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Research Article

DIGESTIBILITY AND METABOLISM OF YAKUT HORSES IN FEEDING THEM WITH SET FODDER ADDITIVES FROM NATURAL RAW MATERIALS IN EXTREME CLIMATIC CONDITIONS OF THE REPUBLIC OF SAKHA (YAKUTIA)

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ABSTRACT. The article presents the research on the effect of the set fodder additives from the local natural raw materials on the indices of the digestibility of nutrients, nitrogen, calcium and phosphorus absorption, the dynamics of body weight and the physiology of young horses of the Yakut breed in the conditions of the Republic of Sakha Yakutia. To determine the developed formula of the set fodder additives from the local raw materials: sapropel from a local lake and coniferous flour according to cropping periods, Hongurin's zeolite, natural Kempendyai salt, a scientific and economic experiment has been carried out on young Yakut horses' breed of the indigenous type in the conditions of Central Yakutia. The feeding conditions for all animals of the experimental groups have been the same. But the animals in the control groups have been also fed with the set fodder additives in different proportions. The supplement of fodder additives to the daily ration of young horses has increased the digestibility of nutrients in terms of dry matter by 8.03% and 6.79%, organic matter – 7.83% and 6.48%, crude protein – 2.52% and 1.31%, crude fat – 4.01% and 2.16%, crude fibre – 12.78% and 10.63% and free-nitrogen extracts – 6.94% and 5.83%; nitrogen deposit in the horses' body in the experimental groups by 18.38% and 7.58%, calcium – 8.28% and 5.75%, and phosphorus – 5.12% and 0.88%. The animals fed by the additives have grown up more intensively by 10.42% and 7.92%. In assessing the biochemistry and morphological composition of the blood, there have not been any adverse effects in the horses' body.

Keywords: *Fattening of young horses, feeding, fodder additives, metabolism.*

INTRODUCTION

The Republic of Sakha (Yakutia) (in Yakut Sakha Sire) is a constituent entity of the Russian Federation, the territorially largest unit in the world. The republic includes 34 districts, which are divided into groups: Central Yakutia (Amginsky, Gorny, Kobyaysky, Megino-Kangalassky, Namsky, Tattinsky, Ust-Aldansky, Khangalassky, Churapchinsky districts and the Yakutsk municipal district), Southern Yakutia (Neryungrinsky,

Olekminsky and Aldan regions), Western Yakutia (Anabar national (Dolgan-Evenk) and Olenek Evenk national districts, Lensky, Mirninsky, Nyurbinsky, Suntarsky, Verkhnevilyuisky and Vilyuisky districts), Eastern part (Tomponsky, Oymyakonsky and Ust-Maya districts North-East (Allaikhovsky, Abyisky, Momsky, Nizhnekolymsky, Verkhnekolymsky and Srednekolymsky districts), Northern districts (Zhigansky, Bulunsky, Ust-Yansky, Verkhoyansk and Eveno-Bytantaysky national districts) (M.Yu. Prisyazhny, 2011) [1]. The land area of Yakutia is 308352.3 thousand hectares, of which agricultural land accounts for 24632.6 thousand hectares, that is about 8% of the total area, including 1637.8 thousand hectares of land for agricultural fields and 104.2 thousand hectares for tillage [2].

The climatic conditions in Yakutia are extreme with typical seasonal severe changes in ambient temperature with light precipitation. According to the weather station of Yakutsk, the long-standing average variations in temperature: the lowest is -64.4°C and maximum +38.8°C. The absolute difference sometimes reaches 100 ° C or more. The winter season is long and cold with a small amount of snow. Average monthly temperatures in winter are -40-50 ° C. There are also some temperature variations when cold period ends in different districts. So, in the group of Central, Western and Southern districts of Yakutia, it averages from 205 to 220 days, and in the North-Eastern group and the Northern groups of districts, including the Arctic zones, it reaches up to 250 days a year. Spring begins mainly in May, autumn in September. Seasons are characterized by a sudden change in ambient temperature. Summer is short with rather high ambient temperatures, mostly sunny. The warmest month of the year is July. The average positive temperature for the Central, Southern and Western groups of districts is about 17-22°C; this indicator in the North-Eastern and the Northern groups of districts is from 4 to 18°C. The number of warm days, depending on the area, averages 75-100 days a year. It should also be noted that there is a high probability of the cold snap at any time of the year [3, 4]. The total duration of sunshine reaches 1900-2000 hours a year [5]. There is 140-270 mm of annual precipitation in average. According to this criterion the indicators are approximately similar to semiarid zones. A relatively large amount of the annual precipitation falls in the summer season (up to 70%). Spring runoff over frozen soils excludes the active water storage by plants and, consequently, affects the range lands yield. The uncongenial severe climate and the regional properties of cryogenic soils affect fodder growing in the republic [3,4,6].

