*Original Research Article*

# Innovations and Challenges in the Development of Halal Cosmetics from Natural Ingredients

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## ABSTRACT

The growing consumer awareness of halal cosmetics is drawing increasing attention to the halal cosmetics industry. This study aims to delve into the process of developing halal cosmetic products using natural ingredients in a selected research center laboratory and to identify its arising issues. The study utilized a qualitative research approach, collecting data through in-depth, semi-structured interviews with two cosmetic experts from the laboratory. These experts were chosen based on their professional backgrounds and years of experience in cosmetic science and halal product development. A thematic analysis was then employed to examine the information acquired from the interviews. This study met its objectives through interviews with two cosmetic researchers at an industrial research and technology organization in Malaysia, offering insights into the development process of halal cosmetic products. The results highlight the capability to produce high-quality cosmetics that meet MS 2634:2019 and Cosmetic Good Manufacturing Practice (GMP) standards without compromising performance. Key steps include sourcing raw materials, screening for bioactivity, ensuring safety, and manufacturing. The research highlights challenges like limited local halal suppliers, difficulty in finding a new halal supplier, availability of raw materials, machine limitations, and maintenance challenges. Due to time limitations, further research is recommended to explore consumer opinions, market trends, and the broader impact on the industry.

**Keywords:** cosmetics, halal cosmetics, natural ingredients, research center laboratory

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## 1.0 Introduction

Halal and *haram* are two fundamental concepts in Islamic law, where halal refers to permissible or lawful activities. In contrast, *haram* denotes prohibited or unlawful ones based on the *Shariah* law and *fatwa* (1). These concepts extend beyond food to include a wide range of products, such as personal care items like cosmetics (2). In cosmetics, halal cosmetics refer to products formulated with ingredients permissible under *Shariah* law and must meet specific conditions outlined in Clause 3.4 of MS 2634:2019 (1). Nordin and Wan Mohamed Radzi's study (2021) highlights four main differences between halal and regular cosmetics: (i) ingredients, (ii) processing, (iii) safety, and (iv) ethics. halal cosmetics use ingredients that follow Islamic guidelines, are made without harmful substances, and undergo strict safety testing (3). The demand for halal cosmetics has increased, driven by the growing awareness among Muslim consumers about the importance of using products that align with their faith (4).

The recent statistics reflect this trend. 57 Muslim countries worldwide are members of the Organisation of Islamic Cooperation (OIC). Malaysia is one of the 49 countries with a Muslim-majority population, with approximately 32 million people (5). As a result, in 2022, the revenue of the halal cosmetics market in Malaysia was valued at approximately 3.64 billion U.S. dollars. The revenue of halal cosmetics in the country is expected to grow with a Compound Annual Growth Rate (CAGR) of 9.11% from 2023 and reach more than 8.5 billion U.S. dollars by 2032 (6). The statistics also show that millions of Malaysian consumers risk their health by spending nearly RM2 billion each year on harmful cosmetics, including those from small businesses. Many consumers follow viral trends without knowing the ingredients in these products. Additionally, some cosmetics companies avoid liability for using harmful ingredients to save on production costs (7).

However, despite this growth, the halal cosmetics industry faces several challenges. Firstly, it is imperative to ensure that the products are free of any *haram* ingredients (8). Secondly, there may be a perceived cost of compliance due to the high cost of sourcing halal ingredients (9). Thirdly, the lack of standardization and competition from other products, like international non-halal-certified products, could hinder the advancement of halal-certified cosmetics in the market (5, 10). Finally, the global cosmetics industry poses a challenge when introducing halal ingredients in cosmetic products made by companies manufacturing non-halal-certified cosmetics (11). Due to the rise of anti-Islamic feelings sparked by the happenings of 9/11 and the continuous strife in the Middle East, some Western consumers have negative associations with companies that have Islamic ties. This can trigger aggressive responses if the name of Islam is mentioned (12).

To overcome these challenges, important organizations in Malaysia, like *Jabatan Kemajuan Islam Malaysia* (JAKIM), *Majlis Agama Islam Negeri* (MAIN), *Jabatan Agama Islam Negeri* (JAIN), and the National Pharmaceutical Regulatory Agency (NPRA) play key roles in overseeing and regulating the halal cosmetics industry. Additionally, both government and non-government organizations in Malaysia support the development of halal cosmetics through research and development (R&D). For example, the selected research center laboratory under the industrial research and technology organization in Malaysia has been actively developing a range of halal-certified skincare, haircare, and makeup

products that meet Good Manufacturing Practice (GMP) standards and halal guidelines using natural ingredients, ensuring safety and quality for customers (13). The laboratory's efforts have also been recognized through the International Invention, Innovation & Technology Exhibition (ITEX) awards and the Selangor Research, Development, and Innovation Expo (14, 15, 16). Some of their successful R&D products made from local natural resources are already in the market which can be referred to in Table 1. This study aims to explore and examine the process of developing halal cosmetics products using natural ingredients in the selected research center laboratory. The study also will identify the challenges faced by the laboratory during the development process. The findings of this study will contribute to the existing body of knowledge on halal cosmetic products and provide valuable insights for academicians, stakeholders, and future researchers interested in the cosmetics sector.

## 2.0 Methodology

### *2.1 Research Design*

This study used a qualitative research methodology, with data collected through in-depth interviews with industrial research and technology organization informants. Typically, the data collected for qualitative studies is presented verbally rather than quantitatively. Qualitative research is the process of gathering and evaluating non-numerical data (text, video, or audio), which is utilized to better comprehend ideas, opinions, or experiences (24). In this research, information was gathered mainly from interviews. According to Singh (2023) (25), a research design is the plan or framework used to conduct a study. To ensure this study is conducted smoothly, the researcher has outlined the research design which can be referred to in Table 2.

