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The Influence Of Feed Additive Of Zeolite On Micromorphology Of Certain Organs Of The Digestive System Of Calves.

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ABSTRACT

With the use of histological and morphometric methods, morphofunctional characteristics of rennet, duodenum, liver and pancreas of cattle on a normal diet and with the introduction of a zeolite of a local deposit are given. Studies have shown that feeding to zeolite bulls at a dose of 3% in the organs and tissues of animals noted structural and functional changes in the digestive system in the form of a deepening of the gastric pits, lengthening the villi of the duodenum with a thickening of the brush border of the enterocytes that reflect the activation of parietal digestion. In the liver and pancreas, the hepatocytes and glandulocytes of the acini showed no signs of granular dystrophy characteristic of the disruption of protein metabolism, which indicated the normalization of metabolism. The obtained results confirm the expediency of using zeolite for improving the digestibility of fodder and improving the meat productivity of cattle.
Keywords: zeolite, bulls, micromorphology, digestion

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INTRODUCTION

In modern conditions of increased man-caused intoxication and intensive industrial technology, prevention and rehabilitation therapy of acute and secretively occurring structurally functional disorders of the digestive organs of agricultural animals is an actual task of veterinary medicine. One of the ways to solve this problem are natural zeolites, which have unique adsorption, ion-exchange and catalytic properties, many studies have been devoted to biotechnology, animal husbandry, practical medicine and veterinary medicine [1,2,4,7,9,11,12]. The positive effect of zeolites on protein, fatty and carbohydrate metabolism in the body, detoxification of the liver, morphological and biochemical parameters of blood is established, they prevent exogenous microelement toxicoses (toxicopathies), promote the excretion of endo- and exotoxins from the organism [3,5,6,8, 10]. Of particular interest are studies of the action of zeolites on the organs of the digestive system, since they, in the first place, interact with the tissues of these organs. A number of researchers report the positive effect of zeolites on the structure and function of the digestive organs of pigs and agricultural birds. It was found that the action of zeolites on the mammalian animals and birds determines a number of factors, primarily the chemical composition and physical and chemical properties of the zeolite rock, which for each deposit are different. The effect of zeolite on metabolic processes and the state of internal organs also depends on the digestion and the pH of the various parts of the gastrointestinal tract of a particular animal species, since it has been established that when the acids are activated, the zeolites are leached [1]. In addition, the effect of zeolite on the body is determined by the doses, methods of preparing and introducing a feed additive into the diet.

In this regard, in each case, a detailed study of the properties of the mineral, its effect on the metabolism and the structural and functional state of the internal organs of animals is required.

The purpose of this work is to study the morphofunctional state of the digestive organs of bull-calves, who received in the rations a zeolite additive of the Tatar-Shatrashan deposit.

MATERIALS AND METHODS

The object of research were some digestive organs of bull-calves of black-and-motley breed at the age of 15 months, grown in the collective farm "Kommuna" of the Buinsk district of the Republic of Tatarstan during the scientific and economic experience. For the experiment, 2 groups of animals were formed. The groups were formed on the basis of analogues from clinically healthy animals at the age of 12 months. According to the scheme of the experiments, the animals of the first control group received the main diet (OP) taken at the farm, the animals of the second test group received a zeolite of the Tatarsk-Shatrashan deposit in the amount of 3% of the dry matter of the diet in addition to the OR within 90 days. During the experiment, clinical observations were constantly conducted, in which the general condition, food excitability, stool consistency, orienting reflexes, and the mass of bull calves were taken into account. Daily safety of livestock, consumption and feed intake were taken into account.

The material for research was obtained after the slaughter of animals at the slaughterhouse of the enterprise by bleeding, during which they were guided by the requirements contained in Art. 11 and 15 of the Federal Law of the Russian Federation "On the Protection of Animals from Cruel Treatment" (adopted by the State Duma on December 1, 1999) and in the "Methodological Recommendations for Studying Meat Productivity and Quality of Cattle Meat (approved by the All-Union Research Institute of Livestock in 1977 g.). For histological studies, pieces of the wall of abomasum, duodenum, pancreas and liver of experimental animals were taken. The material was fixed in 10% aqueous and alcoholic solutions of formalin. Sealing of the material was carried out by pouring into paraffin. Histos cuts were stained with Bemer's hematoxylin and an aqueous 0.1% solution of eosin, azur-2, and eosin by Romanovsky-Giemsa (AV Zharov, 2003; RM Suleimanov, 2007). The preparations were analyzed using a Biomed-1 light microscope (LOMO, Russia), Vol. 20 and 40, approx. 10.

