PAN AFRICAN FOOD SAFETY TESTING CAPACITY SURVEY REPORT 2022

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1. EXECUTIVE SUMMARY

This survey was initiated on behalf of AFRIMETS, to consolidate information on the laboratory food testing capabilities on the continent and identify gaps that would inform future food testing capacity building activities within the Africa Continental Free Trade Area (AfCFTA) in support of the African Union's Food Safety Strategy for Africa (FSSA). Responses (113) were received from 60% of the countries in Africa (1333 views) and were supplemented with additional ISO/IEC 17025 laboratory accreditation information to reflect the food testing capabilities of 76% of the countries.

Gaps and capabilities were grouped according to food testing categories and were evaluated against planned future testing capabilities over the next 10 years; prioritised commodities to boost African agricultural trade; the regulatory environment; and the agricultural commodities/ testing categories experiencing the most trade rejections.

Food testing capabilities fell into 3 distinct groups namely:

1) Major food testing (Microbiological, Nutritional Content, Heavy metals, Toxins and Pesticides)
2) Intermediate categories (Chemical Content (Environmental and Manufacturing Contaminants; Additives and Preservatives Veterinary Drug Residues), Food Adulteration and Authenticity Testing)
3) Emerging/ less established (Allergens, GMOs, Sampling and Radionuclides)

Group 1 has the most accredited laboratories (with up to 216 laboratories) with anticipated growth of 17-43% in this area, while group 2, has on average less than 20 laboratories offering these services, but with significant growth (81-89%) anticipated in the next 10 years. Group 3 has less than 10 laboratories offering these services, with similar growth (71-94%) anticipated as for group 2.

The regulatory environment has seen enforcement through a growing number of national food monitoring and inspection programmes prioritised for major food testing (group 1). Similarly, the main rejection of AU exports to the EU stems from group 1: mycotoxins (48%) and pesticides (12%) and group 2: chemical content (14%). The measurement capability and the anticipated growth in these categories should be supported and maintained. Furthermore, antimicrobial resistance and climate change are global concerns, which will spur additional growth in veterinary drug residue, pathogen and toxin testing. Additional concerns raised through the Codex Committee Africa included the increased/uncontrolled use of banned / new pesticides, food fraud, and contamination of the water used in food production. These upcoming threats should be prioritised as part of the One Health Approach.

Most imports are sourced from outside the continent which makes African countries vulnerable to 1) dumping of lower quality goods, and 2) disruptions in international logistics and distribution. Major imports include cereals and edible oils. Relevant foodstuffs that should be prioritised for testing on the continent include cereals and grains; poultry, fish, beef and derived animal products; dairy; animal feed; fruits and vegetables, fats and oils. This list overlaps with commodities that have been prioritised to boost African agricultural trade (rice, legumes, maize, palm oil, beef, dairy, poultry and fishery products, cassava, sorghum and millet).

Laboratory challenges identified stem from either absent, poorly implemented or lack of organization-wide adoption of quality management systems. Training needs include sample preparation; method validation; instrument operation and maintenance, the setup of specific methods for heavy metals, pesticides, and veterinary drug residue analysis; estimation of uncertainty of measurement; establishing metrological traceability, implementation of quality management systems, ISO/IEC 17025 accreditation, quality control and general laboratory management. Several laboratories develop their own in-house methods, where method validation using appropriate matrix Reference Materials (RMs) and Proficiency Testing (PT) are critical for demonstrating methods are fit-for-purpose, prior to use and accreditation.

2. CONTENTS

3. ACKNOWLEDGEMENTS

This report was prepared by the National Metrology Institute of South Africa (NMISA), under the leadership of Dr Maria Fernandes-Whaley (NMISA Senior Manager: Analytical and Material Sciences) with contributions from NMI members of the AFRIMETS Technical Committee for Chemical Metrology (TCQM), Dr Wynand Louw, AFRIMETS Secretariat, and NMISA staff. Additional contributions were received from NMI/DI representatives from Egypt, Kenya, Tunisia, Uganda, Eswatini, Rwanda, Tanzania, Zambia, and Zimbabwe.

We appreciate the support from colleagues within the Physikalisch-Technische Bundesanstalt (PTB), IAEA Technical Cooperation AFRA regional project – the Africa Food Safety Network (AFoSaN), Pan African Quality Infrastructure (PAQI), , Association of Analytical Communities-Sub-Saharan African Section (AOAC-SSA), National Laboratory Association of South Africa and the South African National Accreditation System (SANAS), United States-Foreign Agricultural Service (US-FAS) that assisted with inputs and distribution of the survey link within their networks.

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We extend our thanks to the laboratory representatives from the testing laboratories that participated in the survey from which valuable insights were obtained for this report. Further appreciation goes to the NMISA Technical and Support Units that provided technical inputs on the survey prior to distribution.

4. ABBREVIATIONS/ ACRONYMS

AAS	Atomic Absorption Spectroscopy
AfCFTA	Africa Continental Free Trade Area
AFoSaN	Africa Food Safety Network
AFSI	Africa Food Safety Index
AFRIMETS	Intra- Africa Metrology System
AOAC	Association of Analytical Communities
ARSO	African Organisation for Standardisation
AU	African Union
CIPM	International Committee for Weights and Measures
CRM	Certified Reference Material
DI	Designated Institute
EAC	East African Community
ELISA	Enzyme Linked Immuno-Assay
EU	European Union
FAO	Food and Agriculture Organization
FDA	Food and Drug Administration
FSSA	Food Safety Strategy for Africa
GAFTA	Grain and Feed Trade Association
GC	Gas Chromatography
GL	Guideline Level
GMO	Genetically Modified Organisms
HACCP	Hazard Analysis and Critical Control Point
IAEA	International Atomic Energy Agency
ICP	Inductively Coupled Plasma Spectroscopy
IEC	International Electrotechnical Commission
ISO	International Organisation for Standardisation
LC	Liquid Chromatography
ML	Maximum Level
MS	Mass Spectrometry
NIR	Near Infrared Spectroscopy
NLA	National Laboratory Association
NMI	National Metrology Institute
NMR	Nuclear Magnetic Resonance Spectroscopy
OES	Optical Emission Spectroscopy
OIE	World Organisation for Animal Health
PCR	Polymerase Chain Reaction
PT	Proficiency Testing (scheme)
PTB	Physikalisch-Technische Bundesanstalt
QI	Quality Infrastructure
QMS	Quality Management System
RASFF	Rapid Alert System for Food and Feed
REC	Regional Economic Community
SADC	Southern African Development Community
SADCFTA	SADC Free Trade Agreement
SoA	Schedule of Accreditation
UNIDO	United Nations Development Organisation
UoM	Uncertainty of measurement
UV-Vis	Ultraviolet-Visible Spectroscopy
WHO	World Health Organisation

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7. INTRODUCTION

There are numerous role players and stakeholders in the food safety value chain. Over the years, several surveys have been conducted along multiple avenues to identify gaps and areas of improvement, which typically include the lack of integrated national food control systems and limited political support for state-funded monitoring and inspection services (AU DARBE, 2022). This survey focussed exclusively on the analytical measurement capabilities of food testing laboratories within the AfCFTA, as an essential component of an effective food control system.

The decisions taken to confirm that foodstuffs are safe and nutritious for consumption; risk assessments that inform food safety legislation; and rejection of export/import consignments are based on the measurement results produced by food testing laboratories. This survey explored the core requirements for producing reliable and comparable measurement results, as described in the ISO/IEC 17025 international standard for the competency requirements of calibration and testing laboratories. The aim was to identify where the gaps and needs are for laboratories within the newly established Africa Continental Free Trade Area (AfCFTA), that can be appropriately supported through relevant training, metrology and proficiency testing to enable the fair and safe trade of foodstuffs. This is linked to the guiding principles of the African Union's Food Safety Strategy for Africa 2022-2036 (FSSA), which underscore harmonization, equivalence and mutual recognition of measures and trade enabling systems (AU DARBE, 2022).

