177. Diurnal variation in urinary purine derivative excretion of dairy cows on different feeding patterns

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Diurnal variation may limit the use of the purine derivative (PD) technique for assessment of microbial protein yield. Other authors have found little diurnal variation in PD from ruminants on low planes of nutrition. Information from three change-over design experiments, with early-lactation dairy cows, was studied for evidence of diurnal variation in PD. In experiment 1, the proportion of dry-matter intake (DMI, mean = 18.8 kg/day) as forage was maintained at 0.4, whilst in the other experiments concentrate DMI was fixed at 10.4 and 6.1 kg/day, with *ad libitum* silage DMI averaging 9.7 and 9.4 kg/day. Concentrates were fed in equal proportion at 09.00 h, 12.30 h and 17.30 h for experiment 1, and 05.30 h and 14.30 h for experiments 2 and 3. Spot urine samples were taken from each cow at approximately 10.30 h and 15.00 h over a period of at least 2 consecutive days. Urinary allantoin, uric acid (collectively PD) and creatinine were measured by high performance liquid chromatography. Diurnal variation was assessed as the morning divided by the afternoon value for PD:creatinine ratio. Significant effects ($P < 0.05$) of diet were seen only in experiment 3, where four widely different silages were offered. The effect of period was significant ($P < 0.05$) for experiments 2 (0.83, 0.76, 0.83 (s.e.d. 0.019)) and 3 (1.02, 1.05, 0.91 (s.e.d. 0.042)), in which the forage:concentrate ratio varied with period. The largest differences between morning and afternoon values were seen in experiment 2, and this may reflect the large concentrate meals. Further work is needed to investigate diurnal variation in PD excretion and its relationship with the level and type of feeding.

178. Supplementation of barley straw with starch: effect on microbial protein supply estimated from purine derivative excretion of sheep

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Supplementation of roughages with starchy cereals is common commercial practice. However, information as to microbial protein (MN) yield is limited, particularly with *ad libitum* feeding. In this experiment, MN supply from supplementation of straw with starch was estimated from the urinary excretion of purine derivatives (PD). The PD excretion model measures MN arriving at the abomasum and thus the 'supply' available to the host animal. Six rumen cannulated sheep of 42 to 48 kg were each offered *ad libitum* each of three diets based on barley straw with 0, 80 or 170 g/kg maize/barley starch plus 50, 90 and 130 g/kg molasses respectively (and 20 g/kg fish meal plus 2 g/kg urea) as two 3×3 Latin squares. Periods were 21 days with excreta collection in the last 7. Intake of digestible organic matter (DOM) increased with starch inclusion as 360, 710, 1021 (s.e.d. 59) g DOM per day. Total PD excretion was 7.0, 12.3 and 21.1 (s.e.d. 0.92) mmol/day, and calculated MN supply as 5.7, 10.5 and 18.2 (s.e.d. 0.84) g/day. Diet did not affect the efficiency of MN supply as 25.1, 22.9 and 27.5 (s.e.d. 2.2) g/kg DOM apparently digested in the rumen (DOMR = 0.65 DOM). Rumen liquid and DM outflow rates from the rumen concentration-time dilution curves of pulse dosed polyethylene glycol and Cr-mordanted straw respectively were 0.047, 0.054 and 0.073 (s.e.d. 0.0074) and 0.078, 0.105 and 0.130 (s.e.d. 0.0083) volumes per h. That efficiency of MN supply was not affected is contrary to our experience of changing outflow by giving the same diet at different intakes. Therefore with starchy diets some factor may offset improvements in efficiency of ruminal MN 'yield' even though outflow rate is increased. The practical implication is that

with roughage/concentrate diets within the range used here, total MN 'supply' to the animal is defined by DOM intake.

179. Effect of diets differing in the ratio of molassed sugar-beet feed to barley and yeast culture on growth and rumen metabolism of sheep

