American Journal of Applied Science and Technology

VOLUME Vol.05 Issue 06 2025
PAGE NO. 86-88
DOI 10.37547/ajast/Volume05Issue06-19

# Comparative Analysis of Plant- And Animal-Derived Chitosan: Physicochemical Properties and Biomedical Applications

Rasulova Yulduz Zikrulloyevna
Bukhara State Medical Institute, Uzbekistan

**Received:** 23 April 2025; **Accepted:** 19 May 2025; **Published:** 21 June 2025

**Abstract:** Chitosan, a natural polysaccharide obtained from the deacetylation of chitin, has gained significant attention due to its biocompatibility, biodegradability, and multifunctional properties. Traditionally extracted from animal sources such as crustacean shells, plant-derived chitosan from fungi and mushrooms is emerging as a promising alternative. This article presents a comprehensive comparison of chitosan derived from animal and plant sources, focusing on structural characteristics, physicochemical properties, and biomedical applications. Analytical techniques including FTIR, UV-Vis spectroscopy, SEM, and XRD, are reviewed to highlight differences and similarities. The findings indicate the potential for tailored biomedical applications based on the chitosan source, with implications for sustainable development and medical innovation.

**Keywords:** FTIR, UV-Vis spectroscopy, SEM, and XRD.

## Introduction:

Chitosan is a linear polysaccharide composed primarily of β-(1→4)-linked D-glucosamine units, obtained by partial deacetylation of chitin. It is widely used in biomedical fields for wound healing, drug delivery, and tissue engineering due to its non-toxicity, biocompatibility, and biodegradability. Traditionally, chitosan is extracted from crustacean shells such as shrimp and crab. However, animal-derived chitosan presents some limitations, including allergenicity and environmental concerns linked to seafood waste.

Recently, plant-based sources of chitosan, particularly fungi and mushrooms like Agaricus bisporus, have garnered attention. These sources offer eco-friendly extraction methods, reduced allergenic risk, and distinct physicochemical properties. This paper aims to compare the structural and functional properties of chitosan derived from animal and plant sources, emphasizing their biomedical applicability.

## Sources and Chemical Structure

### Animal-Derived Chitosan

Animal chitosan is primarily obtained from the exoskeletons of crustaceans, which contain 15–20% chitin. Extraction involves demineralization, deproteinization, and deacetylation steps. The degree of deacetylation (DDA) significantly influences solubility and biological activity. Animal-derived chitosan typically exhibits a high DDA (above 80%), contributing to its strong film-forming ability and mechanical strength.

### Plant-Derived Chitosan

Plant-derived chitosan, especially from fungal sources, differs in molecular weight and acetylation patterns. Mushrooms contain chitin in their cell walls, which can be extracted through eco-friendly processes with less chemical usage. Plant chitosan generally has a lower DDA (~70–75%) and a more heterogeneous molecular structure, affecting its solubility and bioactivity.

## Physicochemical Properties

### Structural Analysis

Fourier Transform Infrared (FTIR) spectroscopy identifies characteristic functional groups in chitosan.

Both sources show amide I (1650 $cm^{-1}$) and amide II (1590 $cm^{-1}$) bands, but plant-derived chitosan exhibits broader hydroxyl (-OH) and amino (-NH2) group peaks, indicating higher moisture retention.

Ultraviolet-Visible (UV-Vis) spectroscopy reveals differences in absorption maxima; animal chitosan peaks around 230 nm, whereas plant chitosan shows additional peaks near 280 nm due to phenolic content.

