International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

http://TuEngr.com

PAPER ID: 10A12F

INFLUENCES OF THE IODINE-POLYMER PREPARATION "MONCLAVIT-1" ON THE HORMONAL, MORPHOLOGICAL AND BIOCHEMICAL STATUS OF THE BLOOD OF LAMBS OF WEST SIBERIAN MEAT BREED

Afanasyeva Antonina Ivanovna [a*], Sarychev Vladislav Andreevich [b], Katamanov Sergey Grigorievich [c], Loretts Olga Gennadievna [d], Neverova Olga Petrovna [d]

[a] *Faculty of Biology and Technology, Altai State Agrarian University, RUSSIA*
[b] *Department of General Biology, Physiology, and Morphology of Animals, Altai State Agrarian University, RUSSIA*
[c] *Administration of the Rodinsky District of the Altai Territory, RUSSIA*
[d] *Ural State Agrarian University RUSSIA*

ARTICLEINFO

Article history:
Received 25 March 2019
Received in revised form 18 June 2019
Accepted 12 July 2019
Available online 05 August 2019

Keywords:
Protein; carbohydrate, lipid metabolism of lambs; blood morphological parameters; Iodine deficiency; thyroid hormones.

ABSTRACT

To increase the economic efficiency of sheep farming and produce high-quality mutton, in 2011 in the Altai Territory a West Siberian meat breed of sheep was created (patent No. 5728, 11.01.2011), characterized by endurance, precocity, high reproductive qualities, and fertility (160 %). Sheep are distinguished by a long, thick, white-colored grease coat and noble crimpiness with wool fineness 21–24 microns. The yield of washed wool is 57–58%, with wool length 9cm in uterus to 11.5cm in rams. The slaughter yield reaches more than 50%. Biogeochemical features of their breeding area are the limiting factor in the breed improvement process. In particular, the Altai Territory is deficient in iodine. Iodine deficiency leads to a decrease in the functional activity of the thyroid gland, metabolic disorders, changes in the morpho-biochemical composition of the blood and reduced productivity. In connection with this, a scheme of application has been studied to study the effect of the iodine-polymer preparation Monklavit-1 on the hormonal, morphological and biochemical status of the blood of lambs of the West Siberian meat breed. It was established that the drug contributes to the preservation of the physiological status of lambs by increasing the level of thyroid hormones (T3 and T4) by 13.1 and 12.3 (P <0.01)%, respectively, as a result of which the protein-synthetic function of the liver is activated, increases the concentration of proteins in the blood of plastic values - albumin by 6.9%, energy metabolism normalizes, which affected the increase in glucose level by 15.7% (P <0.01) and decrease in cholesterol concentration by 25.0%; groups; the number of erythrocytes and hemoglobin increased by 8.1 and 9.7 (P <0.01), respectively, leukogram stabilized.

*Corresponding author (Sarychev Vladislav Andreevich). E-mail: smy-asau@yandex.ru

1. INTRODUCTION

Modern Russian sheep breeding is traditional for many regions of the country, but due to the rapid growth in the synthetic fibers production, wool production, on which sheep breeding was mainly based, has decreased significantly [1]. Therefore, the problem of increasing the economic efficiency of sheep breeding is solved by increasing the meat productivity of sheep raised in the regions [2], as well as creating new breeds of sheep of intensive meat productivity [3]. At the Altai Territory (Western Siberia) in 2011 after long-term breeding work, was bred the West Siberian meat breed of sheep (patent number 5728, 11.01.2011), well adapted to breeding in harsh climatic conditions with a long winter, low temperatures, sharply continental climate. Sheep are characterized by endurance, precocity, high reproductive qualities, and fecundity (160%). Animals have a long, thick, white-colored grease coat and noble crimpiness with wool of fineness 21–24 microns. The output of scoured wool is 57–58%, with a hair length of 9 cm in uterus to 11.5 cm in rams, the slaughter yield reaches more than 50%. The breed is in demand in many regions of the Russian Federation.

Figure 1: West Siberian Meat Breed.

Despite the high productive indicators of these sheep, the biogeochemical characteristics of their breeding area are the limiting factor in the process of improving the breed; in particular, the Altai Territory belongs to the regions deficient in iodine.

