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# The influence of non-traditional feed additives on the productivity of horses in Yakutia

A A Sidorov<sup>1</sup>, M F Grigorev<sup>1</sup>, A I Grigoreva<sup>2</sup> and A N Kyundyaytseva<sup>1</sup>

<sup>1</sup> Yakut State Agricultural Academy, 3, Sergelyakh street, Republic of Sakha (Yakutia), Yakutsk, 677007, Russian Federation

<sup>2</sup> North-Eastern Federal University named after M.K. Ammosov, 48, Kulakovskogo street, Republic of Sakha (Yakutia), Yakutsk, 677013, Russian Federation

E-mail: grig\_mf@mail.ru

**Abstract.** The article presents data from the results of a study to determine the effectiveness of using unconventional feed additives for horse productivity in Yakutia. To conduct scientific experiments, 3 groups of horses of the indigenous Yakut breed were formed, 12 animals each. In order to enrich animal diets by macro and microelements, as well as to increase horse productivity in winter, the effect of zeolite-sapropelic feed additives on milk production and physiological state of animals was studied. In the process of conducting research, the following methods were used: biochemical, physiological, biometric and economic research methods. As a result of the research, it was found that the use of feed additives in feeding horses contributed to an increase in the milk yield of the experimental groups of mares 10.42% and 14.89%. At the same time, annual milk yield increased by 10.43% and 14.98%. It was found that the feed additive contributed to the improvement of the qualitative composition of milk, so for fat by 0.15% and 0.16% and protein by 0.19% and 0.32%. A study of the physiological status of animals found that the feed additives affected the biochemical composition of blood. An increase of albumin by 5.95% and 9.52%, globulin - by 1.37% and 3.42%, hemoglobin - by 1.74% and 3.20% was found in animals consuming feed additives. Analysis of the economic efficiency of the use of zeolite-sapropel feed additives in feeding mares has shown that in the experimental groups consuming feed additives, the profitability was 27.34% and 32.33%. Studies have proved the perspective of the use of organic mineral feed additives in feeding horses in the conditions of Yakutia.

## 1. Introduction

The introduction of feed additives consisting of natural mineral compounds in the diet of animals, along with the provision of complete fodder, should be a comprehensive solution to the problem of mineral nutrition of animals (Baurhoo B., Ruiz-Feria CA, Zhao X., 2008; M.G. Gamidov, E.G. Bystrov, 2009; Ronquillo, MG, Hernandez, JCA, 2017) [1, 2, 3]. The horse's body actively responds to the use of biologically active compounds, the hemoglobin content in blood increases; the albumin fraction of protein and minerals increase in the blood serum (VV Kalashnikov, IF Draganov, VG Memedeykin, 2011) [4]. One of the ways to reduce stress is the use of feed additives and biologically active substances with adaptogenic effects (A. B. Andreeva, L. Yu. Karpenko, A. A. Bakhta, 2011) [5]. The growing zone and feed production technology have a big impact on the mineral content in plant feed. Therefore, minerals occupy an important place in animal nutrition. Their role in the body is diverse and great. Farm



animals often suffer from the lack of calcium, phosphorus, magnesium, sodium, sulfur, iron, copper, zinc, manganese, cobalt, iodine, selenium (N.A. Shareiko, N.A. Yatsko, I.Ya. Pakhomov, 2005) [6]. Therefore, the presence of macro and micro- elements in feed plays a large role in the balance of animal nutrition [7].

Zeolites in agriculture are used as fertilizers for plants and as feed additives for farm animals (I.Yu. Zhidik, MV Zabolotnykh, 2016) [8]. They affect the digestibility and metabolism of nutrients, increase productivity and improve animal health (A. M. Shadrin, V. A. Sinitsyn, 2008) [9]. Adding zeolite to the diet allows toxins, heavy metals, and radionuclides to be excreted from animals (Papaioannou D., et al., 2005) [10]. Zeolite reduces feed costs per unit of production, accelerates the gain in live weight (MG Savkova, SO Tsyrenov, LA Minina, 2010) [11].