AFRIMETS, the regional organisation for metrology in Africa, is undertaking a project toward Strengthening Food Safety and Quality Testing within the Africa Continental Free Trade Agreement Area (AfCFTA). The project takes place in two phases, where Phase 1 is the undertaking of a Pan African Survey to determine food safety and quality testing capacity, and Phase 2 is a series of capacity-building activities in the form of proficiency testing schemes and training workshops. The project targets AFRIMETS member National Metrology Institutes (NMIs), designated institutes (DIs), and laboratories in the AfCFTA with food testing services.

This report presents the activities of Phase 1 of the project:

The objectives of Phase 1 were to:

- Identify and consolidate measurement needs and gaps for NMIs/DIs and food monitoring laboratories for hazardous food contaminant testing (pesticides, toxins, heavy metals, antibiotic residues, etc) through a comprehensive (on-line and/or follow-up telephonic) survey
- Propose the implementation of a Food Safety & Quality PT programme as a pilot study for Africa (Phase 2) to enable the free movement of goods through the delivery of reliable measurements conducted within the AfCFTA and aligning with the AU's FSSA 2022-2036.

Due to the limited responses received for the on-line survey (113 laboratories), additional information was obtained through a parallel compilation of the schedules of accreditation of food testing laboratories in Africa, increasing the information for accredited testing services and food matrices to 382 laboratories to date.

These accreditation schedules will supplement the AFRIMETS database that is being established for NMIs and DIs with CIPM-recognised calibration and measurement capabilities on the continent, in addition to Food Testing laboratories.

8. APPROACH

The survey was prepared, and addressed the following areas of interest:

- Training needs and staff qualification profiles
- Instrumentation, automation and Laboratory Information Management systems
- Access to PT and reference materials (neat and incurred matrix)
- Accreditation and Quality Systems
- General laboratory operational challenges
- Participation in food monitoring programmes
- Donor funding
- Testing services (current/ planned)
    - Microbiological
    - Toxins
    - Veterinary drug residues
    - Heavy metals
    - Environmental and manufacturing contaminants
    - Additives and preservatives
    - Food adulteration and food fraud
    - Radionuclides
    - Nutritional content
    - Genetically modified organisms (GMOs)
    - Sampling
- Foodstuff categories
- Volumes of samples analysed and client demographics
- Gap score; the difference between the need for the testing service in the country and the degree to which it is established in the laboratory

The SurveyLab™ software platform was used for compiling, distributing and consolidating results (https://www.surveylab.com/en/survey-software-features/). SurveyLab™ is an on-line platform that allows for easy access by participants through desktop PCs or mobile phones, only requiring internet access. The survey was available in English, French and Portuguese. Participants could select their preferred language for survey completion upon portal entry. Further data processing was completed in Microsoft Excel.

To complete the survey, assuming all services are offered, would take participants an estimated 40 minutes to complete. Refer to Appendix 1 for the Pan African Survey that was distributed in English.

9. DISTRIBUTION

The survey was distributed through the following networks during the period 14 March extended to the end of April 2022:

- Pan African Quality Infrastructure (PAQI)
- National Laboratory Association (NLA) and the SADC Regional Laboratory Association (SRLA)
- The Africa Food Safety Network (AFoSaN), that is supported through the IAEA RAF 5084 Africa technical cooperation project.
- Physikalisch-Technische Bundesanstalt International Cooperation
- The AOAC-Sub Saharan Africa Section
- The United States Department of Agriculture - Foreign Agricultural Service
- Virtual delegates of the NMISA Africa Food Safety Workshop 2021

10. RESPONSES AND DEMOGRAPHICS

The survey concluded with 113 unique responses received. Although this response rate is low, interest was reflected through 1333 views of the survey on-line over an 8-week period. The summary report of these results would be shared with all participants and is available in Appendix 2 of this report. The country breakdown is presented in Figure 1A. To allow for a more representative reflection of food safety testing capabilities in Africa, a parallel exercise of sourcing all ISO/IEC 17025 schedules of accreditation (SoA) of African laboratories from ILAC recognised accreditation bodies, was conducted and combined with survey data (Figure 1B).

While only 60% of African countries were represented through the on-line survey participation, this percentage increased to 76% when SoA information was included. This information was used to complete the accreditation status, scope and food matrix sections in the survey for these laboratories. No additional information could be extracted from the SoAs.

In this report, no data is available for testing capacity in Central African Republic (CAR), Congo, Djibouti, Equatorial Guinea, Eritrea, Gambia, Guinea, Guinea-Bissau, Liberia, Libyan Arab Jamahiriya, Niger, Sao Tomé and Principe, and Western Sahara.

The laboratory type breakdown from participants was dominated by public laboratories, while the inclusion of the accredited facilities, equalised the spread of public and private institutions to 43 and 44 % respectively (Figure 1C and 1D respectively). The survey results also do not adequately reflect measurements being conducted in the academic and research laboratory environments, which were reported at 5-6% of the total participation. Laboratories that identified with “Other” are those involved with clinical diagnostics, toxicology, and zoonosis testing of live animals. Some laboratories have dual functions thus the totals do not sum to 100%.

Africa is a diverse commodity-based economy, accounting for just over 3% of global trade, with the main exports from Africa in 2020 comprising (Observatory of Economic Complexity (OEC), 2022):

- Minerals (gold, copper, iron, aluminium, titanium, salt) and diamonds
- Petroleum fuels, petroleum waxes and gas
- Agriculture (cocoa, coffee, tea, nuts, spices, cotton, tobacco and essential oils), forestry and fishing

The importance of enabling agricultural trade within the AfCFTA and supporting agricultural exports to the rest of the world remains a priority within the AU, especially in the regions indicated in Figure 1E, where the agricultural sector continues to be the main source of employment (>80%) in several countries across east, west and southern Africa.

Furthermore, the African map (Figure 1F) depicts the countries with the largest Euro value export of agricultural commodities to the EU (African Union, 2020), these include countries such as South Africa, Egypt, Kenya, Morocco, Tunisia, Nigeria, Cameroon, Ivory Coast, Ghana, Tanzania, and Uganda. This chart also correlates well with countries that have extensive laboratory food safety testing capacity, i.e. the number of ISO/IEC 17025 accredited food testing laboratories and survey participants (Figure 1 B) within the AfCFTA. Similarly, it can be observed that countries with limited agricultural activity have limited food safety testing laboratory participation/ accredited facilities, this could be a concern for the level of testing occurring at national levels for local foodstuff consumption and protection of public health.

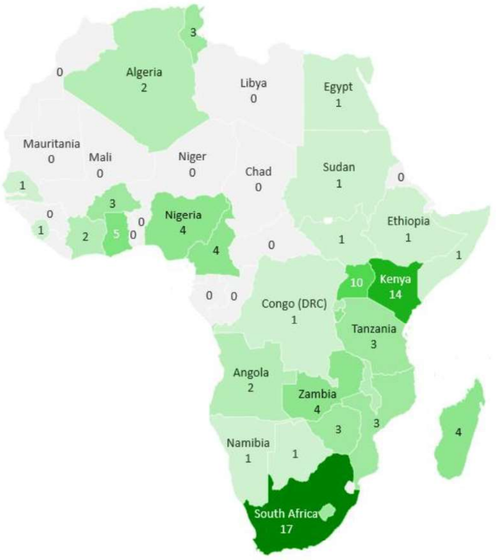


Figure 1 A: Number of laboratories from African countries that participated in the on-line survey (113)

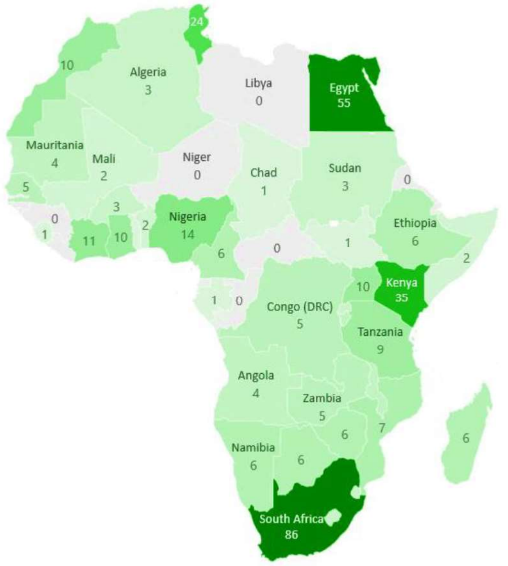


Figure 1 B: With additional ISO/IEC 17025 accredited laboratories information combined with survey data (>350)