**Table 1:** Examples of developed products.

| No. | Types of Products | Main Active Ingredients | Benefits | Consumers Feedback | Sources |
|---|---|---|---|---|---|
| 1. | Skin-lightening cosmeceutical product | Zingiber family extracts (*Temulawak*, Ginger, and *Lempoyang*) | Brightens the skin thoroughly through 3 processes that occur in the skin; prevents harmful UVA and UVB, helps to stop the tyrosinase enzyme activity that produces melanin, and reduces the formation of melanin on the skin's surface. | - "Acne scars and pores are shrinking and eyebags are disappearing after a month of using this product."<br>- "I have been using this product for 6 weeks and this is the result. Alhamdulillah the freckles have faded 80%." | (17, 18, 19) |
| 2. | Skincare products | Pineapple extract (*Bromeline* enzyme) with nanoemulsion | It can slow down the aging process, inhibit skin inflammation, increase elasticity and evenness of the face, and brighten the skin. | - "Black spots were successfully treated and the skin became healthier after 5 months of using this product." | (14, 17, 20, 21) |

| | | | | | |
|---|---|---|---|---|---|
| | | | | - "Freckles and scars on my face are fading. Thank you very much." | |
| 3. | Anti-fungal nail & skin cream | Rambutan rind extract (*Nephelium lappaceum*) | Multi-spectrum anti-fungal and anti-inflammatory properties, with minimal side effects or toxicity. | - "Warts are removed after 5 days of consistently applying this product and the skin becomes soft."<br>- "It is only been 4 days since I applied it on my legs, and the calluses are getting smaller." | (17, 22, 23) |

**Table 2:** Research design.

| No. | Research Objective | Approaches | Sampling | Instrumentation | | Analysis |
|---|---|---|---|---|---|---|
| | | | | Data Collection | Data Analysis | |
| 1. | To explore the developmental stages of halal cosmetic products using natural ingredients. | Interview | Cosmetic researchers | In-depth interview | Thematic analysis | The procedure is provided |
| 2. | To identify the arising issue in the development of halal cosmetic products using natural ingredients. | Interview | Cosmetic researchers | In-depth interview | Thematic analysis | The procedure is provided |

*2.2 Sampling*

Data collection for this study was made easier by using a technique called non-probability sampling. This method involves selecting participants based on factors like practicality or specific criteria rather than random selection (26). As part of this research, semi-structured, in-depth interviews were conducted in person with two informants who are cosmetic experts at the selected research center laboratory. The purpose of selecting these two informants was to gain a theoretical understanding of how the laboratory produces cosmetics using natural ingredients while ensuring that their innovative products comply with *Shariah* laws and the guidelines set by authorities.

The experts were chosen based on their professional backgrounds and years of experience. Both individuals are researchers and formulators specializing in cosmetics and halal cosmetics, bringing over 20 years of experience in the cosmetic industry and dedicating more than a dozen years to the halal cosmetics sector. Table 3 presents the demographic details of the informants, including their designations, areas of expertise, and years of service. The sample size for this research is only two and it is considered quite small. This is due to time constraints from the researcher in collecting

**Table 3:** Demographic information per informants.

| Number of Informants | Designation | Expertise Field | Service Period |
|---|---|---|---|
| Informant 1 | Researcher & Formulator | Cosmetic | 20 Years |
| Informant 2 | Researcher & Formulator | Cosmetic and Halal Cosmetic | 28 Years |

data and time constraints from several parties in conducting interview sessions. Nevertheless, the information obtained through the interview session still achieves the objectives of the study.

*2.3 Data Collection*

To answer the research questions, a data collection method is used. This method involves gathering and organizing information from two types of sources: primary and secondary.

This study's primary data collection method was through a semi-structured, in-depth interview method. Interviews were conducted with two informants from the laboratory in groups. This method is implemented jointly between the two informants to facilitate the interview session following a lot of information or opinions that can be shared by them without any shyness or misgivings. To prevent data leakage, interviews were conducted in person with the informants at the laboratory for almost 2 hours.

Before the interviews, a list of 8 to 10 questions was shared with the informants via email. This list was created based on the research objectives and the informants' areas of expertise. During the interviews, the informants were asked detailed and in-depth questions from the list, but the conversation remained flexible, allowing for natural discussion. Follow-up questions were also asked based on their responses to explore the topics further. The information and data collected were recorded, as shown in Figure 1, and were later analyzed and transcribed for the study. Additionally, the study intended to use observation methods to examine the process of developing halal cosmetic products with natural ingredients. However, due to confidentiality concerns regarding company information, which is referred to as private and confidential, the observation method could not be implemented.

This study also utilizes secondary data to enhance the search for relevant information. Secondary sources include commentary and information from other researchers that discuss, interpret, evaluate, or analyze data derived from primary sources (27). The sources were chosen based on how well they align with the research objectives and the specific topics being studied. These sources must come from reputable sources, rather than unreliable blogs or fictitious information. The researcher employs secondary sources to support arguments by analyzing data from primary sources and integrating findings from other researchers. Examples of the mediums and tools used in this study can be found in Figure 1.