On the territory of the Republic of Sakha (Yakutia) there is the Suntarskoe zeolite deposit, the reserve is estimated at 11.4 million tons. The zeolite of the Suntarskoye deposit includes: SiO<sub>2</sub> - 65.11%, Al<sub>2</sub>O<sub>3</sub> - 12.16%, Fe<sub>2</sub>O<sub>3</sub> - 1.08%, CaO - 2.62%, MgO - 1.88%, K<sub>2</sub>O + Na<sub>2</sub>O - 3.3%, TiO<sub>2</sub> - 0.13%, H<sub>2</sub>O + - 8.89%, H<sub>2</sub>O- - 4.26% and other trace elements - 0, 57% [7].

There is also information on testing the mineral mixture using zeolite as a component in feeding horses in Yakutia, so the addition to the daily diet contributed to an increase in live weight of young animals up to 17%. The use of feed additives contributed to filling the deficit in the diet of horses with sodium, phosphorus, iron, cobalt and iodine (RV Ivanov, 2004) [12]. Similar experiments were conducted at the FAA MO RF CSKA Moscow, the effect of natural clinoptilolite in feeding horses was studied, it was found that the additives contributed to the improvement of physiological parameters of animals (A.A. Zelenchenkova, R.V. Nekrasov, M.G. Chabaev, and others. , 2018) [13].

Researches by A.D. Shagivalieva (2001), on the influence of propolis, zeolites, biotrin, bifidumbacterin and their composition on their productivity and resistance of Bashkir mares found that the composition of feed additives improved immunity and intestinal microflora, increased levels of vitamins in milk, increased actual milk productivity, live weight and milk yield index of mares. So, the addition of zeolite increased milk productivity by 1.02; zeolite with propolis - by 1.13; bifidumbacterin + zeolites - by 1.08 times [14]. According to the abovementioned, the rational use of sapropele in feeding horses is 200 and 300 g per head per day. Supplements provide an increase in the average daily gain in live weight; improve digestibility; balance of nitrogen, calcium and phosphorus; help increase their productivity; improve blood biochemical parameters and reduce feed costs per increase unit.

In the literature we studied, there is insufficient information on the use of premixes, feed additives taking into account the mineral supply of the diets of milking mares.

The goal is to study the influence of zeolite-sapropele feed additives on milk productivity of Megegek breed mares in Yakutia:

- to study milk productivity when using feed additives in the feeding of mares;
- to determine morphobiochemical parameters of mares' blood when using feed additives;
- to determine the economic efficiency of feed additives for milking mares.

## 2. Material and methods of research

The studies were organized on mares of the Mezhezek breed, on the basis of the peasant farm "Eige" of the city of Yakutsk. For the experiments, experimental groups of mares were formed by the method of analogues, which took into account the indicators of age, live weight and physiological state of animals. The selected mares for the experiments were clinically healthy. The average live weight of the mares was 450 kg, the nutritional state is average. In scientific experience, the components of the feed additive in the indicated proportions were mixed and given together with the main diet. To prepare the feed additive, the components for the experimental group I were mixed: zeolite - 172 g (0.4 g / kg body weight) with 200 g of sapropele. For the second experimental group: zeolite - 215 g (0.5 g / kg live weight) was mixed with 300 g of sapropele. The conditions of the scientific experiment for all groups of mares were identical except for feed additives in the experimental groups. The ration for 1 head per day consisted of 15 kg of hay, 4 kg of concentrated feed (oats) and 40 g of common salt. The experimental

