Supporting Halalan Tayyiban Assurance: Operational Constraints and Organisational Responses in a Food Testing Laboratory

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ABSTRACT

Halalan tayyiban connects food permissibility with goodness and wholesomeness, including safety and quality. Laboratory evidence supports these concerns when the analytical question, sample and interpretation are appropriate. This study examines testing functions, operational constraints and organisational responses in one food-testing laboratory. Semi-structured interviews with two purposively selected management and technical representatives were conducted in December 2025, recorded with consent, transcribed and analysed thematically. Halalan tayyiban informed a subsequent interpretation of the themes; it was not a framework used in the original interviews. Reported functions included specification checks, composition testing, halal-related verification and nutrition labelling. Constraints concerned unfamiliar methods, instrument downtime, sample condition and identification. Funding, staffing and continuing competency development were improvement priorities. Management and technical accounts differed in their emphasis on equipment problems. The analysis distinguishes the assurance question, the reliability of laboratory evidence and its interpretation within wider halal assessment. Routine composition tests and specialist authentication methods address different questions but depend on shared controls over samples, competence and reporting. Proposed joint reviews would connect technical records with management decisions on maintenance, sample traceability and follow-up. These recommendations were not evaluated interventions. The findings offer context-specific insight from two informants in one organisation and support comparative research across laboratories and regulatory jurisdictions.

Keywords: Halalan tayyiban, Laboratory analysis, Halal assurance, Food safety, Operational constraints

INTRODUCTION

Halalan tayyiban brings together the permissibility of food and its goodness or wholesomeness. In food assurance, this directs attention to both halal requirements and relevant concerns about safety, hygiene and quality. Awang (2021) explains the relationship between food safety and the tayyib dimension in halal food reference standards. This perspective helps explain why scientific evidence about food can be useful within a wider halal assurance process.

Laboratory analysis contributes to that process by answering specific questions about a sample. Tests may measure nutrient content, assess composition or investigate substances relevant to food safety and halal requirements. Manufacturers can use results to support product specifications and label declarations. Halal assurance personnel may use analytical evidence when investigating ingredients or possible contamination. The usefulness of a result depends on whether the sample and method are suitable for the question being asked.

The literature places laboratory evidence within a wider assurance process. Van der Spiegel et al. (2012) discuss analytical testing together with audits and certificate verification, while Ahmad et al. (2018) identify laboratories alongside legislation, management control, inspection and education within Malaysian halal food control. Read together, these studies locate the laboratory at the interface between a specific analytical question and the wider assessment of ingredients and production. The operational connections are the testing request, the identity and condition of the submitted sample, the suitability of the method and the interpretation of the report. These connections explain how laboratory data can inform halal certification assessment without making an analytical result equivalent to a certification decision.

Producing useful evidence requires suitable samples, competent staff, appropriate methods and functioning equipment. Results must also be checked and reported correctly. ISO/IEC 17025:2017 provides requirements for the competence, impartiality and consistent operation of testing and calibration laboratories (International Organization for Standardization [ISO], 2017). Maintaining these conditions involves decisions about resources and daily work, including training, maintenance and documentation (Krismastuti & Habibie, 2022; Panagiotidou et al., 2025).

This study examines those operational connections through interviews with two personnel in one food-testing laboratory. It asks how laboratory analysis contributes to assurance, what constraints arise and which organisational responses are reported or proposed. The contribution is to connect these workplace accounts with the conditions under which analytical evidence can inform halalan tayyiban assessment. It does not assess the full compliance status of products or the laboratory. The discussion develops practical implications for joint management and technical decisions, while distinguishing the interview findings from recommendations derived from them.

LITERATURE REVIEW

Halalan tayyiban and the supporting role of laboratory evidence

Halal concerns permissibility under Islamic requirements, while tayyib directs attention to what is good and wholesome. In food-related applications, safety, hygiene and quality are important aspects of that wider concern. These aspects need to be considered together, although they cannot all be established through the same type of test. Awang (2021) examines their relationship through the food safety provisions found in halal reference standards.

Abdul Mokti et al. (2022) analyse Malaysian food guidelines and regulations in relation to halal food quality. Their study draws attention to the importance of quality alongside permissibility. This supports a broader understanding of assurance in which a halal claim and the evidence concerning food quality are both relevant. It does not mean that every quality measurement establishes the overall tayyib status of a product.

