PRODUCTIVE PERFORMANCE, SOCIAL BEHAVIOUR AND MEAT CHARACTERISTICS OF HOLSTEIN ENTIRE OR CASTRATED MALES

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Abstract – Holstein male calves are traditionally destined to beef production in the south of Uruguay, previous castration. Bulls could have some advantages in growing performance but could increase agonistic social interactions and affect welfare. A 65 weeks experiment was performed to compare social behavior, growing performance and carcass and meat quality, between Holstein bulls and steers from 229 to 654 kg. Average weight gain and dressing percentage were higher in bulls (43 kg and 3.1%, respectively), but bulls had significant higher frequency of agonistic behaviour that caused management problems. Significant differences were registered in meat color and cooking losses between treatments, but no differences were found in meat tenderness. Luminosity and redness were higher in castrated animals, determining a better quality of the product. However, yellowness and cooking loss were also higher in steers.

1. INTRODUCTION

In the dairy production region of Uruguay, Holstein male calves are traditionally destined to beef production. Normally young calves are castrated before the fattening period, but entire animals could have some advantages in growing performance and meat characteristics. However, fattening bulls in intensive systems could increase agonistic social interactions and affect welfare.

In this context, the main objective of the present work, was to compare the growing performance, behaviour and meat quality of entire or castrated Holstein males, in order to evaluate the advantages or disadvantages of both animal conditions during the fattening period.

2. MATERIALS AND METHODS

The experiment was carried out at Las Brujas Experimental Centre of the National Agricultural Research Institute (INIA) of Uruguay (34º40`S lat, 56º20´W, 36m alt). The experimental period lasted 434 days.

2.1. ANIMALS, HOUSING AND FEEDING

Sixty Holstein males with average live weight of 229 Kg, half entire and half castrated, were individually identified and randomly divided into 6 groups with ten individuals (3 groups of entire animals and 3 groups of castrated animals).

At the beginning of the experiment, animals were placed at grassland parcels built with electric fencing, and the surface was calculated depending on the forage offered to reach 8% of average live weight *per* animal. Animals were weekly moved to a new parcel. At day 125 of the experiment, animals were confined in outdoor 21x10m yards, built with electric fencing. At day 301 of the experiment, due to behaviour problem with bulls, animals were moves to grassland parcels in similar conditions to the first part of the experiment. Pasture offered was a mix of alfalfa (*Medicago sativa*) and dactylis (*Dactylis glomerata*).

Animals had access to an automatic water trough and free availability of alfalfa hay. Three times a day, maize grain and commercial concentrate were supplied.

Calves were weighted every 14 days and food intake estimation was done every week.

2.2. BEHAVIOURAL OBSERVATIONS

The calves' behaviour was directly observed in two daily three hours turns, three days per week, in eight weeks distributed throughout the experiment. Twelve people were trained to perform the observations. There was one observer for each group in each three hours turns. Observers were randomly assigned to each treatment and timetable every day. Social behaviour was continuously recorded, throw the items described in table 1.

Table 1 - Description of registered social behaviours

Type	Behaviour	Description
Negative interaction	Head pushing (hp)	Animal enticed by initial push of head-rush at each other with forehead clashing, then push, release, push, etc.
	Displacing (dis)	One calf displacing another, with shoulder, side, flank or rump from its standing or lying place.
	Pushing with chest (pwc)	One calf pushing with the chest to another calf from its standing place
	Head Knocking (hk)	One calf knocking another with the head in any part of its body
Sexual interaction	Flhemen (fle)	Initiated by olfactory cues followed by the animal inhaling and curling its upper lip while raising and extending its neck and lower jaw
	Nosing (nos)	Sniffing the penile or anal regions of other animals, when it was not a "pre-flehmen" behaviour
	Mounting (mou)	Calf clasping or trying to clasp other calves back with both legs
Positive interaction	Licking a group mate (lic)	Calf licking another at any part of its body
	Smelling a group mate (sme)	Calf smelling another with contact with its skin
	Scratching with other (swo)	Calf scratching with the body of another calf

2.3. MEAT QUALITY

Muscle colour was measured on the longissimus dorsi (LD) after three days of aging at the L*, a* and b*colour spaces, using a Minolta C10 colorimeter. Shear force (WBSF) was measured at a cooked sample of the second LD steak obtained using Warner Bratzler (Model D 2000). Cooking loss was determined as the percentage difference between the raw steak (pre-cooked weight) and its weight after cooking.

