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Ethics and Philosophy of Science in Herbal Medicine Technology: Opportunities and Challenges for SDGs

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Abstract

Objective: This study aims to examine the opportunities, challenges, and relevance of Islamic philosophy of science and ethics in the development of herbal-based pharmaceuticals that integrate halal and thayyib principles as spiritual and ethical foundations in addressing modern health needs and contributing to the Sustainable Development Goals (SDGs). **Theoretical framework:** The study adopts the philosophical approach of Islamic science and ethics as a moral and spiritual basis for developing herbal medicine technology, emphasizing principles such as justice (ʿadl), trust (amanah), and societal benefit (maslahah). **Literature review:** The study analyzes research from scientific databases, including Sinta, PubMed, and Google Scholar, focusing on herbal innovations, regulatory frameworks, and the integration of Islamic values in pharmaceutical development. **Methods:** A descriptive-analytical literature review was conducted, synthesizing information from scientific articles on technological advancements, regulatory challenges, and Islamic perspectives in herbal pharmacy. **Results:** Findings indicate that technological innovations, such as nanotechnology, significantly enhance the efficacy of active compounds in medicinal plants. Nevertheless, challenges remain, including the lack of standardized formulations, incomplete regulatory frameworks, and limited availability of internationally recognized halal certification. **Implications:** The study highlights the importance of collaboration among government, academia, and industry to establish a sustainable, Sharia-compliant herbal pharmaceutical ecosystem that supports ethical, effective, and culturally relevant healthcare. This approach also contributes to SDG 3 (Good Health and Well-Being), SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 10 (Reduced Inequalities). **Novelty:** The originality of this research lies in its integrative framework, combining Islamic philosophy of science, ethics, and modern herbal pharmaceutical technology to provide a holistic, contextually grounded model for ethical innovation in healthcare.

Keywords: islamic philosophy of science, herbal medicine technology, ethics in pharmaceutical development, sdgs, halal and thayyib.

INTRODUCTION

Herbal-based medicine has become a key approach in both traditional and modern healthcare systems. Its utilization not only provides natural therapeutic solutions but also reflects the sustainability and richness of local cultural knowledge. In Islam, references to

medicinal plants are found throughout the Qur'an and Hadith, including the black seed *(Nigella sativa)*, honey, and dates, which have been scientifically validated for their significant therapeutic properties [1].

Islamic medicine, as defined by Dr. Elkadi in 1983, is a blend of modern medical science and technology with the Divine teachings in Islam. This approach integrates modern medical techniques with spiritual values, where Muslim patients are convinced that true healing comes from Allah. Islamic medicine, which differs from the Medicine of the Prophet (al-Thibb al-Nabawī), encompasses the practice of herbal-based therapeutic practices, hygiene, diet, and exercise, and has evolved since the beginning of the Islamic period until now. It is applied by doctors in various parts of the world, both in Muslim and non-Muslim countries [2].

The Islamic philosophy of science and ethics offers a robust framework for developing herbal medicine technology. Principles such as halal and thayyib ensure product safety, quality, and sustainability while promoting moral responsibility in natural resource management. In countries like Indonesia, which has the largest Muslim population globally [3], adherence to these principles aligns with religious obligations to consume halal and good products, reflecting a broader societal commitment to ethical and sustainable practices [4].

The convergence of Islamic values with modern herbal pharmaceutical technology presents substantial opportunities. Innovations such as nanotechnology can enhance the efficacy of medicinal plant compounds while remaining consistent with Islamic principles emphasizing quality and societal benefit. Nevertheless, challenges including standardization, halal certification, and equitable access remain critical concerns in the Sharia-based pharmaceutical industry [5].

Developing modern herbal medicine grounded in Islamic teachings not only supports physical health but also reinforces spiritual well-being and harmony with nature. As Assauqi et al. highlight, natural ingredients such as honey, black cumin, ginger, olives, and pomegranate possess antibacterial, antioxidant, anti-inflammatory, and cardioprotective properties [6], [7]. Regular consumption, proper dosage, and faith in Allah as the ultimate healer, combined with a healthy lifestyle and balanced nutrition, are essential for maximizing the benefits of these medicinal plants [8].