mares were near the stables. Daily rations took into account live weight and age of milking mares according to feeding standards (AP Kalashnikov, NI Kleimenov, VN Bakanov, 1985) [15]. To study the physiological state of experimental mares, the morphological parameters of blood were studied, 3 heads from each group. Morphobiochemical parameters of blood in the veterinary clinic "Darwin" and the Federal State Budget Scientific Institution of YANIISH according to generally accepted methods. Blood for analysis from experimental mares was taken in the morning before feeding. To account for the milk productivity of the mares, control milking was performed. For analysis of milk was taken from 3 animals from each group. Milk samples were taken in the middle of the experiment - the second month of lactation. Milk sampling in accordance with the methodology of GOST 26809.1-2014, and GOST 3622-68. Physico-chemical parameters of mare's milk were studied by the following methods: acidity according to GOST 3624-92; mass fraction of fat according to GOST 5867-90; mass fraction of protein and nitrogen according to GOST 25179-2014, and GOST 23327-98; density according to GOST 3625-84; mass fraction of dry skim milk residue in accordance with GOST R 54761-2011; determination of sugar according to GOST 3628-78; The chemical composition of the mare's milk was studied according to generally accepted methods in the laboratories of the Federal State Budget Educational Establishment of Higher Education Yakutsk State Agricultural Academy, the Federal State Budgetary Institution Yakutsk Scientific Research Institute of Agricultural Sciences and the State Public Institution Yarvil. The economic efficiency of the use of zeolite-sapropel feed additives definition is determined per 1 head. The experimental results were processed using standard methods of mathematical statistics [16].

### 3. Research results and discussion

According to the content of trace elements in plants of Central Yakutia, there is evidence: cereals contain iron 82 mg / kg, manganese 63 mg / kg, zinc 30.2 mg / kg, nickel 5.6 mg / kg, barium 25.4 mg / kg, strontium 26.2 mg / kg. In sedge - it contains iron 119 mg / kg, manganese 63 mg / kg, zinc 24.7 mg / kg, nickel 5.6 mg / kg, barium 49.3 mg / kg, strontium 54.8 mg / kg. In legumes - iron 67 mg / kg, manganese 30 mg / kg, zinc 32.9 mg / kg, nickel 6.8 mg / kg, barium 38.4 mg / kg, strontium 87.1 mg / kg. Forbs - iron 94 mg / kg, manganese 47 mg / kg, zinc 35.4 mg / kg, nickel 4.1 mg / kg, barium 31.6 mg / kg, strontium 64.0 mg / kg. In horsetail - iron 235 mg / kg, manganese 137 mg / kg, zinc 18.2 mg / kg, nickel 2.7, barium 32.7, strontium 50.3 mg / kg. In the humus horizon of soils in Central Yakutia, on average, iodine contains 0.51-12.14 mg / kg, manganese 126 mg / kg, zinc 10.2-83.5 mg / kg, nickel 2.6-62.1 mg / kg, barium 190 mg / kg, strontium 95-896 mg / kg (A.D. Egorov, D.V. Grigoryeva, T.T. Kuriluk, et al., 1970 N.N. Sazonov et al., 1973) [17, 18]. The diets of farm animals can have an imbalance in nutrient and mineral components due to the influence of climatic factors. In the conditions of Central Yakutia, to better provide dairy mares with macroelements especially calcium, phosphorus, magnesium, and iodine and microelements (iron, copper, zinc, cobalt and manganese), the use of local feed additives will allow to balance their diet to more fully realize their potential, which is of particular scientific and practical importance in the conditions of Central Yakutia.

When analyzing the dynamics of milk productivity of milking mares, it was found that the inclusion of zeolite-sapropel feed additives in the composition of the main diets had a positive effect on the productivity indicators of animals of the experimental groups (table 1).

**Table 1.** Dairy productivity of mares, (M ± m, n = 12).

Indicators	Rate	Mare Groups		
		Control	I experimental	II experimental
Average daily productivity of marketed milk, liter		4.03±0.13	4.45±0.15*	4.63±0.08***
Average productivity per experiment, liter		362.67±11.44	400.50±13.90*	417.00±7.46***
Mass fraction of fat, %	Not less than 1.0	1.03±0.00	1.18±0.02***	1.22±0.02***
Mass fraction of protein, %	Not less than 2.0	2.21±0.12	2.40±0.02	2.53±0.06*

Acidity °T	Not less than 6.0	5.70±0.28	5.80±0.29	5.80±0.31
Density, g/cm <sup>3</sup>	Not less than 1032	1.033±0.00	1.034±0.00	1.034±0.00
Dry skim milk solids %	8.5-10.7	8.84±0.09	8.92±0.06	9.03±0.06

