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Shariah Governance and Halal Compliance of Cultured Meat: A Maqasidi Analysis of in Vitro Meat Production

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Abstract

Background: Cultured meat, produced through cellular bioprocessing rather than conventional slaughter, raises substantial and largely unresolved questions for Islamic dietary law and halal governance, and no study to date has integrated the complete Maqasid al-Shariah framework with a comparative assessment of international halal regulatory infrastructure.
Objectives: This study evaluates the Shariah governance dimensions and halal compliance requirements of cultured meat through the five essential interests (al-kulliyyat al-khams) of Maqasid al-Shariah and identifies substantive gaps in existing halal certification infrastructure.
Methods: A qualitative doctrinal (usul al-fiqh) methodology was employed, drawing on the Quran, Sunnah, and classical fiqh manuals of the four Sunni madhabs, contemporary fatawa, and international halal standards (OIC/SMIIC, JAKIM, GSO, MUIS), supplemented by a systematic mapping of peer-reviewed literature (2018–2026) on cultured meat and Islamic bioethics.
Results: Cultured meat occupies a novel legal space (fiqh al-mustajaddat), generating three scholarly positions conditional permissibility, prohibition, and tawaqquf. Three governance gaps were identified across existing halal standards: absent biopsy protocol specifications, no framework for evaluating growth media (notably Foetal Bovine Serum), and structural inapplicability of conventional chain-of-custody models to continuous bioprocess production. The May 2025 resolution of the International Islamic Fiqh Academy conditionally permitting cultivated meat corroborates the governance-centred trajectory this study proposes.
Conclusion: Cultured meat requires purpose-built Shariah governance combining scholarly ijtihad, institutional oversight, and a 'Shariah-by-design' approach. The study contributes a Maqasidi cost-benefit framework and a four-tier governance architecture to Islamic regulatory discourse.

A. Introduction

Islamic dietary law (ahkam al-at'ima) occupies a structurally significant position in the Shariah's normative architecture. The Quran addresses food permissibility in numerous passages, establishing halal consumption not merely as a ritual obligation but as an expression of taqwa (God-consciousness), human stewardship (khilafah), and bodily sanctity (Q. 2:168; Q. 5:3; Q. 16:114). Classical jurists from all four Sunni schools devoted considerable attention to the taxonomy of permissible and impermissible substances, elaborating principles the default permissibility of foodstuffs (ibaha asliyyah), the transformation-based rule of istihala, and the harm-prevention imperative embedded in the legal maxim al-darar yuzal that

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continue to inform contemporary halal determination. The rapid advancement of food biotechnology, however, has introduced production modalities for which classical categories offer only partial guidance, necessitating fresh ijtihad (independent legal reasoning) on questions that earlier scholarship did not anticipate (Kurniadi & Frediansyah, 2016; Musfiroh et al., 2026).

Cultured meat produced by extracting myosatellite cells from a living donor animal, proliferating them in a nutrient bioreactor, differentiating them into myotubes, and scaffolding the resulting tissue into a structured food product represents one of the more technically novel of these emerging food categories. The technology attracted widespread attention in August 2013, when Professor Mark Post of Maastricht University presented the first laboratory-cultivated beef burger. Within a decade, regulatory approvals had been granted in Singapore (December 2020) and the United States (June 2023), with the global cultivated meat market expected, according to industry analyses, to reach considerable commercial scale by 2030, including in Muslim-majority markets across Southeast Asia, the Gulf Cooperation Council (GCC), and South Asia (Attwood et al., 2023; Martins et al., 2024; Yun et al., 2024).

The Islamic scholarly discourse on cultured meat has developed notably since 2013, yet it remains marked by considerable divergence. Early fatwas addressed the question in relatively narrow terms, focusing primarily on whether the initial cell extraction constituted a form of prohibited blood consumption. More substantive analyses have since emerged including work by (Hamdan et al., 2024; Qudsiyah & Tsania, 2024) yet a systematic treatment that integrates Maqasid theory with comparative halal regulatory analysis remains, to the best of the present author's knowledge, largely absent from the published literature (Rahman et al., 2024).

A review of existing scholarship reveals several recurrent limitations, summarised comparatively in Table 1 below. First, most analyses treat the permissibility question as a unitary determination covering the entire production process, whereas each stage cell sourcing, growth medium composition, scaffolding materials, and final processing raises analytically distinct jurisprudential questions. Second, few studies have examined the structural adequacy of existing international halal standards for a food category produced through continuous cellular bioprocess rather than through conventional animal slaughter and processing. Third, the Maqasid al-Shariah framework, though frequently invoked in Islamic bioethical discourse, has not been systematically applied to cultured meat with reference to all five essential interests across their three-tiered structure of necessity. Fourth, the governance dimension specifically, what institutional architecture is required to ensure ongoing halal compliance in cultured meat production has received comparatively little scholarly attention (Bryant et al., 2019; Mi et al., 2022).