*2.4 Data Analysis*

Data for this study were collected through semi-structured interviews with two halal cosmetic researchers. Thematic analysis was used to identify key themes related to the development of halal cosmetic products using natural ingredients and the challenges faced. The transcripts were thoroughly reviewed multiple times, and the recordings

were listened to repeatedly to become familiar with the content and ensure accuracy. This helped in gaining a clear understanding of the participants' views. An inductive approach was then used to code the data, and key themes were identified. The analysis results are shown in Table 4.

## 3.0 Results and Discussion

In this section, the researcher will address the first and second objectives which are the developmental stages of halal cosmetic products using natural ingredients in the laboratory and its challenges.

### *3.1 Developmental stages of halal cosmetic products using natural ingredients in the laboratory*

The development of halal cosmetics using natural ingredients through the R&D method by the laboratory can take about 6 months to 1 or 2 years. This is because to create exclusive formulations, it needs to start from scratch (16) and it starts with sourcing and screening raw materials, followed by extracting and standardizing active substances. Next, the materials undergo bioactivity screening and safety assessments. In later stages, the products are evaluated

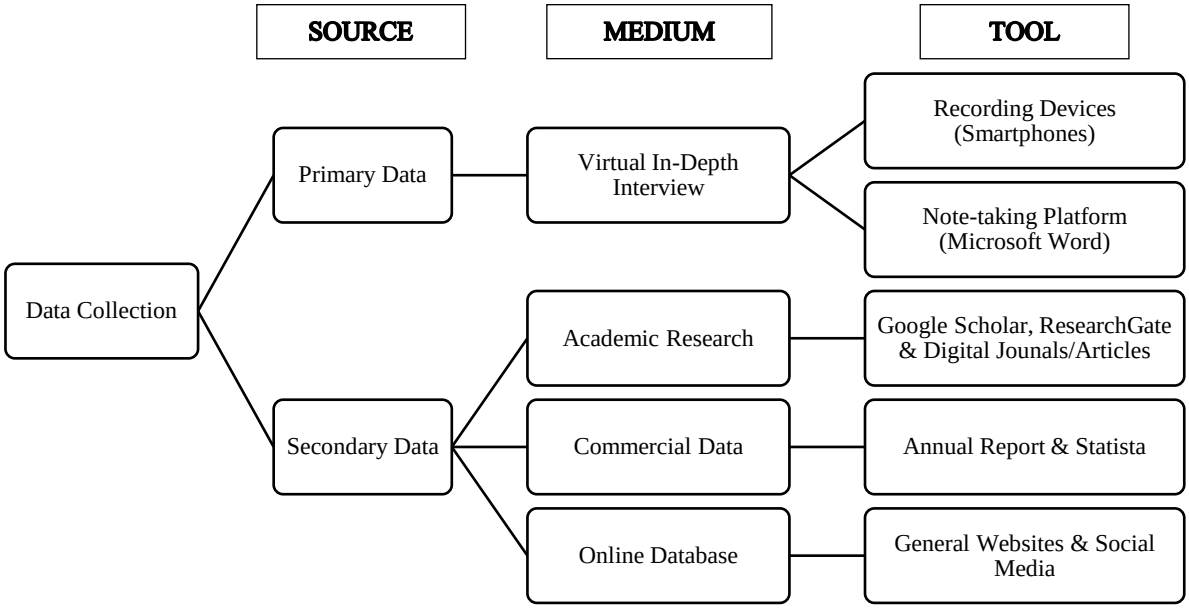



**Figure 1:** Framework for research data collection.

**Table 4:** Research data analysis framework.

| No. | Research Questions | Statements/ Quotations | Keywords | Codes | Themes |
|---|---|---|---|---|---|
| **1.** | What developmental stages are involved in producing halal cosmetic | "We will not use materials that have been banned worldwide because we prioritize consumer safety." | - Raw materials<br>- Halal standards<br>- Safety<br>- Sourcing | - Sourcing Raw Materials<br>- Regulations Compliance<br>- Ethical Sourcing | Rigorous Raw Material Sourcing |

| | | | | | |
|---|---|---|---|---|---|
| | products using natural ingredients in the laboratory? | "The laboratory has extracted most local herbs to isolate bioactive compounds." | - Extraction<br>- Bioactive compounds<br>- Technologies | - Extraction Methods<br>- Standardization<br>- Bioactive Screening | Advanced Extraction Techniques |
| | | "We always ensure the products are safe for consumers by conducting several tests." | - Safety evaluation<br>- Toxicology<br>- Efficacy | - Safety Testing<br>- Claim Substantiation<br>- Efficacy Testing | Safety and Efficacy Testing |
| | | "The product will be manufactured according to the formulation made." | - Product development<br>- Manufacturing<br>- Quality control | - Product Formulation<br>- Quality Assurance<br>- Traceability | Product Development and Manufacturing |
| | | "We ensure that all claims on a product's labeling and marketing materials are accurate, truthful, and comply with relevant regulations." | - Compliance<br>- Regulations<br>- Halal certification | - Regulatory Framework<br>- Documentation and Records<br>- Halal Certification Process | Regulatory Compliance |
| **2.** | Have any issues arise during the development of halal cosmetic products using natural ingredients in the laboratory? | "We are currently facing challenges related to raw materials." | - Supply chain<br>- Halal certification<br>- Sourcing issues | - Supply Reliability<br>- Quality Control<br>- Market Demand | Sourcing Raw Materials |
| | | "We cannot meet client demands for products that require compression techniques, such as compact powder, blush, and eyeshadow." | - Technology<br>- Equipment limitations<br>- Production capacity | - Machine Limitations<br>- Production Efficiency<br>- Maintenance Challenges | Technological Constraints |

stability, claims are substantiated, and finally, the end products are manufactured (28).

