Jurnal Studi Ilmu-Ilmu al-Qur'an dan Hadis – ISSN: 1411-6855 (p); 2548-4737 (e)
Vol. 26, No. 1 (Januari 2025), hlm.189-216 , doi: 10.14421_qh.v26i1.6134
https://ejournal.uin-suka.ac.id/ushuluddin/qurdis/index
Article History: Submitted: 21-01-25 Revised:06-02-25 Accepted: 09-03-25

Fiqh of Biotechnology: Reinterpreting Qur'anic Verses on the Impurity of Pigs and Its Implications for the Halal Status of Vaccines

Fikih Bioteknologi: Reinterpretasi Ayat-ayat Al-Qur'an tentang Najis Babi dan Dampaknya terhadap Kehalalan Vaksin
Indonesia

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Abstract

The use of pig-derived ingredients in vaccine production, such as trypsin enzyme and gelatin, has sparked controversy among Muslims. This issue stems from the fiqh understanding of the impurity (*najāsah*) of pigs as stipulated in the Qur'an and Hadith through Qur'anic interpretation. This study aims to reinterpret Qur'anic verses and Hadith on the impurity of pigs within the framework of Fiqh of Biotechnology, a novel approach integrating Islamic jurisprudence and biotechnology. This research employs a qualitative method based on library research, analyzing Qur'anic verses, Hadith, classical and contemporary tafsir, fatwas of Islamic scholars, and relevant biotechnology literature. The findings reveal that there are six Qur'anic verses and at least three Prophetic Hadiths declaring the prohibition of pigs, yet interpretations among scholars vary. From a biotechnological perspective, the trypsin enzyme used in the cell culture stage of vaccine production is entirely removed through filtration and purification processes, rendering it pure. Meanwhile, pig-derived gelatin undergoes significant transformation during vaccine production, which, according to the concept of *istihalah*, has the potential to alter its legal status to halal. By integrating the fiqh principles of *thaharah*, *najis-mutanajjis*, and *istihalah* with the purification principles of biotechnology, this study proposes the Fiqh of Biotechnology as a new approach in assessing the halal status of vaccines containing pig-derived ingredients.

Keywords: Fiqh of Biotechnology, Impurity of Pigs, Qur'an-Hadith, Istihalah, Halal Status of Vaccines

Abstrak

Penggunaan bahan turunan babi dalam produksi vaksin, seperti enzim tripsin dan gelatin, telah menimbulkan kontroversi di kalangan umat Islam. Isu ini berakar pada pemahaman fikih tentang najis babi yang diatur dalam Al-Qur'an dan hadis melalui penafsiran Al-Qur'an. Studi ini bertujuan untuk mereinterpretasi ayat-ayat dan hadis tentang najis babi dalam kerangka pengembangan Fikih Bioteknologi, suatu pendekatan baru yang mengintegrasikan hukum Islam dan bioteknologi. Penelitian ini menggunakan pendekatan kualitatif berbasis studi pustaka dengan menganalisis ayat-ayat Al-Qur'an, hadis, tafsir klasik dan kontemporer, fatwa ulama, serta literatur bioteknologi terkait. Hasil penelitian menunjukkan bahwa terdapat enam ayat Al-Qur'an dan setidaknya tiga hadis Nabi yang menyatakan keharaman babi, tetapi terdapat variasi dalam interpretasi ulama. Dari perspektif bioteknologi, enzim tripsin yang digunakan dalam tahap kultur sel dalam produksi vaksin sepenuhnya dihilangkan melalui proses filtrasi dan purifikasi, sehingga dianggap suci. Sementara itu, gelatin babi

mengalami transformasi signifikan dalam produksi vaksin, yang menurut konsep istihalah berpotensi mengubah status hukumnya menjadi halal. Dengan mengintegrasikan In recent years, biotechnology has emerged as a rapidly advancing and highly influential field of science. One of its most significant applications is vaccines, proven effective in preventing infectious diseases. However, the use of pig-derived ingredients in vaccine production has sparked considerable debate. The Qur'an and hadith explicitly prohibit the consumption of pigs, raising concerns among Muslims. Therefore, it is crucial to explore how fiqh can adapt to biotechnological advancements and offer clear guidance to Muslims on this matter.

Kata Kunci: *Fikih Bioteknologi, Najis Babi, Al-Qur'an-Hadis, Istihalah, Kehalalan Vaksin*

Introduction

This article aims to explore the Qur'anic verses and hadith regarding pigs, formulate a new fiqh framework, and provide fresh interpretations with implications for the halal status of vaccines. By integrating fiqh and biotechnology, this study seeks to address the issue of vaccine halalness, alleviating public concerns and ultimately improving the health of Muslim communities.[1]

A number of works associated with this research are listed below:

Tabel 1. Relevan Works with this research

Author Name	**Writing Title**	**Legal Conclusion on the Use of Pig Ingredients in Medicine**
Abdul Hakim, Yazid Imam Bustomi	Analysis of Istinbath Ahkam Fatwa of the Indonesian Ulema Council Number 14 of 2021 on the Law of Using the Covid-19 Vaccine for Astrazeneca Products	The AstraZeneca vaccine is considered haram due to the use of porcine-derived trypsin but is permissible under emergency conditions.[2]

1 Abu Hena Mostofa Kamal et al., "Factors Affecting Willingness to Receive COVID-19 Vaccine Among Adults: A Cross-Sectional Study in Bangladesh," *Journal of Health Management* 25, no. 3 (October 14, 2021): 414–423, accessed December 23, 2024, https://journals.sagepub.com/doi/10.1177/09735984211050691.

2 Abdul Hakim and Yazid Imam Bustomi, "Analisis Istinbath Ahkam Fatwa Majelis Ulama Indonesia Nomor 14 Tahun 2021 Tentang Hukum Penggunaan Vaksin Covid-19 Produk Astrazeneca," *Muâṣarah: Jurnal Kajian Islam Kontemporer* 3, no. 2 (December 31, 2021): 9–14, accessed December 25, 2024, https://jurnal.uin-antasari.ac.id/index.php/muasharah/article/view/5704.

Padela, Aasim I.	Islamic Verdicts in Health Policy Discourse: Porcine-Based Vaccines as a Case Study	The decision by MUI to initially prohibit the GSK Meningitis vaccine but later permit it under emergency conditions highlights key considerations in Islamic bioethics.[3]
Abdul Moben Amin, Hacı Mehmet Günay	The Role of Istihalah (Transformation) and Istihlak (Dilution) in the Permissibility of Vaccines Derived from Forbidden Origins: An Islamic Law Perspective	The use of haram ingredients in vaccines can be legitimized through processes of istihalah (transformation) or istihlak (dilution), which alter their original nature.[4]
Ahmad Atabik, Muhammad R. Muqtada	Maqashid Quran's Critical View on Indonesian Ulema Council's Fatwa on Halal Certification of COVID-19 Vaccine	MUI's fatwa permits the use of COVID-19 vaccines containing porcine ingredients under emergency conditions, aligning with the principles of maqashid sharia.[5]
Heri Sudarsono, et al.	Does "Halalness" Affect Young Muslims' Intentions to Use the COVID-19 Vaccine?	Halal awareness significantly influences vaccine acceptance, although the use of porcine-based vaccines is permissible in emergencies.[6]

3 Aasim I. Padela, "Islamic Verdicts In Health Policy Discourse: Porcine-Based Vaccines As A Case Study," *Zygon* 48, no. 3 (2013): 655–670.

