

# DIET SHIFTS PROVOKE COMPLEX AND VARIABLE CHANGES IN THE METABOLIC NETWORKS OF THE RUMINAL MICROBIOME

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## ABSTRACT

Grazing mammals rely on their ruminal microbial symbionts to convert plant structural biomass into metabolites they can assimilate. To explore how this complex metabolic system adapts to the host animal's diet, we inferred a microbiome-level metabolic network from shotgun metagenomic data. Using comparative genomics, we then linked this microbial network to that of the host animal using a set of interface metabolites likely to be transferred to the host. When the host sheep were fed a grain-based diet, the induced microbial metabolic network showed several critical differences from those seen on the evolved forage-based diet. Grain-based (e.g., concentrate) diets tend to be dominated by a smaller set of reactions that employ metabolites that are nearer in network space to the host's metabolism. In addition, these reactions are more central in the network and employ substrates with shorter carbon backbones. Despite this apparent lower complexity, the concentrate-associated metabolic networks are actually more dissimilar from each other than are those of forage-fed animals. Because the both groups of animals were initially fed on a forage diet, we propose that the diet switch drove the appearance of number of different microbial networks, including a degenerate network characterized by an inefficient use of dietary nutrients.