In recent years, there has been a decrease in the content of bio elements in the soil and plants throughout the world, including iodine [4]. Iodine is essential to trace elements that are part of biologically active substances, it is necessary for the organism of animals and humans [5, 6].

The main role of iodine is its presence in the composition of thyroid hormones, which regulate the basal metabolism, the consumption of carbohydrates, proteins and fats in the body, the processes of heat formation, affect growth, development, and the function of reproduction [7]. Neogenesis, metabolic processes, resistance, hemopoiesis, growth and development of young animals, processes of ruminal digestion are regulated by thyroid hormones [8, 9]. Lack of iodine in animals leads to severe damage to the thyroid gland and disruption of growth and development, as well as reduced product quality [10, 11]. In this regard, it is necessary to introduce iodine-containing preparations and additives into the rations of sheep, however, the most common inorganic iodine salts are not effective enough because of their instability and easy oxidation in air.

That's why one of the promising areas in meeting the physiological needs for iodine of farm animals is the use of organic forms of iodine [6], which is the iodine-polymer preparation "Monklavit-1".

In this regard, the purpose of our research was to study the effect of the iodine-polymer preparation "Monklavit-1" on the hormonal, morphological and biochemical status of the blood of lambs of West Siberian meat breed in the conditions of the Altai Territory.

2. MATERIAL AND RESEARCH METHODS

The research was performed in accordance with the thematic plan-task for the implementation of research works (No. AAAA-A18-118090300003-7; from 03.09.2018) by order of the Ministry of Agriculture of Russia. The experimental part of the work was carried out in LLC "Mayak" of the Rodinsky district of the Altai Territory.

In our experience as an iodinating agent was used a wide spectrum of the iodine-polymer medicine for animals, Monklovit – 1. It is an aqueous-polymer system based on iodine in the form of a complex of poly-N-vinylamidecyclosulfoiodide.

The study of the effectiveness of the use of the drug "Monclavit-1" in the raising of lambs was carried out on 20 rams at the age of 4 months, formed into groups after weaning from ewes: control and experimental 10 heads each, with an average live weight of 27.1 ± 0.47 kg.

In the control group, lambs received the main ration, and in the experimental group, the main ration and additionally the iodine-polymer preparation "Monclavit – 1" were added to the feed immediately before feeding.

The drug was used in a dose of 1 ml per kg of live weight, 1 time per day, during the weaning period - for 10 days and after 1 month for 10 days. Blood for research was obtained at the age of 4 and 12 months.

The level of thyroid hormones (triiodothyronine, thyroxin) and adrenal cortex (cortisol) in the blood serum of animals was determined by immunoenzyme method on a Bio-rad photometer for microplate (Model 680 Microplate Reader) using the "Thyroid IFA – thyroxin 01" using reagent kit "Syrophi-Iph" 01 ", "SteroidIFA - cortisol 01 ".

A study of the morphological parameters of blood (the number of red blood cells, leukocytes, and hemoglobin) was conducted on a veterinary hematology analyzer MicroCC-20Plus using hematological reagents CDS (Clinical Diagnostic Solutions (Russia).

The smears were painted using the combined Popenheim method using May-Grunwald and Romanovsky-Giemssee dyes. Counting and differentiation of leukocytes using a MICROMED-3 trinocular microscope with a ToupCam video eyepiece.

Blood biochemical parameters (total protein, albumin, glucose, calcium, phosphorus, cholesterol, triglycerides, alkaline phosphatase) were studied on a BioChemSA analyzer using "Vital" reagent diagnostic kits.

The determination of serum protein fractions (albumin, globulins, α-globulins β-globulins,

*Corresponding author (Sarychev Vladislav Andreevich). E-mail: smy-asau@yandex.ru Volume 10 No.10 ISSN 2228-9860 eISSN 1906-9642 CODEN: ITJEA8 Paper ID:10A12F http://TUENGR.COM/V10A/10A12F.pdf DOI: 10.14456/ITJEMAST.2019.156

γ-globulins) was carried out using electrophoretic separation of serum proteins on an agarose gel using the CORMAY-GELPROTEIN 100 kit on a densitometer scanning DM 2120. Densitometry was performed by control from a PC according to the user manual "Software for automatic phoregram analysis for the densitometer DM 2120" according to the method "CORMAY-GELPROTEIN 100 (5F) [8].

