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Research Article

The Influence of Hemobalance and Mixtures of Tetravit with Asd-2f on the Hemogram and Physiological and Biochemical Status of Blood of Sows in Different Physiological State

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ABSTRACT.

The scientific and production experience on studying of influence of hemobalance with a mixture of tetravit and ASD-2F on a metabolic profile of blood of sows in various physiological periods is carried out. The aim of our research was a comprehensive study of the metabolism state in sows, depending on the duration of gestation and lactation, and scientific justification of the effectiveness of the drug “Hemobalance” and its combination with tetravit and ASD-2F (KG). The influence of KG on the hemogram of sows in different physiological states was determined. Biochemical analysis of the metabolic profile was monitored in the blood of sows in the dynamics – 90 and 102 days of gestation and 12th and 26th day of lactation. The following parameters were determined: glucose levels, total cholesterol, triacylglycerols, total protein, albumins, globulins, creatinine and urea. A decrease in the globulin fraction of proteins at KG injection by 23.9% by the 26th day of lactation relative to the control animals in the same period was established. The marked decrease occurred simultaneously with an increase in glucose content by 20.5% compared to the control. Based on the studies it is proved that the additional introduction of biologically active substances contained in hemobalance, tetravit and ASD-2F, has a positive effect on the body of sows in deep gestation state, and subsequently in lactation. This is reflected in the normalization of metabolic processes of proteins and carbohydrates - the main plastic and energy metabolites, especially necessary in these physiologically stressful periods in the life of sows.

Key words: sows, hemobalance, tetravit, ASD-2F, gestation, pregnancy, lactation, and metabolism.

INTRODUCTION

The accumulation of animals of all kinds in a limited area with industrial methods of industry inevitably leads to economic losses. They are caused by stress, immunodeficiency, a decrease in the overall resistance of the body, the quality and bioavailability of nutrients, including biologically active substances, and, as a consequence, metabolic disorders and related diseases [4,5,10,11,16,20,29,30,32,37,38,40].

To compensate for these negative manifestations in livestock and pig production a large number of drugs adaptogens normalizing "oppressed" functions of the body and activating innate immunity are used. These include vitamins, enzymes, minerals etc. [9,12,21,24,26,35,39]. The list of medicines is quite large. Let us focus only on some of them.

For example, tetravit - a popular drug that includes fat-soluble vitamins that reduce the body's susceptibility to infection, normalizes protein, carbohydrate and mineral metabolism, regulates redox reactions, normalizes the exchange of phosphorus, calcium, and improves reproductive function. Vitamins that are part of tetravit make up for their deficiency in animals. Therefore, vitamin A regulates the function, regeneration and structure of epithelial tissues, reducing the body's susceptibility to infections. Another component of the drug – tocopherol - the most important antioxidant, vitamin reproduction, affects carbohydrate and fat metabolism, regulates redox reactions, and enhances the effect of other vitamins that make up the drug. Vitamin D3 normalizes the metabolism of phosphorus and calcium, affects their absorption in the gastrointestinal tract [1,6,8,19].

A certain interest is the hemobalance - a complex drug that includes amino acids, vitamins and minerals that complement and enhance the effect of each other. A list of studies on the effect of this drug on the organism of animals of different species (rabbits, dogs, horses, cattle, etc.) is known [2,7,13,18,22,23,25,28,33]. The authors noted its normalizing effect on nitrogen, carbohydrate and mineral metabolism, specific and nonspecific immunity, as well as on the reproductive function of the body.

Dorogov's antiseptic stimulant of 2nd fraction (ASD-2F) is well-known. It is a product of dry distillation of raw materials of animal origin and contains in its composition compounds with active sulfhydryl group, derivatives of amides and aliphatic amines, carboxylic acids, aliphatic and cyclic hydrocarbons, water.

I. E. Mozgov attributed this drug, which has a versatile effect on the body to pharmacological stimulants with a stimulating effect, which is manifested even in small [17].