Note: \*P>0.95 \*\*P>0.99 \*\*\*P>0.999

An analysis of the milk productivity of the mares found that the control group of animals yielded to experimental groups I and II 10.42% (P> 0.95) and 14.89% (P> 0.999) or 0.42 and 0.6 l, respectively, on average daily milk yield indicator. At the same time, the difference between the experimental groups in daily milk yield was 0.18 L or 4.04% in favor of the experimental group II. Milk productivity for 90 days of experiment was 362.67 L in the control group, which is 37.83 and 54.33 L or 10.43% (P> 0.95) and 14.98% (P> 0.999) compared with the experimental groups respectively. At the same time, II experimental group II possessed the highest indicators, which exceeded experimental group I by 16.5 liters or 4.12%. In terms of fat, the control group lost only 0.15% and 0.19% to the experimental groups. The difference of indicators is reliable P> 0.999. In terms of protein content, the control group was slightly inferior to the experimental groups - by 0.19% and 0.32% (P> 0.95). No significant difference in acidity and milk density between groups was found. When studying dry skim milk solids, the highest indicator was observed in experimental group II, which was 0.08% and 0.19% higher than in the control and I experimental groups.

Blood counts show the internal functioning of the body. Adaptive and productive qualities of animals are determined by the biochemical composition of the blood and the content of minerals. To study the physiological state of experimental mares, morphobiochemical parameters of blood were studied (table 2).

**Table 2.** Morphological and biochemical composition of blood of mares (M ± m, n = 3).

Indicator	Rate	Mares group		
		I - control	II - experimental	III - experimental
At the beginning of the experiment				
Total protein, g / l	55-73	74.67±3.18	73.67±2.96	75.67±2.91
Albumin, g / l	27-42	27.33±0.88	27.00±0.58	27.67±0.67
Globulin, g / l	21-38	47.33±2.40	46.67±2.40	48.00±2.31
Hemoglobin, g / l	110-170	113.33±7.22	112.33±8.69	114.33±7.75
White blood cells X10 <sup>9</sup> /л	5.2-13.9	8.82±0.42	8.85±0.53	8.81±0.43
Red blood cells X10 <sup>12</sup> /л	6.4-10.0	6.19±0.51	6.14±0.53	6.53±0.29
Phosphorus, mmol	0.7-1.4	1.01±0.00	1.01±0.01	1.01±0.00
Calcium, mmol /	2.65-3.25	2.74±0.19	2.68±0.20	2.83±0.11
At the end of the experiment				
Total protein, g / l	55-73	76.67±2.91	79.00±3.61	81.00±1.73
Albumin, g / l	27-42	28.00±0.58	29.67±1.86	30.67±0.88
Globulin, g / l	21-38	48.67±2.33	49.33±2.40	50.33±0.88
Hemoglobin, g / l	110-170	114.67±3.71	116.67±3.28	118.33±2.40
White blood cells, X10 <sup>9</sup> /л	5.2-13.9	9.83±0.04	8.40±0.10***	7.26±0.02***
Red blood cells, X10 <sup>12</sup> /л	6.4-10.0	6.54±0.25	8.29±0.60	8.71±0.91
Phosphorus, mmol	0.7-1.4	1.03±0.02	1.07±0.03	1.08±0.01
Calcium, mmol /	2.65-3.25	2.89±0.10	3.06±0.11	3.19±0.02*

Note: \*P>0.95 \*\*\*P>0.999

The study of the morphological and biochemical composition of the blood did not reveal deviations from physiological norms, which indicates the safety of the zeolite-sapropel feed additive. At the end of the experiment the mares of the control group yielded to II and III experimental groups 3.04% and 5.65% on the level of total protein in the blood serum indicator. An increase in the concentration of proteins in the blood of mares of the experimental groups is usually associated with a good state of metabolism.

