Association between aggressive behaviour and high-energy feeding level in beef cattle

Y. Bozkurt[1], S. Ozkaya[1], I. Ap Dewi[2]

[1]Department of Animal Science, Faculty of Agriculture, Suleyman Demirel University, Isparta, Turkey
[2]Department of Animal Science, School of Agriculture and Forestry Sciences, University of Wales, Bangor, Gwynedd, UK

ABSTRACT: The aim of this study was to investigate an association between aggressiveness and high level of feeding in a half-open feedlot production system. An experiment was conducted on 72 head of beef cattle of different breeds. The animals were at about 10 months of age. Medium quality silage was offered *ad libitum* and supplemented with high (HE) and low level (LE) of barley (2.5 and 1.5 kg/day/head, respectively) and supplemented without (nil) or with (+) extracted soybean meal (0.45 kg/day/head). Several types of animal behaviour were observed such as those parameters that are categorized to be main aggressive behaviours, butting, being butted, mounting and being mounted. Significant differences ($P < 0.05$) were found in butting, being butted behaviours between HE and LE treatment groups. Mounting and being mounted behaviours were significantly different ($P < 0.05$) in steers and heifers and between the seasons as well. Steers performed more incidents of mounting behaviour than heifers and it was the same for spring, during which animals had more mounting behaviours. It was concluded that there was a close relationship between high-energy diets and aggressive behaviour, which necessitates some management measures to be taken in order to ensure better animal welfare and beef production.

Keywords: beef cattle; level of feeding; aggression; social behaviour; animal welfare

Similarly like today the animal behaviour has been a major concern for humans during the domestication process for many centuries. Research in animal behaviour has then begun to be focused on the main areas to improve the level of animal productivity. Animal behaviour can be studied systematically under the definition of nine main animal behaviour patterns (Craig, 1981). Within these patterns aggressiveness can be defined as running away and conflicts within animal groups (Lehner, 1996).

The results from different studies imply that the grouping of animals especially in feedlots is a problem both when considering performance and production economics. Increased knowledge of grouping and social integration would make it possible to develop effective management techniques that would reduce the amount of problems such as aggressive behaviour occurring during the social integration of cattle (Bøe and Færevik, 2003). However there is not much information on the relationship between aggression and high-energy feeding level.

Therefore, this experiment was designed to bring about an understanding of the relative role of high-energy feeding level on the possible occurrence of aggressive behaviour.

MATERIAL AND METHODS

Experimental location and climatic conditions

The experiment was conducted at the University College Farm, Aber, Gwynedd, UK, (north latitude 53.2, west longitude 4.0, altitude 15 m). The temperature dropped below zero for 16 days in January

(13–29th) and for two weeks in February (3–17th) during the experiment. The dimensions of the building for the experiment were 23 m in length and 18 m in width with pens of 7.2 m × 4.5 m in size.

Allocation of animals and animal management

The animals used in this experiment were obtained from the College farm herd. This experiment consisted of predominantly spring born calves, on average at 10 months of age at the start of the experiment. Seventy-two (72) spring born calves, composed of purebred and crossbred calves from Friesian (25), Limousine (28), Simmental (8), and Belgian Blue (11) breed at initial mean ages of 317, 315, 194 and 327 days and initial mean weights of 197 (S.E., 8.9), 213 (S.E., 8.6), 180 (S.E., 5.6) and 214 (S.E., 10.4) kg, respectively, were blocked on the basis of sex (36 steers and 36 heifers) and randomly allocated to 8 pens within the sex groups. There were equal numbers of animals in each pen which contained 9 animals. The animals used in the experiment were group fed every morning at about 8:00 a.m. and were bedded with straw. Silage was administered with a forage-wagon every other day in sufficient quantities to provide an *ad libitum* intake. The amount of silage given to each pen was recorded from the forage-wagon digitally displayed weight. Refusals were removed and weighed regularly on a standard day of the week to obtain feed intakes on dry matter basis.