4 Abdul Moben Amin and Haci Mehmet Günay, "The Role Of Istihalah (Transformation) And Istihlak (Consumption) In The Permissibility Of Vaccines Derived From Forbidden Origins: An Islamic Law Perspective," *Journal Of Halal And Ethical Research* 5, no. 2 (January 1, 2023): 1–23, accessed December 25, 2024, https://www.academia.edu/113319873/Doi: 10.51973/head.1338259

5 Ahmad Atabik and Muhammad R. Muqtada, "Maqashid Quran's Critical View on Indonesian Ulema Council's Fatwa on Halal Certification of COVID-19 Vaccine," *HTS Teologiese Studies / Theological Studies* 80, no. 1 (March 20, 2024): 6, accessed December 25, 2024, https://hts.org.za/index.php/hts/article/view/9050/26619. Doi:10.4102/HTS.V80I1.9050

6 Ponchanok Nuanmark Heri Sudarsono, et.al. "Does 'Halalness' Affect Young Muslims' Intentions to Use the COVID-19 Vaccine? | Sudarsono | Indonesian Journal of Halal Research," *Indonesian Journal of Halal Research*, last modified 2023, accessed December 23, 2024, https://journal.uinsgd.ac.id/index.php/ijhar/article/view/19248/8794. https://doi.org/10.15575/ijhar.v5i1.19248

M. Asrorun Niam Sholeh, Muhammad Ishar Helmi	The COVID-19 Vaccination: Realization on Halal Vaccines for Public Benefit	The use of impure vaccines is permissible in emergencies to safeguard public health and achieve herd immunity.[7]
Padela, Aasim I., et al.	Dire Necessity and Transformation: Entry-Points for Modern Science in Islamic Bioethical Assessment of Porcine Products in Vaccines	While the use of porcine products in medicine is generally prohibited, emergency situations and the concept of istihalah provide exceptions, though debates persist.[8]
Abdelhalim Mohamed Mansour	"Hukm al-Tadāwa bi-A′ḍā′ al-Khinzīr: Dirāsah Fiqhiyyah Muqāranah."	The use of porcine-derived components is permissible in emergencies when no halal alternatives are available to save lives.[9]
Wan Nur Ezzah, Mohd Hafidz Maifiah	Porcine and Bovine-Derived Ingredients: Islamic Rules in Halal Pharmaceutical Products	The use of porcine-derived ingredients in pharmaceuticals is permissible under emergency conditions, supported by the principles of istihlak and istihalah.

7 M. Asrorun Niam Sholeh and Muhammad Ishar Helmi, "The COVID-19 Vaccination: Realization on Halal Vaccines for Benefits," *Samarah: Jurnal Hukum Keluarga dan Hukum Islam* 5, no. 1 (June 30, 2021): 174–190, accessed December 23, 2024, https://jurnal.ar-raniry.ac.id/index.php/samarah/article/view/9769. ttp://dx.doi.org/10.22373/sjhk.v5i1.9769

8 Abdelhalim Mohamed and Mansour Ali, "T*he Legal Ruling Of Using Pork Parts For Medication: A Comparative Legal Study* | Al Qasimia University Journal of Shari'a Sciences and Islamic Studies,"*Majallaẖ al-Jāmi'aẖ al-Qāsimiyyaẖ li al-'Ulūm al-Syar'iyyaẖ wa al-Dirāsāt al-Islāmiyyaẖ* , last modified 2022, accessed December 25, 2024, https://journals.alqasimia.ac.ae/index.php/ssis/article/view/152.

9 Abdelhalim Mohamed and Mansour Ali, "T*he Legal Ruling Of Using Pork Parts For Medication: A Comparative Legal Study* | Al Qasimia University Journal of Shari'a Sciences and Islamic Studies," *Majallaẖ al-Jāmi'aẖ al-Qāsimiyyaẖ li al-'Ulūm al-Syar'iyyaẖ wa al-Dirāsāt al-Islāmiyyaẖ* , last modified 2022, accessed December 25, 2024, https://journals.alqasimia.ac.ae/index.php/ssis/article/view/152.

Mardian, et al.	Sharia (Islamic Law) Perspectives on COVID-19 Vaccines	The use of COVID-19 vaccines to combat the pandemic aligns with Islamic law, though vaccines free from animal-derived ingredients enhance public acceptance.[10]

This paper distinguishes itself from previous studies by introducing a novel scientific branch: The Fiqh of Biotechnology. This new framework elaborates and interconnects key concepts in traditional fiqh and biotechnology, such as the principles of filtration and purification in vaccine production, which are correlated with the concept of purifying najis-mutanajjis in fiqh.

This research employs a library research method, encompassing data collection, selection, analysis, and documentation of findings. Primary data is sourced from the Qur'an and tafsir books, including *Tafsir al-Qurthuby*, tafsir *Ibnu Katsir*. Meanwhile, secondary data is obtained from journal articles, fiqh books, fatwas issued by Islamic scholars and official institutions, as well as literature on vaccine biotechnology. This approach is expected to yield a comprehensive understanding of the relationship between fiqh and biotechnology.

Qur'anic Verses, Prophetic Hadiths, and Classical Interpretations on Pig Impurity

There are four verses of the Qur'an that state the prohibition of pigs, namely:

> Indeed, He has only forbidden you carrion, blood, pork, and that which is slaughtered in the name of other than Allah. But whoever is in a state of necessity, without desiring it and not transgressing the limits, then there is no sin for him. Indeed, Allah is Forgiving, Merciful." (QS 2:173)
>
> Forbidden to you are carrion, blood, pork, and that which is slaughtered in the name of other than Allah, as well as animals that are strangled to death, animals that are beaten, animals that fall, and animals that are gored, and what is eaten by wild animals, except what you have time to slaughter, and what is slaughtered on an offering stone, and you should not draw lots with arrows. These are all sins) (Quran 5:2).
>
> Say, 'I have not found in what has been revealed to me anything that

10 Wan Nur Ezzah Syahirah Wan Ismail and Mohd Hafidz Mahamad Maifiah, "Porcine and Bovine-Derived Ingredients: Islamic Rules in Halal Pharmaceutical Products," *Journal of Fatwa Management and Research* 28, no. 3 (2023): 41–57. ttps://doi.org.10.33102/jfatwa.vol.28no3.549

> is forbidden to a person who wishes to eat it, except if it is carrion, flowing blood, or pork. For these are filth or sinful things slaughtered in the name of other than Allah. So, whoever is in a state of necessity, without desiring it and not exceeding the limit, then surely your Lord is Forgiving, Merciful) (QS 6: 145).
>
> Indeed, He has only forbidden you carrion, blood, pork, and that which is slaughtered in the name of other than Allah. But whoever is in a state of necessity, without desiring it and not transgressing the limits, then there is no sin on him. Indeed, Allah is Forgiving, Merciful) (Quran 16:115).

