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ORIGINAL ARTICLE

Efficiency of alfalfa granulated feed additive in balanced ration of Ukrainian Riding Horse

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We established positive influence of granulated alfalfa feed on the growth, development intensity, and sport qualities of the race horses. We registered the increase in live weight of young horses, which consumed the full granulated alfalfa feed by 8.0-9.8%. These animals had a more pronounced constitutional breed type. Thus, at the age of 18 months, they outclassed their peers in main linear dimensions: they had higher values of thoracic development (by 4.6%), higher thoracic diameter (by 4.5%), higher body length (by 5.7%). At the age of 24 months, these advantages were 6.4, 8.2, and 6.0% respectively. We found that the colts and fillies in the experimental group at the age of 12 months outperformed the same year horses from the control group by 1.1% by the index of format. Further, at the age of 18 and 24 months, the animals of the experimental group outperformed their counterparts from the control group by 0.2 and 0.4%, respectively. In terms of breast circumference index, the advantage of the exerimentary group animals at the age of 12 months was 0.1%, at the age of 18 months - 1.7%, at the age of 24 months - 1.8%, respectively. Similar results were recorded for the compactness index, where the advantage at the age of 12 months was 1.2%, at 18 months - 1.9%, at 24 months - 2.3% respectively. The effective use of environmentally friendly feed is confirmed by the results of hematological blood tests. It was found that for the vast majority of indicators they correspond to the physiological norm. This blood composition naturally characterizes changes in horses during the whole period of research. The received hematological profile is the basic characteristic of the state of health of horses in the research enterprise.

Key words: Horse feeding; Ecologically safe fodder; Growth and development intensity; Hematological indices of blood

Introduction

Since 2008, Ukraine has seen an increase in the number of horse breeding and maintenance companies, but this is mainly due to private owners, equestrian organizations, clubs and tourist facilities (Gluschko & Sobol, 2018). The necessary condition for the development of the horse breeding industry is the improvement of their feeding technology and the search for new types of unconventional raw materials for the production of feed, the use of which will reduce the cost of feed products. In practice of domestic mixed fodder productions the share of grain components in recipes is 60.0-80.0%. While in the foreign countries, there is a steady tendency to reduction of expenses of grain at manufacture of mixed fodders.

Race horses require special attitude and individual approach (Yegorov & Tsiundyk, 2017). They are sensitive to the structure of the diet, the conditions in which they are kept and are sensitive to changes in the daily routine. The main characteristic of horses is their maximum muscular performance. Therefore, the energy value of the diet for horses is very important.

In many countries around the world, alfalfa is used as the main food culture in animal nutrition. It has a high technological quality and is suitable for a variety of feeds: hay, haylage, grass meal, haylage, pellets, briquettes, combined silage. High quality haylage, haylage, vitamin meal, pellets, briquettes are produced from green mass.

The efficiency of use of horses of different productivity is largely due to the conditions of their feeding, for the organization of which it is necessary to know the general structure of the digestive canal and the peculiarities of digestion, factors that determine the need of horses for nutrients, species composition, nutrition and digestibility of feed (Normando et al., 2003 ; Halatyuk & Behas, 2016; Stachurska et al., 2018). Complete feeding of horses contributes to the increase of their use, productivity and reproduction rates.

The main objective of feeding horses is to provide them with sufficient amounts of nutrients and biologically active substances to support the vital functions of the body and compensate for the energy costs of muscle work. The daily nutrient requirements of working horses depend on the specifics of the work they do, their health, age, breed and the like. In the practice of horse breeding, the ability of the staff to feed the horses, i.e. to notice changes in the appetite of animals, their attitude to food, health, etc. is of great importance. Average and high fatness, satisfactory external condition, vigour, ability to quickly restore performance is evidence of properly organized quality feeding of horses (Lesnovskay & Dinnikova, 2017).

