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Setting a Structured Food and Feed Laboratory Testing Capacity in the Arab Region

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Abstract

Food and feed analysis is a key component in the healthy function and performance of a food control system. Sound decision making relies upon accurate food and feed test results such as robust scientific data to inform the risk analysis process: the foundation for establishing responsible regulatory measures. This paper presents efforts presently underway in the Arab region to structure the operation of food and feed testing laboratories and to coordinate sanitary and phytosanitary measures, as a means to stimulate intra-regional trade of food and agri-food commodities. It examines previous experiences undertaken to frame such collaborative action in food and feed testing in the European Union (EU), and, more recently, in South East Asia. In addition, the outputs of a survey conducted among key opinion leaders, actors of accreditation bodies, and food competent authorities with regard to current assets and challenges faced by food and feed regulatory testing in the Arab region are discussed. Lastly, a path forward is proposed to shape the development of Arab regional Reference Laboratories, and requirements are recommended to achieve a common policy direction and criteria for the designation of such Reference Laboratories. A regional approach is introduced to promote the integration of food regulatory systems in the region, to strengthen the performance, and to enhance the reliability of food and feed testing in priority areas, with the aim to better characterize the food safety and quality realities in the Arab region.

Keywords: food safety, food analysis, feed safety, official laboratory, reference laboratory, capacity Building, Arab region

1. Introduction

Food and feed analysis is a key component in the healthy function and performance of a food control system. Sound decision making relies upon accurate food and feed test results, such as robust scientific data, to inform the risk analysis process: the foundation for establishing responsible regulatory measures [4].

Food and feed laboratory operations in support of a food control system must be positioned according to the minimum requirements of a "quality infrastructure" being satisfied, the availability of technical competencies in the various fields of food and feed analysis, and the accreditation of qualified laboratories. These operations are also contingent upon the availability of a relevant structure identifying Official Laboratories (OLs) as well as Reference Laboratories (RLs), at the national and/or regional level, in addition to the associated legislative and regulatory arsenal, to set roles and responsibilities to ensure all components function harmoniously as part of the healthy operation of the food control system.

Several efforts were made domestically and internationally to enhance food laboratory capacities and competencies as key components of building a robust food control system, some of which resulted in the development of a priority-setting tool, inspired by the World Trade Organization's Standards and Trade Development Facility (STDF) Multiple Criteria Decision Analysis (MCDA) approach [7], to identify and rank priority areas and investment needs in food laboratory capacity building, such as that offered by the Partnership Training Institute Network (PTIN), a public private initiative of the Asia Pacific Economic Community (APEC) Food Safety Cooperation Forum (FSCF) [1].

2. Imperatives of Food and Feed Laboratory Testing Organization and Structure

The European regulation concerning "Official controls and other official activities performed to ensure the application of food and feed law, rules on animal health and welfare, plant health and plant protection products" [6] is a foundational text, clearly outlining certain key specifications of laboratory performance involved in generating results for official purposes

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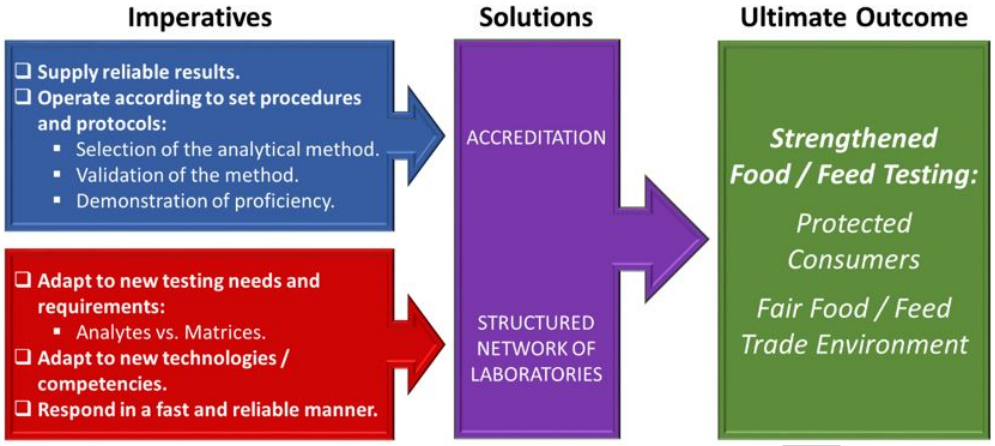

