BREED AND PRODUCTION SYSTEM EFFECTS ON MEAT QUALITY CHARACTERISTICS OF PASTURE FINISHED BULLS

Sibhekiso Siphambili[1,2], Frank J. Monahan[1,*], Mark McGee[2], Edward G. O'Riordan[2], Aidan P. Moloney[2].

[1] School of Agriculture and Food Science, University College Dublin, Belfield, Dublin 4, Ireland
[2]Animal & Grassland Research and Innovation Centre, Teagasc, Grange, Dunsany, Co. Meath, Ireland
[*]Corresponding author email: frank.monahan@ucd.ie

Abstract -The effect of production system (grass only (GO) vs grass with 40% cereal concentrate (G40)) and breed type (early-maturing (EM) vs late-maturing (LM)) on Warner-Bratzler shear force (WBSF), cook loss, pH_U and proximate composition of beef was investigated. WBSF was lower (P < 0.05) in beef from GO animals (EM 37.1N, LM 39.5N) compared to G40 animals (EM 41.4N, LM 46.0N) but was not significantly affected by breed type. Fat content was higher (P < 0.05) in EM (GO 0.47%, G40 0.64%) compared to LM (GO 0.19%, G40 0.21%). Moisture and protein content were not affected by either production system or breed type.

Key Words- cook loss, intramuscular fat, shear force,

I. INTRODUCTION

Many studies have investigated beef breed and gender effects on meat quality but little information is available on the impact of these factors when bulls are finished on pasture and slaughtered at the same age [1]. Breed types differ in tissue growth rates and therefore in body composition at a constant age or weight. Thus, the suitability of a breed to a production system depends on growth rate, with early-maturing (EM) breeds, such as Aberdeen Angus, being more suited to grass finishing [2]. Breed type affects the amount and type of collagen deposited as well as the amount of intramuscular fat and, hence, affects tenderness. Breed effects on tenderness are also related to differences in fibre type characteristics and proteolytic enzyme activity [3]. The objective of this study was to determine if LM bulls differ from EM bulls in tenderness (assessed by Warner Bratzler shear force (WBSF)) and proximate composition when finished on either pasture only or pasture with a concentrate supplement.

II. MATERIALS AND METHODS

Fifty six spring-born bulls (28 Aberdeen Angus cross, (EM); 28 Charolais and Limousin cross, (LM)) were assembled in autumn at approximately 8 months of age and offered *ad libitum* grass silage plus 2 kg concentrate per head daily for a 135 day indoor winter period. Subsequently, they were finished on either unsupplemented grazed pasture (grass only, GO) (14 EM, 14 LM) or on pasture supplemented with a barley-based concentrate offered at 40% of estimated dietary dry matter intake (G40) (14 EM, 14, LM), and slaughtered at 19 months of age. Carcasses were chilled for 48 h. *M. longissimus thoracis et lumborum (LTL)* was excised from each carcass, vacuum packed, aged for 14 days at 4 °C and frozen at -20 °C until required for analysis. Prior to WBSF measurement the muscle was thawed for 24 h at 4 °C, trimmed of visible external fat and connective tissue, and cooked to an internal temperature of 70 °C. The cooked muscles were cooled, blotted with absorbent paper to remove excess moisture and left to temper overnight at 4 °C. For WBSF measurement cores were taken parallel to the direction of muscle fibres and sheared perpendicular to the muscle fibres. Cook loss measurement involved weighing muscle before and after cooking. Ultimate pH (pHu) of muscle was measured 48 h post-slaughter. Protein content was measured using the Leco FP328 (LECO Corp., St. Joseph, MI, USA) protein analyser. Moisture and intramuscular fat content (IMF) were analysed using the SMART System 5 microwave moisture drying oven and NMR SMART Trac rapid fat analyser (CEM Corporation, Matthews, NC, USA). Data was analysed in a 2 x 2 factorial design using the PROC mixed procedure of SAS 9.4 (SAS Institute Inc., Cary, NC, USA).

III. RESULTS AND DISCUSSION

The main effects of production system, breed type and their interaction on WBSF, cook loss, pH_u and proximate composition of *LTL* are shown in Table 1. Production system had an effect only on WBSF whereby values were lower (P = 0.05) in *LTL* of GO compared to G40 bulls. Breed type had an effect only on IMF of *LTL* with higher (P < 0.05) values in EM compared to LM bulls.

