



Effect of Chitosan Hydroxyapatite on Biochemical Parameters of Rabbit Blood

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Abstract: For the experiment, 16 local breed rabbits aged 1.5–2 months were obtained from the rabbit breeding enterprise “Aslxo‘ja Darg‘om Agro Velikan” LLC. The animals were divided into four groups of four rabbits each and kept in wire cages. The first group served as the control group and was fed a standard farm ration. The second, third, and fourth groups were experimental groups: the second group received chitosan 20–80 at a dose of 10 mg/kg, the third group received 15 mg/kg, and the fourth group received chitosan 70–30 at a dose of 18 mg/kg, mixed into the feed for 30 days. The effectiveness of the administered preparation was evaluated based on the morphological parameters of the blood.

Keywords: rabbit, chitosan, hydroxyapatite, erythrocyte, leukocyte, thrombocyte, hemoglobin.



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Introduction

Rabbit breeding is considered one of the economically efficient and highly profitable sectors of animal husbandry. Compared to other animals, rabbits reach sexual maturity earlier, and their gestation period is relatively short, resulting in high reproductive capacity. Within one year, a single female rabbit can produce 4–6 litters, and up to 100 kg of meat products can be obtained relative to body weight. Rabbits are also widely used as laboratory animals in various experimental studies in general biology, medicine, and veterinary science [1; 2; 3].

Currently, in private subsidiary farms of our country, rabbits are mainly raised for personal consumption. The low level of production of rabbit products in household farms is due to the use of extensive and outdated breeding technologies, failure to follow basic zootechnical and veterinary rules, and the lack of systematic development of highly productive rabbit breeds. Therefore, addressing these issues is of great importance for the development of the sector [4; 5].

The number of individuals engaged in this profitable activity is still limited, and many lack sufficient information. Thus, it is necessary to intensify awareness and promotion activities. Rabbit breeding must reach an industrial level, where producers clearly understand the market opportunities for their products. The formation of a proper feed base is also an urgent issue. In this regard, significant attention is being paid at the national level to strengthen and develop this sector [6; 7; 8]

Rabbit skin is also considered a high-quality raw material for the production of leather goods and footwear. One kilogram of rabbit wool can produce up to 2000 meters of high-quality yarn. In

general, rabbits have numerous valuable economic and biological advantages. Therefore, the development of this sector is highly relevant [9;10].

The chitosan (CS) hydroxyapatite (HA) composite has been studied for applications in various fields, including bone tissue engineering, dentistry, and veterinary practice. Chitosan is of particular interest due to its biological activity, excellent matrix-forming ability, and antibacterial properties. Currently, calcium phosphates such as tricalcium phosphate, monocalcium phosphate, and dicalcium phosphate are widely used as feed additives in poultry and livestock production. In modern poultry farming, rapidly growing birds often develop skeletal disorders. Studies have shown that nano-hydroxyapatite administered in ovo has a positive effect on bone condition and promotes body weight gain [11; 12].

Its closest structural analog, chitosan sulfate, also exhibits anticoagulant activity, which increases with the degree of sulfation.

Considering that the chitosan *Bombyx mori* hydroxyapatite preparation contains calcium and phosphorus elements and possesses immunomodulatory properties, this study aims to determine the effects of its various fractions on the physiological condition of rabbits and certain hematological parameters of their blood, thereby contributing to solving the aforementioned problems [13; 14; 15].

Materials and Methods

Laboratory experiments were conducted using 16 local breed rabbits aged 1.5–2 months obtained from the rabbit breeding enterprise “Aslxo‘ja Darg‘om Agro Velikan” LLC located in Pastdarg‘om district, Samarkand region. The animals were divided into four groups of four rabbits each and housed in wire cages.

The first group was fed a standard farm ration and served as the control group. The second, third, and fourth groups were experimental groups. The second group received chitosan 20–80 at a dose of 10 mg/kg, the third group received 15 mg/kg, and the fourth group received chitosan 70–30 at a dose of 18 mg/kg mixed into the feed for 30 days.