The opinion about the introduction of oats and hay into horse diets fully can provides them with all the necessary nutrients, vitamins, micro and macro elements has long been refuted. After all, it is known that in different ecological and geographical zones, the chemical composition of feed received from different fields of the same farm is different. Horses digest concentrated fodder well, especially cereals, worse - coarse, because they have a lot of fiber. However, coarse feed is one of the main components of the horse diet and accounts for 50.0% or more of the total diet. Therefore, dried alfalfa grass is better digested in granules with the addition of vitamins, micro and macro elements.

The purpose of our study was to determine the effectiveness of alfalfa feed application in feeding of Ukrainian race breed and to establish the possibility of replacing hay in the diet by this product (fully or partially).

Methods

We used a forage product made from dried alfalfa grass dried under artificial conditions.
Advantages of alfalfa fodder:
1. Absence of pollen, mould and mycotoxins;
2. Ideal replacement for coarse plant foods;
3. It has a high nutritional value and high digestibility and digestibility of nutrients;
4. It does not lose nutrients and vitamins during the storage;
5. Easy to feed horses, high degree of digestion, low losses;
6. Effective replenishment of the body with vitamins and trace elements;
7. Convenience during transportation and storage.

The research was carried out on young horses of Ukrainian Ride Horse at municipal extracurricular educational institution "Specialized Children and Youth Sport School of Olympic Reserve on equestrian sports" (Dnipro, Ukraine) in 2018-2019. Groups of animals were formed according to the analogue group method (experimental and control). Each group had six animals.
The quality of complete granulated feed was determined according to GOST 4687-2006 "Feeds artificially dried" and JMA "feeds intensive drying of herbs. Typical technological process of preparation". Samples for water quality determination were taken according to GOST No 5667-8: 2007 "Water Quality. Sampling". When sending water to the laboratory to determine the ammonia content and oxidation we added 2 ml 25.0% sulfuric acid solution per 1 liter of test water, and when determined other components we added 2 ml chloroform per 1 liter of test water. Water conservation was not performed for bacteriological studies.
The peculiarities of horse exterior were determined by linear biometric measures. Body indexes of young horses were determined on the basis of taken measurements, %:

1. Relative body index = body length / withers height × 100;
2. Thoracic development = thoracic perimeter / withers height × 100;
3. Compact index = thoracic perimeter / body length × 100.

Live weight was determined in the morning before the feeding and watering. Blood for hematological studies was taken from jugular vein before the morning feeding. To determine hematological indices, the number of leukocytes and erythrocytes was counted by Goryaev chamber. To calculate the leukocyte formula, a key counter was used, for which we made a blood smear according to Romanovsky-Gimza. Hemoglobin level was determined by Sahly's method, erythrocyte sedimentation rate was counted with Panchenkov apparatus, color indicator was counted by formula (Salyha, 1999; Mazurkevich, 2008; Luzenko & Petrushko, 2015):

$$Hb^2 = Er_1 / Er_2 \times Hb_1,$$

where Hb_2 is the number of hemoglobin in research animals; ER_2 is the number of red blood cells in research animals; Hb_1 is the average normal number of hemoglobin for this species; ER_1 is the average normal number of red blood cells for this species; Hb_2/ER_2 - the relative amount of hemoglobin in one erythrocyte of research animal; Hb_1/ER_1 - the relative normal amount of hemoglobin in one erythrocyte for this species.
The results were processed using Statistica v. 12.0 (StatSoft Inc., USA). The probability of the difference between the values in experimental and control group animals was estimated using the Student t-criterion ($P<0.05$; $P<0.01$; $P<0.001$) after verifying the normal distribution and difference between the general dispersion.

Results

We determined the composition of experimental granular feed from dried alfalfa grass (Table 1).

Table 1. Feed composition and nutrition value.

Chemical composition of feed ingredients (dry matter basis)								
Total moisture, %	**Crude Protein, %**	**Crude Fiber, %**	**Ash, %**	**Crude Fat, %**	**Ca, %**	**P, %**	**Carotin, mg**	**Fodder units, %**
9.3	18.1	19.4	8.2	1.4	2.16	0.37	160	0.69

*Alfalfa 96.4%, Mineral-protein part 3.6%.