RESULTS AND DISCUSSION

In control animals, in the abomasum and in the small intestine, a moderate folding of the mucosa, an abundance of thick mucus on the surface, and a moderate supply of wall vessels were detected. The liver had

several blunted edges, a flabby consistency, a gray-brown color, a smoothed pattern of the lobate structure on the incision. Pancreas - pale gray color, unevenly-elastic consistency, with a distinct lobulation of the structure.

At histological examination, the walls of the abomasum of control bull-calves revealed the three-layer principle of structure characteristic of the organ. The mucous membrane contained cardiac, base and pyloric glands with moderate functional activity of the glandulocytes. Gastric fossae had a slight depth, the lining of their epithelium was with signs of increased secretory activity.

The duodenum on the surface of the mucosa contained well-formed villi, covered with limpid epithelium, which on most of its apical areas was desquamated. The main plate of the mucosa was infiltrated by lymphoid-histiocytic cells. The vascular pattern was clearly distinguished in connection with hyperemia. Complex alveolar gland of submucosa had enlarged lumens of terminal sections.

The liver of the control bull-calves had a weakly expressed pattern of lobed structure characteristic of ruminants. Centrolobular hepatocytes had a moderate granularity of the cytoplasm with signs of karyopicnosis in individual cells (see Figure 1). Among the periportal hepatocytes met diploid cells. The central vein and sinusoidal capillaries are enlarged, the perisinusoid spaces of Diss are distinctly visible. Sinusoid cells are moderately activated. In the interlobular connective tissue, the structures of the triads were well identified. Among the cells of the stroma of the organ contained a significant number of lymphoid and histiocytic elements.

In the lobules of the pancreas, the acini of the exocrine part of the body were lined with glandulocytes with well-differentiated basal and apical with zymogenous granular poles, with a moderately pronounced lumen (Figure 2). Pancreatic islets consisted of a small number of endocrinocytes, larger in size than exocrine glandulocytes. Sinusoidal capillaries of the islets were distinctly distinguished.

In bulls that received a feed additive of the zeolite, no examination of organs and tissues showed macroscopically visible changes in organs and tissues. Structural and functional state of the abomasum, duodenum, liver, pancreas corresponded to the parameters of species for cattle and age indices of animals.

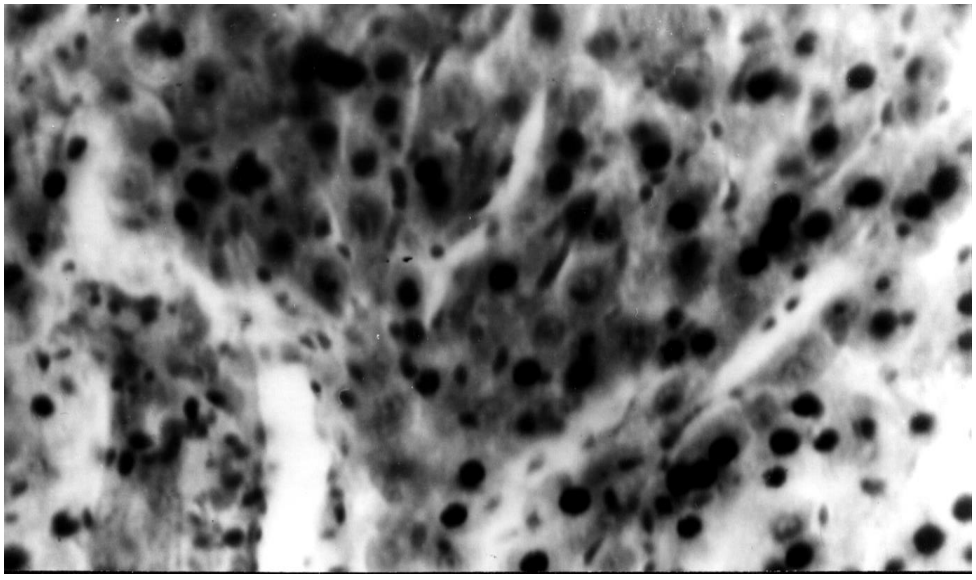

Fig 1: Centrolobular hepatocytes with moderate cytoplasmic granularity and karyopicosis of individual cells in the liver of control bull-calves. Staining with hematoxylin and eosin. x 400

