Applied Animal Behaviour Science xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Effect of social feeding environment on the feeding behaviour of dairy cows and their willingness to consume a novel feed

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ARTICLE INFO

Article history:
Received 19 December 2015
Received in revised form
22 September 2016
Accepted 3 October 2016
Available online xxx

Keywords:
Behaviour
Novel feed
Dairy cow
Social feeding

ABSTRACT

Dairy cows are often exposed to novel situations and may show a strong behavioural response to novel feeds. To test the impact of social contact while feeding and the reaction of mature cows towards a novel feed we compared: 1) animals fed individually and 2) cows fed socially (in pairs). It was hypothesized that animals feeding together would show similar behavioural patterns and a greater willingness to consume a novel feed product. Twelve Holstein cows (parity = 3.3 ± 1.3; mean ± SD) were assigned to 4 groups of 3 animals (each with 1 fed alone: **Single cow** and 2 fed socially: **Pair 1 and Pair 2 cows**). Two feed types were offered separately: a familiar food: total mixed ration (**TMR**) and, 5 kg of carrots topped with 6 kg of TMR (as-fed). Each group was observed for 10 d, each consisting of 3 periods: 1) 4 d of adaptation (only TMR); 2) d 5–7 the carrots were introduced to the Single cow and to 1 of the 2 cows fed socially (Pair 1 cow); and 3) from d 8–10 all 3 cows were fed carrots and TMR. Dry matter intake (**DMI**), feeding behaviour, rumination time, and sorting activity were monitored for each animal. Cow behaviour was observed for an hour after each feed delivery. No differences in DMI of TMR (27.1 kg/d) or carrots (0.09 kg/d) and feeding time (193.9 min/d) were found between any animal eating as a Single or in Pairs. However, the DMI of carrots increased from period 2 to period 3 (0.04–0.12 kg/d; $P = 0.03$). In period 2, Pair 2 (subordinate) animals ate faster than the other cows (0.19 vs 0.13 and 0.12 kg/min; $P = 0.05$). In period 2, Pair 2 cows tended to select more for medium particles (106 vs 102%; $P = 0.08$) and sorted to a greater extent against short (97 vs 99%; $P = 0.02$) and fine fractions (89 vs 97 and 96%; $P = 0.05$). Overall, the intake of carrots was very low in all treatments, however, animals consumed more carrots in the third period. These results suggest that the acceptance of novel food might increase with the length of exposure. It is also concluded that animals showed similar feeding behavioural patterns regardless of feeding situation.

1. Introduction

Researchers have shown that cattle eating in a herd exhibit a more constant feeding rate than animals fed individually (Fraser and Broom, 1997). This is the result of behavioural synchronization, since dairy cows tend to eat, ruminate and rest all at the same time (Miller and Wood-Gush, 1991; Rook and Huckle, 1995; DeVries et al., 2004). Related to this, social ranking plays a crucial role in any group and can be detrimental for submissive animals (DeVries et al., 2004; Dollinger and Kaufmann, 2013). Negative social interactions may create an acute or chronic stress response resulting in increased signs of behavioural conflict, more fearful animals, less exploratory behaviours, lower feed intake, and a reduced ability to cope with the environment (Rushen et al., 1999).

Adaptation to novel events varies between animals (Boissy and Bouisson, 1995; Van Reenen et al., 2004), although ruminants typically show a strong behavioural response (neophobia) to novel feeds (Lauchbaugh et al., 1997; Costa et al., 2014). Researchers have shown that neophobia can be accentuated or diminished by factors such as age, diet history, presence of social models, and feed composition (Lauchbaugh, 1995; Herskin et al., 2004; Villalba et al., 2010; De Paula Vieira et al., 2012b). There is evidence to suggest that dairy cattle acquire their knowledge from individual trial and errors and from other members of their social group, where feeding behaviour might be influenced by older animals (Duve et al., 2012). De Paula Vieira et al. (2012b) demonstrated that young calves housed with older companions, as opposed to only those of the same age, had increased solid intake and greater growth.