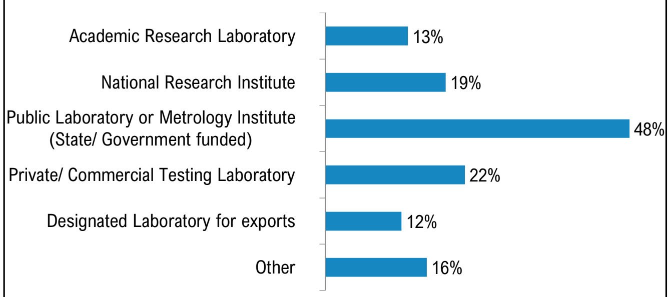


Figure 1 C: Laboratory categories of respondents that participated in the on-line survey. Some respondents may have selected more than one category.

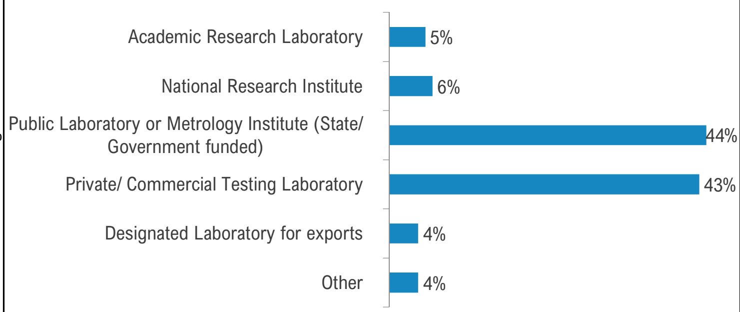


Figure 1 D: Laboratory categories of respondents including ISO/IEC 17025 accredited laboratories. Some respondents may have selected more than one category.

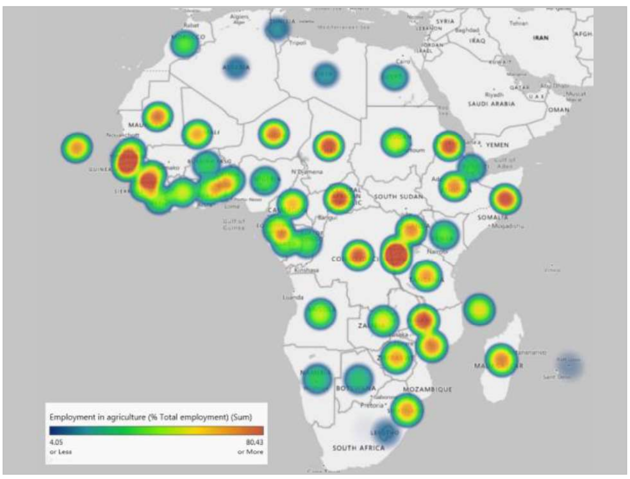


Figure 1 E: Percentage of total employment in the African Agricultural Sector

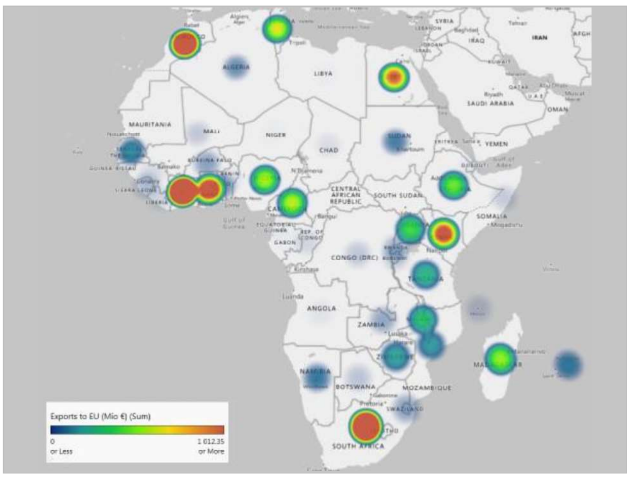


Figure 1 F: African exports to the European Union (Million Euros)

Figure 1 Survey participation; ISO/IEC 17025 Accredited laboratories; agricultural production and trade demographics within the AfCFTA

11. REGULATORY FRAMEWORKS

Africa possesses a heterogeneous mix of National Food Control systems. Some countries, have an extensive and well-developed network of food controls. While others are not yet established, fragmented or poorly implemented (AU DARBE, 2022).

In the absence of a centralised national food safety agency, that is tasked with coordination of all legislation, regulation, SPS standards, monitoring and inspection relating to food safety and quality, these activities tend to be fragmented and distributed between several government departments. Typically, the Department of Health (overseeing the public health of citizens); Department of Agriculture (overseeing SPS standards and agricultural commodity standards, border controls for plant health, animal health and agricultural commodities); Department of Trade and Industry (protecting against technical barriers to trade, standards, conformity assessment and consumer protection).

To date, where National Food Control Systems, legislation and regulations do not exist, countries defer to the FAO/WHO Codex Alimentarius. The World Trade Organization (WTO), as the intergovernmental organization that regulates and facilitates international trade between member countries, established the Agreement for the Application of Sanitary (relating to human and animal health) and Phytosanitary (relating to plant health) measures, and the Agreement on Technical Barriers to Trade (TBT), wherein both of these agreements the FAO/WHO Codex's food safety standards, guidelines and recommendations are sited for best facilitating international trade and protecting public health (WTO, 2022).

The Codex Alimentarius is an international code of food standards developed by the Codex Alimentarius Commission (Codex), under the United Nations, as a joint program of the Food and Agriculture Organization (FAO) and the World Health Organization (WHO). The food safety standards, guidelines, and recommendations established by Codex are the official food safety references used by the World Trade Organization (WTO) in international trade disputes.

The Codex includes standards, guidelines, and recommendations on the following:

Food additive uses, Labelling requirements, Definition and composition of products, Maximum levels of contaminants, pesticides, and veterinary drug residues, Microbiological guidelines, Agricultural and food production codes of practice. (FAO/WHO, 2022)

For exports, regulatory requirements of the export destination are adhered to, which may in some instances be stricter than the requirements laid out by the Codex. For example, the European Union and the United States of America legislative requirements are respectively compiled and enforced through the European Commission (EC, 2022) and the United States Food and Drug Administration (US-FDA) (US FDA, 2022) and US Department of Agriculture (USDA) (USDA, 2022).

The African Union recently released the Food Safety Strategy for Africa 2022-2036 (AU DARBE, 2022), building on the AU Sanitary and Phytosanitary Policy Framework for Africa (AU DARBE, 2019) with the support of key role players such as the African Organisation for Standardisation (ARSO, 2022) and the Codex Committee for Africa (FAO/WHO, 2022).

The FSSA mission is to strengthen national food safety systems to protect consumers and ensure fair practices in food trade, in order to contribute to improved public health, food and nutrition security, improved trade, economic growth and sustainable livelihoods. Of the six (6) identified strategic objectives, there are 2 applicable to capacity building of Africa’s food testing laboratories, as key components of a sustainable food control system that are highlighted below.

1) Strategic Objective Two: Strengthen the human and infrastructure capacity for food control systems, which includes the strategic actions to:
    - “Improve public and private laboratory infrastructure, analytical capacity and performance, laboratory networking, twinning and designating reference laboratories.
    - develop and strengthen food supply monitoring and foodborne disease surveillance programs and the management of food safety emergencies and response systems.”

