



## Welfare evaluation of fat-rumped lambs under stall feeding condition with different feeder design

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### ABSTRACT

Animal welfare is directly related to animal performance and farm profit. It is associated with their autonomy to take feed and water along with a lack of discomfort. Feeding welfare determines farm profit as major cost of a farm is associated with feed. The objective of the study was to investigate the effect of feeder design on lamb welfare evaluated through feeding behaviour and lamb performance. Sixteen growing fat-rumped lambs of 3–4 months of age were categorized into two groups with an average weight of  $23.20 \pm 0.25$  kg. Group I lambs were fed in conventional feeder, i.e. without divider and group II in designed feeder, i.e. with divider, respectively. The eating time was significantly low in group I with longer and strong agonistic behaviour suggesting intense competition within the group. This group showed minimal weight gain and maximal feed wastage due to extreme struggle for food during the period of the study. The time spent in comfort behaviours like lying rumination was more and agonistic behaviour was less in group II lambs. They showed significantly higher bodyweight gain. It can be concluded from the study that group feeding of growing lambs in feeder with divider allocates designated space for individual lamb, reduces agonistic behaviour and brings better growth in lambs under stall feeding conditions.

**Keywords:** Behaviours, Feeding trough, Group feeding, Growth performance, Lambs

Sheep are multi-faceted animals so act as a financial cushion for the small and marginal farmers of developing countries where agriculture alone cannot secure the livelihood of farm families. Farmers of developing countries now a day's prefer to rear sheep under intensive stall feeding system instead of traditional extensive system in response to the progressive shrinkage of natural vegetation, increasing demand for sheep meat (animal protein) and climate change complications (Devi *et al.* 2020). Feeding management plays a pivotal role in the stall feeding system. It emphasizes optimal utilization of resources, minimal feed wastage and maximal commercial benefit (Ahmed *et al.* 2020). Recently many researchers highlighted that if the intensive system of sheep rearing is practiced for only 3–6 month lambs (post weaned lambs), then optimal productivity and profitability can be achieved (Sahoo *et al.* 2015, Devi *et al.* 2020). Another fundamental benefit of the stall feeding system is that animal gains more weight as no energy exhausted (Costa *et al.* 2019) in

migration. Sheep are gregarious animals and perform better in group rearing compared to individual rearing (Titto *et al.* 2010). Adversely, stall feeding might affect animal welfare in terms of sociability, fear, competition for resources, etc. According to Broom (2010) animal welfare is directly linked to sustainability. Competition for feed between the animals affects their feeding behaviours (DeVries and Keyserlingk 2009) which ultimately influences the growth of lambs. Therefore, appropriate feeding trough can reduce feed wastage due to soiling (Lukuyu *et al.* 2015). Providing separator in feeding trough might reduce the competition for feed without affecting their social welfare. This study aimed to compare the feeder with and without separator on feeding behaviours and lamb performance.

### MATERIALS AND METHODS

**Site of experiment:** The present study was conducted at the experimental animal farm which is located in the semi-arid region of the country at  $26^{\circ}26'N$ ,  $75^{\circ}28'E$ , at altitude of 320 m above mean sea level. The study was conducted in the spring season of (February) 2020–21, where the average ambient temperature is about  $22^{\circ}C$ .

**Selection of animal and animal management:** Sixteen fat-rumped lambs of 3–4 months of age having bodyweights between 15–28 kg were selected from the herd. All lambs were randomly divided into two groups with an average group bodyweight of  $23.20 \pm 0.25$  kg and group size of 8 with

