Physical measures of the carcass and the chemical composition of Longissimus dorsi muscle of Alentejano pigs between 70 and 110 kg LW

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Physical measures of the carcass and the chemical composition of *Longissimus dorsi* muscle of Alentejano pigs between 70 and 110 kg LW

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Abstract. The aim of this work was to determine the relationship between physical measures from the subcutaneous tissue and Longissimus dorsi (LD) muscle (area, depth, and width measured between the 3rd and 4th lumbar vertebrae, at the last rib, and between the 3rd and 4th last ribs) and the chemical composition of LD at 70, 80, 90, 100, and 110 kg LW. The content of water, protein, neutral and polar lipids, total and soluble collagen, and total pigments, were determined. Globally, the measures taken and the chemical composition were not affected between 70 and 110 kg, except for the LD depth and width at the 3rd-4th lumbar vertebrae. At 70 kg, the LD depth was greater than at 110 kg (3.77 vs 2.75 cm, P<0.05) and the width was smaller (8.14 vs 9.82 cm, P<0.05). In conclusion, from 70 to 110 kg: (i) the morphological changes in the lumbar region were due mainly to the width dimension, with no impact on the chemical composition of the muscle; and (ii) the chemical composition did not change drastically, even though the amount of intramuscular fat increased slightly between 70 and 110 kg (5.32 and 6.67%, respectively) suggesting an early intramuscular fat deposition.

Keywords. Alentejano pig – Carcass – Meat quality – Live weight.

Mesures physiques de la carcasse et composition chimique du muscle* Longissimus dorsi *des porcs Alentejano entre 70 et 110 kg de poids vif

Résumé. *Le but de ce travail était de déterminer la relation entre les mesures physiques du tissu sous-cutané et le muscle* Longissimus dorsi *(LD) (superficie, profondeur et largeur mesurées entre les 3e et 4e vertèbres lombaires, à la dernière côte, et entre les dernières 3e et 4e côtes) et la composition chimique du LD à 70, 80, 90, 100, et 110 kg de poids vif. Les teneurs en eau, protéines, lipides neutres et polaires, collagène total et soluble, et pigments totaux ont été déterminées. Globalement, les mesures prises et la composition chimique n'ont pas été modifiées entre 70 et 110 kg, sauf pour la profondeur et la largeur du LD au niveau des vertèbres lombaires 3e-4e. À 70 kg, la profondeur du LD a été supérieure (3,77* vs *2,75 cm, P <0,05) et la largeur inférieure (8,14* vs *9,82 cm, P <0,05) par rapport à 110 kg. En conclusion, entre 70 et 110 kg: (i) les changements morphologiques dans la région lombaire ont été principalement attribuables à la dimension de la largeur, sans impact sur la composition chimique du muscle; et (i) la composition chimique ne change pas radicalement, même si la quantité de lipides intramusculaires a légèrement augmenté entre 70 et 100/110 kg (5,32 et 6,42/6,30%, respectivement) suggérant un dépôt de gras intramusculaire précoce.*

Mots-clés. *Carcasse – Composition chimique – Alentejano.*

I – Introduction

For centuries, the agriculture in Alentejo region was based in a production system characterised by a strong interdependence between natural fed resources and animal production. In this context, the Alentejano pig breed gained importance by its rusticity and the rational use of fed resources. Comparatively with others, the Alentejano pig shows a slow rate of growth and a high lipogenesis activity at early stages of development. The lipids are deposited mainly in the subcutaneous, renal and pelvic regions. The percentages of fatty cuts can attain more than 50%

of the carcass weight and the backfat thickness at the last rib can reach 60 mm at 120 kg live weight (LW) (Almeida *et al*., 1993; Neves *et al*., 2001). Nowadays, the production fulfills a double function: it provides meat for the manufacture of cured products and also for fresh consumption. Considering the volume and the increase of fresh pig meat consumption in Portugal, the farmers have increased their production for this market, traditionally dominated by the meat from precocious pig breeds reared in intensive production systems. Based on high organoleptic quality, pork from Alentejano hogs could be an effective alternative for meat from industrial breeds. However, carcass has too much fat and a bad proportion of lean cuts, which impair the economic rentability of this production system. The animal growth implies chemical, biochemical, and physical changes in the adipose and muscular tissues, mainly due to an increase on the lipid content (subcutaneous and intramuscular) (Mayoral *et al*., 1999). These changes affect the gross chemical composition. Thus, it was interesting to find if the growth process and fat deposition induce significant changes on muscle chemical composition that could influence its global quality. Since it is possible to measure the depth of LD *in vivo*, it was interesting to study the possible relationship between this measure and the chemical composition of the muscle, particularly with the amount of intramuscular fat at the usual commercial slaughter weights.

