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Use of low intensity ultrasound in the *Longissimus dorsi* muscle from pigs with different genetic background

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SUMMARY – In this work, the use of low-intensity ultrasound on the *Longissimus dorsi* muscle as an objective and non-destructive analytical technique to differentiate between raw meat from pure Iberian pigs (Ib) and from Iberian x Duroc (IbxD) crossbreed pigs, was studied. Measurements of ultrasonic velocity at different temperatures (0°C-25°C) were carried out. Ultrasonic velocity decreased with the temperature of the samples. The decrease was significantly higher in the pure Iberian batch than in the IbxD batch. Measurements of ultrasonic velocity in the *Longissimus dorsi* muscle from Ib were higher at low temperatures (0-10°C) and lower at temperatures over 10°C, than in those from IbxD pigs. Taking into consideration that the fatty acid composition of both batches were similar, this factor is unlikely to explain the differences on ultrasonic velocity between samples. However, *Longissimus dorsi* muscles from Ib pigs show higher fat content than those from IbxD pigs (12.832±0.937 vs 6.644±0.662), which involves a higher fat/water proportion in the former. Therefore, this fact might explain that, compared to the other batches, the ultrasonic velocity in samples from Ib was higher at low temperatures and lower at high temperatures. Moreover, the higher fat content in Ib batch could explain the intense decrease of ultrasonic velocity with temperature in this batch. In conclusion, this results show that the measurement of the ultrasonic velocity in the *Longissimus dorsi* muscle could be used to differentiate between raw *Longissimus dorsi* muscles from pure Iberian pigs and from Iberian x Duroc crossbreed pigs.

Keywords: Iberian, Iberian x Duroc, *Longissimus dorsi*, ultrasonic velocity, fat content, temperature.

RESUME – "Utilisation d'ultrasons à faible intensité dans le muscle *Longissimus dorsi* de porcs de différent type génétique". Dans cette étude a été examinée l'utilisation d'ultrasons à faible intensité sur le muscle *Longissimus dorsi* comme technique d'analyse objective et non destructive pour différencier la viande crue de porcs Ibériques (Ib) et celle de porcs croisés Ibérique x Duroc (IbxD). Les mesures de vitesse des ultrasons ont été effectuées à différentes températures (0°C-25°C). La vitesse des ultrasons a diminué avec la température des échantillons. Cette diminution était significativement supérieure chez le lot Ibérique pur par rapport au lot IbxD. Les mesures de vitesse des ultrasons sur le muscle *Longissimus dorsi* d'animaux Ib étaient plus élevées à faible température (0-10°C) et moins élevées à des températures supérieures à 10°C, par rapport au même muscle de porcs IbxD. Compte tenu que la composition en acides gras des deux lots était similaire, ce facteur n'est pas censé expliquer les différences de vitesse des ultrasons entre échantillons. Toutefois, les muscles *Longissimus dorsi* de porcs Ib montraient une teneur en gras supérieure à ceux de porcs IbxD (12,832 ± 0,937 vs 6,644 ± 0,662), ce qui implique une proportion gras/eau supérieure chez les premiers. Donc, ce fait pourrait expliquer que, en comparaison aux autres lots, la vitesse des ultrasons chez les échantillons d'animaux Ib était plus élevée à faible température et moins élevée à forte température. De plus, la teneur en gras supérieure chez le lot Ib pourrait expliquer la baisse prononcée de la vitesse des ultrasons avec la température dans ce lot. En conclusion, ces résultats montrent que la mesure de la vitesse des ultrasons dans le muscle *Longissimus dorsi* pourrait être utilisée pour différencier le muscle cru *Longissimus dorsi* de porcs Ibériques purs et celui de porcs croisés Ibérique x Duroc.

Mots-clés : Ibérique, Ibérique x Duroc, *Longissimus dorsi*, faible intensité, température.

Introduction

Ultrasound has advantages over other traditional analytical techniques because measurements are rapid, non-destructive, precise, fully automated and might be performed either in a laboratory or on-line. In this work, the use of low-intensity ultrasound on muscle *Longissimus dorsi* to differentiate between raw meat from pure Iberian pigs (Ib) and from Iberian x Duroc (IbxD) crossbreed pigs, was studied.

Materials and methods

Fat content determination (Bligh and Dyer, 1959) and measurements of ultrasonic velocity (V) at different temperatures (from 0°C to 20°C) (Simal *et al.*, 2003) were carried out in *Longissimus dorsi* samples from different Iberian pig crossbreeds (pure Iberian-Ib-, Iberian sow x Duroc boar-IbxD- and Duroc sow x Iberian boar -DxIb-).

