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Effects of Feeding Buckets Number Per Pen on Performance and Behaviour Indicators of Lambs

Research Article

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ABSTRACT

Twenty-four 35-day-old lambs were distributed to a completely randomized design with 3 treatments to study the effects of number of feeding buckets per pen on performance, haematology and behaviour indicators. Treatments consisted of 8 (T1), 4 (T2) or 2 (T3) feeding buckets/pen (8 lambs/pen). During the experiment, concentrate was fed at 08:30 in individual feeders. Daily dry matter intake (DMI) and average daily gain (ADG) were recorded weekly. Blood samples were taken from all lambs at the time that animal allocated to experimental diet and at the end of the first, second, third, fourth, fifth and sixth weeks and analyzed for haematological parameters. Maintenance and social behaviours were registered based on the methods of scan sampling. Decreasing number of feeding buckets per pen resulted to low overall DMI and ADG ($P<0.05$). However, feed conversion ratio (FCR) and haematological parameters were not affected by treatments. As the number of feeding buckets per pen decreased, the lambs have low eating and ruminating but high walking and playing behaviour ($P<0.01$). Decreasing the number of feeding buckets per pen resulted in increase in the number of attempts to access occupied feeder, displacements among lambs from feed containers and occupying feeder (by two or more lambs) ($P<0.01$). It seems that increasing social pressure and feeding competition between lambs could result to low DMI, ADG and welfare indicators.

KEY WORDS behaviour, feeding place, newborn lamb, performance.

INTRODUCTION

Animals start the intensive fattening period after weaning at different ages and with different physical, behavioural and physiological conditions depending on the production system of origin. At the time of weaning, marketing, and reallocation to new facilities, animals are exposed to stress, which may be detrimental for animal welfare (Gonyou, 1986; Grandin, 1997) and negatively affect performance and immune response (Galyean *et al.* 1999). The quantity and quality of resources should be optimized to reduce stress and facilitate adaptation. Social stress is mainly a consequence of the rupture of social bonds, mixing of animals, and establishment of a new social hierarchy. This process is an important consideration for management (Kondo *et al.* 1984), and an inadequate design of facilities may negatively affect adaptation of stressed animals. Accordingly, sufficient availability of feeding space may provide uniform opportunities of access to feed among animals facing this process. Gonyou and Stricklin (1981) stated that growth of beef cattle was negatively affected during the initial 2 weeks while adapting to limited feeding space. The reduction of feeding space had increased aggression (Huzzey *et al.* 2006), which may result from the individual's pressure in a group to earn a social rank that allows them priority to access resources (Syme, 1974). Also, at the

time of reallocation to new facilities and restriction of feeding space, lambs are exposed to stress, which may be detrimental for animal welfare and negatively affect immune response as changes in haematological and hormonal status (González *et al.* 2008). The effect of feeding space on performance and welfare indicators of calves were studied (Corkum *et al.* 1994; Gonzalez *et al.* 2008) but there is no sufficient data in weaned lambs. Therefore, the aim of the current study was to investigate effects of increased social pressure caused by a reduced number of concentrate feeding places on performance and behaviour indicators of weaned lambs that start the intensive fattening period.

