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The use of ultrasound scanning at different times of the finishing period in lean cattle

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ABSTRACT

This study aimed to evaluate the predictive ability of ultrasound at different ages based on the 10–12th rib-cut composition. Ultrasound measurements at different times of the finishing period and 10–12th rib-cut composition were measured on 163 bulls of three European beef breeds (Charolais, $n=55$; Limousine, $n=55$; Retinta, $n=53$). Ultrasound measurements (area and intramuscular fat percentage of the *longissimus thoracis* muscle, 12th-rib fat thickness, rump fat thickness, and *gluteus medius* depth) were taken every 30 ± 5 days until slaughter (approximately at 180, 150, 120, 90, 60, 30, and 1–7 days before slaughter). Correlation and determination coefficients between ultrasound measurements and rib-cut composition were low-medium. The regression equations, developed from the live ultrasound measurements explained 45%, 43%, 35%, 35%, 35% and 36% of the variation in total lean, *longissimus thoracis* muscle, fat (total, subcutaneous and intermuscular) and bone percentages obtained by dissection of 10–12th rib-cut, respectively, and 34% in intramuscular fat determined by ether extract analysis of 12th rib. The predictive precision of ultrasonic measurements increased as animals approached slaughter, reaching maximum values at the last scan. When data from two or more scans were included, the last scan could be advanced in at least 30 days under the conditions of this experiment.

1. Introduction

Adequate information on carcass composition is useful both to optimize beef production (growth and nutritional purposes) and to attend scientific and consumer demands. The reference method is the dissection of the whole carcass. However, this method is destructive, costly, and time-consuming. Also, it is a subject to sampling error and not practical under large scale commercial operations or where large numbers of animals are involved. Because of these restrictions, alternative methods have been used in beef cattle to predict carcass composition, such as partial dissection using sample joints and techniques "in vivo". Several researchers, notably Hankins and Howe (1946), investigated the usefulness of cuts for predicting carcass composition and concluded that the rib was the portion that best represented the carcass. Partial dissection has been widely used because it is easy, fast and inexpensive, and it has produced good results which have been confirmed by more recent reports (Ledger and Hutchison, 1962;

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Robelin et al., 1975; Rodrigues et al., 2005). In those studies a strong relationship between rib-cut composition and carcass composition was found (R^2=0.63–0.96). However, main limitations are differences in the predictive value of one-, two- and three-rib cuts (Forrest, 1968) and the need of specific equations for different breeds (Alhassan et al., 1975).

Of primary interest to feedlot managers is the ability of techniques "in vivo" to predict well in advance the composition of the carcass at slaughter (Houghton and Turlington, 1992), so that increases their use (Williams, 2002). It is desirable that these methods be applicable in young animals or at extended periods before slaughter. Among "in vivo" techniques, real-time ultrasound technique stands out as a non-invasive and non-destructive tool, as it can provide a precise, fast and accurate determination of beef carcass composition (Bergen et al., 2005; Aass et al., 2009), and can be used very effectively as a sorting tool in the feedlot (Ribeiro et al., 2006). However, the accuracy and repeatability of ultrasound measurements are highly dependent on several factors (technician, ultrasonic instrumentation, etc.). Additionally, several studies showed that the application of ultrasound just before slaughter offered acceptable results, but predicting carcass composition for extended periods before slaughter decreased significantly (Wall et al., 2004; Conroy et al., 2010).

Ultrasound technology is a well-established method for cattle production systems characterized by the use of steers with high intramuscular fat levels, while there few works have investigated the use of ultrasound in cattle with low intramuscular fat like in the European markets where cattle production is mainly based on intact males (Albertí et al., 2008) that produce leaner carcasses (< 2–3% of intramuscular fat). In Spain, beef production is based mainly on semi-extensive systems with young bulls from local (i.e., Pirenaica, Rubia Gallega, Avileña Negra-Ibérica, and Retinta) and highly-selected French (Charolais and Limousine) cattle breeds or their crosses (MAPA, 2003). They are slaughtered at an age of approximately 12–15 months and 500–550 kg (Albertí et al., 2005, 2008). However, there are few studies on the ability of ultrasound technology to predict carcass composition of these biotypes (Aass et al., 2006, 2009; Indurain et al., 2009) and even fewer studies examining its utility at extended periods before slaughter (Conroy et al., 2010; Lambe et al., 2010).

