

Review

Halal Cosmetics: A Review on Ingredients, Production, and Testing Methods

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Abstract: The demand for halal cosmetic products among the 2.4 billion Muslim consumers worldwide is increasing. However, the demand for halal cosmetics remains unmet because cosmetics production is dominated by non-halal cosmetic manufacturers, whose production methods may not conform with the requirements of halal science. The development of halal cosmetics and the assessment of their product performance is still in its infancy. The integration of halal science in the manufacture of most cosmetic products remains inadequate. Moreover, there is a global dearth of guiding documents on the development and assessment techniques in the production of comprehensively halal cosmetics. This paper aims to abridge existing literature and knowledge of halal and cosmetic science in order to provide essential technical guidance in the manufacture of halal cosmetics. In addition, the adoption of these methods addresses the unique ethical issues associated with conformance of cosmetics' product performance to religious practices and halal science. It highlights the applicability of established methods in skin science in the assessment of halal cosmetics.

Keywords: cosmetic ingredients; cosmetic manufacture; halal cosmetics; formulation; in vitro testing

1. Introduction

Halal denotes permissible and lawful, whereas haram means prohibited by Islamic law. Najis refers to uncleanness, analogous to the contamination of something considered halal. Halalan-toyyiban is a concept wherein a product is deemed halal, contains wholesome ingredients, and does not pose any health risk when the product is used. The halal-haram rule is a part of the entire legal system of Islam. The term halal is often associated with food. However, this term essentially includes a wide area apart from food. Halal is relevant in every aspect of a person's life, such as source of income, attitude towards a product, and religiosity, among others [1]. Halal law prioritizes the importance of the permissibility of food to be consumed, because food intake directly impacts the development of human wellness and behavior. In parallel, consuming haram products (prohibited) is purported to be injurious to one's physical health and overall character. It is a dictum among Muslims to consume only halal products as this is viewed to affect religiosity [1,2].

Halal pharmaceuticals and cosmetic products are gaining awareness and increasing demand among the 2.4 billion Muslim consumers worldwide. The global halal market is anticipated to expand at a compound annual growth rate of 6.8% until 2024 [3]. Apart from the large Muslim population

who exhibit high loyalty to halal products, halal cosmetics carry a wider market appeal among non-Muslim consumers, who attribute these products with ethical consumerism and more stringent quality assurance standards. In addition, for non-Muslims, halal can become a benchmark of accepted conformance and quality in trade dealings with Muslims [1,4].

Halal cosmetic products must not contain ingredients derived from pig, carrion, blood, human body parts, predatory animals, reptiles, and insects among others. Cosmetic ingredients derived from permissible animals must be slaughtered according to Islamic law to be considered halal [4]. In the preparation, processing, manufacture, storage, and transport of halal cosmetic products, maintenance of hygiene and pure conditions must be ensured at all times. There is an emphasis on the absence of filth. The intent of certifying products as halal is parallel with the goals of most quality assurance procedures (e.g., cGMP, HACCP) [1]. Hence, halal cosmetic products, bearing the halal logo, must be recognized as an indicator of cleanliness, safety, purity, and quality.

Although pharmaceutical products have gained scientific advancement way beyond cosmetic products as evidenced by the numerous halal-certified drug products in the market, scientific efforts in the development of cosmetics as a halal product must be probed further to adequately fulfill global demand. For Muslim consumers, knowing the origin of raw materials and the production process of cosmetic ingredients is vital, due to the Islamic law stating that every Muslim must consume only halal and wholesome products [5]. Moreover, scrutinizing cosmetic products can be very challenging and demands technical knowledge of the ingredients, their sources, and manufacturing methods. Cosmetic products are complex and constitute several highly processed products that are manufactured using ingredients of animal or plant origins. Upon application, cosmetic products may be unintentionally ingested (e.g., lipstick), inhaled (e.g., perfumes), or absorbed through the skin (e.g., alcohol or ingredients of critical origin) [6]. With the known challenges, manufacturers have to guarantee that cosmetic products are critically developed to be halal in composition and support holistically the requirements of Islamic rituals (e.g., wudu, cleansing before praying, or reading the Qur'an) performed on a daily basis.

