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Exploring Halal Cosmetics: *Morus Nigra* As An Alternative To Halal Coloring In Lipstick And Antimicrobial Cream Formulations

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ABSTRACT

The demand for halal-certified cosmetics has significantly increased due to consumer awareness of ethical, safe, and Shariah-compliant ingredients. Conventional cosmetic colorants often raise concerns regarding their synthetic origin, potential toxicity, and non-halal sources. *Morus nigra (M. nigra),* or black mulberry, is a flowering plant native to southwestern Asia, valued for its nutritious fruits with antioxidant, anti-inflammatory, and antibacterial properties. The high anthocyanin content in *M. nigra* provides an intense natural pigment of suitable for cosmetic applications while offering antioxidant and antimicrobial properties. The aim of this study is to explores *M. nigra* extract as a natural halal alternative for lipstick coloring and antimicrobial cream formulation. *M. nigra* was extracted using a maceration method. Antimicrobial cream and lipstick containing *M. nigra* extract were formulated using halal-certified ingredients, supported by relevant documentation, including the Halal Certificate, Certificate of Analysis (CoA), International Nomenclature of Cosmetic Ingredients (INCI), and Material Safety Data Sheet (MSDS). Formulated lipstick and antimicrobial cream were tested using disk diffusion test. The antioxidant properties of *M. nigra* cream and lipstick (5, 10, 15 % W/W) were tested by using DPPH and FRAP method and UV protection properties were tested using SPF test. Furthermore, physicochemical properties of lipstick and antimicrobial cream were also evaluated. The lipstick formulation was assessed for color intensity, pH stability, and texture, while the antimicrobial cream was tested for its antimicrobial activities agianst *Staphylococcus aureus* and *Pseudomonas aeruginosa*. The results showed that *M. nigra* lipsticks exhibit a purplish red color with a fruity odour. Lipstick has uniform aspect, good spreadability and stable at pH 5.72 to 6.02 making it suitable to be applied onto the lip. *M. nigra* extract (100µg/ml) have great antioxidant activity of 85.86% in DPPH and 2.409 µmol Fe (II)/g in FRAP assay and have UV protection percentage of 37.23% on SPF test. The antimicrobial testing showed that *M. nigra* cream was able to inhibit the growth of *S. aureus* and *P. aeruginosa*. This study highlights *M. nigra* as a sustainable, halal-friendly, and bioactive alternative to synthetic dyes and antimicrobial agents in the cosmetic industry. The findings contribute to the development of natural and halal-certified beauty products, catering to the growing market demand.

Keywords: *Halal cosmetics, Morus nigra, natural colorant, antimicrobial cream*

Introduction

The global demand for halal cosmetics has significantly increased, driven by the rising awareness among Muslim consumers regarding the permissibility and ethical sourcing of cosmetic ingredients. Halal cosmetics must comply with Islamic principles, ensuring that products are free from prohibited (haram) substances such as porcine-derived ingredients, alcohol, and animal-derived colorants that are not slaughtered according to halal guidelines (Ali et al., 2016). As a result, the cosmetic industry is increasingly exploring natural, plant-based alternatives that meet both regulatory and religious standards. Among these, *Morus nigra (M nigra*) (black mulberry), a fruit known for its rich anthocyanin content and deep pigmentation, has emerged as a promising candidate for use in natural colorant applications (Khoo et al., 2017). Its vibrant hue and halal-friendly botanical origin make it a potential substitute for synthetic dyes and animal-derived pigments commonly used in lipstick and topical formulations.

In addition to its coloring properties, *M nigra* has also attracted attention for its antimicrobial and antioxidant activities, which are beneficial for skin care and therapeutic cosmetic formulations. Studies have shown that extracts of *M nigra* possess broad-spectrum antimicrobial properties, which can be harnessed in the development of antimicrobial creams aimed at preventing or managing skin infections (Hemavathi et al, 2024). This dual functionality—providing both pigmentation and bioactivity—aligns with the growing consumer preference for multifunctional, clean-label, and ethically produced cosmetics. Therefore, investigating the potential of *M nigra* in halal-certified lipstick and antimicrobial cream formulations not only addresses religious and ethical concerns but also supports the development of sustainable and health-promoting cosmetic products.

Methodology

Identification of Halal Ingredients

A halal certificate was provided by the supplier during the purchase of raw material. The raw material without halal certificate was checked using Certificate of Analysis (CoA), Material Safety Data Sheet (MSDS) and International Nomenclature Cosmetic Ingredient (INCI) to ensure the safeness and the sources of the material purchase are from plant based and safe to be used.