*3.1.1 Raw materials sourcing and screening*

This stage was the first process in developing halal cosmetics. The process is shown in Figure 2.

Based on Informant 2's statement, the product development process at the laboratory begins with brainstorming the project's concept, where researchers define the product type, such as a cleanser, serum, or foundation, and determine its functional purpose, such as anti-aging, moisturizing, or skin-brightening. Additionally, laboratory researchers consider the product's texture and select suitable materials that meet the project's requirements. Not only that, the target users also will be identified to ensure it is tallied with the project's goals.

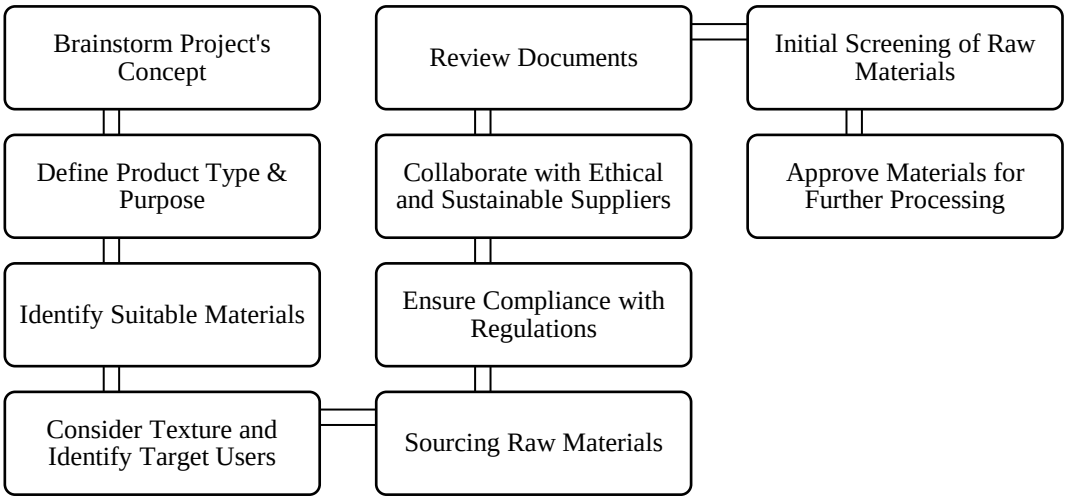
The laboratory is responsible for sourcing raw materials that are safe, effective, high-quality, and meet halal standards. This requires ensuring that no banned substances are used, whether the bans are in Malaysia or internationally. As Informant 1 explained, "We will not use materials that have been banned worldwide, even if Malaysia has not banned them, because we prioritize consumer safety." To meet these standards, the laboratory ensures that all raw materials comply with regulations set by NPRA under

the Ministry of Health (KKM) and JAKIM (29). Other than permitted substances by NPRA that can be referred to in Clause 3.3 (30), the company also focused on discovering new active ingredients with medicinal properties or therapeutic benefits over synthetic ones, using mainly herbs and botanicals in its cosmetic products (28, 31).

To ensure regulatory compliance, the laboratory collaborates with ethical and sustainable suppliers who provide high-quality, traceable plant materials. According to Informant 1 statement, the selection of these suppliers is based on the completeness and validity of all documents related to raw material safety and halal compliance. In addition, suppliers must meet the project's requirements and adhere to guidelines outlined in MS 2634:2019 and NPRA regulations such as all materials used in the manufacturing of halal cosmetics shall comply with the halal requirements as materials may be from synthetically or naturally derived sources (1). The laboratory verifies this by reviewing documents such as the supplier's halal certificate, Certification of Analysis (COA), Material Safety Data Sheet (MSDS), and invoice. This process also occurs when raw materials are received from the supplier (32).

The initial screening of raw materials begins with preliminary tests to assess their quality and suitability for extraction. At this stage, the laboratory evaluates the materials for purity, potency, and the presence of any contaminants or harmful substances. This process ensures that all raw materials are both halal and safe for use. Specifically, tests are conducted to detect contaminants such as pesticides, heavy metals, and microbial load. Only materials that meet these strict standards move on to the next phase. This approach aligns with the guideline that requires samples of raw materials to be physically inspected for compliance with specifications before being approved for use (33).

**Figure 2:** Raw materials sourcing and screening process.



*3.1.2 Extraction and Standardization*

Extraction involves using specific solvents and a systematic procedure to isolate the medically active mixture of natural chemicals found in plant tissues (34). According to Informant 2, the laboratory employs advanced extraction technologies to selectively isolate bioactive compounds from plants. Their expertise includes various methods such as solvent extraction, aqueous extraction, and supercritical fluid extraction (SFE) (17). The choice of extraction method depends on the selected herbs or ingredients. For instance, the laboratory has used a variety of herbal waste materials with strong antioxidant and antifungal qualities to perform solvent and aqueous extraction. The skin of rambutans is one of them (14).

The process begins by cleaning, drying, and cutting the raw materials as needed. Depending on the plant type, the materials are then processed into suitable forms—such as puree for fruits like pineapple or powder for leaves like *Syzygium aqueum* (water guava) (32, 35). Each type of raw material, whether puree, juice, dregs, or other parts, undergoes extraction to isolate its active ingredients. Each raw material extract production has its certificate of analysis for quality, safety, and standard reference in terms of its chemical profile, biological, and enzyme activity. There are three main types of extraction: liquid/solid, liquid/liquid, and acid/base. The extraction method considers factors like the type of plant material, the solvent used, extraction time, particle size, and stirring. Common extraction techniques include solvent extraction, distillation, pressing, and sublimation, with solvent extraction being the most widely used (34).

