Hematological Parameters of Boars-Producers at Use of a Natural Mineral Additive in a Diet

A. T. Varakin, D. K. Kulik, V. V. Salomatin, V. S. Zoteev, G. A. Simonov

Abstract*: The aim of the research was to study the morphological and biochemical indicators of the blood of boars-producers using in the diet of a natural mineral additive-bischofite of the Volgograd field. To conduct scientific and economic experience, four groups of boars-producers of 5 animals each were formed. In the experiment, boars-producers of the control group received the main diet, and I, II and III experimental groups – in addition to the main diet, respectively, 5, 8 and 11 ml per animal per day of natural bischofite. Against the background of scientific and economic experience, studies were carried out to study hematological parameters in experimental boars of comparable groups. The results of the research showed that the hematological parameters in the boars of the producers of the compared groups were within the physiological norm and characterized the normal activity of all organs and systems. Compared with animals of the control group, at the end of the main period, after testing the blood of the boars of the experimental groups, the number of erythrocytes was higher by 2.77-6.77%, hemoglobin - by 0.80-2.95%, and the total protein content in blood serum was higher by 0.87-1.57%, albumin by 2.44-6.50% . The boars of the experimental groups exceeded the albumin-globulin coefficient of the animals of the control group by 2.56-8.97%. The content of inorganic magnesium in the blood serum of the boars-producers of the experimental groups, compared with the control, was 0.14 more; 0.20 and 0.24 mmol / L. According to the results on the productive qualities of boars, the introduction of natural bischofite into the diets contributed to an increase in ejaculate volume by 5.0-7.81%; increased sperm cell concentration in 1 ml of sperm - by 2.79-5.12%, sperm activity - by 2.27-6.82%, in comparison with the control. The use of bischofite in the diet of boars, in comparison with the control, contributed to the economic effect due to the cost of additional sperm production - 14080.0 - 22848.0 rubles. At the same time, the best results in terms of hematological and productive indicators of boars-producers, economic efficiency were achieved when bischofite was included in the diet at a dose of 8 ml per boar per day.

Keywords*: boars-producers, diet, bischofite of the Volgograd field, hematological parameters, sperm production quality, economic efficiency.

I. INTRODUCTION

To further improve the indicators of animal husbandry, it is necessary to expand the range of effective feed products, the use of which contributes to the realization of genetically determined potential of animal productivity, cost reduction and increase the profitability of production [1-4].

The work in this direction is significantly promoted by the applied modern technologies of keeping farm animals [5, 6]. At the same time, an important condition for increasing the production of livestock products, improving the productive qualities of animals is the organization of their full balanced feeding [7-10].

It should be noted that the economic component also plays an important role in the management of livestock [11, 12].

At the organization of feeding of animals, in particular pigs also the great attention is paid to mineral security of their diets.In this connection, it is necessary to widely use various mineral additives to balance animal diets for the missing macro-and microelements, in particular natural bischofite of the Volgograd field [13].

Natural bischofite is an effective magnesium additive and a source of other vital mineral elements for animals-manganese, copper, iodine and others [14, 15]. Its use as a mineral additive for animals is based on the study of its effect on their productivity, physiological and biochemical processes occurring in the body.

Researchers also pay special attention to the study of blood parameters in animals in connection with feeding peculiarities [16, 17].

An important factor influencing the quality of sperm production is a complete mineral nutrition, which is determined by sufficient intake of macro - and microelements in the diet. At the same time, the use of bischofite from the Volgograd field in the diets of boars is of considerable interest.

Knowledge of biochemical processes and their changes that occur in the body under the influence of natural bischofite serves as a theoretical justification for its use in feeding boars-producers.

In this regard, the purpose of our research was to study the hematological parameters of boars-producers during the period of receiving different doses of natural bischofite from the Volgograd field with food.

The objectives of our research was to determine the morphological and biochemical composition of blood in boars-producers, their productive indicators, economic evaluation of sperm production with the use of natural bischofite in the diet.