Islamic ethics further emphasize the integration of modern scientific advancements with spiritual values. Such an approach fosters innovation while ensuring that technology development aligns with moral and sustainability principles. This integration provides a unique solution to global healthcare needs, preserving spiritual identity and cultural authenticity [9]. Implementing Sharia values in herbal medicine development also supports a more inclusive pharmaceutical ecosystem, including public education, robust regulation, and transparent halal certification, benefiting both local and global communities.

Importantly, aligning herbal pharmaceutical development with Islamic principles also contributes to achieving the Sustainable Development Goals (SDGs). The promotion of safe, sustainable, and ethical herbal products addresses SDG 3 (Good Health and Well-Being) by improving access to quality medicine, SDG 12 (Responsible Consumption and Production) by ensuring sustainable resource use, and SDG 9 (Industry, Innovation, and Infrastructure) by fostering innovation in Sharia-compliant pharmaceutical technologies. Moreover, supporting equitable access and education in herbal medicine contributes to SDG 4 (Quality Education) and SDG 10 (Reduced Inequalities), emphasizing the broader societal and ethical impact of this approach [10].

The novelty of this study lies in its integrative framework, combining Islamic philosophy of science, ethics, and modern herbal pharmaceutical technology. Unlike prior research that

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often isolates medical advancements from religious and ethical foundations, this study positions Islamic epistemology—rooted in halal, thayyib, trust (amanah), and justice (‘adl)—as both a spiritual compass and regulatory paradigm in pharmaceutical innovation. It examines how modern scientific methods, including nanotechnology, can enhance traditional herbal efficacy within a Sharia-compliant context while addressing regulatory gaps such as standardization and international recognition of halal certification [11].

Furthermore, the research offers a unique model for intersectoral collaboration involving government, academia, and industry, based on Islamic ethical principles. This tripartite approach underlines the importance of a comprehensive and inclusive pharmaceutical ecosystem that ensures not only technological progress but also public trust and spiritual integrity. The emphasis on embedding spirituality into pharmaceutical development processes highlights a significant paradigm shift—from merely functional medicine to ethically conscious healthcare rooted in divine guidance. In this way, the study fills an academic void by offering a practical, faith-based alternative to the secular pharmaceutical development model, making it highly relevant to the global Muslim population while also contributing to the broader discourse on ethics in science and technology. Ultimately, the study contributes to the sustainable development of the herbal pharmaceutical sector by aligning innovation with Islamic moral values, offering a novel pathway for ethical, effective, and culturally attuned medical solutions in the modern era [11].

Additionally, this research proposes a model for intersectoral collaboration among government, academia, and industry, guided by Islamic ethical principles. By embedding spirituality into pharmaceutical development, the study highlights a paradigm shift from purely functional medicine to ethically conscious healthcare rooted in divine guidance. This approach aligns with global sustainability priorities and offers a faith-based alternative to secular pharmaceutical models, making it highly relevant for Muslim-majority societies while contributing to global discussions on ethics in science and technology. Ultimately, this framework promotes the sustainable development of the herbal pharmaceutical sector, integrating innovation, ethical standards, and cultural alignment to support both human health and the SDGs.

LITERATURE REVIEW

Herbal Medicine

Herbal medicine in general is a form of traditional medicine that utilizes plants or plant parts such as leaves, roots, flowers, seeds, or bark to prevent and treat diseases. Herbs have naturally active compounds that provide pharmacological effects, such as antioxidant, anti-inflammatory, antibacterial, and antiviral, which support the body's natural functions [12].

In modern medicine, herbs have been used both as the primary therapy and as an adjunct therapy (complementary) to support health recovery. Some examples of herbs that are often used are ginger to treat indigestion and inflammation, turmeric to speed up wound healing and reduce inflammation, and ginseng to increase energy and immunity. Scientific research continues to develop an understanding of the active compounds in these plants to support evidence-based treatment and improve their therapeutic efficacy [13].