There are several challenges that need to be taken into account in the development of halal cosmetics. Cosmetic ingredients derived from animals such as gelatin, lecithin, glycerol, fatty acids, and collagen are very difficult to verify as halal. Some coloring agents may be derived from insects, hence qualified as haram. Moreover, ingredients that are of bovine origin poses another challenge as the animals may be slaughtered in non-halal manner. Not only the use of halal ingredients is required in the production but also the overall cosmetic product performance, in order to meet requirements of Islamic rituals. A case in point, a lacquered nail must be penetrable by water to allow sufficient rinsing, and cosmetic products applied on skin must also be penetrable to water or be completely rinsed off to allow Muslims to perform their rituals accordingly.

While the detection methods for haram materials are in place, the development of halal cosmetics and the assessment of product performance are still in their infancy. Cosmetics production is dominated by non-halal cosmetic manufacturers [6] whose production methods do not conform to the requirements of halal science, hence, emphasizing the need to develop guiding documents for such purpose. Moreover, there is a global dearth of guiding documents in the development and assessment techniques in the production of comprehensively halal cosmetics. This paper aims to abridge existing literature and knowledge of halal and cosmetic science in order to provide essential technical guidance in the manufacture of halal cosmetics. It highlights the applicability of established methods in skin science in the assessment of halal cosmetics.

2. Source of Halal Cosmetic Ingredients

Halal cosmetics are products, sourced from halal ingredients and produced in accordance with the halal system, intended to be applied on a specific part(s) of the body, whether as leave-on or rinse-off, for the purpose of beautifying, cleansing, protecting, and changing the appearance of the body.

Cosmetics constitute a myriad of ingredients including water, oils, surfactants, polymers, organic solvents, colorants, proteins, vitamins, plant extracts, preservatives, and antioxidants, among others [7].

With the complex mixture of ingredients in a cosmetic product, cosmetic manufacturers must critically evaluate the ingredients and their corresponding source prior to development and production.

The source of ingredients intended for the development and manufacture of halal cosmetics plays a crucial role in the outcome and overall performance of the product. It is the responsibility of manufacturers rather than regulators to substantiate the safety of the ingredients used for halal cosmetic products [8]. Manufacturers have to work closely with suppliers to ensure only halal certified ingredients are being supplied. It should begin with an end in mind that raw materials, actives, or excipients must be obtained from certified sources considered halal. Not only do the ingredients have to be halal, but also safe for consumers for the intended use. This section focuses on the common ingredients used in the preparation of cosmetic products. These ingredients are classified into halal, haram, and critical.

2.1. Halal (Permitted) Cosmetic Ingredients

Halal cosmetic ingredients are any constituents derived from plants, soil, water, permissible animals slaughtered according to Islamic law, marine animals deemed halal, and synthetic materials that are safe for consumers and unadulterated with filth (najis). Table 1 provides a representative list of ingredients considered halal. Plant-derived components and chemical synthesis (precursor compounds) of ingredients are replacing animal-derived ones in the manufacture of halal cosmetics as a means to diminish doubt and to better gain acceptance among consumers. Reducing the number of critical ingredients used in the development of cosmetics facilitates the certification process, because it rules out the incorporation of unacceptable or haram ingredients. As a rule of thumb, manufacturers must secure halal certification for each ingredient from suppliers.

Table 1. Halal cosmetic ingredients.