The four verses above serve as the legal foundation for Muslims to avoid all products containing pig-derived ingredients. The prohibition of pork is further supported by the following hadith narrations from the Prophet Muhammad (peace be upon him):

The Messenger of Allah said in the year of Fathu Makkah: 'Verily, Allah and His Messenger have forbidden the sale of alcohol, carrion, pigs and idols.' Then someone asked: 'O Messenger of Allah, what about the fat of carcasses, because it is used to coat boats, smear leather, and oil night lamps?' The Messenger of Allah replied: 'No, it is haram. (HR Bukhari: 2082, Turmudzi: 1218, Muslim: 2960).

The Messenger of Allah said: "Verily, Allah has forbidden wine and the money from its sale, forbidden carrion and the money from its sale, and forbidden pork and the money from its sale ".(HR Abu Daud: 3024).

> The Prophet said: "May Allah curse the Jews, lard has been forbidden to them, but they still pack and sell it .(Ibn Majah: 3374).

The classical interpretation of the prohibition of pork has been extensively discussed by Islamic scholars throughout Islamic history. Many Islamic scholars refer to tafsir books that elaborate on the meaning of the verses prohibiting pigs. For instance, *Tafsir Ibn Kathir* and *Tafsir al-Jalalayn* assert that the prohibition of pork is absolute, with no exceptions permitted. When interpreting QS al-An'am: 145 above, Ibn Kathir stated:

> *"Ma'nāhu, lā ajidu shay'an mimmā ḥarramtum ḥarāman siwā hādhihi. Wa qīla Ma'nāhu, lā ajidu min al-ḥayawānāti shay'an ḥarāman siwā hādhih. Fa-'alā hādhā yakūnu mā warada min at-taḥrīmāti ba'da hādhā fī sūrati 'al-Mā'idah', wa fī al-aḥādīthi al-wāridati, rāfi'an li-mafhūmi hādhihi al-āyah*."
>
> (Its meaning is, I do not find anything that you have declared forbidden to be haram except these. It is also said: Its meaning is: I do not find any animals (1) that are haram except these. Based on this, the prohibitions mentioned after this in Surah 'Al-Ma'idah' and in the hadiths that have been narrated are considered as exceptions to the

understanding of this verse).[11]

Meanwhile, Al-Qurtubi, in his tafsir (exegesis) book, states:

"*Khaṣṣa Allāhu Taʿālā dhikra al-laḥmi mina al-khinzīri liyadulla ʿalā taḥrīmi ʿaynihi dhukkīya aw lam yuzakk, waliyaʿumma ash-shaḥma wa mā hunālika mina al-ghuḍārīf.*" (Allah the Almighty specifically mentioned the meat of the pig to indicate the prohibition of its essence, whether it has been slaughtered properly or not, and to include the fat and the cartilage therein).[12]

Al-Baidhawi saat menafsirkan QS al-Baqarah: 173 ia menyatakan:

"*Innamā khashsha al-lahma bi al-dzikri, li'annahu aʿzhām mā yu'kulu mina al-hayawāni wa sā'iru ajzā'ihi ka al-tābiʿi lahu*. (The meat is specifically mentioned because it is the main part of the animal that is consumed, while the rest of its parts follow it in ruling). [13]

The majority of Indonesian Muslims adhere to this view, [14] as echoed by scholars like Ranuwijaya.[15]

However, the interpretation of the verses regarding pigs is more nuanced. Al-Qurthubi, for example, when interpreting QS Al-Baqarah: 173, states that pig hair is not forbidden and may still be used. He says:

"Lā khilāfa anna jumlata al-khinzīri muḥarramatun illā ash-shaʿra fa-innahu yajūzu al-khirāzatu bihi. Wa qad ruwiya anna rajulan sa'ala Rasūlallāh ﷺ ʿani al-khirāzati bishaʿri al-khinzīr, fa-qāla: (Lā ba'sa bidzālik). Dhakarahu Ibn Khuwaiyz Mandād, qāla: wa li'anna al-khirāzata ʿalā ʿahdi Rasūlillāh ﷺ kānat, wa baʿdahu mawjūdah ẓāhirah, lā naʿlamu anna Rasūlallāh ﷺ ankrahā wa lā aḥada mina al-a'immah baʿdahu. Wa mā ajāzahū ar-Rasūl ﷺ fahuwa ka-ibtidā'i ash-sharʿi minhu."

(There is no disagreement that the entirety of the pig is prohibited, except for its hair, as it is permissible to use it for stitching. It has been reported that a man asked the Messenger of Allah ﷺ about stitching with pig hair, and he said: "There is no harm in that." This

11 Ibnu Kathir, Tafsir Ibnu Kathir, accessed via *"Al-Bāḥits al-Qur'ānī* | 6:145 | *Tafsīr Ibnu Kaśīr,"* January 8, 2025, https://tafsir.app/ibn-katheer/6/145.

12 al-Qurthuby, "*Al-Bāḥits al-Qur'ānī* | 2:173 | *Tafsīr al-Qurṭubī*," accessed March 8, 2025, https://tafsir.app/qurtubi/2/173.

13 al-Baidhawi, "*Al-Bāḥits al-Qur'ānī* | 2:173 | *Tafsīr al-Baiḍāwī*," accessed March 8, 2025, https://tafsir.app/albaydawee/2/173.

14 J. M. Muslimin, Rizky Fauzi Iskandar, and Yulia Fatma, "Islam and Medicine: A Study on The Fatwa of Indonesian Ulama Council on Vaccines," *Al-Istinbath: Jurnal Hukum Islam* 6, no. 1 (2021): 85–106.

15 Utang Ranuwijaya, "Keharaman Hewan Dalam Perspektif Al-Qur'an Dan Hadits," *Al Qalam* 22, no. 3 (December 30, 2005): 457–475, accessed December 25, 2024, https://jurnal.uinbanten.ac.id/index.php/alqalam/article/view/1370.

> was mentioned by Ibn Khuwaiyz Mandād. He said: "Because stitching existed during the time of the Messenger of Allah ﷺ and after him, and it was openly practiced, yet we do not know that the Messenger of Allah ﷺ ever prohibited it, nor did any of the scholars after him. And whatever the Messenger ﷺ permitted is considered as the beginning of legislation from him).[16]

In the narration mentioned by al-Qurtubi, it appears that pig bristles used as "al-khizarah" (a tool for sewing) are considered pure, not impure, because the Prophet himself did not instruct that they be washed. Meanwhile, al-Alusi, in his tafsir, states that this verse (al-Baqarah: 173) can indeed be understood to mean that all parts of the pig are forbidden; however, some scholars interpret that only its flesh is prohibited, such as the Zahiriyah group. He states:

> "*Khushsha al-lahmu bi al-dzikri ma'a anna baqiyyata ajzā'ihi aydhan harāmun khilāfan li al-Zhāhiriyyah.*" (The meat is specifically mentioned, even though the rest of its parts are also prohibited, contrary to the view of the Zahiri school).[17]

Abd al-Ḥalīm Manṣūr 'Alī from Alqasimia University, United Arab Emirates, in his research published in the AQU *Journal of Shari'a Sciences and Islamic Studies*, identifies two main opinions on this matter.[18] The first opinion, held by the majority of Islamic scholars from the Hanafi, Shafi'i, Hanbali, and Zahiri schools, asserts that pigs are inherently impure (najis al-'ayn). This includes all parts of their bodies, such as sweat, saliva, and other bodily fluids.[19] The second opinion, prominent in the Maliki school, maintains that pigs are impure only while they are alive. They argue that all living beings are inherently pure, and impurity is an acquired characteristic rather than an intrinsic one. According to this view, every living creature, including dogs and pigs, is inherently pure, along with their bodily fluids such as sweat, saliva, tears, and mucus. [20] However, these animals remain haram to consume. Its status is similar to that of snakes, lions, and other animals which are *haram* (forbidden) while alive, but their bodies are considered pure.