The territory of the region is located in permafrost area with peculiar features of the geographic landscape [7,8]. In turn, permafrost also has protective properties (protection against soil degradation), as well as barrier properties (wet deposition in the mellow topsoil layer). This occurs due to seasonal melting of ice and serves as a source of water for root nutrition of plants [3,9].

Freeze-thaw actions actively affect the formation of soils. This is also reported in the issues of the accumulation of organic and mineral substances in soils, and the nutritional habits of the plant associations [10,11].

It is necessary to use mineral and organomineral fertilizers, special preparations in plant growing to gather in a sufficient harvest of agricultural and green crops in the permafrost conditions [12,13].

Mineralogically, the composition of the basic soils of Yakutia is represented by quartzo-feldspathic composition. The analysis of nutrients (N, P, K, Ca, Mg, I), plant-available in different basic types of soil formations is presented in the diagram (Fig. 1). The mineral content is significantly lower in the top layer compared to the subsurface of

C horizon. This is due to the slight solodization and podzolization. The accumulation of biogenic elements in soils and plants is explained by slowed biological processes occurring directly in frosen soils [14,15,16].

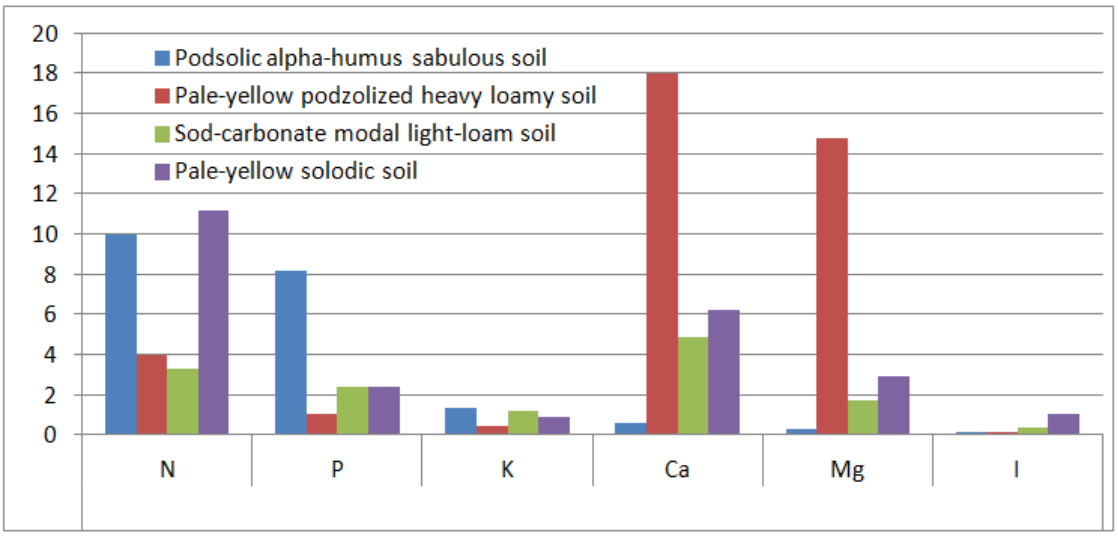

Fig. 1. *The content of the basic biogenic elements in soils, % (in a layer of 0-20 cm), mg / kg of soil*

According to A.V. Argunov (2011) in three biogeochemical provinces of Yakutia, the feed contains: magnesium salts – 150.3-194.8 mg/kg, copper 17.8-26.5 mg/kg, zinc 28.3-39-8.9 mg/kg, cobalt – 0.08-0.19 mg/kg, fluorine 0.12-0.48 mg/kg and strontium 6.8-24.7 mg/kg. It is also indicated that there is a deficit of minerals, especially calcium, phosphorus, iodine, cobalt in water and vegetable food and an excess of copper and strontium. It is noted that the etiology of endemoepidemic of farm animals is directly caused by the imbalance of mineral metabolism in the body [17].

The permafrost of Yakutia is the main factor of the heterogenic migration of micro and macroelements in soils, and for this reason there is a lack of basic biogenic nutrients in vegetable food as it is indicated in the scientific works. Thus, there are relatively more pools of microelements in the soils of the Central districts but at the same time they have a low content of available forms for assimilation of the plant association. It has also been noted that a large fraction of microelements migrates with the waters. Therefore, the spread of human and animals endemoepidemic is associated with the content of macro and microelements in the vegetable feed and the climatic pattern of the district. Various fertilizers for crops seeding and vegeculture are used for improving the productivity of frosen soils and crops. Adequate supply of the body with deficient minerals normalizes metabolism, realizes animals' potential and increases their resistance. The accumulation of minerals in subaqual landscapes, including sapropels, creates the basis for their application as a top dressing for plants and fattening animals [18,19,20,21].