Category	Examples	References
Skin whitening agents	4-potassium methoxysalicylate (4-MSK)	[9,10]
	Arbutin	[11,12]
	Ferulic acid	[13]
	Hinokitol	[14]
	Kojic acid	[15,16]
	Resveratrol	[17]
	Tranexamic acid	[18]
	Vitamin B ₃	[19]
	Vitamin C	[20]
Anti-aging agents	Capsanthin	[21]
	Capsorubin	[21]
	Delphinidin	[22]
	Gallic acid	[23]
	Genistein	[24]
	Glycyrrhizin	[25]
	Lutein	[26]
	Phloretin	[27]
	Salidroside	[28]
	Sclareol	[29]
	Trans-communic acid (TCA)	[30]
Thickeners	Umbelliferone	[31]
	Vitamin B ₃	[19]
	Carboxymethyl cellulose	[32]
	Carnauba wax	[33]
	Carrageenan	[34]
	Petrolatum	[35]

Table 1. Cont.

Category	Examples	References
Colorants	Carotene (red-orange)	[7,36]
	<i>Lithospermum</i> purple (violet)	[7,36]
	Paprika (yellow, orange, red)	[7,36]
	Safflower (yellow, red)	[7,36]
	Turmeric (yellow)	[7,36]
Solvents	Avocado oil	[37,38]
	Corn oil	[39]
	Cottonseed oil	[40]
	Dipropylene glycol	[41]
	Jobba oil	[42]
	Liquid paraffin (mineral oil)	[43,44]
	Polyethylene glycol	[45]
	Safflower oil	[46]
	Sesame oil	[47]
	Water	[4]

The cosmetic ingredients listed below are classified as halal on the basis that they remain uncontaminated or unadulterated with najis after obtaining and producing them from their halal sources.

2.2. Haram (Prohibited) Cosmetic Ingredients

Haram cosmetic ingredients are any constituents derived from human body parts, blood, forbidden animal parts and insects, and prohibited or restricted chemicals that are harmful or injurious to consumers. Ingredients recognized to be prohibited or restricted by governing bodies in cosmetic products are recognized as haram. Table 2 provides a representative list of ingredients considered haram.

Table 2. Haram cosmetic ingredients.

Category	Examples	References
Restricted chemicals	Chlorofluorocarbon propellants	[48]
	Chloroform	[48]
	Halogenated salicylanilides	[48]
	Hexachlorophene	[48]
	Mercury compounds	[48]
	Methylene chloride	[48]
	Prohibited cattle materials	[48]
	Vinyl chloride	[48]
	Zirconium-containing complexes	[48]
Insect derived	Carmine dye (Cochineal; E 120 or Natural Red 4)	[7,36]
	Crimson dye (from <i>Kermes vermilio</i>)	[7,36]
	Laccaic acid	[7,36]
	Beeswax	[49]
Human derived	Amniotic fluid	[4]
	Growth factors	[4]
	Placenta	[4]
Porcine derived	Amniotic fluid	[4,50]
	Gelatin	[4]
	Growth factors	[4,50]
	Placenta	[4,50]

2.3. Critical Cosmetic Ingredients

Cosmetic ingredients are classified under this category if they originate from sources (e.g., unspecified animals, halal animals slaughtered in an unspecified manner) and process of synthesis (e.g., incorporation of haram processing aids, contamination with haram or najis) nonconforming to the halal system. However, the use of alternatively sourced ingredients classified as “critical” may still be allowed to be part of a halal cosmetic product after the manufacturer has secured halal certification for its origin and production, at the same time, uncontaminated with najis. Particularly, the presence of ethanol in cosmetic products is controversial, but according to the Department of Islamic Development Malaysia (JAKIM) and the Assessment Institute for Foods, Drugs and Cosmetics Indonesian Council of Ulama (LPPOM-MUI) [51], cosmetic products may contain ethanol as long as it is sourced from natural aerobic fermentation (i.e., natural fermentation process in the presence of oxygen) or synthetic sources (i.e., prepared from ethylene oxide, acetaldehyde, acetylene) and not from the khamr (liquor) industry. Table 3 provides a representative list of ingredients classified as critical.

Table 3. Critical cosmetic ingredients.