The researchers found activating effect of ASD-2F on the nervous system, motor activity of the gastrointestinal tract, normalization of digestion and absorption of nutrients. In addition, it shows an increase in the natural resistance of the body, accelerating the regeneration of damaged tissues.

The positive effect of ASD is preserved when it is used as an ingredient in other drugs. Therefore, ISeeDevit, which in addition to the pharmaceutical substance ASD-2F is composed of succinic acid and vitamins A and E. The drug is harmless, prevents postpartum complications in cows and increases nonspecific resistance of the body [14, 15].

With all the variety of effects of these drugs (tetravit, ASD-2F, hemobalance) in the available scientific literature, we have not found any mention of their comparative evaluation in the process of joint use of sows, in general, and in various physiological states, in particular, which prompted us to start our research in this direction.

Research objects and methods

Scientific and production experience was carried out on pregnant and lactating sows of large white Landras breed in the conditions of industrial pig complex on the territory of Belgorod region.

The maintenance of the livestock was carried out according to the generally accepted zootechnical norms: in a state of deep gestation – in groups of 20 heads, and four days before the expected birth – individually.

The composition of the diet (according to the physiological state of sows) included barley, wheat, corn, full-fat soy, wheat bran, sunflower meal, soybean meal, mycelium, sunflower oil, L-lysine sulfate, DL-methionine, L-threonine,

monocalcium phosphate, Mycosorb, feed chalk, table salt and other biologically active substances. The content of exchange energy and crude protein for pregnant sows was 12.53 MJ/kg of feed and 15.20 %, and for lactating sows 12.85 MJ and 18.15%, respectively.

40 pregnant sows (90 days or 24 days before farrowing) were selected for the experiment, which on the principle of pairs-analogues were divided into two groups: the first group – control (I-C) – received the necessary biologically active substances in the composition of the company's diet. The second group was injected intramuscularly five times with an interval of 72 hours with hemobalance and a mixture of tetravite with ASD-2F. Hemobalance was injected at a dose of 1 ml / 50 kg of body weight, and a mixture of tetravit with ASD-2F (a composition obtained by mixing 100 ml of tetravit and 4 ml of ASD-2F) at a dose of 0.25 ml/ 50 kg of body weight. The first injection was made on the 94th day of pregnancy. The scheme of experience is presented in table 1.

Table 1. Scheme of experience

Groups	n, head.	Doses and schedule of use of drugs
I - C	20	-
II	20	Hemobalance in a dose of 1 ml / 50 kg of body weight and a mixture of terravit with ASD-2F at a dose of 0.25 ml/50 kg intramuscularly five times with an interval of 72 hours

For 24, 12 days before farrowing and 12, 26 days after it, five animals from each group were taken blood from the cranial vena cava.

In whole blood hemogram and glucose concentration were determined, and in its serum - biochemical parameters characterizing lipid and nitrogen metabolism.

Morphological blood tests were performed according to the conventional method with the determination of the number of red blood cells and leukocytes with the inference of leukocyte formula.

The concentration of glucose, total cholesterol, triacylglycerols, total protein and its fractions, creatinine and urea was determined using a semi-automatic StatFax 1904 Plus analyzer.

The obtained results were subjected to statistical processing using t-Student criterion.

Research results and discussion

In the course of the present experiment, we studied the effect of the use of hemobalance and tetravit mixture with ASD-2F on the morphological and biochemical composition of blood of deep-gestating and lactating sows.

The dynamics of hemogram parameters is presented in table 2.