II. MATERIALS AND METHODS

Scientific and economic experience was carried out on a pig-breeding complex of industrial type.

Revised Manuscript Received on November 10, 2019.

Varakin A. T., Volgograd State Agrarian University, Volgograd, Russia.
Kulik D. K., All-Russian Research Institute of Irrigated Agriculture, Volgograd, Russia.
Salomatin V. V., Volgograd State Agrarian University, Volgograd, Russia.
Zoteev V. S., Samara State Agrarian University, Samara, Russia.
Simonov G.A., Vologda science center RAS, North-West Scientific Research Institute of Dairy and Grassland Management, Russia.

For the experiment, four groups of breeding boars with 5 animals each were formed. The selection of animals in groups was carried out according to the principle of analogues. The conditions of maintenance and care were the same for all boars of the compared groups.

The duration of the scientific and economic experience was 90 days, including a preliminary period of 10 days, a transitional period of 5 days and a main one of 75 days.

During the preliminary period of scientific and economic experience, boars-producers of the compared groups received the main diet. In the transition period of the experiment, the animals of the control group received the main diet, and their analogues from the I, II, and III experimental groups were accustomed to the test diets. In the main period of scientific and economic experience, the boars of the control group received the main diet, and the I, II, and III experimental groups received, in addition to the main diet, 5, 8, and 11 ml, respectively, per animal per day of natural bischofite. The diets for experimental boars were developed according to detailed feeding standards. In feeding the boars of the producers of the compared groups used full feed.

Hematological parameters in experimental boars-producers were determined by generally accepted methods. Blood tests were performed on 20 boars, 5 from each group.

The quantity and quality of sperm products was studied in 20 boars of producers, 5 from each group. The sperm of experimental boars were examined by the following indicators: ejaculate volume — in graded sperm receptors, activity — under a microscope with an increase of 180 times, concentration — in a Goryaev counting chamber under a microscope at dilution 200 times.

The obtained experimental data were analyzed by means of variation statistics.

III. RESULTS AND DISCUSSION

All ongoing processes in the animal organism are reflected to one degree or another on the composition of their blood and physical and chemical properties.

For a more objective assessment of the physiological state, the nature of metabolism and age differences of animals, morphological and biochemical studies of blood are increasingly used [18,19,20].

Knowledge of biochemical processes and their changes occurring in the body of boars, under the influence of natural bischofite, is the theoretical basis for its use in feeding pigs.

Analyzing the data of hematological studies at the end of the main period of scientific and economic experience, taking into account the affiliation of the boars-producers to one group or another, it should be noted that all the studied parameters were within the physiological norm and characterized the normal vital activity of all organs and systems. experimental boars are given in Table 1.

Table 1: The morphological composition of the boars-producers' blood

Indicator	Group			
	control	I experimental	II experimental	III experimental
Erythrocytes, 10^{12}/l	6,50±0,10	6,70±0,21	6,94±0,12*	6,68±0,11
Leukocytes, 10^{9}/l	13,42±0,16	13,74±0,17	14,10±0,22*	13,92±0,11*
Hemoglobin, g/l	121,88±0,91	122,86±0,42	125,48±0,39**	124,20±0,28*

*$P \leq 0,05$; **$P \leq 0,01$*

The content of red blood cells and hemoglobin in the blood to a certain extent can be judged on the intensity of redox processes occurring in the body of animals.

In the process of research, it was found that the introduction of natural bischofite boars into the main diet had a positive effect on the concentration of red blood cells in the blood. So, the number of red blood cells in the blood of the boars of I, II and III of the experimental groups at the end of the main period of the experiment was higher, compared with the animals of the control group, respectively, 3.08; 6.77 and 2.77%.

According to this indicator, the difference between the boars-producers of the experimental groups at the end of the main period of the experiment was 3.58 and 3.89%, in favor of group II.