By the feed chemical analysis we found that the structure of the feed product contains 19.4 percent of crude fibre, 18.1% of crude protein, 8.2% of crude ash and 1.4% of crude fat. The feed contains Calcium and Phosphorus in 2.16% and 0.37% respectively. The amount of carotene is 160 mg.
The consumption rate for young horses with live weight of 450-500 kg is 1.5-2 kg per day in dry form or half from this if mixed with water. So, these food products prevent the stomach volume of young horses makes from over-saturation. The structure of the diet for horses of different research groups is given in Table 2.
Such structure of the diet is optimal for horses of Ukrainian riding breed with live weight of 450-500 kg (Table 2). Thus, hay and leguminous hay (42.0%) and oats (37.0%) occupy the greatest percent in the structure of the diet of horses of both groups. Corn kernels in 1 (control group) and complete granulated fodder (PGF) in 2 (experimental group) make up 10.5% each. Other components of the diet (carrots and wheat millrace) constitute 5.25% each.
Water intended for horse watering was not much different from water for humans. It is clean, transparent, colourless, odourless and free of harmful substances and bacteria. Indicators of sanitary and hygienic qualities of water for drinking are regulated by state standards, which specify the permissible values of its physical, chemical and bacteriological properties. In particular, the state standard GOST 2874-73 "Drinking water" is used in Ukraine. The quality of water has been assessed by its physical, chemical and bacteriological characteristics (Table 3).

Table 2. Horse ration structure, %.

Ingredient	Group	
	I (control)	II (experimental)
Oat	37.0	37.0
Hay crop sillage	42.0	42.0
Maize corns	10.5	–
Carrot	5.25	5.25
Wheat millrace	5.25	5.25
Pellets	–	10.5
Total	100.0	100.0

Table 3. Drinking water quality.

Parameter	MAC (Ukrainian state standard)	Sampled value
T, °C	7-15	8.9 ± 0.67
Turbidity, $m^2 L^{-1}$	1.5	1.48 ± 0.39
Color, conventional degrees	20°	16.1° ± 1.23
Odor and taste, scores	≤ 2	1.08 ± 0.63
Dry substances, mg L^{-1}	≤ 1500	1190.5 ± 4.57
Hardness, L^{-1} (degrees of conventaionl scale)*	< 20	17.6 ± 2.14
Acid capacity, pH	6.5-8.5	7.21 ± 0.45
Content (mg L^{-1})		
Chlorides	< 350	213.4 ± 24.61
Sulphates	<o 500	329.7 ± 32.44
Fe	0.9	0.73 ± 0.82
Microbial count	100	56.8 ± 3.27
Coli index	< 3	0.96 ± 0.88
Coli-titer	≥ 300	342.3 ± 26.92

*Water hardness in former USSR is commonly expressed in conventional degrees. One degree of hardness corresponds to 0.337 mg-eq/L, which in terms of CaO and MgO is 10 and 7.2 mg/L respectively.

The experimental animals received drinking water of 8.9°C without any foreign smell, taste or colour. The water did not contain aquatic organisms that could be seen with the naked eye. The turbidity did not exceed 1.5 $m^2 L^{-1}$. Thus, the water had a weakly alkaline reaction at pH 7.21, hardness (in terms of calcium and magnesium salts) - no more than 17.6 degrees of conventional scale. The number of *E. coli* in one liter of water did not exceed the norm. The quality of water corresponds to international standards, and its uninterrupted supply together with balanced feeding has a positive impact on animal productivity, provides maintenance of proper sanitary conditions in the premises. The impact of the quality and structure of the diet and water on the growth and development intensity of young horses was assessed by the dynamics of linear measurements (Table 4).

Table 4. Horse biometric measure dynamics and growth rates.

