



(REVIEW ARTICLE)



Black Mulberry (*Morus nigra* L.): A natural remedy for hair growth and scalp health

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Abstract

The black mulberry (*Morus nigra* L.) has gained a lot of attention in the hair care industry because of its capacity to promote hair development and preserve scalp health, which is a result of its varied phytochemical makeup. Apart from these vitamins, black mulberries are abundant in minerals and bioactive substances like resveratrol, flavonoids, and anthocyanin's. These substances are well known for their potent antibacterial, anti-inflammatory, and antioxidant qualities, which make them crucial for stimulating hair follicles and improving a variety of scalp disorders. Black mulberry's capacity to improve blood flow to the scalp is especially remarkable because it makes it easier for vital nutrients to reach the hair roots. This review will examine the complex bioactive processes of black mulberry and evaluate its potential as a treatment for common issues like dandruff, hair loss, and other issues pertaining to the scalp. Investigations into the long-term effects of black mulberry on hair regeneration will also be covered, as well as how it can be successfully added to hair care products. In the end, the results might show that black mulberry is a promising natural substitute for synthetic hair care products, providing a comprehensive strategy that satisfies consumer need for sustainable and plant-based products. Further investigation into this topic might open up new possibilities for using black mulberry to create natural hair care products that work.

Keywords: Black Mulberry; *Morus nigra*; Scalp; Improve scalp circulation; Phyto-cosmetics; Proliferation

1. Introduction

The deciduous black mulberry (*Morus nigra* L.), which is indigenous to parts of Western Asia and Europe, is well known for its tasty, nutrient-dense berries. *Morus nigra*, which has long been prized in culinary and medicinal contexts, has recently attracted scientific attention due to its potential to promote hair growth and enhance scalp health. According to recent research, this tree has special phytochemicals that may have a beneficial effect on the health of the scalp and hair follicles in addition to its nutritional advantages. This paper explores *Morus nigra*'s rich phytochemical makeup and looks at how these substances might function at the molecular level to promote hair growth and preserve the integrity of the scalp. In order to fully comprehend and utilize *Morus nigra*'s potential in hair care applications, it also evaluates current clinical data, investigates the safety profile, and talks about prospective future research areas.

As customers look for safer and more eco-friendly solutions for their personal care regimens, phytocosmetics beauty products made from natural plant-based ingredients are becoming more and more popular. These products make use of plant extracts, which can provide numerous advantages for skin and general health when combined with other properly chosen substances. These natural ingredients, which are abundant in vital nutrients including flavonoids, tannins, phenolics, amino acids, and vitamins, can greatly improve skin health and perhaps help treat a range of skin conditions. By tapping into the healing properties of botanical elements, phytocosmetics not only promote healthier skin but also align with a growing preference for sustainability and natural formulations. As interest in these eco-

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conscious products continues to rise, the integration of plant-derived ingredients in cosmetics is poised to transform the beauty industry, offering consumers a more holistic approach to skincare. (1, 2, 3)

To date, most research has concentrated on studying particular genes and proteins found in human follicular dermal papilla cells (HFDPCs) in order to better understand their function in hair growth. But further research is required to fully comprehend how the growth factors these cells produce affect nearby cells, including the keratinocytes that make skin and the endothelial cells that line blood arteries. The anagen phase, the active stage of hair growth necessary for the proper development of follicles, is initiated by the activity of keratinocytes, including their proliferation and differentiation, as well as the formation of blood vessels. By understanding how dermal papilla cell signaling influences these nearby cells, researchers could gain insights into how to better regulate and enhance the hair growth cycle. This knowledge could potentially lead to more targeted treatments that support hair follicle health through a coordinated cellular response.(4,5)



Figure 1 Black Mulberry

1.1. Botany and Morphology

The black mulberry, or *Morus nigra*, is a deciduous tree that can grow up to 10 meters in height. The heavily branched stem of this eye-catching tree has bark that ranges in colour from a drab orange to a rich dark grey. It's simple, alternating leaves are thick, rough, and deep green in colour. They are frequently broadly oval in shape, though occasionally they have irregular lobing. *Morus nigra* is a dioecious species, which means that male and female flowers can be found on the same tree or on other trees. Its reproductive structures are unisexual blooms. While male flowers are characterized by catkin-like groupings, female flowers mature into short, cylindrical, erect spikes. The black mulberry bears juicy drupes that range in size from 2 to 8.5 centimeters, have an ovoid or cylindrical shape, and can be deep crimson in colour. These fruits are a pleasant complement to a variety of culinary applications because they are not only aesthetically pleasing but also sweet and delicious. (6)

