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Deficiency Of Iron As A Cause Of Dysfunction In Calves And Piglets.

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ABSTRACT

In many farms for the cultivation and fattening of young cattle and piglets, iron deficiency anemia is often recorded. Iron deficiency in the body leads to a decrease in the level of vital hemoglobin of erythrocytes, the iron of which plays an important role in the formation of the oxygen-hemoglobin complex and the prolongation of its existence. With iron deficiency, the formation of hemoglobin and erythrocytes is disrupted in animals due to the ineffectiveness of erythropoiesis in the following sequence: depletion of the reserve stock of iron; the drop in the level of plasma iron and the percentage of saturation with it of the total iron-binding capacity of the plasma; decrease in the intake of iron in the bone marrow; a violation of the formation of hemoglobin and erythrocytes; reduction of hematocrit and hemoglobin concentration in blood and erythrocyte, microcytosis and hypochromia develop. The iron content in the blood serum of animals inevitably leads to depletion of red blood cells by hemoglobin and the appearance of various tissue changes, the formation of tissue iron-containing and iron-dependent enzymes is disrupted. In order to correct iron deficiency in calves and pigs, iron-containing preparations (imphoferon, imposal-200, myofer, armoredextran, ferrobol, ferrodextran, ferrodex, ferroglucin) are used. The administration of the preparations is two-fold with an interval of 7-10 days, which in most cases fully provides the animals with the necessary amount of iron.

Keywords: iron deficiency, anemia, calves, piglets, hemoglobin, iron-containing enzymes.

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Further development of the society is possible with the intensification of livestock development, which is an important source of food for a large part of humanity [1,2,3]. To solve this problem, it is necessary to improve the feeding patterns of animals, how to grow them and keep them. Very important in this is the solution of the issues of improving the livestock of cattle [4,5].

It is noted that in many Russian farms of all forms of ownership, the intensity of the increase in the number of productive animals depends on effective prophylaxis and correction of various deviations from homeostasis in the young. To the maximum extent, this can be done with the optimal supply of blood in the growing animal organs and tissues, providing the supply of the necessary nutrients and oxygen, as well as the removal of unnecessary metabolic products and carbon dioxide from them [6]. At the same time, until now in many farms for growing and fattening young cattle and piglets, iron deficiency anemia is often recorded among other conditions, in which, in addition to direct losses from animals, large funds are used to correct and carry out various preventive veterinary and sanitary and organizational work to prevent various complications that can additionally cause a reduction in the number of livestock [7].

It is shown that under unfavorable conditions of keeping and feeding of pregnant cows or sows before farrowing and newborn calves and pigs, iron deficiency is most often observed [8]. At the same time, in calves and pigs the serum iron level is lowered, which is normally 12.5-30.4 $\mu\text{mol/l}$. The total iron-binding capacity of their serum is normal, fluctuating from 30.6 to 84.6 $\mu\text{mol/l}$, while sharply increasing [9,10].

Iron deficiency in the body leads to a decrease in the level of vital hemoglobin of erythrocytes, the iron of which plays an important role in the formation of the oxygen-hemoglobin complex and the prolongation of its existence in order to reach this complex of capillaries, where it gradually decomposes and releases oxygen to the tissues [11,12]. With a lack of iron, the duration of such a complex is reduced to a varying degree, being one of the causes of hypoxia [13,14].

Signs of iron deficiency anemia are detected in 6.9-29.3% of 1-3-day calves and about 20% in 30-40-day calves [15]. This is due to the fact that, with a relatively high content of iron in plant foods, the average daily balance of calves in the calves even in the first two months of life is negative, since the young in this period is insufficiently able to absorb the necessary amount of iron from the feed due to the imperfection of its digestive apparatus [16,17]. The cause of iron deficiency anemia in newborn calves largely explains the pre-natal iron deficiency in the cow's feed. Less often iron deficiency anemia in calves of early age can quickly arise in the presence of their gastrointestinal diseases with a decrease in the absorption of alimentary iron and with increased consumption of iron against a background of various diseases [18, 19]. In this regard, iron deficiency in bovine fetuses is the main cause of iron deficiency anemia in calves. Thus, with the industrial method of growing in the phase of newborns, iron deficiency anemia occurs most often, causing an overall decrease in the resistance of the animal's organism to infectious diseases and slowing growth [6]. This iron deficiency anemia occurs immediately after birth and is aggravated during the colostrum due to inadequate intake of iron and food, creating the condition that a significant number of the calves become anemic [20].