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The effect of diets differing on carbohydrate and yeast culture inclusion was investigated using Suffolk cross lambs, 8 months old, initial weight 36 (s.e. 1.5) kg. The diets, which consisted of pelleted molassed sugar-beet feed (Trident Feeds Ltd), rolled barley and soya-bean meal in the following proportions (fresh weight (FW) basis) either A, 770:170:60 or B, 470:470:60 g/kg were each fed *ad libitum* to 14 lambs for 7 weeks; within each diet 2 g/day Yea-sacc (Alltech Inc) was offered to seven lambs. All lambs were offered an additional 100 g FW hay per day. Yea-sacc had no significant effect on any measurement. Lambs given diet B consumed more dry matter (DM) (0.95 v. 1.23 (s.e.d. 0.042) kg/day, A v. B, ($P < 0.01$), grew faster (0.11 v. 0.24 (s.e.d. 0.015) kg/day, A v. B, ($P < 0.01$) and had higher food conversion efficiencies (0.11 v. 0.20 (s.e.d. 0.013), A v. B, ($P < 0.01$)). Despite lower DM intakes, sheep fed diet A had higher rumen volatile fatty acid concentrations 3 h after feeding (155 v. 125 (s.e.d. 7.0) mmol/l, A v. B, ($P < 0.01$)). *In vitro* gas production from diets A and B, measured using the Menke system with rumen fluid taken 17 h after feeding was faster (46.5 v. 41.5 (s.e.d. 3.04) ml/6 h per 200 mg DM ($P < 0.05$) for rumen fluid from sheep fed diet A; however, more gas was produced (75.5 v. 38.8 (s.e.d. 9.96) ml/24 h, A v. B, ($P < 0.001$)) when rumen fluid from sheep fed diet A was incubated without substrate. In addition, diet A absorbed greater quantities of water *in vitro* (4.6 v. 3.3 (s.e.d. 0.05) ml/g, A v. B, ($P < 0.001$)). Therefore the lower DM intakes for sheep fed diet A may be caused by physical factors contributing to an apparent reduction in the *in vivo* but not *in vitro* fermentation of the diet by rumen microflora.

180. Effect of sward height on rumen degradation in Merino grazing sheep

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The study was carried out on a continuously stocked pasture in August 1992. Pastures were maintained at sward heights of 4 cm (low: LSH) and 6 cm (high: HSH), which had a mass of herbage dry matter (DM) of 633 and 1397 kg/ha, respectively. Three rumen-cannulated Merino ewes were allocated to each of the paddocks (LSH and HSH). After a preliminary period (10 days) samples of the grazed herbage (obtained using three oesophageal-fistulated ewes), grass hay and filter paper were incubated into nylon bags in the rumen of each sheep for 3, 6, 12, 24, 48, 72 and 96 h. Data from DM disappearance were fitted to the model $y = a + b(1 - e^{-cy})$. Rumen fluid was sampled for 2 days at the incubation time (11.00 h) and 3, 6 and 12 h afterwards and pH was determined. HSH grazing sheep presented higher ($P < 0.05$) rumen pH values than LSH grazing sheep at 14.00 h (6.91 v. 6.55) and at 17.00 h (6.97 v. 6.63), but there was no difference at the other sampling times. The mean value of herbage and hay DM

disappearance for all the considered times was higher ($P < 0.01$) in HSH grazing sheep (78.2 v. 75.1 and 52.2 v. 50.2 for herbage and hay, respectively). However, there were no differences ($P > 0.05$) either in the rate of degradation (*c* value) of herbage (0.1142 v. 0.1161 for HSH and LSH respectively) and hay (0.0325 v. 0.0354) or in the filter paper disappearance at the considered times. These data suggest that the sward height did not affect either the quality of the grazed herbage or the rumen microbial activity.

181. The effect of reduced protein supply on energy and nitrogen metabolism in early lactation cows

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During early lactation, milk yield increases faster than food intake and the cow mobilizes body fat in addition to some body protein. This study was undertaken to determine the effect of reducing absorbed protein supply on body energy and nitrogen (N) mobilization in cows. Measurements were conducted weekly from week 1 to 8 of lactation, using open-circuit indirect respiration calorimetry. Two groups of 10 Holstein-Friesian cows were fed hay, maize pellets and concentrates (barley, maize, wheat and soya) in equal ratios to meet energy requirements (both groups) and either 1.0 (control, C) or 0.7 (treatment, T) of estimated absorbed protein requirements. At all times C cows ate more food with increased intakes of metabolizable energy (193.7 (s.e. 2.87) v. 158.9 (s.e. 2.72) MJ/day, $P < 0.01$) resulting in increased outputs of milk energy (99.2 (s.e. 1.20) v. 77.2 (s.e. 1.59) MJ/day, $P < 0.01$). All cows lost body energy throughout the experiment ranging from 60 MJ/day (week 1) to 19 MJ/day (week 8) and no differences due to treatment were observed (C 31.9 (s.e. 2.82); T 26.7 (s.e. 3.10) MJ/day). N digestibility was unaffected by treatment (C 0.62; T 0.60) but digestible N intakes were higher on C (274.1 (s.e. 5.53) v. 191.7 (s.e. 3.59) g/day, $P < 0.01$) resulting in increased milk N (C 175.4 (s.e. 2.12); T 136.5 (s.e. 2.82) g/day, $P < 0.01$) and milk protein (C 1053.1 (s.e. 15.42); T 839.2 (s.e. 16.49) g/day) output but no change in milk protein content. Control cows lost body N in week 1 (19.2 g/day) but then showed net gains upon 23 g/day (mean 15.0 g/day). In contrast T cows showed a large loss of body N in week 1 (53.0 g/day) followed by small positive retentions (4.5 g/day). The efficiency of energy utilization for lactation (kl) was unaffected by treatment (mean 0.60) but appeared to decline with advancing lactation (0.63 to 0.58) as more of the available energy was supplied from the diet than from tissue mobilization. It is concluded that reducing protein supply to early lactation cows whilst maintaining energy intake did not stimulate increased body N mobilization. Consequently, milk yield was compromised and this was further exacerbated by a substantial reduction in voluntary food intake.

