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ISLAMIC ETHICS AND APPLIED SCIENCE PERSPECTIVES ON ECO-CONSCIOUS ALTERNATIVES TO MICROPLASTIC-BASED COSMETICS: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

Microplastics are widely used in cosmetic formulations for their functional properties but have raised serious environmental and potential human health concerns. These issues are increasingly relevant in Muslim markets, where expectations extend beyond halal compliance to include safety and environmental responsibility. Islamic ethical principles such as *khilafah* (stewardship), *amanah* (trust), and *maslahah* (public interest) provide a framework that integrates ritual permissibility with ecological accountability. This study

employed a systematic literature review guided by PRISMA 2020 to examine eco-conscious alternatives to microplastic-based cosmetics within an Islamic ethics and applied science perspective. Searches were conducted in Web of Science and Scopus, yielding 15 peer-reviewed studies based on predefined inclusion criteria. Findings show that biodegradable materials such as plant-derived cellulose, chitosan-based particles, seaweed polymers, and natural waxes can effectively replace microplastics while offering improved biodegradability and reduced environmental impact. Islamic ethical literature further supports the preference for products that are *tayyib*, safe, and environmentally responsible. The study highlights convergence between Islamic ethics and applied cosmetic science in advancing sustainable cosmetic innovation.

Keywords: microplastics, eco-conscious cosmetics, biodegradable ingredients, sustainable development, halal cosmetics

INTRODUCTION

The cosmetic industry has increasingly come under scrutiny due to its reliance on microplastic ingredients such as polyethylene microbeads, which are widely used to enhance texture, stability, and exfoliating performance. These particles are not effectively removed through conventional wastewater treatment and subsequently enter aquatic environments, where they persist, accumulate, and contribute to long-term environmental pollution. Microplastics have been widely detected in marine ecosystems, rivers, and even drinking water sources, raising concerns about ecosystem disruption, bioaccumulation of toxic substances, and potential human exposure through the food chain (UNEP, 2021; WHO, 2019). These environmental consequences highlight that technological solutions and regulatory bans alone are insufficient, and

that more fundamental shifts in product design, consumption patterns, and ethical values are required.

In response to these concerns, scientific research has introduced a range of biodegradable and bio-based alternatives to microplastics in cosmetic formulations. Materials such as plant-derived cellulose particles, chitosan-based microspheres, seaweed-derived polymers, and natural waxes have demonstrated comparable functional performance in exfoliation and product stability while offering significantly lower environmental impact (Rochman et al., 2019; Nasser, Sharma & Kaur, 2024). At the same time, global consumer awareness is shifting toward safer, cleaner, and more environmentally responsible cosmetic products. This shift is particularly evident in the expanding halal cosmetics market, where Muslim consumers increasingly expect products that align not only with halal requirements but also with the broader concept of *halalan tayyiban*, encompassing purity, safety, and ethical responsibility (Wilson & Liu, 2011; Kamali, 2013; Ma'wa et al., 2023).

Within this context, Islamic ethical principles provide a meaningful framework for guiding sustainable cosmetic practices. Concepts such as *kehilafah* (stewardship), *amanah* (trust), *maslahah* (public interest), and *lā ḍarar wa lā dirār* (no harm and no reciprocating harm) emphasise environmental responsibility as both a moral and practical obligation. These principles reinforce the idea that cosmetic products should not only be permissible in composition but also beneficial and non-harmful to humans and the environment. Thus, sustainability in cosmetics can be understood as part of a broader ethical duty grounded in the Islamic worldview (Kamali, 2013; Ambo et al., 2025).

Despite advances in both scientific innovation and halal market development, a significant gap remains in integrating Islamic ethics with environmental and material science perspectives in cosmetic research. While studies on microplastics and biodegradable alternatives are expanding, limited attention has been given to how Islamic ethical frameworks can inform and strengthen the transition toward eco-conscious cosmetic ingredients. This disconnect suggests that

sustainability discourse in Muslim-majority contexts has not yet fully leveraged religious-ethical resources that could enhance both consumer awareness and industry transformation (Ambo et al., 2025).

Therefore, this study aims to address this gap by systematically reviewing existing literature on microplastic-based cosmetics, biodegradable alternatives, and Islamic ethical principles. By integrating scientific findings with ethical analysis, the study seeks to provide a more holistic understanding of sustainable cosmetic development. In doing so, it contributes to bridging applied science and Islamic ethics, supporting the advancement of eco-conscious cosmetic practices that are scientifically sound, ethically grounded, and aligned with the principles of *halalan tayyiban*.

METHODOLOGY

This study adopted a systematic literature review (SLR) methodology following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines. The review was designed to examine the environmental and health implications of microplastic-based cosmetic ingredients, explore eco-conscious and biodegradable alternatives, and analyse Islamic ethical principles related to sustainability in cosmetics, based on the four research questions (RQ) below:

RQ1: Environmental and health implications of microplastic-based cosmetic ingredients

RQ2: Eco-conscious and biodegradable alternatives to microplastic-based cosmetic ingredients

RQ3: Islamic ethical principles relevant to eco-conscious cosmetic practices

RQ4: Integration of Islamic ethics with eco-conscious cosmetics and consumer behaviour

The literature search was conducted in two major databases, namely Web of Science (WoS) and Scopus, using the search strategy presented in Table

1. The search covered publications from 2020 to 2025 to capture recent developments in microplastic pollution, biodegradable cosmetic materials, and Islamic environmental ethics. Inclusion and exclusion criteria were defined in advance to ensure transparency and reduce selection bias, as shown in Table 2. A Three-Pillar Modular Logic approach was applied to integrate technical, environmental, and ethical keywords, ensuring comprehensive yet focused retrieval of relevant studies. The review followed three phases, namely planning, conducting, and reporting as illustrated in the PRISMA flow diagram in Figure 1.

