Ethnomycological relevance, ecology, and bioactive potential of *Stereum hirsutum*: a review with emphasis on Central Asia

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Research

Abstract

Background: *Stereum hirsutum* is a widespread wood-inhabiting fungus whose ethnomycological significance remains fragmented and insufficiently synthesised, particularly in relation to Central Asia. Although the species is visually conspicuous and ecologically common, direct documentation of its traditional medicinal relevance remains limited compared with the expanding literature on its chemistry, bioactivity, and applied potential.

Methods: Published literature, taxonomic databases, and regional specimen-based records were critically reviewed to compile data on nomenclature, morphology, ecology, host associations, distribution, ethnomycological relevance, mycochemical diversity, and reported biological and biotechnological properties of *S. hirsutum*, with particular emphasis on Central Asia.

Results: *Stereum hirsutum* is broadly distributed and has been documented in Uzbekistan on multiple woody hosts, indicating substantial ecological plasticity. The available ethnomycological evidence suggests limited but credible traditional-use associations, especially in East Asia, whereas direct documentation from Central Asia remains scarce. In contrast, modern studies identify *S. hirsutum* as a chemically rich species producing sesquiterpenoids, benzoate- and depside-related aromatics, sterols, phenolics, organic acids, polysaccharides, fatty acids, minerals, and additional inducible metabolites revealed through strain-specific and co-culture approaches. These metabolites and extracts have been associated with antimicrobial, α-glucosidase-inhibitory, cytotoxic, antioxidant, acetylcholinesterase-related, and anti-inflammatory effects. Recent studies further extend the relevance of the species to ginsenoside biotransformation, lignocellulosic degradation, and symbiotic fungal systems.

Conclusions: *Stereum hirsutum* represents an ecologically widespread, chemically rich, pharmacologically promising, and biotechnologically relevant fungal resource whose ethnomycological importance remains under documented, particularly in Central Asia. Future voucher-supported field studies integrated with chemical profiling and bioactivity assessment are needed to connect ecological occurrence, local knowledge, and experimentally supported functions within a single regional framework.

Keywords: Medicinal macrofungi; Vernacular knowledge; Wood-decay fungi; Secondary metabolites; Pharmacological potential; Voucher-based documentation; Regional mycobiota

Background

Ethnomycology examines the relationships between fungi and human societies, including their recognition, naming, classification, collection, food use, medicinal application, and broader cultural significance (Tayjanov *et al.* 2021, Gafforov *et al.* 2023a, 2023b, 2026). Mushrooms have long been valued as both nutritional and therapeutic resources and are increasingly recognized as sources of structurally diverse natural products with pharmacological potential (Gafforov *et al*. 2025a, 2025b). Nevertheless, ethnomycological knowledge remains unevenly documented across fungal groups. In particular, non-gilled and wood-inhabiting macrofungi are often ecologically conspicuous but culturally underreported compared with more widely collected edible mushrooms (Ullah *et al.* 2022, Zhao *et al.* 2020, Krupodorova *et al.* 2025). This pattern is especially relevant in Central Asia, where traditional healing systems and the work of physicians and natural scholars have long contributed to a substantial body of knowledge on medicinal plants. In contrast, fungi, and especially medicinal information related to macrofungi, have remained far less thoroughly documented (Tayjanov *et al.* 2021, Gafforov *et al.* 2023b).

This imbalance is especially evident across the Central Asian region. Although the vascular flora of the region has been comparatively well documented (Khassanov 2015, Khojimatov *et al.* 2023, Gafforov *et al.* 2024), fungal diversity remains incompletely known (Cheek *et al.* 2020, Lestari *et al.* 2021, Gafforov 2017, Gafforov *et al.* 2017, 2025a). Central Asia, here treated as comprising Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, encompasses a broad environmental gradient extending from arid plains and desert landscapes to riparian forests, foothill zones, and major mountain systems, particularly the Western Tien Shan and Pamir–Alay (Mamadalieva *et al*. 2024, 2025). Given the environmental heterogeneity and floristic richness of this region, a high diversity of fungi, including potentially endemic elements, may also be expected. However, fungal records from Uzbekistan and neighbouring countries remain fragmentary, and even an approximate estimate of total fungal richness is still unavailable. This knowledge gap continues to constrain both biogeographic interpretation and conservation-oriented understanding of the regional mycobiota (Gafforov *et al.* 2017, 2020, 2025a, Cazabonne *et al.* 2022).

Fungi are ecologically indispensable organisms, functioning as decomposers, symbionts, and regulators of ecosystem stability, including in environmentally stressful habitats where fungal associates may support tree persistence and substrate turnover (Varma 1995; Stutz *et al*. 2000). In Uzbekistan, however, fungal identification has often relied on names transferred from neighbouring or better-studied floristic traditions. Subsequent taxonomic studies have shown that many collections, particularly among microfungi, do not represent true matches to previously reported taxa, but instead correspond to distinct lineages or newly recognized species (Gafforov & Hoshino 2015, Gafforov & Rakhimov 2017, Gafforov *et al*. 2014, 2019, Samarakoon *et al*. 2018, Pem *et al*. 2018, 2019a, 2019b, 2025, Liu *et al*. 2019, Abdurazakov *et al*. 2021, Appadoo *et al*. 2021, Htet *et al*. 2021, Aluthmuhandiram *et al*. 2022, Bradshaw *et al.* 2023, Senwanna *et al*. 2024, Peng *et al*. 2025a, 2025b, Cao *et al*. 2025, Hongsanan. *et al*. 2025). Basidiomycetous fungi, including wood-inhabiting macrofungi, have received even less attention, increasing the likelihood of underreporting and overlooked diversity in the region (Yatsiuk *et al*. 2016, Antonín *et al*. 2017, Yuan *et al*. 2017, Kan *et al*. 2017, Gafforov *et al*. 2014, 2017, Wang *et al.* 2022, Dong *et al.* 2025).

Within this context, *Stereum hirsutum* (Willd.) Pers. is a particularly relevant taxon. This widespread lignicolous basidiomycete in the family Stereaceae colonises dead trunks, branches, stumps, and exposed woody tissues, where it contributes to white-rot decay. Its ecological amplitude is broad, and voucher-based studies from Uzbekistan have documented the species on a wide range of deciduous hosts, including *Juglans*, *Salix*, *Acer*, *Fraxinus*, *Quercus*, *Celtis*, *Crataegus*, and *Populus*, indicating substantial substrate tolerance and repeated occurrence across woody habitats in the region (Gafforov *et al*. 2020, 2025a). Its frequency, visual distinctiveness, and wide distribution further suggest repeated opportunities for recognition by local communities, even where it is not collected as a major edible fungus.

Despite its broad occurrence and clear ecological visibility, the ethnomycological significance of *S. hirsutum* remains insufficiently synthesised. Existing literature suggests that the species has been associated with traditional medicinal use in parts of Asia and has also entered ethnobiological discussion through its connection with the East Asian Jin'er mushroom complex. However, the relevant information remains scattered across medicinal mushroom surveys, natural-products research, and regional biodiversity accounts rather than being treated as a coherent species-level ethnomycological subject. This gap is particularly evident in Central Asia, where fungal diversity documentation has advanced more rapidly than the recording of vernacular knowledge, local perceptions, and medicinal traditions associated with wood-inhabiting fungi (Duan *et al*. 2014, 2018, Mišković *et al*. 2021, Gafforov *et al*. 2023a, 2023b, 2025b).

