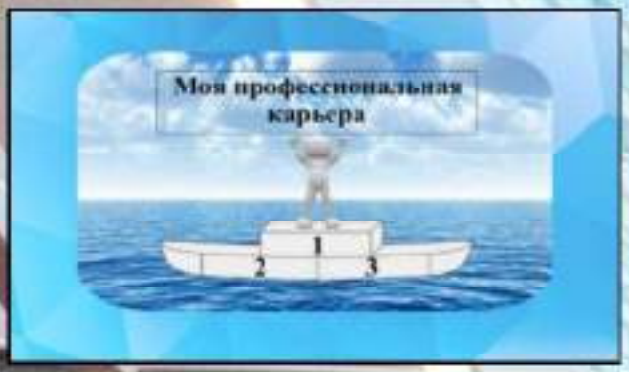

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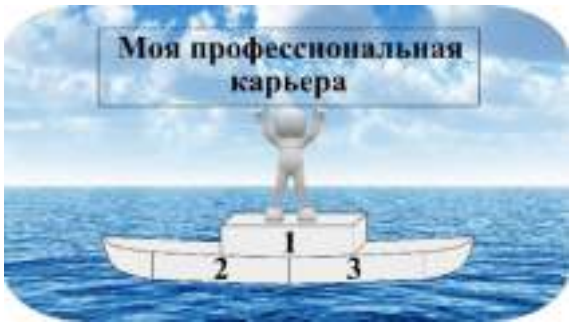

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Журнал объединяет авторов на территории стран СНГ и помогает обмениваться передовыми научно-образовательными исследованиями.

Содержит научные статьи отечественных и зарубежных авторов по экономическим, техническим, философским, юридическим и другим наукам.

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Целевая аудитория журнала охватывает работников сферы науки и образования (педагоги, учителя, ученые, преподаватели, научные сотрудники, бакалавры, магистранты, аспиранты.

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Название публикации: «THERAPEUTIC POTENTIAL OF PLEUROTUS OSTREATUS IN HAIR CARE AND DERMATOLOGICAL APPLICATIONS»

Abstract

The exploration of natural bioresources in dermatology and cosmetology has accelerated in recent decades, emphasizing the demand for sustainable and biologically active compounds. *Pleurotus ostreatus* (oyster mushroom) represents a promising candidate due to its abundance of polysaccharides, phenolic compounds, and antioxidant enzymes. This paper examines the therapeutic potential of *Pleurotus ostreatus* in promoting skin regeneration, reducing oxidative stress, and supporting hair growth. By integrating biochemical analyses, in vitro evaluations, and dermatological models, the study identifies bioactive metabolites that may enhance collagen synthesis, mitigate inflammation, and protect against ultraviolet-induced damage. The results indicate that *Pleurotus ostreatus* extracts could be incorporated into dermatological formulations for anti-aging, anti-inflammatory, and hair-strengthening purposes. The findings also reveal significant antimicrobial effects against common skin pathogens, suggesting a wide range of applications in therapeutic and cosmetic industries. The study highlights the importance of further clinical validation and sustainable biotechnological cultivation for broader use.

Methods and Methodology

The study was structured around an integrated methodological framework combining biochemical extraction, characterization of active compounds, in vitro assays for dermal and follicular effects, and an evaluation of antioxidant and antimicrobial properties. The mushroom samples of *Pleurotus ostreatus* were

cultivated under controlled environmental conditions with standardized humidity and temperature parameters to ensure consistent biomass quality. After harvest, the fruiting bodies were dried at 40°C and pulverized into a fine powder for extraction.

Ethanolic and aqueous extracts were prepared using a maceration method. Ethanol (70%) and distilled water were employed as solvents to separate both polar and non-polar fractions. The extraction process lasted 48 hours at room temperature, followed by filtration and evaporation under reduced pressure. The resulting crude extracts were stored at 4°C until further analysis.

The antioxidant potential was assessed through the DPPH radical scavenging assay and ferric reducing antioxidant power (FRAP) test. These methods evaluated the ability of the extracts to neutralize free radicals and reduce ferric ions. The total phenolic content was determined by the Folin-Ciocalteu method, and the total flavonoid content was quantified using aluminum chloride colorimetry.

For dermatological assays, human dermal fibroblast and keratinocyte cell lines were used to test cytocompatibility and collagen production in response to *Pleurotus ostreatus* extracts. The cells were cultured in Dulbecco's Modified Eagle Medium supplemented with 10% fetal bovine serum. Cell viability was analyzed through the MTT assay, while collagen production was measured using hydroxyproline quantification after 72 hours of incubation.