Table 2. The influence of hemobalance and mixtures of tetravit with ASD-2F on the hemogram of sows in different physiological state

Indicators	Groups			
	I-C	II	I-C	II
	Before farrowing			
	Before 24 days		**Before 12 days**	
Erythrocytes, 10^{12}/l	4,90±0,09	4,74±0,08	5,00±0,09	4,94±0,09
Hemoglobin, mmol/l	129,6±2,8	129,8±1,9	127,8±4,2	133,4±2,7
Leukocytes, 10^{9}/l	11,80±0,91	11,88±1,25	12,10±1,42	12,04±1,70
Eosinophils, %	5,8±1,4	7,0±0,7	6,4±1,8	6,4±0,9
Rod neutrophils, %	6,2±1,5	5,8±1,2	6,8±1,2	6,8±1,2
Segmented neutrophils, %	41,6±4,3	41,8±2,4	37,2±3,6	39,2±3,3
Lymphocytes, %	41,4±4,3	41,6±1,7	45,2±3,9	44,0±4,2
Monocytes, %	4,6±0,5	3,6±0,4	4,4±0,5	3,6±0,5
	After farrowing			
	After 12 days		**After 26 days**	
Erythrocytes, 10^{12}/l	4,84±0,16	5,21±0,12*▪♦	4,52±0,11▪	5,07±0,10**▪
Hemoglobin, mmol/l	129,4±3,0	134,6±4,4	125,6±4,1	132,8±3,6
Leukocytes, 10^{9}/l	11,56±2,24	11,72±0,86	11,60±1,01	12,74±0,93
Eosinophils, %	7,4±2,4	5,6±0,9	6,2±1,2	3,8±1,3
Rod neutrophils, %	9,8±1,6	9,6±1,1▪	9,2±1,3	5,2±1,0*★

Segmented neutrophils, %	50,8±2,6♦	42,8±0,8*	49,2±1,3♦	40,2±2,2**
Lymphocytes, %	28,2±3,6♦	37,8±1,6*	31,8±3,3♦	45,4±1,9**★
Monocytes, %	3,8±1,0	4,2±0,9	3,6±0,8	5,4±0,5♦

Note: * - hereinafter, the difference with respect to the group I; ▪ - in relation to the 1st period;♦- 2nd period; ★ - 3rd period;* (▪;♦) - p<0,05; ** (▪▪;♦♦)p<0,01; *** (▪▪▪;♦♦♦) p<0,001

As it can be seen from table 2, 24 and 12 days before farrowing, there were no significant changes in the morphological composition of sow blood. However, after it we identified some changes.

With the transition from such a physiological status as pregnancy to another state – lactation – in sows of groups II, multidirectional changes in the number of red blood cells and I were noted. Thus, if in relation to the background values in control animals on the 12th day of lactation the tendency to decrease in "red" blood cells is shown, and on the 26th day their significant decrease is already significant (by 7.8%, p<0.05), then the sows of the experimental group had an increase in the content of red blood cells in these periods (by 9.9%, p<0.01 and 6.9%, p<0.05).

In addition, in sows treated with hemobalance and a mixture of tetravit with ASD-2F, the number of red blood cells was higher than the values of intact animals: on the 12th day of lactation – by 7.6% (p<0.05), and on the 26th – by 12.2% (p<0.01).

In this case, the main component that directly affects the functionality of the "red" blood cells and characterizes them - hemoglobin – was at a high level with a slight predominance of concentration in group II. Considering the combination of these two blood parameters, it can be assumed that the use of hemobalance and a mixture of tetravit with ASD-2F for sows at the final stage of pregnancy contributed to the activation of transport and respiratory functions of blood during lactation.

Throughout the experiment, the content of white blood cells in the blood of sows of both groups was almost the same and showed the overall dynamics of this indicator when changing the physiological status: 12 days before farrowing, there was an increase in the number of "white" cells, probably associated with preparation for the birth process, and after – a decrease, presumably, due to their release into the perivascular tissue (especially reproductive organs) for reparative function.

By the end of the suckling period (on the 26th day) sows, receiving hemobalance and a mixture of tetravit with ASD-2F, exceeded intact females in the number of leukocytes in the blood by 9.8% (p>0.05). Taking into account the available data that at a high level of leukocytes during hunting the probability of fruitful insemination is greater [3, 27], we can assume that the uterus of the second group in the subsequent sexual cycle will be more prolific.