Table 1 Warner Bratzler Shear Force (WBSF), cook loss, pH_u, moisture, protein and intramuscular fat (IMF) content of *longissimus thoracis et lumborum* muscle of bulls from two production systems (PS: Grass only, Grass with 40% concentrate) and two breed types (Early maturing (EM), Late maturing (LM)).

Variable	Grass only		Grass with 40% concentrate		SEM	P-value		
	EM	LM	EM	LM		PS	Breed	PS*Breed
WBSF (N)	37.1	39.5	41.4	46.0	1.93	0.05	0.15	0.61
Cook Loss (%)	29.3	29.3	30.3	29.6	0.44	0.29	0.53	0.63
pH_u	5.63	5.64	5.62	5.65	0.02	0.86	0.17	0.95
Moisture (%)	75.0	75.2	75.3	75.0	0.19	0.45	0.19	0.37
Protein (%)	23.1	22.9	22.8	22.9	0.08	0.33	0.95	0.27
IMF (%)	0.47	0.19	0.64	0.21	0.09	0.47	0.02	0.21

The higher IMF ($P < 0.05$) in *LTL* of EM was expected since EM bulls deposit fat earlier than LM bulls. However, although IMF has been shown to be positively correlated with tenderness [3], WBSF was not significantly affected by breed type in this instance. Mezgebo et al. [4] observed higher sensory tenderness in EM compared to LM bulls and, in support of a correlation between tenderness and IMF, differences in tenderness were not significant when adjustment for IMF was made. In the current study, *LTL* of both EM and LM bulls, had lower IMF (EM 0.56%, LM 0.20%) than has been observed in other studies [3, 4], which reported values in the range 1.0% - 5.5%. Thus, in the current study, although there was more than a two-fold difference in *LTL* IMF between the breed types, the IMF content may have been too low to have a significant effect on WBSF. Lower WBSF values in *LTL* of GO were unexpected. In general, a higher plane of nutrition leads to higher intramuscular fat content as well as higher growth rate, which is associated with a higher protein turnover and lower maturity of collagen. In addition a higher plane of nutrition affects the fibre composition resulting in more glycolytic fibres and a higher post-mortem tenderisation rate [4]. All pH_u in the current study were normal and below 5.75, the threshold above which meat quality deteriorates [5]. The lower WBSF in the GO treatment requires further investigation.

IV. CONCLUSION

Beef from bulls finished on unsupplemented pasture appears to have lower WBSF values than that of bulls finished on supplemented pasture but this finding requires further investigation.

ACKNOWLEDGEMENTS

This project (11/SF/322, “BullBeef”) was funded by the Irish Department of Agriculture, Food and the Marine’s competitive research programmes. The assistance of Ciaran Lenehan with animal management and staff at Teagasc, Grange, and Kepak Group, Clonee, Co. Meath is greatly appreciated.

REFERENCES

1. Monsón, F., Sañudo, C. & Sierra, I. (2004). Influence of cattle breed and ageing time on textural meat quality. Meat Science 68: 595-602.
2. Keane, M. G. & Drennan, M. J. (2008). A comparison of Friesian, Aberdeen Angus × Friesian and Belgian Blue × Friesian steers finished at pasture or indoors. Livestock Science 115: 268-278.
3. Shackelford, S., Koohmaraie, M., Cundiff, L., Gregory, K., Rohrer, G. & Savell, J. 1994. Heritabilities and phenotypic and genetic correlations for bovine postrigor calpastatin activity, intramuscular fat content, Warner-Bratzler shear force, retail product yield, and growth rate. Journal of Animal Science 72: 857-863.
4. Mezgebo, G.B., Monahan, F.J., McGee, M., O’Riordan, E.G., Picard, B., Richardson, I.R. & Moloney, A.P. (2016). Biochemical and organoleptic characteristics of longissimus thoracis muscle from early and late maturing suckler bulls raised on different production systems to a common carcass weight. Animal. https://doi.org/10.1017/S175173111600272X.
5. Immonen, K., Schaefer, D.M., Puolanne, E., Kauffman, R.G., & Nordheim, E.V. (2000).The relative effect of dietary energy density on repleted and resting muscle glycogen concentrations. Meat Science 54: 155-162.

Formatted: Finnish