II – Materials and methods

Thirty Alentejano pigs were castrated at the age of 60 days. After weaning, piglets were transferred to individual pens at open air and fed a commercial diet (15% CP; 3100 kcal DE) offered at 85 % of *ad libitum*. At the beginning of the experiment, 5 animals with 40 kg LW were slaughtered. The remaining animals were weighted weekly and slaughtered (5 animals) at 70, 80, 90, 100, and 110 kg LW. After 12 h fasting, the animals were weighted and then slaughtered. Twenty four hours after chill, the left side of each carcass was submitted to commercial cuts, according to the Portuguese Norm N – 2931. The measure of loin muscle depth was done 6 cm lateral to the mid-line of the carcass and resulted from the average of the first measure and two others 0,5 cm apart from it in both directions. The loin muscle area and width were also measured. Those measures were taken at three anatomical sites (between the 3rd and 4th lumbar vertebrae, the last rib and between the 3rd and 4th last ribs). Samples were taken from the loin cut and were vacuum packaged and stored (-30ºC) until analysis. Moisture (Portuguese Norm 1614), total protein (Portuguese Norm 1612), total, neutral, and polar lipids (Marmer and Maxwell, 1981), and total pigment (Hornsey, 1956) were determined. Total hydroxyprolin was analyzed (Woessner, 1961) and multiplied by 7.14 (Etherington & Sims, 1981) to obtain the total collagen. The soluble fraction of collagen was also analyzed (Hill, 1966). An ANOVA was carried out and the means comparison was made by SNK test. The correlation between the variables studied was determined by the Pearson coefficient. SPSS statistical program was used.

III – Results

Globally, the chemical composition and the measures taken weren't affected by live weight between 70 and 110 kg (Tables 1 and 2), except for the depth and width of LD between the 3rd and 4th lumbar spot (Table 2). At 70 kg the depth of the LD was greater ($P<0.05$) than at 110 kg LW (3.77 cm *vs* 2.75 cm) and the width was smaller (8.14 cm *vs* 9.82 cm). In the other anatomical sites, no significant differences were found. However, the LD area at the last rib tended to be greater ($P=0.052$) at 110 kg than at 70, 80, and 90 kg LW (21.45 cm^2 *vs* 17.27, 17.68, and 17.56 cm^2, respectivelly). The average area, depth and width presented no significant differences between 70 and 110 kg LW (17.77 cm^2 *vs* 20.76 cm^2 for area; 3.52 cm *vs* 3.32 cm for depth, and 7.42 *vs* 8.37 cm for width). However, the P value obtained for the width was 0.057 which seems to indicate that the increase in the muscle area was due essentially to the increase in width dimension. Daza *et al*., (2006) observed in Iberian pigs reared extensively

and slaughtered at 152 kg LW, a LD area measured at last rib level of 26.73 cm^2 , and in pigs in confinement slaughtered at 159 kg, 30.31 cm^2. These values, greater than those observed on this work, could be justified by the greater slaughter weight. Nevertheless, they showed a development pattern similar to the one observed in the present work.

Table 1. Chemical characteristics of *Longissimus dorsi* muscle of Alentejano pigs at various live weights

	Slaughter weight groups (kg LW)				
	70	**80**	**90**	**100**	**110**
Water	69.97 ± 1.7	70.33 ± 0.3	67.39 ± 2.1	67.24 ± 2.5	68.70 ± 0.8
Protein	23.07 ± 0.6	22.41 ± 1.4	22.50 ± 0.9	22.97 ± 0.6	21.86 ± 0.7
Neutral lipids	5.37 ± 2.3	5.23 ± 0.5	6.24 ± 1.3	6.42 ± 1.2	6.67 ± 1.5
Polar lipids	0.85 ± 0.1^{ab}	1.18 ± 0.1^{ab}	0.99 ± 0.2^{ab}	0.73 ± 0.2^{b}	0.86 ± 0.1^{ab}
Total pigment	69.53 ± 2.8	67.32 ± 5.9	84.18 ± 11.7	71.90 ± 17.1	73.78 ± 10.3
Total collagen (ug/mg, DM)	12.47 ± 4.0	9.99 ± 1.0	10.84 ± 1.0	8.98 ± 2.0	10.23 ±.2.0
Soluble collagen (ug/mg, DM)	1.93 ± 1.0	1.20 ± 0.1	0.76 ± 0.3	1.17 ± 0.2	0.97 ± 0.4

Means in the same line with different letter are significantly different (P<0.05).