MATERIALS AND METHODS

The study was conducted in a sheep herd with approximately 200 lambs per year at Mashhad suburb (northeast of Iran). The flock was a semi-intensively managed breeding flock, with both ewes and lambs kept indoors during the suckling period. In 5 weeks of age, lambs were weaned and separated from dams and allocated to the experimental treatments. Male lambs were randomly assigned to 1 of the 3 treatment pens (8 lambs/pen). Treatments consisted of 8 (T1), 4 (T2) or 2 (T3) feeding bucket/pen. On the other hand, the number of lambs per feeding bucket feeder was 1, 2 and 4 for T1, T2, and T3, respectively. Natural day light and 10-25 ºC ambient temperature were available during the experimental period. Diets were being base on NRC, 1985 (Table 1). Diets were formulated to be relatively high in protein and energy contents in order to support the potential growth of lambs. Feed intake was recorded daily in the mornings. All lambs were weighed weekly for average daily gain (ADG) and feed conversion ratio (FCR). Whole blood samples from each lamb were taken at 09:30 by jugular veni-puncture on day diet were offered to lambs (day 0) and then weekly. Anti-coagulated blood sample (5 mL Vacutainer with EDTA, Plymouth, UK) was immediately stored at 4 ºC until differential cell counts were determined. The method of behavioural observation was based on the methods of scan sampling (Napolitano *et al.* 2004; Tapkı *et al.* 2006). With this method on the instant of each sample point, the observer records whether or not the behaviour pattern is occurring. Behavioural observations were made every 10 min over an 8-h period (8:00 to 16:00 h), giving a total of 48 sets of observations per day. Observations were made twice a week. On observation days, an observer for each treatment walked slowly past the front of each pen from a distance of 4 m and recorded behavioural traits. The Maintenance behaviour activities were included; eating, ruminating, drinking, walking, standing, playing, resting and others (defecation and urination), and the social behaviour activities included; attempts to access occupied feeder, displacing lamb from occupied feeder and occupying feeder by two or more lambs. The descriptions of behavioural categories are given in Table 2.

Table 1 Ingredients and chemical composition of diet

Item	%DM
Corn	59.5
Soybean meal	21.25
Wheat bran	12
Molasses beet	5
Limestone meal	1.5
White salt	0.4
Vitamin-mineral premix[1]	0.35
Chemical composition	
Metabolizable energy (Mcal/kg)	3.1
Crude protein (%)	18
Ether extract (%)	3.12
Neutral detergent fibre (%)	13.9
Non-fibre carbohydrates (%)	61.87
Calcium (%)	0.68
Phosphor (%)	0.39
Ca:P ratio	1.75

[1] Each kg of supplement contain: Vitamin A (50,000 IU), Vitamin D3 (10,000 IU), Vitamin E (0.1 g), Calcium (196 g), Phosphorus (96 g), Sodium (71 g), Magnesium (19 g), Iron (3 g), Copper (0.3 g), Manganese (2 g), Zinc (3 g), Cobalt (0.1 g), Iodine (0.1 g), Selenium (0.001 g).

Table 2 Description of the recorded behaviours

Behaviour	Description
Maintenance behaviours	
Eating	Chewing of starter in mouth.
Ruminating	Chewing regurgitated food, either in standing or in lying position.
Drinking	Swallow water.
Standing	Standing without any movement or behaviour.
Walking	Walking in pen.
Playing	Different body movements, sounding, jumping, buck- kicking and touching or contacting equipments and floor and lambs next to point lamb.
Resting	Lying without ruminating activity.
Others	Defecation, urination, etc.
Social behaviours	
Attempts to access occupied feeder	Entering the feeder parallel to another lamb that is already occupying.
	The feeder or pushing the head with force against the body of another lamb.
	Occupying the feeder; also, placing the chin on the body of another.
	Lamb occupying the feeder.
Displacing lamb from occupied feeder	Causing another calf that is already occupying the feeder to leave the feeder as a consequence of attempts to access occupied feeder; subsequently, the lamb enters the feeder itself.
Occupying feeder (two or more lambs)	Standing in the feeder starter eating or inactivity two or three lambs.

Behavioural variables were expressed as proportion of observations activity was performed/48 (number of scan samplings). A log transformation was used to normalize skewness in behaviour data (Napolitano *et al.* 2004). The data

were analyzed by SAS 9.1 (SAS, 2002) version statistical package. Because data measured over time, a repeated measures approach using ANOVA with mixed linear models in SAS was used. Interactions between treatment and time (weeks 1, 2, 3, 4, 5 and 6) were tested. When differences were significant (P<0.05), means were compared using Duncan's test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The results are summarized in Tables 3-5. Group and age had no significant effect on the values of haematological parameters (Table 3). Significant interactions between sampling time and group were only seen for monocyte count (P<0.05) (Table 3). Dry matter intake and performance of experimental lambs were presented in Table 4. DMI decreased (P=0.04) with an increasing number of lambs per feeding place. ADG were significantly (P=0.005) different between lambs of different groups; lambs of group T1 were growing to a faster rate compared with those of groups T2 and T3 (P=0.005). However, there were no statistically significant differences in feed conversion ratios among lambs of three groups.

