CHANGE IN PARTICLE SIZE DISTRIBUTION OF RUMEN DIGESTA WITH TIME AFTER FEEDING IN SHEEP GIVEN HAY ONCE DAILY

T. Ichinohe, T. Tamura, T. Ngwe, T. Morooka, M. Okubo and Y. Asahida

Department of Animal Science, Faculty of Agriculture,
Hokkaido University, Sapporo 060, Japan

Introduction

Particle size reduction of ingested roughage in the rumen associates closely with rumen degradation of roughage and passage of digesta through the rumen, and influences upon roughage digestibility,voluntary intake and ultimately the efficiency of feed utilization by ruminants. However, little is known of particle size reduction in various kind of roughages under different feeding conditions. There have been also few studies on the relationship between the process of particle size reduction and change in chemical or physical properties of rumen digesta. As a part of studies on particle size reduction, in this experiment, using rumen emptying technique, we determined the change in particle size distribution of rumen digesta with time after feeding in sheep given hay once daily.

Materials and Methods

Four castrated adult sheep (mean body weight 71 kg) fitted rumen cannula (75 mm o.d.) were used. Sheep were kept individual pens and fed 1.5 kg of long orchardgrass 2nd cut hay once daily at 10:00. The hay was all ingested in 3 hr. Water and mineral salt block were accessed freely. Total rumen digesta were removed via cannula once daily from each sheep at 3, 7, 11, 15, 19 and 24 hr after feeding. Representative sample were obtained after weighing and mixing whole digesta. The residual digesta were returned into the rumen. Sampling sequences were organized to allow a minimum of 3 days between subsequent sampling. Sample of digesta were used to determine dry matter content and particle size distribution. Particle size distribution was determined by wet sieving technique using 8 sieves (screen openings were 5600, 4750, 2360, 1180, 600, 300, 150 and 47 μm) and a sieve shaker (MRK-Retsch). Particle size distribution was described as percentage of dry matter retained on each of sieves to total sample dry matter. The fraction passed through the 47 μm screen was termed "soluble fraction".

Results and Discussion

Changes in dry weight of rumen digesta with time after feeding are showin in figure 1. The dry weight decreased from 1,672 g at 3 hr to 833 g at 24 hr after feeding. Figure 2 shows changes in particle size distribution of rumen digesta. Percentages of particle retained on 5600, 4750, 2360 and 1180 μm sieves decreased with time after feeding. Inversely, percentages of particle retained on 300, 150, 47 μm sieves and soluble fraction increased. In these changes of particle size distribution, the decrease of particle on 5600 μm sieve was especially remarkable (from 23.8% at 3 hr to 4.3% at 24 hr after feeding). The percentage of soluble fraction was higher than other particle fractions at each time. Moseley and Jones (1984) have examined the change in particle size distribution of rumen digesta in sheep given perennial ryegrass hay once daily, and found that the largest particle decreased with time after feeding. But at any time, the percentage of largest particle was higher than our result. In addition, the remarkable increase with time after feeding was found in the percentage of particle retained on 150 μm sieve, but very little change in the other fractions. The difference between particle size distribution obtained by Moseley and Jones (1984) and in our experiment may be mainly due to the different feeding level.

It has been found that particles greater than a certain size rarely pass through the rumen, and this has led to the idea of a critical particle size. Poppi et al. (1980) suggested that the critical particle size would be nearly 1000 μm. According to his suggestion, we grouped digesta particles into three fractions to simplify the interpretation of the change in particle size distribution in view of

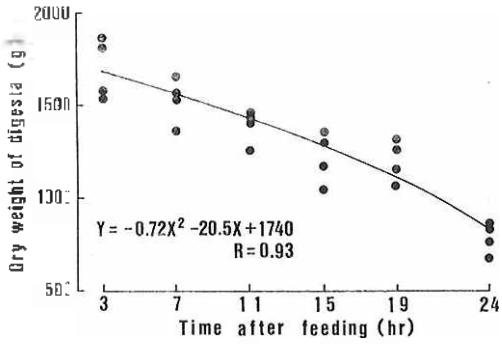

Figure 1. Changes in total dry weight of rumen digesta with time after feeding.

rumen dynamics. Three fractions were large particle fraction (retained on 5600, 4750, 2360 and 1180 μm sieves), small particle fraction (retained on 600, 300, 150 and 47 μm sieves) and soluble fraction. These changes in dry weight of each fraction with time after feeding are given in figure 3. Large particle fraction decreased with time after feeding. But there were no significant changes in small particle fraction and soluble fraction from 3 hr through 24 hr after feeding. This is consistent with the findings of Moseley and Jones (1984). Figure 3 suggests that the reduction rate of large particle was equal to the rate of small particle disappearance, which consists of passage and reduction. In addition, the reduction rate of small particle was also equal to the rate of soluble fraction disappearance, which consists of absorption and passage.

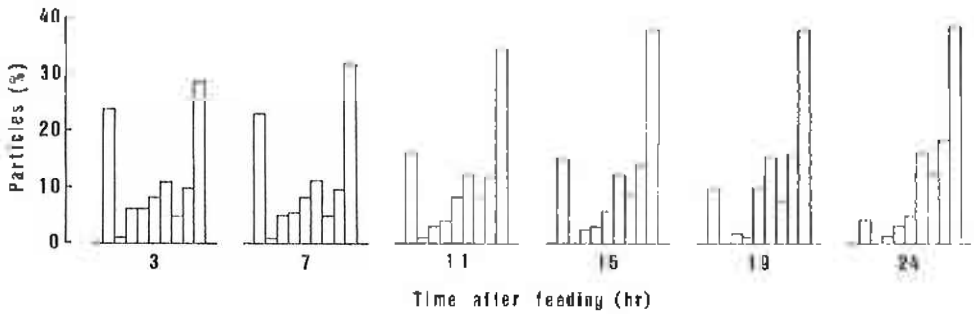

Figure 2. Changes in particle size distribution of rumen digesta with time after feeding.
Each of blocks arranged from left to right at time after feeding indicates particles retained on 5600, 4750, 2360, 1180, 600, 300, 150 and 47 μm sieves and soluble fraction.

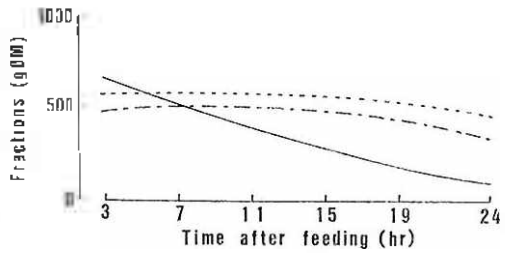

Figure 3. Changes in dry weight of large particle fraction (——: $Y = 0.63\ X^2 - 44.2\ X + 775$, $R = 0.94$), small particle fraction (- - - -: $Y = -0.53\ X^2 + 8.9\ X + 533$, $R = 0.46$) and soluble fraction (— · —: $Y = -0.81\ X^2 + 14.8\ X + 432$, $R = 0.61$) with time after feeding.

(Key Words: Particle Size Distribution, Roughage, Sheep)

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