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# A Comprehensive Review of Mushrooms in Skincare and Haircare Cosmetics the Fungal Frontier

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**Abstract--** This review article provides a comprehensive overview of the increasing integration of mushroom- derived ingredients into skincare and haircare cosmetics. Due to growing consumer demand for natural, sustainable, and effective beauty solutions, functional mushrooms offer a broad spectrum of bioactive compounds with comprehensive benefits. This paper delves into the specific properties of key species such as Reishi, Tremella, Shiitake, Chaga, and Cordyceps, detailing their mechanisms of action in promoting skin hydration, combating oxidative stress, reducing inflammation, modulating hyperpigmentation, and stimulating hair growth. Furthermore, the report emphasises on the emerging role of mushroom mycelium in sustainable cosmetic packaging.

**Keywords--** Mushrooms, Mycocosmetics, Skincare, Haircare, Bioactive compounds, Anti- aging, Hydration, Anti-inflammatory, Antioxidants, Hyperpigmentation, Scalp Health, Regulatory Affairs, Sustainability, Functional Fungi.

## I. INTRODUCTION: THE RISE OF MYCOCOSMETICS IN NATURAL BEAUTY

The global cosmetics market is undergoing a profound transformation, marked by an escalating consumer preference for ingredients derived from natural, plant- based, and sustainably sourced origins. This shift is primarily fuelled by heightened consumer awareness regarding product safety, environmental impact, and ethical production practices, compelling manufacturers to seek out novel bio- resources for their formulations. Traditional cosmetic science, which historically balanced artistry with chemistry, is now increasingly integrating principles from biological and dermatology. This evolution emphasises the development of natural compounds that offer tangible benefits for skin and hair, extending beyond mere aesthetic enhancement.

Within this evolving landscape, mushrooms have emerged as a particularly promising category. Long revered in traditional medicine systems across various cultures and valued as a nutritious food source, these fungi are now attracting considerable attention in the cosmetics industry. Their appeal stems from a diverse array of bioactive compounds, which include complex carbohydrates like polysaccharides and beta- glucans, potent antioxidants such as triterpenes, phenolic acids, ergothioneine, and glutathione, as well as essential vitamins and carotenoids.

These constituents collectively contribute to a wide spectrum of beneficial properties for both skin and hair health.

The increasing demand for “natural” and “organic” cosmetics is a significant market driver for mushroom- based products. However, the long- term success and widespread acceptance of mycocosmetics will ultimately hinge on robust scientific validation of their specific bioactive compounds and their precise mechanisms of action. While the perceived natural origin is appealing to consumers, the actual efficacy and safety of these ingredients must be thoroughly substantiated through rigorous research. This necessitates transparent communication from brands, moving beyond broad “natural” claims to clearly articulate the science- backed benefits of mushroom ingredients, thereby fostering consumer confidence and ensuring sustained market growth.

## II. KEY MUSHROOM SPECIES AND THEIR MULTIFACETED BENEFITS IN SKINCARE

Functional mushrooms are a rich reservoir of bioactive compounds, including polysaccharides, beta- glucans, various antioxidants (such as superoxide dismutase, ergothioneine, and glutathione), and potent anti- inflammatory agents. These compounds work synergistically to promote a youthful appearance, enhance skin hydration, stimulate hair growth, and provide crucial protection against environmental damage. The diverse profiles of these fungi suggest that combining different species in formulations could yield more comprehensive and potent effects than single- extract products. This indicates that the true strength of mushroom- based cosmetics likely resides in the combined, complementary actions of their varied bioactive components, paving way for advanced formulation strategies focused on maximising these synergistic advantages.

### 2.1. Reishi (*Ganoderma Lucidum*): Anti- Aging and Anti- Inflammatory Properties

Reishi, often referred to as the “mushroom of immortality”, is highly valued for its calming and anti- aging properties. It is particularly rich in polysaccharides and triterpenes, including ganoderic acid.