The Republic of Sakha (Yakutia) is the largest agricultural production region in the Far Eastern Federal District. The share of livestock products in the gross output of the agro-industrial complex of the region is more than 80%, the production of meat more than

60% and dairy products more than 20%. That is why animal agriculture is one of the important directions of the economy in Yakutia. The main task of an agro-industrial complex of the region is to provide the local population with high-quality safe food. At present, the looking for ways to increase the reserve of agricultural production, the providing the population with high-quality biologically complete food is an urgent socio-economic and important political issue. Through the lens of economics, agricultural production is to ensure rentability, to satisfy the population needs for food. The output of commercial farming in any form of ownership depends on land areas, land and livestock productivity. These factors also influence on the rentability of agricultural production (State program of the Republic of Sakha (Yakutia) "Development of agriculture and market regulations of agricultural products, staples and food for 2012-2016; Agricultural system in the Republic of Sakha (Yakutia) for the period 2016-2020) [22,23].

Horse, reindeer and cattle breeding are the traditional industries of animal husbandry in the districts [24,25]. Yakutia has a vast experience in cattle breeding in severe climatic conditions. It is known that the deficit of nutrients and minerals and various vitamins in animals' rations leads to a deterioration in reproduction, various specific diseases, and decreases their livability. These specific diseases are hypovitaminosis (vitamin deficiency) and macro-microelementosis (minerals deficiency). These noncontagious diseases reduce productivity and deterioration of animal reproduction, the period of economic use, causes growth retardation of young animals and waste of feed for output of products. Animals have alimentary diseases when they are fed improperly. These diseases caused by a deficit and an excess of individual nutrients in their rations, including vitamins (hypovitaminosis). Therefore, in feeding practice of animals, rationing of vitamins is rather important. Actually, vitamins are not a source of energy and structural material of the body. But they act upon the metabolic processes in the animals' body, their hormones, because they are part of various enzymes. In animal husbandry, vitamins are subdivided into carotenoids (vitamin A), calciferols (vitamin D), tocopherols (vitamin E), phylloquinones (vitamin K), B vitamins (thiamine - vitamin B1, riboflavin - vitamin B2, pantothenic acid - vitamin B3, choline - vitamin B4, nicotinic acid - vitamin B5, pyridoxine - vitamin B6, corinoids - a group of vitamins B12), ascorbic acid (vitamin C) etc. [26].

At present, the effect of some promising fodder additives from natural raw materials in horse breeding has not been studied. This is especially urgent for horse breeding in Yakutia, because horses are the only species of animals that are kept outside all year round in winter at -50...-60°C, in summer +30°C. A chronic deficit of some vital microelements and vitamins in the animals' rations is noted. In this regard, we have taken an aim to study the effect of the set fodder additives from the local natural raw materials on the indices of digestibility, absorption of nitrogen, calcium and phosphorus in young horses kept for fattening and slaughter.

MATERIALS AND METHODS

The work has been carried out on the basis of the Department of General Animal Science of the Agrotechnological Faculty, Federal State Budgetary Educational Institution of Higher Education "Arctic State Agrotechnological University", Yakutsk, Republic of Sakha (Yakutia), Russian Federation. In a scientific managemental experiment, the effectiveness of the set fodder additives from the local natural raw materials in feeding young thill horses has been studied.

The effect of the fodder factors on growth and development, physiological data, digestibility and balance of nutrients, meat productivity of young thill horses has been tested in the conditions of the peasant farm enterprise of IE Rumyantsev S.I., Ust-Aldan district of the Republic of Sakha (Yakutia). The scientific research studies the effectiveness of the set fodder additives from the local natural raw materials: sapropel 0.5 and 0.7 g/kg of body weight (at age of 4-5 months), 75 and 100 g of coniferous flour (at age of 6-7 months), zeolite hongurin 0.5 g per kg of body weight, 16 g of Kempendyai salt. For research, three groups of young thill horses have been formed. There were 10 animals in each group. The animals from the control group consumed only the food from the basal ration, and the animals from the test groups ate the additional experimental fodder additives.

The selection of the experimental animals and setting them in scientific and managemental experiments, as well as the analysis of the chemical composition of feed and meat products have been carried out according to the standart practice. The keeping conditions corresponded to the breeding techniques for individual animal species and the technology adopted in these farms. The rations of the experimental animals met the accepted modern detailed feeding norms in terms of energy level and the content of basic nutrients, such as crude protein, crude fiber, starch, crude fat and other indicators. The recommendations have been taken into account during the feeding procedure [27, 28]. There was the daily allowance of experimental fodder additives that has been given to animals from the experimental groups.