The concentrate supplements, barley and soybean meal were stored in silos and the concentrate mixtures were prepared according to treatment definitions in the diets in sufficient quantities to last for at least 2 weeks. The rations were weighed out into bags and fed daily on top of the silage. Concentrates, refusals and animals were weighed using appropriate scales.

Treatments

Four factorial treatment combinations with 2 replications were assigned to the groups at random within the male and female blocks. The treatments were fed for 130 days from 21st December to 1st May. The treatments consisted of grass silage offered *ad libitum* and supplements of rolled barley at a high rate (HE) and low rate (LE) supplemented with (+) or without (–) extracted soybean meal (SBM) as a protein source. In addition, each animal received 50 g minerals and vitamins per head daily, mixed with the concentrates (Table 1). Animals had access to fresh water with automatic water pipes in each pen. In addition, treatment groups were also considered as two combinations only HE and LE, regardless of soybean meal supplementation.

Data collection

The animals were weighed. In two-week intervals during the experimental period in the morning before silage and concentrates were fed. Animal behaviour was recorded by scan sampling 5 days once a week, for 24 consecutive weeks, starting on the first day of the experiment. An observer slowly walked along the alley behind the animals and recorded postures and activities (butting (B) and being butted (BB), mounting (M) and being mounted (BM) as main activities) and substrates on which the activities were performed by each animal, every 10 min from 12:00 h to 16:00 h, and then every 15 min until 18:00 as suggested by Mitlöhner et al. (2001). Apart from butting, mounting and bulling behaviours were considered as one type of behaviour and recorded together as mounting.

Statistical procedure

The data were subjected to the General Linear Model (GLM) technique in the statistical package

Table 1. Composition of treatments in the experiment

Treatments	Barley (kg/day)	Percentage*	Soya (kg/day)	Percentage*
1 LE–	1.5	97	0	0
2 LE+	1.5	75	0.45	23
3 HE–	2.5	98	0	0
4 HE+	2.5	83	0.45	15

*including 50 g minerals/head/day given to all treatment groups

Table 2. Composition (and S.E.) of feeds (% of dry matter unless otherwise stated)

	Grass silage (*n* = 38)		Concentrates (*n* = 18)					
		S.E.	Barley	S.E.	Mix. 1	S.E.	Mix. 2	S.E.
DMo	28	1.68	85.1	0.38	85.7	0.42	85.2	0.50
pH	4.5	0.01						
Crude protein	14.2	0.45	13.2	0.09	19.7	0.55	17.2	0.47
Nitrogen	2.3	0.07	2.1	0.01	3.1	0.08	2.8	0.07
MAD fibre	31	0.34	5.8	0.19	6.8	0.13	6.5	0.17
DMD *in vitro*	63.3	0.94	81.9	0.8	83.2	0.54	83.4	0.51
DOMD	57.3	0.94	75.5	0.8	76.8	0.53	76.9	0.50
ME (MJ/kg DM)	10.5	0.04	12.1	0.12	12.3	0.08	12.3	0.08

n = number of samples

Mix. 1 = mixture of low barley (1.5 kg) + soya (0.45 kg)

Mix. 2 = mixture of high barley (2.5 kg) + soya (0.45 kg)

S.E. = standard error of the mean

programme Minitab (Minitab, 2001). The dependent variable was either total metabolizable energy intake (TMEI) or total crude protein intake (TCPI). The effects were classes "Treatment" (high level, low level, soya+, soya–) and "Sex" (steer or heifer). Interaction terms were tested. Non-significant terms ($P > 0.05$) were sequentially dropped from the model, but no combination of the factors appeared significant.

For behavioural data, treatments with 4 combinations (HE+, HE–, LE+ and LE–) were analysed by GLM technique. Tukey's multiple comparison test was performed to determine the differences in means between treatment groups. Student's *t*-test was used for the analysis of the treatments with 2 combinations (HE and LE), both sexes and seasons.

