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Preweaning feed exposure and different feed delivery systems to enhance feed acceptance of sheep

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Abstract. Prior exposure of sheep to a novel feed has been shown to expedite the acceptance of that feed later in life. This study was designed to investigate the benefits of early social transmission of feed recognition for productivity and feeding behaviour of sheep in a feedlot. On a research farm near Armidale, Australia, 175 12-week-old Merino × Dorset lambs, together with their dams, were exposed to one of three preweaning treatments: (i) no exposure to feedlot pellets, (ii) offered feedlot pellets on the pasture, or (iii) offered feedlot pellets in feed troughs. The feedlot pellets were offered on two occasions at a rate of 200 g/dam, 1 month before weaning. After weaning, from 18 weeks of age, the lambs were observed for feeding behaviour and their growth during a 50-day feedlot finishing phase. Preweaning exposure to the pellets and the feed delivery system increased the rate of feed acceptance; however, there was no difference in the growth of lambs between the preweaning treatments at the end of the feedlot phase. The difference in percentage of lambs not eating between treatment groups was most pronounced during the first 2 days of the feeding period, with the differences gradually diminishing over the initial week of the feedlot phase. It is considered that differences in feedlot performance due to rate of acceptance of novel feeds are more likely under commercial conditions where pen densities are higher and feed ration transitions may be more rapid.

Additional keywords: lamb growth, shy feeding, feedlot entry weight.

Introduction

It is estimated that 5 to 20% of all sheep that enter a feedlot do not adapt to the feedlot environment and/or their ration (Kirby *et al*. 2004; Jolly 2006). These animals display neophobia and are typically referred to as 'shy feeders'. As a consequence of this, these animals display reduced productivity and may be more predisposed to disease (Kahn *et al*. 2000). Clearly, any strategy that can be applied to reduce the incidence of shy feeders would have clear economic and animal welfare benefits for intensive lamb producers.

Prior experience with a novel feed has been shown to expedite the acceptance of that feed later in life, overcoming the fear of new foods, which is a trait of ruminant species (Lynch and Bell 1987). Moreover, further improvements in novel food acceptance are possible if initial exposure is undertaken in the presence of social partners (Green *et al*. 1984; Lynch and Bell 1987) or dams who have prenatal (Schaal *et al*. 1995) or postnatal (Saint-Dizier *et al*. 2007) experience of the novel feed. In the context of reducing the incidence of shy feeders in feedlots, preweaning exposure of lambs to a novel feed or supplement while they are with experienced dams may expedite the acceptance of these feeds later in life, with considerable practical and economic benefits.

The aims of the present study were to: (i) determine the benefits of preweaning exposure of Merino × Dorset lambs to a grain-based pelleted feed in the presence of experienced dams on subsequent feedlot productivity and the incidence of shy feeders, and (ii) establish whether the method of supplement delivery influenced subsequent feeding behaviour.

Materials and methods

The study was conducted at 'Kirby Research Farm', owned by and adjacent to the University of New England at Armidale, Australia (151°66′E, 30°51′S). The Armidale region is characterised by a summer dominant rainfall pattern with an average annual rainfall of ~750 mm and a cool, subtropical climate. This study was conducted during the warmer months of December through to April.

Pre-feedlot phase

At the commencement of the study, 240 fine wool Merino ewes were selected from a single flock of sheep at Kirby Research Farm. The selected ewes were mature animals and born in the same year, and with an average fat score (average 3, using a 5-point scale). These ewes were joined to four Poll Dorset rams to produce a typical commercial example of first-cross lambs.

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During and following joining, all 240 ewes were grazed as one flock and the ewes were gradually introduced to a pelleted grain-based supplement during the course of their pregnancy to facilitate acceptance of the feed. The feed was offered by trail-feeding on pasture. Ewes that were observed not to readily accept the supplement were excluded from the study. After lambing, mothering-up was conducted using the method described by Wilkins and Cox (1980) to identify the lambs from ewes that had accepted feed previously.