The benefits of herbal medicine include higher safety compared to synthetic drugs when used correctly, lower cost, and holistic support for physical and mental health. However, limitations exist, such as potential interactions with other medications and toxicity risks if consumed inappropriately. Therefore, proper dosage and, if necessary, supervision by healthcare professionals are essential [14].

From the perspective of Sustainable Development Goals (SDGs), the development and use of herbal medicine contribute to several targets:

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1. SDG 3 (Good Health and Well-Being): By providing safe, affordable, and accessible treatment options that support prevention and recovery, herbal medicine enhances health outcomes.
2. SDG 12 (Responsible Consumption and Production): Promoting sustainable harvesting and utilization of medicinal plants encourages responsible management of natural resources.
3. SDG 9 (Industry, Innovation, and Infrastructure): Integrating modern scientific methods, such as phytochemical analysis and nanotechnology, fosters innovation in the herbal pharmaceutical sector.
4. SDG 10 (Reduced Inequalities): Increased accessibility to herbal medicine, especially in rural or resource-limited areas, supports equitable health solutions for diverse populations.

Thus, herbal medicine not only supports individual health but also aligns with global sustainability goals by promoting ethical, innovative, and inclusive healthcare practices.

Herbal Medicine in Islam

Herbal medicine in Islam is rooted in the teachings of the Qur'an and Hadith, which encourage the ummah to utilize natural resources as part of worship and obedience to Allah SWT. The Qur'an mentions several plants such as olives, dates, and black cumin (*Habbatussauda*) that have scientifically proven health benefits, including antioxidant, anti-inflammatory, and immunomodulatory properties [15]. In Islam, the use of herbs is not only aimed at curing illnesses but also maintaining spiritual balance by believing that true healing comes from Allah [16].

The Islamic approach to herbal medicine emphasizes adherence to Sharia values, where halal principles form the foundation of product development. This ensures that both ingredients and production processes comply with religious guidelines. Studies indicate that integrating halal and ethical principles enhances consumer confidence in herbal products, both locally and internationally [17]. Furthermore, the use of herbs in Islam often aligns with preventive health measures and overall quality of life improvements, reflecting a holistic understanding of health that integrates physical, spiritual, and social dimensions [18].

From the perspective of the Sustainable Development Goals (SDGs), Islamic herbal medicine contributes to:

1. SDG 3 (Good Health and Well-Being): By promoting natural, safe, and preventive treatments that support physical and spiritual health.
2. SDG 12 (Responsible Consumption and Production): By encouraging sustainable sourcing and ethical production of medicinal plants in accordance with Sharia principles.
3. SDG 9 (Industry, Innovation, and Infrastructure): By integrating modern research techniques, such as phytochemical analysis, quality control, and halal certification systems, into traditional herbal medicine practices.
4. SDG 10 (Reduced Inequalities) and SDG 4 (Quality Education): By enhancing accessibility and knowledge about safe, Sharia-compliant herbal remedies for diverse populations, including marginalized communities.

Thus, Islamic herbal medicine not only fosters health and spiritual well-being but also aligns with global sustainability priorities, promoting ethical, innovative, and inclusive healthcare practices.

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METHODOLOGY

This research is categorized as a literature study with a qualitative approach that uses data tracing techniques from various scientific journal sources. This study only uses secondary data in the form of journal articles that are relevant to the research theme. Data is collected from trusted databases such as Scopus, PubMed, Google Scholar, and Garuda to obtain journals that meet predetermined criteria. The data obtained will be analyzed using descriptive methods to understand the opportunities and challenges in the development of herbal-based medicine technology from an Islamic perspective [19].

Data Search Process

A reference search was conducted in January 2025 using the following keywords:

a. Indonesian: "philosophy of science", "Islamic ethics", "herbal pharmaceutical technology", "Islamic-based herbal medicine", "opportunities and challenges of Islamic pharma".

b. English: "philosophy of science", "Islamic ethics", "herbal pharmaceutical technology", "Islam-based herbal medicine", "opportunities and challenges in Islamic pharmacy".