The daily activities of experimental lambs are presented in Table 5. As the number of feeding buckets per pen decreased, the lambs had low eating and ruminating positions but more walking and playing (P<0.01). The high locomotors activities (walking and playing) of lambs were seen in T3 group. The number attempts to access occupied feeder, displacements among lambs from feed containers and occupying feeder (by two or more lambs) are also presented in Table 5. The number of social behaviours responded significant increase (P<0.001) as decreasing the number of feeding buckets per pen, being greatest in T3, intermediate in T2 and lowest in T1.

Haematological parameters

The number and proportion of leukocytes in the blood represent their state of distribution in the body and the activation of the immune system in response to stress. However, there are no studies of the effect of feeding buckets number on haematological parameters in lambs but few studies have used the immune response, such as the ratio of neutrophil to lymphocyte and lymphocytes, as an indicator of stress and immuno-supression in calves (Hickey *et al.* 2003) or rats (Dhabhar and McEwen, 1997). Rats with chronic stress showed decreased lymphocyte counts triggered by high adrenal hormones such as corticosterone (Dhabhar and McEwen, 1997). Gonzalez *et al*. (2008) reported no significant effects on these indices of Friesian calves during the first month after arrival at the feedlot. However, none of these variables were affected in the present study indicating that immune response was not compromised.

Performance

Total DMI and ADG decreased in the overall period as the number of feeding buckets per pen decreased; however, FCR was not affected by treatment. In another study, there are inconsistent results. A few studies concerning DMI in experiments dealing with feeding space have resulted in no effects on DMI (Longenbach *et al*. 1999; Oloffson, 1999). Reynolds and Campling (1981) found no differences in the consumption of grass silage that was offered for *ad-libitum* intake to 11 cows from 6 or 11 mangers. Frank and Magnusson (1994) also found no differences in total feed intake for 1 or 3 cows per feeding place with a total mixed diet. In contrast, Leaver and Yarrow (1977) found a 5% reduction in the average consumption of maize silage by heifers when feed bunk space was changed from 0.4 to 0.2 m per heifer. In accordance to our results, Gonzalez *et al.* (2008) found that decreasing the number of feeding places per pen resulted in a decreasing response of concentrate and total DMI, ADG, and BW during the 28-d period of calve' arrival at the feedlot. Nielsen (1999) suggested that social animals, try to attain a preferred feed intake and a preferred feeding rate, while feeding at specific times of the day. In addition, groups of animal also synchronize their behaviour trying to eat and rest at the same time. This means that when social pressure at the feeder increases, animals may adapt to it by feeding at a faster rate than they prefer, eating less than they prefer or by feeding at less preferred times of the day. In accordance with these suggestions, Gonzalez *et al*. (2008) showed increase in the total time spent eating straw as the number of concentrate feeding places per pen decreased, particularly at preferred eating times while the amount of intake of concentrate was decreased.

Behavioural categories

As the number of feeding buckets per pen decreased, the overall number of maintenance behaviours activities (eating, ruminating and resting) decreased. However, another locomotors and social activities increased. Drinking and standing and other behaviours (defecation, urination and etc.) were not affected by feeder number per pen. T1 group lambs showed higher eating behaviour than the other groups because this group had more bucket feeder's number. Therefore, T1 lambs showed higher ruminating behaviour, whereas fewer attempts to access occupied feeders. Due to this, group lambs were more comfortable than the other groups that showed more resting behaviour.