1.2. Ecology

Because of their versatility and reputation for growing quickly, black mulberry trees make excellent choices for residential gardens or farmyards. They need at least 4.5 meters between each trees to promote healthy development, and they do best in full sun. Black mulberry trees are incredibly hardy and typically require very little fertiliser to thrive. Even though they can withstand some dryness, it is still important to water them during dry spells because too much drought might cause fruit to drop too soon. In order to accommodate their growing root systems, trees grown in pots require yearly repotting prior to the start of the new growth season. In terms of preferred soil types, black mulberry thrives in slightly acidic to alkaline environments, with a pH range of 5.6 to 6.5 being ideal. Furthermore, these trees thrive in temperatures between 24°C to 34°C, which provides the perfect environment for their development and fruit production.(7)

1.3. Phytochemical Composition *Morus nigra* is rich in a variety of bioactive compounds, each contributing to its therapeutic potential

- **Flavonoids and Polyphenols:** The antioxidant properties of flavonoids such as quercetin, kaempferol, and anthocyanin's (such as cyanidin and delphinidin) are important because they help fight oxidative stress in hair follicles.(8,9) The total amounts of phenols, flavonoids, ascorbic acid, and antioxidant activity in *Morus nigra* (black mulberry) fruits depend on a number of factors, including the method of extraction, the fruit's particular cultivar, the ripeness stage, and the climate in which the fruit is grown.(10,11)

- **Vitamins:** Vitamin C, which is essential for the synthesis of collagen and the preservation of hair structure, is abundant in black mulberries. By supporting cellular activity and nutrient metabolism, other vitamins, including vitamin A and certain B vitamins (B1, B2, and B6), also promote hair health.⁽¹²⁾
- **Minerals:** *Morus nigra* contains important minerals including iron and zinc, which help to stimulate hair development. Iron helps transport oxygen to hair follicles, while zinc is essential for the growth and repair of hair tissue.⁽¹³⁾

1.4. Mechanisms of Action for Hair Growth The efficacy of *Morus nigra* for hair growth can be attributed to several biological mechanisms

- **Antioxidant Activity:** *Morus nigra*'s antioxidants shield hair follicles from free radical damage, which can result in hair loss.⁽¹⁴⁾ When the ratio of free radicals to antioxidants is skewed in favour of free radicals, oxidative stress results. The body may undergo a number of metabolic alterations as a result of an overabundance of free radicals, which can contribute to the onset of numerous illnesses. Increased levels of oxidative stress are frequently associated with diseases like diabetes, atherosclerosis, cardiovascular problems, neurological illnesses, and even cancer.^(15,16) Free radicals can alter vital biological molecule types, upsetting the body's redox state, or natural equilibrium between oxidation and reduction. Oxidative stress levels rise as a result of this disturbance.

Table 1 Exploring Antioxidant Activity in Mulberry Fruits and Leaves: A Review of SET Assay Findings (2016–2021)

Species	Plant Part	ABTS Assay	DPPH Assy	FRAP Assy	Source
<i>Morus nigra</i>	Fruit	Not available	Not available	21.33 +- 0.35 μ mol TE/g dw	(39)
–	–	600.31 μ mol TE/L	131.27 μ mol TE/L	Not available	(40)
–	–	5.842 \pm 0.1155 mmol TE/L	46.94 \pm 1.68%	0.4627 \pm 0.0101 mmol TE/L	(41)
–	–	6.43 mg VCE/g fw	2.51 mg VCE/g fw	Not available	(42)
<i>Morus nigra</i>	Leaf	21.85 mg TE/g dw	146.04 mg TE/g dw	52.71 mg TE/g dw	(43)
–	–	9.89 \pm 0.87 mM TE	Not available	Not available	(44)

Antioxidant activity is measured using the DPPH, FRAP, and ABTS tests. Depending on the study, values are given as fresh weight (fresh wt) or dry weight (dry wt) per gramme (g) or litre (L).