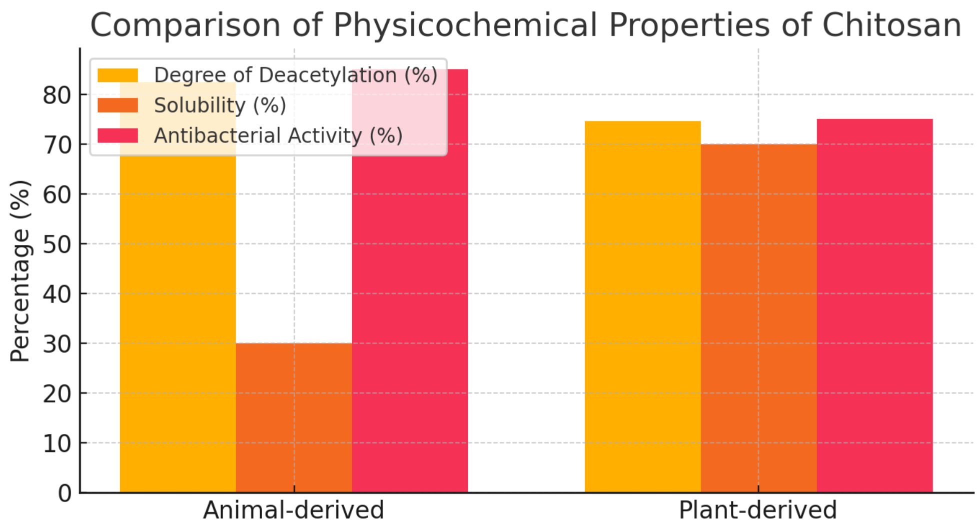


**Figure 1. Comparative bar chart of Degree of Deacetylation, Solubility, and Antibacterial Activity of chitosan from different sources.**

**Morphology**

Scanning Electron Microscopy (SEM) shows animal chitosan has a dense, ordered surface, while plant chitosan exhibits a porous, fibrous morphology favorable for adsorption and drug encapsulation.

**Degree of Deacetylation and Solubility**

| Source | Degree of Deacetylation (%) | Solubility in Acidic Medium (%) |
|---|---|---|
| Animal-derived | 82.5 | Low |
| Plant-derived | 74.6 | Higher |

Solubility differences impact biomedical applications such as drug delivery and tissue scaffolding.

**Biomedical Applications**

Animal-derived chitosan has demonstrated superior performance in wound healing and hemostatic materials due to its high DDA and mechanical strength. It is widely used in surgical dressings and antimicrobial coatings.

Plant-derived chitosan offers advantages in drug delivery systems, gene therapy, and tissue engineering due to its better solubility and biocompatibility. Its porous structure supports cellular adhesion and proliferation.

Both types show antibacterial, antifungal, and antioxidant activities, but the degree varies with source and extraction method.

**Environmental and Economic Aspects**

Animal chitosan production depends on seafood waste, which poses seasonal and geographical limitations. Environmental concerns include chemical waste from processing. Plant chitosan extraction is more sustainable, with lower chemical consumption and allergenic risks. Mushrooms can be cultivated year-round, providing a consistent supply. Economic feasibility favors animal sources in regions with abundant seafood, while plant chitosan production is promising for sustainable and hypoallergenic products.

**Diagrammatic Comparison**

This section includes bar charts comparing Degree of Deacetylation (DDA), solubility, and antibacterial activity; SEM micrographs showing morphology differences; and UV-Vis spectra overlays.

## CONCLUSION

Both animal- and plant-derived chitosan possess unique physicochemical and biomedical properties. Animal chitosan excels in mechanical strength and wound healing applications, while plant chitosan's solubility and biocompatibility make it ideal for drug delivery and tissue engineering. Future research should focus on hybrid materials combining advantages of both sources and optimizing extraction methods for environmental sustainability.

## REFERENCES


Rinaudo, M. (2006). Chitin and chitosan: Properties and applications. Progress in Polymer Science, 31(7), 603-632.

Kurita, K. (2001). Controlled functionalization of chitin and chitosan. Carbohydrate Polymers, 49(3), 213-221.

Aranaz, I., et al. (2009). Functional characterization of chitosan and its derivatives: Antimicrobial activity. Marine Drugs, 7(4), 785-812.

Dash, M., et al. (2011). Chitosan—A versatile semi-synthetic polymer in biomedical applications. Progress in Polymer Science, 36(8), 981-1014.

Jayakumar, R., et al. (2010). Biomedical applications of chitosan-based hydrogels: A review. International Journal of Biological Macromolecules, 47(1), 1-8.

Do'stmurodov T. Collection of lectures on the subject of "Organic Chemistry" Part 2 Karshi, QMII 2006 145 p.

Kou S. G., Peters L. M., Mucalo M. R. Chitosan: A review of sources and preparation methods //International Journal of Biological Macromolecules. – 2021. – T. 169. – C. 85-94.

Iber B. T. et al. A review of various sources of chitin and chitosan in nature //Journal of Renewable Materials. – 2022. – T. 10. – №. 4. – C. 1097.

Pellis A., Guebitz G. M., Nyanhongo G. S. Chitosan: sources, processing and modification techniques //Gels. – 2022. – T. 8. – №. 7. – C. 393.

Huq T. et al. Sources, production and commercial applications of fungal chitosan: A review //Journal of Bioresources and Bioproducts. – 2022. – T. 7. – №. 2. – C. 85-98.

Peniche C. et al. Chitin and chitosan: major sources, properties and applications //Monomers, polymers and composites from renewable resources. – 2008. – T. 1. – C. 517-542.