PE4.81 The relationship of ultrasound readings of Longissimus dorsi area in live animals to carcass traits in Spanish beef 285.00

M Jose Beriain (1) mjberiain@unavarra.es, Gregorio Indurain( ), Tom R Carr , Kizkitza Insausti Victoria Sarries Maider San Román Josean Mendizabal Antonio Purroy
(1)Universidad Pública de Navarra
(2)Neiker Tecnalia
(3)University of Illinois

***Abstract*— Ultrasound readings of *Longissimus dorsi* area (ULDA) were recorded in twenty intact bulls of Pirenaica breed in vivo 50, 25 and 1 days before slaughter. After the yearling bulls were harvested, carcass grades for conformation and fatness according to the official European standards [1, 2] were assigned. Carcass measurements associated with yield grades and beef quality grades according to the standards of the USDA [9] were also collected. Pearson correlation coefficients between ultrasound readings of *Longissimus dorsi* area (ULDA) in live animals and carcass traits associated with EU and US beef grading systems were significant for conformation, *Longissimus dorsi* muscle area and marbling. However, there was no relationship between the measurement of the ULDA in live animal and other carcass traits such as fatness, dressing percentage, dorsal fat thickness and kidney pelvical percentage. From these results it is possible to say that the best correlation coefficients were obtained when scanning animals 25 days before slaughter.**

Authors are with E.T.S. Ingenieros Agrónomos, Universidad Pública de Navarra (corresponding author to provide phone: 34948169136; fax: 34948168430; e-mail: mjberiain@ unavara.es).

Carr, T.R. Author is with the College of Agricultural, Consumers and Environmental Sciences. University of Illinois, Urbana, Illinois 61801, USA.(e-mail: trcarr1@uiuc.edu).

Indurain, G. Author, was with E.T.S. Ingenieros Agrónomos, Universidad Pública de Navarra, Spain. He is now with Neiker Tecnalia, Departamento de Producción Animal, campus de Arkaute 01080 Vitoria, Spain (gindurain @neiker.net)

***Index Terms*— Beef, Carcass grading, Ultrasound.**

I. INTRODUCTION

Beef carcass grading systems are market tools that try to predict the economic value of a beef carcass through differences observed in some carcass traits that determine economic value, such as retail yield and palatability. Beef grading systems used today are those in which carcasses or primal cuts are grouped together by using the visual evaluation of parameters easily measured on a moving slaughter chain and provide economic value for farmers and retailers. Visual appraisal by trained evaluators is a method commonly used in beef grading systems.

Recently there is an increasing interest in investigating the incorporation of new technologies based on ultrasounds [3] which allow estimating the meat quality parameters and therefore to give its commercial value based on rapid measurements in both live animal and carcass. The aim of the present work was to study the relationship between ultrasound readings of *Longissimus dorsi* area at different pre-slaughter moments in live animals with carcass traits in Spanish beef.

II. MATERIALS AND METHODS

Twenty intact bulls of Pirenaica breed (Spain,Southern Europe) were born on private farms located in the region of Navarra (Northern Spain). After weaning at approximately six months of age, the calves were fed the following concentrate ration: 85% barley, 10% soybean meal, 3% protected fat, and a 2% commercial supplement that included minerals and vitamins. Animals were fed concentrate and straw both *ad libitum*. The following measurements were recorded in all animals 50, 25 and 1 days before slaughter at the farm: live weight, daily growth rate, and ultrasound cross sectional images between the 12^{th} and 13^{th} ribs. Images were taken using Sonovet 600-real-time ultrasound equipment (Madison Co. Ltd. Korea) equipped with a linear probe (3.5 MHz, 120 x 20 mm). Mineral oil (Echoultragel; Pirrone & Co.SPA, Italy) was used to obtain adequate acoustic contact. Once a suitable two-dimensional image had been obtained, the image was digitalized and stored. Images were evaluated and interpreted by a technician at the laboratory of the *Public University of Navarra* using image analysis software (Optimas 6.5, Media Cybernetics Inc., USA). Animals were harvested and dressed in an officially approved slaughterhouse. After the yearling bulls were harvested, carcass grades for conformation and fatness according to the official European standards (European Commission, 1981, 2006) were assigned. Carcass measurements associated

with yield grades and beef quality grades according to the standards of the USDA [9] were collected, too. Taking into account USDA beef grading system (1997), it was calculated marbling grade at 24 hours *postmortem*, which is estimated on the lean cut surface of the rib eye muscle at the 12th rib surface. Dorsal fat thickness (FT) was measured at the 12th rib, taken 3/4 the length ventrally over the *longissimus* muscle, with a stainless steel caliber after chilling. There were also measured: carcass weight, *Longissimus dorsi* muscle area using a grid (LDA), and kidney pelvical fat was removed and weighed and expressed as carcass percentage. Yield grade was determined combining these four parameters [9]. For more precise estimation of conformation and fatness classes and quality and yield grade, photographical standards developed for both the European and US grading systems were used. In addition, a grid and caliber (probe) were used to measure *Longissimus dorsi* area and dorsal fat thickness.