The studies of animal feed and waste have been carried out according to the following methods: hay defined in the standard GOST GOST 4808-87 and GOST R 55452-2013 [29, 30]; green forage – GOST 27978-88 and GOST R 56912-2016 [31, 32]; crude fiber – GOST 13496.2-91 [33]; carotene – GOST 13496.17-95 [34]; crude fat – GOST 13496.15-97 [35]; crude ash – GOST 26226-95 [36]; nitrogen and crude protein content – GOST R 50466-93 [37]; determination of the nitrogen weight fraction of and calculation of the mass fraction of crude protein – GOST R 51417-99 [38]; calcium – GOST 26570-95 [39]; phosphorus – GOST 26657-97 [40]; moisture – GOST 27548-97 [41]; the content of nitrates and nitrites – GOST 13496.19-93 [42]. The separate methods in the analysis of individual feeds, rations and metabolic products have been carried out in accordance with the recommendations [43, 44, 45].

The chemical composition of the coniferous flour used in the experiment is represented by the following chemical composition: dry matter - 21.2%, crude protein - 7.8%, carbohydrates - 33.3%, crude fat - 10.5%, crude fiber - 11.0% , organic acids - 15.1%, other organic substances - 1.1%, minerals - 6.2 mg%, calcium - 0.4%, phosphorus - 0.3%, potassium - 2.5%, magnesium - 20.2%, ferrum - 168.0 mg, copper - 13.8 mg, manganese - 221.0 mg, carotene - 173.0 mg, vitamin E - 217.0 mg, B vitamins - 7.4 mg% , Vitamin C - 126.0 mg, citrine - 28.1 mg.

The research data have been processed using standard methods of statistical theory according to the technical tips of Plokhinskiy [46] and S.K. Merkurieva [47]. The reliability of the indicators' difference has been assessed by Student t-test.

In the present article statistical calculations were carried out basing on the technique by Plokhinskiy [46] and S.K. Merkurieva [47], in Microsoft Excel 2007. And there were used the following formulas:

$$M = \sum \frac{V}{n},$$

$$\sigma = \sqrt{\frac{\sum (V - M)^2}{n - 1}},$$

$$m = \pm \frac{\sigma}{\sqrt{n - 1}},$$

$$t_d = \frac{M_1 - M_2}{\sqrt{(m_1)^2 + (m_2)^2}},$$

where

$M,\ M_1,\ M_2$ - an arithmetic mean values,
V – variant,
n – number of observations,
σ - standard deviation,
m, m_1, m_2 - Mean Squared Error.

The reliability of data was established by statistical test using Students table ($P > 0.999, P > 0.99, P > 0.95$).

RESULTS AND DISCUSSION

Aboriginal Yakut horses have been bred for a long time by native people selection under the strong impact of natural and climatic conditions. Therefore, this is the only specimen of farm animals that is best adapted to the severe climate and can be kept outside all year round. The traditional technology of horse breeding in Yakutia is based on the principles of year-round keeping. Therefore, the high profitability of this enterprise bases on the fact that animals graze for almost all the year and eat soiling food and pasture forage. The state of horse breeding also depends on the productivity of natural lands. In this regard, the rational use of forage lands, as well as the proper labour management, gives high efficiency of horse meat production.

Horses are fed with hay and oats in a severe cold period to supply their weakened body and for waste productivity. The fodder base of horse breeding in the districts of Central Yakutia consists of soling food, hay and oats. Horses are kept near the breeding bases. The poorly nourished animals are weeded out for separate keeping. The forage base and the feed supply depend on year season, the amount of annual precipitation, the thickness of the snow cover, and the actual productivity of hayfields and natural boundaries. It is believed that in good winter-grasing conditions, soling food supplies animals' body with nutrients up to 80%, and in the worst conditions – up to half of the nutrilite requirement.

There are also the methods to fatten horses. The first one is a formation of the special herds of young horses after weaning. Further, the fattening growing horses are kept on a separate place, where they are intensively fed. In the second method, the fattening herd is sent for winter grasing for one month in the fall, where they additionally eat oats.

The features of consuming the feed and nutrients by young horses of the Yakut breed in the summer are presented in Table 1.

Table 1. *The average daily feed and nutrients consumed by the young horses of the Yakut breed at the age of 4 months*

Indicants	Normal range	Groups		
		1nd control	2nd experimental	3rd experimental
Milk, kg		4.0	4.0	4.0
Grass sward, kg		12.0	12.0	120
Oat, kg		1.5	1.5	1.5
the ration contains:				
Metabolic energy, mJ	58.60	59.40	59.40	59.40
Dry matter, kg	6.43	5.82	5.83	5.83
Digested protein,g	670.0	514.23	533.78	548.25
Crude protein,g	860.0	806.41	826.45	858.24
Crude fiber,g	1030.0	1340.15	1412.04	1435.10
Potassium,g	42.0	48.55	49.32	51.23
Phosphorus,g	34.0	27.14	28.67	31.15
Magnesium,g	8.0	10.25	10.44	11.29
Ferrum, mg	600.0	649.25	656.31	674.33
Copper, mg	74.0	50.70	51.62	52.85
Zink, mg	257.0	201.75	208.35	219.89
Cobalt, mg	4.8	3.65	3.96	4.10
Manganese, mg	240.0	274.82	290.45	311.19
Iodine, mg	6.4	3.82	4.00	4.02
Carotine, mg	35.7	182.64	205.46	227.37
Vitamin D, thous. ME	3000,0	3130.38	3227.35	3356.12
Vinamin E, mg	236.0	237.91	245.22	256.48
Vinamin B_1, mg	18.0	24.22	25.37	26.31
Vinamin B_2, mg	18.0	25.84	26.48	27.12
Vinamin B_3, mg	30.0	40.20	42.32	43.00
Vinamin B_4, mg	900.0	1230.08	1278.57	1355.52
Vinamin PP, mg	60.0	78.19	80.22	81.31