182. The fate of low molecular weight polyphenolics in the rumen of sheep

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Polyphenolics, or tannins, in fodder plants have been implicated in the poor performance of ruminants in the tropics. However, little is known about the mechanisms whereby individual compounds exert their negative effect. The fate of rutin (a monomeric unit of condensed tannins) and gallic acid (a monomeric unit of hydrolysable tannin) when exposed to rumen microbes was

examined *in vitro* (RUSITEC), *in sacco* and *in vivo*. With 600 mg rutin per day infused into a 1 l RUSITEC vessel, at steady state, 0.975 (s.e. 0.005) of rutin disappeared. Loss was due both to binding to food particles (0.258 (s.e. 0.023)) and to microbial degradation (0.713 (s.e. 0.018)). With infusion of a similar rate of gallic acid, a lower proportion appeared to bind to food particles (0.045 (s.e. 0.005)) with higher microbial degradation (0.905 (s.e. 0.025)). Incubation, in polyester bags, or ornamental chestnut leaves containing 15 g rutin per kg dry matter (DM) indicated that rutin in plant tissue had a similar fate to the pure compound. After 36 h, 0.227 (s.e. 0.031) DM and 0.943 (s.e. 0.024) rutin had disappeared from the leaves. Rapid disappearance was also observed *in vivo*: a single intraruminal administration of rutin (200 mg) had a half life of 0.35 (s.e. 0.05) h, while even after 10 days continuous feeding of gallic acid (51 g/kg diet DM), no gallic acid was detectable in rumen or duodenal contents. The results suggest that these low molecular weight phenolics, although present in fodder leaves, are unlikely to contribute to the negative effects on animal performance, although the possibility of a negative effect on the rumen digestion of fibre still needs to be examined.

183. Effect of level of available carbohydrate offered as a supplement to a forage-based diet on milk yield and milk composition

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The effects of providing varying levels of available carbohydrate to supplement the diet of Holstein dairy cows fed a forage mixture of 40 g/kg urea-treated whole crop wheat (UWCW) and grass silage (GS) were investigated. Forty cows were fed UWCW and GS in the ratio 40:60 (dry matter (DM) basis) *ad libitum* supplemented with one of four test diets which differed in the amount of readily available carbohydrate supplied to rumen micro-organisms. The test diets were 7 kg/day unmolassed sugar-beet feed (diet 1), 4 kg/day sodium hydroxide-treated wheat and 3 kg/day rolled wheat (diet 2), 3.5 kg/day rolled and 3.5 kg/day ground wheat (diet 3) and 4 kg/day ground wheat and 3 kg/day molasses (diet 4). In addition each cow received 3 kg/day of a protein, oil, mineral/vitamin supplement. The diets were formulated to be isoenergetic and isonitrogenous. During a 13-week study the milk yields were 25.1, 27.6, 27.2 and 25.7 (s.e.d. 1.18) kg/day for diets 1 to 4 respectively. The corresponding non-protein nitrogen contents were 0.034, 0.034, 0.036 and 0.031 (s.e.d. 0.0015). There were no other significant differences between treatments in milk quality or yield of milk components. Forage intakes were 9.9, 10.1, 9.1 and 10.1 (s.e.d. 0.38) kg DM per day and concentrate intakes were 6.8, 7.9, 8.2 and 7.2 (s.e.d. 0.16) kg DM per day on diets 1 to 4 respectively. In this study increasing the levels of readily available carbohydrate in the diet appeared to improve the function of rumen micro-organisms in terms of the efficiency of milk production.

184. The intake and digestion of high and low digestibility ryegrass hays by South American camelids and sheep

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Two ryegrass hays of high (A) and low (B) nutritive value were used to determine if South American camelids (llama × guanaco) differ from sheep in terms of voluntary intake and digestibility. The diets were fed *ad libitum* to six animals of each species for two periods of 22 days in a cross-over design. Voluntary dry matter