Figure 1: Addressing the needs of enhanced reliability and continued improvement of food and feed testing

(i.e., developing and contributing to the documentation of scientific evidence that informs food regulatory decisions), which states that, "*Laboratories designated by competent authorities to carry out [...] test [...] in the context of official controls [...] should possess expertise, equipment, infrastructure and staff to carry out tasks to the highest standards*" [6]. Increased expectations are observed from the stakeholder community – consumers, industry, and competent authorities – that all actions should be taken to support strengthened accountability and to build trust among the various actors of the food supply chain, with the overall objectives of securing added protection for consumers and ensuring a fair environment for the trade of food and agri-food products. Those that exercise oversight of food control and contribute to characterize hazards in food and feed are increasingly faced with emerging issues in the form of new hazards in novel food products that may demand detection with increasingly more precision.

The accreditation of food laboratory procedures, in particular according to the ISO/IEC 17025:2005, supports the attestation of reliability in the performance of food and feed testing laboratories within a given scope of applying an analytical procedure or for the general scope, which would be permitted provided certain conditions of consistency in technologies and targeted analytes are met. This process must be complemented by additional measures that enable a food and feed laboratory to evolve within an environment striving for continual improvements, by means of adding capacity to identify new analytes or to acquire proficiency in new analytical technologies to improve the speed, precision, and reliability of food analytical response capacity. Paragraph 71 of Regulation (EU) 2017/625 advocates for such continuous improvement, calling for, "*analytical, testing, and diagnostic methods to [...] meet state of the art scientific standards and to offer sound, reliable and comparable results*" [6]. The Regulation also calls for these, "*methods used by (official) laboratories as well as the quality and uniformity of analytical testing and diagnostic data generated by them*" to be, "*continuously improved*" [6].

The development of food and feed testing laboratory networks where leading institutions are designated from among the network to fulfill requirements of performance, capacity, and competencies, offers a direct response to the above-mentioned needs. These principal laboratories would be identified as RLs and would assume a leadership role in a given region or area and for a specified scope, serving as a hub for the dissemination of knowledge, training and competency development, in addition to awarding assistance to other laboratory network members aspiring to access accreditation, enhance their performance, and corroborate the reliability of their results (Figure 1). The concept of RLs has been applied in various parts of the world, such as the European Union, and are under consideration in the Asia Pacific region; likewise, this approach has been applied with success at national levels.

This paper will discuss some features of this experience at the international level and offer considerations for possible application in the Arab region, to complement continued efforts of enhancing the reliability of food and feed testing currently being carried out by the Arab Accreditation Cooperation Body (ARAC) and the Arab Taskforce on Food Safety (ATF), a permanent structure of the League of Arab States aimed to coordinate food (safety) regulatory measures towards more convergence and harmonization.

3. Reviewing the European Experience in Setting Reference Laboratories

As previously introduced, Paragraph 71 of the preamble to Regulation (EU) 2017/625 stipulates that, "*official controls and other official activities should be based on analytical testing and diagnostic methods that [...] offer sound, reliable and comparable results*" [6]. Article 5 of the same regulation goes further in defining the responsibility of European member states' food competent authorities, mandating under article 5.1-d that they, "*have or have access to an adequate laboratory capacity for analysis, testing and diagnosis*" [6].

To help structure the reliance on such laboratories, the European regulations specify three types of institutions necessary to intervene in official controls: Official Laboratories, National Reference Laboratories, and European Reference Laboratories (EU RLs) (Figure 2).

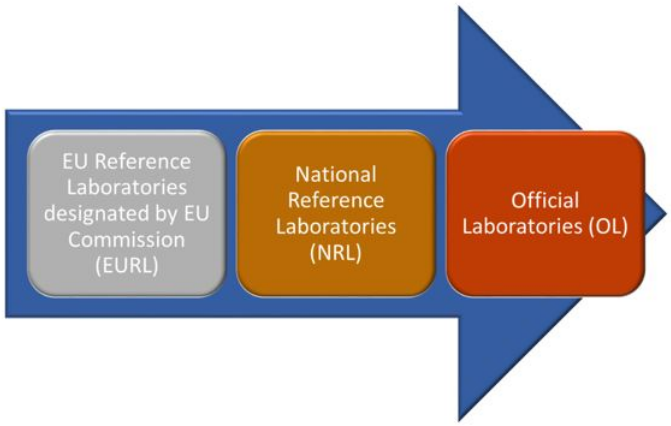

Figure 2: Structure of food/feed testing laboratories in Europe, with decreasing regional level of oversight from the European structures to the National and Official structures

3.1. Official Laboratories

Article 37 of Regulation (EU) 2017/625 defines and sets the conditions of designation and operation for OLs. Competent authorities in European member states have the prerogative of designating such laboratories as the food and feed testing facility empowered to carry out, "*analysis, tests and diagnoses on samples taken during official controls and other official activities*" [6]. The designation of an OL can be made beyond the borders of the EU member state; however, such designation must be conducted from within the European Economic Area, for example, extending to Norway, Iceland, and Switzerland.