This article connects halalan tayyiban to laboratory operations through three analytical questions: what assurance question a test addresses, whether its evidence is reliable and how that evidence is used in a wider assessment. The first concerns the attribute or suspected substance being investigated. The second concerns sample identity and condition, method suitability, staff competence and reporting. The third concerns the interpretation of a result alongside ingredient, process and other relevant information. This structure connects permissibility and wholesomeness with laboratory work while preserving the limits of individual measurements. It is a literature-informed interpretation of the findings, rather than a framework applied during the original data collection.

Laboratory testing within food safety and halal assurance

Food testing serves several purposes. Some tests measure composition, such as protein, ash and moisture. Others examine particular hazards, including selected contaminants or microorganisms. These purposes are related, but the results answer different questions. A laboratory must therefore understand the reason for a testing request before deciding which method is appropriate.

The same principle applies to halal-related analysis. Halal assurance includes the origin of ingredients and the way products are made, stored and handled. Van der Spiegel et al. (2012) explain how laboratory analysis can support the verification of halal certificates alongside audits. This places testing within a broader system of checks. Ahmad et al. (2018), in their examination of Malaysian halal food control, also draw attention to the organisational arrangements through which halal requirements are implemented.

Research on analytical methods shows why the purpose and scope of each test matter. Kim et al. (2022) applied gas chromatography with flame ionisation detection to determine alcohols in fermented foods. Rahayu et al. (2018) examined Fourier transform infrared spectroscopy and statistical analysis to identify dog meat adulteration in beef meatballs. Both studies address specific testing problems. Their methods cannot be treated as a general test for every food safety or halal concern.

Differences between methods also need to be explained accurately. Polymerase chain reaction (PCR) is a DNA-based approach, whereas enzyme-linked immunosorbent assay (ELISA) generally detects specific proteins through antibody reactions. Putri Basuki et al. (2025) compared these approaches for porcine detection in collagen-based products. This distinction matters when laboratory findings are explained to clients or used to support halal verification. The name of a method should be connected to the substance it detects and the type of product for which it is suitable.

Resources needed to maintain laboratory quality

Laboratory quality depends on the resources used to carry out testing. ISO (2017) sets requirements for laboratory competence and consistent operation. Krismastuti and Habibie (2022) discuss the personnel, equipment, facilities and other resources needed to meet ISO/IEC 17025:2017 requirements in Indonesian laboratories. Their discussion shows why maintaining competence involves continuing attention to daily operations, rather than documentation alone.

Equipment maintenance is one example. Ikranbegiin et al. (2019) examined difficulties in maintaining laboratory equipment in Central Asian and other developing settings. Their study highlights the importance of servicing arrangements and the support needed to keep equipment operational. The equipment and institutional conditions differ from those of a Malaysian food laboratory, but their work provides a useful comparison for discussing maintenance as an organisational responsibility.

Management also influences how technical requirements are put into practice. Panagiotidou et al. (2025) identified and validated factors supporting ISO/IEC 17025 implementation. Their findings link implementation with management commitment, personnel and quality management processes. This provides a basis for examining how funding, training and technical procedures work together in the laboratory studied here.

Documentation and sample traceability

Reliable testing also requires a clear connection between the sample received and the result reported. Sample registration, identification and record keeping help maintain that connection. A laboratory information management system (LIMS) can support these activities by linking sample information, testing progress and reports.

Oakley et al. (2025) evaluated LIMS implementation in a microbiology laboratory in Timor-Leste. They reported improvements in data management and reporting, while identifying continuing needs for training, funding and technical support. Their study concerns clinical microbiology rather than food analysis, so its outcomes cannot be transferred directly to the present setting. It nevertheless shows that a digital system requires organisational support to remain useful in everyday work.

The studies reviewed address complementary parts of this relationship. Halal assurance literature explains why laboratory results need to be considered alongside other verification evidence; method studies define what particular analyses can detect; laboratory quality research identifies the resources needed to produce reliable results. The remaining issue for this study is how personnel experience the operational links between these

parts in daily work. Comparing management and technical accounts offers a way to examine how testing requests, sample control and resource decisions interact within one workplace, without claiming to represent all Malaysian food-testing institutions.