Following extraction, the bioactive compounds are purified and isolated from other components like sugars, fats, and secondary metabolites (34). Standardization ensures a consistent concentration of phytochemicals in the final extract. For example, in a study by Palanisamy et al. (2011) (35), the high-performance liquid chromatography (HPLC) method was used to standardize the *Syzygium aqueum* extract. Ensuring batch-to-batch consistency is crucial for product efficacy and safety, which involves adjusting the process to maintain the same concentration of bioactive ingredients in each batch (36). Formulators also conduct standardization, profiling, and bioactive identification based on the Ministry of Agriculture's Herbal Monograph (MOA) (17).

*3.1.3 Bioactivity screening*

The laboratory uses advanced extraction technologies to selectively isolate potent bioactive compounds from plants, which are then carefully evaluated for safety and incorporated into cosmeceutical formulations. The main goals in developing effective cosmetic products at the laboratory are achieving high product potency, visible therapeutic effects, and strong skin permeability. To accomplish this, researchers perform thorough bioactivity screening using *in vitro* (laboratory) and *in vivo* (animal or human) assays as shown in Figure 3 to evaluate the biological activity of the natural extracts. This rigorous testing ensures that the laboratory's cosmetic products are not only safe but also provide therapeutic benefits (17).

According to Informant 2, formulators of the laboratory conduct biological testing at this stage to assess the bioactivity of the extracted compounds. They evaluate properties such as antioxidant, anti-inflammatory, and antimicrobial activities, as well as other cosmetic benefits. This testing is crucial to ensure that the product meets the expected

standards and serves as evidence to support the product's claims later. Laboratory tests (*in vitro*) help to understand the extracts' mechanisms of action and efficacy.

For example, antioxidant activity is tested using assays like 2,2-diphenyl-1-picrylhydrazyl (DPPH) or 2,2′-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) (ABTS), while anti-inflammatory activity is assessed using cytokine inhibition assays. These methods were used in a study by Palanisamy *et al.* (2011) (35), which focused on the antioxidant assay of *Syzygium aqueum* extract. If necessary, animal (*in vivo*) studies are conducted to further assess the safety and effectiveness of the compounds before human trials. This includes testing for skin irritation, sensitization, and overall toxicity. This approach helps to validate the claims and demonstrate the real-world effectiveness of their cosmetic products.

### *3.1.4 Safety evaluation*

At this stage, toxicology assessments are conducted to ensure the extracts are safe for use in cosmetic products. The laboratory's researchers and formulators carry out comprehensive safety evaluations to ensure the products are safe for consumers (12). The examples are listed in Figure 4. Key tests that will be conducted can be referred to in Figure 5 including (16, 17):

1. **Microbiology Test:** Ensures the product is free from microbial contamination and checks the effectiveness of preservatives in extending the product's shelf life.
2. **Heavy Metal Test:** Verifies the absence of harmful heavy metals, such as cadmium, mercury, lead, and arsenic.
3. **Skin and Eye Irritation Test:** Ensures that the product does not cause irritation or discomfort to the skin or eyes.

It also helps validate the product's safety claims. This test checks for prohibited substances like hydroquinone, azelaic acid, retinoic acid (tretinoin), steroids, colorants, and preservatives. Based on information from Informant 2, safety tests are carried out following the guidelines set by NPRA, KKM, JAKIM, and other relevant regulatory bodies. The laboratory compiles and organizes all documentation related to safety tests and toxicology assessments to facilitate the product development process and regulatory submission.

### *3.1.5 Product development*

This stage focuses on creating and testing new cosmetic formulations. The process is shown in Figure 7 below. The laboratory also works on bioactive delivery technologies where it is crucial to ensure that ingredients like antioxidants, anti-aging compounds, or even drugs perform effectively and safely (17). Scientists and chemists at the laboratory develop product formulas that meet safety, efficacy, and halal standards. First, they design the formulation Informant 1 mentioned that the formulator combines standardized extracts with other functional ingredients as shown in Figure 7 which to achieve desired characteristics, such as texture, absorption, and stability. Essentially, they are developing formulations that include biologically active ingredients extracted earlier, considering factors like ingredient compatibility, stability, and consumer preferences.

Next, the formulator creates prototypes and conducts preliminary tests to evaluate performance. Based on test results and feedback, they refine the formulations repeatedly to optimize effectiveness and sensory qualities. Informant 2 mentioned that sensory evaluations, such as texture, scent, and appearance, will be conducted at this


**Figure 3:** Examples of bioactivity screening process

| | | |
|---|---|---|
| 3T3 NRU Cytotoxicity Study | Heavy Metal Test (Arsenic, Lead, Mercury) | *In vitro* & *in chemical* Skin Sensitization Test |
| *In vitro* Eye Irritation Test | *In vitro* Skin Corrosion Test | *In vitro* Skin Irritation Test |
| *In vitro* Skin Pigmentation Test | Microbiological Evaluation (Bioburden) | Parabens, Prohibited Colourants |
| Prohibited Substance (Hydroquinone, Tretinoin) | Retinoic Acid (Tretinoin) | Steroids (Hydrocortisone) |
| | UV Filters | |

**Figure 4:** Examples of safety and biocompatibility evaluations.



| Logam Berat | Had maksimum dibenarkan (ppm)* |
|---|---|
| Cadmium | - |
| Mercury | < 0.5 |
| Lead | < 10 |
| Arsenic | < 5 |

**Figure 5:** Examples of safety evaluation process.

stage, and the product will be shown to the client for feedback. This process may be repeated up to three times until the client is satisfied and the product meets their

standards. Once the trial product is approved, the process moves on to stability testing and eventual production. Each raw material in the formulation is tested for quality and compatibility using techniques like spectroscopy, chromatography, and microbiological testing to ensure they meet the required standards. This step ensures that no ingredients compromise the product's quality or safety.

