du sexe et du poids à l'abattage sur des caractères de la carcasse mesurés en vif par ultrasons et sur la carcasse post mortem pour le porc Ibérique

Résumé. *Dû à l'importance que les caractères de composition de la carcasse du porc ibérique ont sur la qualité des produits séchés, on a étudié l'effet du sexe et du poids à l'abattage sur ces caractères, qui avaient été mesurés avant l'abattage par écographie, et ultérieurement sur la carcasse. On a abattu 165 mâles et femelles castrés, avec un poids entre 130 et 175 kg. Avant l'abattage ils ont été échographiés avec une sonde de 3,5 Mhz et 12 cm. On a récupéré deux images échographiques perpendiculaires au* Longissimus dorsi*, l'une entre les côtes 10 et 11, et l'autre après la dernière côte. Après l'abattage on a pesé la carcasse, les jambons et les épaules, et les filets, et on a réalisé sur la carcasse les mêmes mesures qu'avec les images échographiques : surface du filet et épaisseur totale et partielle de la graisse dorsale dans les couches extérieure, moyenne, interne, externe + moyenne et total. Le sexe a affecté les caractères des épaules, les épaisseurs ultrasons-graphiques mesurées entre les côtes 10 et 11, et diverses épaisseurs de la dernière côte. L'abattage d'animaux ayant plus de 165 kg n'a pas signifié une amélioration des rendements de la carcasse ou des coupes.*

Mots clés. *Porc Ibérique – Caractères de la carcasse – Graisse dorsale – Poids d'abattage – Ultrason.*

I – Introduction

Fat tissue deposition is very important for Iberian pig production, since the quality of Iberian pig meat depends on the amount and distribution of fat. Iberian pigs are finished in two well differentiated systems: one is based in the use of concentrates, with the animals being in general a crossbred between Iberian females and Duroc males that are raised either indoors or outdoors are slaughtered at around ten months of age. The other system is based in the use of natural resources (acorns and grass) and the animals are pure breed Iberian pigs, which are raised outdoors and slaughtered at 17-18 months of age. This second system is the most traditional and yields a high quality meat (with a high percentage of intramuscular fat) which is very appreciated by consumers. However, to reach this high percentage of intramuscular fat, a

large amount of subcutaneous back fat cover (around 90 mm thick) and large deposits of internal fat must be accumulated. This back fat thickness is divided into three layers that behave differently depending on the age or breed of the pigs (Eggert and Schinckel, 1998; Alfonso 2004). Thus, the aim of this study is to determine differences in fat layers' thickness due to sex and slaughter age as measured at two different rib locations *in vivo* with ultrasound and *postmortem* in the carcass in Iberian pigs.

II – Materials and methods

Animals: For this study, 163 Iberian pigs of the red *("Retinto"*) strain were used. Animals were raised indoors in standard commercial conditions up to 25 kg of body weight (BW). After this period, animals were raised outdoors in extensive conditions and fed a concentrate in a restricted diet (as usual in this traditional system) up to 12 months of age. At this age, animals were divided in five groups and started an "ad libitum" feeding period with different types of food: One group was fed only pasture and acorn; the second was fed pasture and acorn up to 135 kg of BW and then finished with a standard, commercial concentrate; the third group was fed pastures, acorn and standard concentrate at the same time; the forth group was fed standard concentrate; and the fifth group was fed a commercial concentrate having a high level of oleic acid to imitate acorn composition. Animals were fed for a period of 2.5 to 3 months and were slaughtered after reaching 135 kg of BW (135 to 175 kg range). To allow for a thorough study of carcasses, no more than 20 animals at a time were slaughtered.

Ultrasound image collection: One day before slaughter, pigs were ultrasonically scanned to measure body composition, using an Aloka 500 apparatus (Aloka Holding - Europe, Switzerland) and a 3,5 MHz, 12 cm long probe. Ultrasound images were collected by placing the probe perpendicular to the loin a two different rib levels: one image was taken between the 10^{th} and 11^{th} ribs (10^{th} intercostal space), and the other was taken just behind the last (14^{th}) rib. A soft, rubbery adaptor made of Supperflap® was used between the animal and the probe to allow for an adequate contact despite of the curved back surface. Images were digitalized and stored in a computer. Image measurements were done afterwards by using the Biosoft® software (Biotronics inc., Ames, IA, USA). For each image, loin area and fat thickness of the 3 layers were measured. The ultrasound ("U") measurements, taken at the 10^{th} intercostal space and behind the last rib, respectively ("10", "14"), were the following: external ("E") back fat layer (F10EU and F14EU); middle ("M") layer (F10MU and FG14MU); internal ("I") layer (F10IU and F14IC); external + middle ("EM") layers (F10EMU and F14EMU); and total ("T") backfat thickness (F10TU and F14TU).

