Why does energy partitioning in ruminants differ on isoenergetic herbage or concentrate rations?

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Ruminants fed herbage diets may store as fat a lower proportion of the energy ingested compared to their counterparts fed concentrate diets (1). No mechanism or metabolic process has been identified as responsible for these differences in partitioning energy and the critical level of concentrate to promote this partitioning change is not known. Studies to-date have compared 100% forage diets with diets containing greater than 50% concentrate, whereas in this study a range of concentrates lower than 50% was used.

Twenty one Merino wethers (41 ± 3.3 kg) were offered one of four diets: forage:oat grain ratio 100:0, 83:17, 66:34 or 50:50 with added urea and minerals. The metabolisable energy intake of all animals was matched to be 90% of the average ad libitum intake of the animals fed 100% forage. Following an acclimatisation period sheep were housed in metabolism crates and offered feed in equal portions at 3 h intervals for 10 days of a nutrient balance study. The rations were formulated to maintain a ratio of crude protein (g) to net energy (MJ) available for tissue gain (excluding requirements for maintenance and wool growth) of 2.94 (2).

Ration composition	Liveweight gain (g/d)[1]	nonglucogenic VFA: glucogenic VFA ratio[1]	Plasma α-amino nitrogen (mg/L)[1]	CH_4 (l/d)[1,2]
100 % forage	47 ± 37	4.57 ± 0.160 [a]	26.8 ± 0.63	29. 1± 2.27
83 % forage	24 ± 34	4.01 ± 0.179 [a]	26.3 ± 0.63	26.1 ± 2.54
66 % forage	80 ± 63	4.73 ± 0.240 [a]	28.1 ± 0.85	27.8 ± 3.21
50 % forage	92 ± 37	2.97 ± 0.179 [b]	28.6 ± 0.63	22.8 ± 2.27

[1]mean ±sem [2] using SF_6 as a marker [a]different superscripts within a column denote statistical differences ($P<0.05$)

Increasing the grain content of the ration tended to increase daily liveweight gain. Only the 50% grain diet resulted in a decrease in the ratio of nonglucogenic to glucogenic VFA in rumen contents ($P<0.001$). The ratio of nonglucogenic VFA was 35% lower in the 50% forage diet than the 100% forage diet, comparable with the 40% decrease in methane production. Plasma α-amino nitrogen tended to increase ($P=0.056$) when the grain content was greater than 34%.

Our findings confirm those of Weston and Margan and suggest that the causal mechanism in changing partitioning involves shifts in VFA proportions and in methane production. However the change in methane production is greater than is predicted by commonly accepted prediction equations. This together with the change in VFA composition may explain the changes in body composition.

1. Weston RH, Margan DE. The contribution of protein to energy storage in sheep in relation to diet type. In:Aguilera JF, ed. Energy metabolism of farm animals. Proceedings of the 13th Symposium Spain. 1994:253-57.
2. Freer M, Moore AD, Donnelly, JR. GRAZPLAN: Decision support systems for Australian grazing enterprises-II. The animal biology model for feed intake, production and reproduction and the Grazfeed DSS. Ag Sys 1997;54:77-126.