Biometric measure	Control group		Experimental group	
	Measures, cm	Growth rate %	Measures, cm	Growth rate %
			12 months	
Withers height	135.9 ± 8.51	-	142.2 ± 9.62	-
Chest width	148.6 ± 5.67	-	155.3 ± 8.12	-
Body length	139.4 ± 5.71	-	147.4 ± 6.87	-
			18 months	
Withers height	143.4 ± 6.57	5.5	151.8 ± 10.23	6.8
Chest width	159.3 ± 6.89	7.2	171.3 ± 8.92	10.3
Body length	144.2 ± 7.43	3.4	152.4 ± 8.46	3.4
			24 months	
Withers height	145.8 ± 7.21	1.7	155.2 ± 9.37	2.2
Chest width	161.2 ± 5.79	1.2	174.4 ± 6.44	1.8
Body length	148.4 ± 6.74	2.9	157.3 ± 7.15	3.2

At the age of 18 months the horses from group I were by 4.6% lower in withers height, by 4.5% lower in chest width and by 5.7% lower in body length. At the age of 24 months, this was lower by 6.4, 8.2, and 6.0% respectively. It should be noted that the horses of Group II had a higher relative growth in all measurements. Young horses of 12 months from group II had a relative growth of withers height of 10.9%, 12.6% of growth had the horses of 18 months and the horses of 24 months had 13.0% vs. 6.0, 7.8, and 6.9% respectively for the horses from Group I.

We also noted a decrease in the relative growth of measurements in experimental animals after one year. Thus, the relative withers height increase in colts of group II was 6.8-2.2%, chest width - 10.3-1.8%, body length - 3.4-3.2%. Relative growth of measurements of foals from group I increased somewhat slower: the withers height 5.5-1.7%, chest width – 7.2-1.2%, body length – 3.4-2.9%. On the basis of the measurements taken from horses at different periods of rearing we determined the dynamics of body indexes (Table 5).

Table 5. Horse conformation indices, %.

Conformation indices	Group	
	Control	Experimental
	12 months	
Relative body index	102.6 ± 13.41	103.7 ± 15.38
Thoracic perimeter	109.3 ± 9.62	109.2 ± 11.67
Compact index	106.6 ± 7.81	105.4 ± 10.92
	18 months	
Relative body index	100.6 ± 11.67	100.4 ± 14.62
Thoracic perimeter	111.1 ± 9.62	112.8 ± 6.34
Compact index	110.5 ± 9.31	112.4 ± 9.12
	24 months	
Relative body index	101.8 ± 10.96	101.4 ± 16.84
Thoracic perimeter	110.6 ± 11.37	112.4 ± 13.36
Compact index	108.6 ± 13.41	110.9 ± 15.24

The relative body index characterizes the relative growth of animals in the chest compared to the length of the body. It is established that young animals of group II outclassed their peers of group I at the age of 12 months by 1.1%. Further at the age of 18 and 24 months foals of group I outclassed their peers of group II by 0.2 and 0.4% respectively.

Thoracic perimeter indicates the sufficient development of the front part of the body, where lungs are located, on which the intensity of oxygen supply to all organs of the animal depends. According to this index, group II animals outclassed the group I peers at the age of 12 months by 0.1%, at the age of 18 months - by 1.7%, and at the age of 24 months - by 1.8%, respectively.

According to the compact index, indicated the relative development of breast girth compared to the length of the trunk, the animals of group I prevailed over group II peers at the age of 12 months by 1.2%. Later on, the intensity of this index increasing was noted in youngsters of group II: at the age of 18 months it was higher by 1.9%, 24 months - by 2.3%, which confirms more intensive growth of the chest compared to the body length. The dynamics of live weight of young growths is shown in Table 6.

Table 6. Dynamics of horse live weight, kg.