These compounds are instrumental in combating oxidative stress, a primary factor in the degradation of collagen and elastin that leads to wrinkles and fine lines. Reishi extracts have been shown to enhance skin elasticity and hydration by actively promoting collagen synthesis. Furthermore, ganoderic acid has demonstrated the ability to reverse collagen degradation and decrease melanin concentration, contributing to improved skin tone.

Beyond its anti-aging effects, Reishi possesses powerful anti-inflammatory properties. It helps to soothe irritated skin, reduce redness, and calm flare-ups by modulating the immune response and decreasing the production of pro-inflammatory cytokines. Specifically, ganoderic acid F has been observed to inhibit the NF- $\kappa$ B pathway, a crucial regulator of inflammatory responses. Reishi also supports wound healing and skin regeneration by stimulating fibroblast activity, which increases the production of collagen and elastin, thereby accelerating tissue repair and reducing scarring. For hair care, Reishi contributes to scalp health by helping to regulate sebum production, balancing the scalp microbiome, and reducing dandruff. Its anti-inflammatory actions also help to calm scalp irritation and prevent hair follicle miniaturization, a common cause of hair thinning.

#### *2.2. Tremella (Tremella Fuciformis): The Natural Hydration Powerhouse*

Tremella, widely known as the “snow mushroom” or “silver ear mushroom”, has gained significant recognition as a natural alternative to hyaluronic acid due to its exceptional water-retention capabilities. This mushroom can hold up to 500 times its weight in water, providing profound hydration and plumping effects on the skin.

A notable advantage of Tremella’s polysaccharides, including glucuronic acid, xylose, mannose, and fucose, is their smaller molecular size compared to hyaluronic acid. This structural characteristic allows for deeper penetration into the skin, facilitating longer-lasting hydration from within, rather than merely superficial moisture retention. This suggests that Tremella offers a more comprehensive hydration solution, actively contributing to the structural integrity and repair of the skin barrier. Beyond its hydrating prowess, Tremella also exhibits antioxidant, anti-inflammatory, and anti-aging properties against UV damage and minimising collagen loss. These attributes position Tremella as a multifaceted ingredient that not only deeply hydrates but also fortifies the skin’s resilience.

#### *2.3. Shiitake (Lentinula edodes): Brightening and Skin Renewal*

Shiitake mushrooms are a valuable ingredient in cosmetics, particularly for addressing skin tone and texture concerns. They are rich in bioactive compounds such as kojic acid, L-ergothioneine, polysaccharides, and triterpenes. Kojic acid, a naturally occurring skin-brightening agent found in Shiitake, effectively inhibits tyrosinase activity, which is the enzyme primarily responsible for melanin production. This mechanism leads to a more even skin tone and a visible reduction in dark spots and hyperpigmentation.

Beyond brightening, Shiitake offers significant anti-aging benefits. Its L-ergothioneine content functions as a potent antioxidant, protecting cells from oxidative stress and extending the lifespan of healthy skin cells. Furthermore, Shiitake has been shown to inhibit elastase activity, an enzyme that degrades elastin, thereby helping to preserve skin elasticity and firmness. The mushroom also possesses anti-inflammatory and antimicrobial properties, contributing to overall skin health and defence against harmful bacteria.

#### *2.4. Chaga (Inonotus Obliquus): Potent Antioxidant and Skin Protector*

Chaga mushroom is recognised as an exceptional antioxidant powerhouse, primarily due to its high levels of superoxide dismutase (SOD), polysaccharides, polyphenols, triterpenoids, betulinic acid, and natural melanin. These antioxidants effectively neutralise free radicals, which are major contributors to oxidative stress and premature aging, thereby protecting the skin from environmental damage.

Chaga’s anti-inflammatory and soothing properties are also noteworthy. It helps to calm redness and reduce irritation, making it beneficial for sensitive skin and conditions such as psoriasis and eczema. The polysaccharides in Chaga contribute to strengthening the skin’s barrier function and retaining moisture. Additionally, betulinic acid found in Chaga may stimulate collagen synthesis, and its natural melanin content provides a degree of defence against UV radiation. Chaga’s ability to protect keratinocytes and inhibit gene expression associated with aging further underscores its role as a multifaceted anti-aging ingredient.