METHODOLOGY

Research design and setting

This study used a qualitative approach to explore the experiences of personnel involved in food laboratory operations. The research was conducted in one Malaysian food-testing laboratory. Semi-structured interviews were the main source of research data. This approach allowed the researcher to cover the study topics while giving the informants opportunities to explain their work. Academic publications and relevant standards provided background and supported discussion of the findings; they were not treated as a separate set of empirical data. Halalan tayyiban was used as an interpretive context for the discussion. It was not treated as a separate topic explicitly examined in the original interviews or as a predetermined coding framework.

Selection of informants

Purposive sampling was used to select two informants with direct knowledge of laboratory work. The first was a Laboratory Management Representative (LMR), who worked as a senior executive in the food laboratory. The second was a Laboratory Technical Representative (LTR), who worked as a food laboratory technician. They were selected for their direct involvement in laboratory management and technical operations. Their roles provided complementary views of testing practices and organisational support. Table 1 summarises the two informants' roles and interview dates.

Table 1 Informant roles and interview dates

Code	Role	Interview date
LMR	Laboratory Management Representative Senior Executive, Food Laboratory	29 December 2025
LTR	Laboratory Technical Representative Technician, Food Laboratory	30 December 2025

Source: Authors' analysis of the interview findings.

Interview guide and alignment with the research questions

An interview guide containing 11 numbered items was organised under the three research objectives and corresponding research questions. Items 1–5 addressed the contribution of laboratory analysis, items 6–8 addressed operational constraints, and items 9–11 addressed organisational responses. The topics included testing functions, staff responsibilities, methods, equipment, sample handling, competency and management support. Table 2 summarises the grouping reported in the study.

Table 2 Alignment of the interview guide with the research questions

Research focus	Topics covered
RQ1 Contribution of laboratory analysis	Testing functions, common analyses, importance of verification, staff roles and qualifications, and confidence in product safety.
RQ2 Operational constraints	Test methods, equipment, sample handling, adherence to procedures, training, competency and understanding of halal requirements.
RQ3 Organisational responses	Current quality practices, management support and long-term service improvement.

Source: Authors' summary of the study interview guide.

This organisation is consistent with the question-alignment principle in Castillo-Montoya's (2016) Interview Protocol Refinement (IPR) framework. The framework separates four phases: aligning interview questions with research questions, constructing an inquiry-based conversation, obtaining feedback on the protocol and piloting it. These phases concern the preparation and refinement of interviews; they do not replace the analysis of interview data. Yeong et al. (2018) demonstrate how the IPR framework can help adapt questions to participants' language and context. Their study also shows how review and piloting can lead to further revisions.

Interview procedure and data preparation

The interviews were conducted face-to-face at the workplace on 29 and 30 December 2025. The guide included questions inviting descriptions of laboratory work, together with a direct question about adherence to standard operating procedures. The guide therefore combined descriptive and direct questions. The semi-structured interview format allowed clarification and further explanation of relevant responses.

The semi-structured format was suitable for exploring practical laboratory experiences while keeping the interviews focused on the research topics. This approach is consistent with guidance favouring broad questions, relevant prompts and understandable language (Jacob & Furgerson, 2012; Castillo-Montoya, 2016).

The informants were informed about the research and provided consent. With their permission, the interviews were audio-recorded and transcribed verbatim. The researcher checked the transcripts against the recordings and read them repeatedly before coding. Published literature was kept separate from the interview evidence about the organisation's own practices.

Thematic analysis

The interview data were analysed using the six phases described by Braun and Clarke (2006): familiarisation with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Relevant statements were coded and organised into themes addressing testing functions, operational constraints and organisational responses.

The analysis considered similarities and differences between the informants' responses. Selected quotations connect interpretations to the reported accounts. Mention frequency was not treated as a measure of incident frequency. Following the thematic analysis, the discussion was structured around the assurance question addressed, the reliability of the evidence and its use in wider assessment, as explained in Section 2.1. This subsequent interpretive step did not replace the interview-derived themes or imply that informants had been questioned directly about the full halalan tayyiban concept. Published studies supported this interpretation; they did not independently verify practices at the research site.

Ethical considerations and research quality

Participation was voluntary. The informants were informed of the research purpose, provided consent and could withdraw without penalty. The organisation is not named to maintain confidentiality, and the codes LMR and LTR are used to attribute interview findings. The study examines professional experiences and views; it is not an external compliance audit.