At the same time, scientific interest in *S. hirsutum* has expanded substantially because the species is now recognised as a chemically rich source of secondary metabolites with promising biological activities. A genus-level synthesis reported 238 secondary metabolites from *Stereum* over seven decades and identified *S. hirsutum* as one of the principal producers of hirsutane-type sesquiterpenoids, together with phenolic derivatives, sterols, and other metabolite classes (Tian *et al*. 2020). Subsequent studies have documented α-glucosidase-inhibitory depsides, antibacterial sesquiterpene–amino acid hybrids, antifungal metabolites active against *Botrytis cinerea*, antioxidant and acetylcholinesterase-related activities in fruiting-body extracts, and β-glucosidase-mediated biotransformation relevant to ginsenoside conversion (Wang *et al*. 2014, Aqueveque *et al*. 2017, Duan *et al*. 2018, Mišković *et al*. 2021, Yang et al. 2021). In parallel, biosynthetic and molecular studies indicate that *S. hirsutum* possesses unusual terpene-biosynthetic machinery and a metabolically responsive regulatory system, suggesting that its chemical diversity remains incompletely explored (Flynn & Schmidt-Dannert 2018, Hu *et al*. 2022).

These developments make *S. hirsutum* a suitable subject for an ethnobiology-oriented review. Its relevance lies not only in its pharmacological promise, but also in the possibility that a widespread and easily recognised wood-inhabiting fungus may occupy meaningful positions in local knowledge systems even when it is not a major edible species. Accordingly, the present review synthesises available knowledge on the taxonomy, ecology, host associations, regional distribution, ethnomycological relevance, and bioactive potential of *S. hirsutum*, with particular emphasis on Central Asia and the current lack of systematically documented traditional-use data from the region.

Materials and Methods

Study area and regional scope

This review focuses on the Central Asian region, here defined as Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, following recent regional mycological syntheses (Elchibaev 1968, 1969, Mosolova 2021, 2023, Gafforov *et al*. 2017, 2020, 2025a, Rakhimova *et al*. 2023). Central Asia represents a geographically extensive and ecologically heterogeneous region encompassing arid plains, desert landscapes, riparian corridors, foothill zones, and major mountain systems, particularly the Western Tien Shan and Pamir–Alay (Kulymbet *et al*. 2023, Gafforov *et al*. 2025, Shakarbaev *et al.* 2025, Khusanov *et al*. 2026, Turemuratova *et al*. 2026). This broad environmental gradient provides diverse woody substrates and microhabitats that are directly relevant to the ecology, distribution, and persistence of *Stereum hirsutum* across the region (Gafforov *et al*. 2020).

The Central Asian region is characterised by pronounced continentality, strong elevational gradients, and substantial spatial variation in moisture availability, all of which shape vegetation structure and the distribution of fungal habitats. Consequently, the region supports a mosaic of natural and semi-natural ecosystems, including mountain forests, river valleys, tugai vegetation, orchards, gardens, and urban green spaces, where corticioid and stereoid fungi may occur on a wide range of host plants and woody substrates. Such ecological heterogeneity makes Central Asia an important biogeographic framework for evaluating the regional occurrence, habitat breadth, and substrate associations of *S. hirsutum*. Although the intensity of published fungal records remains uneven across individual Central Asian countries, the currently available literature collectively indicates that wood-inhabiting fungi are broadly associated with the major woody habitats of the region and that suitable ecological conditions for the repeated occurrence of *S. hirsutum* are widespread (Gafforov *et al.* 2017, 2020, 2023a). Existing voucher-based reports, including those from Uzbekistan, should therefore be interpreted within a broader regional context rather than as isolated national observations (Gafforov *et al*. 2017, 2020). From this perspective, Central Asia should be regarded as a mycologically meaningful and ecologically relevant region for understanding the occurrence and habitat relationships of *S. hirsutum*.

Literature search and source selection

This study was conducted as a critical narrative review with an ethnomycological focus on *Stereum hirsutum*. Literature was gathered from Google Scholar, Scopus, Web of Science, PubMed, publisher platforms, and accessible full-text repositories. Search combinations included the terms "*Stereum hirsutum*", "ethnomycology", "traditional use", "folk medicine", "medicinal mushroom", "wood-inhabiting fungi", "secondary metabolites", "bioactive compounds", "antioxidant", "antimicrobial", "cytotoxicity", "alpha-glucosidase inhibition", "lipase inhibition", "Uzbekistan", and "Central Asia". The search included literature available up to March 2026.

Priority was given to peer-reviewed journal articles, monographs, taxonomic treatments, voucher-based biodiversity studies, and authoritative nomenclatural databases. Only publications explicitly referring to *Stereum hirsutum* at the species level were retained for the main synthesis. Sources treating *Stereum* only at the generic level, records lacking reliable species-level identification, and duplicate summaries were excluded unless they provided essential taxonomic, ecological, or comparative context. Because ethnomycological information on *S. hirsutum* remains scattered and limited, both biodiversity-oriented and natural-products-oriented publications were considered relevant when they contributed verifiable information on nomenclature, local names, ecology, host associations, traditional uses, or experimentally supported biological activities (Tian *et al*. 2020, Gafforov *et al*. 2023a).

Taxonomic treatment and nomenclatural standardisation

The focal taxon was treated under the accepted name *Stereum hirsutum* (Willd.) Pers. Synonyms encountered in older taxonomic and floristic literature were checked against current nomenclatural treatments and standardised under the accepted name before analysis in order to avoid duplication and interpretative inconsistency (Index Fungorum 2026, MycoBank 2026). This step was particularly important because historical literature on stereoid fungi often includes outdated combinations or parallel synonym usage. For this review, all verified records, specimen citations, vernacular references, and natural-product studies were interpreted under a single taxonomic concept of *S. hirsutum*.

Regional records, herbarium framework, and host data

For the regional component of the review, published occurrence records from Central Asia were combined with voucher-based specimen data and host annotations derived from the working manuscript and from published regional studies (Gafforov *et al*. 2020, Mosolova *et al.* 2021, 2023, Gafforov & Ordynets 2022, Haelewaters *et al*. 2022, Rakhimova *et al*. 2023). Emphasis was placed on records supported by herbarium material, specimen citations, or clearly traceable literature sources. In addition to multiple records from Uzbekistan, the regional evidence base also includes a specimen from Tajikistan preserved under the herbarium acronym TAAM and a literature-based record from Kyrgyzstan (Elchibaev, 1968, 1969). Because some Central Asian collections are housed outside the region, repository locality and collection origin were treated separately during interpretation. Regional specimen data used in the synthesis include collections from the ranges of the Western Tien Shan Mountains. The compiled material also documents host and substrate information for *S. hirsutum* from Central Asia, including unknown fallen wood and woody hosts (Gafforov *et al*. 2020, 2023a).

Data extraction and thematic synthesis

Information from the selected sources was extracted into six thematic groups: (1) taxonomy and synonymy; (2) vernacular names and ethnomycological relevance; (3) morphology, ecology, host associations, and distribution; (4) traditional or local medicinal uses and cultural perception; (5) mycochemical composition; and (6) biological and pharmacological activities.