Table 1: Search strategy for systematic review process.

Database	Search Strategy
Scopus	TITLE-ABS-KEY=((("cosmetic*" OR "personal care" OR "scrub*") AND ("microplastic*" OR "microbead*" OR "microparticle*") AND ("biodegradab*" OR "alternative*" OR "green" OR "clean" OR "free"))) OR TITLE-ABS-KEY(("Islamic perspective" OR "Islamic ethics" OR "Islamic framework") AND ("environmental sustainability" OR "environmental protection" OR "sustainable development")) OR TITLE-ABS-KEY(("halal" OR "toyyib*" OR "tayyib*") AND "cosmetic*" AND ("environment*" OR "sustainab*"))
Web of Science	TS=((("cosmetic*" OR "personal care" OR "scrub*") AND ("microplastic*" OR "microbead*" OR "microparticle*") AND ("biodegradab*" OR "alternative*" OR "green" OR "clean" OR "free"))) OR TS=((("Islamic perspective" OR "Islamic ethics" OR "Islamic framework") AND ("environmental sustainability" OR "environmental protection" OR "sustainable development")) OR TS=(("halal" OR "toyyib*" OR "tayyib*") AND "cosmetic*" AND ("environment*" OR "sustainab*"))

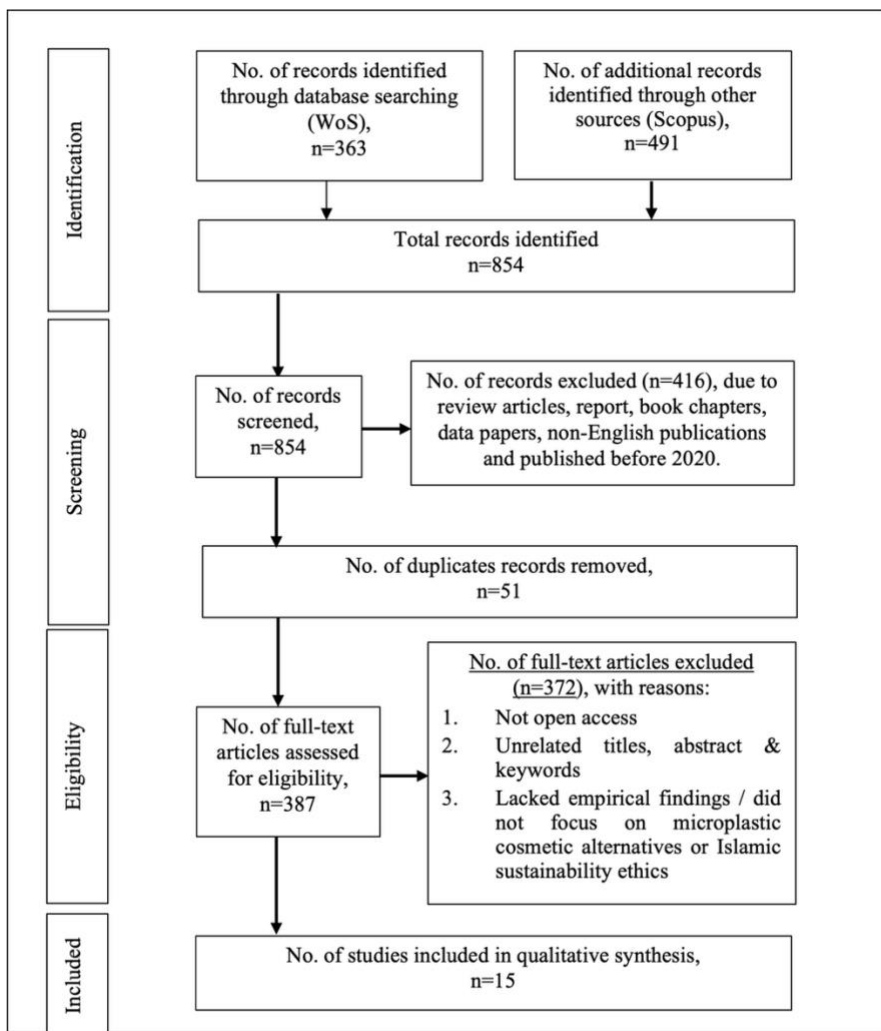


Figure 1: Flow of information through the different phases of a systematic review (Adapted from Nordin et. al., 2021).

Table 2: The inclusion and exclusion criteria.

Criteria	Inclusion	Exclusion
Time duration	Published between 2020 to 2025	Published before 2020
Language	English	Non-Engl
Document Type	Peer-reviewed journal articles, proceeding papers and conference papers	Review articles, reports, book chapters, data papers and non-academic sources

A total of 854 records were initially identified (WoS = 363; Scopus = 491). After removing 51 duplicates, 803 records were screened based on titles and abstracts, resulting in the exclusion of 416 irrelevant records. The remaining 387 full-text articles were assessed for eligibility, during which 372 were excluded due to irrelevance to cosmetic microplastics, biodegradable alternatives, or Islamic ethical frameworks, or due to a non-empirical focus. Ultimately, 15 studies met all inclusion criteria and were included in the final analysis. Data extraction was conducted using a structured table capturing authorship, methodology, and key findings, with studies categorised according to the four research questions covering environmental impacts, alternative materials, Islamic ethics, and consumer behaviour.

Data analysis employed descriptive and thematic synthesis approaches due to heterogeneity in study designs. Studies were first mapped according to methodological type and thematic focus, distinguishing laboratory analyses of microplastic impacts, experimental studies on biodegradable alternatives, conceptual discussions on Islamic ethical principles such as *kebilafah*, *amanah*, *maslahah*, and *lā ḍarar wa lā dirār*, and empirical studies on consumer behaviour. Thematic synthesis identified key patterns across the four RQs, focusing on environmental harm from microplastics, effectiveness of bio-based alternatives, ethical grounding in Islamic environmental thought, and consumer demand for halal and sustainable

cosmetics. The findings were synthesised into an integrated narrative linking scientific evidence with Islamic ethical perspectives in eco-conscious cosmetic development.