Research quality was supported by the alignment of interview topics with the research questions, checking transcripts against the recordings, repeated reading before coding and the use of quotations to support interpretation. Yeong et al. (2018) distinguish protocol refinement from additional strategies used to strengthen the trustworthiness of interview findings. Consistent with that distinction, these procedures are reported for their specific purposes rather than as proof that all aspects of validity and reliability were established. Formal expert review, pilot testing, member checking, independent coding and triangulation with operational records were not documented and are not claimed. The small sample supports a focused description of two professional perspectives, without establishing thematic saturation or representation of other laboratories.

RESULTS AND DISCUSSION

Contributions of laboratory analysis to assurance

Supporting regulatory and specification requirements

The informants described laboratory analysis as a way to check food products against relevant requirements. LMR referred to national food legislation, ISO/IEC 17025 and product specifications for sugar and wheat flour. These references serve different purposes. Food legislation and product specifications guide the assessment of products, while ISO/IEC 17025 concerns the competence and operation of the laboratory.

LTR also identified scientific knowledge and practical experience as relevant to analytical work:

"In the field of laboratory testing, a laboratory analyst should have a background in science, chemistry, or physics to operate laboratory instruments, or have extensive experience in laboratory analysis over a long period of time" (LTR, 30 December 2025).

LTR explained that laboratory responsibilities extend from receiving samples to preparing results for review. Staff need relevant scientific knowledge and practical experience. Technical supervision and report checking were also described as parts of the process. The findings therefore show that reliable results depend on several connected tasks: receiving a suitable sample, performing the analysis correctly and checking the records before a report is released.

This finding helps explain how laboratory work supports compliance decisions. A client receives a report after several people have completed and checked their tasks. The reference to accreditation shows the importance LMR placed on external quality requirements. However, accreditation applies to a defined scope of work. It should not be interpreted as evidence that an organisation is accredited to perform every type of food or halal test.

Assessing composition and selected safety-related attributes

Routine wheat flour analysis provided a concrete example of the laboratory's contribution. LMR identified protein, ash and moisture as commonly requested parameters:

"Basically, wheat flour samples that are commonly submitted to the food laboratory are analysed by a laboratory technician for protein, ash, and moisture content for each sample" (LMR, 29 December 2025).

The informants linked these measurements to product specifications and suitability for use. They paid particular attention to moisture because transport and storage conditions could change it before testing. This example shows why the way a sample is handled matters to the meaning of its result.

Protein and ash results mainly describe composition and quality. Moisture results can help assess storage conditions and the possibility of deterioration. These tests provide useful information, but they do not show whether all microbial or chemical hazards are absent. The finding is therefore best understood as support for checking selected product requirements. A wider food safety assessment would require other tests and controls chosen for the product concerned.

Informing halal verification

LMR described tests relevant to halal verification:

"In halal testing, there are various methods used, such as identifying the alcohol and the DNA present in food products" (LMR, 29 December 2025).

This response shows an understanding that some concerns about ingredients or contamination require scientific investigation. It also suggests that laboratory evidence can help those responsible for halal assurance make better-informed decisions.

The methods used for this work need to be described accurately. PCR examines DNA, whereas ELISA uses antibody reactions to detect specific proteins or other suitable targets. Putri Basuki et al. (2025) examined this distinction in collagen-based products. The choice of method depends on the substance being investigated and the type and condition of the food sample. Rahayu et al. (2018) demonstrate another approach using infrared measurements and statistical analysis for a specific meat adulteration problem.

Kim et al. (2022) provide an example of alcohol measurement in fermented foods. Such a result states how much alcohol was measured under the test conditions. The halal assessment must also consider relevant information about ingredients and processing, together with the applicable requirements. The contribution of the laboratory is to provide clear scientific evidence. The wider halal decision requires that evidence to be considered with the other information needed for certification or verification.

Substantiating product labelling

LTR described client requests for nutritional analysis as supporting evidence for product labels:

"At lab food, sample that we received from client to do nutrition analysis such as milk, fruit juice, coffee. They require the results as supporting evidence for their product labelling" (LTR, 30 December 2025).

This response shows that laboratory services also help manufacturers prepare product labels. Clients may request different nutritional measurements for different food products. The laboratory provides evidence for the measurements requested, which the client can use when checking a declaration. The usefulness of the report therefore depends on whether the testing request matches the information needed for the label.

These findings show that the same laboratory can support several types of decisions. The connection between a test and its purpose needs to remain clear. Composition testing, nutrition testing and halal-related testing may use different methods and require different explanations when results are reported.