When counting the number of white blood cells important to the determination of the ratio of types of cells, their components, reflecting the leukocyte formula are shown in table 2. As it can be seen from the table, significant changes in the percentage of "white" blood cells occurred after the farrowing. Thus, on the 12th day of lactation there was an increase (about 1.6 times) in the proportion of rod neutrophils relative to their background values in sows of both groups. However, in animals exposed to hemobalance with a mixture of tetravit and ASD-2F, this growth was statistically significant (p<0.05). An interesting fact is that further to the 26th day of lactation this group shows a decrease in the considered indicator by 45.8% (p<0.05) and the return of the value of rod neutrophils to the initial level. At the same time, the level of this type of leukocytes in intact sows was higher by 43.5% (p<0.05) than in experimental sows.

During the lactation period, the share of segmented neutrophils in the blood leukogram of sows of the control group increased compared to the second experimental period (12 days. before farrowing): on the 12th day of suction-by 36.6% (p<0.05) and on the 26th day-by 32.3% (p<0.05). At the same time, in group II their values remained almost unchanged and were inferior to the control by 15.8 (p<0.05) and 18.3% (p<0.05), respectively, 3 and 4 terms of experience.

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On the 12th day of lactation, the total share of neutrophils increased in sows of both groups, indicating a regenerative shift to the left associated with the recovery of the female body after childbirth. On the 12th and 26th day of lactation the evolution of the values of lymphocytes in the total white blood cell count in the control showed a decrease of 37.6 ($p<0.05$) and 29.6% ($p<0.05$). In the second group, their content remained unchanged to the 3rd period, and to the 4th increased by 20.1% ($p<0.05$). This circumstance led to the predominance of experimental animals over intact ones by the 12th day after farrowing – by 34.0 ($p<0.05$), and by 26 – by 42.8% ($p<0.01$).

We would like to note that in the differential calculation of leukocytes we showed the inverse relationship between the number of segmented neutrophils and lymphocytes. This relationship is consistent with the results previously described by A.A. Sysoev. (1978) [27].

In addition, in the experiment we obtained data characterizing carbohydrate-fat and nitrogen metabolism, which is presented in table 3.

Table 3. The influence of hemobalance and mixture of tetravit with ASD-2F on biochemical blood indicators of sows in different physiological state

Indicators	Groups			
	I-C	II	I-C	II
	Before farrowing			
	Before 24 days		**Before 12 days**	
Glucose, mmol/l	4,16±0,24	3,86±0,16	3,52±0,09▪	3,74±0,20
Cholesterol, mmol /l	2,44±0,17	2,26±0,12	2,30±0,15	2,12±0,15
Triacylglycerol, mmol/l	0,40±0,03	0,33±0,03	0,46±0,03	0,47±0,04▪
Total protein, g/l	76,4±1,7	77,6±2,4	77,6±1,4	71,4±2,4
Albumins, g/l	36,4±0,8	35,9±2,2	41,3±2,2	36,9±2,2
Globulins, g/l	40,0±1,3	41,7±0,5	36,3±1,2	34,5±1,2▪▪▪
A/G	0,9	0,9	1,1	1,1
Creatinine, µmol/l	109,9±4,1	119,3±5,7	79,9±1,9	85,6±3,5
Urea, mmol/l	4,68±0,21	4,86±0,45	6,16±0,32	6,28±0,49
	After farrowing			
	After 12 days		**After 26 days**	
Glucose, mmol/l	3,88±0,15	4,68±0,18**▪▪♦♦	3,76±0,17	4,62±0,21*▪♦
Cholesterol, mmol /l	1,65±0,05▪▪ ♦♦	1,79±0,11▪	1,61±0,07▪▪♦♦	1,83±0,14▪♦♦♦
Triacylglycerol, mmol/l	0,23±0,01▪▪▪♦♦♦	0,24±0,03♦♦	0,31±0,06	0,22±0,02▪▪
Total protein, g/l	100,8 ±1,8▪▪▪♦♦♦	91,2±1,0**▪▪▪♦♦♦	94,4±2,3 ▪▪▪ ♦♦♦	83,3±1,9**♦♦★★
Albumins, g/l	47,8±2,8▪▪	47,7±0,6▪▪▪ ♦♦	42,6±2,9	43,9±1,7▪♦
Globulins, g/l	52,9±1,6▪▪▪ ♦♦♦	43,5±0,9***♦♦♦	51,8±4,5▪ ♦	39,4±2,1*
A/G	0,9	1,1	0,9	1,1
Creatinine, µmol/l	124,4±6,9♦♦♦	127,5±13,8 ♦	122,2±3,3▪ ♦♦♦	110,0±10,7
Urea, mmol/l	4,46±0,25♦♦	4,56±0,53 ♦	4,51±0,32♦♦	3,49±0,30*▪ ♦♦