The final synthesis was qualitative rather than statistical because the available literature is highly heterogeneous in content and method, ranging from fungal biodiversity checklists and taxonomic treatments to medicinal mushroom surveys and natural-products studies. Where similar information was reported by multiple sources, preference was given to the most taxonomically explicit, voucher-supported, regionally relevant, or experimentally detailed publication. Chemical data were grouped by metabolite class, whereas biological activities were grouped by activity type in order to connect ethnomycological significance with modern laboratory evidence. Regional distribution and host data were interpreted conservatively and were included only when a clear association with *S. hirsutum* could be confirmed (Elchibaev 1968, 1969, Gafforov et al. 2020, 2023a, 2023b, Mosolova *et al.* 2021, 2023, Rakhimova *et al.* 2023).

Limitations
This review has several limitations. First, directly documented ethnomycological and traditional-use records specifically devoted to *S. hirsutum* are much fewer than taxonomic, ecological, chemical, and pharmacological reports. Second, some historical records from Central Asia provide limited methodological or voucher detail, even when they remain regionally important. Third, the broad global distribution of the species contrasts with the still-fragmentary documentation of local knowledge, especially in Central Asia. Therefore, the present review should be regarded as a critical baseline synthesis and a framework for future voucher-supported ethnomycological field studies rather than as an exhaustive account of all traditional knowledge associated with the species.

Results

Taxonomic identity, nomenclature, and vernacular recognition
Stereum hirsutum (Willd.) Pers. is a wood-inhabiting stereoid basidiomycete in the family Stereaceae (Bernicchia & Gorjón 2010). Older names encountered in historical and regional literature were standardised under this accepted name to avoid ambiguity across floristic, herbarium-based, and natural-products sources. Principal synonyms reported for this taxon include *Stereum neuwirthii* Velen., *S. ochraceum* Lloyd, *S. reflexum* (Bull.) Sacc., *Thelephora hirsuta* Willd., and *T. reflexa* (Bull.) Lam. & DC.

From an ethnomycological perspective, *S. hirsutum* is notable for having a relatively broad multilingual vernacular profile despite limited documentation of direct traditional medicinal use. In English, the species is commonly known as “false turkey tail” and “hairy curtain crust,” names reflecting its concentrically zonate basidiomata and distinctly hirsute upper surface (Breitenbach & Kränzlin 1986, Bernicchia & Gorjón 2010). Additional vernacular names recorded in the compiled literature and working dataset include Uzbek, Russian, Chinese, Japanese, French, German, Korean, Persian, Turkish, and Serbian usages, indicating that the species is visually well recognised across different linguistic settings.

The diversity of common names associated with *S. hirsutum* suggests that the species is repeatedly noticed and named because of its conspicuous morphology, broad distribution, and frequent occurrence on woody substrates. However, the existence of multiple vernacular names should not automatically be interpreted as evidence of a deeply documented medicinal tradition. Rather, these names are better understood as indicators of ethnobiological visibility, whereas the cultural, therapeutic, and practical meanings attached to the species remain incompletely recorded, particularly in Central Asia (Gafforov *et al*. 2023a, 2023b, 2026). For this review, all synonymic, vernacular, and regional records were interpreted under a single taxonomic concept of *S. hirsutum* to maintain consistency between floristic reports, specimen-based records, and modern studies on chemistry and bioactivity (Bernicchia & Gorjón 2010, Gafforov *et al*. 2020, 2023a).

Morphological recognition and diagnostic features
Accurate recognition of *Stereum hirsutum* is important in ethnomycological and biodiversity studies because the species is conspicuous in the field, widely distributed, and frequently encountered on dead woody substrates, yet it may be confused with other stereoid or thin bracket-like fungi if only superficial characters are considered. The basidiomata are perennial, tough to hard, resupinate to effused-reflexed or distinctly pileate, usually semicircular to flabelliform, several centimetres long, and up to about 2 mm thick, with pilei projecting approximately 5–30 mm from the substrate (Fig. 1) (Breitenbach & Kränzlin 1986, Bernicchia & Gorjón 2010, Gafforov *et al*. 2023a).

The upper surface is characteristically tomentose to hirsute and concentrically zonate, initially whitish to yellowish orange and later becoming darker brownish, often with greenish tones caused by algal colonisation. The margin is usually paler, thin, and undulating, which further contributes to the distinctive field appearance of the species. The hymenial surface is smooth to slightly tuberculate, yellowish to cream or yellowish orange when fresh, and may become grayish-brown with age. In dry material, the fertile surface may crack, and the basidiomata remain leathery and tough, becoming hard and crust-like over time (Breitenbach & Kränzlin 1986, Bernicchia & Gorjón 2010).

Microscopically, *S. hirsutum* is characterised by a dimitic hyphal system composed of thin- to thick-walled generative hyphae and thick-walled skeletal hyphae. Two cystidial elements are usually present, namely long pseudocystidia arising from skeletal hyphae and pointed acanthocystidia. The basidia are slender, four-sterigmate, and simple-septate at the base, whereas the basidiospores are ellipsoid-cylindrical to slightly curved, smooth, thin-walled, hyaline, and amyloid, generally measuring about 6.5–12 × 3.5–5 µm (Breitenbach & Kränzlin 1986, Bernicchia & Gorjón 2010). These characters are taxonomically important because they allow reliable separation of *S. hirsutum* from morphologically similar stereoid taxa and provide a stable basis for linking specimen-based records with ethnomycological observations.

Figure 1. Basidiomata showing variation in color and morphology. (A, B) Basidiomata on *Acer tataricum* subsp. *semenovii* (Regel & Herder) A.E. Murray, voucher YG-030; (C) basidiome with concentric ridges and a prominent crack on the same host tree, voucher YG-056; (D) hymenial surface associated with algal growth and bryophytes on unidentified fallen wood, voucher YG-048. Photos by Yusufjon Gafforov.

From a practical field perspective, the most useful diagnostic combination includes thin, tough, shelf-like basidiomata; a conspicuously hairy and zonate upper surface; a smooth, yellowish to orange hymenial side; and regular occurrence on dead branches, trunks, and exposed hardwood surfaces. This distinctive morphology likely explains why the species is repeatedly recognised and assigned vernacular names in different linguistic traditions, even though direct medicinal-use documentation remains relatively limited (Breitenbach & Kränzlin 1986, Bernicchia & Gorjón 2010, Gafforov *et al*. 2023a).

Global ecology, host associations, and distribution

Stereum hirsutum is a lignicolous white-rot fungus that typically develops on dead trunks, branches, twigs, and exposed woody parts of living trees. It is most often associated with deciduous hosts and is especially frequent on hardwood substrates, although occasional occurrence on coniferous wood has also been reported in the broader literature (Ryvarden 2010, 2020). Its ecological behaviour indicates a species with broad substrate tolerance and substantial adaptability across temperate woody habitats.

Within Central Asia, *S. hirsutum* is confirmed from Uzbekistan, Tajikistan, and Kyrgyzstan on the basis of specimen-based and literature-based records. The material compiled for the present review documents multiple collections from Uzbekistan, particularly from Tashkent Province, including the Ugam-Chatkal State National Natural Park, the Ugam and Pskem ranges of the Western Tien Shan Mountains, Xumson, Beldirsoy, Oqtosh, Chimyon, Xojikent, and the Tashkent Botanical Garden, as well as records from gardens in Namangan Province. In addition, a specimen from Tajikistan preserved under the herbarium acronym TAAM and a published record from Kyrgyzstan indicate that the species is more broadly distributed across the mountainous and woody habitats of Central Asia.

