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Growth, carcass traits and palatability: Can the influence of the feeding regimes explain the variability found on those attributes in different Uruguayan genotypes?

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ABSTRACT

It is well known what genetic and nutritional factors affect growth and meat quality, but there is less information related to interactive importance of them during the productive process. These systems are mainly based on rangelands affecting animal growth in early stages of life thus producing smaller cattle and reduced retail yield comparing with well grown calves. During the last ten years, Uruguayan livestock production systems have been intensified using improved pastures, concentrates and better genetic. The main breeds in Uruguay are Hereford, Angus and their crosses. These British breeds are under genetic evaluation programs which consider carcass trait parameters. It is important for beef industry to know if interactions between genotype and nutrition during growth and fattening phases are influencing production, efficiency, carcass weight and meat quality attributes. The aim of this article is to present information obtained under different feeding strategies during the post weaning and fattening and their influence on those attributes.

1. Introduction

The beef cattle industry is constantly changing to meet the production requirements of sustainable agriculture and consumer demands for beef quality (Boleman et al., 1998; McKenna et al., 2002). Thus, several segments of the beef industry are striving to increase product quality, productivity, and economic returns. It is well known that these variables may be determined by different growth paths during early and later stages of the animals. The cattle nutrition and growth during gestation and after birth have a great incidence on feed intake efficiency, carcass composition and meat quality. The major nutritional factors affecting tissular composition of the calf at weaning are the lactation performance of the dam and the quality of nutrients offered during early life of the cattle. The growth patterns are affected by climate and availability and quality of the pasture and the entire offered diet.

Much attention has been given to the influence of previous plane of nutrition on subsequent rearing and finishing performance. Meyer, Hull, Waitkamp, and Bonilla (1965) found that whereas cattle made compensatory gains on pasture after having been wintered on low plane of nutrition no compensatory growth was observed. The magnitude of compensatory gain tends to increase as dietary energy levels increase. Fox, Johnson, Preston, Dockerty, and Klosterman (1972) found that the efficiency of protein use for growth was greater in compensating cattle growth and suggested that higher protein:energy ratios are required for such cattle.

Numerous attempts have been made in the US to characterize many breeds and breed crosses for carcass traits (Koch et al., 1976; Wertz et al., 2002). Two studies (Koch, Dikeman, Lipsey, Allen, & Crouse, 1979; Wheeler, Cundiff, Koch, & Crouse, 1996) concluded that ranking of breed groups varies for several carcass traits depending on different slaughter end points (age, carcass weight, fat thickness, fat trim percentage, and marbling score).

Meat eating satisfaction depends on the social demographic condition of the consumer. Nowadays, taste and nutritional value are two important quality attributes of meat for most of consumers. The tendency is to produce lean animals with adequate levels of fat thickness, but it is accepted that the amount and type of fat contribute to some organoleptic properties of meat as tenderness and flavor (Wood & Enser, 1997). Dietary recommendations for humans promoting the consumption of less saturated fat have led to an increased interest in meats containing more unsaturated fatty acids. Beef cattle growing and feeding programs can have deep effects on body composition and nutrient metabolism. These nutritional programs may alter the fatty acid

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composition of ruminant fat tissue. Recent research studies have focused on the nutritional importance of the n6:n3 fatty acid ratio in the human diet and on the content of conjugated linoleic acid (CLA) isomers because of their anticarcinogenic properties (Ip, Singh, Thompson, & Scimeca, 1994).

Uruguayan economy is strongly dependent on beef export. The production systems are mainly based on native pastures but other feeding strategies have advanced like the use of improved pastures and concentrates, which improve animal performance and modify meat quality traits and those could be accompanied or not by some international market requirements. Generally, the experimental results showed that grass-fed beef is often discounted compared to grain-fed beef because of consumer perceived differences in meat tenderness, color, and flavor acceptability (French, O'Riordan, et al., 2000). Currently, there is interest in reducing the amount of grain in the diet of animal associated with increasing the amount of forages due to production cost reduction and to satisfy consumer expectations, which are privilege health, food safety, animal welfare and environmental sustainability (Montossi et al., 2014).

The aim of this article is to present a summary of some research studies done under different Uruguayan production systems, evaluating the effect of the combination of the diets (first winter stocking and finishing periods) on carcass and meat quality and considering different British breeds.

2. Effect of different levels of protein in the diet on the first winter of life of calves and fattening on pastures or grain