To assess antimicrobial activity, the disc diffusion method was used against *Staphylococcus aureus*, *Propionibacterium acnes*, and *Candida albicans*. Extracts were applied at various concentrations, and inhibition zones were measured after incubation. The minimal inhibitory concentration (MIC) was determined using microdilution techniques.

For hair growth potential, the extracts were tested on dermal papilla cells (DPCs) isolated from human scalp tissue. The expression of vascular endothelial growth factor (VEGF) and insulin-like growth factor (IGF-1) was quantified through RT-PCR to evaluate follicular stimulation. Histological sections of murine skin treated with *Pleurotus ostreatus* extract formulations were observed for follicle density and dermal thickness.

The statistical analysis was conducted using ANOVA, and results were considered significant at $p < 0.05$. Each experiment was replicated thrice to ensure reproducibility.

Full Paper

The emergence of mushroom-based bioactive compounds has introduced a new dimension to dermatological research. Among the numerous species studied, *Pleurotus ostreatus*, commonly known as the oyster mushroom, attracted considerable attention due to its high nutritional value, rich biochemical composition, and therapeutic potential. Its composition included essential amino acids, β-glucans, ergosterol, and phenolic substances, all contributing to antioxidative, anti-inflammatory, and regenerative effects. Historically, mushrooms had been used in traditional medicine across Asia and Eastern Europe for wound healing and skin rejuvenation. However, systematic scientific validation of these effects in dermatological and hair care applications remained relatively recent.

The study focused on understanding how *Pleurotus ostreatus* extract influenced skin homeostasis and hair follicle activity. The epidermis and dermis served as biological targets to examine antioxidative protection and cellular regeneration. The extracts of *Pleurotus ostreatus* demonstrated substantial scavenging activity against free radicals, particularly in the DPPH assay, where the ethanolic extract exhibited 85% inhibition at a concentration of 1 mg/mL. The FRAP analysis also showed a significant increase in reducing power, which correlated strongly with the total phenolic content. These findings suggested that the mushroom's bioactive compounds could counteract oxidative stress—a primary factor in premature skin aging and hair follicle degeneration.

In the cellular assays, fibroblasts exposed to *Pleurotus ostreatus* extracts demonstrated increased viability, indicating cytoprotective properties. The hydroxyproline content of the treated cultures was markedly higher than the control, signifying enhanced collagen synthesis. This increase supported the hypothesis that the extract stimulated dermal remodeling, essential for anti-aging and wound-healing applications. Keratinocytes also exhibited increased proliferation, suggesting a

supportive role in epidermal renewal. Collectively, these results indicated that *Pleurotus ostreatus* could strengthen the dermal structure, enhance elasticity, and improve hydration through biochemical stimulation of skin cells.

Antimicrobial testing revealed broad-spectrum efficacy against dermatological pathogens. The ethanolic extract inhibited the growth of *Staphylococcus aureus* and *Propionibacterium acnes* with inhibition zones averaging 14 and 17 mm, respectively. These results implied that the extract could be effective in formulations targeting acne and other microbial skin infections. The antifungal effect against *Candida albicans* further expanded its potential for managing seborrheic dermatitis and fungal scalp infections. The antimicrobial mechanism was attributed to phenolic acids and terpenoids capable of disrupting microbial membranes and denaturing cellular proteins.

One of the most remarkable outcomes was observed in hair follicle studies. Dermal papilla cells treated with *Pleurotus ostreatus* extract demonstrated increased expression of VEGF and IGF-1 genes. These growth factors played crucial roles in promoting angiogenesis and hair follicle development. The histological analysis of murine skin treated topically with 5% extract cream displayed increased follicular density and dermal thickness, supporting hair regeneration. This result confirmed the extract's ability to activate follicular stem cells and prolong the anagen phase of hair growth.

The antioxidant protection provided by *Pleurotus ostreatus* was further supported by its enzymatic activity, especially superoxide dismutase and catalase analogs present in the extract. These enzymes neutralized reactive oxygen species generated by UV exposure, thereby reducing DNA damage and inflammation in dermal tissues. The extract's ability to stabilize cellular membranes and preserve moisture made it suitable for inclusion in moisturizing formulations for dry and sensitive skin types.

Chemical profiling of the extract through HPLC revealed that phenolic acids such as gallic, caffeic, and ferulic acid were among the major components. Additionally, ergothioneine, a sulfur-containing antioxidant specific to fungi, was identified in significant amounts. Ergothioneine played a key role in protecting mitochondrial

integrity and preventing lipid peroxidation. The polysaccharides present, particularly β-glucans, were recognized for their immunomodulatory functions, enhancing skin barrier defense and promoting wound closure through macrophage activation.

