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# APPLICATIONS OF OYSTER MUSHROOM IN THE FOOD AND PHARMACEUTICAL INDUSTRIES: ANALYSIS OF BIOLOGICALLY ACTIVE COMPOUNDS.

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**Annotation.** Species of the genus *Pleurotus*, commonly known as oyster mushrooms, are macrofungi recognized globally for their high nutritional density and therapeutic potential. This review provides a systematic analysis of the major biologically active compounds found in *Pleurotus* species—specifically beta-glucans, lovastatin, ergosterol, phenolic compounds, and functional proteins (lectins and laccases)—and evaluates their applications in the food and pharmaceutical sectors. In food processing, oyster mushrooms serve as meat substitutes, structural enhancers, natural antioxidants, and functional ingredients. In therapeutics, isolated bioactive fractions demonstrate immunomodulatory, hypocholesterolemic, antitumor, antioxidant, and antimicrobial efficacy.

**Keywords:** *Pleurotus ostreatus*, beta-glucans, lovastatin, bioactivity, functional food, mushroom therapeutics, HPLC analysis.

**Annotatsiya.** Pleurotus turkumiga mansub, odatda veshenka zamburug’lari deb ataladigan turlar yuqori oziqaviy qiymati va terapevtik salohiyati bilan dunyo miqyosida e’tirof etilgan makrozamburug’lardir. Ushbu sharhda Pleurotus turlarida uchraydigan asosiy biologik faol birikmalar beta-glukanlar, lovastatin, ergosterol, fenol birikmalari hamda funksional oqsillar (lektinlar va lakkazalar) tizimli tahlil qilinib, ularning oziq-ovqat va farmatsevtika sohalarida qo’llanilishi baholanadi. Oziq-ovqat mahsulotlarini ishlab chiqarishda veshenka zamburug’lari go’sht o’rnini bosuvchi mahsulotlar, mahsulot tuzilishini yaxshilovchi qo’shimchalar, tabiiy antioksidantlar va funksional ingredientlar sifatida qo’llaniladi. Terapevtik qo’llanishda ajratib olingan biologik faol fraksiyalar immunomodulyator, qondagi xolesterin miqdorini kamaytiruvchi, o’smalarga qarshi, antioksidant va antimikrob ta’sirlarni namoyon etadi.

**Kalit so’zlar:** Pleurotus ostreatus, beta-glukanlar, lovastatin, biologik faollik, funksional oziq-ovqat, zamburug‘larning terapevtik qo‘llanilishi, yuqori samarali suyuqlik xromatografiyasi (HPLC) tahlili.

**Аннотация:** Виды рода Pleurotus, широко известные как вешенки, представляют собой макрогрибы, признанные во всём мире благодаря высокой пищевой ценности и

терапевтическому потенциалу. В данном обзоре представлен систематический анализ основных биологически активных соединений, содержащихся в видах Pleurotus, — бета-глюканов, ловастатина, эргостерола, фенольных соединений и функциональных белков (лектинов и лакказ), а также оценено их применение в пищевой и фармацевтической отраслях. В производстве пищевых продуктов вешенки используются в качестве заменителей мяса, компонентов, улучшающих структуру продуктов, природных антиоксидантов и функциональных ингредиентов. При терапевтическом применении выделенные биологически активные фракции проявляют иммуномодулирующее, гипохолестеринемическое, противоопухолевое, антиоксидантное и антимикробное действие.

**Ключевые слова:** Pleurotus ostreatus, бета-глюканы, ловастатин, биологическая активность, функциональные пищевые продукты, терапевтическое применение грибов, анализ методом высокоэффективной жидкостной хроматографии (ВЭЖХ).

**Introduction.** Global demand for sustainable, plant-based functional ingredients has accelerated interest in cultivated edible macrofungi. Among these, the genus *Pleurotus* (Family: Pleurotaceae), which includes species such as *Pleurotus ostreatus*, *Pleurotus eryngii*, *Pleurotus citrinopileatus*, and *Pleurotus djamor*, represents one of the largest segments of global mushroom cultivation. *Pleurotus* species are primary decomposers capable of efficiently biotransforming agricultural and lignocellulosic wastes into protein-rich fruiting bodies.

Beyond basic nutrition—providing complete protein profiles, dietary fiber, essential vitamins (B-complex, D precursor ergosterol), and minerals—oyster mushrooms synthesize a wide array of bioactive secondary metabolites and structural macromolecules. These molecules exhibit targeted physiological actions, bridging the gap between food chemistry and pharmacology.