Statistical processing of digital data was carried out using the method of variation statistics on a personal computer using Microsoft Excel, the value of the accuracy criterion was determined according to the Student-Fisher table [12].

3. RESEARCH RESULTS

The regulation of all physiological functions in the organism of animals depends on the coordinated work of the nervous and endocrine systems. The full value of their activities is determined, inter alia, by the presence of all the components that are necessary for the synthesis of certain biologically active substances. In particular, iodine is an indispensable trace element [6, 13].

Up to 65% of iodine is found in the thyroid hormones – in thyroxine and triiodothyronine [14]. Therefore, according to the content of thyroid hormones in the blood of animals, it is possible to judge the effect of organic iodine on the functional state of the thyroid gland. In connection with the above, we studied the concentration of thyroid hormones in the blood serum of lambs from the control and experimental groups prior to the beginning of the experiment and at its end (at 12 months of age). The results are presented in Table 1.

Table 1: Dynamics of the thyroid hormones concentration in lambs of the West-Siberian meat breed.

Indicator	Before the beginning of the experiment		At the end of the experiment	
	Control group	Experimental group	Control group	Experimental group
Thyroxine, nmol / l	3.26±0.71	3.32±0.73	3.24±0.72	3.69±0.81
Triiodothyronine, nmol / l	90.1±5.81	91.6±5.72	89.8±4.32	102.9±5.21**
Coefficient thyroid conversion (T3 / T4 *100)	3.62	3.63	3.61	3.59

*P <0,05; **P <0,01; ***P<0,001 - the difference is statistically reliable in comparison between groups.

We found that the concentration of thyroxine (T4) and triiodothyronine (T3) before the administration of the drug corresponded to the physiological norm. At the end of the experiment, the concentration of T3 and T4 in the blood serum of young animals in the control group did not change significantly, in the experimental group it increased by 13.1 and 12.3 (P <0.01)%, respectively.

This may be connected with the fact that iodine contained in the drug is absorbed in the gastrointestinal tract and enters the blood it increases the protein content of iodine metabolism in the thyroid gland and protein-bound iodine, able to regulate the production of thyroid-stimulating hormone [15], which affects all stages of iodine metabolism and activates the production of thyroid hormones.

It is known that if during the normal functioning of the thyroid gland thyroxin is predominantly synthesized, then under the conditions of iodine deficiency the ratio in the synthesis of T4 and T3 changes and the thyroid gland switches to a more active synthesis of T3, which has more hormonal activity, thereby reducing iodine consumption [16,17].

In our studies, this was reflected in a higher thyroid conversion rate in the control group of lambs at the end of the experiment. A higher level of T3 and T4 in the lambs of the experimental group contributes to the strengthening of metabolic processes.

It is known that thyroid hormones have a significant impact on the processes of hemopoiesis [18]. In this regard, we analyzed the morphological parameters of the blood of experimental lambs (Table 2).

Table 2: Dynamics of morphological parameters of the blood of rams of the West-Siberian meat breed when using the drug "Monklavit-1".

Indicator	Group			
	Before the beginning of the experiment		At the end of the experiment	
	control	experimental	control	experimental
Erythrocyte, 10^{12}/l	7.58±0.24	7.68±0.31	7.4± 0.37	8.0±0.35
leukocyte,10^{9}/l	11.7± 1.14	11.3±1.09	11.2±1.07	12.3±1.73
Hemoglobin, g/l	103.2±2.33	104.0±2.50	91.0±4.24	100.0±4.62*
Leukogram, %				
Basophils	-	-	0.3±0.01	0.4±0.01
Eosinophils	0.2±0.02	0.2±0.03	0.2±0.03	0.3±0.03
Band neutrophils	1.6±0.7	1.7±0.6	1.5±0.5	1.6±0.8
Segmentonuclear neutrophils	32.3±1.9	32.4±1.7	35.7±1.8	34.5±2.1
Monocytes	2.6±0.18	2.7±0.19	2.4±0.16	2.2±0.2
Lymphocytes	63.3±1.24	63.1±1.27	58.5±1.7	61.0±1.2

*P <0,05; **P <0,01;***P<0,001 - the difference is statistically reliable in comparison between groups.