All statistical analyses were computed using SPSS software (SPSS V. 15.0, SPSS Inc. USA).

III. RESULTS AND DISCUSSION

Mean and standard deviation (sd) values of productive parameters and carcass traits are shown in Table 1. Young Bulls showed an adequate Average Daily Gain (ADG) that led to good carcass dressing percentages. Carcasses were characterised by a high conformation grade and low fatness grade.

Mean and standard deviation (sd) values of ultrasound readings of *Longissimus dorsi* area (ULDA) in live animal 50, 25 and 1 days before slaughter are shown in Table 2. Table 1 and 2 show that the *Longissimus dorsi* area measured on the carcass was approximately 10 cm^2 higher than the ULDA.

Pearson correlation coefficients between ULDA in live animal and carcass traits associated with EU and US beef grading systems are shown in Table 3. The *Longissimus dorsi* area measured on the carcass was significantly correlated to the area of the same muscle measured by ultrasound *in* vivo, and this correlation was significant during the feeding period (50, 25 and 1 day before slaughter). The differences found between these two measurements are in agreement with some authors [4, 5] and would mainly be due to the skill of the operator. Several authors reported that the ULDA was usually lower than the area measured on the carcass, as it was also observed at the present study [5,7]. On the contrary, [3] reported that the ULDA was over estimated, giving differences between 3,31 and 6,76 cm^2. At the present study, higher differences were found (10,4cm^2). This fact may be explained because [3] recorded these measurements in US carcasses with an approximate LD area of 80 cm^2, while Spanish beef show higher muscle development and thus higher LD area (100 cm^2, approximately). The variables related to muscling, conformation and *Longissimus dorsi* area (LDA) were closely related to ULDA measured *in vivo*, as it was expected. ULDA values were also significantly correlated to marbling and kidney pelvical fat percentage 50, 25 and 1 day before slaughter. Traditionally, ultrasound readings in live animals have been reported in the literature as useful tools to estimate fat thickness and *Longissimus dorsi* area, but most authors have obtained better results for fatness estimation than for muscle area estimation [7,9]. At the present study, no correlations were found between ULDA and other carcass traits related to animal fatness such as fatness score, dressing percentage, dorsal fat thickness and kidney pelvical percentage.

In general, the best correlation coefficients between ULDA and conformation and *Longissimus dorsi* marbling were obtained when scanning animals 25 days before slaughter (Table 3). Therefore the measurement of the ULDA 25 days before slaughter could be considered as the best moment to predict the conformation of the carcass and the carcass traits

IV. CONCLUSION

It can be concluded that 25 days befote slaughter is a good point to record ultrasound measurements in live animals at the 12th rib in young bulls from Pirenaica breed in order to estimate the conformation score and the *Longissimus dorsi* marbling.

ACKNOWLEDGEMENT

Authors thank Ministerio de Ciencia y Tecnología (PETRI 95-0703-OP) FUND and the University of Illinois by funding this study and IGP Ternera de Navarra that contributed with meat samples from Pirenaica young bulls.

REFERENCES

[1] European Commission. Regulation (EC) 103/2006. Official Journal of the European Communities L 17/6 (January 21st 2006)

[2] European Commission. Regulation (EC) 1208/1981 Official Journal of the European Union L 123 (May 7th 1981)

[3] Greiner, S. P., Rouse, G. H., Wilson, D. E., Cundiff, L. V., & Wheeler, T. L. (2003). The relationship between ultrasound measurements and carcass fat thickness and longissimus dorsi muscle are in beef cattle. Journal of Animal Science, 81: 676-682.

[4] May, S. G., Mies, W. L., Edwards, J. W., Harris, J. J., Morgan, J. B., Garrett, R. P., Willians, F. L., Wise, J. W., Cross, H. R., & Savell, J. W. (2000).Using live estimates and ultrasound measurements to predict beef carcass cutability. Journal of Animal Science, 78: 1255-1261.