Operational constraints

Preparing unfamiliar methods

LMR described unfamiliar or non-routine requests as requiring further preparation:

"If there is a new R&D and a request from a client involving an unfamiliar or non-routine analysis, the technician in the lab needs to learn and study the method" (LMR, 29 December 2025).

This response shows that a new testing request creates additional work before routine analysis can begin. Staff need to understand the method and its suitability for the sample. A laboratory may therefore need time for preparation, method verification or validation, depending on the circumstances. Accepting a request is also a decision about whether the laboratory has the skills and resources to perform it properly.

The practical issue is how this preparation is included in service planning. If new work is treated as identical to an established test, the extra demand on staff may be overlooked. The response suggests that laboratories should discuss preparation time with clients and include technical staff when deciding whether a new service can be offered.

Instrument downtime and differing operational perspectives

LTR identified equipment downtime, unreadable data and ageing instruments as difficulties affecting testing:

"During testing, one of the main challenges is unexpected equipment downtime, unreadable data..." (LTR, 30 December 2025).

LTR viewed equipment reliability as an important difficulty in daily testing. The reference to equipment used for more than five years describes this informant's experience; it is not a general rule that instruments become unsuitable after five years. Decisions about continued use should depend on condition, performance and maintenance history.

LMR placed more emphasis on routine flour tests that used relatively simple procedures and equipment. The two responses therefore describe the importance of equipment problems differently. This may reflect their different responsibilities or the tests they had in mind. LTR worked directly with testing tasks, while LMR discussed the wider service. The difference identifies a useful topic for discussion between management and technical staff.

Ikranbegiin et al. (2019) also highlight the importance of maintenance arrangements and servicing support. In the present setting, a shared review of maintenance records and equipment downtime could help management and technical staff identify which instruments most often interrupt work. This would give a more specific basis for deciding whether servicing, replacement or access to backup equipment should receive priority.

Preserving and identifying samples

Sample handling was discussed as a constraint because material could change before testing. LMR explained the particular sensitivity of flour to environmental exposure:

"Some samples are sensitive to environmental conditions, such as flour. When samples are transported from the port to the laboratory, testing needs to be carried out immediately. If the samples are exposed to the environment for too long, humidity can increase and affect the moisture content" (LMR, 29 December 2025).

LTR also discussed careful handling of samples containing volatile substances, which can evaporate. Both responses show that sample condition can affect the result before analysis begins. A test may be performed correctly but describe a sample that has already changed during transport or storage. Laboratories therefore need to consider handling conditions and timing together with the test procedure.

LTR explained the identification checks used before analysis:

"To avoid sample mix-ups, Laboratory Technicians will first verify the samples received, such as checking the sample number, supplier name, and type of flour" (LTR, 30 December 2025).

These checks connect the sample received with the request and the final report. The finding shows that traceability begins with routine identification tasks. Even a reliable measurement loses its value if it is assigned to the wrong sample or client.

Organisational responses and proposed improvements

Management support for equipment and staffing

LMR emphasised the need for resources directed at analytical work:

"Top Management need to allocate a dedicated budget for the purchase of equipment, equipment maintenance, and the procurement of high-quality chemicals for laboratory analytical testing" (LMR, 29 December 2025).

The staffing proposal was stated directly by LTR:

"More staff should be hired to speed up the laboratory testing processes" (LTR, 30 December 2025).

Together, the responses identify funding and staffing as priorities for maintaining service quality. These were the informants' proposed improvements. The interviews did not assess a new recruitment programme or measure the results of additional expenditure.

The proposals connect service quality with management decisions. Purchasing an instrument creates continuing needs for maintenance, reagents and trained users. Staffing also affects the time available to conduct tests and check results. Panagiotidou et al. (2025) similarly link laboratory quality implementation with management and personnel factors. The present findings show how these factors arise in discussions about everyday testing work.

Continuing competency development

The informants discussed technical training and participation in halal-related conferences and seminars as ways to maintain staff knowledge. These activities meet different needs. Technical training supports the ability to perform tests correctly. Halal-related learning helps staff understand why particular tests are requested and how their results contribute to halal assurance.