Table 1. State-of-the-Art Comparative Matrix: Positioning of the Present Study Relative to Recent Literature

Study (Author, Year)	Primary Focus	Methodological Approach	Gap Relative to Present Study
Hamdan et al. (2024)	Islamic perspective on cultured meat; initial jurisprudential mapping	Doctrinal / conceptual review	Does not apply the Maqasid framework or assess halal standards infrastructure
Kashim et al. (2023)	Scientific and Islamic perspectives on halal status via istihalah	Doctrinal analysis + laboratory/scientific review	Single-jurisdiction (Malaysian) focus; no cross-standard comparative governance analysis
Ho et al. (2023)	Muslim consumer perceptions of cultured meat in Singapore	Qualitative focus-group study	Consumer-perception focus; does not address jurisprudential or governance architecture
Hamdan et al. (2024)	Systematic review of Islamic discussions on	Systematic literature review	Descriptive synthesis of existing fatawa; does not

Study (Author, Year)	Primary Focus	Methodological Approach	Gap Relative to Present Study
	cultivated meat (2013–2023)		propose a governance framework
Farhana et al. (2025)	Jurisprudential analysis of cultured meat production stages	Library-based doctrinal analysis	Stage-based fiqh mapping only; no Maqasidi cost-benefit evaluation or standards audit
Alqurashi et al. (2026)	Narrative review of halal perspectives and regulatory challenges	Narrative literature review	Broad narrative scope; does not conduct a structured four-standard adequacy assessment
Present Study	Integrated Maqasidi (5-interest × 3-tier) analysis + 4-standard halal governance gap assessment + Shariah-by-design architecture	Qualitative doctrinal (usul al-fiqh) + comparative regulatory analysis	—

Source: Author's own synthesis of the reviewed literature.

These gaps in the existing literature constitute the research problem that the present study addresses. The contribution of this paper is threefold: it offers what appears to be among the first systematic applications of the complete five-Maqasid framework, across all three tiers of necessity, to cultured meat production; it conducts a comparative adequacy assessment of four leading international halal standards OIC/SMIIC, JAKIM, GSO, and MUIS against the specific parameters of the in vitro meat bioprocess; and it introduces the concept of 'Shariah-by-design' as a normative governance paradigm for novel food biotechnologies.

The study is guided by three research objectives: (1) to map the jurisprudential issues arising at each stage of the cultured meat production process against classical and contemporary Islamic legal sources; (2) to apply the five-Maqasid framework as a structured evaluative instrument for assessing cultured meat's compatibility with the higher objectives of Islamic law; and (3) to identify governance gaps in existing halal certification infrastructure and propose an institutional framework for their resolution.

B. Research Methods

Research Design and Type

This study employs a qualitative doctrinal research design situated within the tradition of usul al-fiqh (principles of Islamic jurisprudence). Doctrinal research in Islamic law involves the systematic analysis and interpretation of legal texts primary sources and their derivative scholarly literature to derive normative principles applicable to novel factual scenarios (istinbat al-ahkam). This design is appropriate because cultured meat represents a factual novelty for which legal principles must be derived through systematic interpretation rather than through direct textual prescription.

Research Object

The primary research object is the in vitro beef production process in its current commercial configuration, with analytical attention directed to four jurisprudentially significant elements: (a) the biopsy procedure for cell extraction; (b) the growth medium, including Foetal Bovine Serum (FBS) and its plant-based or recombinant alternatives; (c) scaffolding materials and the cell differentiation process; and (d) the final processed product and its supply chain characteristics.

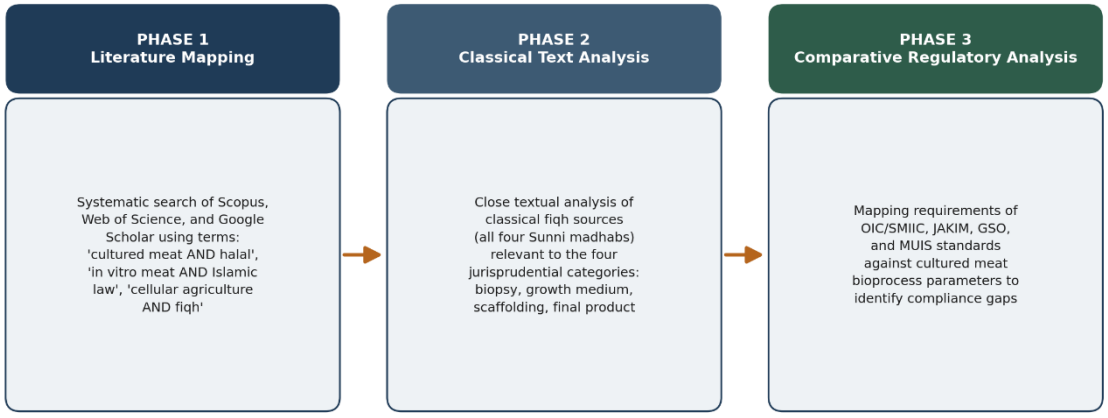
Data Sources

Primary jurisprudential sources include Quranic verses bearing on food permissibility and human stewardship (Q. 2:168; Q. 2:172-173; Q. 5:3-5; Q. 6:118-119; Q. 16:114-115), authenticated hadith

