Effectiveness of using fermented probiotic supplement Cellobacterin+ on inclusion of flax and hemp cakes in ruminant diets

Darya Kislova 1*, Elena Sheida 1, and Olga Kvan 1

1 Russian Academy of Sciences, Federal Research Centre of Biological Systems and Agrotechnologies, 460000 Orenburg, Russia

Abstract. Cellobacterin+ is a feed additive with enzymatic activity containing a complex of natural live bacteria. It is a probiotic that improves fibre digestion, accelerates the maturation of rumen microflora and normalises the digestive system. The set task is achieved using a standard ruminant diet, in which traditional soya cake was replaced by linseed cake and hemp cake in equivalent amounts of 5% and 10% with the use of the enzymatic probiotic preparation “Cellobacterin+” in a dose of 10.0 g.

1 Introduction

Control sample I (standard diet for lactating goats) and four experimental samples were prepared for the first series of in vitro experiments of the study. The experimental samples consisted of standard ration, part of which was equivalently replaced by flaxseed cake in dosages II - 5% of NE, III - 10% of NE, IV - 5% of NE of ration + preparation “Cellobacterin+” (“BIOTROF”, St. Petersburg) in dosage of 10 g, V - 10% of NE of ration + preparation “Cellobacterin+” in dosage of 10 g.

For the second series of in vitro experiments of control sample I (standard ration for lactating goats) and four experimental samples were prepared. The experimental samples consisted of standard ration, part of which was equivalently replaced by hemp cake in dosages II - 5% of NE, III - 10% of NE, IV - 5% of NE of ration + preparation “Cellobacterin+” (“BIOTROF”, St. Petersburg) in dosage of 10 g, V - 10% of NE of ration + preparation “Cellobacterin+” in dosage of 10 g.

The level of volatile fatty acids (VFA) in the contents of the rumen was determined by gas chromatography with flame ionisation detection on a gas chromatograph “Crystallux 4000M”. Nitrogen forms were determined according to GOST 26180-84.

Numerical data were processed using the programme SPSS “Statistics 20” (“IBM”, USA), mean (M), standard deviations (±σ), standard deviation errors (±SE) were calculated. The non-parametric analysis method was used to compare the variants. Differences were considered statistically significant at p≤0.05, p≤0.01, p≤0.001.

* Corresponding author: kislova@gmail.com
1.1 Results of the first series of the pilot study

Digestibility of DM of the control sample was 64.5%. Additional inclusion of linseed cake in the volume of 5% and 10% decreased digestibility of digestible nutrients of experimental samples II by 0.6% and III by 1.1%, respectively, relative to the control (Fig. 1). Introduction of enzyme preparation "Cellobacterin +" increased digestibility of DM of samples with flaxseed cake by 0.9% in sample IV and by 0.3% in sample V in comparison with the standard diet (p ≤ 0.05).

Fig. 1. Digestibility of diet dry matter in rumen fluid with additional inclusion of flaxseed cake and enzyme preparation, %

During the in vitro studies it was found that the VFA level in the samples when flaxseed cake was included was different (Fig. 2). In the control group, a rather low total VFA level was observed; when 5% flaxseed cake was included, the total VFA level decreased by 9.9%, and when 10% was included, it increased, but not significantly (by 1.4%).

Note: * - P ≤ 0.05; ** - P ≤ 0.01, in comparison with control

Fig. 2. Concentration of volatile fatty acids in rumen fluid with additional inclusion of linseed cake and enzyme preparation, mg/dm$^3$
Administration of enzymatic probiotic to II and III samples increased the total VFA level by 34.6 % in IV sample relative to II and by 21.4 % in V relative to III (p≤0.05). Relative to the control group, the level of acetic acid was higher by 25.6 % (p≤0.05), propionic acid by 41.4 % (p≤0.01) and butyric acid by 14.8 % in group IV, acetic acid by 20.2 % (p≤0.05), propionic acid by 37 % (p≤0.01) and butyric acid by 11.3 % in group V. The levels of valerianic and caproic acids in groups IV and V were higher relative to both control and II and III samples.

