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EFFECT OF BENTONITE IN PELLETED FEED FOR CALVES

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ABSTRACT

Numerous researching show that bentonite except of using as binding material which increases pellets durability, act as buffer, also has favorable effect on ruminal acetate to propionate ratio, on ammonium N utilization in rumen, efficiently adsorbs mycotoxins in feed. Using of bentonite in feed for all category of cattle, can be of particular importance for high-concentrate rations, rations with high content and surplus of rumen degradable protein, as in diets that include feeds with presence of mycotoxins. Considering results of previously studies, and nonexistence of exactly results concerning on effects of using bentonite in diets for calves, this experiment was conducted with objective to determine effects of using of bentonite in concentrate for calves, on production performances of calves 30-120 days old. Twenty male Holstein calves were assigned in two groups: control group, fed feed without bentonite, and experimental group fed feed with added 1.5 % of bentonite. Mixture contained 18 % of CP, and in addition to feed, calves were fed high-quality alfalfa hay ad libitum. Experimental group show higher average daily gain (1.084 and 0.972 kg/day), higher average intake of feed (1.89 and 1.81 kg/day), better feed conversion (1.74 and 1.86 kg/kg of gain), and higher values of ruminal pH at age 80. and 120. day. In diets for calves with ad libitum intake of feed, it can be recommended using of bentonite for improvement of production performances.
Key words: *bentonite, feed, calves, nutrition*

INTRODUCTION

Bentonite is colloid clay of volcanic origin, and it is hydrated aluminum-silicate (montmorilonite) that contains sodium and calcium as changeable ion. Sodium-bentonite characterized distinct ability for hydration when increases mass and volume. Bentonite as binding material increases pellet durability and quality (*Stojanović et al. 2008*). In mixtures for animal nutrition, bentonite is used in proportion of 1-2 % (*Salari et al. 2006*). In water suspension particles of bentonite are charged with negative electricity, and this causes cation attracting (*Bringe and Schultz,* 1969). Using of bentonite in diets for rams in portion of 2 %, increased N retention, especially in condition of increased releasing of NH_3 in rumen (*Martin et al. 1969*). Authors emphasized the significance of

bentonite as binding material for pelleting of mixtures for animal nutrition. Cows fed high-concentrate ration (75:25 % of feed to hay ratio, DM basis) with mixture contained bentonite, showed increased ruminal concentration of acetate, decreased ruminal concentration of propionate, and higher concentration of acetate in blood serum (*Rindsig et al. 1969*). There were no decreasing of DM intake, characteristic for using $NaHCO_3$ and MgO. *Erdman* (*1988*) determined favorable effect of using bentonite in feed for lactating cows fed diets with high content of pelleted feed. Using bentonite in diet for lactating cows increased daily milk yield, increased concentration of ruminal acetate and decreased concentration of propionate, decreased lowering of ruminal pH, and had no effect on DM intake, that is usually for using other buffers. Using bentonite in rations for dairy cows results in slowing of ruminal digesta passage (*Rindsig et al. 1969*). The same assumption presented *Bringe and Schultz* (1969) for lactating cows fed high-concentrate diets, using fact that bentonite absorbs water and increases volume by 10-15 times, and in that way increases volume of ruminal content, reducing rate of ruminal passage. *Pasha et al.* (*2008*) reported that using bentonite in feed (0.5-1 %) affected longer retention time of feed in broiler digestive tract, enabled longer effect of digestive enzymes and increased digestibility of nutrients.
Considering results of reviewed studies, and nonexistence of exactly results regarding to effects of using bentonite in diets for calves, experiment is conducted with objective to determine the effect of using bentonite in pelleted feed for calves on production performances of calves 30-120 days old.

MATERIALS AND METHODS

Researching was conducted on 20 male Holstein calves on one of farms of dairy cows, of "PKB-Poljoprivredna Korporacija Beograd", in November/January period 2008/09. Selected 20 male calves at age of 30 days were assigned in two groups (experimental and control group), equalized for average BW, and housed in group-stalls (10 calves) with litter in closed-type object for calves rearing. Beside the liquid part of diet (scheme of liquid nutrition is presented in table 1) calves were fed pelleted feed contained 18 % of CP (composition of mixture is given in table 2) and high-quality alfalfa hay.

Table 1. Scheme of liquid nutrition of calves

Age, days	Fullfat milk	Milk replacer
5-29	6.0	-
30-39	3.0	3.0
40-69	-	6.0
70-80	-	3.0

Table 2. Feed composition

Component	Control group without bentonite	Experimental group with bentonite
Corn, ground grain, %	34.30	34.30
Barley, ground grain, %	10.00	10.00
Soybean, extruded, %	22.50	22.50
Sunflower mill, 33% CP, %	10.50	10.50
Wheat middlings, %	16.50	15.00
Dehydrated alfalfa, %	3.00	3.00
Limestone, %	1.20	1.20
Dicalcijum-phosphate, %	0.40	0.40
Salt, %	0.60	0.60
Vitamin and mineral premix, %	1.00	1.00
Bentonite, %	0.00	1.50
Totally	100.00	100.00

After age of 80. days, calves fed feed and alfalfa hay ad libitum. Control group fed feed without bentonite, while experimental group consumed mixture with 1.5 % of bentonite. Chemical composition of added bentonite is presented in table 4. Diameter of pellets was 4 mm. Calves consumed water ad libitum.

