International Journal of Research in Pharmacy and Pharmaceutical Sciences
www.pharmacyjournal.in
ISSN: 2455-698X
Received: 09-11-2025, Accepted: 08-01-2026, Published: 23-01-2026
Volume 11, Issue 1, 2026, Page No. 70-73

A Brief Review on *Hypsizygus tessellatus*

Sinchana H Gowda[1*], Dr. Suresha B S[2], Dr. T Balasubramanian[3]
[1] Department of Pharmacology, Bharathi College of Pharmacy, Bharathinagara, Karnataka, India
[2] Professor and Head, Department of Pharmacology, Bharathi College of Pharmacy, Bharathinagara, Karnataka, India
[3] Principal, Bharathi College of Pharmacy, Bharathinagara, Karnataka, India

Abstract
Mushrooms are macroscopic fruiting bodies produced predominantly by Basidiomycota, with some species arising from Ascomycota. Globally, an estimated 2.2 to 3.8 million fungal species exist, many of which offer significant nutritional and therapeutic value. Among edible mushrooms, *Hypsizygus tessellatus*-commonly known as Shimeji-has emerged as an important temperate saprophytic species valued for its nutritional richness and bioactive compounds. This mushroom contains a wide range of essential nutrients, including proteins, fibers, vitamins, minerals and polysaccharides, particularly β-glucans, which contribute to its notable health-promoting properties. Morphologically, *H. tessellatus* is characterized by a tessellated cap surface, white gills and a monomitic hyphal system with clamp connections. Its two major commercial varieties, Buna-shimeji (brown) and Bunapi-shimeji (white) are widely cultivated in East Asia.
Pharmacologically, *H. tessellatus* demonstrates strong immunomodulatory, antioxidant, antimicrobial, anti-inflammatory and anticancer activities. Extracts of Bunapi shimeji have shown potent free radical scavenging ability and selective cytotoxicity against breast cancer cell lines (MCF-7 and MDA-MB-231) with acetone extracts exhibiting the highest activity. Although the mushroom possesses antioxidant and antimicrobial components, aqueous extracts show only moderate antibacterial activity. Studies on pathogen persistence indicate that *Listeria monocytogenes* survives longer on harvested mushrooms than on actively growing ones, highlighting the need for improved post-harvest control strategies. Overall, *Hypsizygus tessellatus* represents a nutritionally dense and pharmacologically significant mushroom species with promising applications as a functional food and a source of natural therapeutic compounds.

Keywords: Clamshell mushroom, Buna Shimeji, edible, fungi, *Hypsizygus tessellatus*

Introduction
Mushrooms are the large, visible fruiting bodies formed mainly by fungi belonging to the phylum Basidiomycota, though a few originate from Ascomycota as well. It is estimated that there are 2.2 to 3.8 million fungal species on Earth, based on their associations with plant hosts [1]. Edible mushrooms hold substantial potential for future applications in both food and medicine because of their rich nutritional value, functional benefits and therapeutic properties [2].
Mushrooms are macrofungi characterized by prominent fruiting bodies that occur epigeously or hypogeously and are sufficiently large to be observed and harvested manually [3]. The global mushroom industry encompasses three key categories—edible, medicinal and wild mushrooms. Notably, global production of cultivated edible mushrooms has expanded by more than a factor of 30 since 1978 [4].
Mushrooms consist predominantly of moisture (85–95%) and contain substantial levels of carbohydrates (35–70%), protein (15–34.7%), fat (approximately 10%), minerals (6–10.9%), and nucleic acids (3–8%). They also provide an extensive array of vitamins, including thiamine (1.4–2.2 mg %), riboflavin (6.7–9.0 mg %), niacin (60.6–73.3 mg %), biotin, ascorbic acid (92–144 mg %), pantothenic acid (21.1–33.3 mg %) and folic acid (1.2–1.4 mg per 100 g on a dry-weight basis). In addition, mushrooms contain essential minerals such as calcium, iron, manganese, magnesium, zinc and selenium. Owing to their notable composition of carbohydrates, dietary fiber, protein, essential amino acids, unsaturated fatty acids, vitamins and minerals-including potassium, iron, copper, zinc and manganese-together with their inherently low caloric value, mushrooms are widely recognized as a nutrient-dense food with considerable health-promoting attributes [5].

