Predicting Feed Intake of Fallow Deer (*Dama Dama*) Using Alkanes as a Marker

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ABSTRACT : The understanding of seasonal forage intake of grazing deer is essential for the development of supplementary feeding strategies in southern Australia. The alkane technique is used in other animal species for estimating feed intake of individual animals and their diet composition. To assess the potential of using alkanes as a marker for predicting feed intake of fallow deer, the daily faecal recovery of alkanes and excretion rate of dosed artificial alkanes (C32 and C36) were measured with 6 deer fed three forage based diets. The artificial alkane capsule designed for use in sheep is suitable for fallow deer. Faecal samples need to be collected over days 7-19 after dosing. The daily excretion rate was 40 mg for C32 and 37 mg for C36. The faecal recovery of natural alkanes is incomplete and the faecal concentrations of alkanes need to be adjusted for an accurate estimation of intake. The actual feed intake of 6 experimental deer over a 5 day period was accurately estimated (R^2=0.52) using alkanes. *(Asian-Aust. J. Anim. Sci. 2002. Vol 15, No. 2 : 209-212)*

Key Words : Fallow Deer, Feed Intake, Grazing, Alkane Capsule

INTRODUCTION

Under a Mediterranean environment, the quantity of herbage in winter, quality of herbage in summer, and both quality and quantity of herbage in autumn are the key factors limiting deer growth. With current farming systems, deer producers often have to supplement hay or feed grains to ensure weaners reach market body weight at the end of the season. The current method of supplementary feeding of deer is a hit or miss strategy due to a lack of knowledge of the seasonal feed intake and nutrient requirement of deer. To enable farmers to match the nutrient requirement with feed supply, it is essential to determine the nutrient intake that deer obtain from grazing during the season.

There are a number of methods used for estimating feed intake of ruminants while grazing. For example, exclusion cages have been used for measuring feed intake of sheep although this method cannot predict intake of individual animals. Chromium oxide has been used as an external marker to estimate individual forage intake for both grazing sheep and deer (Kusmartono et al., 1996). However, this method requires a digestibility value of the herbage for calculating feed intake.

Plant alkanes have been studied extensively as a marker for estimating feed intake of grazing sheep. N-alkanes are long-chain (C25-35) hydrocarbons, predominantly with odd-numbered carbon chains, which occur in the cuticular wax of most plant materials. Dove and Moore (1995) and Dove and Mayes (1996) showed that feed intake, diet composition and supplementary feed intake of individual

animals can be estimated from the pattern of alkanes in each component of the diet and the faeces. With the wide adoption of this method, a commercial alkane capsule has been developed for sheep. However, there has been no attempt to assess the potential of using the alkane technique to predict feed intake of selective grazing ruminants like deer. It is critical to determine the recovery of the marker from the faeces before n-alkanes can be used to measure feed intake and diet composition of deer under grazing condition. The objective of this experiment was to evaluate the potential of using alkanes to measure feed intake of fallow deer by measuring the faecal output of artificial and natural alkanes after dosing deer with alkane capsules.

MATERIALS AND METHODS

Animals and housing

Nine male fallow deer (weaners), 8 months of age, were obtained from a commercial deer farm in South Australia. The average body weight was 26 kg. The deer were housed as a group in a 7 m × 7 m compound constructed in the middle of an animal house, with 1,900 mm ring-lock fence strained 100 mm off the floor giving a 2 m high fence, in the Animal Research Centre at Roseworthy Campus, 60 km north of Adelaide and 10 km east of Gawler in South Australia.

After 2 months of training of the deer by hand-feeding of fresh lucerne or grains, 6 weaner deer were transferred into individual stalls with dimensions of 1,200 mm long × 1,950 mm high × 900 mm wide. Holes with a diameter of 100 mm were cut in the stalls to allow deer to view each other in the next stall and reduce fractious behaviour. The feeder was fixed on the door with the water bucket next to the feeder. To reduce the stress on deer from fitting and using collection bags, a faecal collection net was placed underneath each individual stall, similar to the faeces

collector used in metabolic cages for sheep.

Feeding and faeces collection

Three diets were used in this experiment with 2 deer/diet. The dietary components were: diet 1: 50% straw, 50% luceme chaff; diet 2: 70% oaten/wheaten chaff, 30% luceme chaff; diet 3: 100% luceme chaff.

Once the deer were housed in the individual stalls, artificial alkane capsules (produced by Captec Pty Ltd.) were dosed via the oesophagus. The deer were fed *ad libitum* and water was available at all times. Faeces were collected daily (9:00 am) for 24 days from day one after dosing. Hair was removed manually from the faeces and 10% of the faeces were subsampled and freeze dried. All samples were milled through a 1 mm screen for alkane analysis. Daily feed intake was measured for 5 days between day 15 and 19 after dosing capsules to enable prediction of the daily feed intake. The alkane concentration in the faecal and pasture samples was analysed using a modified method of Dove and Combe (1992). To a dry sample of 100-500 mg. an appropriate amount (50-200 mg) of internal standard ($C_{34}H_{70}$ in dodecane) was added. The samples were then subjected to 1.5 M ethanolic KOH in a heating-block at 90°C for 1 h with stirring. After cooling, the hydrocarbons were extracted in n-hexane several times, filtered, purified and quantified by gas chromatography. The recovery of alkanes was calculated based on total intake and faecal output of alkanes.