Table 2. Physical characteristics of the backfat of Alentejano pigs at a various live weights

	Slaughter weight groups (kg LW)				
	70	**80**	**90**	**100**	**110**
3th and 4th LuVA (cm^2)	18.70 ± 1.9	19.45 ± 2.3	21.32 ± 2.1	20.66 ± 1.7	20.94 ± 4.1
3th and 4th LuVD (cm)	3.77 ± 0.7^{b}	2.99 ± 0.1^{b}	3.12 ± 0.2^{b}	3.00 ± 0.1^{b}	2.75 ± 0.3^{a}
3th and 4th LuVW (cm)	8.14 ± 0.4^{a}	8.73 ± 0.6^{a}	8.41 ± 1.1^{a}	8.54 ± 0.3^{a}	9.82 ± 1.1^{b}
LaRA (cm^2)	17.27 ± 2.4	17.68 ± 2.8	17.56 ± 1.4	19.42 ± 2.8	21.45 ± 1.7
LaRD (cm)	3.41 ± 0.2	3.43 ± 0.5	3.30 ± 0.5	3.17 ± 0. 5	3.63 ± 0.5
LaRW (cm)	7.28 ± 0.5	7.46 ± 0.3	7.08 ± 0.6	7.64 ± 0.5	7.82 ± 0.5
3th and 4th LaRA (cm^2)	17.35 ± 2.9	18.57 ± 2.9	20.49 ± 2.5	19.35 ± 1.9	19.88 ± 1.4
3th and 4th LaRD (cm)	3.38 ± 0.2	3.57 ± 0.2	3.46 ± 0.4	3.53 ± 0.4	3.59 ± 0.3
3th and 4th LaRW(cm)	6.84 ± 0.2	7.37 ± 0.4	7.37 ± 0.9	6.68 ± 0.2	7.48 ± 0.6

Means in the same line with different letter are significantly different (P<0.05).
LuVA: lumbar vertebrae area; LuVD: lumbar vertebrae depth; LuVW: lumbar vertebrae width; LaRA last ribs area; LaRD: last ribs depth; LaRW: last ribs width.

The amount of neutral lipids showed a ~20% increase between 70 and 100/110 kg LW(5.32% vs 6.42/6.30 %, respectively). The same was observed in a previous work by Neves *et al*., (1996). However, Estevez *et al.* (2003) reported in three genetic lines intramuscular fat contents between 2.51 and 3.34% in pigs with 90 kg LW. Those amounts, substantially lower than the ones obtained in this work, could be explained by some genetic selection in the lines of the Iberian pigs studied in that work. The correlation analysis showed a negative relation between neutral intramuscular fat and protein (-0.557; P<0.01) of the LD muscle, as expected. The average area showed a greater correlation coefficient with the area of LD measured at the last rib (0.873), than with the areas measured at the two other spots (0.821 and 0.798 for the 3rd and 4th lumbar vertebrae spot and the 3rd and 4th last ribs spot, respectively). The correlation study between the average area and the individual measure of depth and width in the three spots

shown only significant correlation with the depth of LD at the last rib (0.399; 0.048) and with the width measured between the 3rd and the 4th lumbar vertebrae (0.464; 0.020). Finally, no correlations were observed between the chemical composition traits and the physical measures taken in the LD muscle.

IV –Conclusions

Between 70 and 110 kg LW, (i) the lumbar region was the one that showed more morphological changes during growth, and the development of the muscle seems to be due to width more than the depth dimension; (ii) the chemical composition didn't change much, and in the particular case of the amount of intramuscular fat, only a slight increase between 70 and the heavier weights (100 and 110 kg LW) was observed, suggesting a earlier intramuscular fat deposition; and (iii) no statistical significant correlation was found between the chemical composition traits and the physical measures taken from the backfat and from the LD muscle.

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