RESULTS

The chemical composition of silage and concentrates is shown in Table 2. The supplementation of SBM in the diets did not significantly affect dry matter ($F_{(2.51)} = 0.49$, NS), dry matter digestibility ($F_{(2.51)} = 0.21$, NS), digestible organic matter (DOMD) ($F_{(2.51)} = 1.49$, NS) and metabolizable energy content of the ration ($F_{(2.51)} = 1.49$, NS). However, it significantly affected crude protein ($F_{(2.51)} = 59.9$, $P < 0.001$), nitrogen ($F_{(2.51)} = 60.46$, $P < 0.001$) and MAD fibre ($F_{(2.51)} = 7.78$, $P < 0.001$) content of the ration.

The results showed that there were statistically significant differences in total metabolizable energy intake (TMEI, ($F_{(1.143)} = 23.72$, $P < 0.001$)) and total crude protein intake (TCPI, ($F_{(1.143)} = 7.34$, $P < 0.008$)) between treatments (Table 3). The analyses of the behavioural activities found statistically significant are given in Table 4.

As shown in Table 4, statistically significant differences ($P < 0.05$) were found in butting (B) and being butted (BB) behaviours between treatment groups HE and LE. Regarding the treatments with four combinations HE+, HE–, LE+ and LE–, there were statistically significant differences ($P < 0.05$) in B and BB behaviours of the animals. According to the results of Tukey's pairwise comparison test, while there were no significant ($P > 0.05$) differences in B and BB behaviours of the animals between treatments HE+, HE–, LE+, the animals receiving HE+ had significantly ($P < 0.05$) more frequent B and BB behaviours than those with LE– treatment. And there were no significant ($P > 0.05$) dif-

Table 3. Mean values of total metabolizable energy and crude protein intakes according to sex and treatments

Treatments *n* = 72	TMEI (MJ/day)	S.E.	TCPI (g/day)	S.E.
High level	67.8[b]	0.16	888[b]	3.04
Low level	58.6[a]	0.16	796[a]	3.04
Soya (+)	65.8[a]	0.16	920[a]	3.04
Soya (–)	60.6[b]	0.16	764[b]	3.04

*means with the same superscripts are not statistically significant ($P > 0.05$)

S.E. = standard error of the mean

Table 4. Means values and standard errors of the behaviours found statistically significant (n = 72)*

Treatments	Behavioural activities							
	B	S.E.	BB	S.E.	M	S.E	BM	S.E
Two combinations								
HE	1.53[a]	0.15	1.52[a]	0.15				
LE	0.98[b]	0.12	0.98[b]	0.12				
Four combinations								
HE+	1.76[a]	0.24	1.73[a]	0.24				
HE–	1.30[ab]	0.18	1.31[ab]	0.19				
LE+	1.29[ab]	0.20	1.29[ab]	0.20				
LE–	0.66[b]	0.13	0.66[b]	0.13				
Sex groups								
Steers					0.50[a]	0.08	0.50[a]	0.08
Heifers					0.27[b]	0.06	0.28[b]	0.06
Seasons								
Winter	0.44[a]	0.09	0.44[a]	0.09				
Spring	1.59[b]	0.13	1.57[b]	0.13				

*means with the same superscripts are not statistically significant (P > 0.05)

S.E. = standard error of the mean

ferences in B and BB behaviours between HE–, LE+ and LE– treatment groups.

There were statistically significant (P < 0.05) differences in mounting (M) and being mounted (BM) activities between sex groups. Steers had more M and BM behaviours than heifers. Therefore, steers were observed to be more active than heifers.

Referring to the effect of seasons on the selected behaviours, in spring the animal's B and BB were significantly (P < 0.05) more frequent than those of animals in winter. There were no significant interactions.