Krismastuti and Habibie (2022) also discuss personnel competence as a laboratory resource requirement. In this study, the need to learn unfamiliar methods makes continuing training especially relevant. A practical response is to link training to assigned duties and follow it with an assessment of the relevant skill. This would provide a clearer basis for assigning work than attendance at a course alone.

Documentation and traceability

The sample checks described by LTR provide a basis for maintaining traceability. A LIMS can help connect sample registration, test assignments and reports. Oakley et al. (2025) demonstrate the potential value of such a system, alongside the need for continuing support. In the present study, the interview evidence is clearer about routine sample identification than the extent of LIMS use. Improving connected records is therefore proposed as a management priority, rather than presented as a proven outcome of software adoption.

The handling concerns also support clear procedures to prevent cross-contamination. The necessary controls depend on the samples, substances and methods involved. These may include appropriate separation of materials, cleaning procedures and careful storage. Table 3 summarises the operational issues and the corresponding priorities for management.

Table 3 Operational issues and implications for laboratory management

Issue	Interview findings	Practical response
Unfamiliar methods	LMR described learning and preparation for non-routine requests.	Plan time for method preparation and staff competency assessment.
Instrument reliability	LTR highlighted downtime; LMR emphasised simpler routine testing.	Review maintenance, downtime and servicing needs for each instrument.
Sample integrity	LMR discussed humidity exposure; LTR described volatile samples and identity checks.	Set appropriate transport, storage and sample acceptance procedures.
Resources and competence	Participants proposed dedicated funding, staffing and continuing learning.	Assess workload, provide continuing training and plan resources for routine and new testing.
Traceability	LTR described checks of sample numbers, supplier details and sample type.	Connect sample registration, testing and reporting records; assess how a LIMS could support the process.

Source: Authors' analysis of the interview findings.

Organisational support for halalan tayyiban assurance

Viewed in relation to halalan tayyiban, the findings suggest that the value of laboratory evidence depends on how technical requirements are supported in daily work. Sample handling, staff competence, equipment and report review appeared as connected issues. A weakness in one area can reduce the value of work completed correctly elsewhere. For example, a suitable method cannot recover the original moisture content of flour if the sample has changed before arrival. Similarly, a well-maintained instrument cannot ensure a useful result if the wrong sample number is entered in the report. These examples help explain why laboratory management needs to consider the whole testing process.

This interpretation supports the resource perspective discussed by Krismastuti and Habibie (2022). Their work identifies the resources required for reliable laboratory operation. The present study adds practical examples of how these requirements are experienced by staff. For LMR, new testing requests created a need for method learning and preparation. For LTR, equipment problems and sample checks were part of daily work. Resource requirements therefore appeared through specific tasks, rather than as separate administrative matters.

The relationship between training and workload is particularly important. Learning a new method requires time, supervision and access to suitable materials. If the same staff must continue routine work while developing a new service, preparation may compete with existing testing duties. LTR's request for additional staff and LMR's explanation of unfamiliar methods suggest a need to consider these demands together. The study does not establish that staff were unable to perform their work. It shows why service expansion should include an assessment of the people and preparation needed to support it.

Panagiotidou et al. (2025) discuss management and personnel factors in the successful implementation of ISO/IEC 17025. The findings here provide a workplace example of that relationship. The informants connected quality with decisions about maintenance budgets, chemicals, staffing and learning opportunities. These decisions affect whether written procedures can be followed consistently. Management support is therefore reflected in the resources available for particular tasks and the way those tasks are scheduled.

Connecting management priorities with technical experience

The differing views on equipment problems deserve attention. LMR highlighted relatively simple routine testing, while LTR described unexpected downtime and unreadable data. These responses do not necessarily contradict one another. A laboratory may perform some tests with simple equipment while relying on more complex instruments for others. Technical personnel may also encounter small interruptions that are less visible in a management overview of completed work.

A practical response would be a joint review of an instrument register and a downtime log. Technical staff could record the fault, affected tests, interruptions, repeat work and any concern about result validity. Management could review these records against service demand, repair costs, servicing access and available funds. Together, they could prioritise maintenance, access to a suitable alternative instrument or replacement. Each decision should identify a responsible person, a completion date and the basis for checking whether the action resolved the problem. The review could occur at an agreed interval, with prompt escalation when a fault may affect results. This is a proposed decision process; the interviews did not establish that it was already in use.