To aggravate iron deficiency anemia in newborn calves may be the lack of availability of their body with trace elements such as copper, iodine, cobalt, manganese, etc. Among these microelements, copper, which participates in hemopoiesis, in particular in the synthesis of hemoglobin, and also contributes to a sufficient level of iron adsorption from gastrointestinal tract into the blood [21,22]. Due to lack of copper, iron begins to be absorbed worse, causing an additional depression of hemoglobin synthesis, which leads to aggravation of anemia on the background of hypocupremia and hypo-fermentation [15,23,24].

Anemia of suckling piglets is found everywhere and is especially common in zones with a long winter period [25]. In this case, pigs with access to grass and soil are less susceptible to anemia than piglets grown on cement floors [26]. One of the important predisposing factors leading to a decrease in iron in the body of piglets is the biological feature of their rapid growth [27,28]. That is why this condition is most often recorded in farms where an intensive system of pig rearing is practiced. It was found that the greatest predisposition to iron deficiency anemia appears in the fastest growing piglets [29,30].

As in all animals, piglets have two possibilities to meet the needs in the gland - at the expense of the mother or feed coming from milk and due to internal (endogenous), associated with the disposal of iron from the destroyed red blood cells [31, 32]. Sows' milk, rich in plastic substances, is very poor in iron [33]. In

particular, in their colostrum, it is 2 times less than in the colostrum of cows. Therefore, with a piglet's milk a day can receive only 1-1.5 mg of iron, or only 15-20% of its needs [34].

Endogenous iron released from hemoglobin during the decay of erythrocytes is absorbed by the reticuloendothelial system and proceeds to the synthesis of new erythrocytes, is consumed in the body or is deposited. However, the peculiarity of young animals, including pigs, is that their reticuloendothelial system functions poorly [35].

Predisposing to the emergence of iron deficiency anemia in pigs is the fact that at birth they have a stock of iron is only 50 mg, since the inflow to the fetus during the gestation of sows is limited by the placental barrier and is only 2% of the sow. This insignificant reserve is quickly consumed, as approximately 1 kg of weight gain requires about 27 mg of this element. Therefore, by the 7th-8th day of life piglets often have iron deficiency, and at 3-4 weeks of age anemia can reach climax. The deficiencies in the body of nutrients, vitamins and mineral elements contribute to the onset and severity of the disease, and the fact that the erythrocytes in pigs have a life-time of 63 days against 120 days in other animals [26,36].

In pigs with iron deficiency anemia average daily growth decreases, there is a lag in growth and development [37]. Appear pallor of the skin and visible mucous membranes, which later acquire a yellow color, swelling of the eyelids. The mobility of piglets is noticeably reduced, they become inactive, "burrow into the litter, poorly suck the sow, quickly lag behind in growth, the bristles become rough, brittle, and the skin wrinkled." 38 The abdomen is often swollen or pulled up, diarrhea alternates with constipation, there may be an admixture of mucus in the feces, hemoglobin is sharply reduced in the blood. [39] The number of erythrocytes usually does not change, but sometimes it can decrease to 2 million in 1 mm³. The qualitative composition of erythrocytes accompanied by anisocytosis ohm poikilocytosis, polychromatophilia. Blood detect erythroblasts in which decreased activity of the enzymes catalase, peroxidase, carbonic anhydrase and reduced ascorbic acid content. In severe disease piglets die [34,40].