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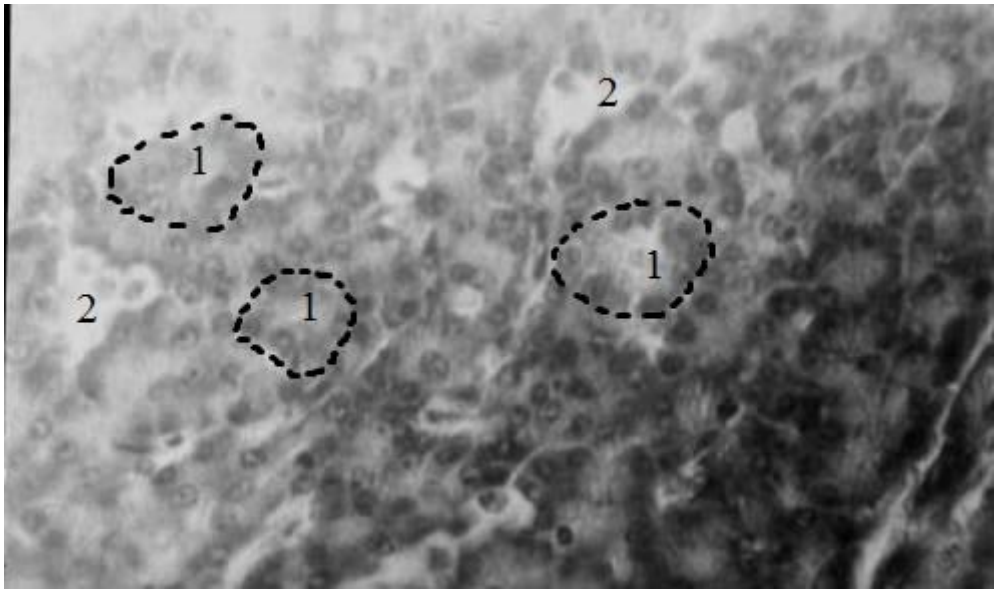

Fig 2: Acinus of the pancreas lobule (1) and pancreatic islets (2) with moderate functional activity in the control bull. Staining with hematoxylin and eosin. x 400

Histological examination of the abomasum noted a deepening of the gastric pits, a moderate functional activity of the glandulocytes of the cardial, base and pyloric glands.

In the duodenum (Figure 3), well-formed elongated villi, covered with limemate enterocytes, were identified. The crypts were of moderate depth, comparatively tightly fitting to each other. The main plate of the mucosa contained cells of the lymphoid and fibroblastic series, histiocytes, single labrocytes. When analyzing the cellular composition of villous epithelial cells, single goblet cells were detected with a large magnification of the microscope, the brush border of surface enterocytes became very noticeable at the apical pole, occupying one third of the height of the cells (Figure 4). The increase in the number of goblet cells is probably due to the compensatory replacement of the deficiency of hydrogen cations, some of which are sorbed by the zeolite [1].

Of particular importance is the study of the effect of zeolite on the morpho-functional state of the liver, because, firstly, the toxicants penetrating the body through the gastrointestinal tract come first to the liver, since it is the first organ on the path of xenobiotics resorbed in the internal environment of the body; Secondly, the liver is the main organ responsible for metabolism. Xenobiotics can have a direct and indirect effect on the cytoskeleton of hepatocytes. This is accompanied by structural disorders with the formation of membrane ruptures and can lead directly to cell death (Florine-Casteel K. et al., 1991).