RESULTS

This review is organised into five main sections. The first section presents the general characteristics of the included studies, including publication year, research context, study design, and thematic focus. The subsequent four sections are structured according to the four research questions (RQs), namely environmental and health impacts of microplastic-based cosmetic ingredients, developments in eco-conscious and biodegradable alternatives, relevant Islamic ethical principles, and the integration of Islamic ethics with eco-conscious cosmetic practices and consumer behaviour. This organisation ensures that the findings are systematically aligned with each RQ, while also facilitating a coherent synthesis of scientific evidence and Islamic ethical perspectives across the reviewed literature.

Descriptive Characteristics of Included Studies

The 15 included studies are summarized and tabulated in Table 3, showing a relatively balanced distribution across the four research questions, with a slightly greater emphasis on microplastic impacts and eco-conscious alternatives (RQ1–RQ2) compared to Islamic ethical frameworks and consumer behaviour (RQ3–RQ4). In terms of methodological orientation, RQ1 and RQ2 studies predominantly employ experimental approaches and product-based analyses, while RQ3 studies are mainly conceptual or normative in nature, focusing on Islamic ethical principles. In contrast, RQ4 studies primarily adopt survey-based designs to examine consumer perceptions and behavioural responses related to halal and sustainable cosmetic products.

The included studies span the period from 2020 to 2025, with a clear concentration of publications from 2024 until 2025, reflecting the recent acceleration of research on microplastics, biodegradable cosmetic alternatives, and halal-oriented sustainability discourse. Geographically,

the studies represent a diverse but uneven distribution, including contributions from Vietnam, Malaysia, Indonesia, the United Arab Emirates, and several international collaborations. This indicates growing regional interest in the subject, particularly within Muslim-majority contexts, while also highlighting gaps in representation from other relevant regions.

RQ1: Environmental and Health Implications of Microplastic-Based Cosmetic Ingredients

This review identified five studies (Dung et al., 2024; Rahim et al., 2022; Bikiaris et al., 2024; Habib et al., 2022; Goh et al., 2025) that examined the environmental and health implications of microplastic-based cosmetic ingredients. Overall, the evidence consistently shows that personal care and cosmetic products are a direct and significant source of microplastic emissions into aquatic environments. This section is organised into three key themes: (a) quantification of microplastic emissions from cosmetic use, (b) biological and toxicological impacts on aquatic organisms and food chains, and (c) regulatory gaps and continued market presence of microplastic-containing products.

In terms of emission magnitude, Dung et al. (2024) provide strong empirical evidence that cosmetic exfoliating products are a major contributor to microplastic pollution. Their analysis of commercial facial scrubs found between 300 and 900 polyethylene microbeads per gram of product, with a single 5-gram application releasing approximately 1,500 to 4,500 particles per wash. On an annual basis, individual users may release between 45,000 and 135,000 microbeads, while at the urban scale, a city such as Ho Chi Minh could contribute up to 1.08 trillion microbeads annually into wastewater systems. Even after wastewater treatment processes, a substantial proportion of these particles remain in the environment, demonstrating that cosmetic-derived microplastics represent a persistent and non-trivial source of pollution. The study further highlights that these emissions are likely transferable to other urban contexts with similar consumption patterns in Southeast Asia.

Beyond environmental loading, the reviewed studies also demonstrate

significant ecological and biological consequences of microplastic exposure. Rahim et al. (2022), through a synthesis of 47 experimental studies, report multiple adverse effects on aquatic organisms, including stunted growth, reduced fertility, lower survival rates, and increased chemical contamination due to adsorption of toxic substances. These particles also facilitate bioaccumulation and trophic transfer through food chains, raising concerns about seafood safety. Supporting this, Bikiaris et al. (2024) document cellular and molecular-level impacts, including inflammatory responses, altered gene expression, immune disruption, and developmental abnormalities in aquatic organisms exposed to microplastics. Collectively, these findings indicate that microplastics from cosmetics contribute not only to physical pollution but also to biological toxicity, with potential implications for ecosystem health and human food consumption pathways, as tabulated in Table 4.

Table 4: Impact of Cosmetic-Derived Microplastics on Aquatic Organisms

Impact	Description	References
Stunted Growth	Fish and invertebrate larvae exposed to microplastics (size range 10–500 µm) show reduced body length, delayed development and lower overall biomass compared to control groups (median effect size: 15–25% reduction in growth rate).	Rahim et al. (2022)
Reduced Fertility and Reproductive Output	Microplastic ingestion impairs gonad development, reduces gamete production and lowers fecundity in multiple fish and crustacean species; in some cases, treated organisms produced 30–50% fewer offspring than controls.	
Lower Survival Rates	Chronic microplastic exposure increases mortality, particularly in	

	larval and juvenile stages; survival rates in treated groups were 10–40% lower than in controls, depending on microplastic type and concentration.	
Chemical Contamination	Microplastics act as vectors for heavy metals (copper, cadmium, lead, zinc) and persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs), which adsorb to particle surfaces and are released in the organism's digestive system.	
Inflammatory Responses	Microplastics induce inflammatory reactions by stimulating the production of pro-inflammatory cytokines and activating immune signaling pathways. Persistent inflammation can contribute to tissue injury and impaired physiological function.	Bikiaris et al. (2024)
Altered Gene Expression	Exposure to microplastics changes the expression of genes involved in oxidative stress regulation, metabolism, immune responses, apoptosis, reproduction, and developmental processes, indicating disruption of normal cellular functions.	
Immune Disruption	Microplastic exposure impairs immune function by altering immune cell activity, reducing the organism's ability to defend against pathogens, and disturbing	

	immune homeostasis.	
Developmental Abnormalities	Aquatic organisms exposed during embryonic or larval stages may exhibit delayed development, reduced growth, skeletal deformities, impaired organ formation, and lower survival rates.	
Bioaccumulation and trophic transfer	Microplastics accumulate in tissues and organs and can be transferred through the food web, increasing long-term exposure and the potential for cumulative toxic effects across trophic levels.	