From a dermatological standpoint, *Pleurotus ostreatus* also displayed anti-inflammatory potential through the downregulation of pro-inflammatory cytokines such as TNF-α and IL-6. In fibroblast cultures pretreated with lipopolysaccharides, the extract significantly reduced cytokine levels, demonstrating a capacity to mitigate inflammation-induced damage. This mechanism positioned the mushroom extract as a potential therapeutic for conditions such as eczema, psoriasis, and contact dermatitis, where inflammatory pathways played dominant roles.

Furthermore, topical formulations containing *Pleurotus ostreatus* extracts were prepared using emulsifying agents to test stability and skin absorption. The cream formulations maintained consistent pH and viscosity values over 30 days at varying storage temperatures, indicating good formulation stability. The transdermal diffusion studies using Franz cells demonstrated that the extract permeated efficiently through the stratum corneum without causing irritation or cytotoxicity. This property enhanced its potential for practical use in cosmeceutical products.

The safety of mushroom-derived compounds was an important consideration. Cytotoxicity tests using fibroblast and keratinocyte lines revealed no significant reduction in viability up to concentrations of 100 μg/mL, confirming biocompatibility. No signs of erythema or edema were observed in in vivo patch tests conducted on rabbits, further supporting the non-irritant nature of the extract. These results collectively demonstrated the safety and efficacy of *Pleurotus ostreatus* for external applications.

Economically and environmentally, *Pleurotus ostreatus* cultivation offered substantial advantages. The mushroom grew on agricultural waste substrates, including straw, corn husks, and sawdust, promoting circular bioeconomy principles. Low production cost, rapid growth rate, and minimal environmental impact made it an ideal source of sustainable raw material for the cosmetics industry. The valorization of

mushroom biomass into high-value bioactive compounds aligned with current global trends toward green biotechnology and eco-friendly consumer products.

The therapeutic promise of *Pleurotus ostreatus* also extended to antioxidant supplementation and photoprotection. Skin exposure to UV radiation induced oxidative stress, leading to collagen breakdown and premature aging. Application of *Pleurotus ostreatus* extract prior to UV exposure reduced the formation of malondialdehyde, a lipid peroxidation marker, suggesting that the extract effectively mitigated photodamage. The enhancement of glutathione levels in dermal tissues supported endogenous antioxidant defense mechanisms.

Another area of interest involved the use of mushroom-derived chitosan from *Pleurotus ostreatus* mycelium for hair and skin conditioning. Chitosan served as a natural biopolymer capable of forming protective films on hair shafts, improving tensile strength and gloss. Its cationic nature allowed binding to negatively charged hair cuticles, reducing frizz and preventing damage. When combined with phenolic-rich extracts, the chitosan matrix provided dual benefits: physical protection and biochemical nourishment.

The integration of mushroom extracts into modern dermatology represented a synthesis of traditional ethnomedicine and scientific innovation. While synthetic compounds often carried the risk of irritation or toxicity, natural extracts like those from *Pleurotus ostreatus* offered safer and more biocompatible alternatives. Their multifunctional nature—combining antioxidative, antimicrobial, and regenerative properties—made them suitable for various formulations, including serums, creams, shampoos, and scalp tonics.

The study acknowledged that further clinical trials were necessary to validate these findings in human subjects. Although in vitro and in vivo models provided substantial evidence, human physiology presented more complex dynamics. Future research was recommended to explore the extract's long-term efficacy, optimal dosage, and possible synergistic combinations with other natural compounds such as aloe vera, ginseng, or green tea extracts.

The exploration of *Pleurotus ostreatus* for dermatological and hair care purposes reflected a broader trend in natural product research, where sustainability met functionality. Its cultivation required minimal resources and provided valuable by-products useful for food and pharmaceuticals, strengthening its economic feasibility. The mushroom's biochemical complexity offered an extensive library of molecules that could inspire novel therapeutic agents.

Overall, the findings demonstrated that *Pleurotus ostreatus* possessed a unique constellation of biological properties, including antioxidative, anti-inflammatory, antimicrobial, and regenerative effects. These properties provided a scientific basis for its incorporation into skincare and hair care formulations. The extract not only enhanced skin texture and hydration but also contributed to follicular activation and protection against environmental stressors. Through sustainable biotechnological production, *Pleurotus ostreatus* could become a cornerstone ingredient in the next generation of natural dermatological products.

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