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http://dx.doi.org/10.1016/j.applanim.2016.10.002
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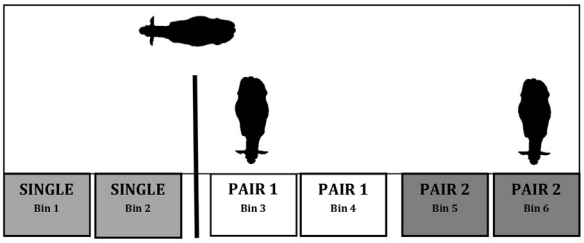

Fig. 1. Layout of the experimental feeding area used for dairy cows (kept in groups of 3) feeding individually (Single cow; n = 4) or in pairs (Pair 1 cow; n = 4; and Pair 2 cow; n = 4).

Many of the previous studies on novelty and social housing environments have involved calves; however, there is a lack of research on the reaction of adult cows toward the consumption of novel feed and the influence of social partners. Thus, the aim of the present study was to test the impact of social contact, while feeding, on the feeding behaviour of dairy cows, and their willingness to consume a novel feed product. It was hypothesized that animals feeding together (in pairs) would show similar feeding behaviour patterns and willingness to consume a novel feed. Specifically, if one animal within the pair demonstrates a desire to consume the novel feed then it was predicted that the other would show similar desire, and alternatively if one animal avoids the novel feed then the other would also be more likely to avoid it. On the other hand, cows that eat alone were predicted to show less similar feeding behaviour patterns from their pen mates and a lesser willingness to consume a novel feed.

2. Material and methods

2.1. Animals and housing

Twelve Holstein cows (5 primiparous (**PP**) and 7 multiparous (**MP**; parity = 3.3 ± 1.3; mean ± SD) were selected from the University of Guelph Kemptville Campus Dairy Education and Innovation Center (Kemptville, ON, Canada) herd and assigned to 4 groups of 3 animals, each blocked by days in milk (**DIM**). Cows were 150 ± 53 DIM, producing 40.2 ± 6.7 kg/d, and weighed 689 ± 88.7 kg at the beginning of the experimental period. Animals were housed 3 at a time in a free-stall research pen, with access to 6 individual waterbeds (DCC Waterbeds, Advanced Comfort Technology Inc, Reedsburg, WI, USA) topped with wood shavings. The pen also included 6 electronic feed bins (Insentec RIC, Marknesse, The Netherlands), which measured feed intake and feeding behaviour, as validated by Chapinal et al. (2007). Each cow had ad libitum access to water from 2 automatic drinkers per pen. Cows were milked 3×/d (0800, 1400, and 2000 h) using an automatic milking system (AMS; Lely Astronaut A3 Next; Lely Industries N.V., Maassluis, the Netherlands), where they received no supplemental feed.

2.2. Experimental design

Within each group the animals were assigned to 1 of 2 treatments: 1) feeding individually (**Single**; 1 cow/group; n = 4; 1 PP and 3 MP [parity = 2, 2, and 5]), and 2) feeding socially (**Pair**; 2 cows/group; n = 8; 4 PP and 4 MP [parity = 3, 3, 3, and 5]). For the animals that were eating socially, the selection of animals for each pair included one older cow (3rd or 5th lactation) and one heifer (1st lactation), whereas the cows eating individually were chosen randomly. Cows were individually trained to access the feed bins in a previous study and had 4 d to readapt and learn to eat from 2 bins (Fig. 1). The Single cows were not able to see the Pair cows while feeding (and vice-versa) due to a barrier (3.63 × 1.89 m) that separated the cows while feeding (Fig. 1).

Table 1
Ingredient and chemical composition of the experimental total mixed ration and novel feed (carrots) (mean ± SD).