Table 3 shows that at the beginning of the experiment the biochemical status of sows of both groups did not have significant differences.

However, "indicators" of the status of carbohydrate and fat and nitrogenous exchanges in varying degrees continuing to be examined, were changed. Thus, the concentration of glucose – the main energy metabolite for the life of the whole organism – in the second experimental period (12 days before farrowing) in the sows of the control group showed a significant decrease of 15.4% ($p<0.05$), while the sows of group II remained

virtually unchanged and became higher than the control by 16.9%.

After farrowing on the 12th day, the blood glucose of sows of both groups increased relative to the previous period with different degrees of reliability: in the I group – by 10.2% ($p>0.05$), and in the II – by 25.1% ($p<0.01$). In addition, when comparing the concentration of the metabolite in animals of group II with the control an increase of 20.6% was shown($p<0.01$).

Injection of hemobalance with a mixture of tetravit and ASD-2F to sows during gestation to the 26th day after farrowing significantly increased the glucose content in their blood in relation to 1 and 2 experimental period by 19.7 and 23.5%, respectively ($p<0.05$). The predominance of the level of the metabolite under consideration in these females and in relation to the control ones by 22.9% ($p<0.05$) was shown. The resulting growth may indicate a favorable completion of lactation without depleting its effects on the female body and increased energy supply for the subsequent sexual cycle.

In addition, lipid metabolism metabolites reflect the degree of energy supply of the body, which are the most concentrated source of energy released by β-oxidation to acetyl-COA required in the Krebs cycle [34].

12 days before the farrowing , the concentration of triacylglycerols in sows of both groups increased with different degrees compared to the previous period: in group I - by 15.0% ($p>0.05$), and in group II - by 42.2% ($p<0.05$). In a comprehensive review of the growth of this indicator against the background of a decrease in glucose levels in intact females, it can be concluded that there is a shortage of energy in their body, replenished by fat depots. Along with this, in group II, with the stability of glucose concentration, an increase in the content of triacylglycerols is shown, which may indicate an excess in energy over the need for it.

In the study of another indicator of lipid metabolism – cholesterol – 12 days before farrowing relative to the background values a tendency to reduce it in sows I and II groups by 5.7 and 6.2% was shown, while after farrowing on the 12th and 26th day there was a significant decrease in the control – by 32.4 ($p<0.01$) and 34.0% ($p<0.01$), and in experimental animals – by 20.8 ($p<0.05$) and 19.0% ($p<0.05$), respectively.

In determining the metabolic status of animals and humans indicators of nitrogen metabolism are not the last important. As it can be seen in table 3, 12 days before farrowing, the total protein and albumin content remained almost at the initial level, and globulins decreased with varying degrees of reliability: in group I – by 9.3% ($p>0.05$), and in group II sows – by 17.3% ($p<0.001$).