Hypsizygus Tessellatus
Hypsizygus tessellatus (Agaricales), commonly referred to as Shimeji, Bunashimeji or Hon-shimeji is a prominent temperate edible saprophytic mushroom. It is abundant in micronutrients and contains polysaccharide fractions-particularly, β-glucans-with strong antitumor and anticancer properties, making it a valuable source of neutraceutical compounds [6].
Hypsizygus tessellatus (Shimeji) is a commonly consumed mushroom in East Asia. Its phytochemical profile includes compounds such as tubuloside A, 6-gingerol, isoflavan, cyclocurcumin and several others, which exhibit antioxidant activity. Studies have also reported that *H. tessellatus* possesses antioxidant, antimicrobial and anticancer properties [7].

Microscopic and Macroscopic Characteristics
Hypsizygus tessellatus (Agaricales), a prominent edible saprophytic mushroom in temperate regions and a member of the family Lyophyllaceae, is commonly referred to as the ‘tessellated oyster mushroom.’ Its fruiting body features a cap that is initially convex, becoming flatter with maturity. This species is widely distributed and consumed in East Asia particularly in Japan, China and Korea-as well as in North America. Owing to its nutritional value and notable medicinal and bioactive properties, it has become an important mushroom in industrial cultivation and commercial production.

Macroscopic characteristics

The cap measures approximately 3 cm in diameter, exhibiting a smooth, light brown surface that develops a distinctly scaly or tessellated appearance with age-hence its common name. When young, the cap is velvety in texture, becoming progressively more rugged and wrinkled as it matures. The gills are white and closely spaced. The stipe is cylindrical, white to pale yellow and about 6 cm long, with a slightly to moderately thickened base and a smooth to subtly fibrous surface. The mushroom emits a mild, pleasant odour reminiscent of fresh vegetables or oysters and its flavor is similarly mild, often described as delicately sweet.

Microscopic characteristics

The spores are smooth, ellipsoid and colorless, measuring approximately 6–8 µm in width and 4–5 µm in length and are non-amyloid. The basidia are clavate (club-shaped), typically 4-spored and average about 25 µm in length. The hyphal system is monomitic, composed of septate hyphae with frequent clamp connections; the hyphae are thin-walled, smooth andcolorless. Cystidia are absent or occur only rarely in *Hypsizygus tessellatus*. The spore print is white [8].

Taxonomical classification [9]

Domain	Eukaryota
Kingdom	Fungi
Division	Basidiomycota
Class	Agaricomycetes
Order	Agaricales
Family	Lyophyllaceae
Genus	Hypsizygus
Species	*H. tessellatus*

Description

Hypsizygus tessellatus, commonly known as the beech mushroom, belongs to the Domain Eukaryota and Kingdom Fungi. It is classified within the Division Basidiomycota, Class Agaricomycetes, Order Agaricales and Family Lyophyllaceae. Native to East Asia, this gilled mushroom typically grows on wood substrates.

Two commercial varieties have been developed in Japan: Buna-shimeji, the wild-type brown form, and Bunapi-shimeji, the white form. Both varieties are noted for their distinctive morphological features and culinary uses.