*3.1.6 Stability evaluation*

After the product is developed, the laboratory conducts stability testing to assess how it behaves under different environmental conditions. According to Informant 2, critical stability tests are performed, including organoleptic tests, which evaluate appearance, color, and odor. In addition, physical and chemical tests, such as pH, viscosity, and water content are conducted to ensure the product maintains its effectiveness. This testing process typically takes about three months, but if this test fails repeatedly, then the product will be tested until it passes and must reach the specified specifications. Informant 2 also mentioned that during this stage, microbiology tests are repeated to ensure the product remains safe throughout its shelf life, which is generally between 2 to 3 years. Stability testing is crucial to ensure that the product remains stable and safe for at least two years in the market (32). At this point, manufacturers also test the packaging materials for compatibility. Informant 2 explained that the laboratory clients provide the packaging and labeling, including design preferences and packaging type. The laboratory staff offers guidance on choosing suitable materials that will protect the product and maintain its quality over time. With this expert advice, clients can select packaging that ensures the product's integrity throughout its shelf life.

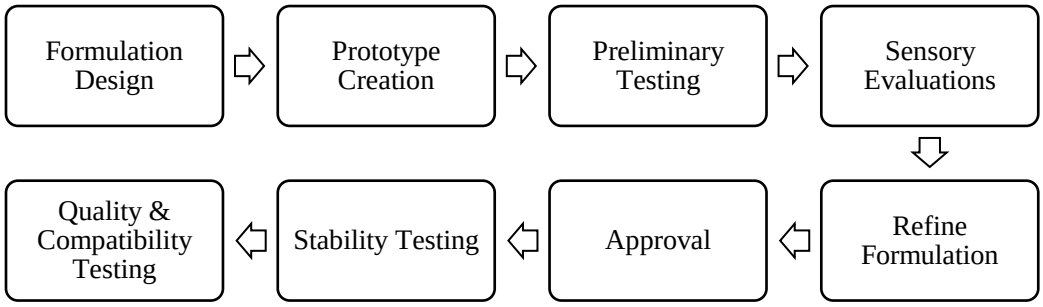



**Figure 6:** Step-by-step workflow for halal cosmetic product development.

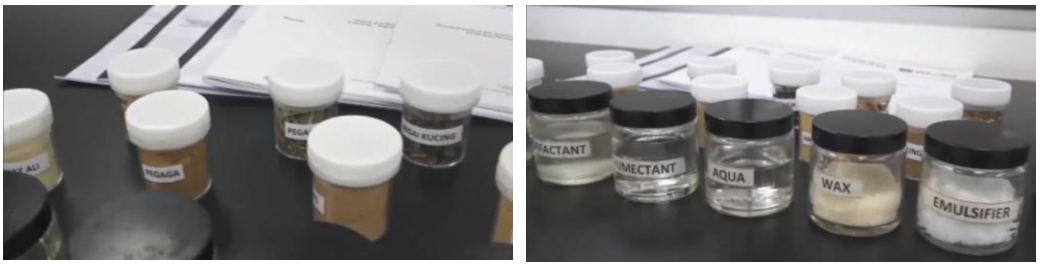



**Figure 7:** Examples of ingredients and preservatives used during design the formulation.

*3.1.7 Claim substantiation*

To validate the product's claims, efficacy testing is conducted. This can involve both *in vitro* and *in vivo* studies to scientifically prove the benefits, such as anti-aging, moisturizing, or brightening effects. Clinical trials and consumer studies are also used to gather evidence supporting the product's performance. At the laboratory, *in vivo* efficacy tests are performed directly on volunteers. According to Informant 1 and Informant 2, these tests are often conducted on the organization's staff as volunteers. Informant 1 explained that the selection of volunteers depends on the type of test and the product being developed. For instance, an effectiveness test for skin-lightening products requires volunteers with issues like uneven skin tone or dull facial skin. The criteria for selecting volunteers are primarily based on studies, research, and relevant guidelines set by the authorities.

In this session, the main aspects they will assess include skin lightening, hydration, elasticity, anti-cellulite effects, and pH levels using skin topography equipment as shown in Figure 8. The skin topography machine is used for visual scanning to measure wrinkles, sagging, peeling, pores, and other skin features (16). The surface of the skin is typically characterized by furrows and plateaus, which define its topography (37). The test starts with a skin screening of the volunteer, followed by a recommendation of a trial product suitable for their skin type. Over 8 weeks, volunteers will undergo facial tests either once a week or every two weeks to track changes in their skin condition after using the product. The goal is to determine whether the product is effective as claimed. For example, if the product claims to lighten the skin, it should show noticeable results in improving skin tone after regular use (16). The laboratory guarantees that all claims on a product's labeling and marketing materials are accurate, truthful, and compliant with relevant regulations, even if the client created the labeling. Before the product is marketed, the laboratory reviews all content and statements on the label. This is important because cosmetic products should not use names or claims that suggest medicinal properties or go beyond the scope of cosmetics (30). For example, skin products cannot claim to 'heal,' 'treat,' or 'stop' acne, as these terms imply medicinal effects. Instead, they should use terms like 'prevent,' 'control,' or 'reduce' acne or breakouts to stay within the scope of cosmetic claims (38). The laboratory helps clients evaluate claims like anti-aging, anti-inflammatory, antioxidant, skin lightening, and efficacy (such as cell-based assays for skin lightening).