Regional substrate data show that *S. hirsutum* occurs on unknown fallen wood and on several deciduous hosts, including *Juglans regia*, *Salix interior*, *Salix iliensis*, *Acer tataricum* subsp. *semenovii*, *Fraxinus excelsior*, and *Quercus robur*. Earlier studies from Uzbekistan further indicate that the species has been recorded on eight tree genera, namely *Acer*, *Celtis*, *Crataegus*, *Fraxinus*, *Juglans*, *Populus*, *Quercus*, and *Salix* (Gafforov *et al*. 2020, 2023a, 2023b). This host breadth suggests considerable ecological plasticity and helps explain why the species is repeatedly encountered in mountain forests, river valleys, gardens, and other woody habitats accessible to local communities.

At the global scale, *S. hirsutum* is widely distributed across both the Northern and Southern Hemispheres and is primarily associated with temperate regions. According to the compiled data, its known distribution includes Central Asia, East Asia, South Asia, the Middle East, the Caucasus, Europe, North and Central America, South America, Australia, New Zealand, parts of Africa, and the Greater Antilles. Such a broad biogeographic range, together with its capacity to colonize numerous woody hosts, indicates that *S. hirsutum* is one of the most ecologically widespread stereoid fungi considered in the present review (Ryvarden 2010, 2020, Gafforov *et al*. 2020, GBIF 2026).

Ethnomycological relevance and traditional/local knowledge

Available evidence indicates that *Stereum hirsutum* has genuine but still limited ethnomycological documentation. The clearest directly traceable traditional-use context comes from East Asia, where *S. hirsutum* is reported as the fungal partner in the heterogeneous basidiocarp known as Jin’er, formed in association with *Tremella aurantia*; this complex has been described as being used as both food and folk medicine in Chinese society (Duan *et al*. 2018). Later synthesis papers have retained this interpretation and treated it as the most explicit traditional-use record currently linked to *S. hirsutum* (Gafforov *et al*. 2023a).

Additional medicinal-use claims have been summarised in later review literature. These include reported use of *S. hirsutum* in traditional medicine for diabetes and dyspepsia, antiseptic use in India (Kumar *et al*. 2017), and folk use in China and Korea for cancer-related treatment (Duan *et al*. 2018, Hu *et al*. 2020, Mišković *et al*. 2021, Gafforov *et al*. 2023a, 2023b). However, these indications are more clearly preserved in secondary compilations than in extensive primary ethnographic documentation devoted specifically to *S. hirsutum*. For that reason, they are best interpreted cautiously as reported traditional uses rather than as thoroughly documented ethnomedical practices.

Taken together, the currently available literature suggests that *S. hirsutum* should be regarded as a fungus with limited but credible traditional medicinal associations, especially in East Asia, rather than as a species with a broad and deeply documented folk-medicinal record. This distinction is important for the present review because the species is chemically and pharmacologically well studied, whereas its traditional and local medicinal meanings remain comparatively under recorded, particularly in Central Asia (Duan *et al*. 2018, Gafforov *et al*. 2023a, 2023b).

Edibility, smell, taste, and folk perception

Stereum hirsutum is generally regarded as an inedible fungus and is not documented in the reviewed literature as a regular food mushroom in Central Asia. Regional and taxonomic sources consistently describe the species as tough, leathery, and of little culinary value, which helps explain its exclusion from ordinary food use despite its frequent occurrence on dead wood (Breitenbach & Kränzlin 1986, Bernicchia & Gorjón 2010, O’Reilly 2016). In the Uzbekistan-focused review literature, *S. hirsutum* is explicitly described as inedible and without a special smell or taste, which is consistent with broader field-guide accounts (O’Reilly 2016, Gafforov *et al.* 2023a, 2023b).

Field descriptions further indicate that the basidiomata are thin, coriaceous, and tasteless, with no noticeable or distinctive odor when fresh. These characters help distinguish the species from fungi that enter local food traditions because they offer neither fleshy texture nor attractive organoleptic qualities. Even when collected in good condition, the basidiomata remain too tough for culinary use, and this practical limitation likely contributes more to their inedibility than any evidence of toxicity (O’Reilly 2016).

From an ethnomycological perspective, *S. hirsutum* appears to function primarily as a visually recognised but non-food fungus. Its hairy, concentrically zonate basidiomata are conspicuous and readily noticed in the field, which likely explains its rich vernacular profile across several languages, yet the currently available evidence does not indicate that it occupies an important place in local culinary practice. Instead, the species seems to be perceived mainly as a common wood-inhabiting crust or bracket fungus, occasionally associated with medicinal interest but not with regular consumption (Gafforov *et al*. 2023a, 2023b). This interpretation is also consistent with the reviewed field-guide literature, which repeatedly emphasises recognition value rather than edibility (O'Reilly 2016). Overall, the reviewed evidence supports a consistent profile of *S. hirsutum* as an ecologically common and culturally visible fungus with little or no direct food value. Thus, its ethnobiological relevance lies less in edibility and more in its recognizability, broad distribution, medicinal associations, and potential pharmacological significance (Gafforov *et al*. 2023a, 2023b).

Chemical diversity and principal metabolite classes

Within the genus *Stereum*, secondary metabolites include sesquiterpenoids, sterols, triterpenoids, polyketides, saccharides, carboxylic acids, and vibralactones, and *S. hirsutum* is among the chemically best investigated species in the group (Tian *et al.* 2020; Rašeta *et al*. 2020, Mišković *et al.* 2021, Pu *et al.* 2021). A concise overview of the principal metabolite classes reported from *S. hirsutum*, together with representative compounds, source material, and documented biological relevance, is provided in Table 1. Genomic analysis of *S. hirsutum* FP-91666 further supports this strong biosynthetic potential by revealing sixteen terpene synthase gene clusters, six polyketide synthase gene clusters, and one polyketide synthase–non-ribosomal peptide synthetase hybrid gene cluster, suggesting a high capacity for metabolite biosynthesis, particularly of terpenoid-type compounds (Pu *et al.* 2021).

Recent studies further indicate that the chemistry of *S. hirsutum* is not yet fully characterised. Zhao et al. (2024) reported twelve isopentenyl benzene congeners from *S. hirsutum* HFG27, including six previously undescribed compounds, stereuins A–F, thereby broadening the known aromatic metabolite profile of the species. Similarly, Wei et al. (2025) isolated eleven new vibralactone derivatives, hirsutavibrins A–K, from co-cultures of *S. hirsutum* and *Boreostereum vibrans*. These findings suggest that cultivation conditions and fungal interactions can influence metabolite expression and reveal compounds that may not be detected in standard monoculture systems. Taken together, the available data show that *S. hirsutum* has a chemically rich but unevenly studied profile, with fermentation-derived metabolites much better documented than compounds from naturally collected basidiomata.

Sesquiterpenoids

Sesquiterpenoids represent the most intensively investigated metabolite class in *S. hirsutum* and form the core of its specialised metabolite profile. Early work isolated three new tricyclic sesquiterpenes with a hirsutane skeleton, hirsutenols A–C, from the fermentation broth of *S. hirsutum* (Yun *et al*. 2002a). In the same period, sterins A and B were reported from the fermentation broth, and a later study described sterin C as a hydroxylated derivative from mycelial culture (Yun *et al*. 2002b, Yoo *et al*. 2005). These initial findings established *S. hirsutum* as an important producer of structurally diverse sesquiterpenoids.