The morphological composition of blood in the rams of the control and experimental groups at the age of 4 months before using the drug corresponded to the physiological norm. At 12 months age, the red blood cells, hemoglobin, and leukocytes were lower by 2.4; 11.8 and 4.2%, respectively, than at 4 months of age. In the young stock of the experimental group, an increase in the number of erythrocytes and leukocytes was found by 4.2 and 8.8%, respectively, and a decrease in hemoglobin concentration by 3.8%, in comparison with the values established in 4 months old animals.

The number of erythrocytes, hemoglobin and leukocytes in the 12 months old rams of the experimental group was higher by 8.1 and 9.7 (P <0.01) and 9.8%, respectively, than in the control group of analogs, which is probably because of a sufficient level iodine provision, which has a significant impact on the functional state of the thyroid gland and provides the hormonal profile that contributes to a more active process of erythropoiesis [19].

Blood leukocytes in the body of animals perform protective, trophic, transport and other functions, stimulate tissue regeneration and participate in intermediate metabolism. The blood leukogram reflects the degree of functional stress of the organism, so we determined the number and ratio of different types of leukocytes in lambs of the control and experimental groups [20].

The leukogram of the rams of the experimental groups had some peculiarities. In the blood of lambs of the control group, were recorded higher rates of the band and segmentonuclear neutrophils by 6, 2 and 3 and 4%, monocytes by 8.6 and 15.3%, in comparison with the same indicators established in the rams of the experimental group. In the experimental group, the values of eosinophils, basophils, and lymphocytes were higher by 33.4; 25 and 4.1%.

*Corresponding author (Sarychev Vladislav Andreevich). E-mail: smy-asau@yandex.ru Volume 10 No.10 ISSN 2228-9860 eISSN 1906-9642 CODEN: ITJEA8 Paper ID:10A12F http://TUENGR.COM/V10A/10A12F.pdf DOI: 10.14456/ITJEMAST.2019.156

For a more objective assessment of the metabolism level occurring in the organism of rams, there was determined the biochemical composition of the blood serum of animals from the control and experimental groups. The research results are presented in Table 3.

Table 3: Dynamics of biochemical parameters of blood serum of lambs of the West-Siberian meat breed using the drug "Monklavit-1"

Indicator	Before the beginning of the experiment		At the end of the experiment	
	Control group	Experimental group	Control group	Experimental group
Total protein, g / l	69.70±2.7	70.2±2.6	62.9±1.8	65.7±1.9
Albumin, g / l	33.40±1.17	33.6±1.12	29.2±1.22	31.5±1.31
Globulin, g / l	35.56±1.21	35.7±1.24	33.7±1.37	34.2±1.42
α-globulin, g / l	9.4±0.73	9.6±0.75	9.6±0.81	9.9±0.71
β-globulin, g / l	10.5±0.98	10.3±0.97	11.3±0.94	11.9±0.91
γ-globulin, g / l	14.4±1.07	15.5±1.05	12.8±0.93	12.6±0.97
albumin/globulin	0.94	0.94	0.86	0.92
Glucose, mmol / l	2.5±0.63	2.4±0.67	1.9±0.45	2.2±0.44**
Ca, mmol / l	2.43±0.13	2.45±0.13	2.38±0.12	2.46±0.10
P, mmol / l	1.64±0.04	1.60±0.05	1.61±0.4	1.61±0.05
Ca: P	1.48	1.53	1.48	1.47
Cholesterol, mmol / l	2.6±0.52	2.5±0.56	2.8±0.78	2.0±0.59*
Triglycerides, mmol / l	0.7±0.12	0.8±0.14	0.27±0.07	0.32±0.08

*P <0.05; **P <0.01;***P<0.001 - the difference is statistically reliable in comparison between groups.

Researches have shown that an increase in the functional activity of the thyroid gland contributed to the enhancement of redox processes and the intensity of protein metabolism in the body of sheep, which received the iodine-containing drug. In the experimental group animals' blood the total protein concentration increased by 1.34; proteins with plastic function - albumin by 1.92%, fractions of α- and β-globulins by 3.0 and 4.0%. The albumin-globulin ratio was 6.9% higher than that of the control group analogs. At the same time, the level of globulins, in particular, γ-globulins was higher in rams of the control group by 1.5 and 1.7%.