Age, months	Group		Difference with the control
	I	II	
12	265.4 ± 1.63	286.7 ± 1.81	+21.3
18	352.1 ± 2.15	386.5 ± 2.32	+34.4
24	415.7 ± 2.71	450.4 ± 3.14	+34.7

The live weight of experimental horses was 185.0 kg at the beginning of the study. Later on, the live weight of group II young horses, which consumed complete granulated feed from dried alfalfa, was increased in comparison with group I peers. Thus, in 12 months the animals of group II outpaced the young of group I by 8.0%, in 18 months - by 9.8%. At the end of the experiment (at 24 months) the young of group II had a live weight of 450.4 kg, which is 8.3% more than the foals of group I. At various violations of feeding conditions and maintenance of horses, the most important energy nutrients are lost, and as a result, horses' productivity decreases. In cases where horses are not used systematically, horses are forced to adapt to the wrong conditions with more stress on their physiological systems. This leads to a stressful condition, which is accompanied by a decrease in performance and worsens the health of the horses.

Blood is of considerable interest as an object of scientific research, as hematological indicators to a certain extent reflect the intensity and direction of metabolic processes occurring in the body. An important aspect in feeding and training horses of Ukrainian horse breed is the formation of animals with a strong constitution and high natural resistance to disease and stress factors. In this regard, we have conducted research to determine hematological blood parameters of Ukrainian horse breed (Table 7).

The results of research on hematological blood indicators (Table 7) show that for most indicators they correspond to the physiological norm. The blood composition that we define is natural and characterizes changes in horses during the whole period of research. It should be noted that the received hematological profile is the basic characteristic of the state of health of horses in the research enterprise. However, when comparing the blood figures of the horses of the experimental and control groups, the differences between them are established. In the horses of the experimental group they were higher but did not exceed the physiological norm. Hemoglobin levels were 9.4 g L^{-1} (7.2%) higher; hematocrit levels were 2.4% higher.

The number of red blood cells was 7.0 ± 0.57 × 10^{12} L^{-1}, which was more by 10.0% or 0.7 × 10^{12} L^{-1}. It is appropriate that the obtained level of erythrocytes caused and more by 10^{-15} L^{-1} - 0.5% MCV (average erythrocyte volume) by 0.4 × 10^{-12} g) - 2.1% more MCH (average hemoglobin mass in erythrocyte) and 0.6% more MCHC (average hemoglobin concentration in erythrocyte). The sedimentation rate of erythrocyte (SDS) was slightly lower, at 50.0 ± 1.26 mm/year.

Table 7. Hematological parameters of horse blood.

Parameter	Normal state	Group	
		I	II
Hb, g L^{-1}	110-190	121.3 ± 14.11	130.7 ± 12.16
Hematocrit, %	34-45	35.0 ± 3.92	37.4 ± 3.77
Erythrocytes, 10^{12} L^{-1}	7-10	6.3 ± 0.74	7.0 ± 0.57
MCV (mean cell volume) 10^{-15} L^{-1}	34-58	56.5 ± 0.73	56.8 ± 0.49
MCH (Mean cell haemoglobin), 10^{-12} g	13-19	18.4 ± 0.22	18.8 ± 0.10
MCHC (Mean cell haemoglobin concentration), %	31-37	32.9 ± 0.30	33.5 ± 0.24
Cell-color ratio, units	0.86-1.05	1.2 ± 0.05	1.2 ± 0.04
Blood sedimentation rate (ESR), mm h^{-1}	20-50	50.7 ± 2.58	50.0 ± 1.26
Leukocytes, 10^{9} L^{-1}	7-12	7.5 ± 0.80	8.3 ± 0.88
Thrombocytes	400-800	578.5 ± 31.04	615.5 ± 30.10
White Cell Count, %			
Basophils	0	0	0
Eosinophils	2-6	3.5 ± 1.08	5.0 ± 0.39
Banded neutrophils	3-6	3.3 ± 0.92	3.3 ± 0.36
Segmented neutrophils	45-62	54.3 ± 2.13	60.0 ± 2.15
Lymphocytes	25-44	32.5 ± 3.69	25.7 ± 2.18
Monocytes	2-8	6.4 ± 0.37	6.0 ± 0.75

We also determined the advantage of the horses in the study group by studying the components of the leukocyte formula, was also established. Thus, the difference in the number of white blood cells was 0.8 109/l (9.6%); platelets 37 (6.0%); eosinophils 1.5%; segmental neutrophils 5.7%; monocytes 0.4%. No difference was observed in the number of neutrophils with bacillus nuclei. In horses of both research groups this index was within 3.3%. The lymphocyte level in the horses of the experimental group was 6.8% lower, which, in our opinion, may indicate the intensity of the cellular immune reactions that work in the body. This indicator is also related and correlated with the number of eosinophils. As a rule, a decrease in the number of lymphocytes leads to an increase in the level of eosinophils, which is observed in horses of the experimental group.

