Volume: 4, Issue: 2, (December, 2022), pp 105-113
agri.rjt.ac.lk/sljae

SRI LANKAN JOURNAL OF AGRICULTURE AND ECOSYSTEMS eISSN: 2673-1401

SLJAE

SHORT COMMUNICATION

Feeding and Drinking Behaviour of Lactating Dairy Cows Fed on Total Mixed Ration Briquettes

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DOI: http://doi.org/10.4038/sljae.v4i2.101

Abstract

The objective of the study was to examine the feeding and drinking behaviour of lactating dairy cows when they were introduced to the Total Mixed Ration (TMR) briquettes. Nine, Jersey x Sahiwal crossbred cows with an average live weight of 275±33 kg in the second week of lactation were randomly assigned to three treatments in a Completely Randomized Design (CRD) with a 14-day adaptation period and 14-d preliminary period. The behaviour observation was conducted during the 7 days of the collection period. The treatments were CTL: guinea grass with commercial feed and two TMR recipe briquettes selected from a previous trial TMR1 and TMR2. The behaviour of the cows was recorded for 2 hrs after offering the feed at 8.00 a.m. and analysed using Behavioural Observation Research Interactive Software. The feeding behaviour did not show any significant difference ($p \geq 0{\cdot}05$) among the treatments. The total number of occurrences of feeding behaviour recorded for CTL, TMR1 and TMR2 were 18.87±8.51, 22.67±8.51 and 42.60±8.51, respectively while the percentage total length of 2 h feeding was 65.97±4.33, 59.00±4.33 and 61.22±4.33%, respectively. There was no significant difference ($p \geq 0{\cdot}05$) in drinking behaviour among the treatments except for total number of occurrences. Total drinking duration was 30.64±55.98, 64.73±55.98 and 206.26±55.98 seconds for CTL, TMR1 and TMR2, respectively. The study revealed that the feeding of chopped forage with concentrate or total mixed ration briquettes does not affect feeding behaviour of lactating dairy cows but may influence their drinking behaviour.

Keywords: *Drinking duration, Feeding duration, Number of occurrences, TMR briquettes*

Date of Submission: 26-10-2022 Date of Acceptance:31-12-2022

1. Introduction

Monitoring the behaviour of dairy cows is important to understand their nutritional status, production performance, health condition and welfare (Mattachini et al. 2016). Feeding behaviour directly influences dry matter intake (DMI), milk production, animal well-being and health (Grant & Albright, 2001) which causes a significant impact on the profitability of the farm (Llonch et al. 2018). The feeding behaviour of dairy cattle can vary with the food composition and feeding arrangement (Albright 1993). Chemical and physical composition, palatability, additives in the feed, composition of the diet, forage chop length, size, method of grain processing, and amount of green leaf availability alter the feeding behaviour (Halachmi et al. 2016). Feeding arrangements such as animals per heard, social interactions, animal grouping strategy and housing facilities control the feeding behaviour of dairy cows (Grant & Albright 2001). Further, the physiological and metabolic conditions such as nutrient sensors present in the tongue and gastrointestinal tract, and hormone secretions may affect feeding behaviour of cows (Llonch et al. 2018) while sensory characteristics of the feed motivate the feeding of a dairy cow. Hence, the type of feed received by the cow may alter its feeding behaviour. In the last few years, feeding behaviour used to understand management and the physiological status of dairy cows (Mattachini et al. 2016). Daily eating pattern and frequency of eating/ruminating are widely used to determine the health condition and productivity of dairy cows.

A total mixed ration (TMR) contains a balanced nutrient composition compared to the traditional ration (Greter & DeVries 2011), and masks different unpalatable feed and flavour compounds as well as enhances the optimum DMI (Schingoethe 2017). According to DeVries et al. (2007) TMR promotes daily intake of meals. The TMR briquettes were recently developed in Sri Lanka for feed preservation for lactating dairy cows (Karunanayaka et al. 2021) but have not yet been evaluated for impact on their feeding and drinking behaviour. Hence, the present study was conducted to examine the effect of TMR briquettes on the feeding and drinking behaviour of lactating dairy cows.