Category	Ingredients	Comments	References
Actives	Allantoin	May be derived from unspecified animal urine	[52]
	Alpha hydroxy acids	May be derived from unspecified animals	[53,54]
	Azelaic acid	May be derived from oleic acid of unspecified animal origin; haram if contaminated with <i>Malassezia furfur</i>	[55]
	Caffeic acid	May be synthesized using microbes or obtained from bee propolis; Halal if plant-derived	[56,57]
	Collagen	May be porcine-derived, human-derived; halal if marine-derived	[58]
	Hyaluronic acid	May be derived from unspecified animal tissues	[59]
	Keratin	May be derived from cashmere goat or sheep wool	[4,60,61]
	Mequinol	May be synthesized using methanol	[62]
	Oligopeptides	May be derived from unspecified microorganisms and animals	[63]
	Ubiquinone (CoQ10)	May be derived from unspecified animals	[64,65]
Thickeners	Urea	May be derived from unspecified animals	[4,66]
	Vitamin E	May be produced from non-halal processes (i.e., use of lipase or unspecified origin of precursor materials)	[67]
	Gelatin	May be porcine-derived; halal if derived from fish	[68]
	Palmitic acid	May be derived from unspecified animals; halal if plant-derived	[69]
Oils	Xanthan gum	Haram if contaminated with fermenting bacterium; halal if uncontaminated and obtained from natural aerobic fermentation	[70]
	Linoleic acid/Linolenic acid	May be derived from unspecified animals; halal if plant-derived	[71]
	Oleic acid	May be porcine-derived	[72]
	Palm kernel oil	May be derived from unspecified animals	[73]
	Stearic acid/stearyl alcohol	May be porcine-derived; halal if plant-derived	[74]
Waxes	Squalane	May be derived from unspecified animals; halal if plant-derived	[75]
	Cetyl alcohol	May be derived from palmitic acid of unspecified animal origin	[76–78]
	Lanolin alcohol	May be derived from non-halal slaughtered animals; halal if obtained from living animals	[79]
	Stearyl alcohol	May be derived from stearic acid of unspecified animal origin	[74]
Solvents	Ethanol	Must be from natural aerobic fermentation or synthetic ethanol; intended as preservative in cosmetic formulations	[51,80]
	Glycerin/glycerol	May be porcine-derived	[81]
	Propylene glycol	May be derived from glycerol of unspecified animal origin	[82,83]

2.4. General Guidelines for Halal and Non-Halal Cosmetic Ingredients

Several guiding documents on the requirements for the certification of halal cosmetics exist, and manufacturers must adhere to the set standards alongside with those mentioned in the previous sections of this paper. These documents provide general guidelines in the production and manufacture of cosmetics but incomprehensive on sourcing of ingredients for the manufacture of halal cosmetics, although none about testing of its product performance (i.e., in support of Muslim rituals). The applicability of the guidelines listed in Table 4 may vary depending on the country of production and the target market, manufacturers have to ensure that these are met.

Table 4. List of guidelines for cosmetic production.

Guidelines	Description	References
ISO 22716:2007	Good Manufacturing Practices (GMP) Guidelines for Cosmetics	[84]
OIC/SMIIC 4:2018	Standard and Metrology Institute for the Islamic Countries—Halal Cosmetics Requirements	[85]
GSO 2055-4:2014	Gulf Cooperation Council Standardization Organization (GSO)—Requirements for Cosmetics and Personal Care	[86]
LPPOM MUI: HAS23000:1	MUI Halal Certification Requirements	[87]
ASEAN Cosmetic Directives	Association for South East Asian Nations Guiding Document for Cosmetic Manufacturers and Consumers	[88]
MS 2200-1:2008	Islamic Consumer Goods Part 1: Cosmetic and Personal Care-General Guidelines	[89]
NPRA Guidelines: 2017	Guidelines for Control of Cosmetic Products in Malaysia	[90]
U.S. FDA Guidance for Industry	Cosmetic Good Manufacturing Practices	[91]
ICH Guidelines Q7: 2016	International Council for Harmonization Guidelines on Good Manufacturing Practices	[92]

3. Production of Halal Cosmetics

The production of halal cosmetics does not only entail critically sourcing ingredients to be considered halal. The same principle follows through the production of the cosmetic products. Aside from cosmetic manufacturing requirements (e.g., cGMP, ISO among others) that manufacturers have to adhere to, a halal assurance system has to be in place as well.