Fiqh of Biotechnology: A New Perspective on Qur'anic Verses

16 al-Qurthuby, "*Al-Bāḥits al-Qur'ānī* | 2:173 | *Tafsīr al-Qurṭubī*."

17 Al-Alusi, "*Al-Bāḥits al-Qur'ānī* | 2:173 | *Tafsīr al-Ālūsī*," accessed March 8, 2025, https://tafsir.app/alaloosi/2/173.

18 Mohamed and Ali, "The Legal Ruling Of Using Pork Parts For Medication: A Comparative Legal Study" *Al Qasimia University Journal of Shari'a Sciences and Islamic Studies*." 2(2), (2022): 87-134. https://doi.org/10.52747/aqujssis.2.2.152

19 'Alī, A. (2022). "Ḥukm al-Tadāwa…" 87-134.

20 'Alī, A.. "Ḥukm al-Tadāwa…" (2022): 87-134.

Prohibiting Pork

The term "*fiqh*" derives from the root *'faqiha-yafqahu-fiqhan*,' which means 'al-'Ilmu bi al-syai' wa al-fahmu lahu wa al-fathanatu' (knowledge, understanding, and discernment of something). It can also be interpreted as *'idrāku al-syai' wa al-'ilmu bihi*,' meaning the ability to know and understand something.[21] Ibn Manzûr, in his dictionary *Lisân al-Ara*b, explains that 'al-Fiqh' has two meanings. The first is *'al-Fathanatu*,' referring to intelligence or sharpness of thought, as illustrated in the expression: *'Khayru al-fiqhi ma dhurrat bihi, wa sharru al-ra'yi al-dabari*' (The best intelligence is that which is preserved, and the worst thinking is that which deviates). The second meaning is *'al-Fahmu*,' which signifies understanding. Ibn Manzûr considers this second meaning to be the more accurate one, as supported by QS. al-Taubah: 122.[22]

The word *'tafaqqaha'* in QS. al-Taubah: 122 refers to someone deeply knowledgeable in Islamic religious matters. This term is also found in a hadith where the Prophet Muhammad (peace be upon him) prayed for Ibn Abbas: 'Allāhumma faqqihhu fī al-dīn' ('O Allah, grant him deep understanding in religion') (HR. al-Bukhârî). Over time, the definition of fiqh evolved. In contemporary times, scholars define fiqh as: *'Al-'ilmu bi al-aḥkām al-syar'iyyah al-'amaliyyah al-muktasab min adillatihā al-tafṣīliyyah'* (the knowledge of practical Islamic rulings derived from detailed evidence).[23]

Islamic scholars recognized the need to develop fiqh to address contemporary challenges, leading to the emergence of new branches such as social fiqh, communication fiqh, minority fiqh, environmental fiqh, and disability fiqh, among others. For instance, environmental fiqh emerged in response to modern ecological challenges, demonstrating the dynamic and flexible nature of fiqh, which integrates seamlessly with various modern sciences. Therefore, integrating fiqh with biotechnology is essential to address contemporary human challenges. While traditional fiqh on the prohibition of pork has guided Muslims, it faces limitations in the context of modern biotechnology, as conventional Islamic jurisprudence often lags behind scientific advancements. These limitations necessitate dialogue and collaboration among scientists, Muslim scholars, and policymakers to develop solutions that align with both health standards and religious principles, ensuring Muslims can access vaccines

21 Al-Thahir Al-Zawî, *Tartib Al-Qamus Al-Muhit*, II. (Beirut: Dar al-Fikr, 1959), https://waqfeya.net/books/*Tartīb al-Qāmūs al-Muḥīṭ 'alā Ṭarīqah al-Miṣbāḥ al-Munīr wa Asās al-Balāgah*-c0d38d322d614e23ab0c8352099442f2.

22 Ibid.

23 Muhammad Norhadi, "Relasi Iman Dan Fikih," *El-Mashlahah* 9, no. 1 (2019): 62–75. Doi: 10.23971/el-mas.v9i1.1354

and health products without compromising their faith.[24]

From an ontological perspective, fiqh of biotechnology is essentially an effort to reinterpret the legal verses in the Qur'an to find solutions to problems arising from the rapid development of biotechnology science. Conventional fiqh has so far struggled to provide precise solutions and has left unresolved issues. Meanwhile, from an epistemological perspective, fiqh of biotechnology is a combination between traditional fiqh and biotechnology, examining the application of Islamic principles in modern biological technologies across health, agriculture, industry, and environmental fields. The Fiqh of biotechnology addresses issues such as CRISPR technology for DNA editing, cloning, gene therapy, organ transplantation, and the use of genetically modified organisms (GMOs), among others. The fiqh of biotechnology aims to provide legal guidance for Muslims on issues arising from biotechnological advancements. It requires Muslim scientists to understand both religious principles and scientific theories, balancing the two in its approach.

The sources of knowledge in the fiqh of biotechnology are diverse. *First*, the primary sources are the Qur'an and Hadith, which serve as the foundational guidelines for Islamic law. Many verses can be interpreted to evaluate the permissibility of biotechnological applications. *Second*, fatwas from religious scholars and institutions are crucial secondary sources. These fatwas provide guidance on contemporary issues, including vaccines, in vitro fertilization (IVF), and human cell therapy. *Third*, scientific research and case studies are essential, offering data to ensure precise and accurate conclusions that avoid harm to humanity. *Fourth*, practical experiences and best practices in biotechnology applications are valuable sources, providing insights into legal and ethical implications.

The methodology for deriving knowledge in the fiqh of biotechnology involves a multidisciplinary approach, integrating Islamic legal principles with contemporary scientific knowledge. A key method is ijtihad, which entails deriving legal rulings from sharia sources like the Qur'an and Hadith, while considering scientific and social contexts. Ijtihad is essential for addressing new issues not explicitly covered in classical texts.

Applying Fiqh of Biotechnology to the Halal Status of Pig-Derived Vaccines

Vaccines are among the most significant biotechnology products in human

24 Eric Wombwell et al., "Religious Barriers to Measles Vaccination," *Journal of Community Health* 40, no. 3 (June 1, 2015): 597–604, accessed December 25, 2024, https://link.springer.com/article/10.1007/s10900-014-9956-1.

history, designed to provide immunity against specific diseases by stimulating the body's immune system. Vaccines introduce antigens—substances that trigger an immune response—into the body. This enables the immune system to recognize and combat the pathogen in the future, offering long-term protection.