Article 37-4 specifies the criteria for OL designation in terms of possessing the, "*expertise, equipment and infrastructure required. It emphasizes the need for the laboratory to perform its analytical tasks [...] impartially*" and to be accredited to, "*operate in accordance with the standard EN ISO / IEC 17025 and for such accreditation to be delivered by an accreditation body operating in accordance with Regulation (EC) No 765/2008*" [6].

The European regulatory framework sets obligations for the designated OLs, such as immediate reporting to the competent authority and transparency related to the method(s) used for each analysis. OLs are also expected to participate in inter-laboratory validation protocols and proficiency testing programs. Article 39 of Regulation (EU) 2017/625 goes as far as specifying conditions for the audit of OLs by the competent authorities and possible repercussions should these audits result in failures [6].

3.2. National Reference Laboratories

At the member state level, NRLs contribute to creating a structure for official food and feed testing by addressing the imperatives identified earlier. For example, the ability to respond to emerging issues, enhanced reliability, and continued improvement. Beyond the necessity to be adequately staffed and equipped, the setup, designation and operation of NRLs are covered by Articles 100 and 101 of Regulation (EU) 2017/625 and are summarized in Table 1.

Although the privilege to designate and operate NRLs is the responsibility of a member state, the European Regulation offers a framework as guidance to establish the institution's mandate, designation, and operation that encourage consistency and aim to harmonize the operational management of food and feed laboratories in the European Union.

3.3. European Reference Laboratories

The European Union created a structure of food and feed testing encompassing European Reference Laboratories and Reference Centers, in areas of expertise, "*where there is a recognized need to promote uniform practices in relation to the development or use of the (laboratory) methods*" and where, "*the effectiveness of official controls and other official activities also depends on the quality, uniformity and reliability*" of the methods of analysis and results produced using such methods [6].

EU RLs are, therefore, established in specific areas of food and feed testing and are also selected among accredited, well-equipped and well-staffed food and feed laboratory operations in the European Union, with a demonstrated knowledge and competency of international practices. The role of EU RLs is well defined in Articles 92-94 of the Regulations, summarized in Table 2.

The designation of EU RLs follows a public selection process and is effective for a limited time, generally five years, and subject to regular review and control by the European Commission to verify compliance with the criteria of designation. Failure to meet such criteria, including instances of non-compliance, would result in withdrawal of designation of the identified laboratory. The structure of EU RLs extends the area of food and feed testing to cover animal health and plant health, also governed by the same European Regulation (EU) 2017/625.

In view of the importance of food fraud and the need to address increasing requirements of food and ingredient authenticity testing, the European structure also identifies the necessity to designate "*reference centers for the authenticity and integrity of the agri-food chain*" [6] whose responsibility is to provide,

Table 1: Setup, designation, and operation of NRLs

Play a leadership and coordination role among OLs with respect to distinct areas of food and feed testing.
Support, ***harmonizing and improving the methods of laboratory analysis, test or diagnosis and their use*** [6], in particular with respect to areas of testing defined by target analytes such as additives, contaminants, substances used or generated as a result of food production.
Organize inter-laboratory comparative testing.
Coordinate proficiency testing programs.
Validate reagents, lots of reagents, and where needed, establish and maintain up-to-date lists of available reference substances.
Deliver training courses to OL staff.
Assist member states in addressing food (safety) incidents, including foodborne illness outbreaks.
Contribute to food and feed monitoring activities, in particular the Multi-Annual National Control Plan (MANCP).