Subsequent studies considerably expanded this chemistry. Ma *et al.* (2014) reported new hirsutane-type sesquiterpenoids from solid-state fermented rice colonised by *S. hirsutum*, whereas Qi *et al.* (2014) identified hirsutic acids D–E together with the heterodimeric sesquiterpenes sterhirsutins A and B. This line of work was extended by Qi *et al.* (2015), who described sterhirsutins C–L and additional sesquiterpenoid derivatives with cytotoxic and immunosuppressive activities. More recently, Zhao *et al.* (2022) reported hirsutuminoids A–Q, indicating that the linear triquinane sesquiterpenoid diversity of *S. hirsutum* remains far from exhausted.

A notable extension of this chemistry is the discovery of sesquiterpene-derived quaternary ammonium hybrids. Duan *et al.* (2018) reported stereumamides A–D as the first naturally occurring quaternary ammonium compounds composed of sesquiterpenes conjugated with α-amino acids. Medium-optimisation studies later expanded this series and yielded additional mixed terpenes and hybrid metabolites, including stereumamides I–K and sterostrein X, confirming that the sesquiterpenoid chemistry of *S. hirsutum* is highly responsive to cultivation conditions (Pu *et al.* 2021). Together, these studies confirm that sesquiterpenoids remain the dominant and most chemically innovative metabolite class currently known from *S. hirsutum*.

Benzoate derivatives

Benzoate derivatives constitute a second major axis of chemical diversity in *S. hirsutum*. Ma *et al*. (2014) isolated two new prenylated benzoate derivatives together with sesquiterpenoids from solid-state fermented rice, demonstrating that aromatic and terpenoid biosynthesis can occur in parallel under fermentation conditions. These benzoate derivatives were associated with antimicrobial and cytotoxic activities, further supporting their pharmacological relevance (Ma *et al*. 2014).

Table 1. Major metabolite classes reported from *Stereum hirsutum* and their documented biological relevance

Metabolite class	Representative compounds or series	Source material	Main reported activity/relevance	Key references
Sesquiterpenoids	Hirsutenols A–C; hirsutic acids D–E; sterhirsutins A–L; hirsutuminoids A–Q; stereumamides A–K	Fermentation broth, mycelial culture	Cytotoxic, immunosuppressive, anti-inflammatory, antimicrobial, antibacterial	(Yun et al. 2002a, 2002b), (Yoo et al. 2005), (Qi et al. 2014, 2015), (Duan et al. 2018), (Hu et al. 2020), (Pu et al. 2021), (Zhao et al. 2022)
Benzoate derivatives	Prenylated benzoate derivatives; sterenins E–M; acetylenic aromatic compounds; sterehirsutynes A–C; stereuins A–F	Solid-state fermented rice, solid culture, culture broth, mycelial culture.	Antimicrobial, cytotoxic, α-glucosidase inhibitory, antibacterial, anti-inflammatory, neurotrophic relevance	(Dubin et al. 2000), (Ma et al. 2014), (Wang et al. 2014), (Liu et al. 2022), (Zhao et al. 2024)
Sterols and steroids	Ergosterol peroxide; oxygenated ergostane derivatives; steresterones A–B	Mycelial culture, liquid culture	Cytotoxic and chemotaxonomic relevance	(Duan et al. 2014), (Zhao et al. 2019), (Senatore 1990)
Phenolics and organic acids	Quinic acid, gallic acid, amentoflavone, *p*-hydroxybenzoic acid, protocatechuic acid, baicalein, chrysoeriol; butyric, malic, oxalic, quinic, and succinic acids	Fruiting bodies	Antioxidant and acetylcholinesterase-related relevance	(Mišković et al. 2021)
Polysaccharides	D-glucose- and D-galactose-based polysaccharide fractions with α- and β-glycosidic bonds	Fruiting bodies	Structural mycochemical relevance; possible medicinal importance	(Mišković et al. 2021)
Fatty acids and minerals	Linoleic acid; Ca, Mg, K, Fe, Mn, Zn, Cu	Fruiting bodies	Nutritional and biochemical relevance	(Mišković et al. 2021), (Senatore 1990)

This broader aromatic chemistry also includes depsides and acetylenic aromatic compounds. Wang *et al.* (2014) isolated nine new isoprenylated depsides, sterenins E–M, from solid culture and demonstrated α-glucosidase inhibitory activity, making this subgroup particularly relevant to the medicinal potential of the species. Earlier, Dubin *et al.* (2000) described four new acetylenic aromatic compounds from *S. hirsutum*, and later Liu *et al.* (2022) reported sterehirsutynes A–C together with three known congeners from culture broth. This aromatic-metabolite spectrum was broadened further by Zhao *et al.* (2024), who isolated twelve isopentenyl benzene derivatives from *S. hirsutum* HFG27, including six previously undescribed compounds designated stereuins A–F. Taken together, these studies indicate that benzoate derivatives, depsides, and related aromatic metabolites form a chemically and biologically important component of the mycochemical profile of *S. hirsutum* (Dubin *et al.* 2000, Wang *et al.* 2014, Liu *et al.* 2022, Zhao *et al.* 2024).

Sterols and steroids

Sterols and steroids are less extensively represented than sesquiterpenoids in the current literature, but they remain a clear and recurrent part of the chemistry of *S. hirsutum*. Duan *et al.* (2014) isolated several ergostane-related metabolites, including ergosterol peroxide and other oxygenated sterol derivatives, from *S. hirsutum* FP-91666. Further support for the importance of this class was provided by Zhao *et al.* (2019), who isolated ten steroids from liquid cultures of *S. hirsutum*, including the previously undescribed steresterones A and B, and demonstrated cytotoxic activity for several ergosteroids. Earlier chemotaxonomic work by Senatore (1990) also documented sterols in *Stereum* species, reinforcing the view that sterol chemistry is a recurring feature within the genus. Although steroidal metabolites are not as structurally dominant as sesquiterpenoids in *S. hirsutum*, they contribute meaningfully to the cytotoxic and biochemical profile of the species.

Phenolics, organic acids, polysaccharides, fatty acids, and minerals

These broader compositional classes are best documented from fruiting-body analyses rather than fermentation-based metabolite discovery. The most informative study is that of Mišković *et al.* (2021), who characterized methanolic extracts of *S. hirsutum* fruiting bodies from Serbia and quantified seven phenolic compounds, among which quinic acid was dominant, together with gallic acid, amentoflavone, *p*-hydroxybenzoic acid, protocatechuic acid, baicalein, and chrysoeriol. The same study also identified five organic acids, namely butyric, malic, oxalic, quinic, and succinic acids, again with quinic acid being the most abundant.

Mišković *et al.* (2021) further used FTIR analysis to characterize polysaccharide fractions from fruiting bodies and reported D-glucose and D-galactose as the dominant constituents, together with the presence of both α- and β-glycosidic bonds. The same fruiting-body study identified 25 fatty acids among 36 investigated fatty acid methyl esters, with linoleic acid representing the dominant fatty acid, and quantified mineral composition, showing calcium, magnesium, and potassium as the major macro-elements and iron, manganese, zinc, and copper as the principal micro-elements. Earlier work by Senatore (1990) likewise documented fatty acids and sterols in *Stereum*, supporting the relevance of this broader compositional layer. Together, these fruiting-body-based data are especially valuable in an ethnomycology-oriented review because they more closely reflect the chemistry of naturally occurring basidiomata than optimized laboratory cultures do (Senatore 1990, Mišković *et al.* 2021).