According to our data, in the liver lobules of animals that received 3% zeolite, the centrolobular hepatocytes had well-formed nuclei, uniformly eosinophilic cytoplasm, formed cell strings causing the beam pattern. The sinusoidal capillaries and perisinusoid spaces of Diss were weakly expressed. In the endotheliocytes, stellate (Kupferov) reticuloendotheliocytes, and fat accumulating cells, the sinusoidal walls did not show any changes visible in the light microscope. Periportal hepatocytes formed a pattern of the beam structure. Among them, there were diploid cells (Figure 5), indicative of physiological regeneration of the organ.

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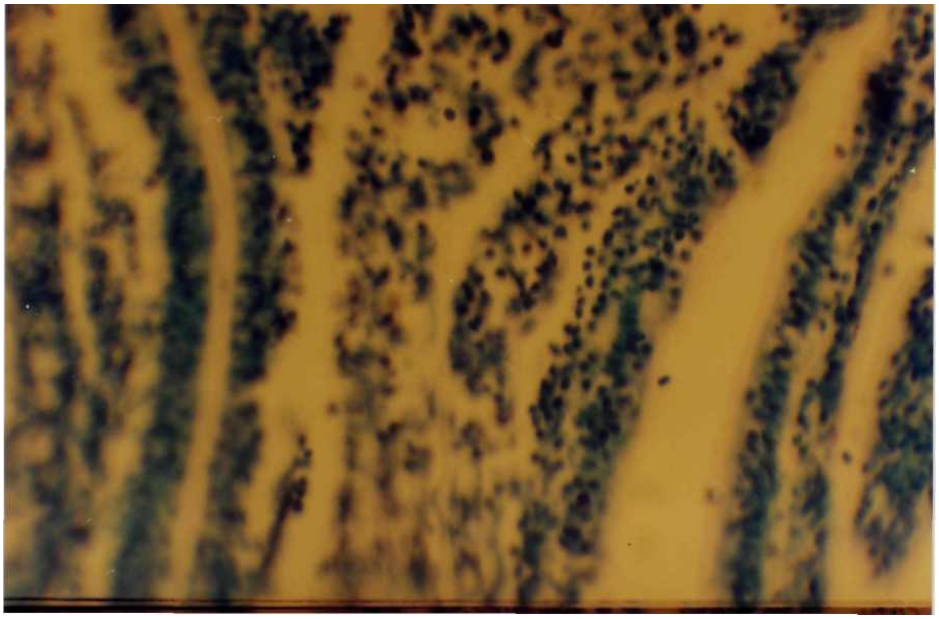

Fig 3: Moderate infiltration of the base with mucous lymphoid-histiocytic cells, limbic enterocytes on the surface of the villi of the duodenum in the bull-calf, which received zeolite in the diet. Coloring by Romanovsky - Giemsa. x 200.