Based on their raw materials, vaccines can be categorized as follows. 1) Live attenuated vaccines use weakened viruses or bacteria that cannot cause disease but still elicit a strong immune response. Examples include the measles, mumps, and rubella (MMR) vaccine.[25] 2) Inactivated vaccines use killed pathogens that cannot cause infection but still stimulate the immune system. An example is the polio vaccine used in immunization programs. 3) Subunit vaccines use specific parts of a pathogen, such as proteins, to trigger an immune response. An example is the hepatitis B vaccine. 4) mRNA vaccines use RNA fragments from a pathogen to produce antigens in the body, triggering an immune response. Examples include the COVID-19 vaccines developed by Pfizer-BioNTech and Moderna.

Each vaccine type is manufactured using unique technologies and processes. Even vaccines for the same disease may vary in ingredients, tools, and methods across brands. Consequently, the halal status of vaccines must be evaluated individually, as general rulings cannot be applied.

Steps in the Vaccine Manufacturing Process

The vaccine manufacturing process involves the following key stages:

Antigen selection and isolation: Antigens, typically viruses or bacteria, serve as the foundation for vaccine production. Genetic analysis is conducted to identify suitable antigen components that can elicit an immune response.[26]

Cell culture for antigen production: Antigen cells are cultivated in bioreactors under controlled conditions of temperature, pH, and nutrient supply to ensure optimal growth. Precise cell culture techniques enhance the quality and consistency of vaccine production.[27] Protease enzymes like trypsin are often added during this stage to facilitate cell separation (*trypsinization*).[28]

25 Sameer Rao et al., "A Review of Immunogenicity and Tolerability of Live Attenuated Hepatitis A Vaccine in Children," *Human Vaccines and Immunotherapeutics* 12, no. 12 (2016): 3160–3165. http://dx.doi.org/10.1080/21645515.2016.1216286

26 Avital Jayson et al., "Application of Ambr15 System for Simulation of Entire SARS-CoV-2 Vaccine Production Process Involving Macrocarriers," *Biotechnology Progress* 38, no. 5 (2022): 1–9.

27 Osnat Rosen et al., "Optimization of VSV-ΔG-Spike Production Process with the Ambr15 System for a SARS-COV-2 Vaccine," *Biotechnology and Bioengineering* 119, no. 7 (2022): 1839–1848.

28 Merck, "Egg-Based and Cell-Based Influenza Vaccine Manufacturing Methods," accessed December 27, 2024, https://www.sigmaaldrich.com/ID/en/technical-documents/technical-article/pharmaceutical-and-biopharmaceutical-manufacturing/vaccine-manufacturing/egg-based-cell-based-influenza-vaccine-

Purification of vaccine antigens: This step removes impurities from the cultured cells to ensure the safety of the vaccine antigen. Techniques such as filtration, chromatography, and precipitation are employed for purification.[29]

Formulation: The purified antigens undergo specific treatments based on the vaccine type. Inactivated vaccines involve killing the pathogen, while attenuated vaccines use weakened pathogens. Subunit vaccines utilize specific protein components, and mRNA vaccines isolate RNA fragments. In this stage, adjuvants and stabilizers, such as gelatin and sorbitol, are added to enhance efficacy, stability, and shelf life.[30] These stabilizers ensure vaccine integrity during storage[31] and transportation.[32]

Pre-clinical testing: The vaccine is tested on experimental animals to assess safety and efficacy before human trials.

Upon approval by health authorities, the vaccine advances to clinical trials, which consist of three phases conducted under stringent supervision. The following table outlines the guidelines employed during the clinical trial stages of vaccine development.

Table 2. the guidelines employed during the clinical trial stages of vaccine.[33]

Phase	Number and Type of Trial Volunteer Sample	Scientific Questions Used to Test

manufacturing.

29 Sun Young Park et al., "Efficient Removal of Non-Structural Protein Using Chloroform for Foot-and-Mouth Disease Vaccine Production," *Vaccines 2020, Vol. 8, Page 483* 8, no. 3 (August 27, 2020): 483, accessed December 25, 2024, https://www.mdpi.com/2076-393X/8/3/483/htm.

30 Nabila A. Ghazy et al., "The Use of Different Stabilizers for Improving Integrity of the Locally Prepared Lyophilized Brucella Melitensis Rev 1 Vaccine," *Journal of Veterinary Medical Research* 25, no. 1 (June 1, 2018): 59–67, accessed December 25, 2024, https://jvmr.journals.ekb.eg/article_43302.html.

31 Janika Wolff et al., "Development of a Safe and Highly Efficient Inactivated Vaccine Candidate against Lumpy Skin Disease Virus," *Vaccines* 9, no. 1 (January 1, 2020): 1–30, accessed December 25, 2024, https://pubmed.ncbi.nlm.nih.gov/33374808/.

32 Nagisa Tokunoh et al., "A Nasal Vaccine with Inactivated Whole-Virion Elicits Protective Mucosal Immunity against SARS-CoV-2 in Mice," *Frontiers in Immunology* 14 (August 31, 2023): 1224634.

33 Emmanuel B. Walter and M. Anthony Moody, "Vaccine Development: Steps to Approval of an Investigational Vaccine," *North Carolina Medical Journal* 82, no. 2 (2021): 141–144.

I	20 to 100 healthy adults	• Is this vaccine safe? • Is this vaccine tolerated by the body? • What are the side effects of the vaccine in relation to the dose given? • Does this vaccine produce the desired immune response?
II	Several hundred people from the target population	• What is the desired dose of vaccine and what is the interval of administration? • Is the desired immune response to the vaccine achieved? • What are some common short-term vaccine side effects?
III	Few hundred to tens of thousands of people from the target population.	• How effective and safe is the vaccine compared to people who did not receive the vaccine? • What are the most common side effects? • Are safety and immune responses in participants consistent across different lots of vaccine production? • What is the effect on safety and immune response when vaccines are given together with other vaccines?

Evaluation: The results of the three-phase clinical trials are submitted to health authorities for assessment. At this stage, three outcomes are possible: full approval, emergency use authorization (due to urgent conditions), or rejection if deemed unsuitable. Only after passing this evaluation can the vaccine be mass-

produced and distributed to the public.[34]

Surveillance (Post-Marketing Surveillance): Even after approval for widespread distribution, vaccines are continuously monitored by health authorities to detect any adverse side effects. If issues arise, the vaccine's distribution license may be revoked, requiring the manufacturer to withdraw it from the market.[35]

Pig-Derived Elements in Vaccine Production: Trypsin and Gelatin

Pig-derived elements are involved in two stages of vaccine production: cell culture (trypsin from pig pancreas) and formulation (gelatin from pig skin, used as a stabilizer). Trypsin is a proteolytic enzyme that breaks down proteins into smaller fragments. In cell culture, it facilitates cell separation (*trypsinization*) and also used to activate vaccine seed viruses by breaking down amino acid chains in host cells in the bioreactor.[36] Trypsin is typically derived from the pancreas of pigs or cows, followed by isolation, purification, and drying.[37] Examples of vaccines using pig-derived trypsin include Novartis,[38] Sanofi Pasteur's, [39] Influenza vaccines, Rabies vaccines, and AstraZeneca's COVID-19 vaccine.[40]

Another pig-derived element commonly used in vaccines is gelatin, a protein obtained from the hydrolysis of collagen in animal skin and bones. Vaccines that may contain pig gelatin during the formulation stage include the Measles, Mumps, and Rubella (MMR) vaccine,[41] Varicella (Chickenpox) vaccine, DPT (Diphtheria-

34 Ibid. Doi: 10.18043/ncm.82.2.141

35 Ran D. Goldman et al., "Caregivers' Willingness to Accept Expedited Vaccine Research During the COVID-19 Pandemic: A Cross-Sectional Survey.," *Clinical therapeutics* 42, no. 11 (November 1, 2020): 2124–2133, accessed December 25, 2024, https://pubmed.ncbi.nlm.nih.gov/33067013/.