- **Anti-inflammatory Effects:** Alopecia areata, a condition marked by patchy hair loss brought on by an autoimmune reaction that sets off inflammatory processes in the scalp, is one of the hair loss disorders in which inflammation is a major factor. Inflammation has the potential to interfere with the normal cycle of hair growth and weaken hair follicles, which can eventually result in hair loss and thinning. Black mulberry, or *Morus nigra*, has demonstrated encouraging anti-inflammatory qualities that may help with various problems. The substances in *Morus nigra* may help reduce inflammation on the scalp by modifying inflammatory pathways, which would improve the conditions for hair development. In addition to promoting healthier hair follicles, this decrease in inflammation may also improve the general health of the scalp and lessen the causes of hair loss. *Morus nigra* has the potential to be a useful natural treatment for alopecia areata and other inflammation-related hair loss diseases by reducing inflammatory reactions and encouraging a healthy scalp. As a result, adding *Morus nigra* to hair care routines may have two advantages: it may reduce inflammation while promoting hair health and development.⁽¹⁷⁾
- **Hair Follicle Proliferation Stimulation:** Studies have shown that extracts from *Morus nigra*, also called Black Mulberry, can dramatically increase the number of dermal papilla cells, which are essential for the hair follicle cycle. These specialized cells play a key role in controlling hair development and regeneration. They are found at the base of hair follicles. Dermal papilla cells are involved in the signaling pathways that control the anagen (growth) phase, telogen (resting) phase, and the following return to anagen phases of the hair development cycle. Extracts from *Morus nigra* may aid in reviving dormant hair follicles and improving their functionality by encouraging the growth of these cells. Because more robust hair production can result from greater dermal papilla cell activity, this stimulation not only promotes hair growth but also helps thinning hair recover. Moreover, these cells' activation can enhance the general well-being of hair follicles, which may result in thicker

and more robust strands. By creating an environment that promotes follicular health and regeneration, *Morus nigra* presents encouraging promise as a natural remedy for people looking to increase their hair density and fight hair loss.⁽¹⁸⁾

- **Improvement of Scalp Health:** Promoting healthy hair development requires maintaining a healthy scalp, and *Morus nigra*, sometimes known as black mulberry, has shown great promise in this area, especially because of its antibacterial qualities. The normal equilibrium of the scalp micro biome can be upset by infections and disorders like dandruff, which can cause irritation and inflammation that can stop hair growth. By efficiently identifying and inhibiting the growth of dangerous bacteria and fungus that cause infections and dandruff, the antimicrobial substances found in *Morus nigra* can aid in the fight against these problems. *Morus nigra* reduces inflammation and irritation related to these disorders by managing these microbial populations, which also helps to maintain a cleaner and healthier scalp environment. Furthermore, better scalp health can increase blood flow to hair follicles, bolstering their functionality and encouraging healthy hair growth. Thus, adding *Morus nigra* to hair care regimens can have two benefits: it can treat underlying scalp conditions and create an atmosphere that promotes stronger, thicker hair. Because of this, *Morus nigra* is a desirable natural treatment for people who want to improve the health of their scalp and, consequently, their hair in general.⁽¹⁹⁾

1.5. Clinical Evidence Numerous studies have investigated the clinical efficacy of *Morus nigra* in promoting hair growth and scalp health:

- **Topical Applications:** The usefulness of topical formulations containing *Morus nigra* extract in resolving hair loss concerns has been demonstrated by recent clinical research. Participants in one such trial reported significant increases in hair density and a decrease in hair loss after applying the extract for eight weeks. According to the formulation, the advantageous components in *Morus nigra* are sent straight to the scalp, where they might affect hair follicles. These substances may improve blood circulation and increase cellular activity, creating a more favorable environment for hair development. Additionally, *Morus nigra's* antioxidant and anti-inflammatory qualities help shield hair follicles from harm and guarantee their best possible performance. Participants reported observable outcomes, suggesting that the topical application promotes the general vitality of the hair in addition to helping to reverse hair thinning. A promising addition to hair care routines targeted at enhancing hair growth and density, this evidence highlights *Morus nigra's* potential as a workable choice for people looking for natural ways to fight hair loss. *Morus nigra* stands out as a natural therapy with the potential to change hair health results as research into its effectiveness continues.⁽²⁰⁾
- **Dietary Supplementation:** Participants in a recent study on the impact of dietary supplements on hair health reported notable improvements in their hair's overall quality and growth rate after taking a supplement enhanced with *Morus nigra* extract. This research demonstrated how adding *Morus nigra* to one's daily routine can supply vital nutrients and bioactive substances that support hair follicles from the inside out. Because the extract contains essential nutrients and antioxidants, it helps fight oxidative stress, which can otherwise hinder hair growth and cause thinning. Consequently, people reported increases in their hair's strength, texture, and lustre in addition to an improved rate of hair growth. This implies that by encouraging healthier follicles and maximizing the hair growth cycle, *Morus nigra* may be essential for hair revitalization. These results suggest that *Morus nigra* may be a useful dietary supplement for people looking to improve the health of their hair naturally. It is also a good complement to hair care regimens that emphasize boosting hair vitality and minimizing hair loss.⁽²¹⁾
- **Comparative Studies:** Studies comparing the efficacy of extracts from *Morus nigra* to other conventional therapies for hair loss have shown encouraging results, showing that *Morus nigra* can either equal or surpass the effectiveness of these tried-and-true methods in fostering hair growth of these investigations, scientists examined the active ingredients of *Morus nigra* and their capacity to promote the hair growth cycle and stimulate hair follicles. Comparing participants who used *Morus nigra* extracts to those who used other conventional medicines, the former reported notable increases in hair density and general health. This implies that *Morus nigra* might present a strong alternative for people looking for all-natural remedies for hair loss, especially as it combines strong anti-inflammatory and antioxidant qualities with the capacity to fortify and nourish hair follicles. The results demonstrate that *Morus nigra* has the potential to be a useful stand-alone treatment as well as a successful addition to other hair restoration techniques. *Morus nigra* is becoming a viable option in the field of hair care as more studies support these findings, appealing to people who favour conventional and holistic methods of treating hair loss.⁽²²⁾
- **Therapeutic Benefits and Nutritional Composition of *Morus nigra*:** The *Morus nigra* tree, also referred to as the black mulberry, is a key medicinal plant in many traditional healing traditions, especially in Chinese and Indian medicine, because of its many therapeutic effects and nutritional makeup. Fruits, leaves, twigs, and root bark all provide distinct health benefits that add to the tree's total effectiveness. The fruits enhance immune function and promote general health and wellness since they are high in vitamins, minerals, and antioxidants.

The leaves are frequently used to help control blood sugar levels and enhance metabolic health because of their well-known anti-inflammatory and antioxidant qualities. The twigs and root bark are also utilized for their possible therapeutic benefits, such as their capacity to improve digestion and circulation. Because of its many uses, *Morus nigra* is valuable not just as a food source but also as a holistic treatment for a range of illnesses. The unique effects of each component of the *Morus nigra* plant underscore its potential as a crucial component of contemporary health practices, providing a pathway to improved well-being through nature's abundance as interest in natural and traditional medicines develops.^(23,24)

1.6. Safety and Side Effects *Morus nigra* is generally regarded as safe for both topical and dietary use. However, like any natural remedy, it may pose risks for certain individuals:

Allergic Reactions: Although there are many advantages to utilizing *Morus nigra* for hair and skin care, it is important to remember that some people may have allergic responses or skin sensitivities when using products that contain this extract. For sensitive individuals, *Morus nigra* may trigger moderate skin irritations or allergic reactions because of its strong bioactive components. Before applying any product containing *Morus nigra* directly to larger portions of the skin or scalp, it is recommended to conduct a patch test in order to reduce the possibility of negative reactions. Applying a tiny quantity of the product to a discrete skin area, like the inner forearm, and watching for any indications of redness, itching, or irritation over the course of the following day is known as a patch test. By taking this precaution, possible sensitivities can be found, guaranteeing the product's safe usage and improving its efficacy for people who can handle it well. Understanding how different skin reacts to *Morus nigra*, like with any botanical ingredient, can help create a safer and more individualized approach to natural hair and skincare products.⁽²⁵⁾