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4 male and 4 female members in each. All lambs were kept in an intensive system of rearing and maintained under proper hygienic conditions in a well-ventilated shed made up of chain-link sides and asbestos roofing. All lambs were fed with 2.5% DM (Dry Matter) on a bodyweight basis. Group I lambs were fed in a feeder without the divider (traditional trough) (Fig. 1A) and Group II was fed in a feed trough with the divider (designed trough) (Fig. 1B). They were fed with total mixed ration (TMR) consisting of 60% roughage (*Cenchrus ciliaris* hay) and 40% concentrate feed (barely 650 g/kg, groundnut cake 320 g/kg, minerals 30 g/kg including 10 g/kg NaCl, with crude protein = 180 g/kg and total digestible nutrients = 650 g/kg). Feed was offered to lambs twice daily, i.e. at 08.00 h and 14.00 h. It was seen in TMR, that there is no scope to become selective (Webb *et al.* 2014). Therefore, the TMR ration was fed to eliminate individual selective attributes in the group. Adequate drinking water was offered to all the lambs throughout the day. The difference in feed and water offered and left as the residue was considered as the feed and water intake, respectively. Ruminants are specific in selecting their diet particularly concentrates over roughage.

**Experimental procedure:** All lambs were housed within one shed with chain-linked fencing separation. The lambs were given 21 days adaptation period concerning their housing and feeding regime. The feeding space allotted for each lamb was (30×40×20 cm<sup>3</sup>) (Sastry and Thomas 2021) and the specifications of feeders were given in

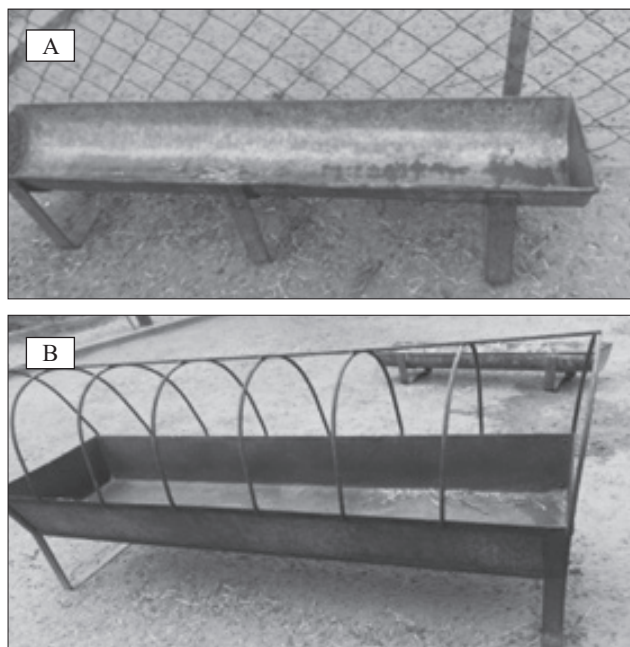


Fig.1. (A) Feeding trough without divider (Group I); (B) Feeding trough with divider (Group II).

Table 1. As the designed trough included the divider, it had a slightly higher length compared to the traditional one. Only one side of the feeder was accessible to lambs by securing another side to the chain-linked side of the shed. All lambs were marked individually with body numbers by using temporary paints for their easy identification from a distance. The experiment was carried out for 30 days. The bodyweight of individual animals was recorded at the beginning and end of the experimental period at 08.00 h. The difference in bodyweight was perceived as an indicator of the productivity and welfare of the lambs.

The behavioural observations were carried out throughout the experimental period for all the lambs daily for 3 h (08.00 h to 11.00 h) by an experienced observer. The behavioural observation was also standardized during the adaptation period. All observations were done by a single trained person for all the groups. Behaviour was recorded instantaneously by a scan sampling for 10 min (Martin and Bateson 1993) for each animal of the two groups. Eating, idle standing, idle lying, standing rumination, lying rumination, vocalization, drinking, and agonistic behaviours like pushing, butting and total physical displacement were recorded during these 3 h. The activity of lambs such as eating, chewing, or swallowing near the feeding trough was considered as feeding; while chewing the cud during standing and lying was considered as standing rumination and lying rumination, respectively. Lambs were considered to be idle standing when they were standing away from the feeder without showing any additional behaviours. Similarly, idle lying was also considered (De *et al.* 2019) in this study. The data obtained during this 30 days' experimental period for each lamb was summarized to obtain the overall behavioural expression of the groups.

**Data analysis:** Data were analyzed by the general linear model (SPSS 16.0, Chicago, IL, USA). The linear model was used for all the respondent variables using a least-squares analysis of variance. The fixed factor was design of feeding trough for each group whereas dependent variables were the growth response and associated feeding parameters like feeding behaviours, feed intake and feed wastage. The level of statistical significance was set at  $P < 0.05$ . Behaviours data of the experiment were presented as mean  $\pm$  SE after summarizing the experimental periods.