Table 2: Responsibilities of EU RLs

Provide guidance to NRLs on methods of food/feed testing, including reference methods.
Organize regular inter-laboratory testing and proficiency testing programs among NRLs.
Arrange aspects related to adopting new methods by NRLs.
Provide training, competency enhancement and programs directed primarily to NRL staff, but also reaching other official laboratories in third countries.
Offer scientific and technical assistance to the Commission within the EU RL scope.
Contribute scientific information/disseminate research outputs related to areas of EU RL expertise.
Collaborate with the European Food Safety Authority (EFSA) and the European Centre for Disease Control (ECDC), within its area of scope.
Assist in addressing food (safety) incidents, including foodborne outbreak management in member states by carrying out confirmatory testing, where required.
Coordinate or perform tests to ensure verification of the quality of reagents and lots of reagents used for the diagnosis of foodborne diseases.
Establish and maintain reference material, substances, and reagents useful, among other purposes, to calibrate analytical equipment and support NRLs by providing them with the samples needed.
Cooperate among other EU RLs and with NRLs, as well as with the Commission, to develop methods of analysis, testing, diagnosis, etc., where relevant and within their area of competence.

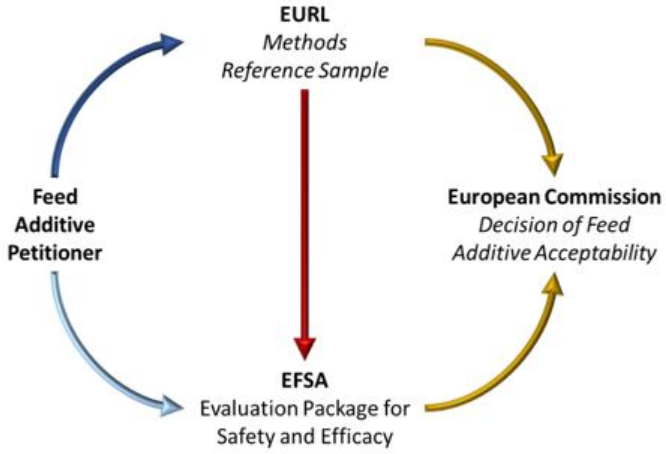

Figure 3: European Union process of handling feed additive submissions

"*specialised knowledge in relation to [...] the methods for detecting violations of the rules*" [6] in the area of, "*food and food safety, integrity and wholesomeness*" [6], "*through fraudulent or deceptive practices*" [6]. These centers of reference are also called upon to help identify the segments of the agri-food chain that are potentially subject to violation, and to develop the decisive official control techniques and protocols to combat such fraudulent practices. The dissemination of research findings and technical innovations within the scope of their mission is another key area of intervention in this highly evolutionary field, where emerging incidents and developments are the norm.

The technical leadership and convening/coordinating oversight exercised by these institutions center around key thematic areas of food and feed testing in the European Union, including:

- Additives for use in animal nutrition – EU Joint Research Centre (JRC)
- Antimicrobial resistance, DTU, Denmark
- Genetically Modified Organisms (GMOs), JRC
- Material intended to be in contact with foodstuffs, JRC
- Metal and nitrogenous compounds, DTU, Denmark
- Parasites – *Trichinella, Echinococcus, Anisakis* – Istituto Superiore di Sanita, Italy
- Residues of veterinary medicines and contaminants in food of animal origin (Annex I, Group B), ANSES, France

The complete list of EU RLs and the network of NRLs that it helps coordinate can be accessed online at https://ec.europa.eu/food/ref-labs_en .

The role of EU RLs may be pivotal in food and feed regulatory processes. This is the case in the context of feed additives, where Regulation (EC) No 1831/2003 specifies how the EU RL in this area contributes directly to the assessment of new feed additive submissions, and therefore, in the regulatory decision [8].

The evaluation of the analytical method used in official controls of the substance projected for use is submitted concurrently to the EU RL, simultaneously with file submission to the European Food Safety Authority (EFSA), responsible for performing the new feed additive's safety and efficacy assessment. The EU RL's task consists of assessing the performance of the method submitted by applicants regarding its suitability for official control, as well as keeping reference samples of the additive intended for use.

The assessment of the method is covered by requirements set in Article 11 of Regulation (EC) No 882/2004, which pertains to official controls performed to ensure the confirmation of compliance with feed and food law, among other requirements. This Application Regulation imposes that petitioners submit analytical protocols suitable for each active substance/matrix combination, along with a single laboratory validation report, to attest to the, "*fit for purpose*"; also, verification by a second laboratory is required to demonstrate the, "*transferability of the method*" to official control laboratories [5].