When the lambs were 12 weeks of age and just before weaning, the ewes and lambs were randomly allocated to one of three treatment groups stratified on lamb liveweight. The treatment groups were: (i) control, no pellets offered; (ii) ground, pellets were trail fed to sheep along the ground; and (iii) trough, pellets were fed in troughs of the same design used to feed the lambs in the subsequent feedlot-phase of the study. Sheep do not generalise between grains (Hinch *et al*. 2004) and therefore the pellets fed to the ewes during the preweaning treatments were the same pellets fed to lambs during the feedlot-phase of the study. The ewes from the ground and trough treatment groups were offered the pellets on 2 days, 1 day apart, at an average rate of 200 g/ewe (therefore, a total of only 400 g/ewe of pellets was offered – 2 days × 200 g/day). Lambs remained with the ewes throughout the preweaning treatments to ensure that exposure to the feeding treatment was achieved.

Lambs received normal husbandry procedures before and at weaning. At weaning, lambs were weighed and maintained as a contemporary group grazing pasture for one week before feedlot entry.

Feedlot phase

One week post-weaning, 175 lambs (mean liveweight 30.5 ± 0.3 kg) from the original 240 ewes described above were selected for the feedlot phase of the study. Lambs were grouped according to their dam's treatment group (control, ground or trough) and allocated to one of three replicates within each treatment group. Allocation involved stratification on weight and sex of the lambs. Seven of the pens had 20 lambs with one pen of 19 lambs and one of 16 lambs (3 pens × 3 replicates = 9 pens). Lambs remained in the feedlot pens for a period of 50 days.

During the feedlot phase, all 175 lambs were fed twice daily with average daily feed intake (on a pen basis) and weekly liveweight change of lambs recorded. The diet offered and feeding management was the same in all feedlot pens. The layout of each feedlot pen was the same. A feed trough constructed from 25-cm diameter PVC pipe cut longitudinally in half was placed on the ground in the centre of each pen. Pen space and feed trough space allocations exceeded industry recommendations to ensure that these factors did not confound feeding behaviour measurements. Feedlot pens were adjacent to each other such that differences in environmental conditions or other external influences between pens were not considered to be of significance. Using an oil-based paint and 'brand' (with a metal number on the end of a steel shaft with a handle), a number (1 to 20) was placed on the mid-side of each lamb. This facilitated identification of individual lambs within each pen from a distance when feeding behaviour observations were made.

Observation of feeding behaviour

Observations of feeding behaviour were conducted during the first 7 days of the feedlot phase. The observations were conducted within each pen twice daily for one hour and 50 min immediately post-feeding. Observations were conducted some distance from the feed pen to minimise influence of human presence on feeding behaviour and numbers of eating and non-eating animals were recorded at 1-min intervals for the first 10 min post-feeding and 10 min intervals for the remaining 1 h or 40 min of the observation periods.

Feeding management and measurement

A commercially produced pellet (60% cereal grain, 20% cottonseed meal, 15.5% roughage, 2.5% molasses, 2% mineral pre-mix; ME = 10.3 MJ/kg DM) designed for use in lamb feedlots by a local company was fed to the lambs throughout the feedlot phase of the study. Lambs were gradually introduced to the pellets over a 10-day period called the 'introductory period' and during this time the weight of pellets offered to lambs was increased from 100 g/day to *ad libitum*. The provision of roughage was reduced during the same period from *ad libitum* to nil by decreasing amount of hay available in hay racks.

Prior to feeding each morning, feed troughs were cleaned and the remaining feed from the previous day was collected as 'refusals'. Refusals were weighed and recorded daily, and a sample of mixed refusals from all pens was collected and stored in a freezer for dry matter analysis. Total feed offered daily was recorded and a subsample of feed offered was collected and frozen for dry matter analysis. Subsamples of daily feed offered and refusal were analysed for dry matter content using standard laboratory procedures (Horwitz 2002). Feed was manually delivered to each feed trough twice daily at 0800 hours and 1600 hours, with 50% of the daily allocation offered at each feeding time. Feed pellets occasionally spilt over the edge of the feed trough onto the ground adjacent as a result of sheep 'pawing' the pellets during feeding. The resulting wastage of some pellets was not collected as refusals and, therefore, was included in the daily feed consumption calculations.

Statistical analyses

The feed intake and weight change data and feeding behaviour data were analysed using different statistical models. Feed intake and liveweight data were analysed using Genstat (2007). Split-plot analyses of variance for overall weight change (weeks 1 to 7 and 2 to 7) were conducted. The pen was taken as the experimental unit for testing the treatment effect, and the animal was the experimental unit for testing sex and individual animal covariates (such as weight). As expected, the between-animal mean square was consistently lower than between-pen. Repeated-measures analysis was used to investigate liveweight change with time. This analysis estimates the Greenhouse–Geisser epsilon as an adjustment for the degree of autocorrelation between successive times. As intakes were only measured on a pen basis, a split-plot

analysis was not required. Repeated-measures analysis was also conducted for feed intakes to investigate patterns over time. The relationship between weight and feed intake over time was investigated.