2) Strategic Objective Four: Improve trade and market access at national, regional, continental and global levels, with the following related actions:
    - “Support compliance to food safety requirements and standards to increase market access.
    - Promote mutual recognition arrangements, systems equivalence and facilitate regulatory coherence and cooperation among MS to reduce non-tariff trade barriers and enhance transparency and trust build in food control systems in Africa.
    - Promote regional recognition agreements of testing certificates from accredited food safety laboratories.”

Successful outcomes of the FSSA would entail that laboratories are able to produce reliable measurement results routinely and sustainably, that would contribute to monitoring and inspection data and food safety risk assessments. The mutual recognition of these measurement results would be achieved through ISO/IEC 17025 accreditation, where well trained analysts, metrological traceability, use of validated methods, regular PT participation are key technical requirements of the international standard.

The AU will measure how effectively the FSSA is being actioned through the African Food Safety Index (AFSI). The AFSI is a tool that will track the implementation of Food Safety Systems at National level. There are several key performance indicators that should be achieved within the initial 5 years of which a robust national monitoring and surveillance programme for priority hazards in at least 5 priority consumed foods is a priority result. With emphasis on regionally relevant commodities, another priority result at the Regional Economic Community level, is for all food standards to be harmonized (technical and mandatory standards) with priority on identified strategic food commodities in the Abuja Declaration (2006); (AU DARBE, 2022).

Furthermore, the FSSA has adopted the One Health approach. Although the FSSA's main goal is to protect human health, food safety is reliant on healthy and sustainable animal and plant resources. The management of risks along the food chain is multidisciplinary and multisectoral and the best way to identify, stop, and address developing diseases at the human-animal-environment interface is through the One Health approach. The role of well capacitated analytical food testing laboratories, able to monitor diverse hazards in diverse foodstuffs, is a critical element of this integrated approach.

*One Health is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems. It recognizes the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and inter-dependent.

The approach mobilizes multiple sectors, disciplines and communities at varying levels of society to work together to foster well-being and tackle threats to health and ecosystems, while addressing the collective need for clean water, energy and air, safe and nutritious food, taking action on climate change, and contributing to sustainable development (World Health Organization, 2022).

12. QUALITY MANAGEMENT SYSTEMS

There are numerous benefits for laboratories to operate within a well-documented quality management system. In the food testing environment, the international standard ISO/IEC 17025 incorporates key elements of quality management that involve:

- Meeting the client's requirements, thereby providing confidence in the laboratory's services, which in turn leads to new and returning clients
- Ensuring compliance with regulatory authorities and delivery of products and services in a cost- and resource-efficient manner for business sustainability

Additional benefits of a well-established QMS include:

- Continuous improvement and control of processes
- Waste reduction
- Prevention of mistakes
- Reduction of expenses
- Identification and facilitation of relevant training opportunities for staff
- Keeping staff engaged
- Delivery of products within agreed turn-around time
- Conveying to stakeholders the laboratory's readiness to generate consistent results

Interestingly, although several of the challenges identified in section 14, highlight a lack of funding and human resources for sustainable laboratory operation, there is a clear skills gap in laboratory leadership and management, that could be addressed through the implementation of robust QMSs. Often it is the technical person that is promoted into management without the managerial leadership skills required for example, financial and HR management to operate the laboratory sustainably.

In institutions where the QMS is prioritised and well-integrated across both the executive management and technical operation level, the prioritisation of funding to meet QMS requirements is not negotiable. This results in the planned instrument maintenance, day-to-day streamlined operational costs including quality assurance (CRMs and PTs), and the continued training and development of analysts, being appropriately planned and funded from the top down.

It would be beneficial to focus on training activities that deal with the implementation of QMS at both leadership and technical levels, toward a sustainable solution for routine food testing laboratories, especially in the public sector.

Twenty-four percent of the 113 respondents indicated they are not accredited, nor have a quality management system (QMS) in place. However, they do intend to implement a QMS and obtain ISO/IEC 17025 accreditation within the next 10-year period. Similarly, 71% of respondents do not have a Laboratory Information Management System (LIMS) but intend to implement one in the same period.

13. LABORATORY ACCREDITATION

Several countries do not have their own accreditation bodies or defer to regional bodies to obtain accreditation, there is still a portion that obtains accreditation through the EU (France, Portugal, Germany), UK, or US. The main accrediting bodies within the AfCFTA, with the largest number of accredited facilities, are SANAS (South Africa), EGAC (Eqypt), TUNAC (Tunisia), and KENAS (Kenya). These coincide with the countries that have the well-established technical quality infrastructure, including National Metrology Institutes participating within the CIPM MRA, and with CMCs in the KCDB for Chemical Metrology services.

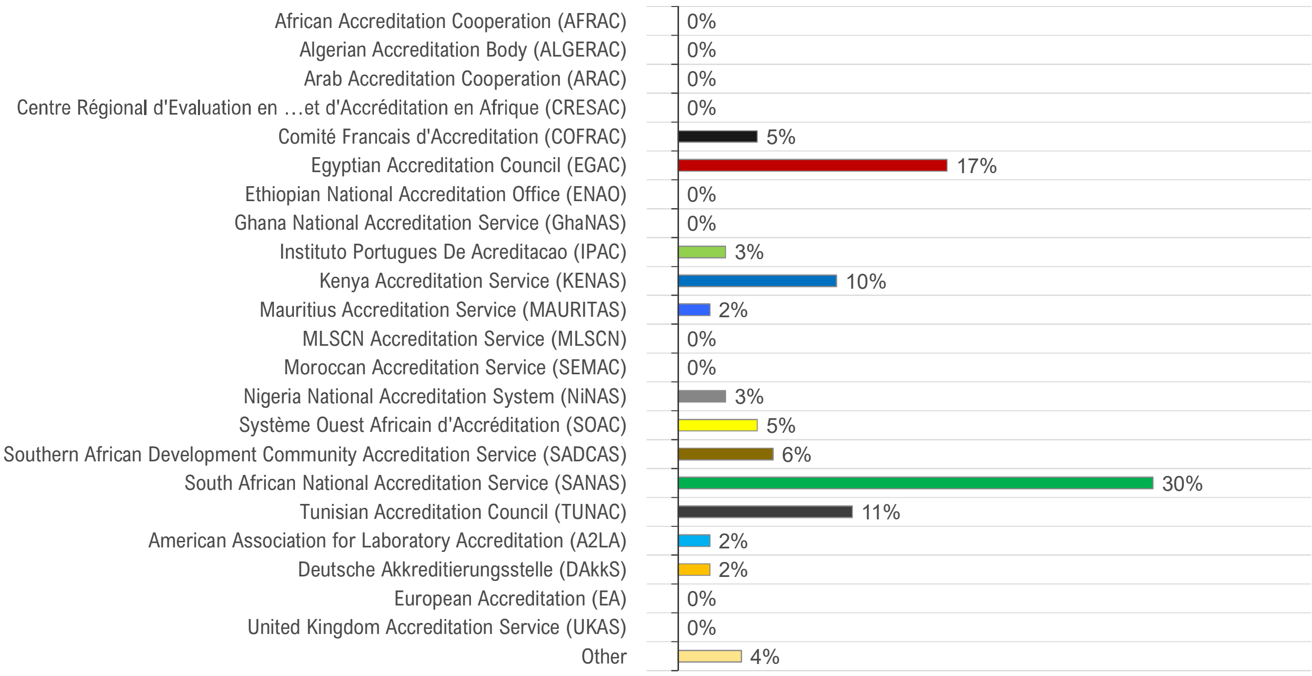


Figure 2 Percentage of Food testing laboratories accredited through ILAC recognised accreditation bodies

14. LABORATORY CHALLENGES

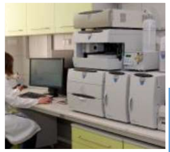
Participants were invited to rank listed challenges with maintaining laboratory operations, where rank 1 is the least difficult and 5 most difficult. The summary of responses received is presented in Table 1.

The top 3 ranked challenges include delays with importing chemicals, reagents, and spare parts for instrumentation and equipment, lack of instrument supplier maintenance and training support, and extremely high laboratory operational expenses.