There are different growth paths during early life and later life and these are consequence of a combination of factors (e.g. nutrient quality and availability, animal genetic) (Greenwood & Cafe, 2007). Normally, the post weaning conditions in Uruguay are determined by poor pasture availability and quality, affecting animal growth patterns. The efficiency of protein use for growth was greater in compensating cattle growth and suggested that higher protein:energy ratios may be required for such cattle. The objective of this study was to determine the main effects and interactions of previous nutrition with different levels and sources of protein and finishing regimen on animal performance and carcass and meat quality traits. Steers were fed during first winter with different levels and sources of protein. Sixty Hereford steers grazed on improved pastures until they reached 350 kg of liveweight (LW), where they were assigned to a finishing period on pastures—P (n = 30) or grain—G (n = 30). Treatments were: T1) P13-P: diet with 13% of crude protein (PC) and fattened on P; T2) P13-G: 13% PC, fattened on G; T3) P15-P: 15% PC, fattened on P; T4) P15-G: 15% PC, fattened on G; T5) P17-P: 17% PC, fattened on P; T6) P17-G: 17% PC, fattened on G; T7) U100-P: 15% PC, using urea 0.5% of diet, fattened on P; T8) U100-G: 15% PC, urea 0.5% of diet, fattened on G; T9) U50-P: 15% PC, urea 1% of diet, fattened on P; and T10) U50-G: 15% PC, urea 1% of diet, fattened on G. The steers were slaughtered in a commercial packing plant at 500 kg of final LW. Ultrasound subcutaneous fat cover – BFTu – in live animal was measured and carcasses data was recorded (hot carcass weight—HCW, carcass conformation index—HCW left side/CL, meat cuts/fat ratio of pistola cut—C:F, color of fat—FC and meat—MC, marbling—MARB, mainly). Fat color was measured by AUSMeat system on the whole carcass using a 1 to 8 points scale and meat color was done by using Minolta colorimeter (CIE Lab). Samples from steaks were taken for Warner Braztler shear force (WBSF) and were individually vacuum packaged and frozen for subsequent analysis. The analytic procedures and methodologies mentioned here are described by del Campo et al. (2008).

Results were statistically analyzed by analysis of variance using the GLM procedure of SAS (SAS Inst. Inc., Cary, NC).

The effects of feeding treatments on carcass traits and yield cutability are shown in Table 1. No effect of treatments was observed in most of the carcass traits (HCW and C:F). However, steers in T6 showed higher carcass length (CL) than steers in most of the other treatments. This could suggest that the offered levels of protein (P17) during the first winter plus grain at the finishing period affected bone growth pattern and carcass conformation index (HCW left side/CL). These animals had a lower (tendency) index, less conformation. No differences were found in the weight of the main valuable cuts (rump and loin) and in the yield cutability among treatments. But when it was related meat cuts with fat trimmings, the steers grazed on pasture previous to slaughtering had a better ratio (C:F) than grain-fed steers, for almost all protein levels at first winter. The animals in P13 did not show differences in C:F, for both finishing systems. In this experience, grain fed steers had more ($P < 0.05$) fat than grass fed ones (9.1 vs 7.8 mm respectively), although the ultrasound measurement of fat thickness in live animals and the degree of finishing in carcasses were not different among the ten treatments ($P > 0.05$, data not shown). Most of the meat quality traits (Table 2) had not been affected by finishing diet (P vs G). The meat color — MC (L^* values) and fat color (FC), as it was expected, were different ($P < 0.05$). Steers fattened on grain presented an average score 2.1 in the AUSMeat scale and the ones on grass were classified as 2.9. Numerous studies have consistently shown that grain finished cattle has whiter fat color scores than grass-fed animals. Despite of that, steers in T7 and T8 had similar FC ($P > 0.05$). *Longissimus dorsi* muscle of grain fed animals had better ($P < 0.05$) L^* values than those on grass (39.8 vs 37.5 respectively, data not shown). Similar result was observed in Chroma ($\sqrt{a2 + b2}$) muscle values, where meat from grain fed steers had higher values with 2 days of aging, getting better appearance of color than meat from grass-fed cattle (26.3 vs 24.5, respectively, data not shown). No difference ($P > 0.05$) was found on tenderness between treatments with 2 days of aging (3.6 vs 3.7 kgF for G and P, respectively). These WBSF values are in the observed range for Uruguayan Hereford cattle (del Campo et al., 2008; Realini, Duckett, Brito, Dalla Rizza, & de Mattos, 2004).

Table 1
Carcass traits and yield cutability.

	HCW left	HCW	LC	HCW left/CL	C:F
Treat					
T1	123.2	248.7	148.9^{ab}	0.83	11.5^{bc}
T2	127.1	253.3	145.3^{ab}	0.87	11.5^{bc}
T3	129.0	257.0	135.3^{c}	0.95	17.4^{a}
T4	126.5	251.9	142.5^{ab}	0.88	12.6^{bc}
T5	124.2	250.1	142.8^{ab}	0.87	13.1^{bc}
T6	128.3	256.1	151.8^{a}	0.84	9.8^{c}
T7	124.5	250.0	146.5^{ab}	0.85	12.4^{bc}
T8	123.9	249.2	142.4^{bc}	0.87	12.0^{bc}
T9	124.1	250.0	137.6^{bc}	0.90	14.2^{ab}
T10	125.3	251.9	141.7^{bc}	0.88	12.9^{bc}
P	0.784	0.192	0.020	0.302	0.001

abc: Means within the same column having no superscript letters in common differ ($P < 0.05$).

Table 2
Meat quality traits.

	FC	Chroma	L*	WBSF	Marb
Treat					
T1	3.2^{a}	24.6	38.1	3.8	215.0
T2	2.2^{bc}	27.6	40.7	3.1	260.0
T3	3.1^{a}	24.6	38.2	4.2	196.7
T4	2.2^{bc}	26.4	40.9	3.6	243.3
T5	3.0^{ab}	23.9	37.9	3.3	268.0
T6	2.2^{bc}	25.2	39.7	3.5	301.7
T7	2.2^{bc}	23.7	37.9	3.4	260.0
T8	2.0^{c}	25.1	37.9	4.5	258.0
T9	3.1^{a}	26.0	36.2	3.8	210.0
T10	2.2^{bc}	27.0	39.5	3.4	248.3
P	0.001	0.341	0.065	0.608	0.144

abc: Means within the same column having no superscript letter in common differ ($P < 0.05$).