Morus Nigra Extraction

2 kg of *M nigra* fruits was dried using an oven at 50°C for 3 days until completely dry. After drying, the fruits were blended and sieved into fine powder. The dried fruit powder was extracted using the maceration method. The crude methanolic extract was obtained, weighed, and stored in refrigerator for lipstick and cream preparation (Arif et al., 2019).

Formulation of M nigra Lipstick Formulation

White beeswax and white soft paraffin were categorized in phase A, olive oil and glycerin were categorized in phase B, Morus Nigra extract, methylparaben and propylparaben were categorized in phase C. Then, melted phase A ingredients by heating up, then added in phase B ingredients. Phase C was added to phase A and B mixture after and then poured in the lipstick molds. It was kept in a laboratory refrigerator for 15 minutes for solidification and then the lipstick was removed from the mold (Saied et al., 2022).

Formulation of M nigra Cream Formulation

40 g cream containing different weight of M. nigra extract (0 g, 2 g, 4 g, and 6 g) were incorporated into the cream. The formulation process started with the emulsifier (stearic acid) and other oil soluble components were dissolved in the oily phase and heated to 75 °C using water bath. Then, the preservatives and other water-soluble components were dissolved in the aqueous phase in a separate beaker followed by heating at 75°C using water bath. After the heating process was completed, the aqueous

phase was mixed with the oily phase with continuous stirring until the mixture cooled. Lastly, the formulated cream was transferred into a plastic container and labeled for further analysis.

Physical evaluation of M nigra Lipstick and Cream

The physical evaluation of the lipstick and cream formulations was conducted by recording their organoleptic after one month of storage. The cream properties such as appearance, colour, odour, texture, phase separation, pH and homogeneity were observed following the method by Viswanad et al. (2012), meanwhile stability, spreadability and breaking point was measured in lipstick.

Lipstick Sun Protection Factor (SPF) Test

SPF value in lipstick was measured with a UV-vis spectrophotometer to analyze UV absorbance of samples. 1 mg of lipstick sample was prepared by dissolving in hexane and washed with distilled water. The absorbances of the lipstick samples (0.1 mg/mL) were measured in the range of 290–320 nm, with 5 nm increments, and three determinations were made at each point (Sadeghifar & Ragauskas, 2020).

Antioxidant Activity of M nigra Lipstick

DPPH (1, 1-diphenyl-2-picryl hydroxyl) Radical Scavenging Assay

0.1 mM DPPH solution was prepared. 1 mL of lipstick samples with different concentrations added to different test tubes. Each test tube contains different concentrations of sample added with 3 mL of DPPH solution. A test tube containing 3 mL of solution containing DPPH in 1mL of distilled water without sample was used as the negative control while 3mL of DPPH solution and 1mL of ascorbic acid was used as positive control. The tubes were then kept in the darkroom for 30 min. The absorbance was determined at 517 nm using UV-vis spectrophotometer. Lipstick samples were prepared and measured in triplicates (Baliyan et al., 2022).

Ferric Reducing Antioxidant Power (FRAP) Assay

1 mL of lipstick samples with different concentrations added to different test tubes. Each test tube contains different concentrations of lipstick samples added with 2.5 mL of the FRAP reagent. The prepared lipstick samples were incubated at 37 °C 30 minutes in complete darkness. A test tube containing 2.5 mL of solution containing FRAP in 3mL of distilled water without lipstick sample was used as the negative control while 2.5 mL of FRAP solution and 1 mL of ascorbic acid was used as positive control. Absorbance was then measured at 593 nm using a UV−vis spectrophotometer. Lipstick samples were prepared and measured in triplicates (Wojtunik-Kulesza, 2020).

Antimicrobial Screening of M nigra Cream

The antimicrobial activity of *M nigra* cream against *S aureus* and *P aeruginosa* was evaluated using the disk diffusion method. Agar plates were first inoculated by evenly spreading the test microorganisms across the surface. Filter paper discs (6 mm) soaked with the extract were then placed on the agar, and the plates were incubated at 37°C for 24 hours to facilitate bacterial growth. Following incubation, clear areas surrounding the discs indicating suppression or absence of bacterial growth were measured in millimeters. Each extract was tested in four replicates against each microorganism, and the results were reported as mean ± standard deviation (Pawar et al., 2019).

Results

Physical evaluation of M nigra Lipstick and Cream

Figure 1 shows the *M nigra* cream in different concentration. The colour increased in intensity in the order of 2 g < 4 g < 6 g of *M. nigra* extracts cream formulations. All the cream formulations with *M. nigra* extract had a berry like smell. The odour of the cream became stronger as the weight of the active ingredient increased. Based on the results, the four creams showed smooth texture and homogenous with no sign of phase

separation. They are also moisturizing, non-greasy, light and washable upon application which made it suitable to be applied onto the skin. A study conducted by Aswal et al. (2013) on polyherbal cosmetic cream indicated that a stable formulation has almost constant pH, homogenous, emollient, non-greasy and easily removed after application.