The laboratory also documents the substantiation process and keeps records to support these claims in case of regulatory


**Figure 8:** Efficacy test using skin topography machine

inspection. Additionally, clients must apply for product notification, which can be done online following the Guidelines for Control of Cosmetic Products in Malaysia. After notification, clients must provide a valid NOT number, formatted as NOTyymmxxxxxK (where 'y' is the year, 'm' is the month, and 'x' is the serial number) (30). If a client wishes to obtain halal certification for their product, they must apply online for a halal certificate through MYeHALAL (39). All registration requirements are outlined in the MPPHM (Domestic) 2020 guidelines. While clients are responsible for completing company documentation such as the *Pihak Berkuasa Tempatan* (PBT) license and company information, the laboratory will provide product-related information and details about the organization's GMP factory, as noted by Informant 2.

The Guidelines for Control of Cosmetic Products in Malaysia, Part IX, Article 41 (3), outline the conditions for using the Malaysian halal logo (30). Furthermore, the organization has specific guidelines for using its name and logo. According to Othman, M. N. (16), the organization's logo cannot be displayed or printed on products, even if the product was formulated and underwent safety testing in the laboratory. The organization's logo cannot be used in any product marketing. The only acceptable label for products formulated by the laboratory is "Formulated by an industrial research and technology organization."

*3.1.8 Product Manufacturing*

The process flow of product manufacturing, as shown in Figure 9, begins with the inspection of raw materials. In producing halal cosmetic products, comprehensive product analysis is crucial to ensure safety, quality, and compliance with halal standards. Every batch of raw materials undergoes a detailed inspection to verify both its quality and halal status. This includes ensuring that the materials are free from contamination, particularly with non-halal substances, and that they meet the necessary standards for cosmetic production. Records are maintained for each batch to guarantee full traceability, in line with the Association of Southeast Asian Nations (ASEAN) Guidelines for Cosmetic GMP. These guidelines require that each delivery be checked against relevant documentation and physically verified for label description, type, and quantity, with a careful inspection for any defects or damage (33).

Transportation also plays a critical role in maintaining the halal integrity of the products. JAKIM mandates that transportation used for halal materials must be kept clean, controlled, and used exclusively for halal raw materials and products to prevent contamination (39). Proper documentation of transportation inspections ensures compliance with these requirements. After that, the materials are carefully weighed using a calibrated scale to ensure precise measurements. Temperature control during production is crucial, as it greatly affects the final product's quality. The materials are mixed in a specific order at an exact temperature to achieve optimal results. After production, an Internal Process Quality Check (IPQC) is performed to confirm the product meets the required standards (40).

Once raw materials are verified, rigorous testing is conducted on product samples to confirm consistency, potency, and safety. According to Informant 2, these tests include (40):

1. **pH Level**: Ensuring the product's pH is between 5.0 and 7.0, which is crucial for maintaining product stability and skin compatibility.

2. **Viscosity**: Measuring the product's thickness to ensure the desired texture.

3. **Microbial Content**: Testing for harmful microorganisms to ensure consumer safety.

4. **Color Evaluation**: Verifying consistency in appearance to meet quality standards.

The testing process, which can take up to three days, is meticulously documented. Any batches that do not meet the required standards are addressed to ensure that only quality products proceed.

After testing, each product is labeled and assigned a unique code as shown in Figure 10, enabling traceability throughout the halal supply chain. This coding system allows for easy identification and quick action in case of any issues. Traceability involves tracking the product from raw material reception to processing, storage, and distribution. According to JAKIM guidelines, combining traceability with other tracking systems can streamline product recall or withdrawal processes in case of non-compliance or contamination (41). These measures ensure that halal cosmetic products maintain their halal status and consistently meet high standards of safety and quality.

*3.2 Arising issues in developing halal cosmetic products using natural ingredients in the laboratory*

The laboratory faces challenges in developing halal cosmetic products using natural ingredients. Informants highlighted two main issues: sourcing raw materials and technological constraints.

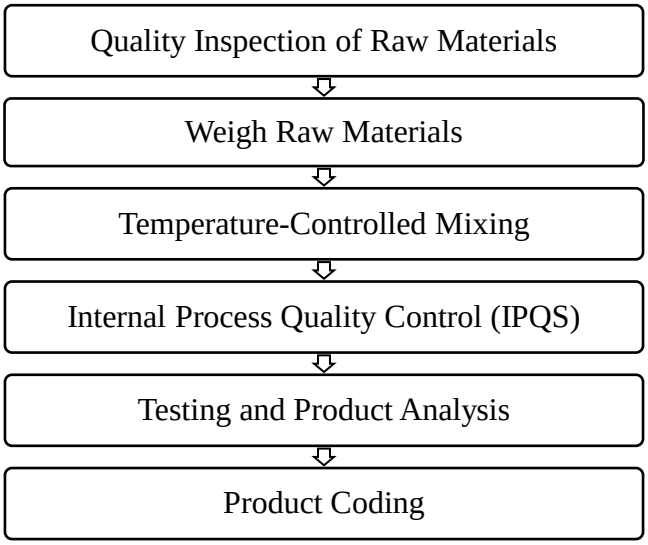



**Figure 9:** Structured workflow for the product manufacturing process.


**Figure 10:** Overview of temperature-controlled mixing processes and bottling of the halal cosmetics in the laboratory.