narrations from the canonical collections of al-Bukhari and Muslim on food purity and harm avoidance, and classical fiqh manuals from all four Sunni schools al-Hidaya of al-Marghinani (Hanafi), al-Mudawwana of Sahnun (Maliki), al-Umm of al-Shafi'i (Shafi'i), and al-Mughni of Ibn Qudama (Hanbali). Contemporary institutional sources include scholarly works and fatawa drawing on the positions of the Islamic Fiqh Academy (IFA, Jeddah) and MUIS Singapore, including IFA Resolution No. 265 (2025), the Academy's own ruling on cultivated meat. Secondary sources comprise peer-reviewed publications in Islamic bioethics and food science alongside technical standards from OIC/SMIIC, JAKIM (Malaysian Standard MS 1500:2019), the Gulf Standardisation Organisation (GSO 2055-1:2015), and Good Food Institute industry reports.

Data Collection and Research Procedure

Data collection proceeded in three sequential phases, illustrated in Figure 1. Phase One involved systematic literature mapping: scholarly articles, fatawa, and institutional reports addressing cultured meat from an Islamic perspective were identified through searches of academic databases (Scopus, Web of Science, Google Scholar) using search terms including 'cultured meat AND halal', 'in vitro meat AND Islamic law', 'cellular agriculture AND fiqh', and related combinations, extended through 2026 to capture the most recent developments including the IFA's 2025 resolution. Phase Two involved close textual analysis of classical fiqh sources relevant to the four jurisprudential categories identified in the research object. Phase Three involved comparative regulatory analysis, mapping the requirements of each major international halal standard against the specific parameters of cultured meat production to identify compliance gaps.



Source: Author's own conceptual framework, based on the study's research procedure

Figure 1. Three-Phase Data Collection and Research Procedure

Analytical Framework

The Maqasid al-Shariah framework, as systematised by Imam Abu Hamid al-Ghazali (d. 505 AH/1111 CE) in al-Mustasfa min 'Ilm al-Usul and elaborated by Imam Ibrahim al-Shatibi (d. 790 AH/1388 CE) in al-Muwafaqat fi Usul al-Shariah, provides the primary analytical instrument. The five essential interests (al-kulliyyat al-khams) Hifz al-Din (preservation of religion), Hifz al-Nafs (preservation of life), Hifz al-'Aql (preservation of intellect), Hifz al-Nasl (preservation of lineage), and Hifz al-Mal (preservation of wealth) are operationalised across three tiers of legal necessity: daruriyyat (necessities), hajiyyat (needs), and tahsiniyyat (improvements). Four legal maxims (qawa'id fiqhiyyah) are additionally invoked: al-umur bi-maqasidiha (acts are assessed by their objectives), al-darar yuzal (harm must be removed), al-mashaqqa tajlib al-taysir (hardship draws facilitation), and la darar wa la dirar (neither harm nor counter-harm may be inflicted).

Scope and Limitations

The study confines its jurisprudential analysis to the Sunni tradition, engaging all four madhabs. Shi'a fiqh positions, which differ on several relevant points, are acknowledged where pertinent but are not systematically treated a limitation that future cross-traditional scholarship should address. The technical parameters reflect industry conditions as of early 2026; given the pace of development in alternative growth media and scaffold materials, certain jurisprudential assessments may require revision as the science

advances. The study does not include primary empirical fieldwork with Muslim consumers or halal certification practitioners, a gap that future mixed-methods research should address.

Table 2. Summary of Research Design

Research Dimension	Description
Research Approach	Qualitative Doctrinal (Usul al-Fiqh methodology)
Research Type	Library-based; Interpretive; Normative-Analytical
Research Object	In vitro beef production: biopsy, growth media, scaffolding, final product
Primary Sources	Quran; Sunnah; Classical fiqh manuals (all four Sunni madhabs); Contemporary fatawa and scholarly positions (IFA, MUIS, Darul Ifta Egypt)
Secondary Sources	Peer-reviewed journals (Scopus/WoS); Halal standards (OIC/SMIIC, JAKIM, GSO, MUIS); GFI industry reports
Analytical Framework	Maqasid al-Shariah: Five Essential Interests × Three Tiers of Necessity; Four Legal Maxims (Qawa'id Fiqhiyyah)
Scope	Sunni jurisprudence; beef-derived cultured meat; international regulatory frameworks (2015–2026)
Limitations	Shi'a fiqh not systematically treated; no primary empirical fieldwork; evolving technical parameters

C. Results and Discussion

The Cultured Meat Bioprocess: A Jurisprudential Anatomy

A precise understanding of the cultured meat production process is a prerequisite for sound jurisprudential analysis, since the permissibility of each production stage is legally independent and cannot be inferred from any other stage. Five stages are of direct jurisprudential relevance.