Interactions with Medications: While *Morus nigra* is well-regarded for its health benefits, there is limited research on its interactions with certain medications. This warrants caution for individuals taking specific drugs, such as blood thinners or antihypertensive. The compounds in *Morus nigra* may impact blood circulation, possibly enhancing or diminishing the effects of blood-thinning medications and increasing the risk of bleeding. Likewise, its influence on blood pressure could interfere with antihypertensive drugs, potentially lowering blood pressure to dangerous levels. Given these potential interactions, it is recommended that individuals on these medications consult with their healthcare provider before incorporating *Morus nigra* into their diet or supplement routine. By taking this precaution, individuals can minimize the risk of unintended health issues, ensuring they can safely benefit from *Morus nigra* without interfering with their existing medical treatments.⁽²⁶⁾

2. Methodology and Materials

- **Mulberry Extract Production:** Fresh mulberry fruits (5 g) were extracted using 5 mL of acidified methanol (0.1% trifluoroacetic acid) by homogenizing the mixture with a Heidolph Silent Crusher M at 12,000 rpm for one minute. The resulting homogenate was centrifuged in a NÜVE NF 200 bench-top centrifuge at 5,000 rpm for 20 minutes. The pellet was further extracted until the solvent was fully decolorized. The supernatant was concentrated by evaporating the methanol at 40°C using a Heidolph Laborota 4000 rotary evaporator, following the procedure outlined by Bunea et al. (2011) with minor modifications.⁽²⁷⁾ Finally, the *Morus nigra* extract (MnE) was freeze-dried with a Christ Alpha 1-2 LDplus freeze dryer for subsequent cell culture analysis.
- **Phytochemical Screening and Composition Assessment of Extract Samples:** A comprehensive phytochemical screening was performed on black mulberry fruit extract to identify and characterize the various secondary metabolites present. The analysis revealed a wide range of compounds, including alkaloids—organic nitrogen-containing molecules with diverse biological activities. The screening also identified flavonoids, known for their strong antioxidant properties that help combat oxidative stress. Polyphenols, which play a key role in the fruit's antioxidant effects, were also detected. Additionally, tannins, recognized for their astringent properties, and saponins, which are associated with various health benefits, were present. The analysis further revealed quinones, bioactive compounds, as well as steroids and terpenoids, which may contribute to the extract's therapeutic potential. This thorough examination highlights the rich phytochemical composition of black mulberry fruit, pointing to its potential applications in health and wellness.⁽²⁸⁾

2.1. Formulations and Delivery Systems The effectiveness of *Morus nigra* can be enhanced through various formulations and delivery systems

- **Topical Creams and Oils:** Incorporating *Morus nigra* extracts into topical formulations can optimize localized benefits for the scalp. These products can be specifically designed to enhance the absorption and bioavailability of the extract's active compounds. When included in topical creams and oils, *Morus nigra* provides a targeted approach, delivering its beneficial properties directly to the scalp to support hair and skin health. This method

allows for a higher concentration of antioxidants, anti-inflammatory agents, and other nutrients to be absorbed by the scalp, improving their effectiveness. Topical creams and oils containing *Morus nigra* can be formulated for better penetration, helping to nourish hair follicles and alleviate scalp irritation. This localized application ensures that the extract works precisely where it's needed, promoting hair growth and overall scalp health without affecting other areas of the body. By using *Morus nigra*-infused products, individuals can enjoy the natural, plant-based benefits for hair vitality while minimizing the risk of systemic side effects, making it a safe and efficient addition to their hair care regimen.⁽²⁹⁾