Data sources come from journals indexed by Sinta, PubMed, and Google Scholar, as well as national platforms such as Garuda.

Study Criteria

Inclusion and exclusion criteria are applied to ensure the quality and relevance of the journals used:

a. Inclusion Criteria

1. Articles published in the 2019–2025 time frame.
2. Articles in Indonesian and English.
3. Articles are available in full-text form.
4. Articles relevant to the theme of Islamic-based herbal medicine.

b. Exclusion Criteria

1. Articles that don't have full text.
2. Articles with abstracts that are not relevant to the research theme.

Quality Assessment and Data Extraction Process

Journal selection is carried out systematically by reviewing abstracts, keywords, and article content to ensure compatibility with the inclusion criteria that have been set. The assessment process aims to ensure that the selected journals meet quality standards and are relevant to the research theme. After the journal is selected, the data extraction process is carried out using Microsoft Excel. The data recorded included the author's name, year of publication, type of research, data collection method, main findings, and recommendations provided by the study. This process ensures all relevant information is well documented to support the analysis and preparation of *the literature review* article [20].

Data Analysis

The extracted data will be analyzed to identify key themes, including:

a. The relationship between the philosophy of science and the development of herbal medicine technology.

b. The role of Islamic ethics in herbal pharmaceutical innovation.

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c. Opportunities and challenges faced in the development of Islamic-based pharmaceutical technology.

The results of the analysis will be visualized in the form of a table to show the connections between the main themes of the study. This visualization aims to provide a clearer picture of the relevance and contribution of research to the development of herbal-based pharmaceutical science.

Data Results and Representation

The results of the data search will be visualized in the form of a table that lists the relevant information of each journal to the research theme. Keyword and abstract analyses were conducted to show the relationship between themes, relevance, and further research opportunities. All results will be systematically documented in the form of written reports [21].

RESULTS AND DISCUSSION

Based on the results of data search using PubMed, Sinta, Google Scholar, and Garuda databases, as many as 500 articles relevant to the research topic were obtained. After the initial screening process, as many as 150 articles were eliminated because they were duplicate articles or did not meet the basic criteria. Of the 350 articles screened further, 110 were selected for review, while 10 were inaccessible. Furthermore, 100 articles were evaluated for eligibility, but 80 articles were removed because 50 of them were reviews, and the other 30 had insufficient data. Thus, the total number of articles that met the inclusion criteria and were used for further analysis was 20.

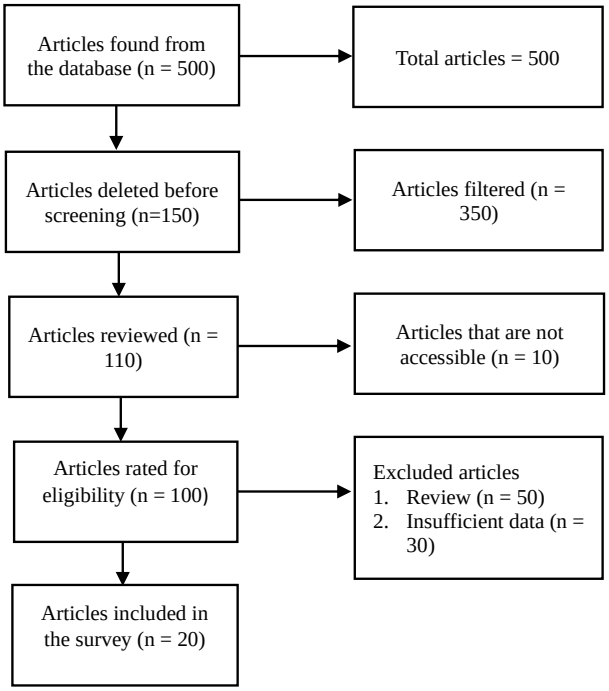

Figure 1. Research Prism Chart

Table 1. Studies on the Perspective of Islamic Philosophy of Science and Ethics in the Development of Herbal Medicine