Additional information for challenges that were listed as “Other” are summarised in Figure 4. These challenges are divided into four categories namely: 1) Supply chain challenges, 2) Funding, 3) Infrastructure and technology and 4) Human Resources (HR). These challenges are not uncommon and have also been described most recently in the FAO CC Africa survey (FAO/WHO, 2019)

Table 1 Ranked laboratory challenges

Weighted ranked difficulties (1 being least difficult and 5 most difficult)	1	2	3	4	5
Delays caused by importing chemicals, reagents and equipment, instrument spares/ repairs	5	10	34	34	118
Lack of instrument supplier’s maintenance and training support	13	22	34	52	96
Operational expenses are too high	7	14	52	34	92
OTHER	50	16	16	22	72
Technology and digitalisation limitations	9	20	58	66	64
Training and retaining of analysts	6	30	54	68	62
Lack of access to relevant PT schemes, reference materials	15	34	66	46	50



Instruments and equipment

- HPLC training & sample preparation, metrological traceability
- Operation of ion chromatography
- Calibration of ICP-OES
- Troubleshooting of ion chromatography, ICP-OES, AAS GC, HPLC, ICP-MS, AES
- Discrete Analyzer Analysis
- Equipment service and maintenance of GC
- Equipment verification and calibration, data analysis
- UV-Vis analysis
- PCR methods
- Laboratory equipment maintenance and troubleshooting (centrifuges, UV spectrophotometers, pH meters)
- Spectra interpretation software

Methods of analysis

- Analysis of natural toxins veterinary drug residues
- Training on the determination of arsenic and mercury in food
- Data processing/ data analysis,
- Method verification
- Structure elucidation
- Nutritional labelling
- LCMSMS- implement method for multiple pesticide residues
- Separation techniques for radionuclides (e.g. Sr-90/Y-90) for radio-analysis
- (NMI) IDMS, qNMR, DSC purity analysis, practical training on reference materials and their characterization; implementation of the gravimetric method; purity assessment
- Allergen testing, gluten testing, analysis of nicotine, amino acids, fatty acid profiling, dioxins, furan, vitamins (B complex) and other vitamins

ISO/ QMS

- ISO 5725 [Accuracy (trueness and precision) of measurement]
- ISO 31000 risk management & risk assessment
- Implementation of ISO 17034:2016
- ISO Guide 35
- OECD GLP compliance
- General requirements for PT ISO/IEC 17043
- HACCP
- Quality control - Internal quality control measures, e.g., using and interpretation of control charts, information from duplicate analysis, etc.

Other

- Information management in the laboratory
- Customer care, costing of services
- Green chemistry principles and application
- How to discard microbial and chemical substances
- Preparation and use of positive control samples, method validation for microbiological tests.
- Relative regulatory techniques, qualification of analytical equipment, MRLs
- Technical report writing skills
- Laboratory managers training courses, training on Laboratory management and laboratory capacity building program (LCB)

Figure 3 Additional training needs listed by on-line survey participants

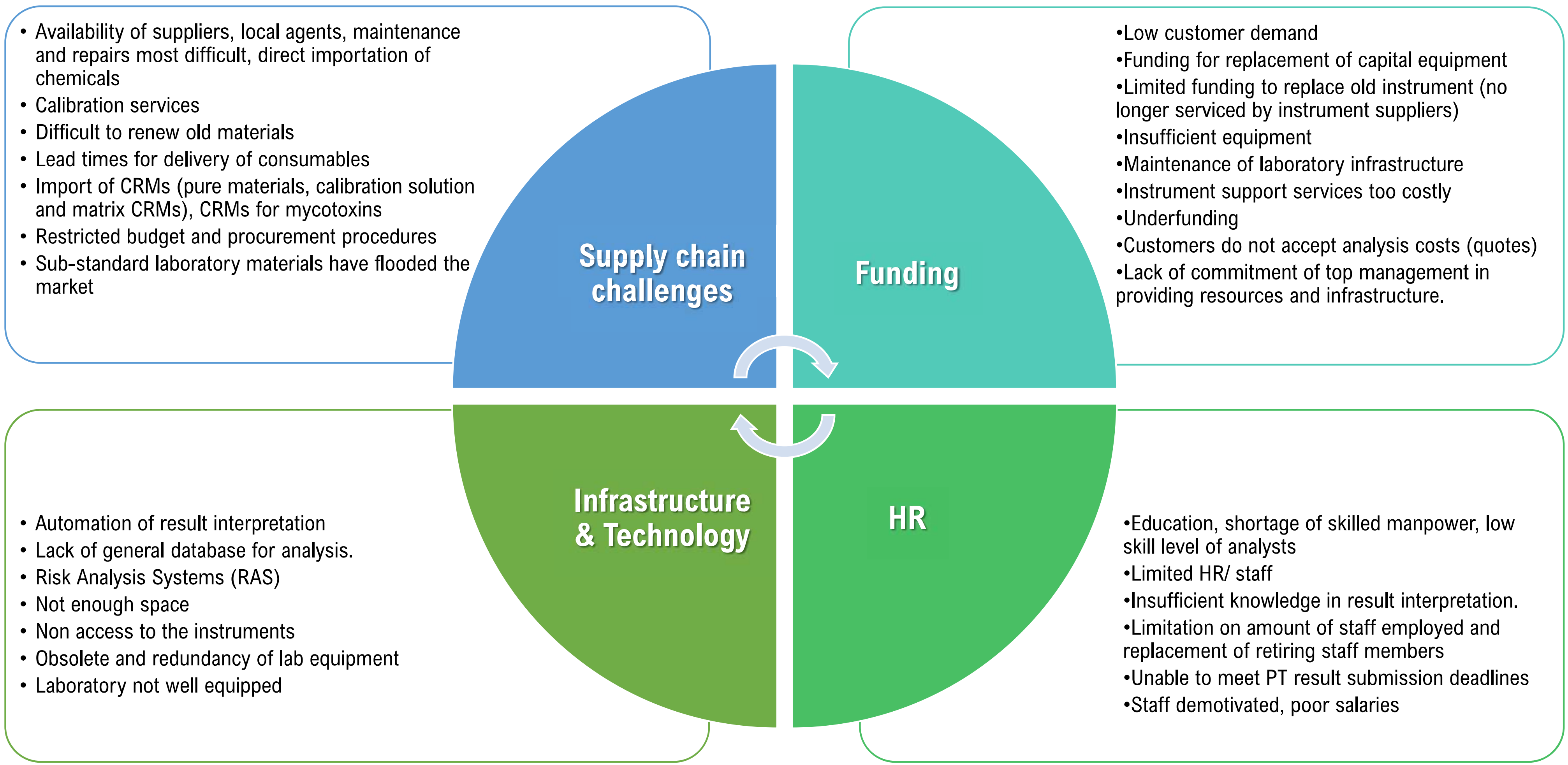


Figure 4 "Other" laboratory challenges identified by on-line survey participants

15. HUMAN RESOURCES AND TRAINING NEEDS

Of the responses received, the average number of staff per laboratory is in the region of 14-15 people, with an estimated qualification profile of 10% PhD, 20% MSc, 60% having a 3-4-year university degree or diploma, and 10% not falling into any of these criteria.

Staff training is distributed between in-house (51%) and external (49%) with the training frequency taking place predominantly on an annual basis (47%), every 2 years (15%), monthly (14%), and other (24%). Comments received for "Other" were mainly described as "training received based on demand", or "on an *ad-hoc* basis as and when the need is identified".

Table 2 presents a summary of ranked training needs. The results were weighted according to need where a rank of 1 indicates less needed, while a ranking of 5 indicates most needed. The following training needs were identified in the top 10%: Mass Spectrometry (MS); method validation; estimating the uncertainty of measurement (UoM); method development; Liquid Chromatography (LC); Gas Chromatography (GC); Implementing metrological traceability for chemical tests; hazardous chemical management (storage, disposal, and use); microbiological tests for food poisoning bacteria; Inductively Coupled Plasma - Mass Spectrometry (ICP-MS); sample preparation training for inorganic analysis (applying ICP-OES, ICP-MS, AAS, AES, ion chromatography techniques).