Calculation of feed intake

Feed intake was calculated using Eatwhat® software developed by Dove and Moore (1995). This software uses a least-squares optimisation procedure. An unresolved issue for this approach is the extent to which different alkanes might have different weightings in determining the feed intake in the mathematical equation. To attempt to solve this issue, the alkane concentrations in faeces and pastures were adjusted by multiplying a correction factor which was calculated as follows using C29 as an example:

Correction factor for C29=Average (C29 for deer 1, 2, ...6)/Sum (C25, C26, C27, ...C33). The sums of all correction factors for alkanes used for the prediction of feed intake should be 1.0.

RESULTS

The alkane concentrations (C32 and C36) in the faeces were stable from day 7-19 after dosing (figure 1). Fallow deer excreted about 40 mg C32 and 37 mg C36 of alkanes daily during this period. After day 19, the concentration of alkanes in the faeces dropped rapidly.

The faecal recovery of alkanes was incomplete. The recovery of alkanes for all diets ranged 43% - 89%. The recovery of alkane C31 was 2% units lower than for C29
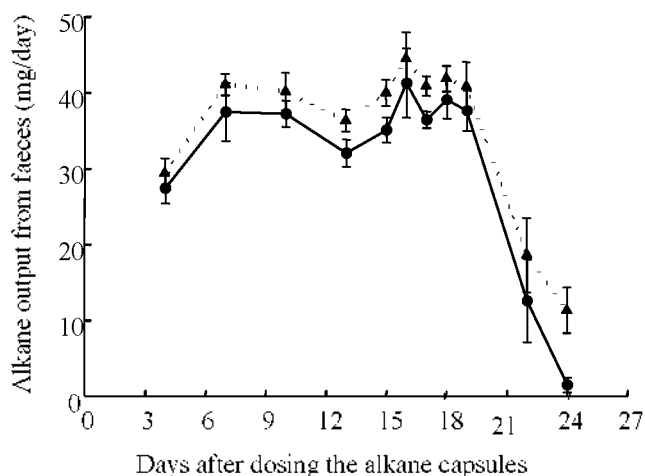

Figure 1. Daily output of alkane C32 (▲) and C36 (●) from faeces of fallow deer after dosing alkane capsule (error bars are standard error)

and 6% units lower than for C33. but the recoveries of natural alkanes tended to increase with the increase in carbon-chain length (table 1). The variation in the faecal recovery of alkanes between diets was not evaluated due to the limited number of animals per diet.

There was no difference (p>0.05) between predicted and actual total feed intake and the intake of luceme chaff in the diet (table 2). The actual intake was strongly correlated with the predicted intake using alkanes as a marker (figure 2. $R^2=0.52$, p<0.05 and figure 3. $R^2=0.96$, p<0.01). More importantly, the weighting procedure used in this study did not improve the accuracy of the prediction of feed intake.
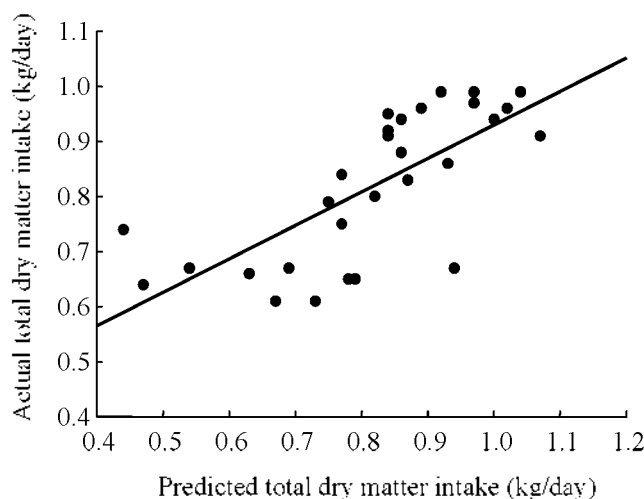