At the market level, evidence suggests that microplastic-containing cosmetic products remain widely available despite increasing global awareness. Habib et al. (2022) report that 18 to 22% of exfoliating and cleansing products in the United Arab Emirates still contained microbeads between 2018 and 2020, although a gradual decline was observed over time. The study also highlights the presence of regulatory arbitrage, where products restricted in regions such as Europe continue to be marketed in regions with less stringent enforcement. This regulatory gap is compounded by limited product transparency and labelling issues, which reduce consumer awareness, particularly in Muslim-majority contexts where consumers may assume compliance with safety and halal-related standards.

At a broader environmental scale, Goh et al. (2025) situate cosmetic-derived microplastics within wider regional pollution patterns, showing extensive contamination across Malaysia's marine ecosystems. Their findings indicate the presence of trillions of microplastic particles in coastal waters and sediments, with personal care products identified as one of several contributing sources. Microplastics were detected in a high proportion of fish and shellfish samples, indicating widespread bioaccumulation and ecological penetration. These findings underscore significant risks to marine

biodiversity, fisheries productivity, and food security, particularly in ecologically sensitive and economically important coastal regions. Together, the reviewed studies demonstrate that microplastic-based cosmetics are not an isolated issue but part of a broader systemic environmental challenge requiring both scientific innovation and stronger regulatory and ethical responses.

RQ2: Eco Conscious and Biodegradable Alternatives to Microplastic Based Cosmetic Ingredients

The second research question focuses on the development and effectiveness of eco-conscious and biodegradable alternatives to microplastic-based cosmetic ingredients. This review identified four studies (Klimaszewska et al., 2025; Ju et al., 2021; Selvasudha et al., 2023; Frigerio et al., 2024) that examine plant-derived, marine-based, and wax-based materials as functional replacements for synthetic microplastics in cosmetic formulations. Overall, the evidence indicates that bio-based materials not only replicate the core functional roles of microplastics but, in several cases, provide additional benefits. Plant-derived cellulose particles, for example, demonstrate comparable texture and exfoliating properties to polyethylene beads while also enhancing skin hydration and exhibiting strong biodegradability under wastewater conditions. Similarly, chitosan-derived chito-beads offer mechanical properties similar to microplastics but also show the ability to adsorb heavy metals, effectively adding an environmental remediation function to cosmetic use.

Complementing these findings, marine-derived polymers and natural waxes further demonstrate the technical feasibility of substitution. Seaweed-based polymers such as ulvan have been shown to achieve efficient encapsulation of active ingredients while degrading rapidly in marine environments without detectable toxicity, indicating strong environmental compatibility. In addition, natural wax-based formulations can replace polyethylene waxes in solid cosmetic products such as sticks and balms without compromising melting behaviour, stability, or consumer acceptability, while requiring minimal changes to existing manufacturing processes. Collectively, these studies demonstrate that

plant-derived cellulose, chitosan-based materials, seaweed polymers, and natural waxes can effectively fulfil the functional roles of microplastics, while offering improved biodegradability and reduced ecological impact. This convergence of performance and sustainability supports the technical viability of transitioning toward eco-conscious cosmetic formulations without sacrificing product quality.

RQ3: Islamic Ethical Principles Related to Eco-Conscious Cosmetic Practices

The third research question explores the Islamic ethical principles relevant to eco-conscious cosmetic practices and how these are addressed in the existing literature. This review identified four studies (Yasmeen et al., 2024; Parven, 2024; Putri Aisyah et al., 2025; Zaki et al., 2021) that collectively highlight the strong alignment between Islamic ethics and environmental sustainability in consumption and production practices. Overall, the literature consistently emphasises that Islamic teachings extend beyond ritual permissibility (*halal*) to include environmental responsibility and product wholesomeness (*tayyib*). This section is organised around three key themes: (a) Islamic legal maxims and environmental protection, particularly *lā ḍarar wa lā dirār*, (b) *maqasid al-shari'ah* as a framework for sustainable development and ecological stewardship, and (c) empirical evidence on consumer perceptions of halal and environmental responsibility in cosmetic consumption.

The reviewed literature strongly indicates that Islamic legal maxims and *maqasid al-shari'ah* provide a robust ethical foundation for evaluating environmental harm in cosmetic production and consumption. Yasmeen et al. (2024) argue that the integration of *maqasid al-shari'ah* with sustainability frameworks reinterprets environmental protection as an essential extension of preserving life, intellect, wealth, lineage, and faith. This perspective is reinforced by Qur'anic principles of *khilafah* (stewardship) and prohibition of *israf* (wastefulness), which together position environmental degradation as a violation of human trusteeship. Similarly, Parven (2024) frames environmental responsibility and

sustainable consumption as forms of ibadah (worship), thereby elevating eco-conscious behaviour from a lifestyle choice to a religiously grounded obligation. Putri Aisyah et al. (2025) further highlight that Islamic environmental ethics emphasise harm prevention and resource stewardship as core duties, reinforcing the interpretation that products causing persistent ecological damage cannot be considered fully *tayyib*, even if technically halal. From this perspective, microplastic-based cosmetics are ethically problematic due to their long-term environmental harm, despite their functional permissibility.