At the same time, the concentration of creatinine in comparison the second with the first experimental period showed a similar dynamics of globulins, decreasing in the control group by 27.3%, and in II - 28.2% ($p>0.05$). The obtained changes in the content of creatinine and globulin in animals do not go beyond the reference values for their physiological state.

The intensity of the metabolism of nitrogenous substances can be judged by the level in the blood of one of the final products of protein metabolism - urea. The content of this indicator by 12 days relative to 24 days before farrowing increased in sows of both groups: in group I – by 31.6%, and in group II – by 29.2% ($p>0.05$). The shown growth we tend to consider as evidence of the increasing processes of catabolism in the body of females, which is a kind of physiological pattern of pregnancy dominant. During this period, it is necessary that feeding meet the needs of sows in substances of protein nature, which are one of the main components not only for the development and growth of the fetus, but also physiological changes in the body of the female [31,36]. At the same time, maintaining the concentration of total protein and albumins at the same high level demonstrates the compensation of increased demand for protein intake with feed.

In the middle of the suction (3rd experimental period) compared with the previous periods (1st and 2nd) there was an increase in the concentrations of total protein, albumins and globulins in both groups. In intact animals, the increase was 31.9 ($p<0.001$) and 29.9%, ($p<0.001$), 31.3 ($p<0.01$) and 15.7%, 32.3 ($p<0.001$) and 45.7% ($p<0.001$), respectively. It is important to note that the values that these metabolites acquired exceeded the norm. In the second group, their

increase was not so active and the concentration of total protein and globulins were lower by the middle of lactation than in the control by 9.5 ($p<0.01$) and 17.8% ($p<0.001$). The observed dynamics continued on the 26th day of suction, when the concentration of total protein and globulins in group II sows was lower than in group I by 11.8 ($p<0.01$) and 23.9% ($p<0.001$), respectively. Shown changes may indicate biocorrosive effects on the body females by applied BAS.

Taking into account all of the above, we can assume that the use of hemobalance with a mixture of tetravit with ASD-2F to sows at the final stage of pregnancy promotes normalization of metabolic processes and morphological composition of blood in the body of females at the time of lactation, which helps to reduce the physiological load of such an important condition and preparation for the subsequent sexual cycle.

CONCLUSIONS

Additional implementation of biologically active substances in the drugs “Hemobalance”, “Tetravit” and “ASD-2F” in the period of deep gestation:

- contributed to an increase in red blood cell content during lactation by 6.9-9.9% relative to background values;
- did not affect significantly the number of leukocytes in the blood of sows, but contributed to the restructuring of their species ratio;
- showed an increase in glucose concentration relative to the control – by 22.9% ($p<0.05$);
- led to the normalization of protein metabolism during lactation.