Stage 1: Cell Extraction (Biopsy): A small muscle tissue sample, typically between 0.5 and 1 gram, is extracted from a living donor animal commonly a bovine through a hollow-needle biopsy. This extraction does not require slaughter (dhabh). The principal jurisprudential question is whether such extraction falls under the prohibition on consuming parts severed from a living animal (ma quti'a min al-hayy fa-huwa mayyit), a position grounded in hadith narrations recorded by Abu Dawud and al-Tirmidhi. Several contemporary scholars have argued, however, that the biopsy does not result in consumption of the severed material in its original form; rather, it is the downstream cellular product substantially transformed through proliferation and differentiation that enters the food supply. This argument invokes the principle of istihala (complete transformation), which may alter the legal status of a substance when its original properties are entirely superseded (Izhar et al., 2023b).

Stage 2: Cell Proliferation in Growth Media: Extracted satellite cells are placed in a growth medium and proliferated in a bioreactor, a process typically requiring several weeks. The predominant growth medium in current commercial applications is Foetal Bovine Serum (FBS), derived from the blood of foetal calves harvested from the uteri of slaughtered pregnant cows. FBS presents a compound jurisprudential problem: blood (dam masfuh) is explicitly prohibited in Q. 5:3; the foetal calves from which FBS is derived are not themselves subject to Islamic slaughter; and the collection procedure raises concerns regarding animal welfare requirements under Islamic ihsan principles. The industry is actively pursuing FBS replacement through plant-derived protein hydrolysates, recombinant albumin and growth factors, and fermentation-derived media developments that would materially alter the jurisprudential calculus if successfully implemented at commercial scale (Chriki & Hocquette, 2020; Wali et al., 2024).

Stage 3: Cell Differentiation: Proliferated cells are induced to differentiate into myotubes (immature muscle fibres) through modification of the growth medium composition. This stage does not raise independent jurisprudential concerns beyond those arising from the medium itself, provided scaffold-free differentiation protocols are employed.

Stage 4: Scaffolding and Tissue Structuring: Structured cultured meat products require cells to be grown on a three-dimensional scaffold. Scaffolding materials in current use include food-grade biopolymers (alginate, chitosan, cellulose generally regarded as permissible), plant-derived protein matrices (generally permissible), decellularised animal tissue (requiring species and slaughter verification), and synthetic polymers (requiring assessment as food additives). The halal status of each scaffold type requires independent evaluation under the criteria of ta'thir (material influence on the final product) and istihlak (dissolution to below a detectable threshold) (Alam et al., 2024).

Stage 5: Harvesting and Processing: The cultured tissue is harvested, washed, and formulated into consumer products. At this stage, standard halal food-processing requirements prevention of cross-contamination with prohibited substances, accurate labelling, and supply chain integrity apply in full.

Islamic Scholarly Positions: A Systematic Overview

The Islamic scholarly response to cultured meat has crystallised into three discernible positions, each grounded in distinct jurisprudential methodologies and reflecting different weightings of the available legal evidence.

Position 1 - Conditional Permissibility: This position, advanced by scholars associated with Majlis Ulama Islam Singapore, the Darul Ifta of Egypt, and several Gulf-based fatwa bodies, holds that cultured meat may be permissible subject to specified conditions: the originating cell donor must be from a species permissible for consumption; the animal should ideally be slaughtered according to Islamic rites prior to cell extraction, though some scholars permit extraction from a living animal on specified grounds; the growth medium must be entirely free of prohibited substances, necessitating FBS replacement; and the final product must be free of contamination. This position draws primarily on the principle of istihala and the legal baseline of ibaha asliyyah, arguing that the cellular product is sufficiently transformed from the original tissue to constitute a jurisprudentially distinct substance (Ho et al., 2021; Qotadah et al., 2022).

Position 2 - Prohibition: Scholars representing this view, prevalent in South Asian jurisprudential circles and articulated by various Pakistani religious authorities, hold that cultured meat is impermissible in its current form on three compounding grounds: the initial cell extraction is held to violate the prohibition on consuming parts severed from living animals; FBS, as blood derived from a non-dhabh-slaughtered animal, renders the growth medium impermissible; and the difficulty of confirming species origin through extended cell line passaging precludes the degree of certainty (zann al-ghalib) required for food permissibility determinations. These scholars also invoke the precautionary principle (ihtiyat), maintaining that abstention is required where prohibited substances are plausibly present.

Position 3 - Tawaqquf (Suspension of Judgment): A third position, associated with certain researchers at al-Azhar and several independent fatwa scholars, advocates suspension of determination pending: greater scientific clarity on the production process, particularly regarding FBS-free alternatives; formal collective ijtihad (ijtihad jama'i) by recognised scholarly institutions; and the development of certification protocols capable of verifying halal compliance at the bioprocess level. This position reflects the classical principle that where evidence is genuinely equivocal, the jurist should withhold a definitive ruling and communicate the uncertainty to the questioner. As discussed below, this position has been partially superseded by the International Islamic Fiqh Academy's 2025 resolution, though the conditions attached to that resolution leave several of these scholars' underlying concerns only partially addressed.