Hematological parameters of the blood allow to determine the adaptive capacity of the body, which in turn affects the compensatory and regenerative reactions of the body at the presentation of increased demands. Hematological blood parameters are of great importance in the study of horse performance and the evaluation of breeding qualities, which lead to the conclusion about the state of the body and its protective capabilities, as the processes associated with growth, development and level of performance, always affect the blood composition. Taking into account the abovementioned, we determined the hematological indices of horse blood in different research groups depending on animal sex (Table 8).

The results of researches of hematological indices of horses blood (Table 8) show that physiological and morphological features of development of geldings and mares, as well as the nature of their physical activity as a result of training and competitions, influence the level and determine the differences in blood indices. The altered horses were characterized by higher level of blood hematological indices compared to mares. However, all blood components in both sexes were within the reference level, indicating their good metabolic status.

The following results were obtained by evaluating the altered horses in the experimental and control groups. Thus, the hemoglobin level in the experimental group was significantly higher by 4.3 g L^{-1} (2.8%; $P<0.05$). The amount of hematocrit also increased by 2.3%; erythrocytes by 0.2×10^{12} L^{-1} (2.5%). In terms of functional activity and morphological evaluation of hemoglobin and erythrocytes this advantage remained. The greater number of erythrocytes, in our opinion, influenced the average volume of MCV (mean volume of erythrocyte), which was less by 10^{-15} L^{-1}. MCH (mean hemoglobin in erythrocyte) increased by 10^{-12} g (1.1%); and MCHC (mean hemoglobin concentration in erythrocyte) increased by 0.8%.

The color index in altered horses of both groups was 1.3 units, while the average MCHC concentration in the erythrocyte was 0.8%. The erythrocyte sedimentation rate (SDS) increased by 2.7 mm/year. A total of 5.1% from the altered horses of the control group indicates an acceleration of metabolic processes associated with enhanced formation and precipitation of erythrocytes. In the study of leukocytes and platelets in altered horses blood, we found an increase of 1.0×10^{9} L^{-1} (13.7%) and 68.7 (11%; $p<0.001$) in the experimental group, respectively.

In the study of altered horses leukocytic formula we observed an increase in the number of eosinophils, neutrophilic bacillus, neutrophil segment and monocytes by 3.7% ($P<0.001$); 1.0%; 5.0% and 0.6%, while the monocyte content decreased by 10.3% in the individuals of the experimental group. Most physiological parameters in the body are clearly differentiated. In normal condition animals have constant blood pressure, pulse, stable level of hematological parameters in blood. Such physiological organization is provided by a complex complex of stabilizing mechanisms that maintain all physiological constants within certain limits and thus ensure the relative independence of the body from the external environment. However, animals that are overloaded lose the ability to create a protective barrier and maintain the balance of the internal environment when necessary. This is particularly important for mares, for which the additional strain compared to stallions is on the stallion, the calving and the feeding of the offspring.

Table 8. Hematological parameters of horse blood vs. animal sex.