#### *2.5. Cordyceps: Revitalization and Cellular Support*

Cordyceps is a unique functional mushroom gaining traction in cosmetic formulations for its revitalising and cellular support properties.

Its bioactive compounds include polysaccharides, cordycepin, adenosine, and beta- glucans. As a potent antioxidant, Cordyceps enhances skin resilience by scavenging reactive oxygen species, thereby reducing oxidative stress and promoting collagen synthesis, which are crucial for addressing skin health and anti- aging concerns.

Cordyceps is also recognised for its anti- inflammatory effects and its ability to improve microcirculation. This enhanced blood flow promotes oxygenation and nutrient delivery to skin cells, leading to a revitalised complexion and a more even skin tone. The beta- glucans in Cordyceps acts as natural humectants, drawing moisture into the skin and strengthening the epidermal barrier, which is particularly beneficial for dry, sensitive, or irritated skin conditions.

In hair care, Cordyceps contributes significantly to scalp health. It helps regulate sebum production, balances the scalp microbiome, and reduces dandruff. Crucially, it improves blood circulation to the scalp, ensuring more oxygen, nutrients, and growth factors reach the hair follicles, thereby stimulating hair growth. Some research also suggests that Cordyceps may help regulate hormone levels, such as dihydrotestosterone (DHT), which is implicated in hair loss, and prevent hair follicle miniaturization. Furthermore, the essential nutrients provided by Cordyceps, including vitamins, minerals, and amino acids, reinforce the keratin structure of hair strands, preventing breakage and split ends. This comprehensive action from scalp to strand highlights Cordyceps' potential for holistic hair wellness.

### 2.6. Other Promising Mushrooms in Skincare

Beyond the extensively studied species, several other mushrooms show significant promise in cosmetic applications:

- *Lion's Mane (Hericium erinaceus)*: This mushroom is rich in compounds that stimulate Nerve Growth Factor (NGF), a crucial element in promoting healthy hair follicles and encouraging hair growth. It also contains hydrating beta- glucans and various antioxidants.
- *Maitake (Grifola frondosa)*: Known as the "dancing mushroom", Maitake is rich in antioxidants, B,C and D vitamins, and amino acids. It supports skin health by promoting elasticity and boosting collagen and elastin production, while also diminishing redness.
- *Fomes Officinalis, Coprinus Comatus, Northern Truffle, and White Truffle*: These species are being explored for their skin brightening, anti- inflammatory, and antioxidant properties.

- *Turkey Tail (Trametes versicolor), Enoki (Flammulina velutipes), Meshima (Phellinus linteus), and Blazei (Agaricus blazei)*: These mushrooms offer a range of benefits including anti- inflammatory effects, strengthening skin immunity, preventing the formation of dark spots, and creating protective barriers on the skin.

### III. MECHANISMS OF ACTION: UNVEILING THE SCIENCE BEHIND MUSHROOM EFFICACY

The beneficial effects of mushroom extracts in skincare and haircare are underpinned by a variety of sophisticated biochemical mechanisms. These mechanisms often involve the interaction of complex bioactive compounds with cellular pathways, leading to demonstrable improvements in skin and hair health.

#### 3.1. Hydration and Skin Barrier

Polysaccharides, are present in various mushroom species such as Tremella, Reishi, and Chaga, which play a key role in skin hydration. These complex carbohydrates function as humectants, effectively attracting and retaining moisture from the surrounding environment. Upon application, they form a protective film on the skin's surface, which not only locks in moisture but also shields the skin from environmental stressors, thereby reducing transepidermal water loss (TEWL) and enhancing overall skin elasticity. Some polysaccharides, particularly those from Tremella, form a hydrogel structure and possess a smaller molecular size compared to traditional hydrating agents like hyaluronic acid, allowing for deeper skin penetration and more sustained hydration.