Figure 1. The *M nigra* cream in different concentration

Figure 2 shows the *M nigra* lipstick in different concentration. The colour increased in intensity in the order of 2 g < 4 g < 6 g of *M. nigra* extracts lipstick formulations. Over a 30-day stability test, no physical changes at room temperature (24.0 ± 3.0 °C) was observed in all formulation. The colour and odour of all formulations remained purplish red and emitted a fruity smell, consistent with Susmiatun et al. (2018), indicating good product durability. Spreadability remained good at room temperature but was impaired under high temperatures, melting points for all formulations ranged from 52.3ºC to 60.2ºC, within the acceptable range for hot climates (50–75ºC) as supported by Rigano (2021), indicating satisfactory thermal stability.

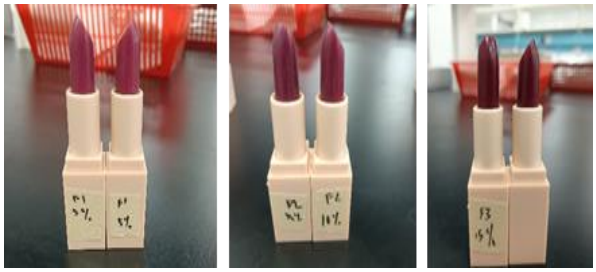

Figure 2. The *M nigra* lipstick in different concentration

The pH values of the lipstick formulations ranged from 5.72 to 6.02, which is within the safe range for lip application (pH 4–7) (Saeid et al., 2022). The pH decreased as more *M nigra* extract was added, due to its acidic nature, as supported by Okatan et al. (2016), who reported an average pH of 3.85 for the fruit.

For the breaking point test, Formulation 1 (2g *M nigra* extract) had the highest breaking point at 133.33 g, while Formulation 2 (4g extract) was slightly lower, and Formulation 3 (6g extract) had the lowest breaking point at 70 g. This indicates that increasing the amount of extract reduced the hardness of the lipstick. According to Chee et al., (2018), a higher percentage of base content results in a harder lipstick with a greater breaking point.

Lipstick SPF Test

The highest percentage of UV protection was F3 as shown in Table 1. This was in line with study by Nareswari et. al. (2019), which uses crude palm oil as an active ingredient to produce natural lip balm with 5 formulations (15, 12.5, 10, 7.5, 5 % b/b). The study found that the higher active ingredients are used, the higher the percentage of UV protection produced.

Table 1. UV Protection Percentage of Lipstick Formulations

Formulation	UV Protection (%)
F1 (2g)	32.22
F2 (4g)	35.38
F3 (6g)	37.07

Antioxidant Activity of M nigra Lipstick

The antioxidant activity of the lipstick formulations was confirmed through both DPPH and FRAP assays. In DPPH, all formulations showed radical scavenging ability with Formulation 3 (F3), exhibiting the greatest antioxidant activity. In the FRAP assay, F3 showed the highest ferric reducing power (0.379 µmol Fe(II)/g), followed by F2 and F1. The results indicated a dose-dependent relationship, where increasing extract concentration led to higher antioxidant effects. These findings align

with research conducted by Pamungkas et al., (2013), which also demonstrated a similar pattern in lipstick formulated with 8g of mangosteen rind extract had the highest antioxidant activity compared to lower concentration of extract.

Table 2: FRAP and DPPH of *M nigra* Lipstick

Lipstick Formulation	FRAP Value (Mmol Fe(ii)/G)	DPPH (%)
Formula 1 (2g)	0.282	10.56
Formula 2 (4g)	0.322	11.40
Formula 3 (6g)	0.379	12.38

Antimicrobial Activity of M nigra Cream

From the study, only the cream formulation with 6 g of *M nigra* extract showed zone of inhibition against *S. aureus*. However, there is no zone of inhibition recorded against *P. aeruginosa* after the *M nigra* extract had been formulated into cream as dosage form. The results were in-line to the study conducted by Melo et al. (2022), in which the emulsion with *M nigra* extract possessed antimicrobial activity against *S. aureus*, but there was no activity recorded against *P. aeruginosa*. This may due to different variations in the performance of the tests, such as different sizes of bacterial inoculum, volume, and type of agar, well size, disc size, incubation period and type of extraction. Thus, standardization through guidelines is the way to reduce the number of conflicts. The findings of this study showed that the *M nigra* extract lost its antimicrobial properties against *P. aeruginosa* after it was incorporated into a cream base. The loss of antimicrobial property in this study might be due to the interaction between the preservatives and active ingredient used in the cream formulation or due to the low concentration of *M nigra* extract used in cream formulation.