The content of nitrogenous components of rumen fluid (RF) is one of the indicators of the degree of digestibility of feed nitrogen, as well as the general orientation of the processes of rumen digestion. It was noted that the level of total protein significantly decreased at the introduction of different dosages of flaxseed cake (Table 1). Thus, in sample II the total nitrogen level as well as its protein form were significantly lower than in the control sample by 39.1 % (p≤0.05) and 53.4 % (p≤0.01), respectively. In III sample, the level of total and protein nitrogen was lower than the control by 52.9 % (p≤0.05) and 53.4 % (p≤0.01), respectively. The use of Cellobacterin + increased the concentration of nitrogen metabolites in rumen contents. Inclusion of 5 % flaxseed cake and enzymatic probiotic increased the level of total nitrogen by 23.6 % (p≤0.05), protein nitrogen by 1.4 % and non-protein nitrogen by 76.8 % (p≤0.01). The use of enzyme preparation against the background of inclusion of flaxseed cake in the volume of 10 % contributed to a significant increase in the level of nitrogen metabolites in the rumen contents relative to the group containing flaxseed cake 10 % without enzyme, but these indicators were slightly lower relative to the control. The level of non-protein nitrogen in all experimental samples was higher than in the control.

Table 1. Content of nitrogenous fractions in rumen fluid with additional inclusion of flaxseed cake in different dosages, mg/%

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<th>no.</th>
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**Note:** *P≤0.05; **P≤0.01 in comparison with control*

1.2 Results of the second series of the pilot study
% when comparing group IV with group II, and by 2.1 % when comparing group V with group III. Relative to the control group, digestibility in experimental groups IV and V was slightly lower, by 0.2 % and 0.7 %, respectively (Figure 3).

Fig. 3. Digestibility of diet dry matter in rumen fluid with additional inclusion of hemp cake and enzyme treatment, %

The level of VFA when Cellobacterin+ enzyme preparation was included and replaced by 5 % was higher relative to the control group, thus, the concentration of acetic acid by 19.9 %, propionic acid by 44.0 % (p≤0.05), butyric acid by 29.1 % (p≤0.05), valerianic acid by 29.3 % (p≤0.05) and caproic acid by 26.7 % (p≤0.05) (Figure 4). No significant increase in VFA level was observed when replaced by 10% and enzyme treatment was included.

Note: * P≤0.05; ** P≤0.01, in comparison with control

Fig. 4. Concentration of volatile fatty acids in rumen fluid with additional inclusion of hemp cake and enzyme preparation, mg/dm³
The enzymatic probiotic preparation increased the level of protein nitrogen in rumen fluid (Table 2). Thus, in group IV this indicator increased by 8.5 % relative to group II, and in group V by 46.3 % relative to group III (p≤0.05). At the same time, the concentration of non-protein nitrogen decreased in these experimental groups, but relative to the control this parameter was higher by 51.6 % in group IV and by 37.9 % in group V (p≤0.01).

The concentration of total nitrogen in the rumen content using Cellobacterin+ was lower by 8.1 % in group IV and by 24.9 % in group V compared to the control. Also, it should be noted the decrease of this index in group IV relative to group II by 5.7 %, and on the contrary the increase in group V relative to group III by 24.8 % (p≤0.05).

The level of ammonia nitrogen in the experimental groups with the addition of enzymatic probiotic preparation increased relative to the control by 56 %, and the level of urea nitrogen when using hemp cake in the volume of 5 % decreased by 5.9 %, when using 10 % on the contrary increased by 4.4 % relative to the control group.

### Table 2

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<th>no.</th>
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Note: *P≤0.05; **P≤0.01 in comparison with control

2 Conclusions

Thus, the inclusion of the enzymatic probiotic preparation Cellobacterin + in the background of diets including 5 % and 10 % of industrial hemp waste (hemp cake) promoted an increase in digestibility of the dietary DM metabolites, VFA and nitrogen metabolites compared to diets without probiotic additives. The highest efficiency was shown by the group with replacement with hemp cake 5% and inclusion of enzymatic probiotic at a dosage of 10.0 g.

3 Acknowledgements

References


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