Table 3. Chemical composition of mixtures and feeds, %

Item	Feed without bentonite	Feed with added bentonite	Milk replacer	Alfalfa hay
Dry matter, %	88.71	88.87	96.12	87.46
Ash, %	3.96	5.13	10.70	10.14
Ether extract, %	5.42	5.36	16.11	1.35
Crude fiber, %	7.8	7.72	1.71	18.80
Crude protein, %	18.51	18.33	20.74	18.55
Calcium, %	0.72	0.74	1.03	1.42
Phosphor, %	0.60	0.58	0.89	0.22
NEL, MJ	6.86	6.78	10.09	3.96

Table 4. Chemical composition of bentonite

Component	Content, %
SiO_2	48.37
Al_2O	22.39
Fe_2O_3	4.73
CaO	5.86
MgO	1.81

Na_2O	0.07
K_2O	0.40
TiO_2	0.34
Particle size	< 50 μm

Body weights of calves were measured at the beginning of experimental period-30 days old, and at the end of period-120 days old. Amounts of consumed feed were recorded for complete groups, and whole experimental period, and average values for daily intake of feed were calculated. Ruminal pH was determined in samples of ruminal content obtained using stomach tube probe, and pH of blood was measured in samples obtained by punction *v. jugularis*, at age of 80 and 120 days. Determination of pH values of ruminal content and blood were done on five calves from each group.

RESULTS AND DISCUSSION

Determined production performances of calves were in appropriate with genotype, sex, age and diet composition (*Adamović et al. 2007., Radivojević et al. 2003., Grubić, 1995*). Results of analysis of average BW and average daily gain of calves (table 5) imply on favorable effects of using bentonite in feed for calves, in portion of 1.5 %. Although there were not statistical significant differences, between treatments, numerical differences were determined, and tendency for increasing of average daily gain and BW of calves, consumed mixture with added bentonite. Determined increasing of average daily gain for calves in experimental group was 11.52 %, compared with control group.

Table 5. Production performances of calves

Item	Control group without bentonite	Experimental group with added bentonite
Age at the beginning of experiment, days	30	37
Age at the end of experiment, days	126	122
Days in experiment	96	85
BW at the beginning of experiment, kg	54.55	54.05
BW at the end of experiment, kg	147.90	146.20
Total gain, kg	93.35	92.15
Daily gain, kg	0.972	1.084
Intake of feed, kg/day	1.81	1.89
Feed conversion ratio, kg of feed/kg of gain	1.86	1.74

It was found greater average daily intake of concentrate by 4.42 %, as better feed conversion by 6.45 %, for calves consumed experimental concentrate.

Table 6. Ruminal content and blood pH

Item	Control group without bentonite	Experimental group with added bentonite
Age at 80. day		
Rumen	6.28	6.54
Blood	7.40	7.45
Age at 120. day		
Rumen	6.14	6.39
Blood	7.40	7.49

Tendency for increasing of ruminal pH was found at age 80. and 120. day, for calves fed feed with added bentonite, even there were no statistical significant differences. Measured pH values were equal between groups. It was determined by organoleptic evaluation that pellets with added bentonite (1.5 %) characterized with shape that is more regular, were more compact and resistant on crumbling. These prevent losses of biologically active components added in concentrate in small quantity (vitamins and trace elements).

Results of this researching are appropriate with previously determined favorable effects of using bentonite in high-concentrate diets for cows (*Erdman, 1988., Bringe and Schultz,* 1969., *Rindsig et al. 1969*). Authors reported favorable effects of this buffer substance on ruminal pH and on increasing ruminal acetate to propionate ratio. This implies on positive effect of bentonite on maintaining optimal pH and preventing ruminal acidosis when high-concentrate diets characteristic for calves are fed. In addition, increasing of dietary DM intake and ruminal digestibility is provided, and stimulating of celulolitic processes in rumen increasing efficiency of fiber and DM utilization (*Stojanović et al. 2007*). Bentonite content in mixture (0.5-1 %) increases retention time of digesta in rumen and complete digestive tract, enables longer effect of ruminal microflora and digestive enzymes, and increasing digestibility of nutrients (*Pasha et al. 2008., Bringe and Schultz 1969*. Bentonite absorbs diluted NH_3, when ruminal concentration is high, and releases ammonia when concentration is low, enabling more efficient utilization of ammonia N for synthesis of microbial protein, in longer period. This decreases the peak of ruminal concentration of NH_3 and his absorption in blood, also decreases load of liver and using of energy for urea synthesis (*Martin et al. 1969*). It was determined that hydrated sodium-calcium-alumsilicates is characterized with high affinity for aflatoxin B_1 forming stable complex and decreases his inhibiting effect on animal growth. Bentonite binds up to 90 % of aflatoxin contained in feeds making unavailable for digestive tract (*Pasha et al. 2008*).

CONCLUSION

Results of this researching imply that using bentonite in proportion of 1.5 % in feed for calves at age 30-120 days, improved pellets quality, increased average daily gain, average feed intake, feed conversion ratio, and ruminal pH. In diets for calves, which

consume feed ad libitum can be recommended using of bentonite for increasing of production performances.

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