Parameters	Normal state	Group I		Group II	
		Altered horses, (n = 3)	Msres, (n = 3)	Altered horses, (n = 3)	Mares, (n = 3)
Hb, g L^{-1}	110-190	150.0 ± 0.71	128.7 ± 3.91	154.3 ± 1.79*	137.0 ± 9.22
Hematocrit, %	34-45	42.7 ± 2.50	27.2 ± 0.57	45.0 ± 0.86	29.7 ± 0.89*
Erythrocytes, 10^{12} L^{-1}	7-10	7.8 ± 0.06	4.8 ± 0.02	8.0 ± 0.02	6.0 ± 0.69
MCV (mean cell volume) 10^{-15} L^{-1}	34-58	58.0 ± 0.06	555.1 ± 0.43	57.8 ± 0.07	55.9 ± 0.36
MCH (mean cell haemoglobin), 10^{-12} g	13-19	18.8 ± 0.13	18.1 ± 0.29	19.0 ± 0.01	18.6 ± 0.01
MCHC (mean cell haemoglobin concentration), %	31-37	32.5 ± 0.12	33.3 ± 0.41	33.3 ± 0.38	33.6 ± 0.43
Cell-color ratio, units	0.86-1.05	1.3 ± 0.01	1.2 ± 0.08	1.3 ± 0.01	1.2 ± 0.07
Blood sedimentation rate (ESR), mm h^{-1}	20-50	53.0 ± 5.63	48.3 ± 1.48	50.3 ± 2.95	49.7 ± 1.08
Leukocytes, 10^{9} L^{-1}	7-12	6.3 ± 1.22	8.8 ± 0.31	7.3 ± 1.83	9.2 ± 0.46
Thrombocytes	400-800	517.3 ± 11.47	639.7 ± 17.43	586.0 ± 64.01***	645.0 ± 18.43
White Cell Count, %					
Basophils	0	0	0	0	0
Eosinophils	2-6	2.0 ± 0.71	5.0 ± 1.88	5.7 ± 0.41***	4.3 ± 0.41
Banded neutrophils	3-6	2.0 ± 0.71	4.7 ± 1.48	3.0 ± 0.71	3.7 ± 0.41
Segmented neutrophils	45-62	52.3 ± 3.51	58.3 ± 3.35	57.3 ± 1.79	62.7 ± 3.91
Lymphocytes	25-44	38.3 ± 5.42	26.7 ± 2.28	28.0 ± 1.88	24.6 ± 4.28
Monocytes	2-8	5.4 ± 0.82	5.3 ± 0.41	6.0 ± 1.64	4.7 ± 0.82

* P<0.05, P<0.001

Assessing the blood values of mares in both groups, we found an increase in hemoglobin levels and erythrocyte counts by 8.3 g L^{-1} (6.1%; P<0.05) and by 1.2 × 10^{12} L^{-1} (20.0%) with a 2 5% increase in hematocrit content in the individuals of the study group.

The increase in MCH (average hemoglobin concentration in erythrocyte) by 10^{-12} g - 2.7%; MCHC (average hemoglobin concentration in erythrocyte) - by 0.3% in the experimental group, indicates the strengthening of recovery processes and more intensive tissue respiration, high stability of the immune system. However, the growth of "red blood" indicators affected MCV (average erythrocyte volume), which decreased by 10^{-15} L^{-1} - 1.4%. The color indicator depends on the level of hemoglobin and indicates the amount of hemoglobin contained in one erythrocyte. In our studies, this indicator was the same for mares of both groups - 1.2 units. The sedimentation rate of erythrocytes (SDS) is used in veterinary and medical medicine to diagnose diseases. In our studies, the erythrocyte sedimentation rate in animals of both groups was within the reference standard. The increase in erythrocyte sedimentation in the individuals of the experimental group by 1.4 mm/h (2.8%) indicates a high level of protective processes, which indicate better natural resistance.

The protective function of blood is associated with leukocytes, the mechanism of action of which is aimed at the formation of humoral and cellular immunity, as well as the processes of recovery in damaged tissue. Thanks to the bacterial function of leukocytes mitotic activity of cells increases and tissue regeneration improves. In our studies, this figure was 0.4 × 10^{9} L^{-1} (4.3%) higher in the mare of the experimental group. These mares also had a higher erythrocyte content - by 5.3%.

