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## The effect of reducing particle size of wheat straw on feed intake, digestibility and energy requirement for chewing in cattle

### Partikelgröße von Weizenstroh und Futteraufnahme

It is well known that a reduction of particle size of roughage and straw increases feed intake and sometimes digestibility of the organic matter. Relatively little information is available about the time required for chewing and the energy requirement of the animal for this activity. Heat production caused by chewing reduces the amount of metabolizable energy available for maintenance and production. The aim of this study was to quantify the effect of reducing particle size of straw on feed intake, digestibility and heat production associated with chewing.

In trial 1, three adult Hinterwälder steers were fed unchopped straw (long) and chopped straw, having an average particle length of 10 mm. All animals received 400 g soybean meal per day and a supplement with minerals and vitamins. Faeces were collected quantitatively for 10 days to determine the digestibility of straw. Animals wore a halter attached with a small rubber balloon connected with a thin tube, in which air flow was detected. Each bite was recorded by a computer during 6 to 9 days.

In trial 2, four steers of the same breed were used to determine the effect of chewing activity on additional heat production. Oxygen consumption was measured in open circuit respiration chambers for 3 hours without feeding (period 1) and for additional 3 hours in which the animals had free access to wheat straw (period 2).

Chewing behavior was measured in the same manner as in trial 1. The measurements were repeated four times per animal.

The results of trial 1 are given in Table 1. Reduction of particle size increased dry matter intake by 0.6 kg per day and digestibility of organic matter by 5 percentage units. Therefore, intake of digested organic matter increased relatively to 25 %. Time spent for eating was 1 h 35 min shorter and for ruminating 46 min longer when fed chopped straw.

**Table 1.** The effect of particle size of wheat straw on feed intake, digestibility and time spent eating and ruminating of three oxen weighing 540 kg (trial 1)

Particle size	long	chopped
Dry matter intake of straw, kg/d	4.51 ± 0.47	5.14 ± 0.55
Digestibility of organic matter, %	52.3 ± 0.8	57.2 ± 3.3
Time spent eating, min/d	554 ± 87	459 ± 46
Time spent ruminating, min/d	404 ± 8	450 ± 31
Time spent chewing, min/d	958 ± 94	909 ± 54

In trial 2, animals showed a mean dry matter intake of straw of 3.4 ± 1.3 kg within 3 hours and an ingestion rate of 2.2 ± 0.6 kg dry matter per h eating. Heat production in the second period was 19 % higher than in the first one. Heat production associated with chewing related to time, body weight, or intake was 282 ± 135 J/s chewing, 26.5 ± 13.1 J/min/kg body weight, and 0.46 ± 0.16 MJ/kg dry matter intake. As time spent for ruminating was identical for both periods, the increased heat production exclusively occurred due to the eating activity.

In Table 2 the effects of the reduction of particle size are summarized and the relative changes are given. Increase of dry matter intake and metabolizable energy concentration are of similar magnitude. As energy re-

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quirement for ruminating amounts to only one third of that for eating (9 J/min/kg body weight; Ku-Vera et al. 1988, Dahm 1910, Pächter 1909), the reduction of the time spent eating leads to a decrease of energy required for chewing by 11 %. The reduction of particle size led to a 43 %-increase of metabolizable energy available for maintenance and production. In this study feed intake level was relatively low, therefore, the effect on the increase of the amount of metabolizable energy available for maintenance and production could be overestimated, if these results are applied to other situations. However, the results clearly show that the effect of reducing particle size on the amount of energy required for chewing is of significant importance, especially in animals fed low quality roughage.

**Table 2.** The effect of reduction particle size of straw on the amount of metabolizable energy (ME) available for maintenance and production in cattle

Particle size	long	chopped	relative change %
Dry matter intake, kg/d	4.51	5.14	+ 14
Intake of ME, MJ/d	32.0	40.3	+26
Energy required for chewing, MJ/d	9.9	8.8	- 11
in % of ME-intake	31	22	
ME available for maintenance and production, MJ/d	22.1	31.5	+ 43

## References

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 Ku-Vera, JC, MacLeod, NA, Orskov ER (1988). *EAAP Publ No* 43:271-274  
 Pächter (1909), cit. by Dahm (1910).