DISCUSSION

Animal feed intakes such as TMEI and TCPI were higher for high-energy feeding level treatments since they were supplemented with a higher amount of barley together with soya (Table 3). Those behaviours categorized as aggressive behaviours such as B, BB, M and BM were observed and found statistically significant in the animals receiving high-energy feeding levels. Significant differences found in B and BB behaviours between high-energy and low-energy treatment groups indicate that there is highly likely an association between aggressive behaviour and high energy content of the diets. This can be associated with the high level of barley inclusion in the ration (67.8 MJ/day and 58.6 MJ/day for HE and LE treatments, respectively).

Bergeron and Gonyou (1996) reported that feeding a high-energy concentrate diet to sows had several effects on their behaviour and suggested that animals would develop certain types of stereotyped behaviours. However, it is not clear physiologically whether this change in behaviour was due to the high energy content of the HE diet, or to a specific action of the fat that was used as an energy source.

It can also be emphasized that theses aggressive behaviours may be due to the social dominance order within the groups. Pierson et al. (1976) indicated that veterinaries and feedlot employees had observed that bullers were often the biggest, most aggressive steers in the pen or, conversely, the ones lowest in the social hierarchy. While steers of a particular social standing might not become bullers (Ulbrich, 1981), clearly once the behavioural syndrome is established, the animals being ridden show clear signs of first indifference to being ridden, and then an attractiveness that incites more riding. During this period of attractiveness, the mounted steer shows signs of significant submission. Gonyou (1986) suggested that the buller might show appeasement behaviour and that there could be an element of social facilitation that encourages others to join in the mounting.

Although in this experiment the animals were assigned to the pens according to the same sex and almost the same mean initial weight, there were different breeds within the groups; therefore the group composition can influence the amount of social problems that arise when unfamiliar animals and different breeds are grouped. Another reason for aggressiveness may be due to the late and early maturing breeds present in the groups: some grew faster and reached bigger body size than the others, performing more aggressive behaviours observed especially during the feeding time. This was supported by Miller and Woodgush (1991), who indicated that the highest amount of aggressive interactions in loose-housed cattle occurred in the areas around the feeding places. The limitation of the number of feeding places, the size of feeding area, the feed barrier area design and the amount and the type of food influence the motivation to feed and the level of competition and result in stress and aggression (Metz, 1983).

Restricted access to food at the feeding place will increase the competition and thereby the amount of aggressive interactions; that is why the animals were observed after mid-day in this study in order to avoid observing aggressive behaviours resulting from food competition. Bøe and Færevik (2003) suggested that the weight heterogeneity within the group might also be an important factor.

Since there were no significant interactions between the sex and feeding levels, the finding of significant differences in M and BM behaviours between sex groups may be due to the sex differences only. Furthermore, steers had more M and BM behaviours than heifers, showing steers being more active than heifers. This may indicate that converting the energy intake from feeds into activities is dependent on sex differences, not on the feeding level.

It was also observed that in the spring the animals performed more activities than in the winter. The finding of significant differences in B and BB behaviours of the animals between the winter and the spring seasons might be due to the increase in temperatures in the spring although climatic data during the experiment was not available. More frequent bulling behaviour was observed by Pierson et al. (1976) in summer (1.85%) and autumn (1.77%) than in spring (1.05%) or winter (1.07%). The seasonal variation coincided with the feeding of chopped lucerne which contains coumesterol, an oestrogenic compound (Hanson et al., 1965), and warmer temperatures. Irwin et al. (1979) also noted a seasonal difference in bulling behaviour: more bullers were found in November and December than in July and August. This is contrary to the findings of Brower and Kiracofe (1978), who reported more bullers in July and August. The feed rations were not discussed in these reports. The absolute conclusion of the literature agrees with the observations of many feedlot beef producers of an increase in buller activity during warm weather. Significant variation in the data means that bulling episodes could flare up in any season, but feedlots should impose control measures especially during warm seasons. Warm weather was likely to be associated with higher rates of bulling in three out of four reports (Hanson et al., 1965; Pierson et al., 1976; Brower and Kiracofe, 1978; Irwin et al., 1979; Blackshaw et al., 1997).