Pharmacological Properties

- *Hypsizygus tessellatus* exhibits notable pharmacological activities, which are largely attributed to its diverse bioactive compounds.
- The mushroom contains polysaccharides that possess strong immunomodulatory effects, enhancing both innate and adaptive immune responses.
- Research has demonstrated its significant antioxidant potential, primarily due to the presence of phenolic compounds and ergothioneine.
- Additionally, the species displays pronounced anti-inflammatory properties by reducing the production of pro-inflammatory cytokines and modulating inflammatory pathways.
- Recent studies have also identified novel peptides from *H. tessellatus* with antimicrobial activity against a range of pathogenic microorganisms [9].
- The antioxidant and antiproliferative effects of mushroom extracts were tested in the lab using chemical methods for antioxidants and cell-based tests for anti proliferation. The chemical composition of the extracts was analyzed with mass spectroscopy (UPLC-QTOF/MS). The results showed that the aqueous extracts of F. velutipes (Enoki) and white *H. tessellatus* (Bunapi shimeji) caps had stronger antioxidant effects compared to methanol extracts. These aqueous extracts were more effective against DPPH (IC50 = 0.202 and 0.573 mg/mL) and H2O2 (IC50 = 0.622 and 0.745 mg/mL), and also had higher ferric reducing antioxidant power (FRAP) values. Additionally, the mushroom extracts displayed strong antiproliferative activity against human breast cancer cells. These findings suggest that the mushrooms contain beneficial phytochemicals with both antioxidant and antiproliferative properties [10].
- The anticancer potential of *Hypsizygus tessellatus* (white variety) caps-commonly known as Bunapi shimeji-was investigated *in vitro* using acetone and ethyl acetate extracts. Their cytotoxic effects were tested against breast cancer cell lines MDA-MB-231 and MCF-7, as well as the normal breast cell line MCF-10A.
- In addition, free radical scavenging and metal-reducing properties were assessed using chemical-based antioxidant assays.
- The phytochemical constituents of the extracts were identified through LC–MS-QTOF analysis.
- The findings revealed that the acetone extract exhibited significantly stronger antioxidant activity, showing lower IC_{50} values for DPPH (0.76 mg/mL) and H_2O_2 (0.84 mg/mL), compared with the ethyl acetate extract (DPPH: 1.10 mg/mL; H_2O_2: 1.26 mg/mL) ($p < 0.05$).
- The acetone fraction demonstrated greater anti proliferative activity against MCF-7 (IC_{50}: 0.051–0.055 mg/mL) and MDA-MB-231 (IC_{50}: 0.122–0.131 mg/mL) than the ethyl acetate fraction (MCF-7: 0.075–0.096 mg/mL; MDA-MB-231: 0.161–0.164 mg/mL) ($p < 0.05$). Both extracts showed comparatively lower cytotoxicity toward MCF-10A normal cells. Overall, the results indicate that Bunapi shimeji caps may serve as a promising natural source of anticancer compounds [11].
- The water extract of Buna shimeji exhibited relatively weak antibacterial activity, showing less than 60% growth inhibition across all tested bacterial strains. Specifically, the Bunapi shimeji water extract inhibited *S. marcescens*, *E. coli*, *B. subtilis* and *S. aureus* by 54%, 67%, 46%, and 44% respectively. In comparison,

the methanol, acetone and ethyl acetate extracts demonstrated significantly lower antibacterial activity than the water extract ($p < 0.05$) [12].

- The metabolic extract from submerged cultures and the mycelium mats of *H. tessellatus* were evaluated for their cytotoxic and antimicrobial properties using the brine shrimp lethality bioassay and disc diffusion method, respectively. The ethyl acetate extract exhibited stronger antibacterial activity than the chloroform extract against both Gram-positive and Gram-negative bacteria, with inhibition zones ranging from 17 to 22 mm. Additionally, the ethanol extract from the mycelium mats demonstrated significant antioxidant activity in the 1,1-diphenyl-2-picrylhydrazyl (DPPH) scavenging assay, along with a moderate total phenolic content of 36.45±1.754 g/100 g and an IC50 value of 105 µg/mL. The total antioxidant capacity of *H. tessellatus* was found to be 442.61 mg equivalents of ascorbic acid. In the brine shrimp lethality bioassay, the LC50 values for the ethyl acetate and chloroform extracts were 7.36 and 10.63 µg/mL, respectively. These results suggest that *H. tessellatus* mushroom exhibits notable antimicrobial properties, along with moderate anticancer and antioxidant activities [13].

Effect of *Hypsizygus tessellatus* on survival of Listeria monocytogenes

A brief period of survival followed by a rapid decline in *L. monocytogenes* populations was observed on mushrooms during the pre-harvest stage. In contrast, the pathogen persisted for much longer on harvested mushrooms stored under refrigeration. These results indicate that certain intrinsic characteristics of actively growing mushrooms may help inactivate *L. monocytogenes*. However, the pathogen was able to survive and remain stable on Trumpet Royale, Alba Clamshell and Brown Clamshell mushrooms during post-harvest refrigerated storage. This underscores the need for additional control strategies-such as antimicrobial coatings or biological interventions-to limit *L. monocytogenes* survival and spread during post-harvest handling [14].