Carcass data: After slaughter, carcass weight and weight of commercials cuts (ham, shoulder and loin) were measured. In addition, a portion of loin containing 4 chops (spanning from the 11^{th} to the14^{th} ribs) was extracted from the carcass and used to measure back fat layers thickness and loin area at the two already mentioned rib levels.

Data was analyzed by using GLM (General Linear Models) procedures in SAS.

III – Results and discussion

Sex effects were not significant for the thickness of any of the back fat layers measured in the carcass at the 10^{th} intercostal space, as shown in Fig. 1. However, sex had a significant effect on the external and middle layer thickness when measured with ultrasound, so that castrate females had more back fat thickness than castrate males. Latorre (2004) indicated that castrate males had more backfat than intact females. Measurements taken at the last rib level were significant for the middle (measured with ultrasound) and the internal layer (measured with both techniques), but not for the external one, as shown in Fig. 2. Total back fat was significantly different for sex effects at the 10-11 rib only when measured with ultrasound, and at the 14 rib,

either measured in the carcass or with ultrasound. Back fat was thicker at the 10-11 rib level than behind the last rib, and this difference was due to differences in the middle layer. In relation to slaughter weight effects, there were no significant differences at the 10th intercostal space in external and internal fat layers once animals reached 155 kg of weight. However, there were significant differences between animals lighter than 155 kg and the heaviest ones, as shown in Fig. 3.

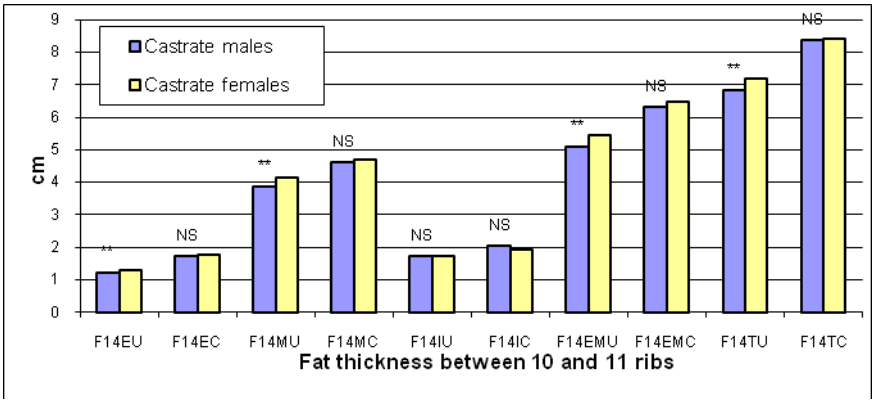

Fig. 1. Effect of sex on the 3 backfat layer thicknesses (E:external; M:middle; I:internal; EM:E+M; T:total) measured with ultrasound (U) and in the carcass (C) at the 10th intercostal space.

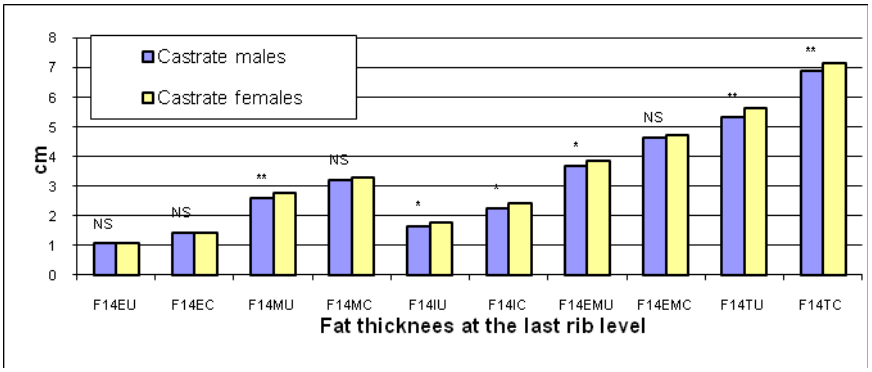

Fig. 2. Effect of sex on the 3 backfat layer thicknesses (E:external; M:middle; I:internal; EM:E+M; T:total) measured with ultrasound (U) and in the carcass (C) behind the last rib (14).