These training needs need to be linked to the equipment and instrumentation resources currently available in the respondents' laboratories. Refer to section 15 for further discussion on laboratory instrumentation. Additional training needs listed under the "Other" option are summarised in Figure 3. These are divided into four main categories for skills development namely: 1) instruments and equipment, 2) methods of analysis; 3) ISO standards and quality management systems (QMS) and 4) Other skills (e.g. report writing skills, laboratory management training).

16. METHODS OF ANALYSIS

Table 3 presents a summary of methods used by the survey respondents. Standard methods such as those provided through ISO/CEN/DIN or the AOAC, are typically methods that have undergone a rigorous performance evaluation process through interlaboratory comparisons and have been demonstrated to be suitably fit-for-purpose.

The CODEX guidance document for methods of analysis typically prescribes the use of ISO or AOAC methods. Often ISO methods are adopted AOAC methods (CXS 234-1999, 1999 amended 2021). While standard methods do need to be purchased, they only require demonstration and verification that the same performance is achieved in the laboratory. In contrast, developing in-house methods from scratch in the laboratory may end up costing the new laboratory more in the longer term. To fully validate and demonstrate consistent, reliable performance.

Table 2 Ranked and weighted training needs from completed survey responses received

Weighted Training Needs (1 = less needed, 5 = most needed)	1	2	3	4	5
Mass Spectrometry (MS) training	22	16	30	68	260
Method validation	22	14	36	88	250
Estimating Uncertainty of Measurement (UoM)	20	18	39	80	250
Method development	22	18	39	64	245
Liquid Chromatography (LC) training	19	20	48	60	245
Gas Chromatography (GC) training	23	22	36	92	215
Implementing metrological traceability for chemical tests	19	20	63	72	205
Hazardous chemical management (Storage, disposal, and use)	21	26	57	76	200
Microbiological tests for Food poisoning bacteria - training	24	18	51	76	190
Inductively Coupled Plasma - Mass Spectrometry (ICP-MS) training	26	16	48	68	190
Sample preparation training - Inorganic Analysis (ICP-OES, ICP-MS, AAS, AES, ion chromatography)	24	18	45	92	190
Microbiological tests for Food spoilage microorganisms - training	26	20	39	88	175
Sample preparation training - Organic Analysis (GC, LC, GC-MS, LC-MS, titration)	22	18	54	104	175
Representative sampling training	21	30	51	84	170
Establishing/ implementing a quality system for ISO/IEC 17025	29	22	60	88	165
Inductively Coupled Plasma - Optical Emission Spectroscopy (ICP-OES) training	25	16	69	64	160
Sample preparation training - Bioanalysis (DNA, RNA, Proteomics)	32	24	48	60	155
Qualitative analysis (screening analysis) training	15	38	63	104	150
Titration training	31	32	63	64	115

The overwhelming majority of microbiological testing laboratories (70% of respondents) are applying ISO/CEN/DIN standards. While the remaining categories in Group 1 and Group 2 are predominantly applying in-house methods (on average 40% of responses). In such cases, there is a bigger responsibility on the laboratory to ensure that the in-house methods are properly validated according to recommended method validation procedures (Magnusson & Ornemark, 2014). The use of appropriate matrix RMs and PT participation are crucial for demonstrating that the method is routinely fit-for-purpose.

There is a gap especially for indigenous foods for which relevant materials are not available. For example, RMs do not currently exist for hydrogen cyanide and other group 1 contaminants that are regulated in cassava and cassava products. This would limit method validation to spiking of contaminants, which would not reflect the analytical challenges associated with optimised contaminant extraction and matrix effects. Lack of appropriate method validation is often leading to the observed differences between laboratory results. In such cases, use of standard methods may be beneficial.

The Pan African Quality Infrastructure (PAQI), comprising of, the following AU Trade and Industry Technical Infrastructure Institution members: African Accreditation Cooperation (AFRAC), the Intra-Africa Metrology System (AFRIMETS), the African Electro Technical Standardisation Commission (AFSEC) and the African Organisation for Standardisation (ARSO), has initiated a project that will support laboratories involved in cassava and cassava product testing, with the development of RMs and PT for hazardous contaminant testing according to the CCAfrica commodity standards. Other similar initiatives should be considered going forward for uniquely indigenous foodstuffs (PAQI, 2020).

There are more laboratories applying standardised AOAC/ ISO methods for the determination of nutritional content and additives/ preservatives. These methods may be prescribed within the national and export destination food labelling regulations. In the case of the veterinary drug residues, allergens and GMOs, the manufacturer's application note/ test kit is the method chiefly applied (40-54% of responses), which is typical for rapid screening techniques such as ELISA's and radio-assays or DNA analysis techniques such as PCR. The comparability of these results may end up being traceable to the manufacturer's system or method, and not necessarily traceable to SI, thus making comparability between different manufacturing system results potentially challenging in the future. For radionuclide testing, IAEA methods are applied and for pesticide residue testing, sample preparation methods would include QuEChERs, microSPE, and LUKE.

Table 3 Methods of analysis used by respondents

	Microbiological	**Nutritional**	**Heavy metals**	**Natural Toxins**	**Pesticides**	**Env/Manuf. Contaminants**	**Food Fraud/ Adulteration**	**Additives/Preservatives**	**Vet drug residue**	**Allergens**	**GMO**	**Radionuclides**
AOAC method	3%	22%	22%	18%	13%	16%	7%	20%	4%	10%	20%	0%
ISO\CEN\DIN standard methods	70%	25%	15%	17%	18%	12%	13%	13%	8%	0%	20%	17%
In-house method	20%	40%	48%	33%	39%	42%	53%	47%	31%	40%	20%	17%
Literature	4%	5%	5%	6%	3%	14%	0%	3%	4%	10%	0%	0%
Manufacturer's application note/ Test kit	3%	1%	5%	22%	9%	7%	7%	0%	54%	40%	40%	17%
Other	1%	6%	5%	4%	9%	9%	20%	17%	15%	0%	0%	0%
Sample preparation	0%	0%	0%	0%	10%	0%	0%	0%	0%	0%	0%	0%
IAEA method	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%
Total responses	1793	221	151	160	93	43	30	30	26	10	5	6

17. INSTRUMENTATION

Figure 5 presents the summary of instruments and techniques available in the 109 laboratories of respondents that completed the on-line survey. 39% of instruments are used for dedicated tests while 61% of lab instruments are shared for different tests and activities. In the case of instrument breakdowns, shared resources would have a significant impact on the laboratory's ability to efficiently deliver test results. The number of instruments can be broadly divided into ranges of 0-20; 20-30; 30-50 and more than fifty (>50). Laboratories using ELISA tests/ lateral flow/strip tests (consumables) were requested to indicate 1 when completing the survey.

In the >50 range, instruments and techniques applied are those that typically require lower capital investment and operational costs (incl. reagents and consumables) and only basic analyst skill levels are necessary. This includes wet chemistry techniques such as total protein determination using Kjeldahl, titrations, ashing in a furnace, microscopes, and Atomic Absorption Spectroscopy (AAS). An often-overlooked expense with these titrations is the cost of hazardous chemical waste disposal and hot acid fume extraction systems.

As one moves into the lower number ranges, the capital investment cost, operational cost and required analyst skill levels increase. These systems also require additional infrastructure for routine operation, such as controlled laboratory temperature and humidity, and reliable electrical and gas supplies. Reduced instrument numbers are therefore observed for instruments required for trace analysis of contaminants in food (CXS 234-1999, 1999 amended 2021), such as ICP-MS, ICP-OES and ICP-MS/MS, GC-MS/MS and LC-MS/MS (<30 range). Advanced PCR techniques for microbiological testing, allergens and food authenticity testing are in the 0-20 range, highlighting the slower uptake of these techniques by the laboratories at this stage.

