Modern American Journal of Biological and Environmental Sciences
ISSN (E): 3067-7920
Volume 2, Issue 1, January, 2026
Website: usajournals.org

EFFECT OF BIOACTIVE CHITOSAN-CONTAINING COMPOUNDS ON THE ACTIVITY OF DIGESTIVE ENZYMES (AMYLASE, LIPASE, PROTEASE)

Rakhmonov Farkhod Kholbayevich
Assistant, Zarmed University, Samarkand, Uzbekistan
E-mail: farxod1313jon@gmail.com

Furkatova Sabrina Farmonovna
Student, Zarmed University, Samarkand, Uzbekistan
E-mail: sabrinariiwix3388@gmail.com

Abstract
This research investigates the modulatory effects of chitosan-based bioactive compounds on three key digestive enzymes—amylase, lipase, and protease. Due to its sorptive capacity, muco-protective behavior, and microbiota-regulating properties, chitosan contributes substantially to optimizing gastrointestinal biochemical conditions. Experimental findings show that a dietary inclusion of 100 mg/kg chitosan markedly improves the hydrolysis of carbohydrates, lipids, and proteins. The demonstrated enhancements suggest that chitosan can serve as a functional feed additive and an effective physiological regulator of digestive enzyme activity.

Keywords: Chitosan, digestive enzymes, intestinal microbiota, pH regulation, amylase, lipase, protease, bioactive compounds.

Introduction
Digestive enzymes are essential for the hydrolysis of macromolecules into absorbable forms. Their activity depends on several physiological factors,

Modern American Journal of Biological and Environmental Sciences
ISSN (E): 3067-7920
Volume 2, Issue 1, January, 2026
Website: usajournals.org

including intestinal pH, substrate accessibility, microbiota composition, and the functional status of the mucosal surface. Chitosan, a partially deacetylated derivative of chitin, has received increasing scientific attention owing to its polycationic structure, which enables interactions with organic acids, lipids, proteins, and microbial cell components.

According to studies by CIS researchers — Sidorov [6], Nazarov [7], and Murygin [8] — chitosan contributes to stabilizing intestinal pH, mitigating pathogenic overgrowth, improving mucosal integrity, and enhancing enzymatic performance. Despite these observations, the mechanistic foundations of how chitosan influences amylase, lipase, and protease activity still require systematic investigation. Therefore, this study aims to evaluate the extent to which chitosan modulates digestive enzyme function and to determine the optimal dosage for maximum physiological efficiency.

Main Part. 1. Biological and functional characteristics of chitosan

Chitosan is a multifunctional biopolymer endowed with physiological effects that are highly relevant to digestive processes. Its principal properties include:

– efficient binding of toxins, bile acids, and microbial metabolites [1];
– formation of protective mucosal films that reduce epithelial irritation [2];
– modulation of chyme viscosity, leading to improved substrate dispersion and enzyme access [3];
– suppression of pathogenic microorganisms, thereby enhancing microbiota balance [6, 7];
– regulation of intestinal pH toward an optimal biochemical range [8].

Collectively, these characteristics allow chitosan to act as a biochemical modulator, helping create favorable conditions for digestive enzyme function.

2. Effect of chitosan on amylase activity

Amylase catalyzes the conversion of polysaccharides into simpler carbohydrates. Chitosan enhances amylase efficiency through multiple mechanisms:

Modern American Journal of Biological and Environmental Sciences
ISSN (E): 3067-7920
Volume 2, Issue 1, January, 2026
Website: usajournals.org

– reducing microbial fermentation in the upper gastrointestinal tract [6];
– improving contact between amylase and its substrate;
– stabilizing pH at physiologically favorable levels [1, 3];
– strengthening mucosal protection, thereby reducing enzymatic degradation [8].

Sidorov [6] reported that the inclusion of chitosan in the diet increases carbohydrate hydrolysis efficiency by approximately 18%.

3. Effect of chitosan on lipase activity

Lipase plays an essential role in the breakdown of triglycerides into free fatty acids and glycerol. Chitosan positively influences lipase by:
– binding inhibitory free fatty acids [7];
– supporting micelle stability and improving lipid emulsification [1, 3];
– moderating intestinal acidity, which enhances pancreatic lipase performance [2];
– promoting uniform dispersion of lipid substrates along the intestinal lumen.

Nazarov [7] documented a 15–20% improvement in lipid utilization when chitosan was incorporated into the diet.

4. Effect of chitosan on protease activity

Proteolytic enzymes such as trypsin and chymotrypsin are responsible for protein breakdown into peptides and amino acids. Chitosan enhances protease activity by:
– facilitating better enzyme–substrate interactions [2, 8];
– reducing the population of proteolytic pathogenic microorganisms [6];
– maintaining pH levels conducive to efficient proteolysis [1];
– protecting proteolytic enzymes from premature degradation [3].

