Proc. Assoc. Advmt. Anim. Breed. Genet. 20:294-297

A POTENTIAL PRACTICAL SYSTEM TO ESTIMATE PASTURE INTAKE OF INDIVIDUAL ANIMALS

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SUMMARY

Pasture feed intake of individual animals is very difficult to estimate. A practical measurement system would better enable the selection of livestock for pasture feed use efficiency and lower maintenance requirements, which are very important biological and economic traits. A prototype (Proway-CottleDove) feed bin system was trialed by comparing chaff intakes by cattle in a feedlot measured by a race fed autofeeder with intakes estimated by marker analysis of faecal and feed samples following the controlled daily consumption of wax labeled supplement. Intake of a native pasture was also estimated by use of the bin. Autofeeder-recorded daily chaff intakes were very variable and unreliable and so the accuracy of the bin system in estimating intake could not be determined. The repeatabilities of chaff intakes estimated from marker concentrations from sequential faecal samples were 0.2-0.3. Chaff intake predictions were in a feasible range, based on cattle liveweight. When the pasture grasses were combined in analyses, following a principal component analysis of markers, the diet composition, digestibility and daily intake of pasture plus supplement estimates, on average, were consistent with the prediction of intake from liveweight and liveweight gain. The average total intakes estimated from days 5, 7 and 10 faeces marker concentrations were 7.8kg, 6.9kg and 9.7kg/head respectively. The bin system used in this trial would estimate pasture intake at an approx. cost of $122/head. Multi-bin systems using Sapien Technology components and databases are being developed for further testing.

INTRODUCTION

The cost of feed is second only to capital costs in importance to the profitability of commercial beef operations. About 70-75% of the total dietary energy cost in a beef cow herd is used for maintenance and these requirements of beef cattle have remained largely unchanged over the last 100 years (Basarab *et al.* 2005). Pasture intake (and the efficiency of its use for liveweight gain) has always been difficult to measure under field conditions. Methods for estimating pasture intake have been extensively reviewed (Langlands 1987; Dove and Mayes 1996; Mayes and Dove 2000; Dove and Mayes 2005; Dove 2010; Crews and Carstens 2012; Cottle 2013). Measurements can be based on plant biomass or be made on animals. Estimates of plant biomass before and after grazing by a mob or herd do not provide estimates of individual animal intake. Some measurement methods can disturb normal grazing behavior and interfere with intakes. Livestock selectively graze (Hanley 1982), so their diet cannot be easily quantified using plant-based measurements.

Residual feed intake (RFI) can be used to directly select for feed use efficiency (Cottle 2011) however the high cost of RFI measurement in a feedlot (~$A500/head) and RFI's interaction with feed type and level (Herd *et al.* 2011) has limited the use of RFI by industry. Hugh Dove and co-workers developed the approach of feeding weighed amounts of wax-labeled supplement to dose animals with natural markers. This has been turned into a more practical approach by enabling the animal to self-dose in the paddock with labelled supplement via a purpose-built feed bin with an electronic identity device tag reader (patent pending). The bin has mechanisms to control and record the daily labeled supplement intake of each animal and in-house algorithms are used to calculate individual pasture intake.

MATERIALS AND METHODS

Animals. In trial 1, Angus-Charolais cross heifers grazed at pasture and in trial 2 these heifers were fed lucerne chaff followed by oaten:lucerne chaff in the feedlot. All cattle that ate labeled supplement regularly were kept in the trial paddock or feedlot pens in each feeding trial.

Feed and bins. The grazing paddock in trial 1 mainly contained wallaby, parramatta and red grass, paspalum, setaria and white clover. Cattle were fed *ad lib* 100% lucerne chaff or *ad lib* 50% lucerne chaff:50% oaten chaff (Manuka Chaff, Tamworth) through race auto-feeders in feedlot pens at 'Tullimba'. The repeatability of daily chaff intake measured by the auto-feeders was less than 0.1, probably due to competition for access to the race and feed bin. The labeled supplement was cottonseed meal (CSM) pellets (Supreme Stockfeed, Guyra) containing 0.75% (w/w) beeswax and 30% oat hulls. The trials used a bin/race system modified from the initial prototype to control daily supplement intake.

Sampling and measurements. After many prototype bin/race technical issues were resolved and individual, daily CSM intakes were consistent, faecal and feed samples were taken at days 5 or 6, 8 or 9 and 10 or 11. Samples were oven dried at 65°C for 7 days, ground through a sieve and mailed to CSIRO, Canberra for analysis of alkane and alcohol content (ppm/OM) (Dove and Mayes 1996).

Statistical analyses. Pasture composition and organic matter intake (OMI) were estimated from the marker concentrations in feed, supplement and faeces using a modification of the methods described by Dove and Moore (1995), Dove (2010) and Cottle (2013). The repeatability of chaff intake prediction from the different faecal samples was calculated from the variances between and within animals for marker predicted chaff intake. The different grasses in the pasture trial were combined in analysis following a principal component analysis (PCA) of the markers (Dove 2010).

RESULTS AND DISCUSSION

Data from six alkanes (C25, 27, 29, 30, 31, 33) and four alcohols (C24, 26, 28, 30) were chosen for analyses. Autofeeder chaff intake measurements were unreliable, however the correlations between them and marker predicted lucerne chaff intakes were 0.96 from day 5 faeces samples; 0.64 from day 8 faeces samples; and 0.89 from day 11 faeces samples. The marker predicted lucerne chaff intakes were higher than autofeeder chaff intakes. These correlations for mixed chaff intake were 0.69 from day 6 faeces samples; 0.45 from day 9 faeces samples and 0.62 from day 11 faeces samples. Predicted chaff intakes of animals with at least 2 faecal samples are shown in Figure 1.