A similar pattern in experimental animals was revealed by the content of hemoglobin in the blood. The hemoglobin content in the blood of boars I, II and III experimental groups was higher than that of analogues of the control group, respectively 0,98 (0,80 %); 3,60 (2,95 %) and 2.32 g / l (1.90 %).

An increase in the blood of animals of the level of hemoglobin and the concentration of red blood cells indicates an increase in the intensity of redox processes in their body [21].

At the same time, in comparison with the control, a greater number of leukocytes was found in the boars-producers of the experimental groups, which in addition to the main diet received natural bischofite. The addition of natural bischofite to the diet of animals of I, II, and III experimental groups, compared with the analogues of the control group, increased the leukocyte content in the blood by 2.38, respectively; 5.07 and 3.72%.

Consequently, the increase in the number of leukocytes in the blood of boars of experimental groups, which occurred within the physiological norm, should be considered as a positive factor, since leukocytes carry out phagocytosis and are the main producer of antibodies.

The level of blood protein to a certain extent reflects the intensity of protein metabolism in animals.

The obtained research data on the content of total protein and its fractions in the serum of experimental boars-producers are presented in Table 2.

The experimental data obtained indicate that the content of total protein and its fractions in blood serum varies depending on the feeding pattern of experimental animals.

The obtained experimental data indicate that the content of total protein and its fractions in serum varies depending on the nature of feeding experimental animals. So, at the end of the main period of scientific and economic experience the content of total protein in blood serum of boars-producers of I, II and III experimental groups was more, in comparison with control, respectively on 0,70 (0,87 %); 1,26 (1,57 %) and 0.90 g / l (1.12 %).

Moreover, the intensity and direction of protein metabolism in animals can be judged by the content of albumin in the blood serum. In animals of the experimental groups I, II, and III, the absolute content of albumin in the blood serum was higher, compared to the analogues of the control group, by 0.86 (2.44%), respectively; 2.29 (6.50%) and 1.45 g / l (4.12%).

Table 2: The content of total protein and its fractions in the serum of boars

Indicator	Group			
	control	I experimental	II experimental	III experimental
Total protein, g/l	80,50±0,13	81,20±0,26*	81,76±0,17***	81,40±0,32*
Albumins:, g/l	35,21±0,39	36,07±0,24	37,50±0,21***	36,66±0,23*
Relative %	43,74±0,43	44,42±0,21	45,86±0,22**	45,04±0,22*
Globulins:, g/l	45,29±0,29	45,13±0,17	44,26±0,19*	44,74±0,25
Relative %	56,26±0,43	55,58±0,21	54,14±0,22**	54,96±0,22*
A/Gcoefficient	0,78±0,01	0,80±0,01	0,85±0,01**	0,82±0,01*

**P≤0,05; **P≤0,01; ***P≤0,001*

Albumin-globulin coefficient (A/G) characterizes the physical and chemical properties of blood and largely the intensity of metabolism in the body. This figure was higher for boars of the experimental groups. Thus, boars I, II and III experimental groups were superior to the A/G coefficient of animals of the control group, respectively, by 2.56; 8.97 and 5.13 %. This indicates a more intense metabolism in their body, in comparison with the control.

The results obtained in studies on the content of mineral elements in the blood serum of experimental boars are shown in Table 3.

Table 3: The concentration of mineral elements in the serum of boars

Indicator	Group			
	control	I experimental	II experimental	III experimental
Total calcium, mmol/l	2,90±0,13	2,88±0,07	2,86±0,07	2,84±0,09
Inorganic phosphorus, mmol/l	2,02±0,11	2,04±0,09	2,08±0,11	2,10±0,13
Inorganic magnesium, mmol/l	1,14±0,04	1,28±0,03*	1,34±0,04**	1,38±0,04**

*P≤0,05; **P≤0,01

At the same time, there were no significant differences in serum levels of total calcium and inorganic phosphorus in experimental animals.