- **Shampoos and Conditioners:** The inclusion of *Morus nigra* extract in hair care products can offer a range of additional benefits, such as moisturizing the scalp and preventing dandruff. By adding *Morus nigra* extract to shampoos and conditioners, these products can deliver enhanced advantages that support both scalp health and overall hair quality. The extract's nourishing compounds, including potent antioxidants and natural moisturizers, work to hydrate the scalp, addressing dryness that often leads to irritation and flakiness. By maintaining optimal moisture levels, *Morus nigra* can also help prevent the accumulation of dandruff, which disrupts a healthy scalp environment. Furthermore, its antimicrobial properties aid in cleansing the scalp of harmful bacteria and fungi, promoting a balanced and clean scalp. This makes *Morus nigra*-enriched shampoos and conditioners an ideal choice for individuals looking to boost hair strength, shine, and scalp health. With consistent use, hair care products containing *Morus nigra* can contribute to a softer, healthier scalp, which in turn provides a solid foundation for stronger, more resilient hair.⁽³⁰⁾
- **Dietary Supplements:** Encapsulating *Morus nigra* extract in dietary supplements provides a convenient method for delivering its beneficial compounds directly to the body, promoting hair health from within. These supplements supply essential nutrients and antioxidants that support hair growth and strength by nourishing the hair follicles at a systemic level. By incorporating *Morus nigra* into daily nutrition, individuals can help mitigate oxidative stress, which can weaken hair follicles and lead to thinning hair. The extract's abundant vitamins, minerals, and other bioactive compounds contribute to a healthier scalp environment, enhancing overall hair vitality. Regular supplementation with *Morus nigra* ensures a steady intake of these nourishing compounds, which work synergistically to improve hair quality, thickness, and resilience. As part of a well-balanced diet, *Morus nigra* supplements offer a natural way to enhance hair care from the inside out.⁽³¹⁾

2.2. Future Prospects and Research Directions Despite the promising findings regarding *Morus nigra*, several avenues for future research remain:

- **Mechanistic Studies:** Even though *Morus nigra* has demonstrated encouraging effects on hair growth, more thorough research is required to completely comprehend how it affects hair growth at the molecular and cellular levels. Examining the precise methods of action may help identify how its bioactive substances interact with the cells that make up hair follicles, maybe promoting the growth phase or preventing damage that causes hair loss. For example, studies might examine if certain antioxidants in *Morus nigra* lessen oxidative stress in hair follicle cells or whether its anti-inflammatory properties could diminish inflammation on the scalp, which can impede hair development. Acquiring a deeper understanding of these pathways may also help determine which cellular reactions and chemical signals are triggered by *Morus nigra*, providing information on how it may enhance hair strength and density. In addition to confirming its conventional applications, such mechanistic research may open the door to the creation of customized hair care products that fully utilize *Morus nigra*'s potential as a natural growth accelerator.⁽³²⁾
- **Long-term Efficacy and Safety:** To establish *Morus nigra* as a reliable option for hair growth treatments, longitudinal studies are essential to evaluate its long-term efficacy and safety. While preliminary studies suggest potential benefits in stimulating hair growth and improving scalp health, understanding its effects over extended periods will provide a clearer picture of its performance in real-world, sustained use. Long-term studies can track how continuous application or supplementation influences hair density, strength, and follicle health, while also monitoring potential side effects or diminishing returns. Additionally, these studies can help identify any delayed responses or cumulative benefits that may not be apparent in shorter trials. Safety is another critical consideration, as long-term data could reveal any risks associated with prolonged use, particularly for individuals with sensitivities or those combining *Morus nigra* with other treatments. Ultimately, these insights would guide recommendations for its effective and safe incorporation into hair care routines, enabling consumers to confidently use *Morus nigra* for lasting hair health benefits.⁽³³⁾
- **Standardization of Extracts:** For *Morus nigra* to reach its full potential as a widely used ingredient in hair growth and scalp health treatments, research must prioritize the standardization of its extracts. Currently, variations in extraction methods, plant sources, and processing techniques lead to inconsistencies in the potency and composition of *Morus nigra* products, which can affect their effectiveness and reliability. Standardization would involve establishing uniform concentrations of key active compounds, such as antioxidants and bioactive molecules, ensuring that each formulation delivers consistent results. By setting

quality benchmarks and standardized dosages, researchers can lay the foundation for more predictable, efficacious products. This process would also enable consumers and healthcare professionals to confidently select *Morus nigra* products, knowing that each batch meets the same high standards. Ultimately, standardized *Morus nigra* extracts could enhance both the credibility and effectiveness of this natural remedy in the field of hair care, paving the way for it to become a trusted ingredient in both commercial and therapeutic formulations.⁽³⁴⁾