36 Hakim And Bustomi, "Analisis Istinbath Ahkam Fatwa Majelis Ulama Indonesia Nomor 14 Tahun 2021 Tentang Hukum Penggunaan Vaksin Covid-19 Produk Astrazeneca." Muåṣarah: Jurnal Kajian Islam Kontemporer, 3, 2021, https://jurnal.uin-antasari.ac.id/index.php/muasharah/article/view/5704 doi: 10.18592/MSR.V3I2.5704

37 Yolandha Tannia, Indra Kusuma, and Siti Nur Riani, "Tingkat Pengetahuan Mahasiswa Fakultas Pengetahuan Mahasiswa Fakultas Kedokteran Universitas Yarsi Mengenai Penggunaan Tripsin Dalam Proses Produksi Vaksin Polio," *Jurnal Sosial Sains* 1, no. 12 (2021): 1561–1571.

38 Zhiyuan Wen et al., "Establishment of MDCK Stable Cell Lines Expressing TMPRSS2 and MSPL and Their Applications in Propagating Influenza Vaccine Viruses in Absence of Exogenous Trypsin," *Biotechnology research international* 2015 (March 30, 2015): 1–9, accessed December 25, 2024, https://pubmed.ncbi.nlm.nih.gov/25918647/.

39 Maroudam Veerasami, "Individual and Multiplex PCR Assays for the Detection of Adventitious Bovine and Porcine Viral Genome Contaminants in the Commercial Vaccines and Animal Derived Raw Materials," *Journal of Veterinary Science & Technology* 05, no. 03 (2014).

40 Fatkul Chodir, "Kehalalan Vaksin Berunsur Babi: (Studi Vaksin Covid-19 Astrazeneka)," *Jurnal Kajian Hukum Islam* 8, no. 1 (March 31, 2021): 61–81, accessed December 25, 2024, https://journal.unsuri.ac.id/index.php/jkhi/article/view/27.

41 Paul Schmidle et al., "Gelatin-Containing Vaccines for Varicella, Zoster, Measles, Mumps, and Rubella

Tetanus-Pertussis) vaccine,[42] Japanese Encephalitis vaccine, and several Influenza vaccines.[43] The permissibility of vaccines containing pig gelatin remains debated among Islamic scholars, with some accepting it and others rejecting it.

In the lengthy process of vaccine production, as outlined in the 8 stages mentioned earlier, the involvement of the enzyme trypsin occurs only in the second stage, namely the cell culture stage for producing the vaccine seed. Here, the virus intended to be the vaccine candidate is provided with various nutrients mixed with the enzyme trypsin. Trypsin plays a crucial role in breaking down proteins into smaller peptides, making it easier for the virus to infect host cells and replicate. During the cell culture stage, trypsin helps ensure that the host cells (which serve as the home for the vaccine seed virus) can optimally support the growth of the vaccine seed virus. By breaking down proteins on the cell surface, trypsin facilitates the entry of the virus into the cells, allowing the virus to multiply and produce the vaccine seed in large quantities. Additionally, trypsin also aids in the detachment of infected cells from the culture surface, making it easier to collect and purify the virus for subsequent stages in vaccine production. Once this process is complete, the presence of trypsin is then removed through repeated filtration and purification processes until it is no longer detected in the final vaccine product injected into the patient's body.

Meanwhile, in the vaccine manufacturing process, gelatin is involved in the formulation stage (the fourth stage). At this stage, gelatin is used as a stabilizer or stabilizing agent that functions to protect the vaccine antigen from damage due to extreme temperatures, pH fluctuations, or mechanical stress during production and storage. Gelatin helps maintain the structural integrity and effectiveness of the vaccine by forming a protective matrix around the antigen, thereby ensuring long-term stability.

Interpreting Filtration and Purification in Vaccine Manufacturing as the Process of *Tathhirul Mutanajjis*

Filtration and Purification are critical stage in vaccine production, aimed at removing contaminants to ensure the safety of the vaccine final product. It follows

Induce Basophil Activation in Patients with Alpha-Gal Syndrome," *International archives of allergy and immunology* 182, no. 8 (August 1, 2021): 716–722, accessed December 25, 2024, https://pubmed.ncbi.nlm.nih.gov/33735861/.

42 Ceren Can and Bahar Kural, "Reassessing the Risks of MMR Vaccination for Egg-Allergic Patients Referred by Healthcare Workers; a Clinical Paradigm," *Iranian Red Crescent Medical Journal* 21, no. 6 (2019): 4–8.

43 Rehab S. Abd El-Rahman et al., "Protective Potential of MMR Vaccine against Complete Freund's Adjuvant-Induced Inflammation in Rats," *Inflammopharmacology* 19, no. 6 (December 2011): 343–348, accessed December 25, 2024, https://pubmed.ncbi.nlm.nih.gov/22081121/.

the antigen production stage, utilizing various biotechnological techniques to isolate antigens from other components.[44] Filtration techniques in vaccine production require thousands of liters of water, which serves as a solvent for antigens and removes contaminants for disposal. The following diagram illustrates the filtration process in vaccine production.

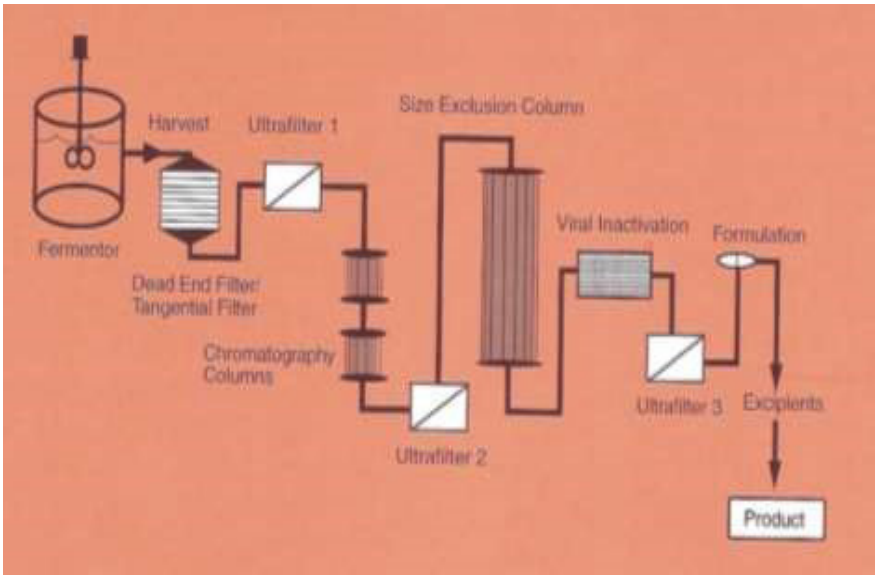

Figure 1. General scheme of purification steps in vaccine production (Source: Jagan S Nathan).[45]

The virus used as a vaccine seed initially holds the status of *mutanajjis*—a pure object contaminated by impurities. Through the purification process, it regains its pure status. While trypsin derived from pigs is considered as impure (*najis*). So, the pathogen used as a vaccine ingredient is classified as *mutanajjis*.

