N-Alkanes: A technique to measure herbage intake in dairy cows

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Background

- Herbage intake influences animal performance at grass
- Sward cutting used to estimate herd intake
  - Poor estimation of individual animal intake
- n-alkane method developed and modified
  - Mayes et al., 1986
  - Dillon and Stakelum, 1989

Introduction

- What are n-alkanes?
  - Long-chain (C_{25} to C_{35}) hydrocarbons
  - Present in cuticular wax of plants
  - In grass odd-numbered chain lengths (C29, C31 and C33) predominate over even-numbered chain lengths
  - Used as fecal markers to estimate herbage intake
  - Incomplete recovery of alkanes in feces
  - Adjacent chain lengths have similar recoveries

Concentration of n-alkanes in cuticular wax of some temperate pasture species

	C_{27}	C_{28}	C_{29}	C_{30}	C_{31}	C_{32}	C_{33}	C_{35}
L. Perenne	19	5	73	9	137	9	116	18
L. Multiflorum	105	8	260	11	250	4	43	0
D. Glomerata	20	2	38	2	58	2	21	0
T. Repens	38	7	109	5	67	1	7	0

(Source: *Dove and Mayes, 1996*)

- This is a review of a number of studies
- Odd-number alkanes predominate
- Species differences in pattern of alkane concentrations

Method Outline

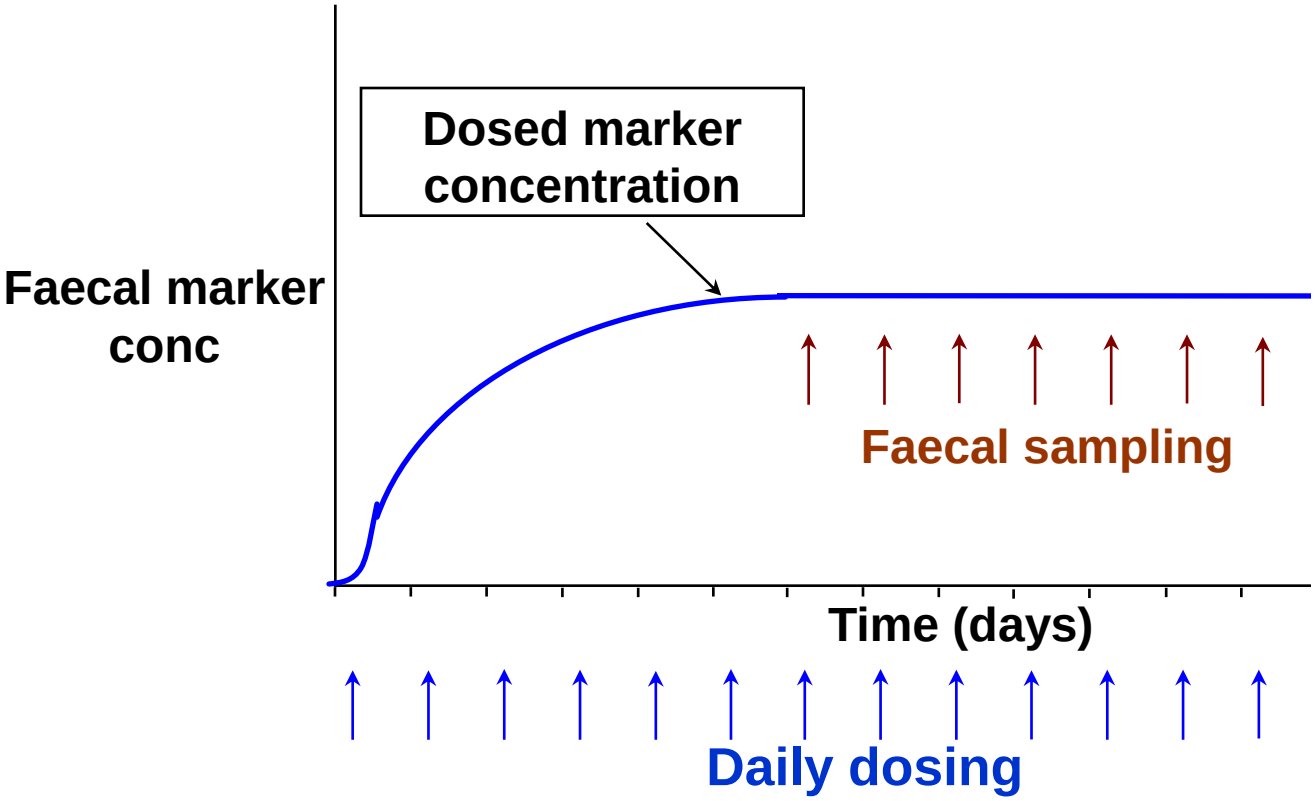
- Method of Mayes et al., (1986), modified by Dillon and Stakelum (1989)
  - Animal dosed with synthetic even-numbered alkane
  - Offered herbage which has been sampled and contains naturally occurring odd-numbered alkane
  - Herbage intake is calculated from the alkane dose, alkane content in the herbage and the ratio of the dosed and natural alkanes in the feces