Variation of mycelium growth in *Hypsizyus tessellatus*

The study aimed to investigate the effect of different parts of the *H. tessellatus* stalk and varying concentrations of Potato Dextrose Agar (PDA) on mycelium growth. Additionally, it sought to assess the impact of alternative substrates, namely *Dicranopteris linearis* (fern leaf), dry leaves of *Terminalia catappa* and *Imperata cylindrica* (lalang grass), on the growth of H. *tessellatus* (shimeji mushroom).

Mycelium from the upper and lower parts of the mushroom stalk was cultured on both half-strength and full-strength PDA and the growth rate (measured as the radius of mycelium spread) was recorded. Results showed that mycelium from the lower part of the stalk exhibited better growth, and full-strength PDA significantly promoted mycelium growth compared to half-strength PDA.

Further, *H. tessellatus* was cultivated on different substrates in capsules. Small pieces of *D. linearis, I. cylindrica,* and dried leaves of *T. catappa* were found to be suitable as alternative substrates for mushroom cultivation. The mycelium growth on these substrates showed no significant difference compared to the commercially used substrate, a mixture of sawdust and rice bran. These alternative substrates, readily available in urban areas, offer an opportunity for individuals without access to commercial substrates to collect and use local materials for mushroom cultivation [15].

Antibacterial studies using different culture media on *Hpsizygus tessellatus*

An attempt to cultivate *Hpsizygus tessellatus* under Philippine conditions was conducted from November 2013 to March 2014 under laboratory settings, using various cultural parameters and its antibacterial activity was also evaluated. Different culture media, temperature and pH levels, as well as spawning and growing substrates, were tested. Among the ten-culture media evaluated, compost agar produced the highest radial mycelial growth, measuring 78.67 mm in diameter. Optimal growth was observed at pH levels 6 and 7 and at temperatures ranging from 20–25 °C. Profuse mycelial colonization was achieved 18 days after inoculation using black beans as the spawning substrate. However, sorghum spawn inoculated in paddy straw and sawdust–rice bran was identified as the most suitable fruiting substrate, yielding the greatest mycelial growth (135 mm).

For the antibacterial assay, methanolic extracts of oven-dried mycelial mats of *Hypsizygus tessellatus* (HMME) were tested against two Gram-positive (+) and Gram-negative (−) bacterial strains. The extract exhibited an average inhibition zone of 15.67 mm against *Staphylococcus aureus*. Overall, *H. tessellatus* demonstrated moderate to fair antibacterial activity. Vegetative growth studies revealed that *H. tessellatus* grows optimally at temperatures of 25–27 °C under laboratory conditions. Moreover, the cultivation of buna-shimeji mushrooms requires lower temperatures and higher relative humidity during the fructification stage.

The cultivation of mushrooms such as *Hypsizygus tessellatus*, which has various valuable applications, requires the identification of the most suitable culture media, spawn substrates, and fruiting substrates. Experimental results indicated that compost agar, potato dextrose agar, spent tea leaves agar, rice bran decoction agar, and wheat agar were the most effective culture media for initiating the growth of *H. tessellatus*. In contrast, potato yeast dextrose agar, standard methods agar, and ground corn agar supported only average growth. Carrot agar and sorghum decoction agar were found to be unfavorable for the growth of *H. tessellatus*.

Regarding environmental requirements, the optimal temperature for *H. tessellatus* growth ranged from 20–25 °C, whereas temperatures of 10–15 °C were considered inefficient. The most favorable mycelial growth was observed at pH 6, although growth was also evident at pH 5 and 7, indicating a preference for slightly acidic to near-neutral conditions.

In terms of spawn substrates, *H. tessellatus* inoculated on black beans, green mung beans and green peas produced the most abundant mycelial colonization. Ground corn and sorghum grains resulted in faster but thinner mycelial growth. Furthermore, paddy straw supported the fastest mycelial run in fruiting bags compared to sawdust, which is more commonly used as a fruiting substrate [16].