2.4. STATISTICAL ANALYSIS

Behavioural data were subjected to a variance main components analysis in order to find a low-dimensional graphical representation, it was performed throughout multivariate procedure of Infostat. Life weight gain and meat characteristics were analyzed with Mixed Proc. of SAS.

3. RESULTS AND DISCUSSION

3.1GROWING AND BEHAVIOUR

Growing performance of both treatments was different throughout the experiment.

In the first grassland period (weeks 0 to 16) and the confined phase (weeks 16 to 44) there was no differences between steers and bulls. In the third part when animal were placed at grassland again, bulls grow significant more than steers. In figure 1 the evolution of accumulated live weight gain is presented.

The best growing results of bulls was expected as was described for several authors [1,2 5]. However, the differences were shown late in the fattening cycle possibly because of environmental conditions and behaviour problems in bulls groups. Related to this, in the confinement period animal had hard agonistic interaction, interfering with food intake and causing social stress. However, the average number of total negative interaction did not differ between periods (p=0.2611). Analyzing the evolution of weight gain in the graph is possible to identify two moments of weight loss (wl1 and wl2). Those moments are associated to rainy and cold periods, promoting the generation of deep muddy soil. These conditions cause difficulties for animal to access to hay supplier and grain trough and generate a very bad condition for resting, probably explaining the mentioned results.

The social agonistic behaviour was significantly superior in bulls, as it can be seen in the analysis of variance (table 2) and the main variance components analysis (fig 1).

Table 2 – Number of individual interactions (medias for the 3 hours observation turn).

Treatm	hp	dis	fle	pwh	lic	mou	sme	ags	pwc	pc	swo	*Pos*	Neg	Sexual
steers	25,5	13,1	6,0	13,6	18,7	4,9	7,1	7,9	10,0	5,0	10,6	49,9	58,9	15,3
bulls	28,5	17,8	17,8	18,5	10,2	13,5	5,7	18,1	11,5	18,8	7,2	41,7	90,3	37,1
P	0,3695	0,0291	<0,0001	0,0642	<0,0001	<0,0001	0,2053	<0,0001	0,332	<0,0001	0,0095	0,0621	<0,0001	<0,0001

Ref: hk= head knocking dis=displacing, fle=flemhen, pwh=playing with heads, lic=licking, mou=mounting, sme=smelling a group mate, ags=ano-genital smelling, oth=otros, pwc=pushing with chest, hp= head pushing, swo=scraching with other

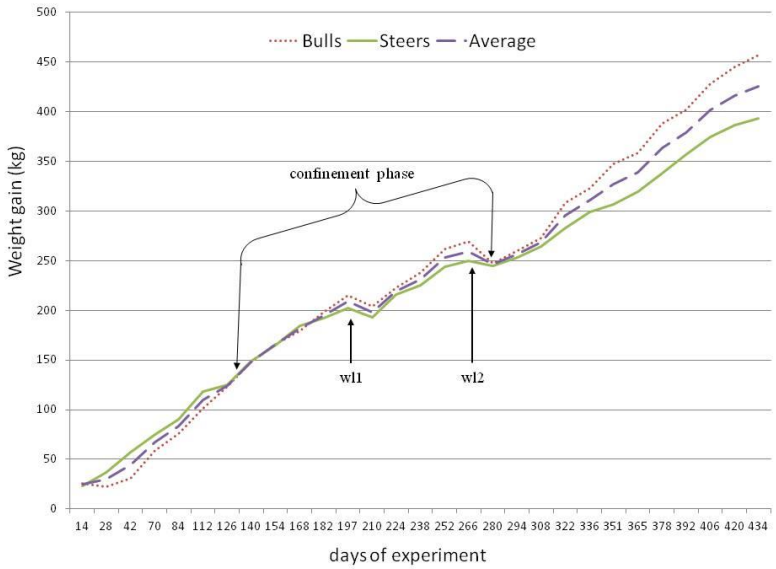

Figure 1 - Average acumulated weight gain for fattening Holstein bulls and steers.