*3.2.1 Sourcing raw materials*

Raw materials refer to any primary or secondary ingredients, including processing aids, used in manufacturing (39). Informants 1 and 2 reported that the laboratory is facing challenges with raw materials. This issue is complex, as it involves multiple parties, including suppliers, clients, researchers/ formulators, and employees at the factory. Previously, the laboratory struggled to find halal raw materials due to the limited number of local suppliers with Halal certification or evidence confirming the halal status of their products. However, with growing awareness of the importance of halal standards in the industry and halal's global recognition, it has become easier for the laboratory to source halal raw materials.

After a significant incident, Informant 1 shared that the laboratory had been struggling to source raw materials, a major concern as it directly impacted customer demands and product manufacturing. When products failed to meet market expectations, some suppliers hesitated and stop to provide materials without consistent demand. When this occurs, they must find a new supplier that meets their specifications and can consistently deliver raw materials, regardless of order duration or frequency. This search process can be challenging, especially when the new supplier's materials may have the same International Nomenclature Cosmetic Ingredient (INCI) name but do not meet the required quality. This affects the laboratory's ability to maintain consistent product quality, raising concerns for their clients.

Additionally, when the laboratory needs to change a raw material, the product's R&D process must start from scratch, increasing the workload. If the current supplier cannot continue providing the necessary materials, the laboratory seeks a reliable new supplier or a substitute with the same specifications and requirements. However, if the required raw material is completely unavailable, they must wait until a suitable supplier is found. Stockpiling raw materials to prevent shortages is not a viable option, as excess materials may expire and lead to waste. To maintain product quality, the laboratory regularly consults with clients and seeks their approval if there are any changes, including adjustments to the raw material specifications.

*3.2.2 Technological constraint*

The term 'technology' refers to tools, procedures, and systems designed to improve various aspects of life, such as entertainment, healthcare, communication, and transportation. It involves applying scientific knowledge for practical purposes, particularly in the workplace (42). Regarding this, Informant 1 and Informant 2 reported issues related to machine limitations. While they have enough machines and equipment to process current cosmetic products, they cannot meet client demands for products that require compression techniques, such as compact powder, blush, and eyeshadow. Additionally, they are unable to produce perfume-type and waterless-type products. Despite their determination to follow industry trends, their progress is restricted, not by the researchers' skills, but by the lack of the necessary machines.

Informant 1 and Informant 2 also pointed out the challenge of having a limited amount of equipment. Overusing a single machine can lead to faster wear and tear, affecting production both in the lab and the factory. This creates challenges for the maintenance team and disrupts project budgets due to increased repair costs. The time required to fix a damaged machine depends on the type of machine and the extent of the damage. In severe cases, parts may need to be replaced if repairs are not possible. Furthermore, machine-related issues

arise when researchers conduct Color Spectro tests on products. Normally, they rely on this equipment for accurate data, but when the Color Spectro machine broke down, they had to perform the test manually through visual observation. To address this, the laboratory-adapted by relying on manual methods until repairs could be made.

During our discussion, Informant 2 emphasized the importance of regular maintenance for all machinery and equipment. She pointed out the necessity of close coordination between the research, production, and maintenance teams. She also highlighted the importance of following the guidelines in Cosmetic GMP and MS 2634:2019, which include regular cleaning and maintenance of equipment. By adhering to these standards, they help ensure the safety and longevity of the machines used in their operations as highlighted by authorities.

## 4.0 Conclusion

The objectives of this research were successfully met through in-depth interviews with two cosmetic researchers at an industrial research and technology organization. The study provides a thorough analysis of the development process for halal cosmetic products in the selected research center laboratory. This process includes key stages such as sourcing and processing raw materials, extracting, and standardizing substances, screening for bioactivity, and assessing initial safety. Subsequent phases involve evaluating product stability, substantiating claims, and eventually manufacturing the final products. The findings reveal several challenges in developing halal cosmetic products at the laboratory, including limited local halal suppliers, difficulty in finding a new halal supplier, availability of raw materials, machine limitations, and maintenance challenges. These challenges underscore the need for greater investment in research, infrastructure, and supplier networks to support the growing demand for halal cosmetics.

However, this study faced limitations, particularly time constraints, which prevented deeper analysis of additional factors such as consumer perceptions and long-term market trends. Furthermore, there was limited available literature and sample data. Future research with more time and resources could explore these areas, helping to inform industry best practices, consumer behavior, and the broader market impact of halal certification. Collaboration between regulatory bodies, industry players, and academic institutions will also be essential for driving innovation and addressing the current barriers to halal product development. This study is anticipated to serve as a valuable reference for individuals in the cosmetics sector, including academicians, stakeholders, and future researchers seeking knowledge about research laboratory processes. By shedding light on the challenges and opportunities in developing halal cosmetics, it provides a foundation for further exploration and improvements in the industry.

## Authorship contribution statement

**NH**: Conceptualization, Investigation, Methodology, Resources, Visualization, Writing – original draft, review & editing; **SYZ**: Visualization, Methodology, Supervision, Writing – review & editing.

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## Conflict of Interest

The authors declared that they have no conflicts of interest to disclose.

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