During the culturing stage, the virus is mixed in the bioreactor along with trypsin. Once this stage is completed, the trypsin impurity is thoroughly removed through purification processes, thereby eliminating its impure status. This process can be compared to the purification of clothing that has been contaminated with urine. Just as the clothing becomes pure again after the urine is washed away, the virus regains its pure status once the trypsin impurity is removed. In the case of *mughalazhah*

44 Kamal et al., "Factors Affecting Willingness to Receive COVID-19 Vaccine Among Adults: A Cross-Sectional Study in Bangladesh."

45 S Jagan Nathan et al., "Filtration Technique in Vaccine Manufacturing," *Advanced Biotech*, no. August (2008): 37–41, https://www.researchgate.net/publication/235706947_Filtration?enrichId=rgreq-1291e71d9049dbad188d674f980b2439-XXX&enrichSource=Y292ZXJQYWdlOzIzNTcwNjk0NztBUzo5OTU1Nzc1Mjk2NzE3OEAxNDAwNzQ3ODI4MjAw&el=1_x_2&_esc=publicationCoverPdf.

(greatest) impurities, such as those from dogs or pigs, Islamic jurisprudence requires purification through washing seven times. One of these washings must include the use of soil minerals, such as celite, to ensure complete purification. This principle underscores the thoroughness required in removing severe impurities and aligns with the rigorous purification processes in vaccine production. Thus, the filtration and purification process is essentially a cleansing process of a mutanajjis (contaminated) substance, which in conventional fiqh is referred to *as tathhirul mutanajjis*.

Istihlak and *Istihalah*: Applicable to Gelatin but Not Trypsin

Some of Islamic scholars justify the use of pig-derived elements, such as gelatin, through the principles of *istihlak* and *istihalah*. *Istihlak* refers to the process where a haram substance loses its properties by being mixed with a larger quantity of other substances, rendering it unrecognizable and halal. *Istihalah*,[46] on the other hand, involves a substantial transformation of a haram substance into a halal one through specific processes. For example, fesses, initially considered impure, becomes pure after decomposing into compost. In the context of vaccines, the pig trypsin enzyme is deemed halal due to the extensive processing that alters its original substance.[47]

However, the theory of *istihalah* is not universally accepted. While scholars from the Hanafi, Maliki, Ja'fari, and some Hambali schools, including Ibn Taymiyyah and Ibn Qayyim, endorse *istihalah* as a means to purify impure substances, others reject it. For instance, Shafi'i scholars and the majority of Hambali scholars do not accept *istihalah*.[48] This divergence of opinion significantly impacts the legal status of vaccine products, as illustrated in the table below.

Table 3. Summary of scholars' views on the use of pigs for medicine

Aspect	Majority of Traditional Scholars	Scholars Who Accept Emergency Principles	Scholars Who Accept Istihalah and Istihlak

46 Aadam T. Aris et al., "Muslim Attitude and Awareness towards Istihalah," *Journal of Islamic Marketing* 3, no. 3 (2012): 244–254.

47 Atabik and Muqtada, "Maqashid Quran's Critical View on Indonesian Ulema Council's Fatwa on Halal Certification of COVID-19 Vaccine."

48 Amin and Günay, "The Role Of Istihalah (Transformation) And Istihlak (Consumption) In The Permissibility Of Vaccines Derived From Forbidden Origins: An Islamic Law Perspective." Journal of Halal and Ethical Research, Istanbul Sabahattin Zaim University. 5 (2), 2023, doi: 10.51973/HEAD.1338259

Pig Origin Law	Absolutely forbidden based on the Qur'an and Hadith.	Still haram, except in emergencies.	Remains haram, unless it undergoes transformation (istihalah and istihlak).
Emergency (Dharurah)	No exemptions without clear emergency conditions.	Permissible if there is no other option and human life is threatened.	Permissible even without an emergency and if other options exist.
Istihalah and *Istihlak*	Not recognized; transformation of matter cannot change the status from impure to pure.	Not the main focus; only applicable during emergencies.	Recognized; Transformation of a substance changes its legal status from impure to pure.
Examples of Supporting Scholars	Shaykh Wahbah Zuhaili, the majority of Shafi'i and Hambali madhhabs.	Yusuf al-Qardhawi, European Studies and Fatwa Council, MUI.	Ibn Taymiyyah, Ibn Qayyim al-Jauziyah, Hanafi Madhhab, Maliki Madhhab, Ja'fari Madhhab.
Dalil	'He has only forbidden to you dead animals, blood, the flesh of swine...' (Al-Baqarah: 173).	'But whoever is forced by necessity, neither desiring nor transgressing, there is no sin upon him' (Al-Baqarah: 173).	Analogized to the Hadith of wine turning into vinegar.
Implications for Vaccines	Vaccines containing pig-derived elements cannot be used, even in emergencies.	Vaccines containing pig-derived elements can be used in emergencies where no other options exist.	Vaccines containing pig gelatin can be used at any time, as they are considered pure after the *istihalah* process.

Islamic scholars who apply the principles of istihlak and istihalah are typically well-versed in religious texts. However, their understanding of biotechnology, particularly enzymology, contains a significant oversight. In enzymology, enzymes, including trypsin, function as catalysts. Their mechanisms of action are explained by two theories: the Lock and Key theory and the Induced Fit theory.

The Lock and Key theory describes the enzyme-substrate interaction, where the enzyme acts as a 'lock' and the substrate as a 'key.' The enzyme's active site binds specifically to the substrate, converting it into a new product while the enzyme remains unchanged and reusable for further reactions.[49] The Induced Fit theory posits that the enzyme adjusts its shape upon substrate binding, enhancing reaction efficiency.[50] After the reaction, the enzyme reverts to its original form, ready for further reaction.[51] Both theories illustrate that enzymes remain unchanged before and after reactions, maintaining their structural integrity. This contradicts the istihalah theory, which posits that the trypsin enzyme undergoes a complete transformation, analogous to a carcass decomposing into compost. From an enzymology perspective, applying the istihalah theory to trypsin in vaccine manufacturing is scientifically incompatible.

Although the trypsin enzyme remains unchanged after the reaction, it does not persist in the final vaccine product. Trypsin is only involved in the cell culture stage, where antigen cells are grown. During the subsequent purification stage, the cultured cells are separated from contaminants, including trypsin, which is entirely removed. This aligns with PT Biofarma's clarification as follows:[52] First, trypsin is not a vaccine ingredient, but is used to harvest cells for viral media. It facilitates the release of cells from the viral medium. Second, trypsin is subsequently removed through washing and dilution with a significant volume of water. Third, no trace of trypsin is detected in the final vaccine product. The following table summarizes some aspects of the involvement of pork trypsin and gelatin in vaccine production from the perspective of Islamic Law and biotechnology.