**Literature Review**

The bioactivity of *Pleurotus* species stems from a diverse profile of primary and secondary metabolites, summarized in.

Polysaccharides constitute up to 35–60% of the dry weight of *Pleurotus* fruiting bodies. The most physiologically significant among these are water-soluble and insoluble beta-(1,3/1,6)-D-glucans. These structural cell-wall polysaccharides bind to pattern recognition receptors (such as Dectin-1 and Toll-like Receptor 2) on immune cells, triggering macrophage activation, cytokine modulation, and enhanced phagocytosis without inducing cytotoxic toxicity.

**Methods section**

This thesis uses a narrative analysis of selected published experimental studies. The examined research covers chemical characterization, antioxidant assays, ultraviolet treatment and a human dietary intervention. No original laboratory experiments or clinical investigations were conducted. Findings are interpreted according to their evidence level,

with particular distinction between chemical measurements, biological activity demonstrated in vitro and effects observed in humans.

**Results**

The development of foods that combine nutritional value with biologically active ingredients has increased scientific interest in edible mushrooms. Oyster mushroom is particularly relevant because it can be consumed as a conventional food and processed into powders or extracts. Its potential industrial value depends on identifying its active constituents and determining how cultivation, extraction and processing influence their properties.

Research has examined β-glucans, polyphenols and lovastatin in raw and processed *P. ostreatus*, demonstrating the importance of analysing the actual product rather than assuming a uniform chemical composition [1]. The objective of this thesis is to examine these compounds and evaluate their relevance to food and pharmaceutical applications.

Phenolic compounds represent another relevant group. Experimental research on *P. ostreatus* extracts has identified phenolic constituents and demonstrated antioxidant and tyrosinase-inhibitory activities in laboratory assays [2]. These findings support further investigation of mushroom extracts as sources of antioxidant ingredients. Nevertheless, activity in a chemical assay does not establish that consuming the extract will prevent oxidative damage or treat disease in humans.

Ergosterol is particularly important because ultraviolet irradiation can convert it into vitamin $D_2$. An experimental study involving *P. ostreatus* and *Agaricus bisporus* demonstrated increased vitamin $D_2$ content following UV-B treatment [3]. This provides a technological basis for producing vitamin $D_2$-enriched mushroom ingredients. The enrichment process requires controlled irradiation and subsequent measurement of vitamin content, since treatment conditions influence the resulting product.

Lovastatin has also been investigated in oyster mushroom [1]. Its reported presence is relevant to chemical characterization, but mushroom consumption cannot be assumed to deliver a standardized medicinal dose. Any pharmaceutical application would require validated identification, quantification and control of the active ingredient.

Applications in the food industry Oyster mushroom can be developed into ingredients for soups, sauces, savoury foods and composite food formulations. Powdered preparations offer a practical approach to incorporating mushroom material into products, while extracts may allow more targeted incorporation of selected compounds. These applications should be evaluated through formulation trials that examine taste, texture, nutritional composition and storage stability.

For antioxidant ingredients, an essential next step is to determine whether laboratory activity persists within a real food matrix. An extract that performs well in an antioxidant assay may behave differently during heating, storage or interaction with other ingredients. Therefore, any proposed preservation benefit should be confirmed by measuring oxidation and product quality under realistic conditions.

UV-treated mushroom ingredients offer a more directly measurable application: vitamin $D_2$ enrichment. Industrial development should establish an appropriate treatment protocol and verify nutrient retention throughout the intended shelf life. Such products should communicate their measured vitamin content rather than rely solely on the mushroom’s species identity.

Potential pharmaceutical applications Pharmaceutical research requires a clear distinction between whole mushrooms, crude extracts and purified compounds. Each preparation has a different composition and may produce different biological effects. Antioxidant or enzyme-inhibitory activity observed in vitro provides a starting point for research, but it does not establish an effective human dose or therapeutic benefit.

A small randomized dietary intervention provides an example of preliminary human evidence. Twenty participants consumed either soup containing 30 g of dried oyster mushroom or tomato soup daily for 21 days. The investigators reported reductions in triglycerides and oxidized LDL in the mushroom group. However, LDL and HDL cholesterol did not change significantly, and the reported change in total cholesterol did not reach the conventional statistical significance threshold [4]. The study supports further investigation but is insufficient to establish oyster mushroom as a cholesterol-lowering treatment.