Conclusion

Hypsizygus tessellatus stands out as a nutritionally robust and pharmacologically significant mushroom whose value extends well beyond its culinary appeal. Its rich profile of essential nutrients, bioactive polysaccharides, phenolic compounds and specialized metabolites underscores its potential as both a functional food and a natural therapeutic resource. Distinct morphological traits, together with its well-documented antioxidant, antimicrobial, immunomodulatory and anticancer activities, highlight its relevance in modern neutraceutical research. Notably, the differential survival of *Listeria monocytogenes* on pre-harvest versus post-harvest mushrooms reveals an important post-production vulnerability, reinforcing the need for enhanced safety interventions during storage and distribution. Overall, *H. tessellatus* represents a promising species at the intersection of nutrition, food technology and biomedical science-offering considerable potential for future applications in health-promoting foods and natural drug discovery.

References

1. Guo X, Xu J. Impacts of global climate change on mushroom productions: challenges and opportunities. Agriculture Communications,2025:3(3):100091.
2. Ionescu M, Dincă MN, Ferdeș M, Zăbavă BȘ, Paraschiv G, Moiceanu G. *et al*. Proteins from edible mushrooms: nutritional role and contribution to well-being. Foods,2025:14(18):3201.
3. Singh R. A review on different benefits of mushroom. IOSR Journal of Pharmacy and Biological Sciences,2017:12(1):107–111.
4. Royse DJ, Baars J, Tan Q. Current overview of mushroom production in the world. In: Edible and medicinal mushrooms: technology and applications, 2017, 5–13.
5. Assemie A, Abaya G. The effect of edible mushroom on health and their biochemistry. International Journal of Microbiology,2022:2022(1):8744788.
6. Chauhan G, Prasad S, Rathore H, Sharma S. Nutritional profiling and value addition of products from *Hypsizygus tessellatus*. Food Biology,2017:6:1–6.
7. Ng SP, Ramanathan R, Chong XJ. The effect of cooking duration on radical scavenging properties of *Hypsizygus tessellatus* and *Pleurotus ostreatus*. Food Research,2022:6:75–79.
8. Alzurgany LM, Alazzawi MA. Identification of some edible mushrooms from Salah Aldin Province, Iraq. Bulletin of the Iraq Natural History Museum,2025:18(3):701–719.
9. HN HK, Rakshitha HS, Ramya S, Gowda SH. A review of enzyme inhibitory activities and therapeutic potential of selected mushroom species. Journal of Pharma Insights and Research,2024:2(5):182–190.
10. Ukaegbu CI, Shah SR, Hamid HA, Alara OR, Sarker MZ. Phenolic compounds of aqueous and methanol extracts of *Hypsizygus tessellatus* (brown and white var.) and *Flammulina velutipes* caps: antioxidant and antiproliferative activities. Pharmaceutical Chemistry Journal,2020:54(2):170–183.
11. Ukaegbu CI, Shah SR, Hamid HA, Normaiza Z, Alara OR. Extracts of *Hypsizygus tessellatus* (white var.) caps inhibited MCF-7 and MDA-MB-231 cell lines proliferation. Journal of Food Measurement and Characterization,2019:13(1):368–382.
12. Shah SR, Ukaegbu CI, Hamid HA, Alara OR. Evaluation of antioxidant and antibacterial activities of the stems of *Flammulina velutipes* and *Hypsizygus tessellatus* (white and brown var.) extracted with different solvents. Journal of Food Measurement and Characterization,2018:12(3):1947–1961.
13. Monira S, Haque A, Muhit A, Sarker NC, Alam AH, Rahman AA, *et al*. Antimicrobial, antioxidant and cytotoxic properties of *Hypsizygus tessulatus* cultivated in Bangladesh. Research Journal of Medicinal Plant,2012:6(4):300–308.
14. Tu T, Liu Z, Li X, Guo C, Chen Z, Wang H, *et al*. Survival of *Listeria monocytogenes* on growing and harvested Trumpet Royale (*Pleurotus eryngii*), Alba Clamshell (*Hypsizygus tessellatus*), and Brown Clamshell (*Hypsizygus tessellatus*) mushrooms. Food Microbiology,2025:130:104778.
15. Thong WH, Khu YM, Geetha S. Alternative substrate for *Hypsizygus tessellatus* cultivation. INTI Journal, 2018, (5).
16. Tinao MJ, Miranda HP, Sumulong EL, Medalla AP. Cultural and antibacterial studies of *Hypsizygus tessellatus* (Buna-shimeji). International Journal of Microbiology,2015:1(3):1–5.