Procedure

- Cow dosed twice daily (am and pm)
- For 12 consecutive days
- With paper pellet containing 500 mg of dotriacontane (C_{32}-alkane)
- Faecal samples collected from d 6 to d 12
  - In both morning and evening
  - In field – collect sample when voided
  - In holding yard – rectal grab samples
  - Stored at -20 C
- Faecal sample preparation
  - Thawed
  - Bulked by cow (10g/cow per d)
  - Dried at 40 C for 48 hrs
  - Milled through a 1-mm screen
  - Analysed for C_{32} and C_{33}

Measuring faecal output

- Dose with a known amount of alkane not in the feed (C_{32})
- Ensure stable excretion in the feces



Procedure

- Herbage representative of what cows graze
  - sampled from each paddock on days 5 to 11
  - sample at similar time each day
  - Two samples of 25 individual snips are taken from the grazing area (depending on paddock size)
  - Stored at -20 C
- Sample preparation
  - Bowl-chopped
  - Freeze-dried
  - Milled and analysed for C_{33}

Intake calculation

- N-alkane analysis to determine the ratio of C_{33} (tritriacontane) concentration in herbage and faeces

$$\text{Grass DMI (kg)} = \frac{F_i / F_j \times (D_j)}{H_i - (F_i / F_j \times H_j)}$$

F_i and H_i are concentration of natural odd-chain n-alkane in faeces and pasture (mg kg^{-1} of DM)

F_j and H_j concentration of even-chain n-alkane in faeces and pasture (mg kg^{-1} of DM)

D_j dose rate of even-chain n-alkane (mg d^{-1})

Comparison to other methods

- Herbage removed R^2= 0.85

  (McEvoy et al., 2007)

- Better than herbage removed or energy calculations

  (Smit et al., 2005)

- Time consuming & delay for results
- Cost

Benefits of n-alkane technique

- Provides estimates of individual animal intake
- Method can accommodate feeding of supplements
- Can estimate diet composition
  - Plant species
  - Plant cultivars
  - Plant parts
  - Plant communities
- Single analytical process

(Dove and Mayes, 1996)

Sources of error

- Diurnal pattern of n-alkane excretion
  - Dosing twice daily to reduce variation in feces
  - 6-day dosing pattern stabilises excretion
- Herbage sampling
  - Animal selection
  - Plant species
- Animal consumption of synthetic alkane
  - Dose in paper pellet
  - Offered in concentrate
- Sample preparation
  - Drying method unlikely to affect n-alkane in herbage (Dove and Mayes 1991)
  - Drying method may affect n-alkane in feces

Conclusions

- Minimise sources of error throughout procedure
- Ensure accurate sampling of feces and herbage
- N-alkane technique provides an accurate method to estimate individual animal intakes at grass