Beyond merely drawing moisture to the surface, mushroom polysaccharides actively contribute to the structural integrity and repair the skin barrier. They have been shown to support keratinocyte differentiation, lipid metabolism, and tight junctions, all of which are crucial for maintaining a robust and healthy skin barrier. This dual action of deep hydration and active barrier fortification suggests that mushroom extracts can serve as comprehensive skin barrier fortifiers, offering a more holistic approach to skin health that addresses underlying structural weaknesses and promotes long- term resilience. Beta- glucans, a specific type of polysaccharide found in many functional mushrooms, further enhance the skin's ability to retain moisture and strengthen its natural barrier function. Their presence promotes skin resilience and supports natural healing processes.



### *3.2. Antioxidant and Anti- Aging*

Mushrooms contain antioxidants, including ergothioneine, glutathione, polyphenols, and triterpenes such as ganoderic acid. These compounds play a crucial role in neutralising reactive oxygen species (ROS) and free radicals, which are primary causes of oxidative stress. Oxidative stress plays a key influence in premature aging, leading to the degradation of essential skin components like collagen and elastin, exhibiting as fine lines, wrinkles, and age spots.

Key aspect of mushroom- derived anti- aging effects is their ability to promote collagen synthesis and inhibit its degradation. Compounds present in species like Reishi, Cordyceps, Chaga, and Maitake actively stimulate collagen production, improving skin elasticity and firmness. Ganoderic acid holds the ability to reverse collagen degradation. Furthermore, mushrooms can inhibit key enzymes such as elastase, hyaluronidase, and collagenase, all of which play vital roles in skin aging by breaking down the extra cellular matrix.

### *3.3. Anti- Inflammatory and Soothing Effects*

Inflammation is a fundamental underlying factor in numerous skin concerns, ranging from acne and rosacea to eczema and accelerated aging. Mushroom species such as Reishi, Maitake, and Cordyceps, possess potent anti-inflammatory properties that address these issues at a cellular level.

These mushroom species regulates the immune response by decreasing the production of pro- inflammatory cytokines such as IL -1a, IL -6, IL -8 and TNF -a, thereby preventing chronic skin inflammation. Chaga's betulinic acid and polysaccharides contribute to calming redness and irritation, supporting the skin's natural healing response. By directly targeting these inflammatory pathways, mushroom extracts do not merely reduce the symptoms but address the root cause of many skin problems. This makes them exceptionally valuable for sensitive, reactive, and problem-prone skin types.

### *3.4. Skin Brightening and Hyperpigmentation*

Mushrooms carry skin brightening properties and helps in the modulation of hyperpigmentation. Shiitake mushroom contains Kojic acid, a natural skin- brightening agent that

specifically inhibits tyrosinase activity. Inhibition of tyrosinase prevents the crucial oxidation of L- tyrosinase to dopaquinone, a necessary step in melanogenesis.

Other compounds, such as arbutin (found in some mushroom extracts), also contribute to inhibiting melanin production. Reishi mushrooms contain Ganoderic acid which decreases melanin concentration. All these compounds collectively contribute to reducing the appearance of dark spots, hyperpigmentation, and promoting a more even skin tone.

### *3.5. Hair Growth Stimulation and Scalp Health*

Hair health is closely linked to a healthy scalp environment. Mushroom extracts provide a holistic approach to haircare by delivering both scalp conditions and hair follicle vitality. Reishi and Cordyceps, play a vital role in modulating sebum production and balancing the scalp microbiome, which helps to reduce dandruff and promote a healthier environment leading to hair growth.

Cordyceps further contribute to hair growth by enhancing the micro circulation to the scalp. There is a greater supply of oxygen, essential nutrients, and growth factors directly to the hair follicles, which stimulates their activity and promotes hair growth. Lion's Mane mushroom contains compounds which stimulate Nerve Growth Factor (NGF), playing a significant role in promoting healthy hair follicles. Cordyceps can also help prevent hair follicle miniaturization and contribute to the regulation of hormones like DHT, which are often linked to hair loss. Mushrooms also provide essential nutrients such as biotin, selenium, and amino acids, which strengthens the keratin structure of hair strands, thereby averting breakage and split ends. Mushroom -based cosmetics act as a holistic solution for overall scalp well being and hair growth promotion.