However, the content of inorganic magnesium in the blood serum of boars-producers of the I, II and III experimental groups, in comparison with the animals of the control group, was higher, respectively, by 0,14 (12,28 %); 0,20 (17,54 %) and 0.24 mmol / l (21.05 %).

Biochemical studies of the levels of vitamins a and E in blood serum give an idea of the intensity of vitamin metabolism in experimental animals (Table 4).

Table 4: The content of vitamins in the serum of boars-producers

Indicator	Group			
	control	I experimental	II experimental	III experimental
Vitamin A, mkg%	33,88±0,21	34,50±0,13*	35,72±0,34**	35,30±0,26**
Vitamin E, mg%	0,45±0,01	0,48±0,01	0,50±0,01**	0,49±0,01*

**P≤0,05; **P≤0,01*

It was established in studies that boars-producers of the I, II and III experimental groups at the end of the experiment exceeded the counterparts of the control group in the content of vitamin A in blood serum, respectively, by 0.62 (1.83%); 1.84 (5.43%) and 1.42 µg% (4.19%), vitamin E - by 0.03 (6.67%); 0.05 (11.11%) and 0.04 mg% (8.89%).

There were no significant and statistically significant differences between the animals of the compared groups in terms of alkaline blood reserve.

The increase of metabolic processes in the body of boars-producers of experimental groups had a favorable effect on the quality indicators of the obtained sperm production (Table 5).

So, for the main period of scientific and economic experience, in comparison with counterparts from the control group, the volume of ejaculate on average among boars-producers of the experimental group I was 16 (5.0%) more, the experimental group - 25 (7, 81%) and the experimental group III - 21 ml (6.56%).

Table 5: Quantity and quality of boar sperm production

Indicator	Group			
	control	I experimental	II experimental	III experimental
Volume of ejaculate, ml	320,0±3,25	336,0±7,21	345,0±5,17**	341,0±6,33*
The concentration of sperm in 1 ml of sperm, billion	0,215±0,002	0,221±0,005	0,226±0,003*	0,224±0,007
Sperm activity, points	8,8±0,17	9,0±0,23	9,4±0,11*	9,2±0,03*

**P≤0,05; **P≤0,01*

Thus, compared with the animals of the control group, the concentration of sperm in 1 ml of sperm on average among boars-producers of the experimental group I increased by 0.006 billion (2.79%), and the second experimental group - by 0.011 billion (5.12%) , III experimental group - by 0.009 billion (4.19%).

In comparison with animals of the control group, their analogues from the I experimental group on average increased sperm activity by 0.2 points (2.27 %), from the II experimental group – by 0.6 points (6.82 %), from the III experimental group – by 0.4 points (4.55 %).

At the end of the research, calculations of the economic efficiency of the use of natural bischofite of the Volgograd field in the diets of boars-producers were performed. Evaluation of the research results showed that increased reproductive performance of boars when administered in the diet of natural bischofite at the rate of 5, 8 and 11 ml per animal per day, compared with the control. In this case, the best result was achieved when natural bischofite was included in the diet at a dose of 8 ml per boar per day, as the highest indicators of ejaculate volume were obtained in terms of ejaculate volume, sperm concentration in it and with their higher activity.

Thus, for the main period of the experiment, the total volume of ejaculates received on average (calculated per animal) from boars-producers of the control group was 5760 ml, of the I experimental group - 6048, II experimental - 6210 and of the III experimental group - 6138 ml. Therefore, the following number of sperm doses was received on average from the control-producing boars of the control group - 412.8, and from the boars of the I experimental group by 32.7; II experimental group - by 55.0 and III experimental group - by 45.5. In general, compared with the control group, the economic effect from the introduction of natural bischofite in the feed of boars-producers of the I, II and III experimental groups at the expense of the cost of the additionally obtained sperm production was 8170.0 per one boar, respectively; 13743.0 and 11365.0 rubles.