The analysis of the daily rations of young horses in the summer season has showed that they have a deficit of phosphorus, copper, zinc and iodine. This is also typical for the winter ration of the young horses (Table 2).

Table 2. *The average daily feed and nutrients consumed by the young horses of the Yakut breed in winter*

Indicants	Normal range	Groups		
		1nd control	2nd experimental	3rd experimental
Meadow hay, kg		4.0	4.0	4.0
Soling feed, kg		8.0	8.0	8.0
Oat, kg		1.0	1.0	1.0
the ration contains:				
Metabolic energy, mJ	58.60	63.20	63.20	63.20
Dry matter, kg	6.43	7.11	7.12	7.12
Digested protein,g	670.0	559.72	573.95	595.53
Crude protein,g	860.0	871.68	880.81	914,5
Crude fiber,g	1030.0	1616.96	1627.23	1645.37
Potassium,g	42.0	48.43	52.55	58.39
Phosphorus,g	34.0	34.85	37.45	38.76
Magnesium,g	8.0	10.64	11.05	12.97
Ferrum, mg	600.0	788.07	805.24	859.43
Copper, mg	74.0	67.30	76.28	86.10
Zink, mg	257.0	209.68	213.79	222.43
Cobalt, mg	4.8	3.38	3.67	3.78
Manganese, mg	240.0	318.10	322.02	330.24
Iodine, mg	6.4	4.12	4.26	4.51
Carotine, mg	35.7	64.39	65.25	66.77
Vitamin D, thous. ME	3000.0	1976.54	2172.27	2449.18
Vinamin E, mg	236.0	232.79	234.92	239.20
Vinamin B_1, mg	18.0	20.16	22.78	23.05
Vinamin B_2, mg	18.0	23.15	24.26	25.41
Vinamin B_3, mg	30.0	28,90	34,68	35.50
Vinamin B_4, mg	900.0	1180,10	1310,40	1398.20
Vinamin PP, mg	60.0	77.00	77.50	78.10

The analysis of the winter ration of the young horses shows that the animals have a deficit of zinc, cobalt, iodine and vitamins A, D, E and B3.

Thus, the existing deficit of biogenic mineral nutrients in the rations of the young horses is typical for the biogeochemical province approved by the data of previous experiments.

The use of the set fodder additives in feeding the young horses of the Yakut breed has effected on the body weight indicators (Table 3).

Table 3. *The dynamics of the body weight of the young horses fed with the set fodder additives (M ± m), kg*

Age, month	Groups		
	1nd control	2nd experimental	3rd experimental
4	147.0±190	146.0±1.92	147.1±1.39
5	172.8±2.15	175.5±1.92	173.3±1.97
6	199.2±2.23	204.1±1.69	202.7±1.99
7	222.8±1.81	229.7±1.97*	228.9±1.68*
Absolute increase	75.8±0.81	83.7±1.72***	81.8±2.16*

Note: * P> 0.95; *** P> 0.999

At the beginning of the experiment, if the body weight was practically the same, then after two months the control group of young horses at the age of 5 months has been noticeably inferior to the animals of the 2nd and the 3rd experimental groups by 1.56% and 0.29%. Further, the young horses from the experimental groups, which consumed the set fodder additives at the age of 6 months, weighed heavier than the animals from the control group by 2.46% and 1.76%, respectively. At the end, at the age of 7 months, they weighed heavier than the young horses from the control group by 3.10% and 2.74%, respectively (P> 0.95).

The additional feeding with the set fodder additives has effected on the indicators of average daily increase (Table 4).