Author and Year	Research Title	Research Objectives	Research Focus	Research Results
If Hanifa Nurrosyidah & Abd. Syakur [22]	*Challenges and Prospects for Implementing Halal Principles in the Jamu Industry in Indonesia*	Examining the challenges and opportunities for the application of halal principles in the Indonesian traditional herbal medicine industry.	The application of halal principles in the Indonesian traditional herbal medicine industry.	The herbal medicine industry faces obstacles in non-halal ingredients that are difficult to find alternatives for, such as gelatin. However, halal certification provides a great opportunity to increase consumer confidence, especially in the international market.
Nur Indah Rahma Dilla et al. [23]	*Integration of Traditional Medicine from the Perspective of Islamic Law and Positive Law*	Exploring the relationship between traditional medicine and Islamic law, and positive law in Indonesia.	The relationship between Islamic and positive law in traditional medicine.	Traditional medicine is relevant as a local cultural heritage that requires strengthening regulations for consumer protection.
Ertati Suarni et al. [24]	Ethnopharmacology in the Tradition of Islamic Medicine: The Change and Sustainability of Civilization	Uncovering the changes and sustainability of ethnopharmacology in Islamic medicine.	The history and potential of Islamic ethnopharmacology.	The ethnopharmacological tradition in Islam has strong roots in the golden age of Islamic civilization, with significant contributions to the development of pharmaceutical science. The study notes that Islamic ethnopharmacology has great potential to be applied in modern medicine, but requires further standardization and research to integrate it with current technology.
Muhammad Luthfi Islamic Service [25]	Hadiths on Herbal Medicine: A Study of Takhrij and Syarah Hadith with a Health Review	Analyze the hadith about herbal medicine from a health perspective.	Understanding the hadith about herbal medicine from a modern perspective.	The study found that the hadith that advocates the use of herbs such as black beans, honey, and dates is supported by modern research that shows their benefits in strengthening the immune system, having an anti-inflammatory effect, and supporting digestive health. This reinforces the relevance of herbal medicine to Islamic values.
Ayurisya Dominata Dumiadi & Razlini Mohd Ramli [26]	*Halal Herbal Medicine Market in Malaysia and Indonesia: Challenges and Its Global Significance*	Examining the market potential of halal herbal medicines in Malaysia and Indonesia and their	Global market development of halal herbal medicines.	The halal herbal medicine market in Malaysia and Indonesia has a competitive advantage due to the high awareness of halal

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		global opportunities.		products. However, the main challenge is to ensure that raw materials and production processes meet international halal standards.
Lenny Herlina et al. [27]	*Nyeruan: Traditional Medicine of the Sasak Tribe from the Perspective of Islam, Medicine, and Legislation in Indonesia*	Understanding the Nyeruan tradition from an Islamic perspective and health modernization.	The tradition of Nyeruan medicine is a form of Islamic-based traditional medicine.	The tradition of using water media remains relevant to Islamic law and can be combined with modern medical science, reflecting the harmony between religious beliefs and traditional medical practices.
Ina Noryani [28]	Chemistry in the Islamic View: An Effort to Find a Common Ground Between Science and Religion	Explain the relationship between chemistry and Islamic values.	Integration of Islamic values with the theory and practice of chemistry.	Chemistry contributed greatly to the development of the modern pharmaceutical and chemical products industry, which supported Islamic principles such as cleanliness and halalism. The research highlights the importance of scientific experiments based on Islamic ethics.
Rubini et al. [29]	*Ethics in the Use of Technology in Islam*	To study the ethics of the use of technology in an Islamic context.	Islamic ethical principles in the use of modern technology, including herbal pharmaceuticals.	Technology should be used for useful purposes, in line with Islamic values, such as justice, trust, and community welfare. This research highlights the importance of maintaining a balance between technological developments and Islamic morality, including in herbal medicine.
Gunawan Widjaja [30]	*The Influence of Traditional Medicine on the Healing of Chronic Diseases*	Assess the effectiveness of traditional medicine in treating chronic diseases.	The potential of integrating traditional medicine with modern medicine for chronic diseases.	The use of herbal medicines has been shown to reduce the symptoms of chronic diseases such as diabetes and hypertension. Research shows the importance of a holistic approach to improving patients' quality of life.
Mahdi Ghaemi Asl & David Roubaud [31]	*Asymmetric Interactions among Cutting-edge Technologies and Islamic Cryptocurrencies*	Examining the relationship between modern technology and Islamic value-based economics.	Modern technologies in the Islamic economy include blockchain and pharmaceutical development.	This research highlights the role of blockchain technology in increasing transparency and efficiency, relevant for the future development of Islamic-based pharmaceuticals, while