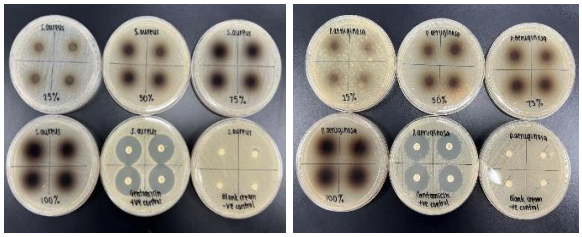

Figure 3. Disk diffusion test *S. aureus* and *P. aeruginosa*

Conclusion

The use of *M nigra* addresses the need for halal-certified natural colorants in cosmetics. Its incorporation into lipstick not only meets aesthetic needs but also fulfills halal requirements for safe, clean, and ethical product development. This study successfully formulated two halal-compliant cosmetic products, lipstick and cream using *M nigra* fruit extract that demonstrated desirable physical and functional properties. Thus, *M nigra* presents a promising multifunctional ingredient offering natural colour, antioxidant and antimicrobial benefits, and compliance with halal cosmetic standards aligning with growing consumer demand for Shariah-compliant, plant-derived cosmetic ingredients.

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Istraživanje halal kozmetike: *Morus nigra* kao alternativa halal bojilima u formulacijama ruža za usne i antibakterijske kreme

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Sažetak

Potražnja za kozmetikom s halal certifikatom značajno je porasla zbog sve veće svijesti potrošača o etičkim, sigurnim i šerijatski prihvatljivim sastojcima. Konvencionalna kozmetička bojila često izazivaju zabrinutost zbog svog sintetičkog porijekla, potencijalne toksičnosti i izvora koji nisu halal. *Morus nigra* (*M. nigra*), odnosno crni dud, je cvjetnica porijeklom iz jugozapadne Azije, cijenjen zbog svojih hranjivih plodova s antioksidativnim, protuupalnim i antibakterijskim svojstvima. Visok sadržaj antocijanina u *M. nigra* pruža intenzivnu prirodnu boju pogodnu za kozmetičke primjene, uz dodatne antioksidativne i antimikrobne efekte. Cilj ove studije je istražiti ekstrakt *M. nigra* kao prirodnu halal alternativu za bojenje ruža za usne i formulaciju antimikrobne kreme. *M. nigra* je ekstrahirana metodom maceracije. Antimikrobna krema i ruž za usne s ekstraktom *M. nigra* formulirani su koristeći sastojke s halal certifikatom, uz prateću dokumentaciju uključujući Halal certifikat, Certifikat o analizi (CoA), Međunarodnu nomenklaturu kozmetičkih sastojaka (INCI) i Sigurnosno-tehnički list (MSDS). Formulirani ruž za usne i antimikrobna krema testirani su metodom difuzije na disku. Antioksidativna svojstva *M. nigra* kreme i ruža (5, 10, 15 % W/W) testirana su pomoću DPPH i FRAP metode, a UV zaštitna svojstva su ispitana putem SPF testa. Također su ispitana i fizičko-hemijska svojstva ruža i kreme. Formulacija ruža ocijenjena je po intenzitetu boje, stabilnosti pH i teksturi, dok je antimikrobna krema testirana na djelovanje protiv *Staphylococcus aureus* i *Pseudomonas aeruginosa*. Rezultati su pokazali da ruž s *M. nigra* ima purpurno-crvenu boju s voćnim mirisom. Ruž ima ujednačen izgled, dobro se razmazuje i stabilan je pri pH vrijednostima od 5,72 do 6,02, što ga čini pogodnim za nanošenje na usne. Ekstrakt *M. nigra* (100 µg/ml) pokazao je visoku antioksidativnu aktivnost od 85,86% u DPPH testu i 2.409 µmol Fe(II)/g u FRAP analizi, te UV zaštitu od 37,23% prema SPF testu. Antimikrobno testiranje pokazalo je da krema s *M. nigra* može inhibirati rast *S. aureus* i *P. aeruginosa*. Ova studija ističe *M. nigra* kao održivu, halal-prihvatljivu i bioaktivnu alternativu sintetičkim bojilima i antimikrobnim agensima u kozmetičkoj industriji. Nalazi doprinose razvoju prirodnih i halal-certificiranih kozmetičkih proizvoda, odgovarajući na rastuću potražnju tržišta.

Ključne riječi: *halal kozmetika, Morus nigra, prirodno bojilo, antimikrobna krema*