### *Mechanisms Of Action Of Mushroom Bioactives In Skin And Hair*

The following table provides a structured overview of the key mushroom species discussed above, detailing their primary bioactive compounds, specific mechanisms of action, and the resulting cosmetic benefits. This organization allows for a clear and concise understanding of the scientific basis behind the efficacy of these natural ingredients.

| <b>Mushroom Species</b>                 | <b>Key Bioactive Compounds</b>  | <b>Specific Mechanism of Action</b>  | <b>Cosmetic Benefit</b>   |
|---|---|--|---|
| Reishi ( <i>Ganoderma Lucidum</i> )     | Polysaccharides, Triterpenes (Ganoderic acid)                                       | Combat oxidative stress; Promote collagen synthesis; Modulate immune response (decrease cytokine production, inhibit NF-kB pathway); Stimulate fibroblast activity; Regulate sebum production. | Anti-aging, Anti-inflammatory, Skin soothing, Improved elasticity, Wound healing, Scalp health, Dandruff reduction.           |
| Tremella ( <i>Tremella Fuciformis</i> ) | Polysaccharides (Glucuronic acid), Xylose, Mannose, Fucose), Polyphenols Flavonoids | Attract and retain water (up to 500x its weight); Smaller molecular size for deeper penetration; Antioxidant activity; Anti-inflammatory   | Deep hydration, Skin plumping, Improved elasticity, Anti-aging, UV damage protection  |
| Shiitake ( <i>Lentinula edodes</i> )    | Kojic Acid, L-ergothioneine, Polysaccharides, Triterpenes                           | Inhibits tyrosinase activity (melanin production); Scavenges free radicals; Inhibits elastase activity; Antimicrobial.   | Skin brightening, Hyperpigmentation reduction, Anti-aging, Antioxidant, Skin renewal, Antimicrobial                           |
| Chaga ( <i>Inonotus Obliquus</i> )      | Superoxide Dismutase (SOD), Polysaccharides, Polyphenols, Betulinic Acid, Melanin   | Neutralizes free radicals (potent antioxidant); Reduces pro-inflammatory cytokines; Strengthens skin barrier; May stimulate collagen synthesis; Provides natural UV defence.                   | Potent Antioxidant, Anti-inflammatory, Skin protection, Anti-aging, Hydration, UV protection                                  |
| Cordyceps                               | Polysaccharides, Cordycepin, Adenosine, Beta-glucans                                | Scavenges reactive oxygen species; Promotes collagen synthesis; Improves microcirculation; Reduces inflammation; Regulates sebum production; May regulate DHT.                                 | Anti-aging, Antioxidant, Revitalization, Even skin tone, Hydration, Scalp health, Hair growth stimulation, Dandruff reduction |
| Lion's Mane                             | Nerve Growth Factor (NGF) stimulating compounds, Beta-glucans, Antioxidants         | Stimulates nerve growth factor (NGF); Protects from oxidative stress   | Promotes healthy hair follicles, Encourages hair growth, Skin firmness, Antioxidant   |

#### IV. SAFETY

The use of mushroom extracts in cosmetics requires a thorough understanding of their safety profiles.

##### 4.1. Safety Considerations and Potential Adverse Reactions

Mushroom species which are commonly consumed as food are considered safe for topical cosmetic use. Mushroom species such as *Ganoderma Lucidum* (*Reishi*) and *Pleurotus Ostreatus* (Oyster mushroom) have shown an absence of toxicity to human skin cells, at relevant concentrations. Only specific compounds from these extracts permeate the skin, suggesting that their topical application does not lead to significant systemic safety concerns.

The main concern is that mushrooms absorb heavy metals from the growth environment. This risk can be mitigated through advanced extraction methods, such as pulsed electric field (PEF) technology, which help minimize contamination. Additionally, while most extracts are benign, some, particularly at higher concentrations (e.g. *Agrocybe cylindracea*), have been observed to exhibit cytotoxic effects, underscoring the critical importance of precise dose consideration in formulations.

