

Understanding rumen microbial growth effectiveness to improve digestive efficiency of ruminants

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Ruminant animals, such as sheep, cattle and goats, are important livestock animals and acquire much of their protein from microbes growing in the rumen. These microbes do not use all energy for growth, but probably direct some energy towards storage (glycogen synthesis), maintenance, and production of heat alone (energy spilling). Whereas stored energy (glycogen) can be used later for growth, energy directed towards maintenance and spilling cannot. Energy spilling and maintenance thus depress efficiency of microbial growth, decrease microbial protein available to the ruminant, and cause need for more protein to be fed to ruminants. Although glycogen synthesis, maintenance, and energy spilling have been measured using pure cultures of bacteria, they have not been simultaneously measured in mixed rumen microbes. The purpose of this study was to measure how much energy mixed rumen microbes direct towards glycogen synthesis, maintenance, and energy spilling. Washed suspensions of mixed microbes were prepared from rumen fluid of a dairy cow. Microbes were dosed with 20 mM glucose and aliquots of culture sampled at increments. Heat production (using a microcalorimeter), free glucose, cell glycogen, and cell protein, and fermentation acids were measured. Results showed that mixed rumen microbes initially direct energy entirely towards maintenance and glycogen synthesis, but, over time, they spilt progressively more energy. This shows that the growth efficiency of microbes is not perfectly efficient and if we can reduce the amount of energy spilled by mixed microbes, we would be able to improve the energy efficiency of ruminant livestock operations.