Cultivation activities were carried out on 17–19 March 2026. According to the supplied source, Pleurotus ostreatus spores were mixed with a wheat substrate at a ratio of 1:1. Slaked lime was also added during substrate preparation. However, the source does not specify the amount of lime or other substrate treatment conditions.

During incubation, mycelial development was monitored, and the room temperature was initially maintained at 22 °C. On day 12, the substrate surface became white, and active mycelial growth was recorded. This visible change was interpreted as a qualitative indication of mycelial spread across the substrate surface.

Incubation continued during days 12–14, with the room temperature maintained between 21 and 22 °C. By the end of the second week, the first oyster mushroom primordia, or initial fruiting structures, appeared. This observation indicated the beginning of fruiting body development.

**Table 1. Observation Results During the Cultivation of Pleurotus ostreatus**

| Date or period | Activity performed | Conditions and observation results |
|---|---|---|
| 17–19 March 2026 | Inoculation with Pleurotus ostreatus spores | Spores and wheat substrate were mixed at a ratio of 1:1. |
| 17–19 March 2026 | Substrate preparation | The substrate was mixed with slaked lime. |
| Incubation period | Monitoring of mycelial development | The room temperature was maintained at 22 °C. |
| Day 12 | Assessment of mycelial growth | The substrate surface became white, and active mycelial growth began. |
| | Continuation of incubation | The room temperature was maintained |

| | | |
|---|---|---|
| Days 12–14 | | between 21 and 22 °C. |
| End of the second week | Observation of initial fruiting body formation | The first oyster mushroom primordia appeared. |

Analysis of the Results The observations describe three stages of mushroom development: inoculation and substrate preparation, mycelial growth, and the appearance of initial fruiting structures. The recorded room temperature ranged from 21 to 22 °C. Since no comparison with other temperature conditions was reported, these observations alone cannot establish this range as the optimum cultivation temperature.

The source does not provide information about humidity, ventilation, lighting, experimental replication or harvested mushroom mass. Consequently, the results describe early developmental stages but do not support a quantitative assessment of yield or cultivation efficiency.

Relevance to Food and Pharmaceutical Applications These observations can contribute to describing the cultivation stage involved in obtaining oyster mushroom material for food production and pharmaceutical research. However, the source contains no measurements of β-glucans, phenolic compounds, ergosterol or other biologically active constituents.

Therefore, the information is suitable for a section entitled “Cultivation Conditions and Observation Results.” Conclusions about bioactive compound content require separate laboratory analyses or supporting scientific literature.

**Discussion**



The duality of *Pleurotus* as both a structural food ingredient and a source of pharmaceutical precursors highlights its versatility. However, translating laboratory results to commercial production presents chemical and engineering challenges.

Variability in Bioactive Yields: Biological variation remains a significant issue. Substrate composition (e.g., wheat straw vs. cotton waste vs. sawdust), room temperature, humidity, and harvest flush timing cause significant variation in lovastatin and beta-glucan concentrations. Without standardized substrate formulations and environmental controls, achieving consistent batch-to-batch chemical profiles for therapeutic applications is difficult.

Processing Degradation: While *Pleurotus* phenolics and polysaccharides are relatively thermal-stable, bioactives such as lectins, laccases, and lovastatin degrade under standard industrial high-temperature thermal processing (e.g., canning, extrusion, high-heat drying). Mild drying methods—such as freeze-drying (lyophilization) or refractance window drying—are required to preserve physiological activity, though they increase operational costs.

**Conclusion**

Oyster mushroom is a promising source of ingredients for functional foods and a useful subject for pharmaceutical research. β-Glucans, phenolic constituents and ergosterol contribute to its scientific interest, while ultraviolet conversion of ergosterol provides a practical route to vitamin $D_2$-enriched products. Preliminary laboratory and human findings justify continued research, but they should not be interpreted as proof of therapeutic efficacy. The most defensible development strategy combines chemical characterization, controlled processing, product quality assessment and appropriately designed clinical studies.

Under the reported cultivation conditions, visible mycelial growth was recorded on day 12, and the first primordia appeared by the end of the second week. These findings document the progression from substrate inoculation to early fruiting body formation. Further measurements are needed to evaluate productivity and characterize the biological compounds present in the cultivated mushrooms.

Editorial note: The term “spores” and the 1:1 ratio have been retained from the supplied source. Before publication, it should be clarified whether the inoculation material consisted of spores or grain spawn, and whether the ratio was calculated by mass or volume.

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