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				keeping in mind Sharia principles.
Yedi Herdiana et al. [32]	*Towards Halal Pharmaceutical: Exploring Alternatives to Animal-Based Ingredients*	Analyze the importance of halal ingredients in modern pharmaceuticals and look for alternatives to non-halal ingredients.	Halal ingredient alternatives in modern pharmaceuticals.	The development of halal ingredients from plant-based and marine sources shows great potential in replacing pork-based ingredients. Collaboration with regulators is important to expand the global market for halal products.
Desy Apriani et al.[33]	*The Use of Science and Technology in Islamic Practices and Rules in the Past, Now, and the Future*	Examines the role of technology in Islamic practice and how the application of science is in harmony with Islamic ethics.	Integration of technology and Islamic values in the development of medicine and health practices.	Modern technology should be geared towards strengthening Islamic values, focusing on striking a balance between the medical and spiritual needs of Muslim communities.
Asim Najmi et al. [34]	*Modern Approaches in the Discovery and Development of Plant-Based Natural Products*	Exploring modern methods in the development of plant-based drugs for therapy.	Development of plant-based natural products through modern methods.	Methods such as data mining and virtual screening improve the efficiency of herbal medicine development, demonstrating great potential to expand the therapeutic spectrum.
Raden Ayu Erika Septiana & Raden Ayu Ritawati [35]	Herbalology in the Qur'an: an analysis in thematic interpretation	Examining the use of herbal plants in the Qur'an for health and Islamic-based medicine.	Herbalism from the perspective of the Qur'an, including the benefits of herbal plants such as ginger, onions, dates, and pomegranates.	Research found that the Qur'an mentions a variety of herbal plants that are effective for treatment, with scientific evidence supporting health benefits such as antioxidants, anticancer, and increased immunity.
Toni Ardi Rafsanjani et al. [36]	*Sharia Pharmacy in the Perspective of the Qur'an: An Analysis of Verses About Medicine*	Analyze the concept of sharia pharmacy based on the Qur'an with a focus on the principles of halal and thayyib.	The principles of halal-thayyib in sharia pharmacy and their relevance to modern pharmaceutical practices.	Studies show that Islamic pharmaceuticals can utilize natural ingredients such as honey and olives, with the integration of Qur'anic values and modern scientific practices increasing Muslim consumer confidence.
Irfan Harmoko [37]	Optimizing the Halal Industry in Indonesia through a Distinctive Competence Strategic Approach	Examining strategic steps to optimize the halal industry in Indonesia using the distinctive competence approach.	The development of the halal industry in Indonesia includes pharmaceuticals and herbal medicines.	The study found that strong regulations, a majority Muslim population, and digital technology are the main potentials in supporting the optimization of the halal industry, including the pharmaceutical sector. Halal certification is prioritized as a strategic step to increase