Equipment age should inform this review alongside performance and servicing history. Ikranbegiin et al. (2019) draw attention to the support needed to sustain laboratory equipment. In the present context, older equipment that performs adequately may remain usable, while repeated failures may justify intervention regardless of age. Technical personnel should assess suitability before testing resumes, with management providing the resources needed for any corrective work. A follow-up review could examine downtime, repeat analysis and delayed reports to evaluate the selected action. These are proposed monitoring measures, not outcomes measured in this study.

Protecting sample integrity and the meaning of results

Sample control was one of the clearest links between routine work and result reliability. The flour example shows that conditions before analysis can influence what is measured. This means that quality control begins before a technician operates an instrument. Instructions to clients and sample collectors, acceptance checks and storage procedures all help determine whether the submitted material remains suitable for the requested test.

Management and technical staff could agree on sample acceptance criteria for each relevant test, including identification, packaging, transport, storage and condition on receipt. Technical staff could document departures from those criteria and assess their analytical implications; management could support client communication, replacement requests and the resources needed for suitable storage. The flour example makes the decision concrete: suspected moisture change should prompt a documented assessment of sample suitability before a result is interpreted as representing the original material. The study did not inspect the laboratory's acceptance or rejection procedures, so these steps are recommendations rather than findings about existing practice.

Traceability decisions should follow the same shared approach. LTR's checks of sample numbers, supplier details and flour type could be extended into a documented link between receipt, any subsamples, testing records and the authorised report. Technical personnel could identify where mismatches or incomplete entries arise, while management could decide on responsibilities, training and record-system support. A joint review could monitor identification discrepancies, requests for replacement samples and report corrections, assigning follow-up actions to recurring problems. Oakley et al. (2025) show that LIMS implementation requires continuing organisational support in a clinical microbiology setting. Here, a digital system is a possible means of maintaining connected records, not an intervention whose effectiveness was demonstrated.

Clarifying the laboratory contribution to halal assurance

The findings also help explain the relationship between general food analysis and halal verification. Routine flour composition and nutrition testing provided detailed examples of the laboratory's work. The discussion of specialist halal tests was broader. This difference matters when interpreting the study: experience in routine food testing provides useful knowledge about laboratory operations, but does not automatically establish detailed expertise in every halal authentication method.

Method-specific research provides a useful comparison. Kim et al. (2022) investigated alcohol measurement, Rahayu et al. (2018) studied a particular meat adulteration problem, and Putri Basuki et al. (2025) compared PCR and ELISA for porcine detection. These studies show that a halal-related concern needs to be translated into a suitable analytical question. A request to determine whether a product is halal may require clarification about the ingredient, suspected substance or processing issue that needs investigation.

This interpretation is consistent with van der Spiegel et al. (2012), who place laboratory analysis alongside other halal verification tools. It is also relevant to the broader food control arrangements discussed by Ahmad et al. (2018). The present study adds the perspective of the personnel producing the evidence used within those arrangements. Their work supports assurance when the sample is suitable, the method matches the question and the result is explained within its scope.

Halal-related competency development should therefore connect technical knowledge with an understanding of how results are used. Staff who explain reports need to distinguish a result for a particular substance from a conclusion about the whole product and production process. This does not require every analyst to make certification decisions. It requires clear responsibilities and effective communication between laboratory personnel and those responsible for halal assessment. Such coordination would make laboratory evidence more useful while reducing the risk of misunderstanding its meaning.

Linking the findings to halalan tayyiban

The first analytical question concerns what is being assessed. LMR's reference to alcohol and DNA testing identifies questions potentially relevant to permissibility, whereas flour composition and nutrition testing

address selected product attributes. Routine composition testing cannot substitute for a targeted authentication method. Equally, detecting or not detecting a particular target does not establish the complete wholesomeness of a product. The connection between these activities lies in their contribution to different, clearly defined parts of an assurance assessment.

The second question concerns the reliability of evidence. Sample integrity, identification, method suitability and staff competence matter across routine and specialist testing, even though the methods and their technical requirements differ. The reported moisture changes and identification checks illustrate these shared dependencies. A composition result assigned to the wrong sample cannot support a specification decision; the same identification failure would also undermine an authentication result. This comparison is an analytical implication of the interviews, not evidence that specialist authentication failures occurred at the study site.