Thus, the best results were obtained from boars, which, in addition to the basic diet, were administered 8 ml of natural bischofite per day per animal.

IV. CONCLUSION

Morphological and biochemical parameters of blood in animals of the compared groups were within physiological norm. However, the natural bischofite of the Volgograd field, included in addition to the main diet of boars-producers of experimental groups, contributed to the increase in their blood: erythrocytes, hemoglobin, leukocytes; in serum: total protein, albumins, vitamins A and E, compared with the control. In animals of the experimental groups was also higher A/G coefficient. In this case, the best result was obtained when used in the diet of bischofite at a dose of 8 ml per boar per day.

Compared to animals of the control group, at the end of the main period of experience, the number of erythrocytes in the blood of boars of the experimental groups was 2.77-6.77% higher, the hemoglobin level was 0.80-2.95% higher, and total protein by 0.87-1.57% and albumin by 2.44-6.50%. Boars of experimental groups exceeded the A / G coefficient of animals from the control by 2.56-8.97%. The content of inorganic magnesium in the serum of boars of the experimental groups, compared with the control, was 0.14 (12.28%) more; 0.20 (17.54%) and 0.24 mmol / l (21.05%).

The use of natural bischofite of the Volgograd Deposit contributed to the increase of the full value of feeding of boars-producers due to the better provision of their mineral nutrition, which had a positive impact on the productive qualities of boars of the experimental groups. Thus, the introduction in the rations of boars-producers natural bishofite at the rate of 5, 8 and 11 ml per animal per day increases the volume of boars ejaculate 5.0; 7,81 and of 6.56 %; the increase in the concentration of sperm cells in 1 ml of semen is at 2.79; 5,12 and 4.19 %, the activity of sperm - 2.27; 6.82 and 4.55 %, compared to the control.

The use of natural bischofite in the rations of boars-producers 5, 8 and 11 ml per head per day, in comparison with the control group, contributed to the economic effect due to the cost of the additionally obtained sperm production - 14080.0; 22848.0 and 18615.0 rubles. However, the best result was achieved with the inclusion of bischofite in the dose of 8 ml per boar per day.