Table 3. Comparative Overview of Islamic Scholarly Positions on Cultured Meat

Criterion	Position 1: Conditional Permissibility	Position 2: Prohibition	Position 3: Tawaqquf
Jurisprudential Basis	Istihala; Ibaha Asliyyah	Prohibition of Dam Masfuh; Ihtiyat	Epistemological Caution; Ijtihad Jama'i
Cell Biopsy	Permissible (transformation doctrine applies)	Impermissible (severed-part prohibition)	Undetermined pending scholarly consensus
FBS Usage	Impermissible; FBS-free alternatives required	Impermissible; invalidates the entire process	Undetermined pending FBS-free protocols
Final Product	Potentially halal if all conditions are met	Haram in current commercial form	Suspended pending further evidence
Representative Bodies	Majlis Ulama Islam Singapore; Darul Ifta Egypt; Gulf scholars	Pakistani religious authorities (various)	Al-Azhar researchers; independent jurists

Maqasidi Analysis: A Structured Evaluative Framework

The Maqasid al-Shariah framework permits a governance evaluation that extends beyond the binary halal/haram question, situating cultured meat within the teleological structure of Islamic law. Each of the five essential interests is examined across the three tiers of necessity below.

Hifz al-Nafs (Preservation of Life): At the daruriyyat level, the Shariah's primary concern is the preservation and sustenance of human life. Cultured meat's potential contribution to food security is notable: the global halal food market is projected to reach US$1.67 trillion by 2025, driven partly by dietary demand in a Muslim population set to comprise approximately 30% of the world's population by mid-century, underscoring the strategic significance of protein security for Muslim communities (Choudhary et al., 2024). Projections from international food policy analyses suggest that global protein demand will increase considerably in the coming decades, while land, water, and greenhouse gas constraints limit equivalent expansion of conventional livestock systems (Smith et al., 2024). For Muslim-majority countries that are net meat importers, the technology may offer a meaningful contribution to food sovereignty. The legal maxim la darar wa la dirar and the Quranic principle of istikhlaf (human trusteeship over creation) support engagement with technologies that plausibly reduce systemic harm. At the hajiyyat level, cultured meat's reduced dependence on densely populated livestock environments associated with increased zoonotic disease transmission constitutes a relevant public health consideration. At the tahsiniyyat level, the potential for targeted nutritional optimisation represents an improvement consistent with this Maqsad.

Hifz al-Mal (Preservation of Wealth): Comparative lifecycle assessments suggest that cultured meat production, at commercial scale, may require substantially less land, water, and energy than conventional beef production, though precise figures vary across studies and production configurations (Noble et al., 2024). For Muslim-majority importing nations, domestically produced cultured meat could potentially reduce foreign exchange expenditure on halal meat imports. A significant countervailing concern arises at the hajiyyat level, however: the global halal meat industry supports large numbers of Muslim livestock producers, processors, and supply chain workers, and the principle of preventing darar extends to economic harm affecting existing communities. Maqasidi analysis at this level therefore requires attention to transition management alongside long-term efficiency considerations (Moritz et al., 2023).

Hifz al-Nasl (Preservation of Lineage and Ecological Integrity): Contemporary Maqasid scholarship, building on contributions by Ibn 'Ashur and Jasir Auda, has extended this essential interest beyond its classical focus on human familial lineage to encompass ecological integrity and biodiversity matters that connect with the Quranic prohibition on fasad (corruption of creation). Cultured meat, by reducing the scale of intensive livestock agriculture, may contribute positively to biodiversity preservation and habitat protection. At the tahsiniyyat level, the concept of fitrah (the natural order of creation as divinely

established) invites reflection on the theological dimensions of producing meat entirely outside the normal biological cycle of animal life, a question that merits sustained scholarly attention (Hong et al., 2021; Munteanu et al., 2021).

Hifz al-'Aql (Preservation of Intellect): Classical applications of this Maqsad centred primarily on the prohibition of intoxicants. Contemporary scholarship has broadened its scope to encompass protection from substances harmful to cognitive and neurological function, as well as the right to informed consumption choices. Cultured meat raises no inherent concerns at the daruriyyat or hajiyyat levels, provided all production inputs are free of prohibited or harmful substances. At the tahsiniyyat level, the sociocultural dimensions of food its role in shared identity, memory, and communal practice may be affected by normalisation of laboratory-produced protein, a matter that warrants sociological investigation alongside jurisprudential analysis, as recent consumer-perception research in Singapore illustrates (Ho et al., 2021).

Hifz al-Din (Preservation of Religion): This is the most structurally complex of the five interests in the cultured meat context, operating across all three tiers of necessity. At the daruriyyat level, the integrity of Islamic dietary practice as a daily expression of religious identity and submission to divine authority is a matter of fundamental concern. The risk that cultured meat in the absence of adequate governance normalises the consumption of mashbooh (doubtful) or haram substances under the cover of technological transformation is genuine, and the legal principle of sadd al-dhara'i' (blocking the means to prohibited ends) supports robust preventive governance. At the hajiyyat level, the halal certification ecosystem faces structural challenges from cultured meat that existing standards were not designed to address. At the tahsiniyyat level, a well-governed halal cultured meat framework may strengthen Muslim communities' access to certified halal protein in contexts where conventional halal supply chains are limited (Wang et al., 2024).