In addition, empirical evidence from Zaki et al. (2021) demonstrates that while Muslim consumers exhibit strong trust in halal certification, they do not automatically associate halal products with environmental sustainability. Their survey findings reveal a clear perceptual gap between halal compliance and ecological responsibility, indicating that consumers treat these as separate dimensions of product evaluation. This disconnect suggests the need for stronger integration of Islamic ethical principles such as *khilafah*, *amanah*, and *lā ḍarar wa lā dirār* into consumer education, product labelling, and marketing strategies. The principles extracted from the reviewed articles were tabulated in Table 5. Collectively, the findings highlight that although Islamic ethical frameworks strongly support environmental stewardship, this understanding is not yet fully translated into consumer awareness or market practice, pointing to an important gap between ethical theory and behavioural implementation in halal cosmetic consumption.

RQ4: Consumer Behaviour and Integration of Islamic Ethics with Eco-Conscious Cosmetics

The fourth research question examines how Islamic ethical principles can be integrated with eco-conscious cosmetic practices through consumer behaviour and market mechanisms. This review identified five studies (Alex et al., 2025; Putri Aisyah et al., 2025; Raza et al., 2025; Yasmeen et al., 2024; Parven, 2024) that collectively highlight the interplay between moral values, social influence, and emerging digital opportunities in

shaping sustainable cosmetic consumption. Overall, the literature suggests that integration occurs across three interconnected dimensions: (a) moral values and ethical intention in selecting eco-conscious cosmetics, (b) the influence of social learning, influencers, and halal certification in shaping consumer trust and decision-making, and (c) the emerging role of digital tools and technologies in operationalising Islamic ethical consumption in practice.

Table 5: Principles of Islamic Environmental Ethics for Eco-Conscious
Cosmetics

No.	Principles	Definition	References
1	Halalan Tayyiban <i>(Lawful and Wholesome)</i>	Evaluated as a primary ethical driver influencing consumer segments, purchase decisions, brand loyalty, and eco-friendly/sustainable consumption values in personal care products.	Masood et al. (2023); Putri Aisyah et al. (2025)
2	Lā Darar wa Lā Dirār <i>(The Harm Prevention Maxim)</i>	Applied as a foundational legal maxim to address the acute toxicity, inflammation, and chronic growth reduction in marine organisms caused by synthetic microbeads.	Zaki et al. (2021); Aslam et al. (2022); Zainuri et al. (2023)
3	Tawhid & Mizan <i>(Unity & Ecological Balance)</i>	Analyzed through Qur'anic Exegesis to establish that massive microplastic emissions (e.g., billions of particles annually) disrupt the divine systemic equilibrium and climate stability.	Zainuri et al. (2023); Yasmeen & Alwi (2024)
4	Khilafah & Amanah <i>(Stewardship & Trust)</i>	Defines the ethical responsibility of consumers, manufacturers, and influencers to transition to non-toxic materials, acting as stewards of environmental preservation.	Zainuri et al. (2023); Putri Aisyah et al. (2025)
5	Maqasid al- Shariah & Hifz al-Biah <i>(Objectives of Shariah & Eco-</i>	A framework prioritizing the mandatory maintenance, preservation, and defense of ecosystems, resources, and public health from physical plastic degradation.	Zainuri et al. (2023); Parveen, K. (2025)

	<i>Protection)</i>		
6	Istibdal (<i>Substitution with Non-Toxic Materials</i>)	The technical and ethical requirement to swap hazardous synthetic polymers (PE, PP) with proven green, biodegradable bio-based polymers (chitosan, seaweed ulvan, cellulose).	Ju et al. (2021); Selvasucha et al. (2023);
7	Maslahah Ammah (<i>Public Interest & Collective Good</i>)	Prioritizes global legislative bans, unified regional regulations, and consumer awareness campaigns over short-term corporate profits to protect human health and aquatic biomes.	Habib, R. Z. (2022); Goh, K. C., et al. (2025)
8	Iqtisad & Green Economy (<i>Moderation & Sustainable Finance</i>)	Integrates Islamic financial instruments (waqf, zakat) and ethical commercial models to fund green alternatives, regional circular supply chains, and low-toxicity formulation research.	Yasmeen & Alwi (2024); Parveen, K. (2025)

Empirical evidence indicates that moral obligation and self-identity are key drivers of eco-conscious purchasing behaviour. Alex et al. (2025) demonstrate that perceived moral responsibility significantly influences consumers' intention to choose clean and environmentally friendly cosmetic products, with self-identity and observational learning further strengthening this relationship. This effect is particularly pronounced when consumers are exposed to influencer behaviour, suggesting that ethical intentions are reinforced through social reinforcement mechanisms. In parallel, Putri Aisyah et al. (2025) show that while halal certification positively influences purchase intention among Gen Z consumers, influencer endorsement exerts a stronger effect, particularly when halal status is framed alongside environmental and health benefits. Raza et al. (2025) further extend this discussion by identifying a significant gap in digital integration within halal cosmetics research and proposing AI-enabled tools and e-commerce platforms that can translate ethical and religious values into actionable consumer

decisions. Together, these studies indicate that effective integration of Islamic ethics and eco-conscious consumption requires a synergistic approach combining moral values, trusted social communication, and enabling digital infrastructure, thereby bridging the gap between ethical intention and practical purchasing behaviour.

DISCUSSION

The findings of this review demonstrate a strong interdisciplinary convergence between environmental science, biodegradable material innovation, and Islamic ethical principles. Evidence from RQ1 confirms that microplastic-based cosmetics are a measurable and persistent contributor to environmental pollution, consistent with global assessments that classify microplastics as ubiquitous emerging contaminants in aquatic systems (UNEP, 2021; SAPEA, 2019). At the same time, RQ2 findings show that plant-based cellulose particles, chitosan derivatives, seaweed polymers, and natural waxes can effectively replace microplastics without compromising cosmetic functionality. This aligns with recent advances in green chemistry and sustainable materials science that prioritise renewable feedstocks and environmental degradability (Anastas & Eghbali, 2010; European Commission, 2023). When interpreted through Islamic ethical lenses, particularly *khilafah*, *amanah*, *maslahah*, and *lā ḍarar wa lā dirār*, these scientific findings elevate microplastic pollution from a technical issue to a moral concern within the *halalan tayyiban* framework, where harm prevention and environmental stewardship become integral to product permissibility.

