ULTRASONIC SCANNING AND CARCASS MEASUREMENTS FOR PREDICTING MARBLING IN PIRENAICA BULLS.

Indurain G., Jimeno K., Goñi V., Sarriés V., Alfonso L., Eguinoa P., Insausti K., Mendizabal J. A., Purroy A., Beriain M. J..
Escuela Técnica Superior de Ingenieros Agrónomos, Universidad Pública de Navarra, 31006 Pamplona, Spain

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Background.

At the moment, in Spain, beef carcass fatness is differentiated according to visual classification by EUROP system. This system, non instrumental but repeatable, doesn't allow to estimate accurately the carcass composition. Although marbling (as a measurement of intramuscular fat) is not used in Spain for carcass evaluation, in other countries like the United States, is the most important parameter to determine carcass quality (Smith *et al.,* 2001). Development of an instrumental measurement of carcass composition is one of the major requirements by the slaughter industry for an instrumental and effective classification of carcasses. Ultrasound has been used for over 40 years, and has emerged as a technology for determining quality attributes of the carcass by prediction of intramuscular fat (Herring *et al.,* 1998; Brethour 1994). For these reasons, the measurement of intramuscular fat from ultrasound images could improve classification of beef carcasses in Spain in order to achieve a more objective carcass classification.

Objective

The aim of this study is to compare accuracy of ultrasound measurements from carcass and other type of post-slaughter measurements, such as EUROP system, dorsal fat thickness and carcass weight, taken in "industrial conditions" to predict intramuscular fat (marbling).

Methods

The study was carried out on 14 Pirenaica breed entire-males that were slaughtered at one-year-old. These animals belong to a wider project and the present data are a preliminary approximation to later and more accurate results.

At the end of the slaughter line animal fatness and conformation were scored according to the EUROP system and carcass weight was recorded. Dorsal fat thickness was measured at the 6th rib level the day after slaughter. All these predictive measurements and scores are going to be considered as "post-mortem measurements".

Carcasses were scanned on the left side by a Sonovet 600-ultrasound equipment, with a linear probe (3,5 MHz, 120 x 20 ml). A mineral oil (echoultragel; Pirrone & Co.SPA) was added on the sites of scanning. The scanning of carcasses was taken at the end of the slaughter line to avoid disturbing the slaughter plant workers. Ultrasound images were taken from 5 anatomical sites: on the 6th, 11th, 12th, and 13th ribs, grey levels of the ultrasound images were measured as a predictive measurement of marbling (Brethour 1994). Also, longissimus dorsi thickness on these ribs and fat thickness at 4th lumbar vertebrae were measured by ultrasound to foretell marbling.

The measurements of marbling (fat area/ longissimus dorsi area) were obtained by an image analysis software (Optimas 6.5.). These parameters were obtained at the 6th rib level.

Firstly, data were analysed for a backward regression analysis between marbling measured by image analysis and ultrasound (grey levels on the ultrasound images) and *post-mortem* (carcass conformation and fatness by EUROP system, carcass weight and fat thickness at the 6th rib level). A series of analyses was run in which the predictive measurements were 1) post-mortem measurements, 2) ultrasound measurements, 3) post-mortem plus ultrasound measurements. The objective of this step was to compare the accuracy of the different groups of predictive measurements. Secondly, all data together were analysed for a stepwise regression. The objective of this second regression was to look for a single predictive measurement for an accurate prediction of marbling. Statistical analysis was calculated using the software SPSS 9.0 (1998)

Results and discussion

Proportions of the variance explained (R^2) and Residual Standard Deviation (RSD) obtained by a backward regression on each method are given in table 1.

Ultrasound measurements appeared to be the best variables to predict marbling (R^2 = 0.60; RSD = 0,008) while post-mortem measurements (EUROP system, carcass weight and fat thickness) explained less than 55% of the variation of marbling. However, both types of measurements had low R^2 showing practically the same accuracy. The combined use of ultrasound plus post-mortem measurements is the best way to improve the accuracy of prediction of marbling, (R^2 = 0.98; RSD = 0,002).

When we used a stepwise regression (table 2), post-mortem measurements and ultrasound were included in the equations: fat thickness, grey levels on the 12th and 13th rib ultrasound images explained 91% of the variation of marbling. If an only predictive measurement was used to predict marbling, fat thickness at the 6th rib level showed the best accuracy but gave a delayed information (R^2 = 0.38; RSD = 0,010) so it was necessary to include other measurements to improve the accuracy, and in this point is where ultrasound technique had an important roll (R^2 = 0.91; RSD = 0.004).

Conclusions

These results confirm the potential efficacy of the ultrasound measurements to improve the prediction of carcass composition. This study showed an improvement in accuracy when post-mortem and ultrasound measurements are included in the regression equations, with regards to equations, which include only post-mortem or ultrasound measurements equations. Fat thickness was the more accurate predictive measurement but didn't had enough accuracy. Ultimately, these results could allow Spanish abattoir operators to have a tool (ultrasound) which improves the current prediction of fat carcass content, although future data which include a higher number of animals could improve accuracy of prediction.

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Pertinent literature

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Table 1: Comparison of the different methods to predict marbling by a backward regression.

		Post-mortem measurements	Ultrasound measurements	Post-mortem + ultrasound measurements
Marbling	R^2	0.54	0.60	0.98
	RSD	0.008	0.008	0.002

Table 2: Comparison of the different methods to predict marbling by a stepwise regression.

	Models	
Marbling	Fat thickness	R^2 = 0.38 RSD = 0.010
	Fat thickness + grey level of 12th rib	R^2 = 0.78 RSD = 0.006
	Fat thickness + grey level of 12th rib + grey level of 13th rib	R^2 = 0.91 RSD = 0.004