The third question concerns how evidence informs a wider decision. Awang (2021) links food safety to the tayyib dimension, while Abdul Mokti et al. (2022) discuss food quality within halal-related guidelines. Together with the broader verification perspective of van der Spiegel et al. (2012), these contributions explain why a result needs to be interpreted in relation to its purpose. At the reporting stage, laboratory personnel can explain the sample examined, the method's scope and relevant limitations. Those responsible for halal assessment can then consider this evidence alongside the ingredient and process information needed for their decision. This division of responsibilities is proposed here as a conceptual bridge; no certification-board personnel were interviewed.

Organisational support connects all three questions. Joint decisions about method preparation, equipment and traceability help maintain the conditions under which results remain useful for their intended purpose. The theoretical contribution is therefore to make the relationship between halalan tayyiban and laboratory work explicit through the production and use of evidence. The practical contribution is the proposed shared review of technical problems and management actions. Neither contribution changes the study into an evaluation of complete halalan tayyiban compliance or demonstrates that the proposed arrangements improve certification outcomes.

Limitations

This study involved two informants from one organisation. Their roles offered different perspectives, but the findings cannot represent all food-testing laboratories. The study relied on interviews and did not independently examine maintenance histories, sample records or test performance. Formal protocol review and pilot testing were not documented, which also limits assessment of the interview guide's refinement before use. It therefore identifies experiences and improvement priorities rather than measuring how frequently problems occurred or how effective particular responses were. The findings also provide more detailed information about routine food testing than specialist halal authentication. The interviews did not directly investigate the informants' understanding of halalan tayyiban; the connection to that concept is an interpretation of the reported findings, not an additional interview result.

Future research directions

Future research should compare food-testing laboratories across regions and regulatory jurisdictions, including sites focused on routine composition testing and sites performing specialist halal authentication. A common interview guide could cover the assurance question, evidence reliability and report use, with context-specific questions about certification and regulatory arrangements. Including management and technical personnel alongside halal assurance or certification assessors would help examine how reports move from laboratory work into assessment decisions. Such a design could distinguish recurring operational issues from differences associated with service scope, resources and institutional requirements.

Comparative interviews could be combined with maintenance logs, sample acceptance and rejection records, report amendments and competency documentation. These sources would allow researchers to examine incident frequency and consequences rather than relying on perceived importance alone. Studies could also evaluate shared maintenance and traceability reviews over time using indicators such as downtime, turnaround

time, identification discrepancies and repeat testing. Differences in laboratory workload, testing scope and regulatory context should be considered when comparing outcomes. This would address the present study's reliance on two interview accounts and test the practical recommendations developed here.

CONCLUSION

This study examined laboratory functions, operational constraints and organisational responses in one food-testing laboratory, and considered their relevance to halalan tayyiban assurance. Interviews with two informants identified contributions to product specification checks, composition testing, halal-related verification and nutrition labelling. Constraints concerned unfamiliar methods, equipment problems and sample control. The informants highlighted funding, staffing and continuing competency development as priorities.

The findings suggest that laboratories support aspects of halalan tayyiban assurance through the question addressed by a test, the reliability of the evidence produced and its interpretation within a wider assessment. Routine composition testing and specialist authentication serve different purposes but share dependencies on sample integrity, traceability and competent work. Proposed joint reviews of equipment problems and sample records would connect technical experience with management decisions, assigned responsibilities and follow-up. Their effectiveness remains to be evaluated.

Laboratory analysis remains one part of a wider assurance process. Specific results must be considered alongside relevant information about ingredients, production and handling. Within the limits of two informants in one laboratory, the study explains how technical controls and organisational support can strengthen the evidence used for food safety, quality and halal-related assessment without presenting testing as complete verification of halalan tayyiban.

Declarations

Ethical approval

Ethical approval for this study was granted by the Academy of Contemporary Islamic Studies (ACIS), Universiti Teknologi MARA, under a collective approval for final-year research projects dated 17 November 2025 (reference: 600-ACIS (PT. 3/1)). The project was listed as minimal risk in the approval appendix under its original title, “Determination of Laboratory Analysis Role Towards the Compliance of Safe and Halal Food Products.” Participation was voluntary, and informed consent was obtained from both informants, including permission to audio-record the interviews. The organisation’s identity was withheld, and participant codes were used to maintain confidentiality.

Conflict of interest

The authors declare that they have no financial or non-financial conflicts of interest related to this study.

Data availability

The interview data are not publicly available because they contain potentially identifiable workplace information and are subject to confidentiality commitments made to the informants.

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