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THE EFFECT OF BREWERS' GRAINS SILAGE SUPPLEMENTATION ON THE RUMEN FERMENTATION CHARACTERISTICS IN COWS

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Abstract

The aim of this paper was to evaluate the effect of a supplement of malt sprouts used as absorbent and silage preservative on the quality of fermentation process in silage made from wet, non-pressed brewer´s grains and their influence in feeding of cows on the rumen fermentation. Wet brewer´s grains (BG; 231.5 g.kg-1 dry matter) were ensiled in combination with dry malt sprouts and supplemented with mixture acids (4 Lt) to plastic bag (with average of press chamber 2.4 m= Rotopres technology). The nutritive value, sugar and starch content were determined in brewer´s grains alone or in silage. In silage with supplement of malt sprouts in ratio 88:12 (brewers' grains: malt sprouts) and a preservative (mixture organic acids) were determined products of fermentation. There found a good LA/VFA ratio, a low pH value (3.82-3.58) and high level of lactic acid (10.63-12.59 g/kg), a low acetic acid content (0.77-0.43 g/kg) in silage. The supplementation of absorbent resulted increasing of content DM in stored brewers' grains (about 32.30 g/kg), reduced escape of silage effluentts and inhibited formation of butyric and propionic acids. The results indicate that brewer´s grains are a suitable product for silage making with malt sprouts and supplemented with mixture acids can be expected the stability of aerobic deterioration. The results indicate that TMR with brewer´s grains silage applicated to dairy cows diet has a positive effect on the rumen fermentation in comparison with control group. In rumen fluid of experimental cow´s was determined high content of VFA (111.1 mmol/L), acetic acid (48.03%), propionic acid (23.51%), 28.51% of butyric acid and higher content of protozoa (266.5 ths./ml). The urea content was 5.24 mmol/L.
Keywords: cow (Bos taurus), brewer's grain, silage supplementation, fermentation

Introduction

Brewer's grains represent an important and qualitative protein fodder, whose chemical composition and digestibility were studied by numerous authors (*Amari and Purnomiadi*, 1996; *Lohnert et al*., 1996; *Daccord et al*., 1997; *Maertens and Salifou*, 1997; *Buchgraber and Resch*, 1997; *De Brabender et al*., 1999; *Wyss*, 1997). Brewer's grains have excellent dietary properties that relate primarily to the high content of B-group vitamins (*Spann*, 1993). Brewer's grains have typically a high nutritive value and a differential degradation of proteins in the rumen (*Costa et al.,* 1995; 1994). *Costa et al.* (1994) inform that 1 kg of brewer's grains dry matter contains 16.19% fibre, 38.63% BNLV, 48.60% NDF and 18.83% ADF.

Predominant carbohydrate components are glucose and maltose. The content of net energy ranges from 6.1-6.7 MJ NEL in 1 kg of dry matter (*Lohnert et al.,* 1996; *Spann*, 1993).

Moreover, the fresh brewer's grains have a relatively high organic matter digestibility, which ranges on average from 63-65% (*Lohnert et al.,* 1996; *Daccord et al*., 1997). Their effect being significantly lactigenous, brewer's grains included in the feed ration of dairy cows foster milk secretion. A specific feature of high-quality brewer's grains is their positive influence on the rumen environment in dairy cows and on the microbial activity, namely on the production of microbial protein. *Munger and Jans* (1997) reported that ensilaged brewer's grains represent a much convenient protein source especially in feed rations for dairy cows in lactation. *Daccord et al*. (1997) observed the rumen degradation of proteins from brewer's grains to be on average 65%. Similarly, *Costa et al*. (1995), *Pereira et al.* (1998) informed that brewer's grains are characterized by the rumen degradability of organic matter ranging from 54.43-81.39%. Both fresh and ensilaged brewer's grains included at higher doses tend to reduce the milk fat content. The brewer's grains are characteristic also by the fact that they get readily spoiled, namely the high content of N-substances is a frequent reason to microbial decomposition at a simultaneous formation of products incompatible with the safe use. As a rule, the fresh, non-conserved grains keep in a feedable condition up to max. 48 hours, after which time essential sensual, nutritive and namely microbial changes take place (*Gruber et al.*, 1997).

The work objective was to assess the effect of ensilaged brewer's grains used as a fodder in the feeding ration of dairy cows on selected indicators of rumen digestion.