Although allergic reactions to edible mushrooms are uncommon, some species, notably Shiitake, have been implicated in instances of contact dermatitis when applied topically.

This highlights a nuanced aspect of natural ingredients: while broadly perceived as inherently safer by consumers, they are not without potential risks. This situation presents a paradox where natural ingredients, despite their beneficial properties, require the same rigorous scientific scrutiny for potential contaminants and adverse reactions as synthetic compounds. Therefore, comprehensive safety and toxicological studies, particularly long-term and clinical investigations, are still needed to fully establish the safety, stability, and compatibility of mushroom extracts in final cosmetic products. This ongoing research, coupled with stringent quality control measures and clear labelling for potential allergens, is crucial for building consumer confidence and promoting responsible innovation in the mycocosmetics sector.

#### 4.2. Sustainable Practices: Mushroom Mycelium in Cosmetic Packaging

There is a great influence of mushrooms which extends beyond their role as active ingredients to their remarkable potential in sustainable packaging. Mycelium is the root-like structure of mushrooms which is being used as a biodegradable, compostable, and recyclable alternative to conventional plastic and Styrofoam packaging materials.

This mycelium-based packaging is “grown” rather than manufactured, thus requires less energy in the production process. It is fully compostable. The mycelium is very versatile and can be molded into various shapes and sizes, suitable for a wide range of beauty products. Several companies including Mushroom material, Evolve Beauty, use this technology to create packaging for brands such as Wildsmith, Ffern, and Lush. This holistic approach to “green beauty”, where environmental responsibility is integrated across the entire product life cycle, from ingredient sourcing to packaging disposal.

#### V. CONCLUSION

It can be concluded that Mushrooms are a vital source of ingredients which are beneficial for skincare as well as for haircare. They act as a promising and innovative ingredient offering multifunctional benefits. Mushrooms act as a natural and sustainable source of actives equipped with comprehensive benefits. The various species of Mushrooms are unique in their own characteristics. The mechanisms/pathways followed by them are unique in their own ways. Their antioxidant, anti-inflammatory, hydrating, brightening, and scalp-supporting properties make them valuable ingredients for modern beauty formulations. Along with that, they act as a sustainable packaging material, strongly aligning with the demand for eco-friendly and science-backed cosmetic solutions.