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				competitiveness and exports.
Abubakar Yusuf Abdullahi [38]	*Comparative Analysis of Arabic and Islamic Medical Ethics with Western Bioethics*	Analyzes the comparison of Islamic medical ethics with Western bioethics in the face of modern health dilemmas.	Islamic medical ethics and Western bioethics.	Islamic medical ethics emphasizes a balance between religious obligations and patient autonomy, while Western bioethics prioritizes individual rights and legality.
Ahmad Nasir Mohd Yusoff [39]	*Santau: The Use of Herbal Medicine and Restrictions in Treatment*	Identify the use of herbal medicine in traditional Malay medicine for Santau disease.	Herbal medicine for traditional Santau medicine.	Traditional remedies such as "Jackfruit Leaf Patterson" have proven to be effective in supporting modern medicine and improving patient recovery.
Shariffah Suraya et al. [40]	*Role of Traditional and Complementary Medicine in Sustaining the Health and Well-being of Malaysians*	To examine the experiences and perceptions of the Malaysian people towards traditional and complementary medicine (TCM).	The use of traditional and complementary medicine in Malaysia.	Traditional medicine provides a holistic approach that supports physical and mental health, and has potential for future growth.
Vicky F Sanjaya [41]	*Circular Economy Development to Achieve Indonesia's SDGs in 2030 from the Perspective of Islamic Economics*	Assess the contribution of a circular economy based on Islamic values to achieve the Sustainable Development Goals (SDGs).	Circular economy from an Islamic perspective.	A circular economy based on Islamic values supports sustainability by utilizing herbal waste as a new resource and reflecting the value of maslahah.

This research aims to understand the relationship between philosophy of science, Islamic ethics, and the development of herbal medicine technology in the modern context. Islamic principles such as halal and thiyab provide an important foundation in the development of pharmaceuticals that focus not only on the effectiveness of drugs but also on conformity with religious values. Halal certification is one of the great opportunities, especially in increasing consumer confidence in herbal medicines, both in the domestic and international markets. Research such as that conducted by Nurrosyidah & Syakur shows that the application of halal principles in the traditional herbal medicine industry can increase product competitiveness, despite facing obstacles in the procurement of non-halal raw materials that require appropriate alternatives. The development of herbal medicines still faces some obstacles, such as a lack of standardization and strict regulations [42]. For example, research by Dilla highlights the need to strengthen regulations to protect consumers in the use of traditional medicine. In addition, Islamic traditionalism, which has strong roots in history, requires further research to be integrated with modern technology. Research by Suarni emphasizes the importance of standardization and in-depth research to develop herbal medicines that are effective and in accordance with sharia principles [43].

Isan's philosophy of science and ethics plays a key role in maintaining a balance between technological innovation and moral values. Islamic ethical principles, such as justice and trust, ensure that the development of herbal medicine technology is not only scientifically beneficial but also in line with the spiritual needs of the Muslim community. Research such as the one conducted by Rubini et al. shows that technology should be directed to beneficial purposes and support the well-being of society, including in the context of herbal-based pharmaceuticals. Overall, the development of herbal tekasi from an Islamic perspective provides a great opportunity to create holistic health products, both from a medical and spiritual perspective. However, the challenges require a collaborative approach between

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government, industry, and academia to create a regulatory system that supports innovation while maintaining religious values. With this approach, herbal-based pharmaceuticals can be a sustainable solution in the modern era.

Analysis

This literature review critically explores the integration of Islamic philosophy of science and ethics in the development of herbal-based pharmaceutical technology. The study reveals that Islamic values, particularly the principles of halal (permissible) and thayyib (pure and beneficial), serve not only as spiritual guidelines but also as regulatory frameworks that shape innovation in the modern pharmaceutical sector. The convergence of traditional herbal knowledge with technological advances, such as nanotechnology, creates new opportunities to enhance the efficacy, safety, and accessibility of herbal medicines while aligning with religious and ethical norms.

The review highlights a growing demand, especially in Muslim-majority countries like Indonesia, for pharmaceutical products that comply with Sharia law. However, several challenges hinder this growth, including the lack of standardized formulations, insufficient halal-certified ingredients, and weak regulatory support. Studies reviewed from databases such as Scopus, PubMed, and Google Scholar emphasize the urgency of addressing these gaps to boost consumer trust and enhance global market competitiveness.