## RESULTS AND DISCUSSION

**Lamb behaviour:** The feeding behaviour of both groups has been depicted in Table 2. The eating time was significantly lower ( $P < 0.05$ ) whereas agonistic behaviour time was significantly higher ( $P < 0.05$ ) in group I than in group II. As per Dwyer (2018) sheep generally do not

Table 1. Feeder specifications for each group of lambs

| Type of feeder                                          | Length | Breadth | Depth | Height from ground |
|---------------------------------------------------------|--------|---------|-------|--------------------|
| Feeding trough without separator (for 8 lambs)- Group I | 240 cm | 40 cm   | 20 cm | 25 cm              |
| Feeding trough with separator (for 8 lambs)**- Group II | 247 cm | 40 cm   | 20 cm | 25 cm              |

\*\*, width of each fence was 7 mm.

Table 2. Effect of feeding trough design on behaviour of lambs

| Group | Mean time spent (min.) on different activities during the 3 h observation period (N=8 for each group) |               |              |                         |                         |            |            |                         |
|-------|-------------------------------------------------------------------------------------------------------|---------------|--------------|-------------------------|-------------------------|------------|------------|-------------------------|
|       | Eating                                                                                                | Idle standing | Vocalization | Lying rumination        | Standing rumination     | Idle lying | Drinking   | Agonistic behaviour     |
| I     | 104.69±1.24 <sup>a</sup>                                                                              | 13.44±0.84    | 0.52±0.16    | 5.76±0.26 <sup>a</sup>  | 11.53±0.86 <sup>b</sup> | 3.96±0.51  | 17.50±0.58 | 21.71±0.70 <sup>b</sup> |
| II    | 112.60±1.24 <sup>b</sup>                                                                              | 12.29±0.84    | 0.42±0.16    | 11.46±0.86 <sup>b</sup> | 5.73±0.86 <sup>a</sup>  | 5.52±0.51  | 15.00±0.58 | 14.69±0.70 <sup>a</sup> |

Values with different superscripts (a,b) within a column vary significantly ( $P<0.05$ ) with each other.

exhibit agonistic behaviour except under limited access to resources. For more comprehensible results, agonistic behaviour was classified as adaptive agonistic behaviour, i.e. pushing from the back and attacking agonistic behaviour like head collision and pushing till complete physical displacement. Results of agonistic behaviour time in group I and II are shown in Table 3. Results highlighted that although adaptive agonistic behaviour time was identical in both the groups (I and II) but attacking agonistic behaviour time was significantly ( $P<0.05$ ) higher in group I.

Table 3. Mean time spent (min) on different agonistic behaviour of group fed lambs due to variation in feeding trough design (N=8 for each group)

| Groups   | Pushing   | Butting                 | Physical displacement  |
|----------|-----------|-------------------------|------------------------|
| Group I  | 1.35±0.21 | 13.96±0.55 <sup>b</sup> | 7.40±0.43 <sup>b</sup> |
| Group II | 1.65±0.21 | 8.65±0.55 <sup>a</sup>  | 4.38±0.43 <sup>a</sup> |

Group I (Feeding trough without separator); Group II (Feeding trough with separator); Values with different superscripts (a,b) within a column vary significantly ( $P<0.05$ ) with each other.

Feed intake/eating time depend upon the hunger level, palatability of feed and motivation to take food. Palatability of feed and level of hunger is nullified by offering same kind and quantity of feed at a definite period throughout the day to all the groups. Nielsen *et al.* (2016) reported that motivation to take food depends on the availability of space for feed consumption and competition among peer members. The welfare of lambs is compromised if the space availability is limited or stocking is increased in sheep (Sevi *et al.* 2009). Lambs manifest this psychological stress by altering their behaviour and feed intake (Mohapatra *et al.* 2021).