Blood morphological parameters were examined on the 10th, 20th, and 30th days of the experiment. Macroelement parameters in blood samples were analyzed using a CS-T180 analyzer at the ARSYMED medical laboratory in Samarkand city hospital.

The obtained data were processed using variation statistics according to S.I. Lyutinskiy and V.S. Stepin (1989). The significance level between values was determined according to Student’s t-test at $P \leq 0.05$.

Results and Discussion

The results of the 30-day experiment and observations showed that rabbits in the second experimental group receiving chitosan 20–80 at a dose of 10 mg/kg with feed demonstrated an increase in blood serum biochemical parameters compared to the control group. Specifically, total protein and albumin levels increased by approximately 3%, total calcium increased by 3.3%, and alkaline phosphatase activity increased by 6.5% relative to the control group.

In rabbits of the third and fourth experimental groups receiving chitosan 50–50 and chitosan 70–30 preparations at doses of 15 mg/kg and 18 mg/kg of feed, respectively, until the end of the experiment, more pronounced changes were observed. Total serum protein levels increased by 8.1–11.3%, albumin by 7.6–11.0%, total calcium by 2.6–3.9%, inorganic phosphorus by 6.4–7.5%, and alkaline phosphatase enzyme activity by 10.5–32.8% compared to the control group.

These findings indicate that chitosan hydroxyapatite supplementation positively affects protein metabolism, mineral metabolism, and enzymatic activity in rabbits. The observed increase in total protein and albumin suggests enhanced protein synthesis and improved metabolic activity, while elevated calcium and phosphorus levels indicate improved mineral metabolism and potential enhancement of bone formation processes. Increased alkaline phosphatase activity further confirms the stimulation of osteometabolic processes.

The obtained results are presented in Table 1.

Table 1. Effect of Bombyx mori chitosan hydroxyapatite-based preparations on biochemical parameters of rabbit blood serum

No.	Group	Preparation	Dose (mg/kg)	Number of rabbits	Total protein (g/L)	Albumin (%)	Total Ca (mmol/L)	Inorganic P (mmol/L)	Alkaline phosphatase (%)
1	Control	—	—	20	61.20 ± 1.28	60.55 ± 1.7	2.35 ± 0.05	0.74 ± 0.02	45.81 ± 0.31
2	Experimental	Chitosan 20–80	10 mg/kg	20	63.05 ± 1.15	62.25 ± 1.1	3.12 ± 1.10	1.00 ± 0.01	48.11 ± 0.33
3	Experimental	Chitosan 50–50	15 mg/kg	20	66.16 ± 1.18	65.14 ± 1.1	6.05 ± 1.16	2.10 ± 0.03	51.46 ± 0.21
4	Experimental	Chitosan 70–30	18 mg/kg	20	68.10 ± 0.05	67.05 ± 2.4	9.11 ± 2.00	2.95 ± 0.01	68.10 ± 0.15

Conclusions

The results of the 30-day experimental study demonstrated that supplementation of rabbit diets with chitosan hydroxyapatite preparations had a positive effect on blood biochemical parameters.

In rabbits of the second experimental group receiving chitosan 20–80 at a dose of 10 mg/kg of feed, increases in serum total protein, albumin, total calcium, and alkaline phosphatase activity were observed compared to the control group.

More pronounced effects were observed in the third and fourth experimental groups receiving chitosan 50–50 and chitosan 70–30 at doses of 15 mg/kg and 18 mg/kg, respectively. In these groups, serum total protein, albumin, total calcium, inorganic phosphorus levels, and alkaline phosphatase activity were significantly higher than in the control group.

These findings indicate that Bombyx mori chitosan hydroxyapatite preparations positively influence protein metabolism, mineral metabolism, and enzymatic activity, thereby improving the physiological and metabolic status of rabbits.

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