Table 4. Maqasidi Evaluative Framework for Cultured Meat Across Three Tiers of Necessity

Maqsad	Daruriyyat (Necessities)	Hajiyyat (Needs)	Tahsiniyyat (Improvements)
Hifz al-Nafs	Food security; protein supply for net-importing Muslim-majority nations	Reduced zoonotic disease risk; public health considerations	Targeted nutritional optimisation; enhanced protein profiles
Hifz al-Mal	Long-term resource efficiency; reduction of import dependency	Transition planning for existing halal meat industry and communities	Potential for new halal biotechnology sector in Muslim-majority countries
Hifz al-Nasl	Biodiversity preservation through reduced livestock intensity	Cell line species integrity; genetic homogenisation concerns	Fitrah considerations; theological reflection on extra-biological food production
Hifz al-'Aql	No inherent cognitive harm where production inputs are compliant	Consumer right to transparent, accurate product information	Sociocultural impact on Muslim food identity and communal practice
Hifz al-Din	Risk: normalisation of mashbooh consumption without adequate governance	Risk: structural inadequacy of existing halal certification frameworks	Opportunity: expanded halal access in non-Muslim-majority contexts

Halal Governance Framework Analysis: Substantive Gaps

A comparative regulatory analysis reveals a structural mismatch between the requirements of cultured meat production and the design assumptions embedded in existing international halal standards. This section examines four leading frameworks.

The OIC/SMIIC 1:2019 General Guidelines on Halal Food conditions the permissibility of animal-derived products on compliance with dhabh (Islamic slaughter) requirements and establishes chain-of-custody (CoC) documentation as the primary verification mechanism. This framework encounters three structural challenges when applied to cultured meat: the dhabh requirement presupposes a conventionally slaughtered animal, whereas cultured meat involves cells extracted from a living donor; the CoC model is designed to track discrete physical units through linear supply chains, whereas a bioprocess produces a continuous output from a cell bank; and the standard's definition of 'animal-derived ingredients' does not encompass growth factors, recombinant proteins, or scaffold materials derived from bioengineered processes (Kawecki et al., 2024).

JAKIM's MS 1500:2019 Malaysian Standard on Halal Food specifies detailed requirements for slaughterhouse operations, processing facilities, and logistics, but its scope is expressly limited to food derived from animals slaughtered in accordance with Shariah. It provides no procedural pathway for certifying products generated through a bioprocess in which conventional slaughter is structurally inapplicable. Similarly, the Gulf Standardisation Organisation's GSO 2055-1:2015 focuses on slaughterhouse and processing facility auditing, with no provisions for cellular agriculture (Alzeer et al., 2025).

Majlis Ulama Islam Singapore's halal certification framework represents what may be the most institutionally advanced national engagement with cultured meat among Muslim regulatory bodies to date. In its preliminary assessments, MUIS has acknowledged the jurisprudential complexity and recommended a staged approach: engagement with producers to understand specific bioprocess parameters, consultation with international Islamic scholarly bodies, and the development of cultured-meat-specific certification protocols prior to any commercial halal certification. This approach which the present study endorses and seeks to support analytically reflects a productive model for proactive halal governance of novel food technologies (Ithnin et al., 2025).

A significant development since the original conception of this study is the International Islamic Fiqh Academy's Resolution No. 265 (10/26), issued at its twenty-sixth session in Doha on 4–8 May 2025. The Academy resolved that the consumption and marketing of cultivated meat is permissible subject to conditions materially consistent with the governance-centred approach advanced here: the donor cells must originate from an animal lawful to eat (and, where applicable, slaughtered according to Islamic law); the cultivation medium must be free of prohibited substances such as flowing blood or porcine-derived gelatin; the entire cultivation process must be supervised by a credible, specialised authority; and companies must disclose relevant information to consumers under supervisory verification (International Islamic Fiqh (Farhana et al., 2025). This resolution substantially validates the present study's central governance thesis, while leaving unresolved precisely the operational questions biopsy protocol specification, growth media certification criteria, and bioprocess chain-of-custody design that the four-tier architecture proposed below is intended to address.

Three substantive and actionable governance gaps emerge from this comparative analysis. Gap 1 Biopsy Protocol Standards: No existing halal standard specifies requirements for the extraction of biological material from living animals for food production purposes. A halal-specific biopsy protocol standard would need to address: permissible species for cell donation; the jurisprudential basis for biopsy permissibility; animal welfare requirements consistent with Islamic ihsan principles; and traceability requirements from donor animal to cell bank. Gap 2 Growth Media Certification: Existing standards contain no framework for evaluating the halal status of complex biochemical growth media containing recombinant proteins, hormones, and growth factors. A dedicated protocol would need to address: the source and production method of each biochemical component; the application of istihala and istihlak principles to transformed or sufficiently diluted substances; and the permissibility of genetic engineering techniques that may involve genetic sequences from non-halal organisms. Gap 3 Bioprocess Chain of Custody: The linear, unit-based CoC model requires replacement, for cultured meat, by a bioprocess integrity audit model capable of verifying the cell bank's compliance credentials, monitoring growth media composition throughout the production cycle, auditing the bioreactor environment for contamination, and verifying the final product's composition against certified specifications.