PCA analyses of plant alkane and alcohol concentrations were carried out to establish *a priori* if the 10 markers could distinguish between plant species. PCA scores 1 and 2 accounted for 98% of the variance in marker profile (Figure 2) and their biplot showed that the labelled CSM, wallaby grass and white clover were easier to distinguish than red grass, setaria, paspalum and parramatta grass.

A marker profile for a single component called 'grass' was calculated and the diet composition, whole-diet digestibility and total daily intake of pasture plus pellet estimates, on average of 11kg/day, were consistent with the prediction of total intake from liveweight and gain using the equation of Minson and McDonald (1987).

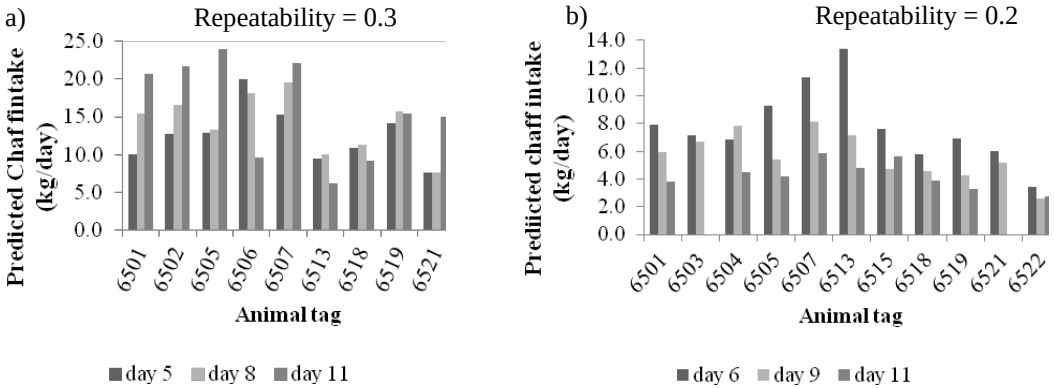

Figure 1. Predicted a) lucerne chaff and b) mixed chaff intake (kg/day) using C27, C29, C31, C33 alkanes and C24, C26, C28, C30 alcohols from 3 different faecal sampling days.

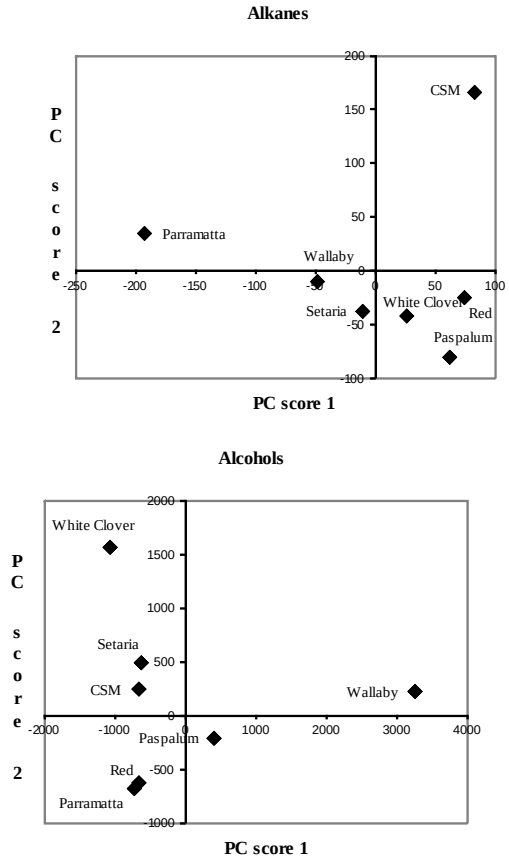

Figure 2. Clustering of plant species based on the first two principal components of alkane and alcohol marker concentrations.

The average total intakes predicted from days 5, 7 and 10 faecal marker concentrations were 7.8 kg, 6.9 kg and 9.7 kg/head respectively. There was a high between animal variation in predicted pasture intakes. These total intakes appeared lower than expected from liveweights and suggest that animals may have been grazing plant species that were not collected (e.g. demeter fescue) as the paddock contained diverse plant species that changed with season. The daily allowance of labelled supplement was consumed rapidly and this may have affected the steady state kinetics of herbage markers.

CONCLUSIONS

The intakes measured by the autofeeders were unreliable, so the accuracy of the intake estimates from the Proway system was unknown. However, the intakes predicted from feeding labelled supplement were realistic given the average liveweight of the heifers (455kg). The prototype bin system tightly controlled the maximum daily supplement intakes (daily supplement intake repeatability >0.9). Assuming a bin life of 20 years and a conservative 20 head tested per bin and a marker test cost of $71.50/sample, the cost per animal tested was $122, which is much less than a RFI test. The Proway-Sapien system shows promise as a practical means of measuring pasture intake and feed use efficiency.

ACKNOWLEDGEMENTS

I am grateful to Dr Hugh Dove for his advice, Andrew Hunter for cattle supply, Col Crampton for cattle husbandry, Adam Fitzpatrick and Jim Cook for autofeeder data processing, Bruce Hunt and Brad Dawson for bin engineering, Ken Bray for bin programming, Guy Ballard for supply of movement detection cameras, Scott McDonald for laboratory marker analyses and MLA for R&D trial funding.

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