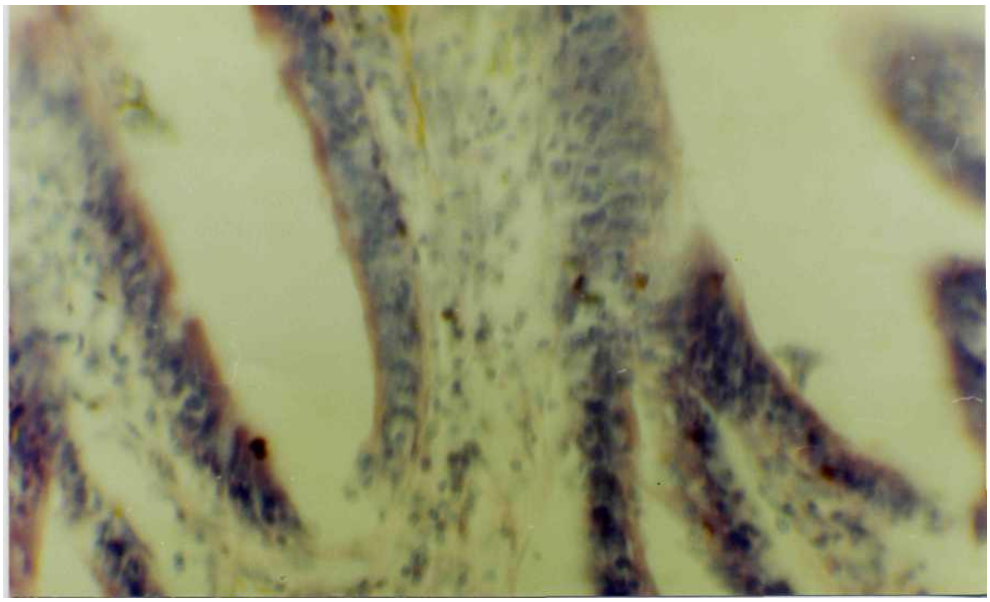

Fig 4: Detail of the figure 3. Expression of the brush border of the enterocytes. x 400

The lumens of the pancreatic acinus were well detected (Figure 6). The glandulocytes forming the wall contained well-formed nuclei in the basal part of the cells. Apical poles were filled with zymogen seeds. Pancreatic islets had a significant saturation with endocrine cells and the fullness of sinusoidal capillaries.

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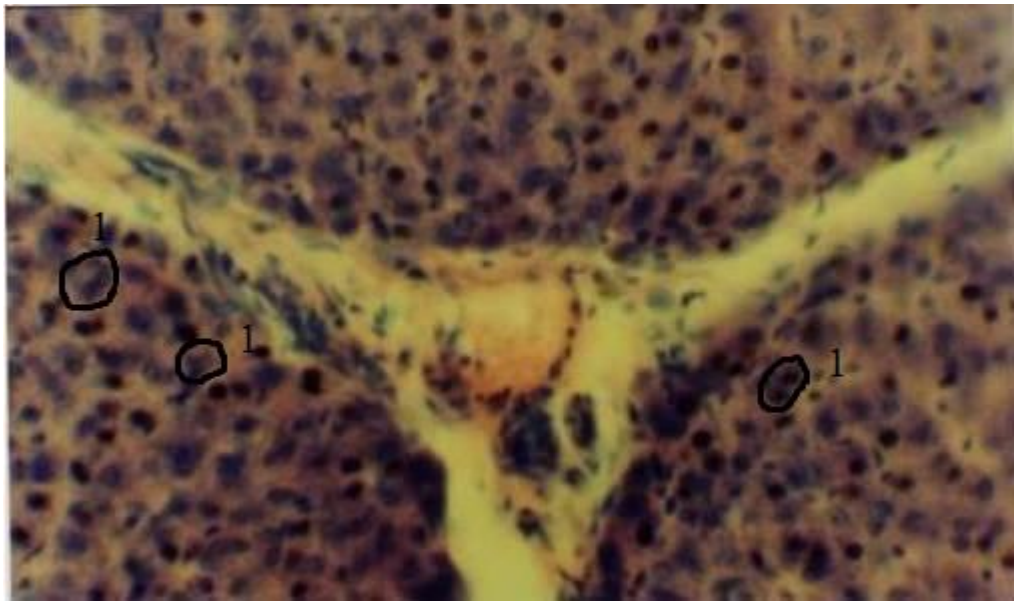

Fig 5: Periportal hepatocytes with the presence of diploid cells (1). Staining with hematoxylin and eosin. x 200