Tabel 4. Comparison of Trypsin and Porcine Gelatin in Vaccine Production: Islamic Jurisprudential and Biotechnological Perspectives

Aspect	**Trypsin**	**Porcine Gelatin**
Origin	Derived from pig pancreas extraction.	Derived from the extraction of pig skin, bone, or connective tissue.

49 "Cara Kerja Enzim Lock and Key Dan Induced Fit | Kumparan.Com," accessed December 25, 2024, https://kumparan.com/tips-dan-trik/cara-kerja-enzim-lock-and-key-dan-induced-fit-21PolNo9Vxj/full.

50 "Induced-Fit Theory | Description, Enzyme, Allosteric Site, & Catalysis | Britannica," accessed December 25, 2024, https://www.britannica.com/science/induced-fit-theory.

51 Xiangying Guan et al., "Biophysical Characterization of Hit Compounds for Mechanism-Based Enzyme Activation," *PLOS ONE* 13, no. 3 (March 1, 2018): e0194175, accessed December 25, 2024, https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0194175.

52 "Vaksin Apa Saja Yang Bersinggungan Dengan Babi?," accessed January 6, 2025, https://health.detik.com/ulasan-khas/d-1946278/vaksin-apa-saja-yang-bersinggungan-dengan-babi.

Stage of Involvement	Involved in the second stage (antigen cell culture) to separate cells.	Used in the final stage (formulation) as a stabilizer.
Function in Vaccine Production	Acts as a catalyst in the cell culture stage to facilitate cell separation.	Functions as a stabilizer in the final vaccine product.
Presence in Final Product	Not present; removed during the filtration and purification process.	Still exist in the final vaccine product.
Administered to Patient?	No, as it is eliminated during purification.	Yes, administered to the patient through injection or other means.
Relevance to *Istihalah* Theory	Not relevant; enzymes remain unchanged after reactions (Lock and Key and Induced Fit theories).	Relevant; gelatin undergoes a substantial transformation, changing its chemical composition.
Views in Islamic Jurisprudence	Vaccine products are considered pure after purification (analogous to purifying *mutanajjis*).	Considered halal by scholars who accept istihalah due to the transformation from pig tissue to gelatin. However, scholars who reject istihalah consider it impure.
Biotechnology Context	Enzymes are catalysts that remain unchanged before and after reactions.	Gelatin is a transformed substance with a new chemical structure after processing.
Implications for Halal Status	Vaccines are considered halal after purification, as impurities are removed.	Halal according to scholars who accept istihalah, but impure for those who reject it.

From the table above, the roles of trypsin and porcine gelatin differ in function and application across distinct stages of vaccine production, with significant implications for their halal status in Islamic jurisprudence. Trypsin, derived from pig pancreas, is utilized during the cell culture stage to facilitate cell separation. Importantly, it is entirely removed through filtration and purification processes, ensuring that no trace of trypsin remains in the final vaccine product. In contrast, porcine gelatin, extracted from pig skin, bones, or connective tissues, is used in the final formulation stage as a stabilizer. Unlike trypsin, porcine gelatin remains present

in the final vaccine and is administered to patients via injection. This distinction is critical in determining their permissibility under Islamic law, particularly concerning the principles of purification (*tathhirul mutanajjis*) and substance transformation (*istihalah*).

From an Islamic perspective, using trypsin is generally considered permissible (*halal*) after purification, as it aligns with the fiqh principle that impurities can be rendered pure through cleansing. However, porcine gelatin presents a more complex issue due to its transformation during processing. Scholars who accept *Istihalah* argue that the chemical changes gelatin undergoes result in a new, pure substance, thereby rendering it halal. Conversely, those who reject *istihalah* maintain that gelatin retains its impure status because it originates from a prohibited (haram) source. From a biotechnological standpoint, trypsin functions as an unchanged catalyst, while gelatin undergoes a fundamental chemical transformation during its production. Consequently, the halal status of gelatin-based vaccines remains a subject of debate, significantly influencing vaccine acceptance in Muslim-majority communities where halal certification is a key concern.

Challenges and Opportunities in Developing Fiqh of Biotechnology: A Path Forward

While the fiqh of biotechnology provides crucial guidance, it faces several significant challenges. One major challenge is the limited understanding of biotechnology among Islamic scholars and the public. Many *ulama* lack the scientific background needed to grasp the complexities of this technology, which can hinder the formulation of informed legal rulings.

Another challenge is the divergence of opinions among Islamic scholars. For instance, regarding vaccines containing non-halal animal ingredients, some scholars permit their use in emergencies, while others oppose it. This disagreement can confuse the public and hinder vaccination programs essential for public health. Additionally, the rapid pace of biotechnological advancements presents a challenge, as classical texts may not provide clear answers to modern issues. A more flexible and adaptive approach is needed to address these emerging questions.

Ethical and social concerns also pose challenges. For example, gene-editing technologies like CRISPR raise questions about the ethical limits of genetic modification. Addressing these issues requires collaboration among scientists of biotechnology, Muslim scholars, and the public to achieve a balanced consensus. Furthermore, regulatory and policy challenges must be addressed. Governments and institutions like MUI need to develop policies that align biotechnological

advancements with Islamic ethical principles.

Despite these challenges, there are significant opportunities to advance the fiqh of biotechnology. Growing public awareness of halal products has increased demand for biotechnological solutions that comply with Islamic principles. With support from educational and research institutions, the fiqh of biotechnology can evolve into a vital branch of Islamic jurisprudence, offering relevant guidance for Muslims worldwide.

Conclusion

In conclusion, the use of pig-derived elements in vaccine production presents a significant challenge for Muslims. While the Qur'an and Hadith clearly prohibit pork, Muslim scholars differ on its impurity status. This study highlights the need to reinterpret traditional fiqh into a dynamic fiqh of biotechnology, integrating sharia principles with modern scientific understanding. For instance, the trypsin enzyme used in cell culture is removed during purification, rendering the final vaccine product pure. Similarly, pork gelatin, used as a stabilizer, can be deemed halal through the principle of *istihalah*, which recognizes substantial material transformation. The purification process in biotechnology aligns with the fiqh concept of purifying *najis-mutanajjis*, where impurities are removed through thorough cleansing. An open dialogue among Islamic scholars, scientists, and policymakers is essential to develop solutions that align with Islamic principles while supporting scientific progress and public health. This approach can establish the fiqh of biotechnology as a dynamic and flexible framework, addressing contemporary challenges while adhering to sharia principles.

This study has limitations, as it focuses solely on the use of pig-derived elements in vaccine production. Other critical issues, such as vaccines involving human embryo cells, dog kidney cells, or pig retina transplants, remain unexplored. Further research is needed to address these topics and expand the scope of the fiqh of biotechnology.

Supplementary Materials

Acknowledgements

Authors' contributions

I did this research by myself, from preparing the materials, writing the paper,

reviewing, and revising.

Data availability statement

All data underlying the results are available as part of the article and no additional source data are required.

Conflicts of Interest

The authors affirm that there are no conflicts of interest that could potentially influence the research outcomes or compromise its integrity.

Funding

This article was not financially supported by specific grant from any funding agency in the public, commercial or not-for-profit sectors.

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