ARTICLE

EFFECT OF CONIFEROUS ADDITIVE ON PRODUCTIVE AND BIOLOGICAL PARAMETERS OF COWS

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ABSTRACT

The article presents the results of studying the effect of the coniferous energy additive on fodder palatability, milk yield and quality, and reproductive ability of cows. The experiment has been performed in the conditions of the Mikhailovskoye Federal State Unitary Enterprise in the Uzhur district of the Krasnoyarsk Krai and at the Krasnoyarsk State Agrarian University. The research has been aimed at studying the effect of the coniferous energy additive on the productive and biological parameters of cows. It has been found that the use of the coniferous energy feed additive in the diets has contributed to the better fodder palatability by the cows in experimental groups III and IV (the metabolic energy concentration has been 11.26 – 11.44 MJ/kg). The cows in the experimental groups have exceeded their peers in the reference group both in terms of the daily produced amount of milk (by 0.6 – 6.8 kg) and in general throughout the experiment (by 56 – 676 kg), P<0.05; P<0.01. The same cows also produced more milk fat and protein by 28.1 – 23.7 and 21.9 – 19.0 kg. The feed additive has contributed to the reduction of the duration of the service period and the conception rate.

KEY WORDS
coniferous energy additive, black-motley breed, hemoglobin, erythrocytes, conception rate, service period

INTRODUCTION

The constant growth of the prices of raw materials makes specialists search for the ways of reducing the cost of fodder, which, as known, accounts for 70 % in the structure of the livestock breeding product costs, and, despite the growth of productivity and the reduction of production costs in physical terms, remains high in monetary terms.

In the conditions of intensifying the livestock production, creating a strong and balanced fodder base plays a decisive role in the successful growth of production. A strong fodder base is determined by both the total fodder production and its quality. Both indicators equally determine the efficiency of dairy cattle breeding. In this respect, a necessity arises to search for and introduce new methods and techniques in the production of animal fodder. One of the ways of reducing the production costs in monetary terms is reducing the formulation costs through the use of various feed additives. The alternatives are nontraditional feed additives obtained from the timber processing wastes and byproducts (branches and treetops, bark, lily pads, chemical processing wastes) that contribute to normalizing the physiological processes, increasing the productivity, and preserving the livestock [1-3].

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In the Krasnoyarsk Krai, 50.5 % of the reserves of ripe and overripe siberian fir (*Abies sibirica*) suitable for use are located. The fir reserves amount to 1,296.6 million m3, or 9.3 % of the reserves of all wood species [4]. The composition of the natural coniferous extract is close to that of the natural cellular fluid in the needles, but the concentration of the water-soluble substances in it is lower. The composition of sugars in the coniferous extract is dominated by glucose, which accounts for almost 30 % of the total amount of monosaccharides. The content of mannose in the spruce water extract is 16 %, in the pine water extract — 9 %; the content of oligosaccharides is 13 – 15 %. The literature data indicate the presence of sucrose, melibiose, and a significant amount of maltose in the needles (up to 20 %). Among macroelements, nitrogen, phosphorus, potassium, iron, sodium are found, and among microelements, manganese, cobalt, copper, zinc are defined. The presence of these and other elements enhances the nutritional value of water extracts and activates physiological and biochemical processes in the body of animals [5, 6].

The employees of the Khiminvest Scientific-Technical Center LLC (Nizhny Novgorod) have developed a technology for processing the needles of coniferous wood species, which is based on extracting biologically active substances with the use of a new selective extractant. A coniferous energy feed additive with improved properties that ensure the long-term preservation of its consumer qualities has been created [7, 8].

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This research has been aimed at studying the effect of the coniferous energy additive (CEA) on the productive and biological parameters of cows in the conditions of the Krasnoyarsk Krai.

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MATERIALS AND METHODS

The studies for determining the effect of the CEA on milk productivity and reproductive ability were performed from September to December 2019, in the conditions of the Mikhailovskoye Federal State Unitary Enterprise in the Uzhur district of the Krasnoyarsk Krai and at the Department of Zootechnics and Cattle Breeding Products Processing of the Institute of Applied Biotechnology and Veterinary Medicine at the Krasnoyarsk State Agrarian University (the protocol was approved by the institute's council No. 2 dated October 24, 2019), with four groups of black-motley cows, 10 animals in each. Reference group I was formed from the cows that received the fodder of in-house production according to the detailed norms of the Federal Science Center for Animal Husbandry [9]. The cows in the experimental groups, in addition to the main diet, received the CEA as part of the concentrated fodder according to the following scheme [Table 1].