2. Materials and Methods

Experimental location

The dairy cows were in cubicles in a tie-stall barn located at the Livestock Experiment Farm, Faculty of Agriculture, Rajarata University of Sri Lanka (80.4160° E, 8.3726° N). The present experiment was conducted under the approval (VERC-19-09) of the Animal Ethics Committee of Faculty of Veterinary Medicine and Animal Science, University of Peradeniya, Sri Lanka.

Experimental animals and treatments

Nine, Jersey x Sahiwal crossbred dairy cows (BW=275±33 kg and parity=3) were randomly assigned to three treatments in a Completely Randomized Design (CRD). There were two treatment diets tested against a control diet. The control diet consisted of 65% of fresh Guinea grass (*Megathyrsus maximus*) and 35% commercial cow feeds (CTL). The two TMR diets (TMR1 and TMR2) consisted of a variety

of air-dried forages and agro-industrial by-products as selected in a previous experiment were the other two treatments. The TMR diets were in the form of a briquette because as stated above, the TMR diets were in the form of a briquette. Each TMR briquette was prepared on as-fed basis and pressed into 10.4 kg size briquettes by applying hydraulic pressure using a briquette machine (Green Pack 09, Christo Creations Pvt Ltd, Negombo). The TMR briquettes were prepared to contain the daily *ad libitum* DM requirement (9.3 kg day^{-1}) of 300 kg BW Jersey x Sahiwal crossbred cow. The procedure of TMR briquette preparation is previously published (Karunanayaka et al. 2021; Karunanayaka et al. 2022). The ingredient composition of the three treatment diets is presented in Table 1. The feeding trial was conducted for 14 days of adaptation period, 14 days of preliminary period and 7 days of collection period. During the whole study period, each cow individually had access to *ad libitum* water via an individual water bowl. Diets were offered individually through a feed bunk containing dividers separating the adjacent cow's feed. Two equal meals were provided daily at 08:00 h and 16:00 h. Before each feed delivery, the remaining feed at each feed bunk was removed.

Observation of behaviour and analysis

The behaviour of each cow was continuously recorded for 2 h after the morning feed delivery using web cameras (DS-U12, Hangzhou Hikvision Digital Technology Co., Ltd, Hangzhou). Each web camera was installed in front of the experimental cows (3 m off the floor and 2 m from the feed bunk) and each camera could record five cows at a time. The recorded animal behaviour was analysed using Behavioural Observation Research Interactive Software (BORIS) (Friard & Gamba 2016). An ethogram was developed for each animal on their behaviour (Table 2). All the behaviour types were considered state events and each behaviour of all the animals were analysed by the same observer.

Statistical Analysis

Data analysis was conducted according to a mixed procedure of Statistical Analysis System (SAS), Ver 9. Means were separated using Tukey's Studentized Range Test (TSRT) and significance was used at $p \leq 0.05$.

3. Results and Discussion

Due to the fact that all the animals were standing, observation of the lying behaviour of the cows was not possible during the recorded period. Since the recorded period was only 2 h after the feeding, it could be the reason for the above observation. The feeding and drinking behaviour in Jersey × Sahiwal cross-bred dairy cows during the recorded period are given in Table 3. There were no significant differences in the feeding behaviour of CTL, TMR1 and TMR2. However, the feeding behaviour of intensive dairy cows is influenced by management practices, physical factors of feeds, social factors and the environment (Llonch et al. 2018). Feed form and composition affect the acceptability of the feed and the rate of intake (Halachmi et al. 2016).

Table 1: Composition of Control diet and selected the two TMR diets on DM basis

Ingredients (%)	CTL	TMR1	TMR2
Gliricidia sepium		8.5	11
Megathyrsus maximus	65	21.5	14
Zea mays		16	11
Napier grass[1]		13	19
Sorghum bicolour		13	21.5
Rice (*Oryza sativa)* bran		10	6.5
Maize (*Zea mays)* meal		2.5	7
Soybean (*Glycine max)* meal		2.5	3
Coconut (*Cocos nucifera)* poonac		11	5
Mineral mixture		2	0
Di-calcium phosphate		0	2
Cattle feed[2]	35		