Space availability depends on trough design and age of the animal. Hoffman *et al.* (2007) reported that limit feeding in cattle reduces the time spent for eating. Eating time was minimal in lambs of group I. As there was no distinct partition in the trough, group I lambs did not get specified space to feed on, so they gobbled up the feed investing less time in eating (stressed feeding). Tables 2 and 4 reveal that the feed consumed per unit time was maximal in group I lambs. Intense competition for food accessibility is the prime reason behind the minimal feeding time in this group. It shows that the frequency of swallowing, bite rate and bite weight might be highest in group I due to severe competition as suggested by Dias-Silva and Filho (2020).

Rumination is normally related to the feed intake of the animals. Lying in lambs is associated with resting behaviour

and is linked to animal welfare (Leme *et al.* 2013, De *et al.* 2017). In this study, we found that the standing rumination of groups I was higher than group II and lying rumination of group II was higher. Lying rumination is associated with relaxed and positive welfare conditions (Phillips 2002). Therefore, group II was considered more relaxed compared to group I.

During this experiment, it was observed that in group-fed animals, drinking of water was due to allelomimetic behaviour/social facilitation; intake of water by one animal was subsequently followed by others. This might be because sheep are highly gregarious and they follow their group members (Gonyou and Keeling 2001). Secondly, motivation to drink water arises from the body condition. Water lost from body fluids triggers the osmoreceptors of the hypothalamus.

Agonistic behaviour was significantly higher in group I than in group II. To make it more clear, the agonistic behaviour was graded as adaptive (pushing) and attacking (butting and pushing till complete physical displacement). It was observed that group I showed prominently attacking agonistic behaviour compared to group II. Group II lambs showed pushing to get access to the specific headspace (area between 2 dividers of the feeding trough) and once a lamb got definite headspace it started feeding until satiety. This synchronous feeding activity of Group II was absent in group I. Tuomisto *et al.* (2019) reported that feeding synchronous behaviour is an indicator of animals' welfare. As the headspace area was not fixed for each lamb of group I, there was a continuous struggle and intense competition.

*Feed and water intake, feed wastage and bodyweight gain:* Table 4 presents the feed and water intake, feed wastage in all the groups along with their bodyweight gain during the experimental period. Feed intake and feed wastage of group I were significantly ( $P<0.05$ ) higher than the rest of the groups. Water intake and bodyweight gain was significantly ( $P<0.05$ ) higher in group II.

According to Mattiello *et al.* (2019) presence of a positive experience or sensation rather than the absence of a negative experience is linked to actual animal welfare. In group I, there was intense competition and aggressive pressure to get space or place to take feed whereas, in group II definite place or space accessible to each animal for feeding resulted mild competition. The wellbeing of group II is validated from the bodyweight gain apart from lamb's behaviour. Table 4 explains, group I had taken maximal feed spending minimum time but gained least with maximal feed wastage. This indicates that the

Table 4. Effect of trough design on feed and water intake, feed wastage and bodyweight gain of lambs of different groups (N=8 for each group)

| Group    | Feed intake (g)           | Water intake (L) | Feed wastage (g)          | Bodyweight gain (kg)   |
|----------|---------------------------|------------------|---------------------------|------------------------|
| Group I  | 860.50±24.15 <sup>b</sup> | 1.81±0.05        | 515.00±11.20 <sup>b</sup> | 2.10±0.03 <sup>a</sup> |
| Group II | 820.00±25.15 <sup>a</sup> | 1.96±0.05        | 235.00±11.20 <sup>a</sup> | 3.60±0.03 <sup>b</sup> |

Values with different superscripts (a,b) within a column vary significantly ( $P < 0.05$ ) with each other.

trough without having the divider is not beneficial for the stall-feeding system with optimal stocking density and hence may not be profitable as well. Group II had mild competition, maximal growth with minimal feed wastage.

It can be inferred from this experiment that the feeding troughs with dividers are not only essential for profitable and farmer-friendly intensive sheep rearing but also for lamb welfare. Such feeding troughs provides conducive social environment that minimizes agonistic behaviours and feed wastage and brings better weight gain in lambs. Further research can be done to optimize the feeding space requirement of lambs and sheep of different age group which allow good access to feed.

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