Table 1: The scheme of the scientific and practical experiment

Group	Feeding conditions	Studied indicators
Reference group I	Main diet (MD)	1 – Consumption of fodder and nutrients 2 – Milk productivity of the cows 3 – Reproductive ability
Experimental group II	MD + 100 g of the CEA	
Experimental group III	MD + 150 g of the CEA	
Experimental group IV	MD + 200 g of the CEA	

The experiment lasted for 130 days in the autumn-and-winter period. The cows were kept in the same conditions.

The coniferous energy feed additive was a uniform viscous pasty mass with a coniferous smell that contained 50 % of glycerol and 50 % of the product ecologically obtained from needles. In the organisms of newly-calved cows, glycerin is easily absorbed in the gastrointestinal tract and becomes a good material for the intermediate metabolism as a gluco-plastic component for glucose synthesis and providing energy for the animal. The phyto component, the needles, is the source of vitamins, amino acids, micro- and macro elements, and various biologically active substances with a positive effect on the organisms of calved cows [10].

Biometric processing of the results of the experiment was carried out using a personal computer in the Microsoft Excel program with the calculation of arithmetic mean values and corresponding errors (M ± m). The significance of the differences between the compared indicators in groups was assessed by the Student's t-test with the following significance levels: * - P <0.05; ** - P <0.01; *** - P <0.001 [11].

RESULTS AND DISCUSSION

Accounting for the fodder consumption allowed to determine the metabolic energy concentrations in the diets of the compared groups of cows; these concentrations did not differ significantly and amounted to 11.26 – 11.44 MJ per kilogram of dry weight. The sugar to protein ratio (0.90 – 0.95) and the calcium to phosphorus ratio (1.90:1.0, 1.98:1.0) corresponded to the physiological needs of the cows during the milking period.

Milk productivity and milk composition are determined by the genetic parameters and the feeding and keeping conditions. The authors studied the effect of the coniferous energy feed additive on milk productivity in the first 100 days of lactation [Table 2].

Table 2: Milk productivity of the cows over 100 days of lactation, kg

Indicator	Group			
	I	II	III	IV
Daily milk yield	20.6 ± 1.53	21.2 ± 1.69	27.4 ± 1.75**	26.4 ± 1.70*
Amount of milk	2,064 ± 68.4	2,120 ± 77.5	2,740 ± 65.9***	2,637 ± 86.5***
Mass fraction of fat, %	3.97 ± 0.04	3.99 ± 0.05	4.01 ± 0.05*	4.00 ± 0.05*
Mass fraction of protein, %	3.34 ± 0.05	3.28 ± 0.04	3.31 ± 0.05	3.33 ± 0.03
Amount of milk fat	81.94 ± 3.66	84.59 ± 3.99	109.87 ± 5.17***	105.47 ± 4.88***
Amount of milk protein	68.94 ± 3.45	69.54 ± 4.20	90.69 ± 5.42**	87.81 ± 4.59***

(Hereinafter, the significance of the difference is shown with respect to the same indicator of the compared control group: *P<0.05; **P<0.01; *** P<0.001)

The cows in the experimental groups were superior to their peers in the reference group both in terms of the daily produced amount of milk (by 0.6 – 6.8 kg) and in general throughout the experiment (by 56 – 676 kg), P<0.05; P<0.01. Over 100 days of lactation, the mass fraction of fat in the milk was also the highest in the cows in groups III and IV; it amounted to 4.01 % and 4.0 %, which was by 0.04 – 0.01 % higher than in their peers. The difference between the indicators of the groups was not reliable. The same cows also produced more milk fat and protein by 28.1 – 23.7 and 21.9 – 19.0 kg, P<0.01; P<0.001. Thus,

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introducing the coniferous energy feed additive in the amount of 150 g had the best effect on milk productivity.

No significant difference was found in terms of the main parameters of milk quality (fat and protein mass fractions, total protein, casein, whey proteins, and mineral substances) in the compared groups of cows [Table 3]. The organoleptic assessment of the milk also showed that the samples had no significant differences in their color, smell, texture, or taste.