Source: (Karunanayaka et al. 2021)
[1]*Pennisetum purpureum* × *Pennisetum americanum*
[2]Cereals, cereal by-products, oil seed meal, vegetable oil, minerals, vitamins and additives

Table 2: Observed behaviour of each animal

Behaviour	Description
Eating	The period when the animal eats/number of eating events
Drinking	The period when the animal drinks/number of drinking events
Standing	The period when the animal stands/number of standing events
Lying	The period when the animal is lying/number of lying events

Table 3: Feeding and drinking behaviour in lactating dairy cows fed with TMR briquettes

Parameter	Treatments			SEM	p-value
	CTL	TMR1	TMR2		
Feeding					
Total number of occurrences of 2 h feeding	18.87	22.67	42.60	08.51	0.1873
The total duration of 2 h feeding (s)	5463.98	5497.42	4681.99	297.02	0.1702
Duration means of 2 h feeding (s)	360.63	303.45	164.09	78.33	0.2659
percentage of the total length of 2 h feeding	65.97	59.00	61.22	04.33	0.5424
Drinking					
Total number of occurrences of 2 h drinking	01.07[b]	02.67[ab]	03.80[a]	0.56	0.0370
The total duration of 2 h drinking (s)	30.64	64.73	206.26	55.98	0.1407
Duration means of 2 h drinking (s)	20.79	29.28	34.80	05.65	0.2847
Percentage of the total length of 2 h drinking	00.39	00.75	02.85	0.78	0.1310

CTL = Animals fed with Guinea grass + commercial cow feed, TMR1 = Animals fed with pre-selected TMR briquette 1, TMR2 = Animals fed with pre-selected TMR briquette

[a,b] Means within raw with different superscripts are significantly different ($p \leq 0.05$).

Therefore, dusty concentrate pellets or meals would have been consumed slowly as it takes time to mix with saliva before being swallowed (Phillips 2002). If the fibre content of the feed is higher, it takes more chewing time. Therefore, feed nutrient composition was affected by the feeding length. In the present study, the CTL diet consists of pelleted cattle feed offered with guinea grasses. This may be the reason for having 65.97% of the 2 h feeding time. In the present study, TMR briquettes consist of different ground (<1 mm) concentrates compared to CTL. Therefore, TMR2 briquettes were eaten more quickly than CTL and TMR1. However, the cows fed with all treatment diets did not show any significant difference in the total length of feeding. In this research, all cows were in individual cubicles and therefore it prevented overcrowding at the feed bunk. Therefore, it might be a reason for the non-significant difference in the feeding behaviour. Higher DMI has been associated with lower feeding efficiency and it improves the longer feeding time. Sorting behaviour leads to imbalanced nutrient intake and it was observed that cows ate the concentrates at a faster rate than the forage particles in all three treatments. It may be due to the loosely-packed nature of individual feed particles as there is no added binding agent into the feed mixtures. There was no significant difference in total duration, mean duration and % of the total length of drinking behaviour among the treatments except for the total number of occurrences in drinking behaviour. Cattle need to drink water to fulfil their nutritional intake and different metabolism activities. Most of the time water intake depends on the temperature, the feed type and environmental factors (Phillips 2002). The total number of occurrences from the cows fed with TMR2 showed a significantly ($p \leq 0{\cdot}05$) higher total number of occurrences compared to the TMR1 and CTL groups and it may due to the variation of the feed.

When water is freely available, cattle drink more frequently. However, water requirements vary with the diet, temperature and physiological state of the cattle (Lukas et al. 2008). Therefore, total water intake varies inversely with feed dry matter content and dry matter intake (Lukas et al. 2008). Therefore, the present study results agreed with Lukas et al. (2008) statements which state that the water intake varies with dry matter content in the feed.

4. Conclusion

In conclusion, cows' feeding behaviour is not affected by feeding chopped forage with concentrate or total mixed ration briquettes. However, it may influence the drinking behaviour.

5. Acknowledgment

This work was supported in part by a grant from the Accelerating Higher Education Expansion and Development (AHEAD) operation project (DOR 39) and the World Bank. We would also like to extend our sincere gratitude to Mrs. R.T.P. Liyanage and Ms. K.S.S. Wimalasiri of the Department of Animal and Food Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka for their companionship

and support extended to us during our research period.

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