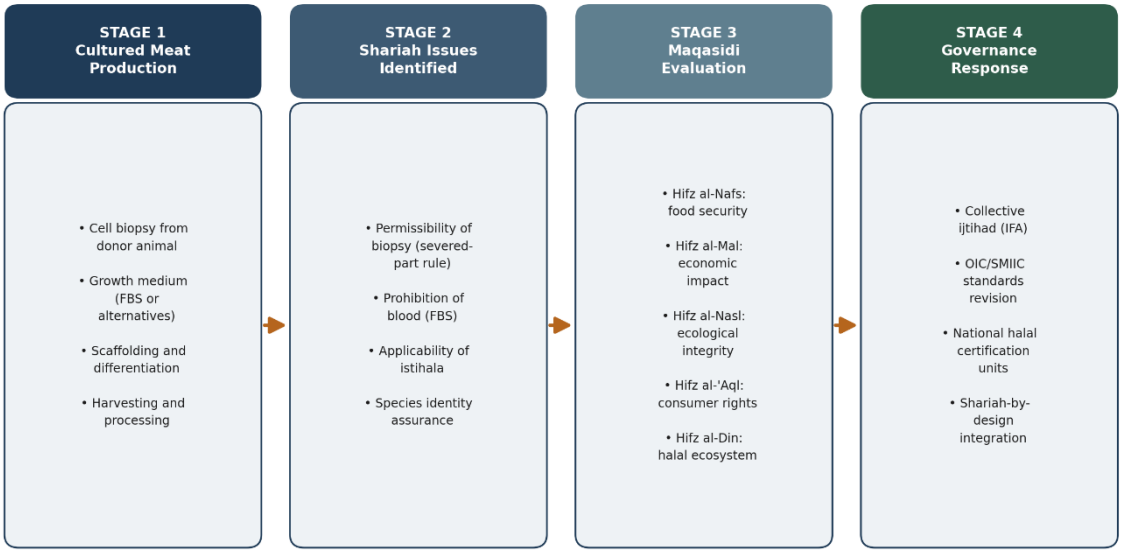
Positioning within Recent Scholarship (2023–2026)

The findings of this study can be situated against five recent contributions that, collectively, illustrate the trajectory of the field. (Izhar et al., 2023b) apply the principle of istihalah tammah (complete transformation) to argue that serum-cultured cells may be classified as halal independent of the donor animal's slaughter status a more permissive reading of istihala than the present study's governance-centred position, which treats transformation as necessary but not sufficient absent institutional verification. (Hamdan et al., 2024), in a systematic review spanning fatawa, academic publications, and personal scholarly opinions issued since 2013, confirm the persistence of the same three-position divergence (permissibility, prohibition, tawaqquf) identified independently in the present analysis, lending external corroboration to the typology advanced in Table 3 above.

(Ho et al., 2021) in a qualitative study of Muslim consumers in Singapore, found that religious respondents would accept cultured meat only if halal certification were independently verified an empirical finding that directly supports this study's Maqasidi conclusion that the central Hifz al-Din risk lies in governance and certification adequacy rather than in the bioprocess technology per se. undertake a stage-based jurisprudential mapping methodologically similar to Stages 1–5 presented above, but do not extend their analysis to a comparative assessment of international halal standards or propose an institutional governance response, a gap this study's four-tier architecture is designed to fill. Most significantly, (Alqurashi et al., 2026), in the most recent narrative review of halal perspectives on cultured meat, similarly conclude that regulatory frameworks for Muslim-majority markets remain underdeveloped relative to consumer-acceptance research a conclusion consistent with, and reinforced by, the governance gap analysis this study contributes. A parallel strand of consumer-facing research, exemplified by (Boereboom et al., 2022) survey of British Muslims, similarly finds willingness to purchase cultured meat strongly conditional on credible halal assurance rather than on the underlying technology itself, reinforcing this study's emphasis on governance and certification as the decisive variable. Read together, these studies confirm that the jurisprudential debate on permissibility is comparatively mature, while the governance-architecture question this study centres remains the area of greatest unmet scholarly need.

Proposed Shariah Governance Architecture

Drawing on the Maqasidi analysis and the governance gap assessment, this study proposes a four-tier Shariah Governance Architecture for halal-compliant cultured meat, illustrated in Figure 2. Tier 1 Scholarly Foundation: A dedicated collective ijtihad process, convened by the Islamic Fiqh Academy (Jeddah) in collaboration with MUIS Singapore, JAKIM, and OIC/SMIIC, should elaborate the operational detail particularly biopsy protocol and growth-media certification criteria left open by IFA Resolution No. 265 (2025). This process should be supported by structured scientific briefings from food biotechnology specialists and include provisions for periodic review as the technology develops. Tier 2 Standards Development: OIC/SMIIC should establish a Technical Committee for Cellular Agriculture with a mandate to draft a cultured-meat-specific annex to OIC/SMIIC 1:2019, operationalising the IFA's supervisory-authority requirement into auditable technical criteria. Tier 3 Institutional Certification: National halal authorities should establish specialist Cellular Agriculture Halal Certification Units staffed by scholars and food biotechnology scientists, empowered to conduct bioprocess audits. Tier 4 Shariah-by-Design Integration: Halal compliance requirements should be incorporated into the cultured meat bioprocess at the design stage rather than applied as retrospective compliance verification.



