Determining maintenance energy requirements of rumen protozoa to improve ruminant livestock feed efficiency

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Ruminant livestock (cows, sheep, goats) are often fed excess amounts of protein due to difficulty in predicting the growth efficiency of microbes in the rumen, which produce over 50% of the protein digested by the animals. Rumen microbes do not grow with perfect efficiency; some energy is devoted to maintenance of cells (maintenance energy) and some is wasted (energy spilling). The goal of this study was to determine the maintenance energy of *Entodinium caudatum* to increase understanding of the growth efficiency of rumen protozoa, which make up 30 to 50% of the rumen microbial biomass. The maintenance requirements of rumen protozoa have not been studied, due in part to difficulty in culturing and separating the protozoa from feed particles and bacteria. *E. caudatum* was separated from culture by filtering under CO_2 through two nylon screens to first remove feed particles and then to separate protozoa from bacteria, a method which results in approximately 60% recovery of cell numbers, 80% viability, and contamination with bacteria of only 2.1% of total microbial protein. The heat production of these pure samples of *E. caudatum* was analyzed, with the goal of using the relationship between growth rate and heat production to predict maintenance energy, or heat production at growth rate 0/h. Heat production at growth rate 0.013/h was found to be 8.54 mW/ g protein at its maximum, less than one-fourth of the expected value. Because calorimeter sensitivity is low at this level of heat production and because heat production would be expected to further decrease at higher growth rates, current experiments are examining the heat production of mixed protozoa from the rumen to determine their endogenous metabolism as a close estimate of maintenance energy. Preliminary results indicate levels of heat production between 30 and 40 mW/ g protozoal protein for mixed rumen protozoa.