Feeding behaviour data (expressed as proportions) were analysed using SAS Version 8.02 (SAS 2005) software package. Main effects and interactions were described for feeding behaviour during the initial 7 days of the feedlot phase.

Results

The overall mean feed intake (± s.e.) for lambs during the feedlot phase of the study was 1114 ± 15 g/day. There were no differences in feed intake between treatment groups. The overall mean daily weight gain for lambs during the feedlot phase was 107 ± 15 g/day. There were no differences in overall weight gain between treatment groups. Variation in lamb weight gain was noticeable with 26% of lambs recording mean daily weight gains of less than 50 g/day and 29% of lambs recording mean daily weight gains of greater than 150 g/day.

Lamb weight gain was not influenced by sex, weaning weight or feedlot entry weight. In the repeated-measures analysis of weight gain, the overall treatment effect was not significant, however the time × treatment interaction was significant ($P = 0.039$). Feed intake was not influenced by sex; however, it was influenced by feedlot entry weight. Feed intake over time was not significantly affected by feeding treatment or the time × treatment interaction (Fig. 1). When the effect of the first week of the feedlot phase (when feed intake was restricted) was removed, no relationship between feed intake and weight gain was found.

Feeding behaviour during the initial week of the feedlot phase was influenced ($P < 0.01$) by treatment. The percentage of time spent eating by pre-weaning treatment exposure groups (ground and trough) during the first 10 min post-feeding was higher ($P < 0.01$) than for those animals that did not receive pre-weaning exposure (control) (Fig. 2*a*). During the following 140 min post-feeding, the time spent eating by the control treatment lambs was higher ($P < 0.10$) than for treatment groups that received pre-weaning exposure to the feed pellets (Fig. 2*b*).

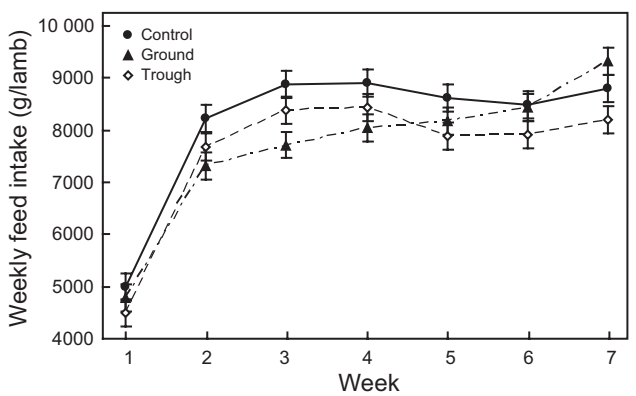

Fig. 1. Pattern of weekly feed intake (g/lamb, mean ± s.e.) for treatment groups during the feedlot phase of the study.