REFERENCES

1. Aliev A.A. Metabolism in ruminants /A.A. Aliev // Moscow: SIC “Engineer”. - 1997. - 419 p.: Il.
2. Andreeva A.B. Correction of immuno-biochemical status of pregnancy in mares: author. Diss. ... Cand. of Vet. Sciences / A.B. Andreeva. - Saint-Petersburg. - 2012. - 24 p.
3. Belyaeva N.Yu. The activation of ovarian function in cows with homeopathic preparation/ N.Yu. Belyaeva, Yu.I. Smolyaninov // Achievements of science and technology of agriculture. - 2013. - № 12. - P. 52-53.
4. Boyarintseva T. Experience of biologically active drugs in pig / T. Boyarintseva // Pig breeding. 2007.- №5.- P. 9-11.
5. Boyarsky L. Improvement of productive activity rations in pork production / L. Boyarsky// Pig breeding. 2007.- №2.- P. 17-21.
6. Waldman A.R. Vitamins in animal nutrition // A. R. Waldman, P.F. Suray, I.A. Ionov, N. I. Sakhatsky //.- Kharkov: RIP “Original”. 1993.- 423 p.
7. Doroshchuk S.V. Influence of biologically active substances on reproductive function of cows / S.V. Doroshchuk, I.S. Shapiev // Proceedings of St. Petersburg State Agrarian University. -2014. - № 36. - P. 76-79
8. Dudin, V.I. Biochemistry of vitamin E and related biologically active substances /V.I. Dudin // M.: 2004.- 255 p.
9. Evdokimov P.D. Vitamins, trace elements, biostimulants and antibiotics in animal husbandry and veterinary science /P.D. Yevdokimov, V.I. Artemyev. - L.: 1974.- 214 p.
10. Karput’ I.M. Immunology and immunopathology of diseases of young animals / I. M. Karput’. - Minsk: Uradzhai. - 1993.- 288 p.
11. Kozhurin V.M. Methods of prevention of metabolic disorders in pigs with industrial fattening / V.M. Kozhurin, G.I. Kozhurina // Mater. Inter. Conf. - St. Petersburg. - 1999.- P. 14.
12. Komarov A.A. Prospects for the use of water-dispersed forms of lipophilic vitamins / A.A. Komarov, D.A. Zhemerichkin, S.V. Semenov // Veterinary medicine. - 1999.- № 11.- P. 45-47.
13. Korochkina E.A. Influence of the drug on the hormonal balance of the drug-manufacturers / E.A. Korochkina, A.R. Musin // Issues of legal regulation in veterinary medicine. - 2010. - № 4. - P. 140-142.
14. Kugeleva T.I. Study of the tolerability Iseedevit in laboratory animals / Abramov V.E., Kugeleva T.I. // Veterinary pathology. - 2008. - № 3 (26). - P. 84 - 86.

