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Differences between domestic herbivores species in alkane faecal recoveries and the accuracy of subsequent estimates of diet composition

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ABSTRACT

This study aimed to evaluate effects of animal species on faecal recovery of *n*-alkane markers. In addition, impacts of using different sets of alkane faecal recoveries on diet composition estimates was assessed. Six mature crossbred mares (383 ± 59 kg live weight (LW)), six adult cows (500 ± 72 kg LW) of Asturiana de los Valles breed, eight Cashmere does (29 ± 5 kg LW) and eight crossbreed ewes (30 ± 5 kg LW) were used. Animals were housed in individual stalls and randomly assigned to one of two diets composed of herbage (D1) or herbage plus heather (D2) (3 animals per diet in the equine and cattle groups and 4 animals per diet in the goat and sheep groups). Diet composition was estimated from alkane concentrations (*i.e.*, C_{25}–C_{33}) in diets and faeces by least-squares procedures. Alkane faecal recovery (AFR) was incomplete and increased ($P<0.001$) linearly with carbon chain length in all animal species. Animal species had an effect on faecal recovery of all alkanes, with equines having the highest recovery and goats the lowest. Differences in AFR between equines and ruminant species were higher for the shorter chain alkanes and tended to decrease with increased of carbon chain length. Within ruminant species, cattle had, in general, the highest faecal recovery for all alkanes indicating a lower level of disappearance of these markers in the digestive tract of cattle. The AFR set used in diet composition calculations affected ($P<0.05$) the estimated proportions of all plant species in both diets. Utilization of uncorrected

Abbreviations: ADF, acid detergent fibre; AFR, alkane faecal recovery; CP, crude protein; DM, dry matter; DMDap, apparent DM digestibility; KSI, Kulcyznski similarity index; LW, live weight; NDF, neutral detergent fibre; PCA, principal components analysis.

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faecal alkane concentrations (AFR0) provided the poorest estimates of diet composition, and use of mean faecal recovery data of the dietary treatment (AFR1) yielded the most accurate. Results show that application of a general set of alkane faecal recoveries (AFR2) results in estimates of diet composition which distinguish less well between diet components with similar alkane profiles.

1. Introduction

The *n*-alkanes have been used as faecal markers to estimate diet composition of domestic herbivores by comparing the profile of these markers in the faeces with that of the vegetation components (*i.e.*, plant species, groups and/or plant parts) that may constitute the animals' diet. An assumption inherent in this procedure is that *n*-alkanes are fully recovered in faeces. However, previous studies in metabolic crates (Brosh et al., 2003; Dove and Mayes, 2005; Ferreira et al., 2005) clearly showed incomplete recovery of alkanes in faeces, with a curvilinear pattern between the carbon-chain length and faecal recovery, for all ruminant species. By contrast, faecal recovery of these markers in equines seems to be independent of the carbon-chain length (Ordakowski et al., 2001; Ferreira et al., 2007a), suggesting that *n*-alkanes, especially those with shorter carbon-chain length, behave differently in the gastrointestinal tract of ruminant and non-ruminant species. Although Dove and Mayes (1991) suggested that the alkane faecal recovery in sheep is generally higher and less variable than in cattle, the influence of animal species fed with the same diets on alkane faecal recovery has not been studied to date.

Another issue that might affect faecal alkane recovery is the composition of the diet. In general, it is assumed that faecal alkane recoveries do not differ among diets composed of different plant species, although Lin et al. (2007) observed differences in the faecal alkane recoveries in sheep fed *Elymus sibiricum*, *Leymus chinensis* or *Leymus dasystachys*. Contradictory results have been obtained on effects of diet composition on faecal recovery of these markers, probably because it depends on the plant species that comprise the diets (Oliván et al., 2007), or on other diet characteristics (*e.g.*, digestibility) as observed in previous studies with goats (Ferreira et al., 2005) and equines (Ferreira et al., 2007a). Furthermore, Elwert et al. (2006) were only able to identify numerical differences in faecal recoveries of major *n*-alkanes used for diet composition estimation. Similar results were obtained by Brosh et al. (2003) in goats, cows and calves.

The present work was designed to study effects of animal species (*i.e.*, cattle, sheep, goats and equines) and its interaction with two diets on faecal alkane recoveries. Additionally, the use of different data sets of faecal alkane recovery was evaluated in order to assess their impact on diet composition estimates under grazing conditions, where the calculation of alkane recovery data is difficult to accomplish.

2. Materials and methods

2.1. Experimental site and design

This study was conducted at the Carbayal Research Station, which is situated at 900–1000 m above sea level, at San Isidro's Mountain, Illano, Asturias, Spain (longitude 6°53′W, latitude 43°21′N), where the vegetation consists of a mosaic of heathlands interspersed with areas of improved pastures dominated by perennial ryegrass (*Lolium perenne* L.) and white clover (*Trifolium repens* L.). The natural vegetation consists mainly of short heathers (*Erica umbellata* L., *Erica cinerea* L. and *Calluna vulgaris* (L.) Hull), tall heathers (*Erica australis* L. and *Erica arborea* L.) and gorse (*Ulex gallii* Planchon), a thorny and woody legume.

The experiment (11 days) took place in the beginning (May) of the grazing and vegetation growth season of 2006, and consisted of a 7 day period for adaptation of the animals to diets and experimental conditions followed by 4 days of collection of samples of faeces, herbage and heather for alkane analysis. During the study, daily total faecal output was recorded by individual animals. For total faecal