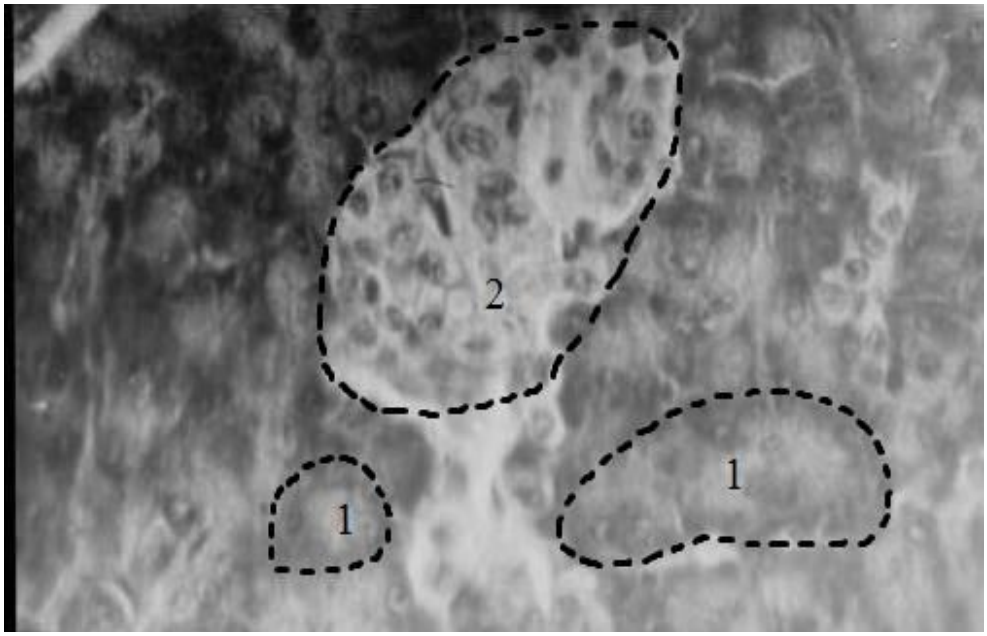

Fig 6: Expansion of the lumen of the acini (1) and the size of the pancreatic islet of the pancreas in the bull which received 3% of the zeolite. Coloration of azur II - eosin. x 400

Studies of the effect of feeding zeolites of the Vanginskoye deposit in an amount of 5% of the weight of the mixed fodder found that prolonged exposure to the mineral on the chickens' organism does not cause pathological changes in the liver, thick and thin sections of the intestinal tract, stabilizes the morphological picture of the liver, small and large intestine, reduces dystrophic, atrophic and inflammatory processes in the liver and intestines, increases the histofunctional activity of hepatocytes of the liver.

When feeding zeolite pigs of the above-named deposit at a dose of 1.0 g / kg of weight after 60 days, researchers also observed significant changes in the histological pattern and morphometric parameters of cells in the liver. The structure of the hepatic lobules was preserved, lobules with a clearly defined girder structure, in places there was a slight increase in the fuchsinophilic connective tissue. Hepatocytes are polygonal in shape, with a uniformly colored cytoplasm. There was an insignificant number of cells with paired nuclei. In

piglets that received zeolites at a dose of 0.25 and 0.5 g / kg, moderate expansion and vasoconstriction was established, expansion of the Disses was maintained, sinusoidal spaces were filled with erythrocytes, along the periphery of the lobules, a proliferation of connective tissue and along it small clusters of lymphoid cells . The lobules were with a pronounced girder structure.

Based on the results of morphological, histological, hematological indices, a positive effect of natural zeolites of the Kempendyai deposit on the structure of the glandular stomach, duodenum and liver of hens was established. The most effective was the use of 5% zeolite for 14 days. It was proved that during this period the absorption processes in the villi of the intestine are activated, the thickness of the mucosa, the submucosa, smooth muscle tissue of the muscular membrane increases, which increased the intensity of motor and enzymatic processing of the forage mass. The pattern of the structure of the liver was well expressed. The general plan for the structure of the organ, its lobules and the basic histological structures is preserved. Sinusoidal capillaries clearly defined. Glycogen is located in the cytoplasm of cells evenly, there were no morphofunctional changes in the karyocytometry and nuclear-plasma ratio of hepatocytes. Analysis of karyocytometry of liver hepatocytes showed that the width and height of hepatocyte nuclei, the width and height of hepatocytes, and the nuclear-cytoplasm ratio of hepatocytes do not vary.

The results of experimental studies indicate that during the passage through the gastrointestinal tract prerequisites arise for the acid and mechanochemical activation of zeolites. It is possible that Liis acid sites formed in positions with three-coordinated Al atoms with deficiency of oxygen atoms are formed in zeolites. Therefore, probably, the number of bocalocytes in the tissue of the small intestine mucosa is increasing. Catalytic centers are located not only in the pores, but also on the open surface, which in the zeolite is highly developed due to structural features. As a result, zeolites are converted into monofunctional catalysts.