Composition	Feed	
	TMR[a]	Carrots[b]
Ingredient, % of DM		
Corn silage[c]	33.4%	–
Haylage#1[d]	16.8%	–
Haylage#2[e]	19.6%	–
High moisture corn	10.5%	–
Protein concentrate pellet[f]	6.7%	–
Grain supplement pellet[g]	13.0%	–
Chemical composition[h]		
DM, %	51.2 ± 8.56	10.6 ± 0.37
OM, % of DM	90.4 ± 1.43	90.0 ± 0.76
CP, % of DM	18.1 ± 0.63	9.2 ± 0.44
ADF, % of DM	25.1 ± 7.37	10.7 ± 0.78
NDF, % of DM	35.3 ± 6.86	13.7 ± 1.01
Starch, % of DM	16.8 ± 10.24	1.8 ± 0.33
Sugar, % of DM	3.8 ± 0.99	53.7 ± 4.51
NFC, % of DM	37.0 ± 8.79	66.9 ± 1.47
Ca, % of DM	1.2 ± 0.19	0.4 ± 0.03
P, % of DM	0.5 ± 0.12	0.4 ± 0.03
NE_L, Mcal/kg of DM	1.5 ± 0.17	–

[a] TMR = total mixed ration.
[b] Carrots were chopped to an average size of 1.41 cm^3.
[c] Corn silage had a DM of 40.1 ± 2.38% and chemical composition (DM basis) 7.0%CP, 26.1% ADF, 45.8% NDF, and 31.6% starch.
[d] Red clover (95%) and orchard grass (5%) haylage had a DM of 38% and chemical composition (DM basis) 22.2% CP, 36.5% ADF, and 44.8% NDF.
[e] Red clover (75%) and timothy/orchard grass (25%) haylage had a DM of 43.1 ± 4.64% and chemical composition (DM basis) 17.8% CP, 20.9% ADF, and 32.2% NDF.
[f] Supplied by Dundas Feed & Seed Ltd (Winchester, Ontario, Canada) including the ingredients (as is); 35–40% corn distillers, 18–33% soybean meal, 8–24% canola, 6.8% calcium carbonate, 1.5–7.5% feather meal, 2.4% salt, 2.0% sodium bicarbonate, 0–3% tallow, 0.8% dicalcium phosphate, 0.4% magnesium oxide, 0.144% trace minerals, and 0.046% vitamins.
[g] Supplied by Dundas Feed & Seed Ltd (Winchester, Ontario, Canada) including the ingredients 20–40% wheat shorts, 16–34% soybean meal, 12–32% corn, 4–14% corn distillers grains, 0–10% oat by-product, 3% molasses, 2.0% dry fat, 0.6% calcium carbonate, 0.9% dicalcium phosphate, 0.3% choline chloride, 0.4% salt, 0.0084% vitamins, 0.0569% trace minerals, 1.25% pellet binder, and 0.125% flavour/attractant.
[h] Values were obtained from chemical analysis of TMR samples. OM = 100 − %ash. NFC = 100 − (%CP + %NDF + %fat + %ash). NE_L was calculated based on NRC (2001) equations.

The novel feed tested was carrots; this feed type was chosen based on the fact that none of the cows had any previous experience with carrots, and that carrots have been used successfully in previous studies on feed novelty in dairy calves (Costa et al., 2014) and cows (Herskin et al., 2003).

Each group was observed for a 10 d experimental period, consisting of 3 sub-periods: 1) the first 4 d were an adaptation period where all the animals had the same TMR diet (Table 1), with half the daily allotment of TMR in each of the cows 2 bins; 2) in d 5 to 7, a novel feed (chopped carrots; Table 1) was introduced to the Single cow that was eating individually and, to 1 of the 2 cows (**Pair 1 cow**) that were eating socially. For those Pair 1 cows, 1 feed bin (bin 3; Fig. 1) contained the familiar food (TMR) and the other (bin 4) had 5 kg/d (as-fed) of carrots in addition to 6 kg/d (as-fed) of TMR, while the other socially-eating cow (**Pair 2 cow**) only had access to TMR (split evenly between bins 5 and 6); and 3) from d 8 to 10 all 3 cows had the TMR in 1 feed bin and the novel feed in the other bin. The Single animal had the novel feed alternated every other day between bins 1 and 2 (Fig. 1) to prevent any effect of location. Alternatively the socially-feeding cows were provided their carrots in the same bins, which were beside each other (bins 4 and 5; Fig. 1)

Please cite this article in press as: Mainardes, G.A, DeVries, T.J., Effect of social feeding environment on the feeding behaviour of dairy cows and their willingness to consume a novel feed. Appl. Anim. Behav. Sci. (2016), http://dx.doi.org/10.1016/j.applanim.2016.10.002