#### REFERENCES

- [1] Ying Zhou, Minghang Chu, Farhad Ahmadi, Osman Tuncay Agar, Colin J. Barrow, Frank R. Dunshea & Hafiz A.R. Suleria (2024) A Comprehensive Review on Phytochemical Profiling in Mushrooms: Occurrence, Biological Activities, Applications and Future Prospective, *Food Reviews International*, 40:3, 924-951, DOI: 10.1080/87559129.2023.2202738. <https://doi.org/10.1080/87559129.2023.2202738>
- [2] Usman, M.; Murtaza, G.; Ditta, A. Nutritional, Medicinal, and Cosmetic Value of Bioactive Compounds in Button Mushroom (*Agaricus bisporus*): A Review. *Appl. Sci.* 2021, 11, 5943. <https://doi.org/10.3390/app11135943>
- [3] Mishra, M., Srivastava, D. (2024). Harnessing the Power of Medicinal Mushrooms into Cosmetics: A Fountain of Youth from Nature. *J. Indian bot. Soc.*, 104(4):200-209 Doi: 10.61289/jibs2024.06.01.1214
- [4] Elkhateeb W, Ishihara A, Daba G. Mushrooms Natural Products Cosmetic Weapons as Anti-Hair Loss, Anti-Ageing Skin and Future Prospect. *J Biomed Res Environ Sci.* 2025 Feb 28; 6(2): 180-190. doi: 10.37871/jbres2070, Article ID: JBRES2070, Available at: <https://www.jelsciences.com/articles/jbres2070.pdf>
- [5] Softa, M., Percoco, G., Lati, E. and Bony, P. (2019) Birch Sap (*Betula alba*) and Chaga Mushroom (*Inonotus obliquus*) Extracts Show Anti-Oxidant, Anti-Inflammatory and DNA Protection/Repair Activity In Vitro. *Journal of Cosmetics, Dermatological Sciences and Applications*, 9, 188-205. <https://doi.org/10.4236/jcdsa.2019.92016>
- [6] Luo, J.; Ganesan, K.; Xu, B. Unlocking the Power: New Insights into the Anti-Aging Properties of Mushrooms. *J. Fungi* 2024, 10, 215. <https://doi.org/10.3390/jof10030215>
- [7] Paterska, M.; Czerny, B.; Cielecka-Piontek, J. Macrofungal Extracts as a Source of Bioactive Compounds for Cosmetics: Anti-Aging Therapy: A Comprehensive Review. *Nutrients* 2024, 16, 2810. <https://doi.org/10.3390/nu16162810>
- [8] Kartika, Engla. ‘Phytochemical and Pharmacological Review of Carrot (*Daucus Carota L.*)’. *International Journal of Pharmaceutical Sciences and Medicine* 6, no. 1 (2021): 75–82. <https://doi.org/10.47760/ijpsm.2021.v06i01.006>.
- [9] Doi, Naoki, Kazuichi Araki, Yoichiro Fukuta, et al. ‘Anti-Glycation and Antioxidant Effects of Chaga Mushroom Decoction Extracted with a Fermentation Medium’. *Food Science and Technology Research* 29, no. 2 (2023): 155–61. <https://doi.org/10.3136/fstr.FSTR-D-22-00120>.
- [10] Mago, Payal, Richa Sharma, Ibtesam Hafeez, Imtshan Nawaz, Mansi Joshi, and Rekha Mehrotra. ‘Mushroom Based Cosmeceuticals: An Upcoming Biotechnology Sector’. *Biosciences Biotechnology Research Asia* 20, no. 2 (2023): 381–94. <https://doi.org/10.13005/bbra/3097>.
- [11] Taofiq, Oludemi, Francisca Rodrigues, Lillian Barros, Maria F. Barreiro, Isabel C. F. R. Ferreira, and M. Beatriz P. P. Oliveira. ‘Mushroom Ethanolic Extracts as Cosmeceuticals Ingredients: Safety and Ex Vivo Skin Permeation Studies’. *Food and Chemical Toxicology* 127 (May 2019): 228–36. <https://doi.org/10.1016/j.fct.2019.03.045>.
- [12] Wu, Yuanzheng, Moon-Hee Choi, Jishun Li, Hetong Yang, and Hyun-Jae Shin. ‘Mushroom Cosmetics: The Present and Future’. *Cosmetics* 3, no. 3 (2016): 22. <https://doi.org/10.3390/cosmetics3030022>.
- [13] Al Qutaibi, Mohammed, and Suresh R. Kagne. ‘Exploring the Phytochemical Compositions, Antioxidant Activity, and Nutritional Potentials of Edible and Medicinal Mushrooms’. *International Journal of Microbiology* 2024, no. 1 (2024): 6660423. <https://doi.org/10.1155/2024/6660423>.