The objectives of this study were to investigate the best time to scan feedlot bulls from three lean beef breeds (Charolais, Limousine, Retinta), and the relationship between ultrasound carcass measurements and 10–12th-rib-cut composition.

2. Material and methods

2.1. Animals and management

This study was a part of the TERNECO research project funded by the Corporación Tecnológica de Andalucía (CTA-90/337); one of the objectives of which was to assess the utility of real-time ultrasound for in vivo prediction of carcass composition in bulls of European lean cattle breeds. This experiment was conducted at the facilities of the COVAP cooperative (Cooperativa Ganadera del Valle de los Pedroches, Córdoba, southwestern Spain) over two consecutive years (2009 and 2010). Three-hundred purebred bull calves representing three breeds (Charolais, CH, n=100; Limousine, LI, n=100; Retinta, RE, n=100) were purchased following weaning (at 7–8 months of age and approximately 250 kg of live weight) from private breeders in Andalucía (southern Spain). Then they were transferred to the feedlot and fattened under identical feeding and handling conditions, following Spanish rules and regulations for animal care (EU Council Directive 86/609/EEC). Bulls were randomly assigned to pens within breed (10×10 m^2, 25 head per pen; a total of 12 pens with straw bedding). The bull calves were raised following the typical beef production system of southwestern Spain (Piedrafita et al., 2003). These animals were considered a representative sample of breeds, sex and ages commonly slaughtered in the area. In the feedlot, the bulls were fed a common medium-concentrate diet (Peña et al., 2014) and wheat straw, both ad libitum. After a 14 days adjustment period, the young bulls were offered a growth diet (barley meal, 341.0 g/kg; maize meal, 310.0 g/kg; whole soybean, 22.5 g/kg; canola, 18.3 g/kg; corn gluten feed, 160.0 g/kg; wheat bran, 72.3 g/kg; palm oil, 37.4 g/kg and minerals/vitamins, 38.5 g/kg; 11.6 MJ/kg) for the first 90 days, after which they were adapted to a finishing diet (barley meal, 324.0 g/kg; maize meal, 350.0 g/kg; whole soybean, 86.4 g/kg; corn gluten feed, 170.0 g/kg; palm oil, 33.1 g/kg and minerals/vitamins, 36.4 g/kg; 11.7 MJ/kg).

2.2. Ultrasound equipment and measurements

The bulls were serially scanned every 30–35 days. The first scan was performed at the end of the first month of fattening period (at approximately 250 days of age), and the last scan was taken within one week before slaughter (at approximately 393 days of age and 500 kg for Retinta bulls, and 425 days of age and 555 kg for the remaining bulls). Seven scans on CH and LI bulls and six scans on RE bulls were obtained. All ultrasounds measurements were obtained on the left side of each animal by the same qualified technician (who was also responsible for image analysis) using an Aquila Pro (Esaote PieMedical) diagnostic real-time Ultrasound equipped with a 3.5-MHz, 18-cm linear array transducer (ASP-18). The image sites were determined by physical palpation to accurately ascertain the scanning sites. To obtain the ultrasound images, bulls were immobilized and restrained by the head in a squeeze chute. The animals were held manually avoiding any abnormal situation that could stress the animal, and they were only scanned in a relaxed posture, permitting accurate measurements. Ultrasound images were measured over the skin without shearing or clipping of hair. Vegetable oil tempered at 25–30 °C was applied to obtain adequate acoustic contact between the probe and the skin. Bulls were individually weighed after each scan.

The measurements collected (Wall et al., 2004; Bergen et al., 2005) were as follows:

– *Longissimus thoracis* m. (LT) area (UREA) between the 12th and 13th ribs.

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