Figure 2. The relationship between actual total dry matter intake and the intake estimated using n-alkanes as a marker of fallow deer fed diets mixed with different proportions of luceme chaff (Y=0.32+0.61X. $R^2=0.52$. p<0.05)
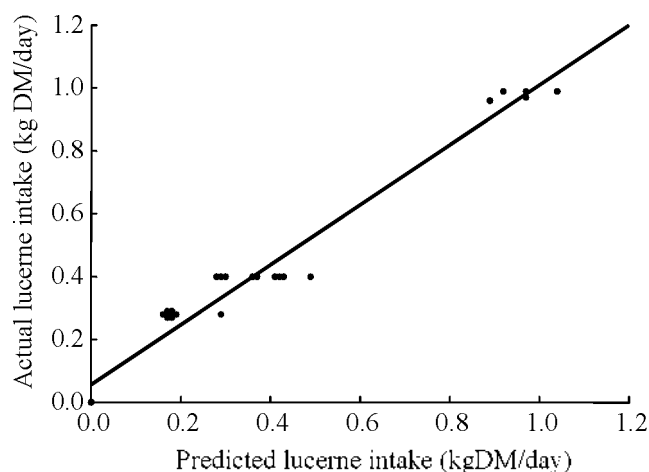
Figure 3. The relationship between actual lucerne intake and the lucerne intake predicted using n-alkanes as a marker of fallow deer fed diets mixed with different proportions of lucerne chaff (Y=0.06+0.95X, R^2=0.96, p<0.01)

Table 1. The faecal recovery of alkanes in plant materials by fallow deer

Alkanes	Means (n=6)	SE
C25	0.427	0.031
C27	0.625	0.026
C28	0.817	0.085
C29	0.845	0.024
C31	0.822	0.038
C33	0.886	0.030

SE=standard error.

Table 2. Actual feed intake and estimated intake using the alkane technique over 5 days for deer of 8 months of age

Composition	Mean intake (kg DM/day)	SE
Predicted intake without weighting		
Other feed	0.464	0.058
Lucerne	0.354	0.058
Total	0.818	0.030
Predicted intake with weighting		
Other feed	0.483	0.062
Lucerne	0.342	0.060
Total	0.825	0.031
Actually measured feed intake		
Other feed	0.425	0.054
Lucerne	0.394	0.057
Total	0.819	0.025

SE=standard error, DM=dry matter.

DISCUSSION

This research has demonstrated that n-alkanes can be used as a marker to estimate feed intake of deer. The commercial alkane capsules designed for sheep are suitable for deer, although deer showed different rates of release of alkanes (C32 and C36) when compared with sheep as suggested in the user instruction by Captec Pty Ltd. Nevertheless, the excretion pattern of alkanes are similar for deer and sheep, indicated by the stable concentration over day 7-19 after dosing. This suggests that the faecal samples need to be taken regularly during this period for estimation of intake. Deer are more difficult to handle than sheep and it is suggested faecal samples be taken 3-4 times during this period to provide a minimum amount of dry material for chemical analyses.

It should be noted that deer excrete only 40 mg C32 and 37 mg C36 alkanes daily, which is significantly lower than the values recommended by the capsule manufacturer for sheep (50 mg/day for both C32 and C36 alkanes). This discrepancy may be associated with difference in metabolism between the animal species. However, the result is similar to that reported by Dove et al. (1991) where the alkane release rates in sheep were 40.06 mg/day and 41.77 mg/day for C28 and C32, respectively. In practice, these values should be used to estimate daily faeces output of deer instead of the recommended values reported by the capsule manufacturer.

Alkanes cannot be fully recovered in the faeces although the recovery rate of natural alkanes increases with the increase in carbon-chain length, as found in sheep. The actual values of faecal recoveries of alkanes are within the range reported by Dove and Olivan (1998) and Mayes et al. (1988) for sheep. The values reported by Dove and Olivan (1998) and Mayes et al. (1988) are higher than values derived from the current research except for C28. The discrepancy between experiments is also apparent in comparison to reports by Dove and Coombe (1992). For example, the recovery of alkane C33 was similar (0.872 vs 0.886), but the recovery for alkane C29 was higher in the current study (0.765 vs 0.845). However, it has been proven that the faecal recovery of natural alkanes is not associated with diet composition (Dove and Coombe, 1992; Dove and Olivan, 1998). Therefore the average recovery of different diets for individual natural alkanes obtained from this experiment can be used to adjust the estimation of feed intake of grazing fallow deer.

The intake of lucerne and other feed components in the mixed diets predicted using alkane method was positively related to the actual intake, indicating a great potential of using the alkane technique for measuring feed intake of individual fallow deer under grazing conditions. However, the weighting system tested in this experiment did not improve the accuracy of feed intake prediction. Further research is required to resolve the weighting system for alkanes where there are different concentrations in the

pasture or faeces .

In summary, n-alkanes have potential for estimating feed intake of grazing deer. The commercial alkane capsules can be directly used for this purpose given the daily output of C32 and C36 is accurately measured. It is important that faecal recoveries of natural alkanes are used to adjust the predicted intake assuming that dietary composition has little effect on the recovery of alkane. If this assumption is not valid, the measurement of feed intake of deer using n-alkane will be impossible due to the difficulty of obtaining the recoveries of alkanes for different types of diets.

ACKNOWLEDGMENTS

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