A key insight from RQ1 is that cosmetic-derived microplastics are not marginal pollutants but significant contributors to urban and national-scale environmental loading. The reviewed studies demonstrate extensive ecological consequences, including bioaccumulation in aquatic organisms, disruption of food chains, and potential long-term risks to human consumption pathways. These findings align with broader sustainability

literature that highlights microplastics as persistent, mobile, and biologically active contaminants (GESAMP, 2015; UNEP, 2021). From an Islamic ethical standpoint, such evidence directly engages the principle of *lā ḍarar wa lā dirār*, where harm, whether immediate or cumulative, invalidates permissibility when avoidable alternatives exist. The concept of *maslahah* further reinforces that private consumer benefit cannot justify widespread ecological harm. Importantly, the availability of biodegradable substitutes weakens the argument for continued reliance on microplastics, shifting responsibility toward manufacturers, regulators, and consumers within an ethical system of shared accountability.

The evidence from RQ2 strongly indicates that a transition toward microplastic-free cosmetics is technically feasible and increasingly scalable. Across the reviewed studies, bio-based materials such as cellulose microspheres, chitosan-based beads, seaweed-derived polymers, and natural waxes consistently demonstrated comparable or superior performance in terms of texture, stability, encapsulation efficiency, and biodegradability. This is consistent with emerging cosmetic science literature that positions biopolymers as next-generation functional ingredients in sustainable formulation systems (Picken et al., 2023; Nasser, Sharma & Kaur, 2024). Notably, several alternatives also introduce additional environmental benefits, such as pollutant adsorption and rapid biodegradation in aquatic systems, suggesting that substitution does not merely reduce harm but can actively contribute to environmental remediation. Within the Islamic ethical framework, this technological feasibility strengthens the normative argument that avoiding microplastics is not only preferable but increasingly a matter of ethical responsibility when safer and equally effective alternatives are available.

Findings from RQ3 demonstrate that Islamic ethical principles provide a coherent and internally consistent framework for evaluating cosmetic sustainability. Concepts such as *khilafah* (stewardship), *amanah* (trust), *maslahah* (public welfare), *israf* (waste avoidance), and *lā ḍarar wa lā dirār* collectively establish a strong normative foundation for environmental responsibility. Importantly, these principles extend the meaning of *halal*

beyond ingredient permissibility to include environmental safety and long-term ecological impact, reinforcing the broader concept of *halalan tayyiban*. This aligns with contemporary Islamic sustainability scholarship that frames environmental protection as a religious obligation embedded in *maqasid al-shari'ah* (Yasmeen et al., 2024; Parven, 2025). However, empirical studies also show that Muslim consumers do not yet consistently associate halal certification with environmental responsibility, revealing a conceptual gap between Islamic ethical ideals and market interpretation. This disconnect suggests that halal governance systems may need to evolve toward a more integrated ethical-sustainability model that reflects both religious and ecological dimensions of product evaluation.

RQ4 highlights a critical behavioural gap between ethical awareness and actual consumption practices. While moral obligation, halal identity, and environmental concern significantly influence intention to choose eco-conscious cosmetics, these motivations are not consistently translated into informed purchasing behaviour. Recent consumer studies in halal cosmetics similarly show that halal certification alone is insufficient to signal environmental responsibility without complementary communication strategies (Wilson & Liu, 2011; Zaki et al., 2021). Instead, social influence, particularly through digital platforms and influencers, plays a dominant role in shaping consumer perception and decision-making. Influencers act as interpretive intermediaries, translating abstract ethical principles into relatable consumption narratives. Emerging digital solutions such as AI-based product scanning, eco-label verification, and halal traceability systems further indicate a shift toward “ethical digital ecosystems,” where sustainability and religious compliance can be operationalised through technology. This reflects a growing global trend in sustainable consumption systems where behavioural change is enabled not only by awareness but also by infrastructure that reduces informational uncertainty.

Taken together, the findings suggest the need for an integrated framework that connects environmental science, Islamic ethics, consumer behaviour,

and digital innovation. The convergence of RQ1–RQ4 demonstrates that the transition away from microplastic-based cosmetics is supported by scientific feasibility, ethical necessity, and emerging behavioural drivers. However, the absence of a unified governance and communication structure limits the full operationalisation of this transition. Recent developments in sustainability governance and halal innovation systems indicate growing interest in integrated certification models that combine environmental, ethical, and safety indicators (European Commission, 2023; UNEP, 2021). Within this context, Islamic ethical principles can serve as a normative anchor for developing more holistic standards that reflect both environmental science and religious values. Such integration would reposition halal cosmetics not only as a marker of religious compliance but also as a framework for global ecological responsibility.

CONCLUSION

This systematic literature review provides strong evidence that microplastic-based cosmetic ingredients contribute significantly to environmental degradation, while viable biodegradable alternatives already exist and perform effectively in cosmetic applications. When examined through Islamic ethical principles, particularly *kehilafah*, *amanah*, *maslahah*, and *lā ḍarar wa lā dirār*, the continued reliance on microplastics becomes increasingly difficult to justify under the broader concept of *halalan tayyiban*, which demands both permissibility and wholesomeness in environmental and health dimensions. The review contributes to current scholarship by integrating environmental science, green cosmetic innovation, Islamic ethics, and consumer behaviour into a unified analytical perspective. It highlights that achieving sustainable cosmetic systems requires not only technological substitution but also ethical reorientation and behavioural transformation supported by policy, halal governance reform, and digital innovation. Future research should expand empirical evidence across diverse Muslim populations, develop life-cycle assessments of biodegradable alternatives, and explore digital and regulatory tools that operationalise the integration of halal, safety, and

environmental sustainability in cosmetic consumption.