Material and methods

The material used in the experiment for its high capacity of absorption was malt sprouts. The required ratio between the fresh brewer's grains and the malt sprouts (88%:12%) was calculated so that the resulting DM content would be at least 30%. Thus prepared silage matter was fed into the PE bag by a loader. The PE bag was filled by using a ROTO-PRESS bagging presser. The preservative was applied by means of three nozzles directly into the receiving bin on the screw feeder, where it was homogeneously worked into the ensilaged brewer's grains at high accuracy. The partly cooled brewer's grains were preserved by using a chemical preparation based on organic acids (formic acid 43.5%; propionic acid 9.0%; ammonium formiate 30.9%) at a total dose of 3 litres per ton of silage material. Upon the end of ensilaging, the bag was air-sealed.

After three months of storage, the feeding experiment with dairy cows was launched the length of which was three months. The first month was a preparatory period and the remaining two months served as a proper monitoring period. Dairy cows included in the experiment were of the combined type, with average live weight 600 kg and mean annual productivity 7 000 kg of milk.

The high-performance dairy cows in loose housing were divided into two groups of which the first one was control and the second one experimental (n= 67 heads). The cows were equably and continually allocated to groups on day 5-8 after calving so that identical pairs were formed in the two groups. The system was chosen for reasons of the long-term monitoring of a large number of cows in groups and for the need to assure functioning of the whole production process of milk extraction in the enterprise. Feeding rations in both groups of cows were nutrient-balanced for a productivity of 30 litres. Fodder was based on a mixed feed ration (TMR) with the representation of 1 kg standard prairie hay, 10 kg clover herbage, maize silage of higher DM content and energy concentrations of 17 kg in the control group and 16 kg in the experimental group. The feed ration was added 2 kg of AVENA protein concentrate (40% CP), 1 kg maize grains and 5 kg corn meals, malt sprouts and soya extracted meal at a dose of 1 kg in the control group and 0.5 kg in the experimental group. The experimental group of cows was given the silage of brewer's grains at 5 kg/head and day. Based on the metabolic test, the cows exhibited a lower rumen urea concentration in the course of the experiment. Therefore, the feed rations in both groups were added equal amounts of high-quality N-substances from the *SoyPass* feed supplement and rape seed cakes. The feeding rations were fed twice a day and pushed to the cows during the day. The dairy cows in both groups were observed for the effect of fed TMR on milk production, content of milk components and somatic cells, rumen function and general health condition. The *Hofírek et al*. (2002) milk production was monitored daily and recorded. The contents of milk components and somatic cells were assessed based on results from the monthly checks of productivity. The level of rumen fermentation that is a subject of this work was evaluated according to selected indicators of rumen fluid in cows from which it was sampled by the throat tube at all times within 4 hours after feeding. The first test was conducted at the beginning of the experimental period and the second one at the end of the experimental period. The rumen fluid was analyzed for the contents of individual volatile fatty acids, lactic acid, ammonia, pH and the count of infusoria by the method according to *Hofírek et al*. (2002). Sample preparation and analyses of rumen fluid (including the counting of infusoria numbers) were carried out according to a method described by *Hofírek and Dvorak* (2002). Numbers of infusoria were counted under a microscope using the Fuchs-Rosenthal chamber. The obtained values were compared with reference data (*Vrzgula et al.,* 1990).

Results and discussion

The results the effects of brewer's grains silage on some biochemical parameters of ruminal fermentation are presented in *Table 1* and *2*. These data indicate that the addition of brewer's grains silage resulted different effects of this product on the course of ruminal. The objective of examining the rumen fluid was to determine rumen characteristics in response to the feeding level and the diagnostics of infusoria as to their total counts and activity.