Biological activities and pharmacological relevance

The available literature indicates that *S. hirsutum* is a pharmacologically promising fungus (Table 1), although the strength of evidence varies among reported activity types and remains dominated by *in vitro* assays, extract-based screening, and metabolite-centered investigations. Compared with its still limited ethnomycological documentation, the species has been studied much more extensively for bioactive compounds and experimentally measurable biological effects. Consequently, *S. hirsutum* may presently be regarded as a species with modestly documented traditional medicinal relevance but substantial laboratory-supported bioactivity potential (Ma *et al*. 2014, Wang *et al.* 2014, Tian *et al*. 2020, Mišković *et al.* 2021).

Antimicrobial potential

Available evidence indicates that *S. hirsutum* possesses a chemically diverse antimicrobial profile. Yun *et al.* (2002a) reported that the hirsutane sesquiterpenes hirsutenols A–C exhibited weak antifungal activity and moderate antibacterial activity against *Escherichia coli*, while no activity was detected against *Aspergillus* spp., *Bacillus subtilis*, *Candida albicans*, *Chlorella regularis*, *Salmonella typhimurium*, or *Staphylococcus aureus*. Subsequent studies expanded this profile. Ma *et al.* (2014) demonstrated that two benzoate derivatives displayed antibacterial activity against *B. subtilis*, methicillin-resistant *S. aureus* (MRSA), and *S. aureus*, and in the same study one benzoate derivative and one sesquiterpenoid also showed strong anti-inflammatory and antitumor effects against A549 and HepG2 cells.

Duan *et al.* (2018) later reported that stereumamides A and D inhibited *E. coli*, *S. typhimurium*, and *S. aureus*, with minimum inhibitory concentration values of 12.5–25.0 µg/mL. Pu *et al.* (2021) further showed that the ammonium hybrids stereumamides I–K and sterostrein Q exhibited weak antibacterial activity against *Mycobacterium tuberculosis*. At the extract level, Sevindik *et al.* (2021) evaluated *S. hirsutum* against nine bacterial and fungal strains and found notable activity against *Acinetobacter baumannii*, *S. aureus*, and MRSA. More recently, Zhao *et al.* (2024) showed that several newly identified isopentenyl benzene congeners from *S. hirsutum* HFG27 exhibited antibacterial activity against *S. aureus*, with stereuin F showing the strongest effect, while stereuin A also promoted neurite outgrowth. Taken together, these findings indicate that the antimicrobial potential of *S. hirsutum* is supported by both purified metabolites and crude extract assays and involves several chemically distinct metabolite classes.

Antidiabetic potential

The antidiabetic relevance of *S. hirsutum* is most clearly supported by α-glucosidase inhibition. Wang *et al.* (2014) investigated isoprenylated depsides isolated from cultures of *S. hirsutum* and found that most of the tested compounds showed significant α-glucosidase inhibition *in vitro*, with IC_{50} values ranging from 3.06 to 36.64 µM. These results suggest that depside-type metabolites from *S. hirsutum* may represent promising leads for the development of hypoglycemic agents and provide a mechanistic basis for considering the species in diabetes-related pharmacological research.

Cytotoxic, anti-inflammatory, antioxidant, and acetylcholinesterase-related activities

Several studies have demonstrated that *S. hirsutum* produces compounds with cytotoxic potential. Qi *et al.* (2015) evaluated structurally diverse sesquiterpene derivatives against HCT116 and K562 cell lines and found that sterhirsutin K additionally exhibited marked autophagy-inducing activity in HeLa cells. Steroidal metabolites have also shown cytotoxic effects. Zhao *et al.* (2019) reported that six isolated steroids displayed cytotoxicity against five human cancer cell lines, including A-549, HL-60, MCF-7, SMMC-7721, and SW480. In a later study, Zhao *et al.* (2022) assessed the anti-inflammatory and cytotoxic properties of eighteen linear triquinane sesquiterpenoids and found that only hirsutuminoid B significantly inhibited nitric oxide production in RAW 264.7 macrophages. Further support for interaction-induced bioactivity was provided by Wei *et al.* (2025), who reported that hirsutavibrins A and B from co-cultures of *S. hirsutum* and *Boreostereum vibrans* showed weak cytotoxicity against A549 cells.

The antioxidant potential of *S. hirsutum* has been documented mainly in extract-based studies of naturally collected basidiomata. Mišković *et al.* (2021) demonstrated notable antioxidant activity in fruiting-body extracts and interpreted this effect in relation to the presence of phenolic compounds, fatty acids, and other low-molecular-weight constituents identified in the basidiomata. Evidence for anti-inflammatory activity is available from both compound-based and broader natural-products studies. Ma *et al.* (2014) reported that one isolated benzoate derivative displayed strong anti-inflammatory activity, while Zhao *et al.* (2022) showed that hirsutuminoid B significantly inhibited nitric oxide production in macrophages. This activity spectrum was extended by Wei *et al.* (2025), who showed that hirsutavibrin D exhibited moderate anti-nitric oxide activity. Acetylcholinesterase-related activity has also been reported, again most clearly in fruiting-body-based analyses, with Mišković *et al.* (2021) showing that extracts from *S. hirsutum* inhibited acetylcholinesterase. Taken together, these studies indicate that *S. hirsutum* possesses a broader bioactivity spectrum than would be expected from its relatively limited ethnomycological documentation.

Biotechnological and applied potential

Beyond direct pharmacological activity, *S. hirsutum* also demonstrates clear biotechnological value. Yang *et al*. (2021) showed that *S. hirsutum* JE0512 can be used for the biotransformation of ginseng extracts into minor ginsenosides, including compound K, ginsenoside F2, and protopanaxatriol. The same study further demonstrated that combining *S. hirsutum* with cellulase markedly increased the yield of these minor ginsenosides, indicating that the fungus may serve as an effective biocatalyst in functional-metabolite production systems. This is particularly noteworthy because compound K itself has been recognized as a pharmacologically important ginsenoside metabolite with anticancer relevance in previous studies (Zhang *et al.* 2013).

Recent work has substantially broadened the applied significance of *S. hirsutum*. Benavides *et al.* (2025) showed that copper and manganese supplementation markedly enhanced manganese peroxidase activity, lignin degradation, and phenol removal by *S. hirsutum* during biodegradation of olive mill solid waste, supporting its potential in biomass pretreatment and mycoremediation-related bioprocesses. In parallel, studies on the JinEr symbiotic system have clarified additional physiological and cultivation-related roles of *S. hirsutum*. Zeng *et al.* (2025) identified *S. hirsutum*-associated genes involved in riboflavin metabolism during color formation in the *Naematelia sinensis* complex, whereas Zhang *et al.* (2026) showed that *S. hirsutum* accounts for more than 80% of fungal biomass in cultivated JinEr and functions as the principal nutrient provider within the symbiotic system. Li *et al.* (2026) further demonstrated that postharvest cold-stress responses are functionally partitioned within the dual-fungal JinEr system, with *S. hirsutum* maintaining stronger basal metabolic activity and storage at 0 °C favoring better polysaccharide retention.