The use of the drug through thyroid hormones had a positive effect on carbohydrate and lipid metabolism in the body of rams of the experimental group due to the fact that thyroid hormones can directly affect some of the hepatocyte genes involved in gluconeogenesis and glycogen metabolism, in addition, T3 causes an increase in mRNA expression glucose-6-phosphatase, the final enzyme gluconeogenesis, and glycogenolysis, which catalyzes the hydrolysis of glucose-6-phosphate to form glucose. Thyroid hormones contribute to the potentiation of the glycogenolytic and gluconeogenic effects of adrenaline and glucagon [21, 22]. In addition to direct action, thyroid hormones can also have an indirect effect on carbohydrate metabolism, which occurs through the paraventricular nucleus of the hypothalamus, leading to an increase in glucose synthesis and an increase in its release into the blood, regardless of the insulin level and corticosteroids in the blood [23].

This fact was reflected in the increase of glucose level by 15.7% (P <0.01) and the decrease in cholesterol concentration by 25.0%, in the blood of lambs of the experimental group in comparison with analogs of the control group. At the end of the experiment, the rams of the control group decrease glycogen stores in the liver by low levels of glucose and triglycerides, increasing blood cholesterol by 28.6% (P <0.05).

It is known that iodine is involved in the metabolism of calcium and phosphorus through

thyroid hormones [24; 25]. Thyroid hormones affecting osteoblasts through the signaling system of nuclear receptors (TR-α1, TR-α2, TR-β1), inducing the expression of the ligand of the nuclear activator receptor κB with subsequent binding and activation of the RANKL receptor (Receptor Activator of Nuclear κB factor Ligand) on precursors of osteoclasts, leading to the stimulation of osteoclastogenesis [26; 27].

In our studies, it was found that the use of the drug did not have a significant effect on the level of Ca and P in the blood of animals, which coincides with the results of F. Kh. Kamilova et al. [27].

Thus, the use of iodine-polymer drug "Monclavit-1" in growing of the West-Siberian meat breed sheep contributes to maintaining the physiological status of lambs by increasing the level of thyroid hormones, as a result of which the protein-synthetic function of the liver is activated, the concentration of plastic proteins in the blood increases -albumin values, energy metabolism normalizes; the number of erythrocytes and hemoglobin increases, the leukogram is stabilized.

4. CONCLUSION

The drug contributes to the preservation of the physiological status of lambs by increasing the level of thyroid hormones (T3 and T4) by 13.1 and 12.3 ($P < 0.01$)%, respectively. This is as a result of which the protein-synthetic function of the liver is activated, increases the concentration of proteins in the blood of plastic values - albumin by 6.9%, energy metabolism normalizes, which affected the increase in glucose level by 15.7% ($P < 0.01$) and decrease in cholesterol concentration by 25.0%; groups; the number of erythrocytes and hemoglobin increased by 8.1 and 9.7 ($P < 0.01$), respectively, leukogram stabilized.

5. REFERENCES

[1] Selionov M.I. From the history of Russian sheep breeding and its scientific support: Monograph. / M.I. Selonov. - M.; FGBNU VNIIOK, 2017. 238 p.

[2] Amerkhanov Kh.A., A new breed of sheep - Russian meat merino / Kh.A. Amerkhanov, M.V. Egorov, M.I. Selionova, S.N. Shumaenko, N.I. Efimova // Agricultural Journal.-2018.-T. 1.-№ 11.-p. 50-56.

[3] Kulikova A. Ya., Chemical composition and biological value of the meat of young sheep of different breeds / A.Ya. Kulikova, A.N. Ulyanov, S.G. Katamanov, Yu.G. Kotomanov // Collection of scientific works SKNIIZH.-2014.-№3.- P.85-90

[4] Braverman L.E. Iodine and the thyroid: 33 years of study / L.E. Braverman // Thyroid, 1994. - Vol. 4. - P.351-356.