Table 4. *The average daily increase of young horses' live weight (M ± m), g*

Age	Groups		
	1nd control	2nd experimental	3rd experimental
4-5 month	860.00±31.74	983.33±42.53*	873.33±37.78
5-6 month	880.00±22.33	953.33±40.73	980.00±52.63
6-7 month	786.67±27.76	853.33±29.90	873.33±46.56
For the whole rearing period	842.22±9.04	930.00±19.11***	908.89±23.99*

Note: * P> 0.95; *** P> 0.999

The superiority of the young horses from the 2nd and the 3rd experimental groups compared to the animals of the control group is observed. At the beginning of the experiment, at the age of 3-4 months, the control group has been inferior to the experimental groups by 14.34% (P>0.95) and 1.55%. In the middle, at the age of 5-6 months, the control group has been inferior to the experimental groups by 8.33% and 11.36%, respectively. At the end, at the age of 6-7 months, the superiority of the young horses from the experimental groups has been 8.47% and 11.02% compared to their herd-mates in the control group. During the whole period of rearing, the young horses from the 2nd and the 3rd experimental groups have exceeded the animals of the control group by 10.42% (P>0.999) and 7.92% (P>0.95) in terms of growth rate.

Thus, the use of the set fodder additives from sapropel, coniferous flour, hongurin and Kempendyai salt in feeding young horses has increased the animals' body weight.

In order to determine the effect of the set fodder additives on the efficiency of using feed components, an experiment on the digestibility of nutrients in the rations has been carried out according to the generally accepted method (M.F. Tomme (1969) and A.I. Ovsyannikova (1976) [48,49]. The data on the digestibility of nutrients in the rations of young horses are presented in Table 5.

Table 5. *The indicators of nutrients digestibility in the ration of the experimental young horses, % (M ± m)*

Groups	Dry matter	Organic matter	Crude protein	Crude fat	Crude fiber	Nitrogen-free extractives
1nd control	57.18 ±0.58	52.39 ±0.60	51.17 ±2.52	52.74 ±1.83	16.09 ±0.82	64.11 ±0.87
2nd experimental	65.21 ±2.61*	60.22 ±2.63*	53.69 ±5.16	56.75 ±3.36	28.87 ±1.27**	71.05 ±4.55
3rd experimental	63.97 ±1.27**	58.87 ±1.25**	52.48 ±2.50	54.90 ±2.20	26.72 ±2.65*	69.94 ±0.76**

Note: * P> 0.95; ** P> 0.99

The presented data indicate the positive effect of the set fodder additives on the digestive processes of young horses. The digestibility coefficients of the young horses from the 2nd and the 3rd experimental groups have been higher in comparison with the control group: dry matter by 8.03% and 6.79%, organic matter by 7.83% and 6.48%, crude protein by 2,52% and 1.31%, crude fat by 4.01% and 2.16%, crude fiber by 12.78% and 10.63% and nitrogen-free extractives by 6.94% and 5.83%, respectively.

In comparing the coefficients' indices of the nutrients digestibility in animals of the experimental groups, the 2nd experimental group has exceeded the other experimental groups in the terms of dry matter by 1.24%, organic matter by 1.35%, crude protein by 1.21%, crude fat by 1.85%, crude fiber by 2.15% and nitrogen-free extractives by 1.11%.

The features of the nitrogen, calcium and phosphorus production in the young horses fed with the set fodder additives. The obtained data are presented in table 6.

Table 6. *The nitrogen balance in young horses, g (M ± m)*

Indicants	Groups		
	1nd control	2nd experimental	3rd experimental
Consumed with the feed, g	8323±0.26	84.84±0.19	85.97±0.23
Obtained, g	63.43±8.95	61.40±4.24	64.66±6.73
Balance (+/-), g	19.80±8.90	23.44±4.28	21.30±6.83
Absorbed nitrogen, %	23.81±10.69	27.62±5.04	24.76±8.83

In the experimental groups, the nitrogen absorption has been slightly higher than in the control group. The set fodder additives have increased the appetite of animals from the experimental groups. This has been indicated in the ability to absorb nitrogen by the animals of the 2nd and 3rd experimental groups, which exceeded the animals from the experimental groups by an average of 18.38% and 7.58%. In analyzing the coefficients of the absorbed nitrogen from the fed one, it has been obtained that in animals from the control group which consumed the basic ration, it was equal to 23.81%, and in the young horses of the experimental groups it has been higher by 3.81% and 0.95%.

This tendency has been also observed in calcium and phosphorus absorption in the animals' body. In animals from the experimental groups, the calcium supply has been slightly higher compared to the control group (table 7).

Table 7. *The calcium balance in young horses, g (M ± m)*

Indicants	Groups		
	1nd control	2nd experimental	3rd experimental
Consumed with the feed	30.63±0.27	32.37±0.42	32.14±0.40
Excreted with fecal, g	17.73±0.23	18.58±0.69	18.56±0.43
Excreted with urine, g	1.43±0.04	1.37±0.07	1.45±0.04
Total excreted amount, g	19.16±0.26	19.95±0.64	20.01±0.44
Balance (+/-), g	11.47±0.45	12.42±0.86	12.13±0.12
Absorbed calcium, %	37.43±1.21	38.34±2.32	37.76±0.66

The calcium deposit in the body of animals from the control group averaged 11.47 g, which is 8.28% and 5.75% less than the indicators of young horses from the 2nd and the 3rd experimental groups. At the same time, the coefficient of calcium absorption in the control group has been 37.43%, while in the animals from the experimental groups the indicator it has been 38.34% and 37.76%, respectively.