We noted that the mares of the experimental group showed an increase in the relative number of segmented neutrophils by 4.4% and a decrease in the number of eosinophils by 0.7%; roded neutrophils - by 1.0%; lymphocytes - by 2.1% and monocytes - by 0.6%. Lymphocytes produce antibodies and take part in cellular immune reactions. The content of lymphocytes in the blood exceeds half of all types of leukocytes and is associated with monocytes, which produce a large number of biologically active substances and is a phagocyte. This functional property determines their great importance for the body as a whole. Mares of both groups had good blood saturation with lymphocytes and developed immune system.

Discussion

Racehorse breeding includes preparation and cultivation of riding breed horses for different Olympic equestrian sports. The intensification of sport direction is possible only through the development and implementation of progressive technological solutions in horse breeding (Andriichuk et al., 2013). Determination of potential capabilities of horses participated in classical equestrian sports requires in-depth comprehensive study of their anatomical, morphological, physiological and biochemical indicators, which play an important role in motor activity (Laskov, 1997; Sukneva et al., 2019).

Inequilibrium diets and deficiency of certain nutrients lead to the poor horse health and result in metabolic disorders of certain organs (Cymbaluk, 1994; Lineva, 2003). According to Petrushko & Kabasova (2018), Guanggang (2012), and Dynnikova et al. (2019), horses should be examined at least twice or three times a week. This can detect changes in their behaviour during the exercise and revent respiratory diseases. According to scientists, the nutritional requirements of race horses depend on their body weight, temperament and the work they do (training, trials, rest) (Gregić et al., 2018; Burt, 2019). During training and trials, the energy requirement increases by 32.0%, protein and lysine by 13.0%, minerals by 12.0%, including table salt by 80.0%, vitamin A

by 85.0%, vitamin D by 66.0%, E by 37.0%, group C by 15.0-80.0% compared to horses on holiday. Researches of many scientists (Feh & de Mazières, 1993; Normando et al., 2003; Hannan, 2006) have proved that reduction of tension of an organism during loading occurs at observance of optimum conditions of feeding of animals. Numerous experiences and observations of practitioners have shown that feeding levels in horses have a significant impact on their health and form productive signs, including body type, rapid maturity and endurance (Kimura, 1998; Zhukorsky & Tkachev, 2014). A 50.0-55.0% balance in feed rations has been shown to determine the potential for realization of hereditary qualities that determine the use and productive longevity of animals (Petrovez et al., 2018; Yegorov et al., 2018; Ivanov, 2019; Kershengolts et al., 2019). An important aspect of raising young horses is their properly organized singing with high quality drinking water. At the same time, water quality due to the impact of discharges of industrial and domestic waste water and natural processes (ice, hydrobiological and physicochemical processes) is deteriorating every year. Therefore, research of hydrologic and hydrochemical characteristics is one of the urgent tasks of modern horse breeding (Klimenko 2010; Zarik, 2014). It is important to study water and animal feed quality, which is required by the World Trade Organization (Kratko, 2017).

Equally important are studies related to the carcinogenic risk of pollution of the environment by various chemical compounds and primary prevention measures. According to studies of Kratko A., in the water found minor concentrations of chlorides (actually found 14.0 mg/dm³, and the optimum content of 10 mg / dm³) sulfate (actually found 25.0 mg / dm³, and the optimal content of 50 mg/dm³). Based on the studies, it was concluded that in terms of chloride and sulfate content, the water was within Class III of quality, in satisfactory condition - in average values and suitable for use by farms of different ownership forms for animal milking (Andriichuk et al., 2013; Hernyi et al., 2017). In our studies, horse drinking water was slightly alkaline, pH 7.21, with hardness not exceeding 17.6 conventioanl degrees. All other studied indicators were within the norm, which indicates its environmental safety. The results obtained coincide with similar works of scientists and practitioners (Zarik, 2014; Kratko, 2017).

Conclusion

We established that the use of ecologically safe granulated alfalfa-based feed in feeding of race horses, as well as quality drinking water, improves their general condition, increases the endurance and efficiency of training and testing. The use of complete granulated feed in the diets of experimental animals allowed to form animals of strong constitution with more intensive metabolism and more expressed adaptive and compensatory possibilities in comparison with animals of control group.

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