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Table 3: Mapping and Summary of the 15 Included Articles

No	Author(s)	Year	Significance of the study	Research scope	Methodology	Study outcomes	Gap
1	Ju, S., Shin, G., Lee, M., Koo, J. M., Jeon, H., Ok, Y. S., Hwang, D. S., Hwang, S. Y., Oh, D. X., & Park, J.	2021	Addresses non-degradable microplastic pollution by developing biodegradable 'chito-beads' from crustacean waste, aligning with environmental stewardship and the search for non-toxic alternatives.	Development and evaluation of reacylated chitosan microbeads (280 m); includes testing mechanical properties, cleansing efficiency, and environmental biodegradability/phytotoxicity.	Laboratory experiment using an inverse emulsion system, conductometric titration, nanoindentation, and ISO 14851/OECD 208 protocols.	Chito-beads achieved a hardness of 128 MPa (comparable to synthetic plastics), 93.2% degradation in seawater over one month, and successfully adsorbed ions.	Need for further exploration into the systemic retrieval of microplastics and long-term impacts of bio-bead degradation products in diverse ecosystems.
2	Zaki, K., Nopiah, R., Walid, A., & Putra, E. P.	2021	Identifies microplastic-related threats in cosmetics and the integration of halal certification with environmental concern and sustainability.	User perceptions of university students in Indonesia regarding halal skincare's environmental concern (ingredients, packaging, and campaigns).	Quantitative descriptive study using primary data collected via questionnaires and analyzed using scoring analysis.	Respondents' perceptions of environmental concern reached 77% for ingredients; 93.37% adopt halal products, but only 76.16% are actually certified.	Future research should focus on varied environmental topics such as waste management and product recycling in broader geographical areas.
3	Rahim, N. A. S. M., Islahudin, F., Abu Tahrir, N. A. B. U., & Jasamai, M.	2022	Highlights the toxicity of microplastic microbeads (PE, PP) on aquatic life while exploring bio-based alternatives like chitin and cellulose.	Analysis of primary microplastics in scrubs and toothpastes and their physiological effects (stunted growth, infertility) on marine organisms and rodents.	Literature search (2014-2021) using databases such as Medline, Mendeley, Science Direct, and Scopus to review health risks and alternatives.	Microplastics cause cytotoxicity and chronic inflammation; identified chitin (shrimp shells) and cellulose (palm oil) as viable, low-toxicity bead alternatives.	Information on long-term effects on human health remains scarce; suitability of bio-based replacements for specific cosmetic formulations is not fully evaluated.
4	Habib, R. Z., et al.	2022	Evaluates the effectiveness of global legislation and consumer awareness in reducing primary microplastic pollution in the UAE market.	163 rinse-off cosmetic products and survey data from 530 participants at UAE University regarding microplastic usage and awareness.	Mixed-methods approach including laboratory extraction (Fenton reagent, FT-IR) and longitudinal quantitative consumer surveys (2018–2021).	Microplastic-containing products decreased from 30% (2018) to 12% (2020); 80% of consumers support a ban, though brand/texture remain high priorities.	Need for continuous global monitoring in regions without binding legislation; gap in consumer behavior where 'texture' overrides

No	Author(s)	Year	Significance of the study	Research scope	Methodology	Study outcomes	Gap
							'environmental safety'.
5	Selvasudha, N., Goswami, R., Tamil Mani Subi, M., Rajesh, S., Kishore, K., & Vasanthi, H. R.	2023	Proposes seaweed-derived polysaccharides (ulvan/alginate) as eco-conscious alternatives to plastic microbeads, revitalizing traditional bioactive ingredients like curcumin.	Fabrication and optimization of microbeads using sodium alginate and ulvan (1:1 ratio) encapsulated with curcumin; stability testing in olive oil, SLS, and aloe vera.	Laboratory experiment (ionotropic gelation, FTIR, DSC-TGA, XRD, SEM, and biological assays for antimicrobial/cell viability).	Achieved 99.2% encapsulation efficiency; beads exhibited ~98% biodegradation in marine water within 10 days; safe skin care dose identified at 1.2 mg/ml.	Future research is needed to evaluate the potency of these bio-beads against commercial products and to conduct a full cost analysis for commercialization.
6	Bikiaris, N., Nikolaidis, N. F., & Barmplexis, P.	2024	Highlights the need for sustainable, biobased, and biodegradable alternatives like cellulose, alginate, and biopolyesters to replace persistent plastic microbeads	Evaluation of microplastics in personal care and cleaning products, global legislative bans, and potential of substitutes like PLA, PCL, and PHA.	Systematic literature review and analysis of recent research on microplastic environmental impacts and green alternative development.	Identified that microplastics are being phased out globally; natural polymers (alginate, chitosan) are technically viable exfoliants with high degradation rates.	Future research must focus on comprehensive life-cycle assessments to ensure alternatives do not introduce unintended environmental drawbacks.
7	Yasmeen, K., Yasmeen, K., & Abri, S.	2024	Proposes a framework integrating Islamic principles (Zakat, Halal, Tayyib) with SDGs to foster ethical environmental stewardship and ecological sustainability.	Synthesis of Islamic teachings with global sustainability agendas, focusing on economic, social, and environmental dimensions.	Systematic literature review (2012–2023) and thematic analysis, complemented by consultations with experts in Islamic economics	Identified 'Halal' and 'Tayyib' as keys to ethical consumption and 'Mizān' (balance) as a guide for climate action within an Islamic Sustainable Development Framework.	Lack of empirical testing and validation of the proposed framework across different socio-economic contexts (Muslim-majority vs. non-Muslim nations).
8	Dung, T. T. T., Ngoc, H. N., & Trinh, N. N.	2024	Quantifies the entry of microplastics into aquatic ecosystems from personal care products in Vietnam, specifically near mangrove	Characterization of microbeads in 9 facial/body scrubs in Ho Chi Minh City and a survey of 126 female	Laboratory experiment (Fenton reagents, microscopic identification) and quantitative survey to	Annual emissions in Ho Chi Minh City estimated at 1.3 billion microbeads; sizes ranged from 66 to 1012 μm with abundances	Lack of specific laws in Vietnam regarding the phasing out of microbeads; need for more extensive studies