Overall, the currently available evidence identifies *S. hirsutum* as a fungus of substantial pharmacological and biotechnological relevance. Its reported activities include antimicrobial, antidiabetic, cytotoxic, antioxidant, acetylcholinesterase-related, and anti-inflammatory effects, while its demonstrated roles in ginsenoside biotransformation, lignocellulosic degradation, and the physiology of the JinEr symbiotic complex further broaden its applied significance (Yang *et al.* 2021, Zahuri *et al.* 2024, Benavides *et al.* 2025, Zeng *et al.* 2025, Zhang *et al.* 2026, Li *et al.* 2023, 2026). In addition, the identification of aromatic metabolites with antibacterial and neurotrophic properties, together with co-culture-derived compounds showing weak cytotoxic and anti-inflammatory activity, indicates that the bioactivity landscape of *S. hirsutum* remains incompletely explored and may be further expanded through alternative cultivation and interaction-based approaches (Zhao *et al.* 2024, Wei *et al.* 2025). A conceptual synthesis of these relationships is presented in Fig. 2.

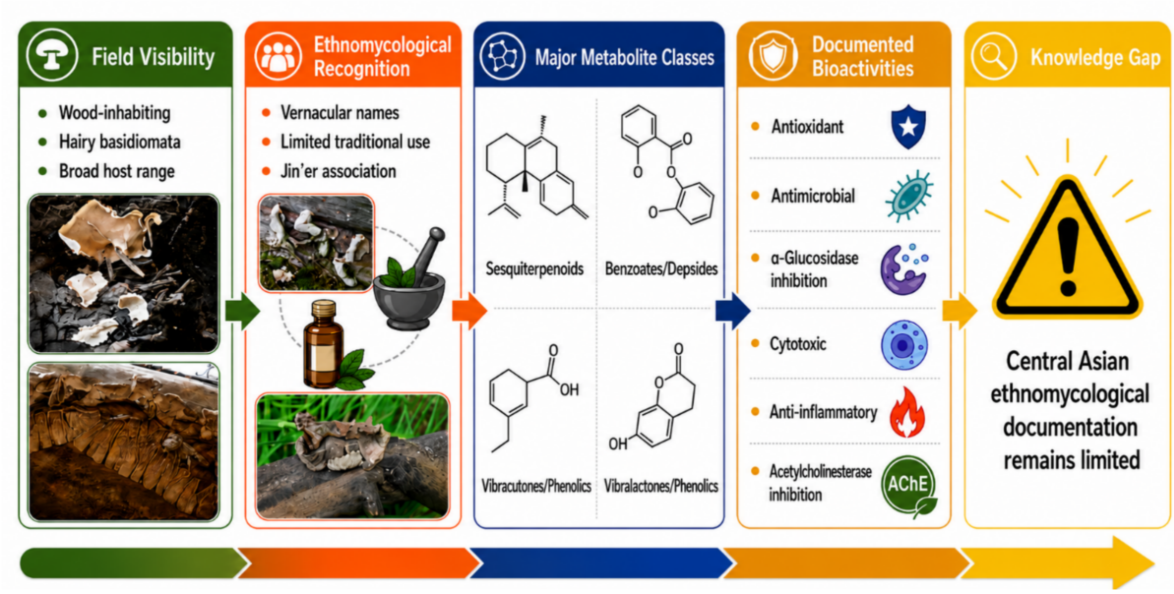

Figure 2. Conceptual overview of the ethnomycological relevance and mycochemical potential of *Stereum hirsutum***.** The figure summarizes the ecological visibility, traditional-use evidence, major metabolite classes, documented bioactivities, and remaining knowledge gaps associated with *S. hirsutum*. It links the species' frequent field occurrence on woody substrates and its recognition through vernacular names with limited but credible records of traditional use. The scheme further connects these ethnomycological observations with the principal metabolite groups and bioactivities reported for the species, including antioxidant, antimicrobial, α-glucosidase-inhibitory, cytotoxic, anti-inflammatory, and acetylcholinesterase-inhibitory effects. It also highlights the current imbalance between relatively modest ethnomycological documentation and more extensive laboratory-based chemical and pharmacological research, particularly in relation to Central Asia.

Discussion

Stereum hirsutum presents an unusual profile among medicinally relevant macrofungi. The species is visually conspicuous, ecologically widespread, and frequently encountered on dead wood, which likely explains its multilingual vernacular profile and regular appearance in biodiversity-oriented literature (Gafforov et al. 2020, 2023a, 2023b). Yet its direct ethnomycological documentation remains much more limited than the taxonomic, chemical, and pharmacological literature on the species. In this sense, *S. hirsutum* is better understood as an ethnobiologically visible fungus than as a thoroughly documented ethnomedicinal species. A likely explanation lies in its practical characteristics: because it is leathery, inedible, and of little culinary value, it is less likely than fleshy and regularly collected mushrooms to sustain food-related or medicinal traditions (Bernicchia & Gorjón 2010, O'Reilly 2016, Gafforov et al. 2023a, 2023b).

The currently available traditional-use evidence is therefore best interpreted as limited but credible rather than extensive. The clearest traceable context remains East Asia, particularly the association of *S. hirsutum* with the Jin'er complex and later secondary reports of medicinal relevance (Duan *et al.* 2018, Gafforov *et al.* 2023a, 2023b). However, compared with this modest ethnomycological record, the laboratory-based evidence for bioactive compounds and biological effects is considerably stronger. This contrast is important because it shows that traditional claims and experimental evidence are related, but not equally documented. For example, antidiabetic relevance suggested in later review literature is supported by stronger mechanistic evidence from α-glucosidase-inhibitory depsides isolated from *S. hirsutum* cultures (Wang *et al.* 2014). Likewise, broader medicinal interest in the species is supported by studies reporting antimicrobial, cytotoxic, antioxidant, and acetylcholinesterase-related activities (Ma *et al.* 2014, Qi *et al.* 2015, Mišković *et al.* 2021). Thus, the medicinal promise of *S. hirsutum* is not merely speculative, although the ethnomedical record remains relatively sparse.

From a chemical perspective, *S. hirsutum* is one of the most important species currently known within *Stereum*. Tian *et al.* (2020) identified the genus as a rich source of sesquiterpenoids, sterols, vibralactones, saccharides, and related metabolites, and the present synthesis confirms that *S. hirsutum* is among the chemically best investigated species within that framework. Hirsutane-related sesquiterpenoids, benzoate- and depside-related aromatic metabolites, ergosteroids, and fruiting-body phenolics together form a chemically layered profile associated with multiple biological activities (Tian *et al.* 2020, Ma *et al.* 2014, Mišković *et al.* 2021). At the same time, this profile is still expanding. Zhao *et al.* (2024) described stereuins A–F and thereby broadened the known aromatic chemistry of the species, whereas Wei *et al.* (2025) showed that co-cultures of *S. hirsutum* and *Boreostereum vibrans* yield hirsutavibrins A–K, indicating that interaction-driven cultivation can reveal additional vibralactone-related metabolites not readily detected in conventional monoculture systems (Zhao *et al.* 2024, Wei *et al.* 2025). These findings suggest that strain-dependent and co-culture-based strategies remain productive avenues for further metabolite discovery.