The mares of the control group were 5.95% and 9.52% inferior to the experimental groups in albumin content. The level of globulin in the blood of animals of the control group was 48.67 g / l, which is 1.37% and 3.42% less in relation to the experimental groups. According to the hemoglobin content in the blood, the mares of the control group were inferior by 1.74% and 3.20% to the experimental groups of animals, respectively. By the content of white blood cells in blood, the mares of the control group exceeded the mares of the II and III experimental groups by 14.55% ( $P > 0.999$ ) and 26.11% ( $P > 0.999$ ), respectively. The red blood cells content in blood of mares of the control group was consequently 26.74% and 33.16% less than in blood of mares of the experimental groups. The increase in red blood cells in blood of experimental groups of mares is explained by the positive effect of the zeolite-sapropel feed supplement on their metabolism in the body. By the content of phosphorus and calcium in the blood serum, the control group of animals was inferior to the II and III experimental groups of mares by 3.55-4.52% and 6.00-10.62%, respectively. It was established that the zeolite-sapropel feed additive in the diet of milking mares in the conditions of Central Yakutia had a positive effect on the physiological parameters of their body.

The effectiveness of dairy horse breeding is determined by increasing the level of mare productivity, improving the quality of dairy products, reducing feed consumption and profitability of production, the main economic indicators are presented in table 3.

**Table 3.** Cost-effectiveness of using zeolite-sapropel feed additives in feeding milking mares (n = 12).

Indicators	Range unit	Группы		
		Control	I experimental	II experimental
Milk yield for experience	liter	362.6	400.5	417.0
Kumiss produced	liter	362.6	400.5	417.0
Production costs per head	Russian ruble	77953.9	78523.9	78778.9
Cost of 1 liter of kumiss	Russian ruble	250	250	250
Proceeds per head	Russian ruble	90500	100000	104250
Proceeds from entire livestock	Russian ruble	1086000	1200000	1251000
Profit	Russian ruble	12546.05	21476.05	25471.05
Profitability level	%	16.09	27.34	32.33

The economic effect of the use of zeolite-sapropel feed additives in experimental group I for the experimental group amounted to 1200 thousand rubles; for experimental group II, this figure was 1251 thousand rubles. Thus, the costs associated with the use of zeolite-sapropel feed additives in feeding milking mares are paying off by the cost of additional products. Consequently, the use of zeolite-sapropel feed additives in the feeding of milking mares of the Megegek breed is economically feasible.

The results of the studies on the effect of zeolite-sapropel feed additives on the milk productivity of mares allow to draw the following conclusions. The use of zeolite-sapropel feed additives in feeding contributed to an increase in the average daily milk yield of the experimental groups of mares by 0.42 and 0.6 L or 10.42% ( $P > 0.95$ ) and 14.89% ( $P > 0.999$ ). The difference between the experimental groups in daily milk yield was 0.18 L or 4.04% in favor of experimental group II. During the experiment, the actual milk yield increased by 37.83 and 54.33 liters, or 10.43% ( $P > 0.95$ ) and 14.98% ( $P > 0.999$ ). Mares from experimental group II, which exceeded experimental group I by 16.5 liters or 4.12%, had high rates. The additive contributed to a change in the qualitative composition of milk, for fat - by 0.15% and 0.16% ( $P > 0.999$ ); protein - by 0.19% and 0.32% ( $P > 0.95$ ).

Feeding zeolite-sapropel feed additives to milking mares affected the blood state. There was an increase in albumin by 5.95% and 9.52%, globulin by 1.37% and 3.42%, hemoglobin by 1.74% and 3.20%. Moreover, all blood counts of experimental mares were within the physiological norms. The economic efficiency of the use of zeolite-sapropel feed additives contributed to an increase in the milk

production of mares by 10.43% and 14.98% with a profitability of 27.34% and 32.33%. The results of production testing have shown the practical feasibility and economic efficiency of the use of zeolite-sapropelic feed additives to milking mares of the Mezhege breed. Thus, in the process of research, the maximum milk productivity of mares was established when feeding in their diet a combination of Suntar zeolite 0.5 g per kg of live weight with 300 g sapropel, providing the productivity increase, improving the quality of milk obtained.

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