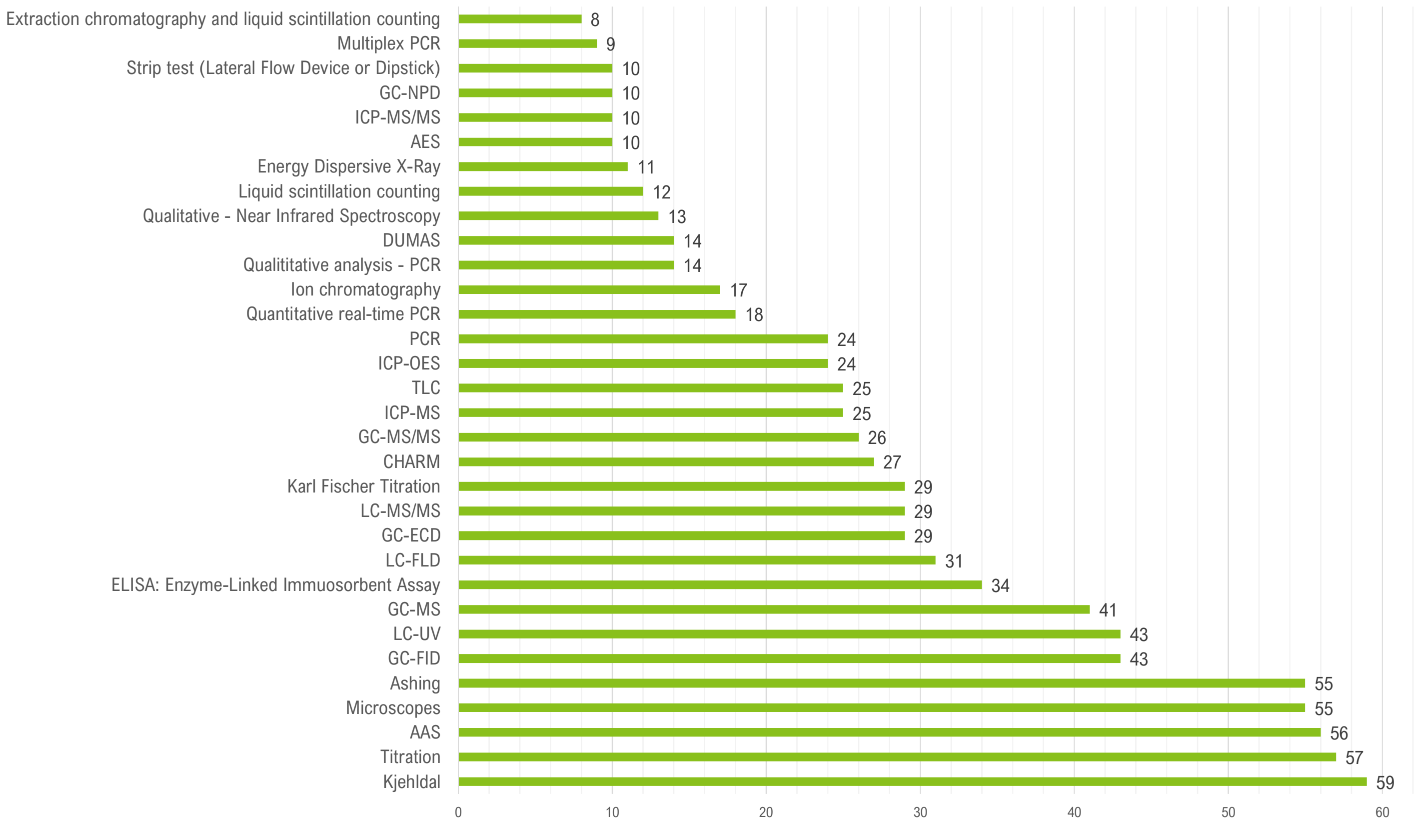


Figure 5 Instrumentation and equipment in participant laboratories

18. FOOD TESTING LABORATORY CAPABILITIES

When completing the survey, laboratories were asked to indicate whether they are ISO/IEC 17025 accredited for the service provided, offer the service but are not accredited, or do not offer the service but were intending to establish the capability. They were also requested to indicate the timeframes for this process from 0-2 years, 3-5 years or 6-10 years. Figure 8 presents a summary of the food testing categories and the number of labs that offer that service. These are further divided into segments as described by the options above. The orange trendline indicates the percentage (%) growth anticipated for food testing services in the respective categories over the next 10 years.

Food testing capabilities could be divided into 3 distinct groups namely:

1) Major food testing (Microbiological, Nutritional Content, Heavy metals, Toxins and Pesticides)
2) Intermediate categories (Chemical Content (Environmental and Manufacturing Contaminants; Additives and Preservatives Veterinary Drug Residues), Food Adulteration and Authenticity Testing)
3) Emerging/ less established (Allergens, GMOs, Radionuclides and Sampling)

Group 1 has the most accredited laboratories (ranging from 40 to 216 laboratories) with smaller anticipated growth (17-43%) in this service area, while group 2 has on average less than 20 laboratories offering these services, but with significant growth (81-89%) anticipated in the next 10 years. Group 3 has less than 10 laboratories offering these services, with similar significant growth (71-94%) anticipated as for group 2.

Group 1 is also the category with established food control regulations either at the National level or within the CODEX Alimentarius that has been adopted by countries within Africa. The enforcement of these regulations is further supported by the survey results which confirm the prioritised monitoring and inspection of group 1 (46-58% of the 52 respondents), as shown in Figure 6. These test results feed into National Food Monitoring Programmes, National Food Fortification Programmes, and CODEX country baseline surveillance data that contribute to risk assessments and setting of Maximum Limits/ Maximum Residue Limits in the CODEX Alimentarius.

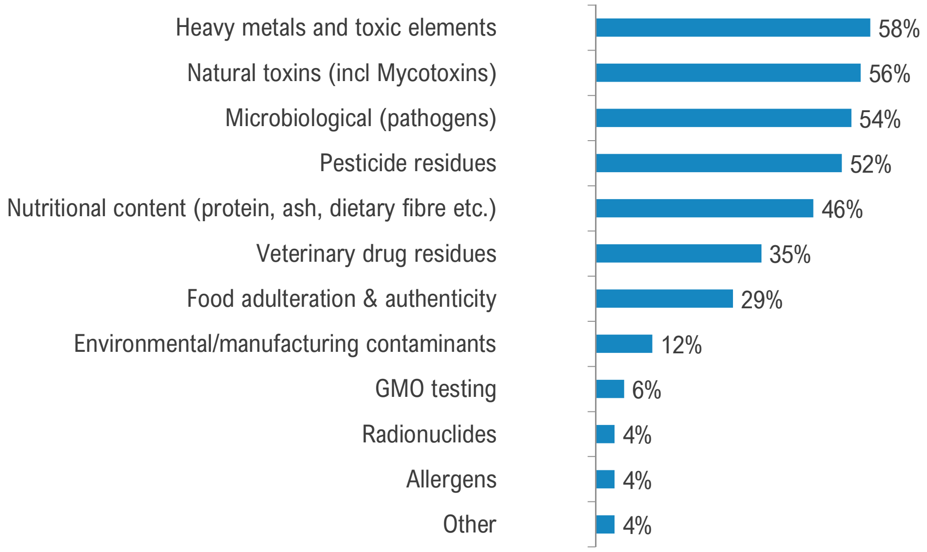


Figure 6 Breakdown of food categories that are being tested as part of national food monitoring programmes (52 responses)

The trend observed is similar to that for instrumentation (section 15). Both microbiological and nutritional (proximate analysis) categories are the testing services with the highest number of accredited laboratories available. These testing services are also more affordable to implement as routine laboratory services, with lower operating and infrastructure costs in addition to the analyst skill levels required.

Similarly, the more complex the analysis, the lower the implementation rate observed to date (Figure 8), i.e. approximately 12% (~50 laboratories out of 388) are offering these services (e.g. for veterinary drug residue testing, environmental & manufacturing contaminants, GMOs, allergens, additives and preservatives, fraud and authenticity testing, sampling and radionuclides). Several of these categories are emerging food safety issues for which standards and regulations are not fully implemented or adopted on the continent. From the percentage growth anticipated, these are also the testing services that have the highest growth rates between 75-94%.