The data on the phosphorus absorption with the feed are presented in Table 8.

Table 8. *The phosphorus balance in young horses, g (M ± m)*

Indicants	Groups		
	1nd control	2nd experimental	3rd experimental
Consumed with the feed	18.96±0.18	18.73±0.37	18.52±0.33
Excreted with fecal, g	12.02±0.47	11.58±0.32	11.62±0.18
Excreted with urine, g	1.28±0.17	1.21±0.12	1.20±0.09
Total excreted amount, g	13.30±0.56	12.79±0.22	12.82±0.27
Balance (+/-), g	5.66±0.38	5.95±0.53	5.71±0.28
Absorbed phosphorus, %	29.90±2.30	31.67±2.22	30.80±1.24

A major absorption of phosphorus in the experimental groups is noted. The data of the young horses from the 2nd and 3rd experimental groups have exceeded by 5.12%

and 0.88%. The deposit of phosphorus in the body of animals from the control group has been 5.66 g. This actually effected on the degree of phosphorus deposit in the control group – 29.90%, the 2nd experimental group – 31.67%, the 3rd experimental group – 30.80%.

The presented data indicate that the set fodder additives, consisting of local sapropel, coniferous flour, hongurin and Kempendyai salt, improve the digestion process and the effective use of nutrients in the animals' rations.

The morpho-biochemical composition of the blood has been studied to determine the effect of the set fodder additives from the local natural raw materials on the young horses' physiology (Table 9).

Table 9. *The morpho-biochemical composition of the blood of the experimental young horses fed with the set fodder additives (M ± m)*

Indicants	Normal range	Groups		
		1nd control	2nd experimental	3rd experimental
at the beginning of the accounting period				
General protein, %	7.8-10.0	7.96±0.29	7.93±0.09	7.90±0.15
Albumin, %	3.0-4.0	3.47±0.03	3.40±0.06	3.43±0.03
Globulin, %	4.0-6.0	4.33±0.23	4.34±0,08	4.33±0.04
Hemoglobin, g/l	110-140	119.00±5.51	118.67±0.88	117.67±1.86
Leukocytes, $X10^9$/l	6.3-12.5	6.50±0.06	6.63±0.09	6.73±0.09
Erythrocytes, $X10^{12}$/l	6.0-19.0	6.33±0.09	6.40±0.06	6.30±0.06
Phosphorus, mmol/l	0.7-1.4	0.89±0.04	0.88±0.01	0.89±0.01
Calcium, mmol/l	2.65-3.25	2.87±0.04	2.90±0.04	2.85±0.03
at the end of the accounting period				
General protein, %	7.8-10.0	8.03±0.24	8.33±0.08	8.19±0.10
Albumin, %	3.0-4.0	3.60±0.06	3.73±0.12	3.67±0.09
Globulin, %	4.0-6.0	4.43±0.25	4.60±0.04	4.52±0.07
Hemoglobin, g/l	110-140	126.00±3,21	128.00±2,52	127.33±2,33
Leukocytes, $X10^9$/l	6.3-12.5	6.87±0.09	6.50±0.10*	6.63±0.07
Erythrocytes, $X10^{12}$/l	6.0-19.0	6.53±0.15	6.80±0.06	6.70±0.06
Phosphorus, mmol/l	0.7-1.4	0.97±0.07	1.06±0.04	1.00±0.02
Calcium, mmol/l	2.65-3.25	2.98±0.03	3.11±0.06	3.05±0.09

Note: * P> 0.95

The adding of the set fodder additives in the rations of the young horses has slightly effected on the biochemistry and morphological composition of the blood. At the beginning of the experience, the difference in the indicants has been insignificant. However, at the end of the experiment the difference has been obtained in the morpho-biochemical parameters of the experimental animals' blood.

Thus, according to the content of total protein in the blood, the animals of the control group have been inferior to the 2nd and the 3rd experimental groups by 0.30% and 0.16%, (albumin – 0.13% and 0.07%, hemoglobin – 1.59% and 1,06%). There has been a less content of phosphorus in comparison with the control groups by 9.28% and 3.09%, calcium – 4.36% and 2.35%. There has been a difference between the groups of animals in terms of erythrocytes and leukocytes. The animals of the control group in terms of the number of erythrocytes in the blood have been inferior to the 2nd and 3rd experimental groups by 4.13% and 2.60%, and the number of leukocytes in these groups gas been slightly less by 5.69% and 3.62%.

The natural and climatic conditions of Yakutia have an impact on the animals' physiology, on the level of total protein and their fractions and on hemoglobin in the horses' blood. A more detailed study of the hematological status of horses of the Yakut breed is reported by Grigorieva [50].