[5] Perkins, T. L., Green, R. D., & Hamlin, K. E. (1992). Evaluation of ultrasonic estimates of carcass fat thickness and longissimus muscle area in beef cattle. Journal of Animal Science, 70: 1002-1010.

[6] Perkins, T. L., Paschal, J. C., Tipton, N. C., & De la Zerda, M. J. (1997). Ultrasonic prediction o quality grade and percent retail cuts in beef cattle. Journal of Animal Science, 79:1378-1385

[7] Smith, M. T., Oltjen, J. W., Dolezal, H.G., Gill, D. R., & Behrens, B. D. (1992). Evaluation of ultrasound for prediction of carcass fat thickness and longissimus muscle area in feedlot steers. Journal of Animal Science, 67(Suplemento 1): 120(Abstr.)

[8] USDA (United States Department of Agriculture).(1997). (on line). http://www.ams.usda.gov/ - Grading Certification and Verification –Standards-Livestock (Including wood and mohair)–Carcass Beef PDF file- Official United States Standards for Grades of Carcass. United States Department of Agriculture (Washington DC, USA). Web site: http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateP&navID=GradingCertificationandVerfication&leftNav=GradingCertificationandVerfication&page=LivestockStandardizationStandards&description=Standardization%20Services (reference 12/05/08) © 2008 United States Department of Agriculture

[9] Waldner, D. N., Dikemana, M. E., Schalles, R. R., Olson, W. G., Houghton, P. L., Unruh, J. A., & Corah, L. R. (1992). Validation of real-time ultrasound technology for predicting fat thickness, longissimus muscle area an composition of Brangus bulls for 4 months to 2 years of age. Journal of Animal Science, 70:3044-3054.

Table 1. Mean, standard deviation (sd) values for the productive parameters and carcass traits

	Mean	SD
Feeding days	128.7	34.159
Weight at Slaughter (kg)	521.55	51.408
Average Daily Gain (kg/d)	1.39	0.193
Cold Carcass Weight (kg)	323.55	33.78
Yield carcass (%)	62.43	2.969
Slaugther live days	348.75	14.956
Hot Carcass Weight (kg)	329.96	6.604
Conformation (1-15)[1]	9.65	0.230(U-)
Fatness (1-15)[2]	4.45	0.279(2-)
Marbling (USDA system)[3]	102.5	12.847
Maturity (USDA system)[4]	37.5	0.300(A)
Kidney Pelvical Fat (%)[5]	1.4	0.13
Yield grade [6]	0.59	0.156
Dressing percentage	64.77	5.30
Longissimus dorsi area (cm^2)[7]	104.468	14.09
Dorsal fat thickness (cm)[8]	0.228	0.085

1 and 2: Carcass conformation score: S superior; E excellent; U very good; R good; O fair; P poor. Scoring from 18 for S+ to 1 for P-. carcass fatness score. 1 low; 2 slight; 3 average; 4 high; 5 very high. scoring from 15 for 5+ to 1 for 1-. (European Comission, 1981, 2006)
3,4,5,6,7 and 8 : Following the Agriculture Department procedure described by the USDA (AMSA, 2001).

Table 2. Mean, standard deviation (sd) values of ultrasounds readings of *Longissimus dorsi* area (ULDA) in live animal [1] 50, 25 and 1 days before slaughter.

		Mean	SD
ULDA (cm^2)			
	50d before slaughter	87.716	13.182
	25d before slaughter	93.616	13.128
	1 day before slaughter	94.884	14.369

1: Ultrasound *Longissimus dorsi* area measured in live animal at the 12^{th} rib

Table 3. Pearson correlation coefficients between ultrasounds readings of *Longissimus dorsi* area (ULDA) in live animal and carcass traits associated with EU and US beef grading systems

	ULDA		
	50d before slaughter.	25d before slaughter	1 day before slaughter
Conformation	0.528*	0.690**	0.650**
Fatness	0.049	-0.077	-0.224
Dressing percentage	0.236	0.336	0.388
Longissimus dorsi area (cm^2)	0.538*	0.639**	0.591**
Marbling	-0.565*	-0.596**	-0.442
Kidney Pelvical Fat (%)	0.536*	0.631**	0.600**

** The correlation was significant at the 0.01 level.

* The correlation was significant at the 0.05 level.