REFERENCES

1. D.K. Kulik, A.T. Varakin, V.V. Salomatin, E.A. Harlamova, "Influence of feed additives on productive indicators of ram", *Ecological and meliorative aspects of environmental management: materials of the International Scientific and Practical Conference*. Volgograd: FSBI VO Volgograd SAU, vol. 4, 2017, pp. 259-264
2. G.R. Fenwick, "The assessment of a new protein source – Rapeseed", *Proc. Nutr. Soc*, vol. 41, 1982, pp. 277-288.
3. S.A. Miroshnikov, E.V. Yausheva, E.A. Sizova, E.P. Miroshnikova, V.I. Levahin, "Comparative assessment of effect of copper nano- and microparticles in chicken", *Oriental Journal of Chemistry*, vol. 31(4), 2015, pp. 2327-2336.
4. V.S. Zoteev, E.I. Pisarev, S.I. Nikolaev, V.V. Salomatin, A.T. Varakin, "False flax cake in mixed feed for the fattening of lactating cows and dairy stores", *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, vol. 9(5), 2018, pp. 1422-1428.
5. H.B. Baymishev, A.A. Perfilov, O.N. Pristyajnyuk, N.N. Edrenin, "Reproductive and productive qualities of primary heifers obtained from cows under conditions of intensive technology", *Izvestiya of Samara state agricultural Academy*, vol. 1, 2009, pp. 22-24.
6. H.Z. Valitov, S.V. Karamaev, "Productive longevity of cows in conditions of intensive milk production technology", Samara: RIC SGSHA, 2012.
7. A.P. Korobov, A.A. Vasilev, "The effectiveness of the use of starter feed in feeding prenursery pigs", *Reports of Russian Academy of Agricultural Sciences*, vol. 3, 2001, p. 43
8. S.I. Nikolaev, V.N. Struk, S.V. CHehranova, A.V. Nikishenko, "Influence of mustard protein-containing feed concentrate "Gorlinka" on milk production of cows", *News of the Nizhnevolzhskyagrouniversity complex: science and higher professional education*, vol. 4(48), 2017, pp. 205-212.
9. G.A. Simonov, V.M. Kuznetsov, V.S. Zoteev, A.G. Simonov, "Organization of complete feeding of dairy cows in the Sakhalin region", *Scientific and practical ways to improve environmental sustainability and socio-economic support for agricultural production: materials of the International Scientific and Practical Conference*, with. Solenoye Zaymische: FSBI "Pre-Caspian Research Institute of Arid Farming", 2017, pp. 1369-1371.
10. I.F. Gorlov, V.I. Levakhin, V.F Radchikov, V.F. Tsai, S.E. Bozhkova, "Effect of feeding with organic microelement complex on blood composition and beef production of young cattle", *Modern Applied Science*, vol. 9(10), 2015, pp. 8-16.
11. A.T. Varakin, V.V. Salomatin, E.A. Harlamova, T.A. Varlamova, "The efficiency of milk production using flax and rapeseed millcake", *Izvestiya of Samara state agricultural Academy*, vol. 13, 2018, pp. 30-34
12. A.M. Uhtverov, Kh.B. Baymishev, I.N. Khakimov, M.A. Kohanov, V.S. Grigoryev, A.T. Varakin, "Duration of economic use of breeding sows with the different levels of fat depth and early maturity", *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, vol. 9(5), 2018, pp. 935-942.
13. V.M. Kulikov, A.G. Korotkov, V.V. Salomatin, A.T. Varakin, "Complex mineral dressing for animals - Volgograd bischofite", *Zootechnics*, vol. 1, 1993, pp. 29-32
14. A.T. Varakin, V.V. Salomatin, O.V. CHeprasova, D.V. Nikolaev, "Physiological indicators and meat productivity of young pigs for fattening with the inclusion of the feed additive Bishtreon in the rations", *Zootechnics*, vol. 3, 2012, pp. 20-22
15. V .Salomatin, A. Varakin, M. Salomatina, "Bishofit in pigs feeding", *Animal husbandry of Russia*, vol. 6, 2015, pp. 27-28
16. V. Salomatin, A. Ryadnov, A. Shperov, "Meat productivity and biochemical blood parameters of pigs with feed additives of selenium-organic preparations into rations", *Chief livestock specialist, vol. 2*, 2010, pp. 32-35
17. C.F. Nascimento, R.H. Branco, S.F. Bonilha, J.N. Cyrillo, J.A. Negrão, M.E. Mercadante, "Residual feed intake and blood variables in young Nellore cattle", *Journal of Animal Science*, vol. 93(3), 2015, pp. 1318-1326.
18. V.V. Salomatin, A.T. Varakin, D.A. Zlepkin, "The effect of natural bischofite on the morphological and biochemical blood parameters of fattened pigs", *Pig production*, vol. 2, 2012, pp. 68-70
19. W.R. Butler, J.J. Calaman, S.W. Beam, "Plasma and milk urea nitrogen in relation to pregnancy rate in lactating dairy cattle", *Journal of Animal Science*, vol. 74(4), 1996, pp. 858-865.
20. C.A. Lents, L.A. Rempel, J. Klindt, T. Wise, D. Nonneman, B.A. Freking, "The relationship of plasma urea nitrogen with growth traits and age at first estrus in gilts", *Journal of Animal Science*, vol. 91(7), 2013, pp. 3137-3142.
21. V.V. Salomatin, A.A. Ryadnov, T.A. Ryadnova, "Physiological indicators of fattened pigs with using biologically active preparations in diets", *Feeding farm animals and fodder production*, vol. 6, 2012, pp. 39-41.