This indicated that the growth of these layers is slow after this weight, with no significant differences between the 155-165 kg and 166-175 kg classes. This results are also similar for total backfat. However, different results were found by Lo Fiego *et al*. (2005), because these authors concluded that pigs with 175 kg on average have thicker total backfat than those averaging 151 and 164 kg. With respect to the middle layer, there were significant differences among the three weight classes if measured with ultrasound, suggesting that this layer has a greater metabolic activity, as stated earlier by Leymaster and Mersmann (1991). Alfonso (2004)

also indicated that the middle layer explained more than 50% of the overall back fat differences between two breeds. Results at the 14 rib level (Fig. 4) were similar to results at the 10-11 rib, with the exception that there were no differences among the three weight classes for the middle layer.

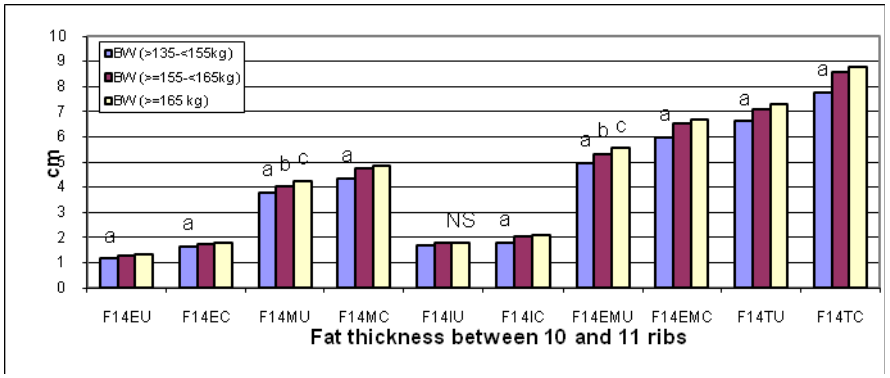

Fig. 3. Effect of slaughter weight on backfat layers (E:external; M:middle; I:internal; EM:E+M; T:total) measured with ultrasound (U) and in the carcass (C) at the 10th intercostal space.

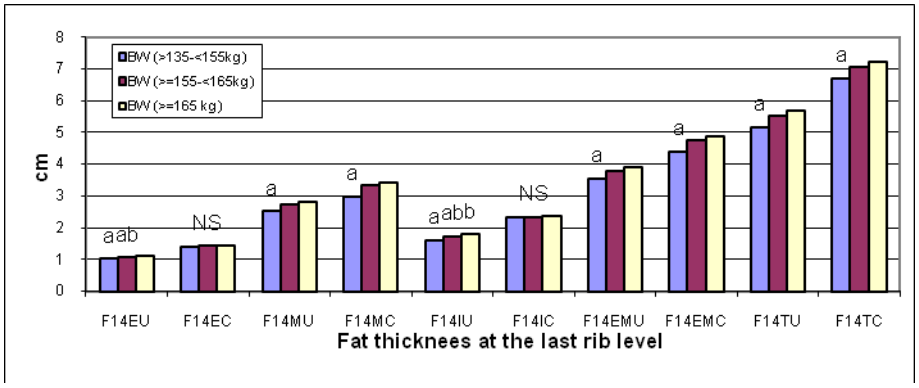

Fig. 4. Effect of slaughter weight on backfat layers (E:external; M:middle; I:internal; EM:E+M; T:total) measured with ultrasound (U) and in the carcass (C) behind the last rib (14).

IV – Conclusions

Backfat layers do not follow an uniform growth pattern. Middle backfat layer growth suggests a greater metabolic activity than the other two layers. Backfat is thicker at the 10-11 rib level than at the last rib level.

Acknowledgements

The authors want to thank FEDER, (PDT09B039) , INIA (RTA2007-0093-00-00) and Junta de Extremadura for financial support.

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