A form of halal assurance system must be developed and adapted as a requirement in seeking halal certification of the cosmetic product. Its main objective is to sustain the halal production processes to assure compliance to the mandates of halal regulating bodies (e.g., LPPOM-MUI, JAKIM). This assurance system must be applied in all processes in the production of cosmetics, wherein proper documentation of the processes is required. This allows the traceability of each process in the production system. Manufacturers must create an in-house manual for the halal assurance system covering components on the halal policy, halal guidelines, halal management organization, standard operating procedures, technical references, administration system, documentation system, stakeholder engagement, training programs, audit system, corrective action system, and management review system [87].

In this section, we provide points for manufacturers to consider and to ensure that a halal assurance system is in place in the manufacture of halal cosmetics. Accuracy in documentation of these lines of evidence is expected among halal cosmetic manufacturers. Table 5 presents points for consideration in developing a halal assurance system.

Table 5. Points for consideration in halal assurance system.

a. Comprehensive document exhibiting halal assurance system
b. Comprehensive material specification used in the production of halal cosmetics
c. Comprehensive and valid halal certification of materials and facility
d. Compliance of formulation ingredients and the list of halal materials
e. Conformity between material purchasing document and the list of halal material
f. Comprehensive document and conformity between production document and the list of halal materials
g. Comprehensive document and conformity between warehousing/storage document and list of halal materials and products
h. Traceability system

Manufacturing, Storing, Packaging, and Distribution

The formulation development of halal cosmetics must begin with ingredients that are undoubtedly of halal origin. Use of alternatively sourced “critical” ingredients (e.g., ethanol, fish-derived collagen, chicken-derived gelatin) must be recognized only when appropriate documents of halal certification are presented. Other critical ingredients of unverified halal certification status are not recommended for use in the manufacture of halal cosmetics.

The manufacture of halal cosmetic products must be produced in accordance with cGMP and other quality standards to assure product quality and safety. The creation of a group of personnel

dedicated to the handling and production of halal cosmetics is recommended. The premises must be designed and located in an area with no risk of contamination by non-halal materials (e.g., proper processes and personnel flow, distant from pig farms) [93]. All production facilities are restricted to the manufacture of halal cosmetics products only. It is imperative that processing of non-halal cosmetics must not be done in the same plant to avoid mandatory ritual cleansing (sertu), which may affect operations [93]. Equipment must be dedicated for use only for halal cosmetic production. Contaminated water (e.g., water recycled from sewage treatment, water contaminated with najis) must not be used in the manufacture of halal cosmetics. The composition of cleaning materials (e.g., scrubs, brushes) used in the maintenance of equipment and facilities must not originate from non-halal animals [93]. Manufacturers have to assure that the warehouse and production lines for halal certified and non-halal ones must be physically separated or located in different plants should the manufacturer opt to produce non-halal certified cosmetics. All the processes involved must be clearly labelled with a sign carrying the word halal to prevent them from mix-ups and contamination by non-halal or najis. In addition, care should also be observed to avoid unexpected contamination from the environment (e.g., haram pets) and manpower particulate contamination (e.g., non-halal food or dust).

Halal cosmetic products must be labelled according to the prescribed labelling requirement of the regulatory bodies of each country. The label must bear a halal logo and accurately reflect the ingredients of the product as a means to aid consumer in their decision and consumption of the cosmetic product. Any text, illustrations as well as its advertisement must comply with Islamic law and local culture. The label should not depict lascivious or provocative images as this will automatically qualify the product as haram. The shape of the final product or its package must not exhibit the human body or body parts that are sexually suggestive. A similar tone is recommended in branding of the product. The brand name of halal cosmetics shall not be named or synonymously named after non-halal materials to avoid confusion.