Murygin [8] confirmed a 10–14% increase in protease activity with chitosan supplementation.

Modern American Journal of Biological and Environmental Sciences
ISSN (E): 3067-7920
Volume 2, Issue 1, January, 2026
Website: usajournals.org

Methodology. The experiment spanned 21 days and included four treatment groups:
– **Control (K):** no chitosan added;
– **H1:** 50 mg/kg chitosan;
– **H2:** 100 mg/kg chitosan;
– **H3:** 150 mg/kg chitosan.

Measured parameters:
– amylase activity (U/ml);
– lipase activity (U/ml);
– protease activity (U/mg protein);
– intestinal pH;
– percentage of pathogenic microflora.

Results

Parameter	K	H1	H2	H3
Amylase, U/ml	112 ± 4	125 ± 5*	138 ± 5	136 ± 5
Lipase, U/ml	63 ± 2	70 ± 2*	78 ± 3	75 ± 2
Protease, U/mg	8.2 ± 0.3	9.0 ± 0.3*	9.7 ± 0.3	9.5 ± 0.3
Intestinal pH	5.9	6.2	6.4	6.3
Pathogenic microflora	100%	82%	65%	68%

*$P < 0.05$ compared to the control.

Analysis

The experimental results reveal a distinct dose-dependent response. The H2 group (100 mg/kg) demonstrated the most significant improvement across all enzyme activities. These enhancements can be attributed to:
– improved physicochemical stability of the intestinal environment;
– increased availability of substrates for digestive enzymes;
– reduction of pathogenic microbial load;
– maintenance of optimal pH conditions [6, 7, 8].

ISSN (E): 3067-7920
Volume 2, Issue 1, January, 2026
Website: usajournals.org

The slight reduction in the H3 group indicates that higher chitosan concentrations may bind substrates excessively, limiting enzymatic access — a phenomenon consistent with the "over-sorption effect."

Conclusion

Chitosan is a highly effective modulator of digestive physiology.

1. Supplementation significantly enhances the activities of amylase, lipase, and protease.
2. Its beneficial effects stem from pH stabilization, microbiota improvement, and increased substrate–enzyme contact.
3. The optimal effective dosage identified in this study is **100 mg/kg**.
4. Chitosan shows strong potential as a functional feed additive in poultry production and as a supportive agent in biomedical digestive regulation.

References

1. Park S., Kim J. Chitosan-based bioactive compounds in digestive physiology // Journal of Nutritional Biochemistry. – 2021. – No. 12. – P. 45–53.
2. Watson L., Green M. Gastrointestinal enzyme regulation and polysaccharides // Digestive Biochemistry Review. – 2020. – Vol. 18, No. 3. – P. 112–120.
3. Lee H. Functional properties of chitosan in metabolic processes // Biopolymers & Health. – 2022. – No. 4. – P. 78–89.
4. Martins A. Chitosan interaction with digestive enzymes // Journal of Biological Polymers. – 2019. – No. 9. – P. 33–41.
5. Ahmed Z., Raza S. Modulatory effects of chitosan on pancreatitis enzymes // Clinical Nutrition Research. – 2023. – Vol. 7. – P. 55–63
6. Sidorov V. A. Biological activity of chitosan and its influence on enzymatic processes in animals // Veterinary Biotechnology. – 2018. – No. 2. – P. 14–19.
7. Nazarov K. V. Regulation of lipid metabolism under the influence of chitosan // CIS Biochemistry Journal. – 2019. – No. 5. – P. 27–34.
8. Murygin A. L. Polysaccharides in the regulation of proteolytic enzymes // Experimental Biology Journal. – 2020. – Vol. 22, No. 1. – P. 40–47.

9. Rakhmanov F., Usmanova Kh., Khodjaerova G. Effect of bioadditional supplements on broiler chicken // International Multidisciplinary Journal of Research and Development. – 2025. – Vol. 1, No. 2. – P. 3–7.
10. Sh. U. T., Kh. R. F. Dry whey: a promising product for the food industry and agriculture // Web of Teachers: Inderscience Research. – 2025. – Vol. 3, No. 3. – P. 16–18.
11. Xolbayevich R. F. et al. Effect of chitosan and whey powder on productivity of broiler chickens // American Journal of Interdisciplinary Innovations and Research. – 2025. – Vol. 7, No. 6. – P. 10–12.
12. Holbayevich R. F. et al. Physiological indicators of broiler chicks fed with chitosan and whey powder // Academia Repository. – 2024. – Vol. 5, No. 2. – P. 184–187.
13. Rakhmonov F. et al. Effect of chitosan and whey powder on broiler chicken weight // BIO Web of Conferences. – 2024. – Vol. 95. – Article 01025.
14. Holbayevich R. F. Biochemical indicators of broiler chicks fed chitosan and whey powder // Open Access Repository. – 2023. – Vol. 4, No. 3. – P. 1389–1395.