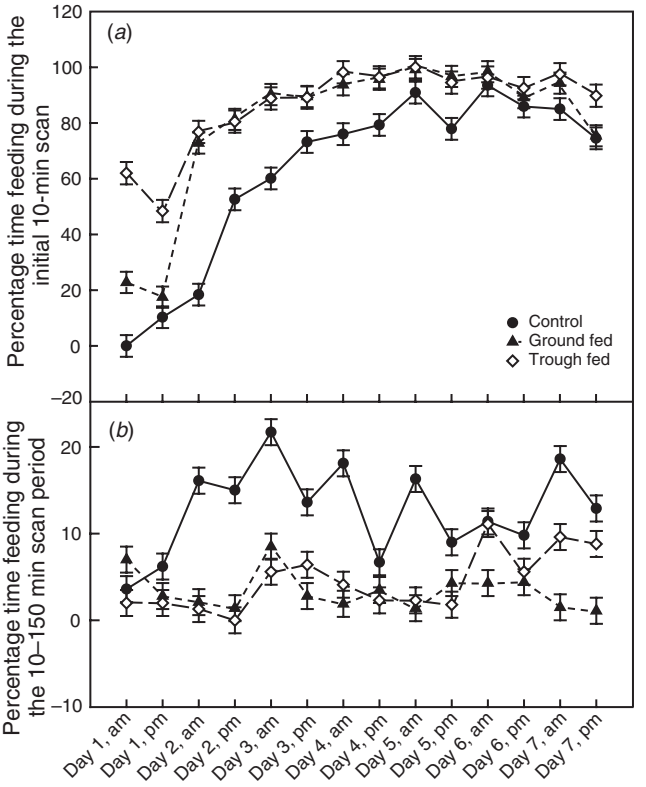

Fig. 2. Interaction between pre-feedlot feeding treatment and feeding period on percentage of time eating during (*a*) the initial 10 min scan period (standard error of the difference is 5.0–5.5) and (*b*) the 10–150 min scan period (standard error of the difference is 2.0–2.1).

The percentage of lambs observed as not eating during the first 150 min post-feeding for the initial week of the feedlot phase was higher ($P < 0.01$) for the control treatment group than the treatment groups that received preweaning exposure to the feedlot pellets (Fig. 3). The difference in percentage of lambs not eating was most pronounced during the first two days of the

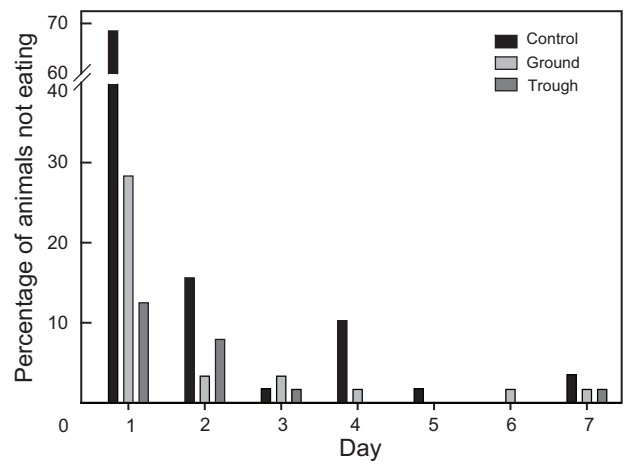

Fig. 3. Percentage of lambs not eating during the initial week of the feedlot phase.

feeding period with the differences gradually diminishing across the initial week of feeding.

Discussion

The findings of this study indicate that initial feeding behaviour of lot-fed lambs can be influenced by preweaning exposure to the feedlot ration and feed trough. However, the results also suggest that differences in feeding behaviour in the initial week of feeding do not impact on the longer term performance (weight gain) of lambs. As this study was conducted under experimental conditions of small pen numbers (maximum of 20 lambs) and below industry recommendations for pen densities, it is possible that the influence of feeding behaviour differences may not have been as great as those occurring in a more competitive commercial context. Another explanation for the lack of difference between treatment groups is that animals exhibiting slower acceptance of feed during the first week of the feedlot phase, compensate with greater acceptance at later stages of the feedlot phase. It may also be that lambs that were not exposed to the feedstuff preweaning (control) demonstrated less 'aggressive' feeding behaviour and, consequently, consumed more of their feed after the 150 min post-feeding observations.

The results of this study suggest that novelty of both the feedstuff and the feed delivery system can impact on the rate of feed acceptance as feed acceptance during the first 10 min post-feeding of the initial week was improved by preweaning exposure to both the feed ration and feed trough. Interestingly, lambs that did not receive preweaning feed exposure appeared to compensate by increased feeding activity after the first 10 min post-feeding. However, as it was time and not consumption that was recorded, the greater time spent at the trough by the control animals subsequent to the first 10 min may reflect time spent in smelling and tasting the unknown food before consumption, as this is normally the behavioural pattern observed for sheep accessing an unknown food in the first 3–4 days of exposure (Hinch *et al*. 2004).

The mean weight gain achieved by the lambs in this study would be disappointing under commercial conditions and a major contributing factor to this low mean weight gain is the large between-animal variation, with only one-third of lambs achieving growth rates greater than 150 g/day; a rate that would be desirable under commercial conditions. Almost the same percentage of lambs recorded growth rates below 50 g/day, reflecting concerns commonly expressed by commercial lot-feeders about 'non-performers' and their impact on the financial viability of lot-feeding systems. There is a need to develop a better understanding of the factors influencing feed acceptance and implementation of practical management systems that will enable pre-feedlot identification of animals that are likely to be 'under performers' in the feedlot context.

Acknowledgements

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