Bulls had higher values of total negative interaction and every individual agonistic behaviour, except by head knocking. This behaviour was the most frequent social interaction in both treatments and did not show differences between them.

When animal were placed at grassland again, probably due to the increase of space availability, the dispersion of the food offered and reduction of the duration of aggressions and sexual interaction, live weight gain increased. As expected, sexual behaviour was more frequent in entire animals, although more than 15 sexual interaction were registered in average, during each observation turn. Aggressive and sexual behaviour in males has been linked to the production of testosterone (Reece, 1990 cited by [3]). The absence of testosterone in steers is likely to explain the lesser mounting and ano-genital smelling in steers than bulls reported in the present study and by others [6]. Mounting behaviour in steers seems to imply more an agonistic role for establishing dominance rather than being sexually motivated[3].

On the other hand, positive interaction were more associated to confined period in both treatments, a as is displayed in fig 2. This situation is probably caused by the reduction of space allowance that increases the opportunities of social contact.

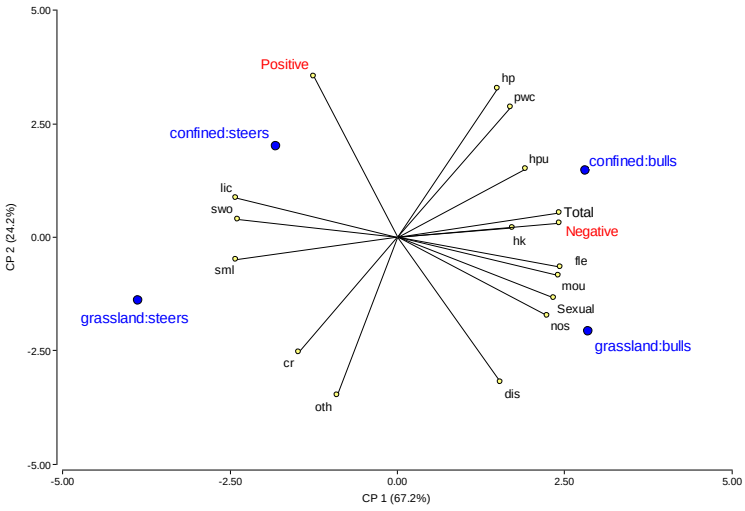

Figure 2 - Main components of variance analisys for social behaviour.

3.2. CARCASS AND MEAT QUALITY

The dressing percent (DP) was 3,1% higher in bulls than in steers. This result is consistent that presented by Keane (2003)[1] This research showed that bulls produced 8 kg more carcass weight, and had better conformation. The data is supported by other studies, where bulls have shown heavier cuts and higher yields

As it was expected, meat from steers had better colour parameters (L*, a*, b*) than bulls. No differences were found in shear force with 3 days of aging, showing both categories acceptable levels of tenderness. This result is not concordant with the literature, where bulls are tougher than steers. Cooking loss also was higher in steers than in bulls (table 3).

Table 3 – Meat characteristics of steers and bulls after three days of aging

			Colour			Cooking loss
	DP %	Shear force (kgF)	L	a	b	(%)
Steers	53,2	2,85	31,35	20,57	8,88	28
Bulls	56,3	2,75	27,57	14,43	4,68	19
p	0,0073	0,6774	<0,0001	<0,0001	<0,0001	<0,0001

4. CONCLUSIONS

The use of entire animals in Holstein beef production, can improve the growing performance and the carcass yield. However the increase of agonistic behaviour could cause stress and become a welfare problem. Also the behaviour can cause management problems due to fights and traditional electric fences are not enough for retaining bulls. For both steers and bulls, is possible to obtain similar meat quality except for colour that is favourable to steers.

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