

Age and the Effectiveness of Chewing During Eating in Holstein Cows

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Summary

Six lactating Holstein cows with ruminal cannulas were separated into age groups of 3, 4, and >5 yr old, to examine the potential effect of age on the effectiveness of chewing during eating. The first 15 boluses swallowed during a meal of high quality long alfalfa hay were collected from the cardia to determine their mean particle size and weight. The mean particle size of the swallowed boluses did not differ between age groups. As the meal progressed, the mean particle size of boluses decreased from 3.1 to 1.9 μm . The weight of the swallowed boluses was also unaffected by age. There did not appear to be any relationship between the weight of the swallowed bolus and the time it was collected or mean particle size. Over the normal productive lifespan of cows in the U.S., age does not appear to greatly affect the effectiveness of chewing.

Introduction

Lactating cows spend about 10 h per day chewing, although the time spent varies with diet (Woodford and Murphy, 1988). Chewing is accompanied by secretion of saliva which helps buffer ruminal fermentation and aids in the prevention of acidosis and other digestive disorders. This buffering enhances the stability of ruminal fermentation, which is needed to optimize dry matter intake, milk production, and milk composition. Chewing is responsible for most of the comminution required before digesta pass from the rumen (Reid *et al.*, 1979; and Murphy and Nicoletti, 1984). It also assists microbial breakdown by providing access to plant tissues and releases soluble plant substrates (Reid *et al.*, 1962).

Others (Silver, 1935; Gill *et al.*, 1966) have suggested that the effectiveness of chewing during eating and rumination may be compromised in older cattle. Matsi (1995) found that chews per minute of rumination were negatively correlated with the age (5 mo. to 8

yr.) of Holstein cattle. A reduction in chewing effectiveness could presumably affect voluntary feed intake and animal performance. It has also been reported that silage composition, feeding method, and long-term consumption (Rogers and Poole, 1987; and Smith *et al.*, 1992) may increase the incidence of dental erosion. Dental erosion can affect chewing and has been associated with lower voluntary feed intakes (Smith *et al.*, 1992). The latter is of particular importance since corn silage represents the dominant feedstuff offered over the normal production lifespan of most lactating dairy cows in the U.S.

By studying the bolus particle size and bolus weight of older and younger cows consuming the same forage, the potential effect of age on chewing during eating could be determined. Therefore, our objective was to examine the effect of age on the effectiveness of chewing during eating in Holstein cows.

Materials and Methods

Animals

Six ruminally cannulated lactating Holstein cows were separated by age into three groups to examine the potential effect of age on chewing during eating. The age groups used were 3, 4, and >5 yr.

Bolus collection

The first 15 boluses swallowed during a morning meal of good quality long alfalfa hay were collected from the cardia by hand as they entered partially emptied rumens, usually in a total of 10 to 15 min. Boluses were packaged individually, weighed, and frozen until thawed for particle size analysis using a method similar to that of Waldo *et al.* (1971). Boluses were rinsed with water through a nest of sieves with decreasing pore size (Woodford and Murphy, 1988) and the weight of the particles retained on each sieve was measured after drying at 55°C to constant weight.

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Calculations

Mean particle size (MPS) was estimated assuming a logarithmic normal distribution (Waldo *et al.*, 1971). This involved the estimation of standard normal deviates using the probit function of SAS (1985) which were then regressed on the logarithm (base 10) of the sieve pore size to determine mean particle size (probit = 5). Other factors being equal, more effective chewing should reduce the MPS of a bolus.

Statistical analysis

Treatment effects were tested by the General Linear Models procedure of SAS (1985) for a repeated measures design using cow (age) and cow x time (age), respectively, as error terms for age, and time and age x time. Differences between age groups were considered significant at $P < 0.05$.

Results and Discussion

From three to five years of age, a range encompassing the average age of most U.S. herds, there appeared to be little effect of age on the MPS of swallowed boluses during eating (Table 1). Although Matsui (1995) found that chews per minute of rumination were negatively correlated with age (5 mo. to 8 yr.); he also reported that the older cattle used in his study spent more time ruminating. These relationships suggest that the effectiveness of ruminative chewing may be maintained in older cattle by extension of total rumination time to offset reductions in the number of chews, assuming that the additional time is available.

Table 1. Effect of age on mean particle size and bolus weight.

Age	Particle size (μm)		Bolus weight (g)	
	Mean	SE	Mean	SE
3	2322.7	± 69.6	106.4	± 6.4
4	2396.9	± 60.0	89.2	± 4.6
>5	2375.9	± 183.3	83.9	± 6.6

Gill *et al.*, (1966) reported that the MPS of boluses swallowed by a cow during a meal tended to decrease with time spent eating. This was also apparent ($P < 0.05$) in our data (Figure 1) and suggests that, as a meal progresses, a cow allots more time for initial mastication. The weight of the swallowed boluses was unaffected by age and did not appear to be related to the time it was collected or MPS. In contrast, Gill *et al.*, (1966) reported that boluses collected at the beginning of a meal tended to be lighter than those collected later in a meal. The lack of agreement may be explained by the difference in the length of time allotted for bolus collection in the two studies.

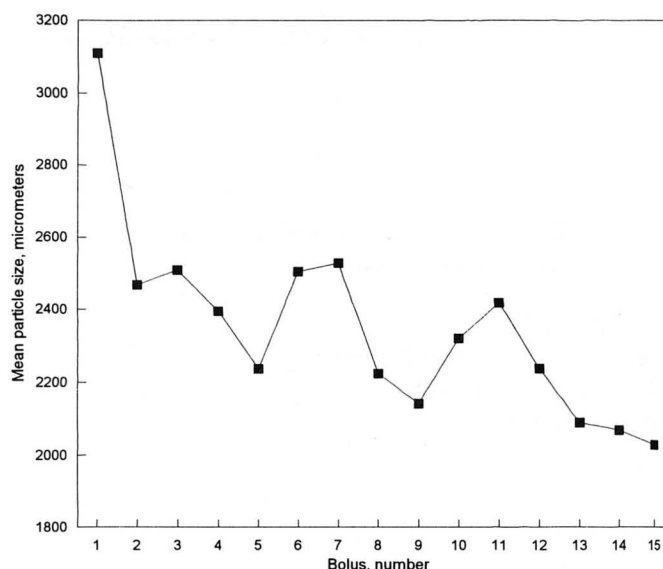


Figure 1. Effect of swallowed bolus number on mean particle size.

Silage consumption has been related to excessive dental erosion (Rogers and Poole, 1987; and Smith *et al.*, 1992), which could adversely affect chewing; however, the results of the present study suggest that the long-term consumption of corn silage (via. age) had minimal effects on chewing during eating. Other potentially confounding factors, such as time spent chewing or actual number of chews before swallowing an individual bolus, were not examined in this trial.

Conclusion

By studying older cows it could be determined whether or not the effectiveness of chewing during eating can limit voluntary feed intake under practical conditions; however, it is reassuring to note that over the normal productive lifespan of dairy cows in the U.S., age does not appear to greatly affect the effectiveness of chewing.

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