The EU RL is assigned the responsibility to help provide a designation for methods in the context of their use in official controls – such as community methods – which are deemed acceptable by the European Committee for Standardization (CEN), as well as methods recognized by other international bodies such as ISO or AOAC International. It is possible for the EU RL to draw on the support of the network of NRLs affiliated to it and operating in the same areas of analysis. The information, in its entirety, is submitted in a report to EFSA and subsequently to the European Commission (Figure 3). The analytical evaluation report produced by the EU RL is an intrinsic part of EFSA's overall evaluation package of the new feed additive.

In summary, EU RLs offer independent, evidence-based advice to food regulators and policy makers on food and feed analytical techniques. They are supported by a strong network of NRLs and OLs resulting in an extensive level of food and feed additive expertise, vital for the robustness and credibility of the food regulatory decisions they underpin (Figure 4).

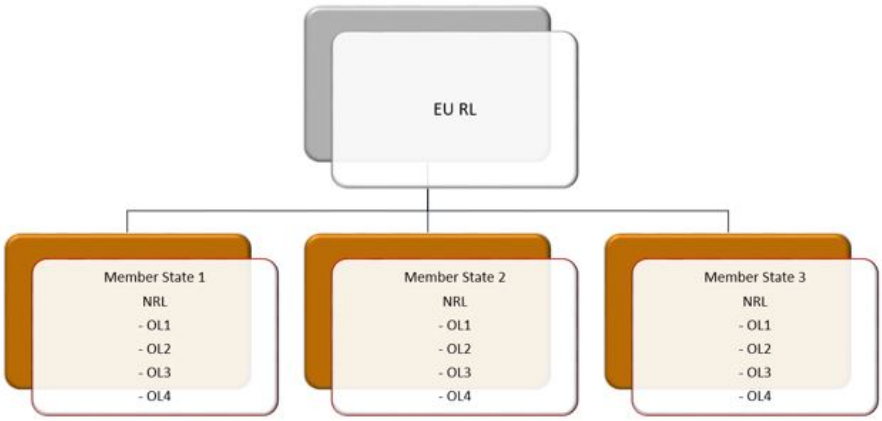

Figure 4: Structure of the network of laboratories within the European Union

4. Reviewing the South East Asian Experience

As part of its effort to promote food regulatory integration, member states of the Association of South East Asian Nations (ASEAN) have committed to developing a regional food safety infrastructure comprising:

- Common requirements for food control, food hygiene, and food labelling
- Guidelines and training tools for the application of GHPs (Good Hygiene Practices)
- A Regional Rapid Alert System for Food and Feed
- A network of ASEAN food RLs, covering Genetically Modified Organisms (GMOs), heavy metals and trace elements, veterinary drug residues, pesticide residues, mycotoxins, microbiology, and other areas

A guideline was endorsed by the ASEAN Consultative Committee on Standards and Quality (ACCSQ) during its 46th meeting (September 19 - 21, 2016) concerning the designation, roles and responsibilities, and operations of the ASEAN Sectoral Networks of Laboratories [2]. This guideline was further refined, then applied to the food sector with the contribution of the Product Working Group on Prepared Foodstuffs (PFPWG) and the ASEAN Food Testing Laboratory Committee (AFTLC), leading to the establishment of the Guideline for ASEAN Food Reference Laboratories.

Similar to the European example, an ASEAN Food Reference Laboratory (AFRL) is designated in a specific area of expertise and possessing a demonstrated competence among accredited ISO/EIC 17025 laboratories in the field. This RL is expected to play a key role in offering training, capacity building, providing and/or coordinating proficiency testing (PT) programs in accordance with ISO/IEC 17043 and ISO/TS 22117, as well as organizing inter-laboratory comparisons, as appropriate. Similarly, the AFRL is expected to act as the resource center for Certified Reference Materials (CRMs) or Reference Materials (RMs).

In essence, the AFRL is the leading expert authority in the region, as it pertains to its area of expertise, and would therefore advise on the selection of suitable test methods from among those developed or recognized by international institutions such as Codex, ISO, CEN or AOAC. The coordinating function of the AFRL encompasses efforts to manage a network of laboratories in the same field of expertise from within ASEAN member states. Presently, nine ASEAN Food Reference Laboratories have been designated and include:

- GMOs → Malaysia
- Food microbiology → Vietnam
- Mycotoxins → Singapore
- Veterinary drug residues → Thailand
- Pesticide residues → Singapore
- Heavy metals and trace elements → Thailand
- Food additives → Indonesia
- Food contact materials → Thailand
- Environmental contaminants → Singapore

A procedure was established for the application and evaluation of the competency of candidate AFRLs [3], including the approach that must be followed to propose and adopt a new AFRL in a distinct area of expertise that is not currently represented, via a consensus that must be reached by the PFPWG.