3. Conclusion

The present study gives detailed information about the plant black mulberry. These substances are recognized for their strong antibacterial, anti-inflammatory, and antioxidant properties, making them essential for stimulating hair growth and addressing various scalp conditions. This review will explore the intricate bioactive mechanisms of black mulberry and assess its potential as a treatment for common scalp concerns such as dandruff, hair loss, and other related conditions. It will also include studies on the long-term impact of black mulberry on hair regeneration and discuss how it can be effectively incorporated into hair care formulations.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

- [1] Dureja, H.; Kaushik, D.; Gupta, M.; Kumar, V.; Lather, V. Cosmeceuticals: An emerging concept. *Indian J. Pharmacol.* 2005, 37, 155–159.
- [2] Binic, I.; Lazarevic, V.; Ljubnovic, M.; Mojsa, J.; Sokolovic, D. Skin ageing: Natural weapons and strategies. *Evid. Based Complement. Altern. Med.* 2013, 2013, 1–10.
- [3] De Wet, H.; Nciki, S.; Van Vuuren, S.F. Medicinal plants used for the treatment of various skin disorders by a rural community in northern Maputaland, South Africa. *J. Ethnobiol. Ethnomed.* 2013, 9, 1–9.
- [4] Mecklenburg L., Tobin D.J., Müller-Röver S., Handjiski B., Wendt G., Peters E.M., Pohl S., Moll I., Paus R. Active hair growth (anagen) is associated with angiogenesis. *J. Investig. Dermatol.* 2000;114:909–916. doi: 10.1046/j.1523-1747.2000.00954.x.
- [5] Alibardi L. Ultrastructural immunolocalization of involucrin in the medulla and inner root sheath of the human hair. *Ann. Anat. Anat. Anz.* 2012;194:345–350. doi: 10.1016/j.aanat.2011.10.012.
- [6] Nomura, T. Fukai, T. Yamada, S. Katayanagi, M. Studies on the constituents of the cultivated mulberry free. 1. Three new pretylflavones from the root bark of *Morus nigra* L. *Clem. Plazm. Ball*, 1978, 26, 1394-1400.
- [7] Ko, H.H., Yu, S.M., Ko, F.N., Leng, C.M., Lin, C.N. Hoactive constituents of *Morus nigra* and *Morus papyrifera*. 1. *Nat. Prof.* 1997, 6L 1105-1011.
- [8] Hossain, M. M., et al. (2015). "Bioactive Compounds and Antioxidant Properties of *Morus nigra*." *Journal of Functional Foods*, 18, 285-295.
- [9] Wang, J., et al. (2019). "Anthocyanins from Black Mulberry: Health Benefits and Antioxidant Properties." *Food Chemistry*, 275, 383-392
- [10] Jiang, Y.; Nie, W.-J. Chemical properties in fruits of mulberry species from the Xinjiang province of China. *Food Chem.* 2015, 174, 460–466.
- [11] Ercisli, S.; Orhan, E. Chemical composition of white (*Morus alba*), red (*Morus rubra*) and black (*Morus nigra*) mulberry fruits. *Food Chem.* 2007, 103, 1380–1384.
- [12] Ghaffar, F. A., et al. (2021). "Vitamin B Complex and Its Role in Hair Growth: A Comprehensive Review." *Journal of Cosmetic Dermatology*, 20(3), 703-710.
- [13] Bhanusali, D., et al. (2021). "Zinc and Iron in Hair Loss: A Review." *Dermatology Research and Practice*, Article ID 5390867.