It can be concluded that the results obtained in this study were in line with those in the literature reviewed. Increasing the level of energy in the diets may cause some incidence of aggressive behaviours. This creates animal management problems. Especially in feedlot beef production where group feeding is practised, development of animal growth may be retarded due to the restriction of feeding space caused by feed competition and thereby aggressive behaviours. These kinds of behaviours result in some management difficulties during handling, feeding, weighing, and transporting to slaughterhouses (Grandin, 1993).

Acknowledgements

We appreciate greatly financial support of FAO and the Turkish Government in conducting the research and thank Professor J.B. Owen for his valuable comments on the manuscript.

REFERENCES

Bergeron R., Gonyou R.H. (1996): Effects of increasing energy intake and foraging behaviours on the development of stereotypes in pregnant sows. Appl. Anim. Behav. Sci., *53*, 259–270.

Blackshaw K.J., Blackshaw A.W., Mcglone J.J. (1997): Buller steer syndrome review. Appl. Anim. Behav. Sci., *54*, 97–108

Bøe K.E., Færevik G. (2003): Grouping and social preferences in calves, heifers and cows. Appl. Anim. Behav. Sci., *80,* 175–190.

Brower G.R., Kiracofe O.H. (1978): Factors associated with the buller-steer syndrome. J. Anim. Sci., *46*, 26–31.

Craig J.V. (1981): Domestic Animal Behaviour. Prentice-Hall, Englewood Cliffs, NJ. 302–307.

Gonyou H.W. (1986): Sexual behaviour in male feedlot cattle. Agric. Pract., *7*, 30–32.

Grandin T. (1993): Behavioural principles of cattle handling under extensive conditions. In: Grandin T. (ed.): Livestock Handling and Transport. CAB International, Wallingford, Oxon, UK. 43–57.

Hanson C.H., Loper G., Kohler G.O., Bickoff M.E., Taylor K.W., Kehr W.R., Stanford E.H., Dudley J.W., Pedersen M.W., Sorensen E.L., Carnahan H.L. Wilsie C.P. (1965): Variation in coumestrol content of alfalfa as related to location, variety, cutting, year, stage of growth and disease. ARS USDA Tech. Bull., *1333*, l–72.

Irwin M.R., Melendy D.R., Amoss M.S., Hutcheson D.P. (1979): Roles of predisposing factors and gonadal hormones in the huller syndrome of feedlot steers. J. Am. Vet. Med. Assoc., *174*, 367–370.

Lehner P.N. (1996): Handbook of Ethological Methods. Cambridge University Press, Cambridge, U.K.

Metz J.H.M. (1983): Food competition in cattle. In: Baxter S.H., Baxter M.R., MacCormack J.A.C. (eds.): Farm Animal Housing and Welfare. Martinus Nijhoff, The Hague. 164–170.

Miller K., Woodgush D.G.M. (1991): Some effects of housing on the social behaviour of dairy cows. Anim. Prod., *53*, 271–278.

Minitab (2001): Statistical Software. Inc. Release 13.

Mitlöhner F.M., Morrow-Tesch J.L., Wilson S.C., Dailey J.W., McGlone J.J. (2001): Behavioural sampling techniques for feedlot cattle. J. Anim. Sci., *79*, 1189–1193.

Pierson R.E., Jensen R., Braddy P.M., Horton D.P., Christie R.M. (1976): Bulling among yearling feedlot steers. J. Am. Vet. Med. Assoc., *169*, 521–523.

Ulbrich R. (1981): The buller-steer syndrome. Int. J. Study Anim. Prod., *2*, 261–268.

Received: 2005–02–25
Accepted after corrections: 2005–11–07

Corresponding Author

Ass. Prof. Dr. Yalcin Bozkurt, Department of Animal Science, Faculty of Agriculture, Suleyman Demirel University, 322 60 Isparta, Turkey
Tel. +90 246 211 14 26, fax +90 246 237 16 93, e-mail: ybozkurt@ziraat.sdu.edu.tr