Packaging materials are one of the concerns in the manufacture of halal cosmetics. Materials used in the production of the primary and secondary packaging must also comply with halal standards. Generally, packaging materials are made from halal sources but awareness on the origin of animal-derived ingredients used as aids in the manufacture of packaging must be recognized. Manufacturers of halal cosmetics must secure packaging materials from reputable producers of halal packaging [94]. Product accessories (e.g., application tools, brushes) must not be derived from porcine, human, or other haram materials.

The distribution system has to ensure that halal cosmetic products reach the market maintaining their halal status without being contaminated by haram materials or najis. Halal cosmetic products are recommended to be handled and shipped separately from non-halal ones to avoid cross-contamination.

4. Testing Methods for Halal Cosmetics

In the analysis of halal cosmetics, sourcing of skin model is a major limitation that is unique to the regulations for cosmetics testing, ideals of skin science, and halal systems. Although human or porcine ears are ascribed [95–98] to be used in the testing of cosmetics, this directly opposes one of the basic tenets of halal science, the absence of human- or porcine-based articles. Consistent with this, the use of rat skin, a competent skin model, or the sacrifice of animals are unacceptable in cosmetics testing as well [99–101]. Skin that is of biological origin would have been ideal in this interest owing to its natural barrier function. These limitations overarch into the possible usefulness of artificial model membranes and reconstructed human skin equivalents primarily due to their questionable barrier function [99,102]. Despite these known limitations, a progressive recommendation must be met to allow evaluation of cosmetics suited to be halal. In this paper, we propose the use of silicone model membrane or Strat-M™ for permeation experiments, which supports the principles of the halal–haram system, data reproducibility, and ease of use. Unavoidably, a 3D reconstructed skin model may be used in determining the distribution of chemicals into stratum corneum (SC) and viable epidermis and dermis (VED).

The methods described for the evaluation of water penetration, skin permeation of alcohol and cosmetic actives of critical origin, and cosmetics “washability” are not yet required by any halal governing bodies, as of the time of writing. However, these methods are viewed to supplement, if not, enhance the assessment of cosmetic products compliant with halal science. Official tests and procedures for the quantification of most cosmetic ingredients have been stipulated in several documents [103–105]. The methods described in this paper are intended for the analysis of compounds in the tests discussed herein. This section presents proposed methods for the analysis of halal cosmetic product performance on critical aspects undefined previously.

4.1. Water Penetration through Applied Nail Polish or Hard-to-Wash Cosmetics

Special criteria for halal cosmetics applied to the skin are their ability to allow water penetration. The concept of classifying nail polish as a halal cosmetic product is still a debate. However, there is a clear method that demonstrates the penetrability of specifically designed nail polish with water. “Rinsing” of the nail may be achieved when a substantial amount of water penetrates the applied layer of nail polish and reaches the nail bed. Breathability (air/oxygen) and water vapor permeability have been claimed for water-based nail polish formulations using tests prescribed in DIN 53380-3 and DIN 53122-1 [106]. These tests, however, do not appear to be reflective of actual in-use conditions such as application onto the nail or rinsing prior to rituals.

Assessment of water penetration of nail polish in its applied form may be done in two ways as a combination of previously described works [107–110]. First, a practical procedure utilizing a Franz diffusion cell and silicone membrane previously applied with nail polish may be employed. A second method being more realistic, suggests the use of human nail, or in this context the use of equivalent material, applied with nail polish and set on a specially designed Franz-type diffusion cell. The temperature of the membrane and nail must be maintained at 32 °C. A finite dose of deuterium oxide (D_2O) is applied on the donor side, with the withdrawal of aliquots at predetermined times. Detection of D_2O using Fourier-transform infrared spectroscopy should directly confirm water penetration through the applied nail polish.

