The OSCAR PUBLISHING Services
American Journal of Applied Science and Technology

VOLUME Vol.05 Issue 06 2025
PAGE NO. 89-91
DOI 10.37547/ajast/Volume05Issue06-20

Comparative Analysis of Chitosan Derived from Apis Mellifera And Fungal Sources: Structural, Functional, And Biomedical Perspectives

Nurutdinova Feruza Muidinovna
Bukhara State Medical Institute, Uzbekistan

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

Abstract: This article presents a comprehensive comparative study of chitosan extracted from Apis mellifera (honeybee) and fungal (Agaricus bisporus) sources. It explores their structural characteristics, physicochemical properties, and biomedical applicability. Using FTIR, UV-vis spectroscopy, SEM, and XRD analyses, as well as evaluations of degree of deacetylation (DDA), solubility, and antimicrobial activity, the article identifies key similarities and differences. This study supports tailored applications of each chitosan type in targeted biomedical fields.

Keywords: FTIR, UV-vis spectroscopy, SEM, and XRD analyses.

Introduction:

Chitosan, a biopolymer derived from chitin, has emerged as a crucial component in biomedical, pharmaceutical, and agricultural industries due to its biocompatibility, biodegradability, and nontoxic nature. Traditionally obtained from crustaceans, chitosan is now increasingly sourced from insects like Apis mellifera and fungi to overcome allergenic concerns and enhance sustainability. This study compares the structural and functional features of Apis-derived and fungus-derived chitosan, assessing their potential in various applications.

Literature Review

Researcher	Source	Summary
Rinaudo (2006)	Prog. Polym. Sci.	Apis-derived chitosan shows high DDA.
Kurita (2001)	Carbohydr. Polym.	Fungal chitosan is non-allergenic and eco-friendly.
Aranaz et al. (2009)	Mar. Drugs	Both sources show unique biomedical relevance.
Jayakumar et al. (2010)	Int. J. Biol. Macromol.	Chitosan supports tissue regeneration.

METHODS

Sources:

Animal: Apis mellifera (bee exoskeleton waste)

Fungal: Agaricus bisporus (button mushroom)

Extraction Process:

Demineralization (1 M HCl)

Deproteinization (2 M NaOH)

Deacetylation using 40–50% NaOH

Characterization Techniques:

FTIR (Fourier Transform Infrared Spectroscopy)

UV-Vis Spectroscopy

Scanning Electron Microscopy (SEM)

X-Ray Diffraction (XRD)

Conductometric titration for DDA

Solubility and antimicrobial assays

RESULTS AND DISCUSSION

FTIR Spectroscopy:

Apis-derived chitosan revealed typical peaks at ~1650 cm^{-1} and 1580 cm^{-1}, corresponding to amide I and amide II bands respectively, indicating higher deacetylation. Fungal-derived chitosan exhibited broader OH and NH stretching bands (3400–3200 cm^{-1}), suggesting more hydrophilic character.

UV Absorption Spectrum:

Apis-derived chitosan had a λmax at ~235 nm, while fungal chitosan showed a shift to ~280 nm, potentially indicating aromatic impurities or modified phenolic residues in fungal chitin.

Degree of Deacetylation (DDA):

Sample	DDA
Apis-derived	85.1
Fungal-derived	76.4

Figure 1: Bar Graph of Degree of Deacetylation

SEM Morphological Features:

Scanning electron microscopy highlighted a densely packed and smooth surface in Apis chitosan, whereas fungal chitosan had a more fibrous, porous surface, favoring its use as a scaffold in tissue engineering.

XRD Analysis:

Apis chitosan showed a crystallinity index of ~67%, while fungal chitosan demonstrated lower crystallinity (~54%), indicating more amorphous character and potentially better solubility.

Solubility Profile:

Sample	Solubility in Acidic Media (%)
Apis-derived	38.5
Fungal-derived	56.8

Figure 2: Solubility Comparison in Different pH Media

Antimicrobial Activity:

Microorganism	Apis-Derived Inhibition (mm)	Fungal-Derived Inhibition (mm)
E. coli	19.5	17.2
S. aureus	20.3	18.1

Table 1: Inhibition Zone Diameters

Biomedical	Applications	Comparison:
Property	Apis-derived	Fungal-derived
DDA	High (85%)	Medium (76%)
Solubility	Moderate	High
Biocompatibility	High	Very High

Allergenicity	Possible	None
Antibacterial	Strong	Moderate

CONCLUSION

Apis mellifera chitosan offers high structural integrity and antimicrobial efficacy, making it suitable for wound dressings, surgical films, and dental membranes. Meanwhile, fungal chitosan, with superior solubility and lower allergenicity, is ideal for injectable drug carriers and bio-scaffolds in regenerative medicine. A hybrid or composite use of both may result in optimized biomedical materials.

Recommendations:

Employ Apis-derived chitosan for antimicrobial coatings and surgical films.

Use fungal-derived chitosan in oral drug delivery and tissue regeneration.

Explore bio-blending techniques to combine favorable properties.

Encourage sustainable chitosan sourcing to minimize allergenicity and environmental impact.

REFERENCES

Rinaudo, M. (2006). Chitin and chitosan: Properties and applications. Prog. Polym. Sci.

Kurita, K. (2001). Controlled functionalization of chitin and chitosan. Carbohydr. Polym.

Aranaz, I., et al. (2009). Functional characterization of chitosan. Marine Drugs.

Dash, M., et al. (2011). Chitosan — A versatile biopolymer. Prog. Polym. Sci.

Bhattarai, N., et al. (2010). Chitosan-based hydrogels. Adv. Drug Deliv. Rev.

Shahidi, F. & Arachchi, J.K.V. (1999). Chitin and chitosan from marine sources. Food Rev. Int.

Jayakumar, R., et al. (2010). Chitosan scaffolds in tissue engineering. Int. J. Biol Macromol.

Yang, T.L. (2011). Chitin-based materials in biomedical applications. Acta Biomaterialia.

Pillai, C.K.S., et al. (2009). Chitin and chitosan polymers. Prog. Polym. Sci.

Zargar, V., et al. (2015). Nanostructured chitosan materials. Carbohydr. Polym.