A methodological limitation, however, deserves emphasis. Most specialized compounds have been isolated from cultured mycelium, fermentation broth, or optimized media rather than from naturally collected fruiting bodies (Ma *et al.* 2014, Duan *et al.* 2018, Pu *et al.* 2021). This distinction matters because ethnomycological interpretation depends not only on what a species can produce under laboratory optimization, but also on what local communities actually encounter in nature. For that reason, fruiting-body-based studies such as Mišković *et al.* (2021) are especially valuable, since they provide a more direct connection between field-observed basidiomata and measurable bioactive chemistry.

The pharmacological evidence for *S. hirsutum* is substantial, although uneven across activity types. Antimicrobial and antibacterial effects have been demonstrated for benzoate derivatives, hirsutane-type sesquiterpenoids, and sesquiterpene–amino acid quaternary ammonium hybrids, while α-glucosidase inhibition supports possible antidiabetic relevance (Ma *et al.* 2014, Wang *et al.* 2014, Duan *et al.* 2018). Cytotoxic and immunosuppressive effects have also been reported for multiple sesquiterpenoids and ergosteroids, whereas antioxidant and acetylcholinesterase-related activities have been shown in fruiting-body extracts (Qi *et al.* 2015, Zhao *et al.* 2019, Mišković *et al.* 2021). More recent work extends this activity spectrum further: Zhao *et al.* (2024) showed that newly identified aromatic metabolites possess antibacterial activity against *Staphylococcus aureus*, while one compound also promoted neurite outgrowth, and Wei *et al.* (2025) reported weak cytotoxic and anti-inflammatory effects in co-culture-derived hirsutavibrins. Even so, most available studies remain heavily dependent on *in vitro* assays or isolated compounds, whereas comparatively fewer investigations examine naturally collected basidiomata, standardized *in vivo* systems, or translational relevance. The current evidence, therefore, supports strong bioactive potential, but it does not yet justify the conclusion that the traditional medicinal value of *S. hirsutum* has been fully validated.

Its significance also extends beyond direct medicinal interpretation. Yang *et al.* (2021) demonstrated that *S. hirsutum* JE0512 can be used in the biotransformation of ginseng extracts into minor ginsenosides, including compound K, ginsenoside F2, and protopanaxatriol, and that combining the fungus with cellulase markedly increases the yield of these metabolites. Recent studies have broadened this applied profile further. Benavides *et al.* (2025) showed that *S. hirsutum* can contribute to lignocellulosic waste valorization through enhanced manganese peroxidase activity, lignin degradation, and phenol removal during treatment of olive mill solid waste. At the same time, studies of the JinEr symbiotic cultivation system indicate a more central physiological role for the species than previously recognized. Zhang *et al.* (2026) showed that *S. hirsutum* accounts for most of the fungal biomass in cultivated JinEr and likely functions as a principal nutrient-providing partner within the symbiotic complex, while related multi-omics and postharvest studies indicate its involvement in color-associated metabolism and low-temperature responses within the same system (Zeng *et al.* 2025, Zhang *et al.* 2026, Li *et al.* 2026). These findings show that a species with relatively modest ethnomycological documentation may nevertheless possess substantial industrial and pharmaceutical value.

For Central Asia, the present review highlights a clear imbalance between ecological documentation and ethnomycological interpretation. Although *S. hirsutum* is sufficiently visible in regional woody habitats and is already supported by specimen-based records from Uzbekistan and neighboring parts of Central Asia, its ethnomycological dimension remains poorly developed (Gafforov *et al.* 2020, 2023a, 2023b, Khojimatov *et al.* 2023). In other words, the species is currently much better understood as a taxonomically verified wood-inhabiting fungus and as a source of bioactive metabolites than as a culturally interpreted organism within local knowledge systems. This pattern reflects a broader tendency in Central Asian fungal research, where biodiversity inventories, floristic reporting, and herbarium-based documentation have advanced more rapidly than field-based studies of vernacular naming, medicinal interpretation, and local collection practices. The absence of published ethnomycological data for *S. hirsutum* should therefore not automatically be taken as evidence of a lack of local recognition; it may instead reflect limited use of specimen-linked ethnomycological approaches (Gafforov *et al.* 2023a, 2023b, 2026). A related limitation is the disconnect between laboratory evidence and regionally grounded material. Much of the current knowledge on the medicinal and applied value of *S. hirsutum* is based on cultured mycelium, fermentation systems, or isolated compounds, whereas locally collected fruiting bodies linked to documented community knowledge remain largely unexamined (Mišković *et al.* 2021, Yang *et al.* 2021).

Future work should therefore prioritize voucher-supported ethnomycological field studies in which interviews, photographed or collected specimens, habitat context, and vernacular terminology are documented together. Particularly valuable would be studies integrating specimen-confirmed identification with local perceptions and targeted chemical profiling of naturally collected fruiting bodies. Such an approach would help connect ecological visibility, regional knowledge, and experimentally supported chemistry within a single analytical framework and provide a more realistic basis for evaluating the actual ethnobiological significance of *S. hirsutum* in Central Asia.

Overall, *S. hirsutum* emerges from this review as an ecologically widespread, chemically rich, pharmacologically promising, and biotechnologically relevant fungus that remains ethnomycological under documented. Its profile is further strengthened by the continuing expansion of its known aromatic and co-culture-induced metabolite repertoire, as well as by new evidence for applied roles in lignocellulosic bioprocessing, symbiotic mushroom cultivation, and postharvest fungal physiology (Zhao *et al.* 2024, Wei *et al.* 2025, Benavides *et al.* 2025, Zeng *et al.* 2025, Zhang *et al.* 2026, Li *et al.* 2026). It is therefore both a strong candidate for further natural products and applied biotechnology research and a useful case study for understanding how visible, common wood-inhabiting fungi may remain culturally under recorded despite substantial biomedical potential (Tian *et al.* 2020, Gafforov *et al.* 2023a, 2023b, Yang *et al.* 2021).

Conclusion

Stereum hirsutum is an ecologically widespread and chemically rich wood-inhabiting fungus with documented pharmacological and biotechnological relevance. However, its ethnomycological significance remains insufficiently documented, particularly in Central Asia. The available literature supports limited but credible traditional medicinal associations, especially in East Asia, while the evidence for secondary-metabolite diversity, experimentally demonstrated bioactivities, and applied biotechnological potential is much stronger than the evidence for well-documented ethnomedical use. This contrast makes *S. hirsutum* a useful example of a visually conspicuous and culturally recognisable fungus whose local knowledge remains under recorded despite its biomedical and applied potential.

This review also identifies a clear methodological gap. Much of the current knowledge on the chemistry and bioactivity of *S. hirsutum* comes from cultured mycelium, fermentation systems, or isolated compounds, whereas naturally collected fruiting bodies linked to documented community knowledge remain poorly studied. Future research should therefore prioritise voucher-supported ethnomycological field studies that combine specimen-confirmed identification, documentation of vernacular names and uses, and targeted chemical profiling of field-collected material. Such an approach would provide a stronger basis for evaluating the ethnobiological significance of *S. hirsutum* in Central Asia and would help connect ecological occurrence, local knowledge, chemical diversity, and experimentally supported biological and applied functions within a single regional framework.

Declarations

List of abbreviations: AChE, acetylcholinesterase; CK, compound K; FT-IR, Fourier-transform infrared spectroscopy; YMG, yeast malt glucose medium.

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