No	Author(s)	Year	Significance of the study	Research scope	Methodology	Study outcomes	Gap
			forests.	students' usage patterns.	estimate annual emissions.	up to 942 particles/g.	on chemical compositions and exposure factors.
9	Frigerio, L., Luigi, P., Simone, C., Miryam Chiara, M., & Enrico, C.	2024	Addresses the crisis of microplastic pollution by replacing polyethylene (PE) wax in cosmetics with bio-based waxes like ABWAX® Revowax to promote sustainability.	Development of a microplastic-free cosmetic stick (lipstick) using sunflower seed wax and hydrogenated castor oil across various oil polarities.	Systematic laboratory experiment (thermal analysis, oil-wax compatibility testing via penetrometry, and QDA sensory evaluation by 25 expert panellists).	ABWAX® Revowax demonstrated comparable thermal properties to PE (74-81°C); bio-based formulations were rated as more comfortable and controlled by panellists.	Future optimization required for non-polar oil synergies where bio-waxes currently struggle to form stable sticks compared to petroleum-based PE.
10	Alex, R. K., et al.	2025	Investigates pro-environmental intentions regarding microplastics in PCPs within an emerging economy context.	Indian consumers (N=375); focus on psychological drivers (TPB, VBN, SCT).	Quantitative nationwide survey; SEM with PROCESS macro analysis.	Moral values significantly predict behavioral intention; younger, female, and science-educated consumers are most supportive of bans.	Sample over-represents younger/female demographics; relies on self-report measures subject to social desirability.
11	Raza, M. W., et al.	2025	Synthesizes a decade of literature to identify global drivers for Halal cosmetic adoption.	51 empirical articles (2014–2024); primarily focused on Asian markets (Indonesia/Malaysia).	Systematic Literature Review (SLR) using PRISMA and TCCM frameworks.	Attitude acts as a key mediator; religiosity and social media influence are primary drivers; 84% of research is offline-focused.	Significant geographical gap in non-Asian markets (UK, UAE, Africa); lacks research on AI and e-commerce.
12	Goh, K. C., et al.	2025	Provides a multi-dimensional strategy (technological/policy) for mitigating microplastic pollution in Malaysia's marine ecosystems, vital for food security.	Current state of microplastic pollution in Malaysia, focusing on sensors, biodegradable polymers, plastic bag bans, and public engagement effectiveness.	Systematic review and evaluation of technological solutions and policy instruments using databases like Web of Science, Scopus, and PubMed.	Advanced sensors show a 20% improvement in detection; biodegradable polymers reduce microplastic release by 15%; public engagement increased clean-up efficiency by 40%.	Lack of a comprehensive national strategy, insufficient enforcement of existing policies, and limited public awareness particularly in rural communities.

No	Author(s)	Year	Significance of the study	Research scope	Methodology	Study outcomes	Gap
13	Klimaszewska, E., Ogorzałek, M., Okulska-Bozek, M., Jabłońska, E., Wylup, H., Nizioł-Łukaszewska, Z., & Tomasiuk, R.	2025	Addresses the environmental threat of synthetic microplastics by exploring spheroidal cellulose powders as natural, 100% biodegradable, and vegan alternatives.	Development of O/W face cream emulsions containing 2 μm and 7 μm spheroidal cellulose powders obtained from black spruce (forestry side-streams).	Laboratory experiment (Turbiscan stability analysis, Brookfield viscosity/texture analysis, and in vivo skin hydration testing on 10 subjects).	Prototypes showed high stability (TSI < 3.0); cellulose increased skin hydration (max 46.8 a.u.) and enhanced sensory parameters like smoothing and absorption.	Future research directed toward demonstrating the applicability of these cellulose powders as potential anti-aging ingredients through skin diagnostic studies.
14	Parven, K.	2025	Explores how Islamic economic diversification can preserve a green economy, addressing pollution and poverty through Shari'ah-compliant ethics.	Analysis of Islamic financial instruments (waqf, zakat), regulatory frameworks, and model economies in Bahrain, Malaysia, and Bangladesh.	Qualitative research method using case studies and document analysis of legislation, treaties, and scholarly literature.	Shari'ah-compliant activities prioritize the maintenance of soul, reason, and assets (Maqasid Syariah), thereby improving socio-economic and environmental conditions.	Lack of consolidated international efforts to reduce inequality; need for better integration of technical eco-alternatives with advanced human capital.
15	Putri Aisyah, A., Nazira, H., Adjeng Zora Amanda Putri, R., & Setiawan, M.	2025	Explores how halal cosmetics align religious values (thayyib) with sustainable, ethical, and eco-friendly consumption.	Drivers of purchasing behavior for halal cosmetics among 194 Indonesian respondents, focusing on quality, labels, and influencer marketing (Gen Z/Millennials).	Quantitative approach using online survey and Partial Least Squares Structural Equation Modelling (PLS-SEM).	Influencer marketing had the strongest impact on purchase decisions ($\beta=0.297$), followed by product quality ($\beta=0.239$) and halal labels ($\beta=0.184$).	Study focuses on the younger generation (Gen Z); suggests future research include older demographics and additional factors beyond the three examined.