- [14] Ranjbar, A., et al. (2018). "The Role of Antioxidants in Hair Growth and Repair." *Journal of Cosmetic Science*, 69(4), 241-248.
- [15] Wei H., Liu S., Liao Y., Ma C., Wang D., Tong J., Feng J., Yi T., Zhu L. A Systematic Review of the Medicinal Potential of Mulberry in Treating Diabetes Mellitus. *Am. J. Chin. Med.* 2018;46:1743–1770. doi: 10.1142/S0192415X1850088X.
- [16] Turan I., Demir S., Kilinc K., Burnaz N.A., Yaman S.O., Akbulut K., Mentese A., Aliyazicioglu Y., Deger O. Antiproliferative and Apoptotic Effect of *Morus nigra* Extract on Human Prostate Cancer Cells. *Saudi Pharm. J.* 2017;25:241–248. doi: 10.1016/j.jsps.2016.06.002.
- [17] Kassem, A. H., et al. (2016). "Anti-Inflammatory Properties of *Morus nigra* Extracts." *Journal of Ethnopharmacology*, 194, 856-865.
- [18] Liu, X., et al. (2020). "Effects of *Morus nigra* on Dermal Papilla Cell Proliferation." *Experimental and Therapeutic Medicine*, 20(4), 2412-2420.
- [19] Al-Qubaisi, M., et al. (2022). "Antimicrobial Properties of *Morus nigra* Extracts against Scalp Microbiota." *BMC Complementary Medicine and Therapies*, 22(1), 1-10.
- [20] Kumar, P., et al. (2021). "Clinical Evaluation of *Morus nigra* for Hair Loss: A Double-Blind Study." *Journal of Cosmetic Dermatology*, 20(5), 1434-1440.
- [21] Shirode, A. R., et al. (2023). "The Role of Dietary *Morus nigra* Extract in Hair Growth: A Randomized Controlled Trial." *Journal of Medicinal Food*, 26(3), 300-308.
- [22] Naderi, N., et al. (2020). "Comparison of Hair Growth Effects of *Morus nigra* and Minoxidil: A Randomized Trial." *International Journal of Trichology*, 12(4), 158-163.
- [23] Khalifa I., Zhu W., Li K. Polyphenols of Mulberry Fruits as Multifaceted Compounds: Compositions, Metabolism, Health Benefits, and Stability—A Structural Review. *J. Funct. Foods.* 2018;40:28–43. doi: 10.1016/j.jff.2017.10.041.
- [24] Gr A., Yankanchi G.M., Gowda M. Chemical Composition and Pharmacological Functions and Principles of Mulberry: A Review. *Int. J. Appl. Res.* 2017;3:251–254.
- [25] Ghosh, S., et al. (2021). "Safety Profile of *Morus nigra*: A Review." *Toxicology Reports*, 8, 1234-1241.
- [26] Niamh, K., et al. (2022). "Herbal Interactions: The Need for Caution." *Phytotherapy Research*, 36(1), 1-15.
- [27] Memete, A.R.; Teusdea, A.C.; Timar, A.V.; Vuscan, A.N.; Mintaş, O.S.; Cavalu, S.; Vicas, S.I. Effects of Different Edible Coatings on the Shelf Life of Fresh Black Mulberry Fruits (*Morus nigra* L.). *Agriculture* 2022, 12, 1068.
- [28] Harborne JB. *Phytochemical methods. A guide to modern techniques of plant analysis.* London, UK: Chapman & Hall; 1973.
- [29] Gupta, A., et al. (2020). "Formulation Development of Herbal Hair Care Products." *Asian Journal of Pharmaceutics*, 14(4), 293-302.
- [30] Sharma, V., et al. (2021). "Enhancing Scalp Health: Role of Herbal Ingredients in Hair Care." *Journal of Cosmetic Science*, 72(3), 123-130.
- [31] Chen, L., et al. (2023). "Dietary Supplements for Hair Health: A Review." *Nutrients*, 15(4), 936.
- [32] Zhang, Y., et al. (2021). "Unraveling the Mechanisms of Herbal Medicines for Hair Growth: The Case of *Morus nigra*." *Evidence-Based Complementary and Alternative Medicine*, Article ID 9785461.
- [33] Ranjbar, A., et al. (2022). "Long-term Efficacy and Safety of Herbal Treatments for Hair Loss." *Journal of Herbal Medicine*, 33, 100546
- [34] Rahman, M. H., et al. (2022). "Standardization of Herbal Extracts: Importance and Challenges." *Journal of Ethnopharmacology*, 283, 114671.