Furthermore, the review underscores the relevance of Islamic epistemology in promoting sustainable healthcare solutions. Ethical principles such as justice (‘adl), trust (amanah), and societal benefit (maslahah) are central to guiding pharmaceutical development. Rather than isolating scientific advancement from religious values, an integrative framework is advocated that merges science, spirituality, and ethics. The novelty of this study lies in its emphasis on interdisciplinary collaboration among government, academia, and industry to establish a holistic and Sharia-compliant pharmaceutical ecosystem. This approach is expected to offer ethical, effective, and culturally resonant alternatives to conventional medicines, particularly in the global South.

From the perspective of the Sustainable Development Goals (SDGs), the integration of Islamic ethics and modern herbal technology contributes to:

1. SDG 3 (Good Health and Well-Being): By ensuring access to safe, effective, and preventive herbal medicines that enhance physical and spiritual health.
2. SDG 9 (Industry, Innovation, and Infrastructure): By fostering innovation in Sharia-compliant pharmaceutical technologies, including quality control, halal certification, and advanced extraction techniques.
3. SDG 12 (Responsible Consumption and Production): By promoting ethical sourcing, sustainable harvesting, and environmentally responsible production of medicinal plants.
4. SDG 10 (Reduced Inequalities): By improving accessibility to safe herbal medicines and healthcare knowledge, particularly for marginalized or rural populations.
5. SDG 17 (Partnerships for the Goals): Through collaboration among government, academia, and industry to create a transparent and sustainable herbal pharmaceutical ecosystem.

In conclusion, this review presents a compelling argument for the ethical transformation of the herbal pharmaceutical sector guided by Islamic values. By aligning innovation with spiritual, ethical, and sustainability principles, healthcare solutions can better meet the needs of diverse communities while contributing to global efforts to achieve the SDGs. This framework not only strengthens consumer trust and scientific rigor but also ensures that herbal medicine development is socially responsible, culturally relevant, and ecologically sustainable.

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CONCLUSION

The development of herbal medicine technology through the lens of Islamic philosophy of science and ethics presents significant opportunities for creating a pharmaceutical paradigm that is both scientifically advanced and spiritually grounded. By emphasizing the principles of halal (lawful) and thayyib (wholesome), Islamic ethics provides a distinctive framework that integrates health, morality, and sustainability. This approach ensures the safety and efficacy of herbal-based treatments while enhancing consumer trust, particularly in Muslim-majority populations and the expanding global halal market. Integrating Islamic values into pharmaceutical development promotes a holistic approach that aligns technological innovation with spiritual guidance and moral responsibility. Herbal compounds mentioned in the Qur'an and Hadith, such as black seed, honey, olives, and pomegranates, have been validated by modern research for their therapeutic benefits, demonstrating the compatibility of traditional Islamic medicine with contemporary scientific advancements, including nanotechnology, which can enhance bioavailability and efficacy. Despite these opportunities, challenges remain, such as the lack of international standardization, limited access to halal-certified raw materials, and insufficient synergy between Islamic ethnopharmacology and modern biotechnology. Addressing these limitations requires a collaborative ecosystem involving policymakers, researchers, and the pharmaceutical industry to develop inclusive regulations, invest in halal research and innovation, and educate the public on the spiritual and medical value of herbal remedies. Ultimately, the fusion of Islamic philosophy of science and modern herbal pharmaceutical technology offers a transformative model for global healthcare. It enables the creation of holistic products that honor religious obligations while advancing medical science. This faith-driven innovation contributes not only to physical healing but also to spiritual well-being, promoting ethical, sustainable, and culturally relevant healthcare. By doing so, it directly supports the objectives of the Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-Being), SDG 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 10 (Reduced Inequalities), highlighting the role of Islamic-guided herbal medicine in achieving global health and sustainability targets.

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Author Contribution

All authors contributed equally to the preparation of this article. Each author has read and approved the final manuscript of the article and declares that they have no conflict of interest in this research.

Conflicts of Interest

All authors declare that there are no conflicts of interest related to the research and publication of this article.

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