[5] Veldanova M.V., Iodine - familiar and unfamiliar / M.B. Veldanova. A.V Skalny M .: IntelTek., 2004 - 192 p.6.

[6] Ji, Chen. *Salt intake and iodine status around the world*. University of Warwick Thesis (Ph.D.). 2013. 327p.

[7] Gerasimov G.A., Iodine deficiency diseases in Russia. A simple solution to a complex problem / G.A. Gerasimov, V.V. Faziev, N.Yu.Siridenko. - Adamant, 2002. - 168 p.

[8] Georgievsky V.I., Mineral nutrition of animals / V. I. Georgievsky, B. N. Annenkov, V. T. Samokhin. - M .: Kolos, 1979. P. 471

*Corresponding author (Sarychev Vladislav Andreevich). E-mail: smy-asau@yandex.ru Volume 10 No.10 ISSN 2228-9860 eISSN 1906-9642 CODEN: ITJEA8 Paper ID:10A12F http://TUENGR.COM/V10A/10A12F.pdf DOI: 10.14456/ITJEMAST.2019.156

[9] Azimov G.I., Influence of processes in the rumen and in the thyroid gland on the fat content of dairy / G.I. Azimov, V.V. Arepiev // Livestock. - №6. - 1965. - p. 18-24

[10] Spiridonov A. A., Enrichment of livestock products with iodine. Norms and technologies / Spiridonov A. A., Murashova E. V., Kislova O. F. - St. Petersburg, 2014. - 105 p.

[11] Shirokova V.I., Iodine insufficiency: diagnosis and correction. / V.I. Shirokova, V.I. Golodenko, V.F. Demin // Pediatrics, № 6 - 2005.-P.23-27.

[12] Korosteleva N.I. Biometrics in animal husbandry: textbook / N.I. Korosteleva, I.S. Kondrashkova, N.M. Rudishin, I.A. Camardina. - Barnaul: Publishing house AGAU, 2009. - 210 p.

[13] Delange F. Iodine requirements during pregnancy, lactation and the neonatal period and indicators of optimal iodine nutrition // Public Health Nutr. - 2007 - Vol 10 - P 1571-158

[14] Afanasyev A.I., Hormonal mechanisms of seasonal adaptive changes in goats of the Gorno-Altai downy breed, Siberian Journal of Agricultural Science. - 2005. - №4. - P. 121-126.

[15] Gromova O.A., Molecular synergists of iodine: new approaches to effective prevention and treatment of iodine-deficient diseases in pregnant women // OA Gromova, I.Yu. Torshin, N.G. Kosheleva / breast cancer. Mother and child .-2011.-T. 19.-№ 1.-S. 51-58.

[16] Kubasova E.D., Physiological characteristics of the bioelement status and its effect on the thyroid gland of children in the Arkhangelsk region: Author. dis ... to-that biol. sciences. - Arkhangelsk, 2007-18 p.

[17] Kubasova E.D., Modern ideas about the role of environmental factors and imbalance of bioelements in the formation of endemic goiter / E.D. Kubasova, R.V. Kubasov // Successes of Modern Biology.-2009. -T. 129.-№2. p. 181-191

[18] Dzhambulatov M., Effect of feeding of sheep by sulphate of copper on the activity of some redox enzymes / M. Dzhambulatov, S.G. Luganov, Sh.K. Salikhov, G.I. Gireyev // Problems of development of the agro-industrial complex of the region - 2011. No. 6. P.12-16.

[19] Mikhaylenko, A. K., Papshuova, R. D., Chizhova, L. N. The hormonal status of sheep depending on age and iodine availability // Proceedings of the VNIIOK. 2010. №1. URL: https://cyberleninka.ru/article/n/gormonalnyy-status-ovets-v-zavisimosti-ot-vozrasta-i-yodnoy-obespechennosti (дата обращения: 04.09.2018).

[20] Spiridonov A. A., Murashova E. V., Kislova O. F. Iodine enrichment of livestock products. Norms and technologies / Spiridonov A. A., Murashova E. V., Kislova O. F. - St. Petersburg, 2014. - 105 p.

[21] Weinberg MB, Utter MF. Effect of thyroid hormone on the turnover of rat liver pyruvate carboxylase and pyruvate dehydrogenase. J Biol Chem 1979;254(19):9492-9499.