The data show the positive effects of the set fodder additives on the physiology of horses.

Horse breeding is a traditional industry for many peoples, as well as some republics within the Russian Federation. The climatic conditions of the Republic of Sakha (Yakutia), as well as the limited forage base, create problems for animal husbandry. Deficiency of macro- and microelements in feed contributes to metabolic disorders of animals, which affects the growth and development, productivity and physiological state of the animal. It is possible to balance the diets of animals by including various unconventional feed additives in them.

The efficacy of various feed additives in horse feeding has been reported by many scientists [51,52,53]. Our research has shown that the inclusion of feed additives (75 and 100 g of coniferous flour, zeolite hongurin 0.5 g per kg of body weight, 16 g of Kempendyai salt) in horse diets helped to increase the live weight at the age 7 months by 3.10% and 2.74%, respectively (P> 0.95), the growth rate of young horses up on 10.42% (P> 0.999) and 7.92% (P> 0.95), digestibility coefficients reached dry matter to 65.21%, organic matter to 60.22%, crude protein to 53.69%, crude fat to 56.75%, crude fiber to 28.87, nitrogen-free extractives to 71.05%, respectively.

A similar experience was carried out in the conditions of the Republic of Tatarstan. In experiments on feeding horses, a feed additive containing zeolite was tested. As a result of the experiment, it was found that the relative increase in live weight of foals in the experimental group was 8.8% more, the average daily weight gain increased by 12.0%, the slaughter weight of horse foals increased by 6.3% with a slaughter yield of 58.9% [54].

At the same time, the maximum achieved average daily gain in live weight did not exceed 875 g per day. In our experiments, in the horses of the experimental groups, the average daily gain in live weight was 930.00 and 908.89 g, respectively. It should be noted that there are significant differences in feeding conditions, breed characteristics of horses, as well as the age of animals. In the summer and autumn periods of keeping horses it is noted a significant increase in live weight, this can be explained by the fact that this time of the year is the most comfortable for animals.

The article presents data on the study of feeding behavior and nutrient absorption in Turkmen horses aged 5 to 11 years, depending on the level of concentrates and grain processing. It was found that with an increase in the concentrated feed up to 30%, the digestibility coefficients of dry matter, organic matter, crude protein and assimilated energy increase (P>0.95) [55]. Similar experiments on the study of the frequency of feeding Turkmen horses on the digestibility of nutrients are presented in the article [56]. Another paper presents data comparing nutrient absorption of three diets for elderly and adult horses [57].

Another paper presents the results of studies examining the absorption of nutrients in Finnish horses. The experience is organized at the age of 7 months. It was found that the digestibility of nutrients increased up to the sixth period (age 12 months), with the exception of fiber [58]. In our experiments do horses of the 2nd and 3rd experimental groups the reliability of the difference was established by dry matter and organic matter (P> 0.95 and P>0.99), andcrude fiber (P>0.99 and P>0.95), which is consistent with the data of similar experiments.

It was carried out a similar experiment on horses in the conditions of the Republic of Sakha (Yakutia). The experiment studied the effectiveness of zeolite-sapropel feed additives on the absorption of nutrients. It was found that the inclusion of zeolite-sapropel supplements in horse diets improved metabolism, as evidenced by increase digestion of drymatterby 0.89 and 1.10%, organicmatterby 0.90 and 1.17%, crudeproteinby 1.07 and 1.48%, crude fat by 2.16 and 5.08%, crudefiberby 1.70 and 2.43%, nitrogen-freeextractivesby 0.63 and 0.77% [59]. The comparatively better results of the first experiment can be explained by the fact that the horses participating in that experiment were older and were in base.

Under similar conditions, when feeding zeolite-sapropel supplements to mares, it contributed to an increase in milk yield by 10.42 and 14.89%, an increase in milk fat content by 0.15 and 0.16% and protein by 0.19 and 0.32%. Improvement of metabolism in horses confirms an increase in blood albumin by 5.95 and 9.52%, globulin by 1.37 and 3.42%, hemoglobin by 1.74 and 3.20% [60].

Thus, the studies significantly supplement the database on the use of non-traditional feed additives in horse feeding.

CONCLUSION

This study has established that the CMSBE of *P. biglobosa* and its EA fraction extract have potentials anthelmintic activities against experimental *H. contortus* infection in WAD goats at doses 2000mg/kg and 1000mg/kg of goats respectively. It is worthy to note that the percentage deparasitisation (99.4%) of EA fraction was more than standard drug ABZ that has 92.3% deparasitisation. This is an indication that the extracts showed high *in vivo* anthelmintic potentials than the ABZ. The high *in vivo* anthelmintic exhibited in this study may be attributed to the presence of secondary metabolites in the extracts. It is therefore recommended to carry out a further research on a larger population size of goats.

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