Table 3: Milk composition and properties

Indicator	Group			
	I	II	III	IV
Mass fraction of fat, %	3.97 ± 0.05	3.99 ± 0.02	4.01 ± 0.05	4.0 ± 0.05
Mass fraction of total protein, %	3.34 ± 0.06	3.28 ± 0.05	3.31 ± 0.04	3.33 ± 0.03
Mass fraction of casein, %	2.65 ± 0.06	2.58 ± 0.07	2.60 ± 0.05	2.62 ± 0.08
Mass fraction of whey proteins, %	0.69 ± 0.03	0.70 ± 0.05	0.71 ± 0.04	0.71 ± 0.03
Mass fraction of lactose, %	4.72 ± 0.03	4.48 ± 0.04***	4.57 ± 0.03	4.75 ± 0.04**
Mass fraction of nonfat milk solids, %	9.08 ± 0.05	8.63 ± 0.06***	8.79 ± 0.04***	9.14 ± 0.04***
Mass fraction of dry matter, %	12.89 ± 0.19	12.46 ± 0.25	12.63 ± 0.21	12.98 ± 0.22
Mass fraction of minerals, %	0.72 ± 0.03	0.69 ± 0.04	0.70 ± 0.03	0.73 ± 0.03
Milk density, kg/m^3	1,030.1 ± 1.25	1,028.3 ± 1.22	1,028.9 ± 1.16	1,030.3 ± 1.23
Energy value, kcal	694.5 ± 4.3	680.2 ± 5.6	688.0 ± 4.7	695.3 ± 4.8

In terms of lactose, nonfat milk solids, and the mass fraction of dry matter in the milk, the cows in group IV insignificantly exceeded their peers by 0.64 – 6.03 % ($P<0.01$).

In studying the biological value of the milk, no significant difference was noted in terms of the amino acid composition. It was found that the milk of the cows that received the CEA with fodder was a biologically complete product suitable for industrial processing and human nutrition as whole milk.

Reproductive ability of the cows in the herd influences the duration of their practical use. With the degradation of the cows' calf-producing ability, the average interval between calvings usually increases and the duration of the cows' practical use decreases. Therefore, studying cows' reproductive ability in scientific and economic experiments is of great economic importance.

Table 4: Reproductive ability of the cows

Indicator	Group			
	I	II	III	IV
Conception rate	1.22 ± 0.17	1.15 ± 0.12	1.10 ± 0.15	1.13 ± 0.16
Duration of parturition, hour-min	3-25 ± 35.9	3-10 ± 28.7	3-00 ± 26.9	3-00 ± 30.1
Duration of afterbirth expulsion, hour-min	2-25 ± 29.5	2-30 ± 30.0	1-55 ± 29.9*	2-05 ± 30.2
Duration of the service period, days	99.0 ± 14.3	98.0 ± 9.8	94.0 ± 11.2	95.0 ± 15.1

The use of the CEA for feeding down-calvers helped enrich their organisms with a complex of vitamins, amino acids, micro- and macroelements, and various biologically active substances. Therefore, calving and afterbirth expulsion occurred faster in the cows in the experimental groups ($P>0.005$). The average value of the indicators showed increased reproductive ability, but was not statistically significant. For instance, parturition was 25 and 15 minutes longer in the cows in the reference group than in their peers. No afterbirth retention and other pathological deviations were observed during parturition. However, the best indicators were observed in the experimental groups; the difference was 5 to 30 minutes. Despite the assertion of many scientists [1, 12, 13] that high milk productivity of cows increases the service period and the conception rate, it was not confirmed in the studies of the authors.

CONCLUSION

The use of the coniferous energy feed additive in the diets has contributed to the better fodder palatability by the cows in experimental groups III and IV, which has had an effect on the metabolic energy concentration that has reached 11.26 – 11.44 MJ/kg. The coniferous energy feed additive has had a positive effect on milk productivity. The cows in the experimental groups were superior to their peers in the reference group both in terms of the daily produced amount of milk (by 0.6 – 6.8 kg) and in general throughout the experiment (by 56 – 676 kg), $P<0.05$; $P<0.01$. The coniferous energy feed additive helps reduce the duration of the service period and the conception rate, and normalizes the parturition activity.

CONFLICT OF INTEREST

The authors declare no competing interests in relation to the work.

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None.

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