Source: Author's own conceptual framework

Figure 2. Proposed Shariah Governance Architecture for Halal-Compliant Cultured Meat Production

Scholarly Contribution, Limitations, and Recommendations

Research Contribution: This study makes three contributions to the existing literature. First, it offers what appears to be among the first systematic applications of the complete five-Maqasid framework, across all three tiers of necessity, to cultured meat, extending beyond partial treatments available in earlier scholarship (Hamdan et al., 2024; Izhar et al., 2023a). Second, it conducts a comparative adequacy assessment of four leading international halal standards against the specific parameters of the in vitro meat bioprocess, generating a structured governance gap analysis that remains absent even from the most recent narrative reviews (Alqurashi et al., 2026). Third, it introduces the 'Shariah-by-design' concept as a normative governance model for novel food biotechnologies, and demonstrates its consistency with the International Islamic Fiqh Academy's 2025 resolution a contribution to both Islamic bioethics and halal regulatory scholarship.

Limitations: Three limitations should be noted. Shi'a jurisprudential positions, which differ on several relevant questions, are not systematically treated and merit dedicated scholarly investigation. The analysis reflects the technical and regulatory state of the field as of early 2026 and may require updating as alternative growth media, scaffold materials, and further IFA operational guidance develop. The study does not include primary empirical data from Muslim consumer surveys or practising halal certification auditors, which would enrich the evidence base for the governance recommendations advanced.

Recommendations: Five governance recommendations are advanced. (1) The Islamic Fiqh Academy (Jeddah), building on Resolution No. 265 (2025), should convene a dedicated multi-disciplinary symposium on cellular agriculture to elaborate detailed operational criteria for biopsy protocols and growth-media certification, accompanied by a technical scientific annex. (2) OIC/SMIIC should establish a Technical Committee for Cellular Agriculture. (3) Muslim-majority governments with developed biotechnology sectors including Malaysia, Indonesia, the UAE, and Pakistan should fund halal-compliant cultured meat research to ensure compliance requirements are integrated from early-stage development. (4) Halal certification bodies should develop specialist competency frameworks for Cellular Agriculture Halal Auditors combining Islamic law and food biotechnology expertise. (5) Future research should address Muslim consumer attitudes empirically across a wider range of Muslim-majority markets, pursue cross-traditional Sunni-Shi'a jurisprudential comparison, and evaluate the 'Shariah-by-design' paradigm through longitudinal case studies.

D. Conclusion

This study has addressed three research objectives through a qualitative doctrinal methodology grounded in Maqasid al-Shariah analysis and comparative halal regulatory assessment. With respect to Research

Objective 1, the study has mapped the jurisprudential issues arising at each stage of the cultured meat production process cell extraction, growth medium composition, scaffolding, and final processing demonstrating that these are analytically distinct and require independent treatment rather than a unitary determination. Three scholarly positions have been identified and compared: conditional permissibility grounded in istihala and ibaha asliyyah; prohibition grounded in the dam masfuh prohibition and ihtiyat; and tawaqquf grounded in epistemological caution a typology corroborated by Hamdan et al.'s (2024) independent systematic review.

With respect to Research Objective 2, the five-Maqasid framework has been applied across three tiers of necessity, indicating that cultured meat offers potential benefits for Hifz al-Nafs (food security, reduced zoonotic risk) and Hifz al-Mal (resource efficiency, reduced import dependency), while presenting governance challenges principally at the level of Hifz al-Din the risk of eroding halal ecosystem integrity in the absence of adequate regulatory frameworks. This analysis supports a governance-centred approach, consistent with the teleological orientation of Maqasid reasoning, rather than a binary permissibility determination a conclusion since corroborated by the International Islamic Fiqh Academy's own conditional 2025 ruling.

With respect to Research Objective 3, three substantive governance gaps have been identified in existing international halal standards concerning biopsy protocol specification, growth media certification, and bioprocess chain-of-custody, and a four-tier Shariah Governance Architecture has been proposed for their resolution. The theoretical contribution of this study lies in integrating classical Maqasid theory with contemporary halal regulatory analysis to produce a governance framework suited to novel food biotechnologies. The principal policy implication is that proactive institutional engagement rather than reactive fatwa issuance following market entry is both practically necessary and jurisprudentially warranted, a claim now partially realised through the IFA's 2025 resolution but still requiring the operational elaboration this study proposes.

Future research should pursue empirical investigation of Muslim consumer perceptions of cultured meat across a broader range of Muslim-majority markets than the Singapore-focused study of Ho et al. (2023), cross-traditional jurisprudential analysis incorporating Shi'a fiqh, and longitudinal evaluation of the 'Shariah-by-design' paradigm through case studies of technology developers that have integrated halal compliance requirements into their bioprocess design.

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F. Author Contribution Statement

LAT: Conceptualization, Methodology, Formal Analysis, Investigation, Writing Original Draft, Writing Review and Editing, Visualisation.

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