Results and discussion

Ultrasonic velocity decreased with the temperature (Fig. 1) due to two effects, the negative temperature coefficient of UV in fat and the increase in the liquid content due to fat melting, which has a lower velocity than solid fat (McClements, 1997). This effect has been observed in previous works (Benedito *et al.*, 2001; Anand Pal Singh *et al.*, 2004). Measurements of ultrasonic velocity in muscle *Longissimus dorsi* from Ib were higher at low temperatures (0-10°C) and lower at temperatures over 10°C, than in those from IbxD pigs and DxIb pigs. *Longissimus dorsi* muscles from Ib pigs show significantly higher fat content than those from IbxD + DxIb pigs (Fig. 2). Therefore, fat melting content in Ib batch is higher than in the others, which involves a higher fat/water proportion in *Longissimus dorsi* muscles from Ib pigs.

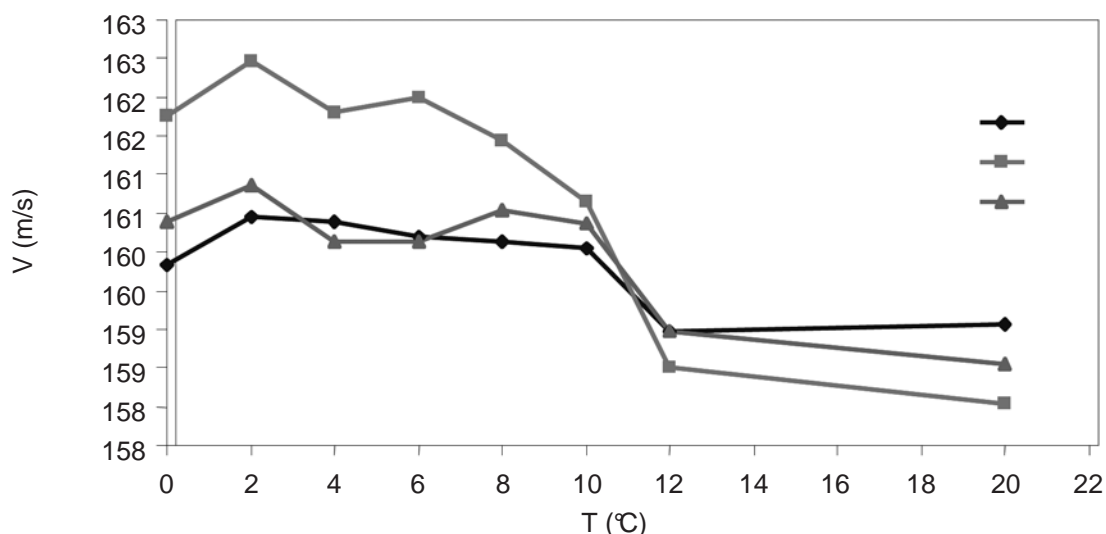


Fig. 1. Evolution of ultrasonic velocity at different temperatures.

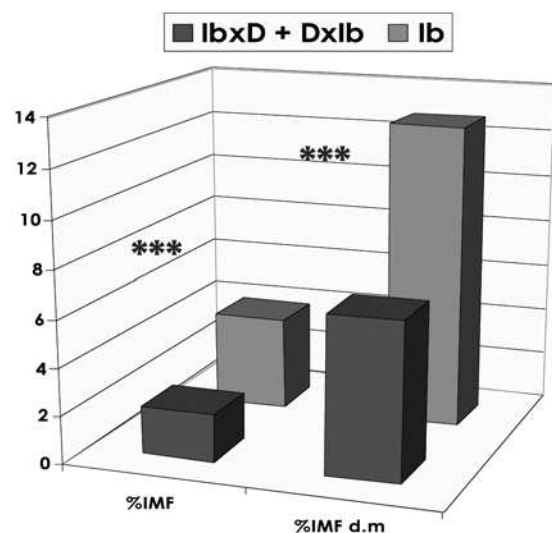


Fig. 2. % of intramuscular fat content (IMF) of muscle *Longissimus dorsi* from pigs with different genetic background. ***: significant differences ($p < 0.005$).

Conclusions

Measurement of the ultrasonic velocity in muscle *longissimus dorsi* can be used to differentiate between raw muscles *Longissimus dorsi* from pure Iberian pigs and from Iberian x Duroc crossbreed pigs and to predict fat content.

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