The same method is viewed to be beneficial in the assessment of water penetration in difficult to wash cosmetics (e.g., lipstick, eye mascara, eye liner). A silicone membrane set on a Franz-type diffusion cell applied with finite dose of D_2O should confirm water penetration as well.

This method opens windows of opportunities for current manufacturers of halal ingredient-based nail polish and difficult-to-wash-off cosmetics to revise and improve formulations, and ultimately, gain compliance.

4.2. Determining Permeation of Alcohol, and Solvent/Cosmetic Actives of Critical Origin

The use of ingredients in the development of cosmetic formulation are employed in accordance with its intended purpose. Cosmetic active ingredients are employed mainly for their purported activity (e.g., skin whitening, anti-aging). Excipients (e.g., ethanol, other solvents) are incorporated to promote solubility of the actives/partitioning into the SC or simply for enhanced tactile impression or psychorheology. It must be noted that ethanol is allowed in topical formulations for use among Muslims provided it does not exceed 1% [80]. Absorption into the skin of solvents with doubtful origin such as ethanol and glycerin are well documented [81,111–113].

Functional cosmetics (contains quasi-drug actives) are now common in the market and have become the preferred way of delivering actives with purported skin enhancement effects. In fact, they are sold in sets (i.e., cleanser, lotion, milk, essence) and are recommended to be applied in layers in a predefined sequence.

Detection and quantification of cosmetic actives in skin (SC and VED) following dermal absorption has long been established [96–100,108,114,115]. Quantification of cosmetic actives permeating through the skin following actual in-use conditions, such as layered application, has been reported recently [116]. Together, these methods could provide insights into product formulation development with respect

to the permeation of ingredients. Manipulating the proportions of ingredients in the formulation or the use of retardants could reveal an ideal formulation that could significantly reduce or eliminate absorption through skin of alcohol, solvent/cosmetic actives of critical origin (e.g., collagen, gelatin, glycerin). Analytical methods described in this section could ascertain whether critical ingredients are absorbed or not. In addition, the evaporation of alcohol and other solvents can be evaluated to clarify its behavior (i.e., permeation or evaporation) once applied on skin [111,112,117].

In the determination of ethanol permeation, radiolabeled ethanol (^{14}C -ethanol) is suggested to be used in the formulation in place of regular ethanol. Permeation experiments for ethanol and other ingredients of concern may be carried out in Franz-type diffusion cells as reported previously [107,112]. In addition, gravimetric techniques have been reported in estimating evaporation of neat ethanol from formulations [112,118].

Realistic evaluation of chemical permeation can be attained when conditions closely simulating actual use conditions are employed [119]. The use of a finite dose and the manner of formulation application (in membrane) must be reflective of actual in-use conditions (e.g., layered application, defined sequence). Sampling from the receiver chamber is then performed as described above. The instrumental detection and quantification of compounds investigated may be performed as described previously. For reference, we summarized instrumental quantification conditions in skin permeation experiments for some cosmetic ingredients classified as critical (Table 6).

Table 6. List of methods used in the quantification of cosmetic ingredients.

Ingredients	Analytical technique	References
Azelaic acid	High-performance liquid chromatography (215 nm, acetonitrile:phosphate buffer; 25:75 (v/v))	[120]
Collagen, pentapeptide	Liquid chromatography–tandem mass spectroscopy (Pentafluoropropionic acid solution:acetonitrile; 87:13 (v/v))	[121]
Ethanol (^{14}C -ethanol)	Liquid scintillation counting	[112]
Glycerin (^{14}C -glycerol)	Liquid scintillation counting	[111]
Propylene glycol	Gas chromatography (helium as carrier gas)	[117]
Ubiquinone (CoQ10)	UV-Vis spectroscopy (405 nm)	[122]
Urea (^{14}C -urea)	Liquid scintillation counting	[111]