[22] Feng X, Jiang Y, Meltzer P, Yen PM. Thyroid hormone regulation of hepatic genes in vivo detected by complementary DNA microarray. Mol Endocrinol 2000;14(7):947-55.

[23] Klieverik LP, Janssen SF, van Riel A, et al. Thyroid hormone modulates glucose production via a sympathetic pathway from the hypothalamic paraventricular nucleus to the liver. Proc. Natl. Acad. Sci. U. S. A. 2009; 106:5966–5971.

[24] Baldaev, SN, Biochemistry of metabolic disorders in sheep and their prevention / S.N. Baldaev, S.A. Kirilov.- Ulan-Ude: Buryat book publishing house, 1991.- p.160

[25] Baymatov V.N., Changes in clinical and biochemical parameters in cows with iodine deficiency / V.N. Baimatov, V.E. Adamushkin, A.F. Khannanova // Veterinary Medicine. - 2006. - № 8. - p. 45-47.

[26] NichollsJ.J., Brassill N.J., Williams G.R., BassertJ.H. The skeletal consequences of thyrotoxicosis. J. Endocrinol. 2012; 213: 209–211. DOI: 10.1530/JOE-12-0059.

[27] Kamilov F. Kh., Effect of experimental hypothyroidism on bone tissue metabolism and mineral metabolism / F. Kh. Kamilov, V.N. Kozlov, T.I. Ganeev, R.R. Yunusov // Kazan med.zh .. 2017. №6. https://cyberleninka.ru/article/n/vliyanie-eksperimentalnogo-gipotireoza-na-metabolizm-kostnoy-tkani-i-mineralnyy-obmen (дата обращения: 10.01.2019).

Professor Dr. Antonina Ivanovna Afanasyeva is Professor and Dean of the Faculty of Biology and Technology, Altai State Agrarian University. She has a Doctor of Biological Sciences degree. Her scientific interests pertains to the study of Physiological Adaptation Mechanisms (Hormonal Status, Morphological And Biochemical Blood Parameters, Productive Indicators) of Farm Animals of the Southern Region of Russia and Import Selection to New Natural and Climatic Conditions of the Altai Territory; ability study of the use of Adaptogens, Immunomodulators, Probiotics for the Prevention of the Negative Effects of Stress and Increasing the Quantitative and Qualitative Indicators of Productivity.

Vladislav Andreevich Sarychev is a Candidate of Biological Sciences, Department of General Biology, Physiology, and Morphology of Animals, Altai State Agrarian University, Russia. His scientific interests include the study of the Adaptive Capacity of Imported Livestock (Hormonal Status, Morphological and Biochemical Blood Parameters, Productive Indicators and Reproductive Ability); Ability study of the use of Adaptogens, Immunomodulators, Probiotics for the Prevention of the Negative Effects of Stress and Increasing the Quantitative and Qualitative Indicators of Productivity.

Dr. Sergey Grigorievich Katamanov holds a Doctor of Agricultural Sciences degree. His scientific interests encompass Breeding and Selection of Fine-Wool and Meat-Wool Sheep; Improving the Qualitative and Quantitative Indicators of Wool and Meat Productivity; Reproductive Ability of Sheep.

Professor Dr. Olga Gennadievna Loretts is Professor and Rector of the Ural State Agrarian University, Russia. She got a Doctor of Biological Science sdegree. She also got a degree in Psychology from Ural State Pedagogical University. Her areas of scientific interests are Biotechnology, Selection and Genetics of Farm Animals, Biology, Processing of Agricultural Products.

Olga Petrovna Neverova is a Candidate of Biological Sciences, Ural State Agrarian University RUSSIA. Her scientific interests are related to the Development of Resource-Saving Technologies in Poultry Farming for obtaining Environmentally Friendly Products.

*Corresponding author (Sarychev Vladislav Andreevich). E-mail: smy-asau@yandex.ru Volume 10 No.10 ISSN 2228-9860 eISSN 1906-9642 CODEN: ITJEA8 Paper ID:10A12F http://TUENGR.COM/V10A/10A12F.pdf DOI: 10.14456/ITJEMAST.2019.156