The increase in the time spent walking and playing was found to be the result of a greater time spent waiting for an occupied feeder when increasing competition in dairy cows

Table 3 Effect of feeding bucket number on haematological parameters

Parameters	Treatment			SEM	Effects		
	T1	T2	T3		Treatment	Week	Treatment × Week
RBC (10^{12}/L)	11.35	9.95	9.67	0.62	NS	NS	NS
HB (g/L)	102.41	103.25	104.21	3.21	NS	NS	NS
WBC (10^9/L)	8.92	8.73	8.86	1.26	NS	NS	NS
Neut (10^9/L)	4.72	4.48	4.25	0.64	NS	NS	NS
Lymph (10^9/L)	2.96	3.21	3.10	0.27	NS	NS	NS
Mono (10^9/L)	0.94	1.05	1.36	0.13	NS	NS	S

T1, T2 and T3 had 8, 4 and 2 feeding buckets/pen, respectively.
S, significant effect (P<0.05), NS: non significant effect.
RBC (red blood cell count); Hb (hemoglobin); WBC (white blood cell count); Neut (neutrophil); Lymph (lymphocyte); Mono (monocyte).

Table 4 Effect of feeding bucket number on performance of experimental lambs

	Treatments			SEM	P value
	T1	T2	T3		
Dry matter intake (g/d)	402.1[a]	349.6[a]	332.2[b]	18.5	0.04
Daily weight gain (g/d)	173.0[a]	136.1[b]	135.7[b]	7.8	0.005
Feed conversion ratio	2.89	3.06	2.91	0.14	0.66

T1, T2 and T3 had 8, 4 and 2 feeding buckets/pen, respectively.
Means with different superscripts within a row differ significantly (P<0.05).

Table 5 Effect of bucket feeding number on behavioural categories (least squares means ± SEM) observed over 8-h in six sessions

	Treatments			SEM	P value
	T1	T2	T3		
Maintenance behaviours					
Eating	0.61[a]	0.57[b]	0.51[c]	0.005	<0.001
Ruminating	0.33[a]	0.29[b]	0.30[b]	0.006	0.001
Drinking	0.15	0.15	0.13	0.006	0.23
Standing	0.33	0.34	0.34	0.007	0.67
Walking	0.24[a]	0.37[b]	0.38[b]	0.006	<0.001
Playing	0.30[a]	0.32[b]	0.40[c]	0.007	<0.001
Resting	0.46[a]	0.44[b]	0.43[b]	0.005	0.001
Others	0.07	0.08	0.08	0.008	0.88
Social behaviours					
Attempts to access occupied feeder	1.27[a]	1.94[b]	2.26[c]	0.03	<0.001
Displacing lamb from occupied feeder	1.20[a]	1.88[b]	2.19[c]	0.05	<0.001
Occupying feeder (by two or more lambs)	1.04[a]	1.75[b]	2.10[c]	0.03	<0.001

T1, T2 and T3 had 8, 4 and 2 feeding buckets/pen, respectively.
Means with different superscripts within a row differ significantly (P<0.05).

(Olofsson, 1999). In groups with low feeders per pen, there was a high level of competition for access to the feeder. Lambs waited longer for access and while occupying the feeder, they were more often disturbed by other lambs attempting to access the feeder themselves. The decreasing eating activity with limited feed space is well documented (Keys *et al*. 1978; Leaver and Yarrow, 1977; Reynolds and Campling, 1981). In experiments using 6 or 17 feeding

places per 17 heifers, Metz *et al*. (1979) found an average decrease in total eating time at the higher competition level for the roughage. A few of the mentioned studies of competition include observations on displacements and, in all cases; an increase in the number of displacements is reported (e.g. Frank and Magnusson, 1994). Olofsson (1999) reported when the competition is increased from 1 to 4 cows per feeding place, the cows altered their average eating rhythm by spending significantly less time eating and more time standing without eating. In summary, increasing the number of lambs per feeder bucket decreased performance, as measured by feed intake and average daily gain. Some behavioural variables could indicate that welfare is poor as the number of feeding buckets per pen decreased. The daily time spent resting decreased, time spent walking and playing increased. The number of social behaviours indicated that the social environment was greatly affected by social pressure.

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