The rumen pH values during the first sampling were ca. 6.8 in both groups and their tendency was decreasing; however, the upper limit of the norm pH 7.0 was not achieved (*Vrzgula et al*., 1990). Differences in the pH values of rumen fluid sampled from experimental dairy cows were statistically insignificant. Rumen ammonia in the first sampling was low – 3.01 mmol/l in the control group while the experimental groups exhibited a value of 3.69 mmol/l. The addition of *SoyPass* preparation and rape seed cakes to the feeding ration resulted in normative values recorded in both groups – 6.75 mmol/l and 6.79 mmol/l in the control and experimental group, respectively (*Vrzgula et al.,* 1990). According to *Vrzgula et al*. (1990), *Bíres* (2000) and other authors the total content of volatile fatty acids in the rumen (VFA) and their percentage contents in rumen change in dependence on both the qualitative and quantitative composition of the diet. The majority of authors reported the values between 80 and 120 mmol/L of rumen fluid as a physiological reference range. The only acid remaining at normal in both groups for the entire experimental period was propionic acid. Acetic acid was maintained in both groups at a level of 48% for the entire period of study with the lower limit of the standard being 55%. Butyric acid was at a level of 29% in both groups for the whole period of study, which is more (*Vrzgula et al*., 1990) than the upper limit of the range (20%). The effect of brewerś grain silage on the average content of rumen infusoria is illustrated in *Table 1.* and *2*. Comparing the control against the experiment, the experimental group showed both a higher count and a greater mobility. As compared with controls, the increasing content of protozoa stimulated the metabolic activity of rumen infusoria. It should be said that a decrease in infusoria numbers results in a reduction of microbial protein synthesis. Protozoa are very sensitive above all to changes in pH of rumen fluid and for that reason a decrease of this parameter below the physiological limit causes their quick disappearance from the rumen environment. The total count of infusoria was lower in both groups and exhibited an increasing trend. These results corresponded with observations of other authors (*Gruber et al.,* 1997). In the second sampling, the experimental group appeared at a lower limit of the norm, i.e. 300 000 infusoria (*Vrzgula et al*., 1990).

Table 1. **Mean parameters of rumen fermentation process in dairy cows (control group, n= 6)**

Parameters	Control group	
	1. Taking	2. Taking
AA (% rel.)	47.55±1.26	47.76±0.76
PA (% rel.)	23.61±1.71	22.23±1.74
BA (% rel.)	28.83±0.98	29.02±1.55
∑ VFA (mmol/L)	106.33±2.01	108.30±2.79
NH_3 (mmol/L)	3.01±0.61	6.75±2.53
Infusoria (ths./mL)	1.83±0.45	2.17±0.41
Infusoria motion (ths./mL)	1.50±0.55	1.83±0.98
pH	6.75±0.24	6.53±0.15

Table 2. **Mean parameters of rumen fermentation process in dairy cows (experimental group, n= 6)**

Parameters	Experimental group	
	1. Taking	2. Taking
AA (% rel.)	47.69±1.81	48.37±2.49
PA (% rel.)	22.78±2.15	24.24±2.09
BA (% rel.)	29.53±0.98	27.39±1.24
∑ VFA (mmol/L)	112.03±3.24	110.13±4.62
NH_3 (mmol/L)	3.69±1.26	6.79±1.18
Infusoria (ths./mL)	2.33±0.52	3.00±0.89
Infusoria motion (ths./mL)	1.67±0.52	2.67±0.52
pH	6.80±0.35	6.75±0.24

Conclusions

The objective of the experiment was to study the effect of feeding ensilaged brewer's grains together with malt sprouts conserved by the chemical preservative on the level of rumen digestion in dairy cows. The silage of grains was stored in a PE bag and included in the TMR of cows. Experimental results and analyses showed that the process of fermentation and the quality of resulting silage were very good with the DM content being about 340 g/kg. Very high was also the stability of the resulting silage. Conclusions following from the commercial-scale trial conducted in the Podorlicko agricultural enterprise demonstrated that the silage of brewer's grains can be successfully fed to high-performance dairy cows as a substitute for qualitative proteins without any negative response to rumen fermentation. Daily records of milk production showed an average increase of productivity by 1.53 litres milk for the experimental period in cows of experimental group that were fed with TMR with the silage of brewer's grains and with the addition of malt sprouts.

Results from the analysis of rumen fluid indicators exhibited a beneficial influence of the feed ration with ensilaged brewer's grains on total counts and metabolic activity of infusoria in the rumen fluid of dairy cows in the experimental group. Although the experimental group exhibited higher values, the total count of infusoria was at the lower limit of the range.

The above results indicate that the silage made of fresh brewer's grains with an addition of malt sprouts can be successfully included in TMR fed to high-performance dairy cows. Apart from the favourable nutritive effect (especially as a source of qualitative feed protein), the silage affected also the palatability of the feeding ration. Inclusion of the silage prepared of fresh brewer's grains with malt sprouts in the TMR system has a significant influence on enhanced productivity and subsequently on improved economics of milk production.

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