15. Kugeleva T.I. Immunotropic activity of the drug Iseedevit. / T.I. Kugeleva, K.G. Kurochkina // Veterinary pathology. - 2008. - № 3 (26). - P. 104 - 105.
16. Merzlenko R.A. Complex of fat-soluble vitamins in animal husbandry / R.A. Merzlenko, L.V. Reznichenko, O.V. Merzlenko // Veterinary medicine. - 2004.- №3.- P. 42-44.
17. Mozgov I.E. Pharmacology of stimulants in livestock / I.E. Mozgov. - M.-1964. - 352 p.
18. Nechaeva T.A. Application in trout production of vitamin-amino acid complex hemobalance in combination with the probiotic Vetom 1.1/ Nechaeva T.A. // Questions of normative-legal regulation in veterinary medicine. - 2010. - № 3. - P. 50-53.
19. Ovcharov V.V. Effect of multivitamin and tetravit on the condition of the bone tissue in sows / V.V. Ovcharov // Innovations in science, education and business – the basis for efficient development of agriculture: Materials of International scientific-practical conference, 1-4 February 2011. – Setl. Persianovsky: publishing house of Don State Agrarian University. – 2011. – Vol.3. - P.189-191
20. Petrovsky V.S. Zootechnical and veterinary aspects of increasing productivity of sows in industrial systems: recommendations / S.V. Petrovsky, N.K. Khlebus, A.O. Sidorenko. – Gorki: BSAA. – 2013. – 64 p.
21. Petrushenko Yu. Non-traditional feed additive / Yu. Petrushenko, S. Guseynov/ Animal husbandry of Russia.- 2010.- №6.- P. 31-32.
22. Pilyuga Yu.A. Immune status of suckling foals in the contracture of the finger flexors: autoref. diss. ... Cand. of Vet. Sciences / Yu.A. Pilyuga. – Moscow. - 2012.– 23 p.
23. Plemyashov K.V. Reproductive function in highly productive cows under metabolic disturbance and its correction: author. dis. … Doct. of Vet. Sciences / K.V. Plemyashov. - Saint-Petersburg. - 2010. - 38 p.
24. Popov V.S. Scientific and practical justification of means and methods of immunometabolic correction in pigs: autoref.dis. ... Doc. of Vet. Sciences / V.S. Popov. – Kursk. - 2015.- 30 p.
25. Salautin V.V. Influence of preparations “gamavit” and “hemobalance” on hematological parameters of horses in a comparative perspective / V.V. Salautin, I.V. Ziruk, A.V. Kudinov [and other] // Questions of normative-legal regulation in veterinary medicine. - 2010. - № 4. - P. 132-134.
26. Sotnikov R. Dry plasma AR-820-immunomodulator for pigs / R. Sotnikov // Animal husbandry of Russia. - 2010.- №10.- P. 33.
27. Sysoev A.A. The Physiology of reproduction of agricultural animals / A.A. Sysoev. – M.: Kolos. - 1978. - 360 p.: Il.
28. Khazimukhametova I.F. Influence of hemobalance on the organism of rabbits / I.F. Khazimukhametova, I.A. Vasilyeva, E.A. Shishkina // Achievements of science and technology of agriculture. - 2013. - №8. - P.57-59.
29. Shumsky N.I. Postnatal diseases of sows in farms of industrial type and the scientific basis of their early diagnosis and prevention: abstract. dis. ... Doct. of Vet. Sciences / N. I. Shumsky. - Voronezh: Voronezh State Agricultural University. - 2002. - 57 p.
30. Einarsson S. A 25 years experience of group-housed sows–reproduction in animal welfare-friendly systems/ S. Einarsson, Y. Sjunnesson, F. Hultén [et al.]// Acta Veterinaria Scandinavica. 2014. - №56(1). – P. 37.
31. Elango R. Protein and Amino Acid Requirements during Pregnancy/ R. Elango; R.O. Ball// Advances in Nutrition. – 2016. - №7(4). – P. 839–844.
32. Kim S. W. Amino Acid Utilization for Reproduction in Sows/ S. W. Kim, R. A. Easter //Amino acids in animal nutrition. – 2003. – P. 203.
33. Korochkina E. Circulating Cortisol and testosterone concentration in rats, submitted to different stress intensities / E. Korochkina // Proceeding Association for Applied Animal Andrology Conference. - Vancouver. - 2012. - P. 5 - 7.
34. Kurtz D. The Clinical Chemistry of Laboratory Animals/ D. Kurtz, G. Travlos. - Boca Raton: CRC Press. – 2018. p. 1162.

35. Lunn D.P. Clinico-Pathological diagnosis of immunodeficiens /D.P. Lunn, J.T. McClure Equine veter/ Educat,- 1993. Vol5. - N1. - P. 30-32.
36. Metges C.C. Intrauterine Growth Retarded Progeny of Pregnant Sows Fed High Protein: Low Carbohydrate Diet Is Related to Metabolic Energy Deficit/ C.C. Metges, I.S. Lang, U. Hennig, [et al.]// PLoS ONE. - 2012. - №7(2). - http://doi.org/10.1371/journal.pone.0031390
37. Munsterhjelm C. Welfare index and reproductive performance in the sow/ C. Munsterhjelm, A. Valros, M. Heinonen [et.al.]//Reproduction in domestic animals. – 2006. – T. 41. – №. 6. – P. 494-500.
38. Peltoniemi O. Parturition effects on reproductive health in the gilt and sow/ O. Peltoniemi, S. Björkman, C. Oliviero// Reprod Dom Anim. – 2016. - № 51. – P. 36–47.
39. Salmon H. The mammary gland and neonate mucosal immunity /H. Salmon// Vet. Immunol/ Immunopath. - Vol 72. - N 1-2. - 1999. - P 143-155.
40. Wu G. Functional amino acids in the development of the pig placenta/ G. Wu, F.W. Bazer, G.A. Johnson, [et al.]// Molecular Reproduction and Development. – 2017. - № 84. – P. 870–882.