Although relatively young, the established network of food laboratories in the ASEAN is striving to maintain momentum by convening regular meetings and engagement opportunities, supported by technical workshops with partner organizations from the European Union (EU), the Food and Agriculture Organization of the United Nations (FAO), and the International Atomic Energy Agency (IAEA).

Table 3: Level of importance assigned by respondents to challenges encountered in the Arab region's food and feed testing

Challenge	High Importance	Low Importance
Availability of, and access to, competent and accredited food/feed testing facilities	86%	14%
Reliability in performance of existing food/feed testing organizations	85%	15%
Availability of, and access to, accreditation processes of food/feed laboratory testing procedures against ISO 17025	86%	14%
Availability of competent food/feed laboratory analysts	75%	25%
Low number of food/feed samples that are required to be tested	66%	34%
Absence of or limited access to reference laboratories at the national/regional level	75%	25%
Existing legal structure defining the role and responsibility of reference laboratories for food/feed testing	79%	21%
Access to analytical standards used in food/feed testing	79%	21%
Access to certified reference material	93%	7%
Access to proficiency testing programs	86%	14%

5. Identifying Opportunities to Structure Food and Feed Testing Laboratories in the Arab Region

A survey was conducted with key opinion leaders and experts from accreditation bodies, food competent authorities, and their stakeholders and partners, including food and feed testing laboratories from the Arab region. The self-assessment aimed at gathering data to qualify the current food and feed laboratory testing capacity in order to identify gaps, priority challenges, and areas of investment recommended by these opinion leaders. It was also designed to capture their professional opinion regarding possible benefits that could be achieved by establishing a network of food and feed testing laboratories, in a structured manner, with the opportunity to create national and regional level RLs in the Arab region.

Administration of the survey was accomplished using an electronic questionnaire hosted on the web-enabled platform Survey Monkey, using the Arab region's three languages: Arabic, French, and English. The self-assessment was carried out March 15th - June 1st, 2020. Twenty-eight respondents from twelve Arab countries contributed to the survey. The majority (46 percent) of respondents represented accreditation bodies, followed by experts and managers of food and feed testing organizations (43 percent), three competent authorities, other establishments specializing in risk assessment, national nutrition, and food institutes. Most respondents considered that food and feed testing in the Arab region is carried out under a well-established legal framework consisting of food standards, food laws and regulations, as well as accreditation requirements for laboratories operating for the purpose of official control, which includes the demonstration of compliance by Food Business Operators (FBOs).

An overwhelming number of respondents (93 percent) considered that the Arab region possesses a sufficient food and feed testing capacity. Between 85 and 93 percent of individuals classified the following challenges as being significant contributors to possible impediments encountered in the Arab food and feed testing environment: the availability or access to competent and accredited food and feed testing facilities; the reliability in performance of the testing institutions; the accreditation processes for testing procedures; access to certified RMs; and proficiency testing programs. Also, 75 percent singled out the availability of analysts and the absence of or access to Regional or National RLs, while 79 percent identified the legal structure that defines the roles and responsibilities of such RLs and the limited access to analytical standards to be of great concern. A summary of these results is presented in Table 3.

Although 75 percent selected the absence or limited access to RLs as a significant issue, only 29 percent of respondents labelled it as very important; it was not clear whether respondents were familiar with the role and contribution of RLs in addressing some of the concerns identified otherwise throughout the survey.

Areas of investments and capacity building needs were centered on the limited capacity of Mass-Spectrometry analytical protocols, as well as the limited number of food monitoring initiatives and the independence of laboratories involved in official controls. There was little to no concern with respect to the coverage of food and feed testing available in the region; however, a suggestion to invest in radionuclide testing was reported. Most respondents considered that guidance and support were needed to enable better access to reference materials and to improve the selection of official methods; they endorsed the idea of setting up and structuring National and Regional RLs in

the region when their mandates were better understood.