4.3. Cosmetics “Washability” Quantification

The ability of applied cosmetics to be washed off is of paramount significance with physical purity. This principle is of great value in the observance of wudu and encouraged prior to the reading of the Qur’an. In fact, many cosmetics (e.g., body lotion, face cream, nail polish, eye mascara among others) are applied as “leave on” cosmetics and adhere on the skin for a long time [123]. “Washability” of applied cosmetics can be realistically simulated using a simple procedure described in a previous work [124]. Concisely, applied cosmetics on the skin is rinsed first with water, and wiped off with a cotton swab previously dampened with sodium lauryl sulfate (0.5%) to mimic consumer use of liquid soap. Lastly, the skin may be rinsed with water to reflect terminal rinsing during bathing or washing.

To ultimately validate the washability of applied cosmetics, dermatopharmacokinetics and tissue distribution studies could validate the deposition of chemicals in the SC and VED, if any, may be done. A previous work presented a practical method for the quantification of chemicals deposited on the SC and hair follicles after topical application [125]. It suggests stripping of the SC 20 times using cellophane tape, extraction of drug from the tape with ethanol, and vortexing for 1 h. Tissue distribution is established by cutting and homogenizing the resulting VED. Quantification may proceed as described elsewhere [125].

5. Detection of Haram Ingredients in Cosmetics

Halal-based “purity” of materials and products is the basis for authenticity of halal products. In this study, we have identified new, yet relevant, methods for qualifying cosmetic products claiming to be halal-compliant.

Compliance should not be viewed only as an oversimplification of the absence or presence of something haram in a product. Rather, one must not neglect the actual product performance and how it interacts with a Muslim's daily rituals. In this manner, products are developed to be halal with an assurance both in composition and performance.

This section presents numerous works made in contribution to promote halal science, halal product quality, and compliance, and efforts in safeguarding the religious interests of Muslims. Methods of detecting haram ingredients, predominantly the presence of porcine-based materials, have been extensively studied [2]. Detection techniques are broadly categorized as chromatographic; high-performance liquid chromatography (HPLC) [126,127], reversed-phase HPLC [128], HPLC–tandem mass spectrometry (MS) [129], ultra-performance liquid chromatography–time-of-flight MS [130], ultra-performance liquid chromatography–electrospray ionization quadrupole time-of-flight MS [131], HPLC/MS linear ion trap/Orbitrap [132], liquid chromatography–tandem MS (LC–MS/MS) [133], and Fourier-transformed infrared spectroscopy [134], or biochemical techniques; conventional duplex polymerase chain reaction (PCR) [135], multiplex PCR–restriction fragment length polymorphism [136], sodium dodecyl sulfate–polyacrylamide gel electrophoresis [137], and calcium phosphate precipitation [138]. A recently developed method using LC–MS/MS claims to significantly reduce sample preparation time and presents excellent sensitivity to a high number of specific peptide markers differentiating materials of bovine and porcine origin [133]. Moreover, the use of a high-performance gas chromatography–time of flight MS with a lipid library search feature allows discrimination of the origin of ingredients. In addition, it has been reported to have isotope pattern analysis resulting in high sensitivity and high mass accuracy of the analytes [4].

It is not the intention of this paper to prescribe analytical techniques for the detection of haram materials but it encourages the use of the described methods, as is feasible with the institution's analytical capacity. Ultimately, any raw materials or finish products can be tested using the tests described above to rule out the presence of haram materials.

6. Conclusions

The development of halal cosmetics encompasses the concept of critically sourcing halal ingredients, applying halal practices in every step of the manufacturing process, and ensuring conformance of product performance to Islamic rituals. This document sheds light on the methods to assess previously disputed concepts in cosmetics and strengthens the existing testing methods in the assessment of halal cosmetics. The use of scientific methods in the development of halal cosmetics must be advanced to ascertain the halal status and promote market acceptance not only among Muslim consumers but also by non-Muslims as well. Halal cosmetics transcends beyond religion because they require rigorous scientific investigation to come up with a product that is safe, effective, pure, and sensitive to the holistic needs of the Muslim community.

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