When zeolite was fed to laboratory rats, structural changes in the liver were not specific, the number of binuclear hepatocytes increased, central veins and sinusoidal capillaries widened. In hepatocytes expressed hyperplasia of the granular endoplasmic reticulum, autophagolysomes were activated. In the disses expansed the pores of the endothelial lining, undergone hyperplasia and focal atrophy of microvilli of hepatocytes and endothelial cells, detritus and free lysosomes accumulated, erythrophagia increased and collagen fibers expanded.

In our studies, in the control group calves who received the main diet, subacute catarrhal gastroenteritis was detected in macro and microscopic examination of organs and tissues; granular dystrophy of liver parenchymal cells; hemodynamic disorders in the form of subacute congestive hyperemia of the vessels of the microcirculatory bed. The revealed changes testified to the violation of protein metabolism in the form of intracellular disproteinoses of the parenchymal organs of the organ, the dystonia of the vessels of the microcirculatory bed.

Feeding of the Tatarsko-Shatrashanskoe zeolite at the dose of 3% (from the dry matter of the diet) had a positive effect on the structural homeostasis of the organs studied. In the organs and tissues of the bull-calves, structural and functional changes were noted in the digestive system in the form of a deepening of the gastric pits, lengthening of the villi of the duodenum with thickening of the brush border of the enterocytes, reflecting an increase in the area of contact between the mucosa and the feed and activation of parietal digestion. In the liver and pancreas, the hepatocytes and glandulocytes of the acini showed no signs of granular dystrophy characteristic of the disruption of protein metabolism, which indicated the normalization of metabolism.

CONCLUSION

Thus, the inclusion of the optimal dose of the mineral additive zeolite of the Tatarsko-Shatrashan deposit of the Republic of Tatarstan in the dose of 3% of the dry matter in the diet had a positive effect on the structural and functional state of the animal's internal organs, and, consequently, on the metabolism in general, that will undoubtedly increase the meat productivity of cattle.

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REFERENCES

[1] Aidash A.A. et al. Effect of zeolite tuffs on the organism during oral intake // Experimental studies. 2016; 1 (53): 115-122.

[2] Holohast K.S. Prospects of Biomedical Use of Natural Minerals // Izvestiya of the Samara Scientific Center of the Russian Academy of Sciences. 2009; 1 (2): 208-211.

[3] Gorkovenko N.E. The use of zeolites for detoxification of broilers 2006; 5: 18-19.

[4] Christaki E. al. Effects of dietary inclusion of natural zeolite and flaxseed on broiler chickens' body fat deposition in an extended fattening period. Arch. Geflügelk 2006; 7: 106-111.

[5] Colic M. Proceedings of the Samara scientific center of the Russian Academy of Sciences, 2009; 11: 210.

[6] Kantiranis N. al. The uptake ability of the Greek natural zeolites. Proceedings of the 6th International Conference on the occurrence, properties and utilization of natural zeolites. Thessaloniki. Greece. 2002: 155-156.

[7] Kralj M. and Pavelic K. Medicine on a small scale. EMBO reports. 2003; 11: 1008-1012.

[8] Nassiri M.H. al. Innfluence of Dietary Zeolite Supplementation on the Performance and Egg Quality of Laying Hens Fed Varying Levels of Calcium and Nonphytate Phosphorus . Journal of Biological Sciences 2008; 2: 328-334

[9] Papaioannou D. al. The role of natural and synthetic zeolites as feed additives on the prevention and or treatment of certain farm animal diseases. Microp. Mesop. Mat. 2002; 84: 161-170.

[10] Safaeikatouli M. al. An Evaluation on the Effects of Dietary Kaolin and Zeolite on Broilers Blood Parameters, T4, TSH, and Growth Hormones. Pakistan Journal of Nutrition 2011; 3: 233-237.

[11] Vesna L. and Ivkovic S. and Vesna T. Prebiotic activity of zeolite based products. 5-th International Conference and Exhibition on Nutraceuticals and Functional Foods, San Francisco 2004: 18-19.

[12] Wang Y. and Lin F. and Pang W. Ion exchange ammonium in natural and synthesized zeolites. Journal Hazardous Materials 2008; 60: 371–375.