6. Towards the Establishment of a Food and Feed Reference Laboratory Structure in the Arab Region

6.1. Drivers

The electronic survey carried out among key opinion leaders involved in food and feed laboratory operations, management, and accreditation confirmed that the region would benefit from the creation of an RL structure at the national and regional levels to help address some of the challenges and existing limitations/gaps identified by most respondents:

- Enhance the ability to select common fit for purpose analytical methods that are recognized according to internationally benchmarked validation processes that could be designated as Reference Methods suitable for official controls at the national and regional levels. This would help create added harmonization and convergence of Arab food regulatory systems in a critical area of food and feed standard setting: Methods of analysis in food control.
- Promote access to reference materials and certified reference materials, essential to enable validation procedures.
- Facilitate the organization of PT programs in key thematic areas of food and feed analysis, indispensable to support the demonstration of competency and therefore to achieve accreditation.
- Gather the necessary competency and associated leadership to guide other laboratories working within the same scope of expertise, to adopt new developments in analytical technologies and be best equipped to address emerging issues.
- Create a community of practice to gather RLs and the OLs with the same expertise to support sharing competencies and present an opportunity for enhanced capacity building.

The RL should act as the lead coordinating force within the community of laboratories to promote sharing of resources, expertise, reagents (where relevant), and competencies.

6.2. Pre-requisites

Based on the references reviewed in this paper about efforts to structure and enhance food and feed testing capacity in the European Union and South East Asia, a number of prerequisites must be met to enable such enhancing of the performance and reliability of analytical testing in the Arab region:

- A clear policy framework endorsed by key actors involved in the oversight of food and feed laboratory operations and official controls (competent authorities) outlining the function of RLs, both regionally and nationally. This policy framework may be supported by a legal framework. At the regional level, this policy framework should be endorsed, at a minimum, by the Arab Taskforce on Food Safety (ATF) and the Arab Accreditation Cooperation Body (ARAC).
- An agreed upon and robust process to designate OLs: laboratories with performance deemed suitable for consideration in official and regulatory settings. These laboratories will constitute members of the projected network.
- A clear, transparent and possibly open process to designate National or Regional RLs in a given area of expertise. The process should be criteria driven and preferably internationally benchmarked according to the experiences of other countries.
- Processes should be adopted at the national and regional levels to designate and endorse RLs.
- A critical mass of laboratories in a chosen area of food and feed testing expertise, operating with the necessary level of performance, among which a RL can be designated that would provide relevant services such as training, availability of reference materials, and coordination of PT programs.
- The process for designation of RLs should be time limited and conducive to continuous improvement, with a periodic review of the fulfillment by the RL of the criteria upon which the designation was made (for example, one year), as the basis to maintain or rescind the designation.
- A clear governance process and administration of the RL structure by the relevant body at the national or regional level.

6.3. Suggested Approach

It is suggested that the adoption of Reference Laboratories leading to an enhanced structure of food and feed testing laboratories in the Arab region follow a parallel track synchronous with:

- Policy and procedural development

  It is suggested that a Joint Arab Reference Laboratory Steering Committee (ARLSC) be established between the ARAC, representing the various accreditation bodies across the Arab region, and the ATF, which gathers representatives of competent food safety authorities in the region. The ARLSC would be empowered to develop the policy framework and any associated guidelines to establish such policy.

  It is recommended that guidelines be developed and submitted for endorsement in relation to:

  - Criteria of designation and operation of OLs in the Arab region

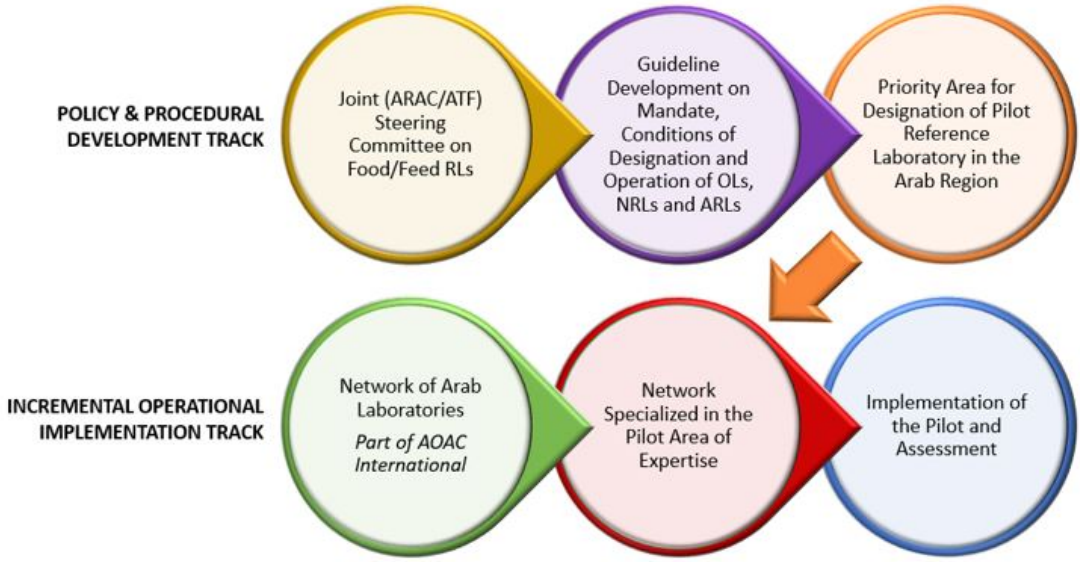

Figure 5: Policy and procedural development and incremental operational implementation tracks

- Criteria of designation and operation, including needed competencies and requirements of performance, of National and Regional RLs
- Guidelines for operation, performance, and assessment of such performance for OLs operating in countries in the Arab region, as well as the expected National RLs and Arab RLs.

  It is recommended that the ARLSC identify one or two areas of priority in food and feed testing to pilot the concept of RLs. In so doing, it is advised to rely upon approaches developed in other regions and internationally to conduct such prioritization, in particular the STDF's Multiple Criteria Decision Analysis (MCDA) approach to identify and rank areas of priority and investment needs in food laboratory capacity building, and the strategy offered by the Partnership Training Institute Network (PTIN), an initiative of the Asia Pacific Economic Community (APEC) Food Safety Cooperation Forum (FSCF) [1].

- Incremental operational implementation
  - Creation of an initial network of food and feed testing laboratories: It is suggested to establish a directory of Arab food and feed testing laboratories by developing a database covering these institutions, including documented areas of expertise and performance characteristics.
  - It is suggested that the above network of food and feed laboratories be integrated as part of a new section of AOAC International dedicated to food and feed testing, headquartered in the Arab region. This would anchor the structure of food and feed testing laboratories in communities of practice developed and operational internationally.
  - The community of practice created above should be narrowed down to those laboratories that are deemed proficient in areas of expertise related to the priority pilot areas determined by the ARLSC.
  - This community of practice could pilot the implementation of guidelines described above and would identify a leading regional laboratory to satisfy all the set requirements, plan, manage, and coordinate activities related to capacity building, including the provision of services in relation to proficiency testing program administration and interlaboratory validation protocols.
  - This pilot experience could be assessed after a period of 2-3 years to refine the guidelines and recommend the extension of RL designation to other national and regional areas of expertise.
  - The designated Arab RL and associated OLs in the specified pilot area of expertise would contribute to food and feed monitoring efforts as part of national food monitoring control plans or other programs set and coordinated regionally.

Figure 5 presents the policy and procedural development and the incremental operational implementation pathway.

7. Conclusion

Food and feed laboratory capacity in the Arab region was identified as being sufficiently mature to migrate towards an upgraded structure through the creation of Reference Laboratories at national and regional levels.

The European experience and the South East Asian experiences can serve as guidance for the Arab region to move forward with the development of an equivalent structure through the creation of a network of excellence of food and feed testing laboratories, to enhance the reliability of testing results when used for official controls.

The development of a policy framework supported by a legal framework for the designation and operation of such laboratories, in conjunction with their role in supporting official food and feed controls, along with the development of guidelines to steer the network development efforts, are essential to ensure a robust foundation at the national and regional levels.

A vigorous governance structure, possibly led by a Joint Committee between the ARAC and the ATF (ARLSC), is also indispensable to ensure the recognition and sustainability of the proposed approach. The Joint Committee could also play a leading role in steering coordination efforts for food and feed monitoring programs in the Arab region and within member states. These programs would contribute to the generation of food and feed laboratory monitoring data, critical for decision making processes but also for the application and maintenance of laboratory expertise to address concrete food safety and quality issues. NRLs and Arab RLs will play a crucial role in driving efforts on harmonization of food and feed regulatory measures in areas related to standard methods used for official controls, thereby reducing impediments to the intra-regional trade of food and agri-food commodities while enhancing the protection of consumers in the Arab region.

8. Declaration of Conflicting Interest

The authors declare that there is no conflict of interest.

9. Disclaimer

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