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- [14] Dharmasanti, Olivia, Ida Sri Iswar, Iga Praharsini, I. Made Muliarta, I. Gusti Ayu Widiyanti, and Ida Ayu Ika Wahyuniari. 'Shiitake Mushroom Extract (*Lentinus Edodes*) Increases Superoxide Dismutase Levels and Collagen Quantity in Male Wistar Strain Rats (*Rattus Norvegicus*) Exposed to Ultraviolet B Light'. *International Journal of Research Publication and Reviews* 4, no. 9 (2023): 1550–55. <https://doi.org/10.55248/gengpi.4.923.92447>.
- [15] Pu, Chunhong, Doudou Shi, Michael Ingrassia, et al. 'Skincare Benefits of a Postbiotic Ferment Produced Through *Djon Djon* Mushroom Fermentation by *Saccharomyces*'. *Journal of Cosmetic Dermatology* 24, no. 2 (2025): e70067. <https://doi.org/10.1111/jocd.70067>.
- [16] Anil Kumar, Nanjangud V., Cristina Quispe, Jesús Herrera-Bravo, et al. 'Potential of Mushrooms Bioactive for the Treatment of Skin Diseases and Disorders'. *Journal of Food Biochemistry* 2023 (December 2023): 1–26. <https://doi.org/10.1155/2023/5915769>.
- [17] Taofiq, Oludemi, Sandrina Heleno, Ricardo Calhelha, et al. 'Development of Mushroom-Based Cosmeceutical Formulations with Anti-Inflammatory, Anti-Tyrosinase, Antioxidant, and Antibacterial Properties'. *Molecules* 21, no. 10 (2016): 1372. <https://doi.org/10.3390/molecules21101372>.
- [18] Rukhsar, Saliha, Muhammad Usman, Nousheen Yousaf, Ghulam Murtaza, Muhammad Aamir Manzoor, and Muhammad Azam. 'Mushrooms in Modern Cosmetics: Unlocking Anti-Aging, Antioxidant, and Therapeutic Potential'. *Archives of Dermatological Research* 317, no. 1 (2025): 542. <https://doi.org/10.1007/s00403-025-04048-7>.
- [19] Srivastava, Anuradha, B. L. Attri, and V. P. Sharma. 'Status Report On Mushroom Based Cosmetic Products In Market'. *Mushroom Research* 29, no. 1 (2020): 65. <https://doi.org/10.36036/MR.29.1.2020.108717>.
- [20] Camilleri, Emma, Renald Blundell, Bikash Baral, Tomasz M. Karpiński, Edlira Aruci, and Omar M. Atrooz. 'Unveiling the Full Spectrum of Maitake Mushrooms: A Comprehensive Review of Their Medicinal, Therapeutic, Nutraceutical, and Cosmetic Potential'. *Heliyon* 10, no. 9 (2024): e30254. <https://doi.org/10.1016/j.heliyon.2024.e30254>.
- [21] Cateni, Francesca, Maria Letizia Gargano, Giuseppe Procida, Giuseppe Venturella, Fortunato Cirlincione, and Valeria Ferraro. 'Mycocochemicals in Wild and Cultivated Mushrooms: Nutrition and Health'. *Phytochemistry Reviews* 21, no. 2 (2022): 339–83. <https://doi.org/10.1007/s11101-021-09748-2>.
- [22] Camilleri, Emma, Renald Blundell, Bikash Baral, Tomasz M. Karpiński, Edlira Aruci, and Omar M. Atrooz. 'A Comprehensive Review on the Health Benefits, Phytochemicals, and Enzymatic Constituents for Potential Therapeutic and Industrial Applications of Turkey Tail Mushrooms'. *Discover Applied Sciences* 6, no. 5 (2024): 257. <https://doi.org/10.1007/s42452-024-05936-9>.
- [23] Mukherjee, Adrija, Shreyansi Das, Debraj Chakraborty, Nilasish Pal, and Nirmalendu Das. 'Fungi's Treasure in Cosmeceuticals—a Comprehensive Chemical Approach'. *South African Journal of Botany* 166 (March 2024): 311–31. <https://doi.org/10.1016/j.sajb.2024.01.036>.
- [24] Fizza, Chasheen, Waseem Khalid, Safura Kausar, et al. 'Applications of Mushrooms in Cosmeceuticals'. In *Bioprospecting of Natural Sources for Cosmeceuticals*, edited by Deepika Kathuria, Ajay Sharma, Meenakshi Verma, and Gulzar Ahmad Nayik. Royal Society of Chemistry, 2024. <https://doi.org/10.1039/9781837672288-00129>.
- [25] Taofiq, Oludemi, Ana M. González-Paramás, Anabela Martins, Maria Filomena Barreiro, and Isabel C. F. R. Ferreira. 'Mushrooms Extracts and Compounds in Cosmetics, Cosmeceuticals and Nutricosmetics—A Review'. *Industrial Crops and Products* 90 (November 2016): 38–48. <https://doi.org/10.1016/j.indcrop.2016.06.012>.