With iron deficiency, the formation of hemoglobin and erythrocytes is disrupted in animals due to the ineffectiveness of erythropoiesis in the following sequence [41]:

- 1) exhaustion of the reserve stock of iron;
- 2) the decrease in the level of plasma iron and the percentage of saturation with it of the total iron-binding capacity of the plasma;
- 3) decrease in the intake of iron in the bone marrow;
- 4) a violation of the formation of hemoglobin and erythrocytes; reduction of hematocrit and hemoglobin concentration in blood and erythrocyte, microcytosis and hypochromia develop.

In all cases of iron deficiency anemia there is a violation of hemoglobin synthesis in erythroblasts and normocytes with predominance of basophilic and polychromatophilic forms of erythrocytes in the bone marrow due to retention of hemoglobin formation. With iron deficiency anemia qualitative and quantitative composition of red blood cells of calves and piglets changes. Normally, one erythrocyte contains about 280 million molecules of hemoglobin [42,43]. In turn, each such molecule consists of 10 thousand atoms of hydrogen, carbon, nitrogen, oxygen, sulfur. The same system includes 4 iron atoms, which play a major role in ensuring the binding of oxygen to hemoglobin for transport from the lungs to the tissues. With anemia, red blood cells become microcytic and hypochromic - slightly colored with the phenomena of anisocytosis and poikilocytosis. The degree of so-called "dyserythropoiesis" in iron deficiency anemia depends on the severity of the decrease in the concentration of plasma iron [7,44].

The iron content in blood serum of animals inevitably leads not only to depletion of red blood cells by hemoglobin and the appearance of various tissue changes. It is usually believed that they are the result of a disruption in the formation of tissue iron-containing and iron-dependent enzymes, weakening the functions of these tissues.

In addition, with iron deficiency in calves and pigs, the concentration of myoglobin in the heart and skeletal muscles decreases. The activity of cytochromoxidase decreases mainly in the liver and kidneys, succinate dehydrogenase - in the kidneys and myocardium, cytochrome C - in the myocardium, liver and kidneys, catalase - in all internal organs. At the same time, the decrease in the activity of cytochrome oxidase

and succinate dehydrogenase in the epithelium of the mucous membrane of the gastrointestinal tract, resulting in an additional deterioration in iron absorption due to disruption of cellular metabolism and dystrophic lesions of epithelial structures [45].

When iron deficiency decreases, the activity of mitochondrial monoamine oxidase, peroxidase and cytochrome oxidase, which, in combination with a shortage in skeletal muscles of myoglobin and glycerophosphate oxidase, creates conditions for the occurrence of phenomena in animals with muscle weakness [46].

In mild cases of iron deficiency anemia, the prognosis in animals is favorable. In others - doubtful or unfavorable. Iron deficiency anemia develops quickly, and without treatment calves and pigs die on the 10-14 day, usually suddenly and the best litters, often without visible signs, most often due to acute hypoxia. The case can be 60-80% [6,47].

For the purpose of correcting iron deficiency, iron-containing preparations are used. The most effective are iron-dextran remedies, which are obtained by combining iron with polysaccharide dextran, which easily form colloidal solutions. These include imoferon, imposal-200, myofer, armoredextran, ferrobol, ferrodextran, ferrodex, ferroglicin [26]. They are administered intramuscularly in the region of the thigh or behind the auricle with a therapeutic purpose, as a rule, twice from the calculation of not less than 200 mg of iron once. In the body, iron is released from the compound with dextran and disposed of (absorbed) by the cells of the reticulohistiocytic system. Absorption begins 3-4 hours after the administration of the drug, is completed within 3-4 days and is consumed by the body for about 30 days [48]. Repeated administration of drugs is practiced after 7-10 days. As a result of two-fold administration of the preparation, calves and piglets are in most cases fully provided with the necessary amount of iron [49]. One of the most long-lasting drugs is well-proven and effective is ferroglicin, which can create enough iron reserves in animals to build a hemoglobin molecule and the functioning of enzyme systems.

CONCLUSION

Iron deficiency is a serious problem in practical biology, animal husbandry and pig breeding and still deserves close attention to the study of the mechanisms of its consequences for the development of the most rational approaches to their complete correction, which facilitates the maximum realization of the genetic potential to animals at subsequent stages of its ontogeny.

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