From Figure 8, Microbiological testing is the dominant food testing service, with 216 laboratories accredited within the AfCFTA, and 29 currently conducting these tests but not accredited. An additional 15 laboratories intend to establish the capability over the next 10 years (i.e.17% growth in this service category).

Nutritional content follows in the second position with 141 accredited labs and 30% anticipated growth. It should be noted that these services are mainly for protein, moisture and ash content determination, and to a lesser extent the macro and micro elements and the vitamin content which are more instrument and HR intensive. Refer to section 23.11 for more detailed information concerning specific tests in this category.

Heavy metals, Natural Toxins and Pesticide residue analysis are the next 3 food safety testing service categories with 86, 72 and 39 accredited facilities respectively within the AfCFTA, and anticipated growth rates of 39%, 43% and 59% respectively. These are still significant growth rates for a larger base of laboratories compared to the intermediate and emerging food testing categories.

When considering the number of EU Rapid Alerts System for Food and Feed (RASFF) alerts/border notifications/rejections received within the AfCFTA during 2019 (Figure 7), mycotoxins, pesticides and chemical content (additives, environmental/manufacturing contaminants and veterinary drug residues) received the highest number at 48**%**, 12**%** and 14% respectively. Thus, highlighting the need for additional measurement support in these 3 sub-categories.

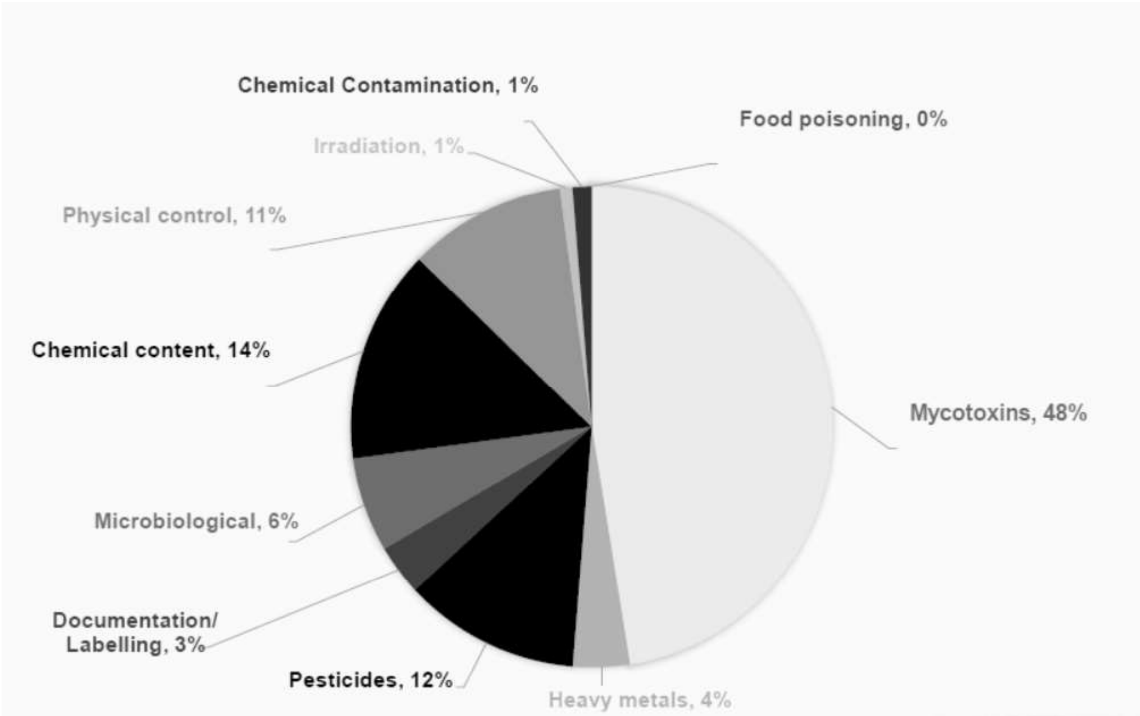
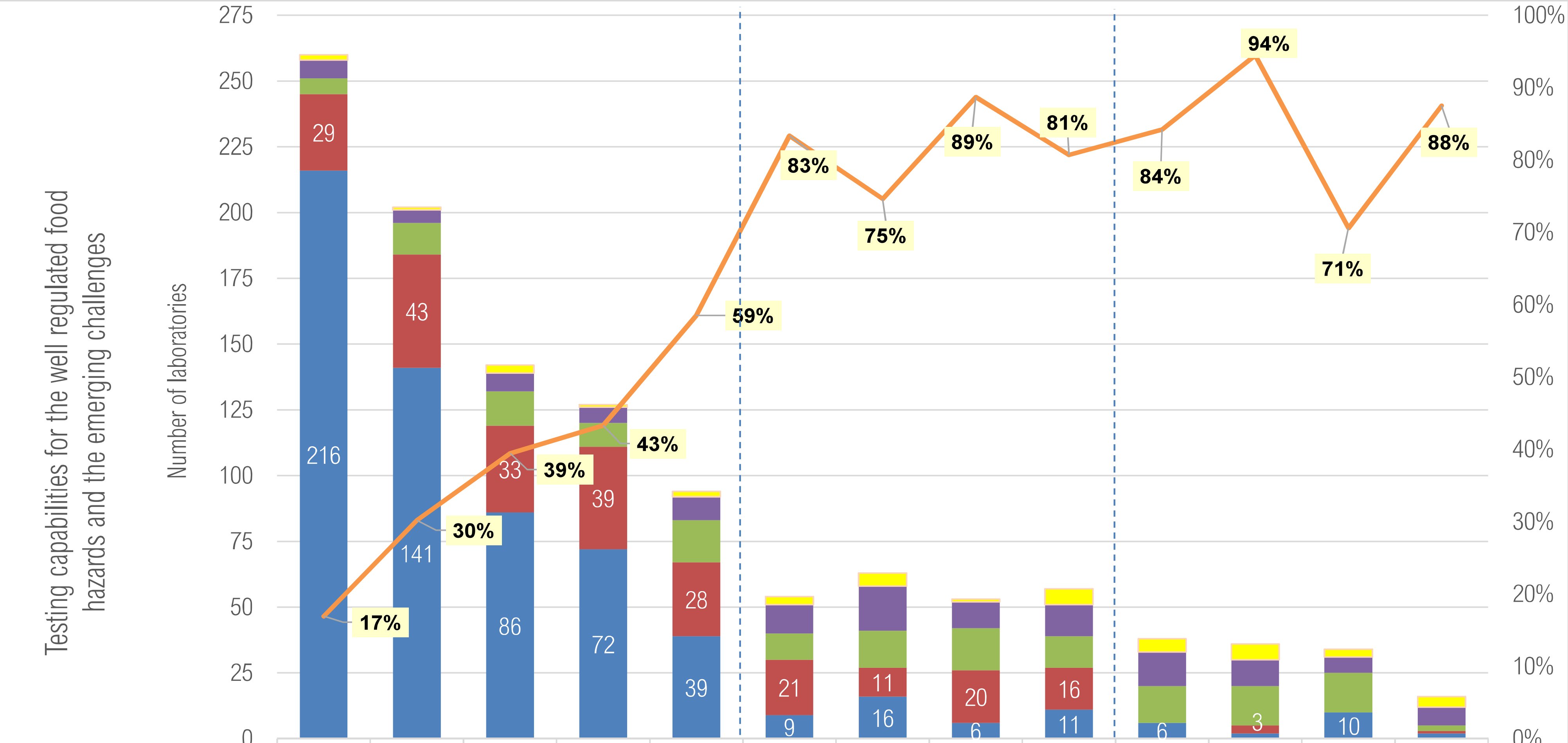


Figure 7 Notifications, alerts and border rejections received by Africa during 2019 from the European Rapid Alert System for Food and Feed (EU-RASFF) (European Commission, 2022)

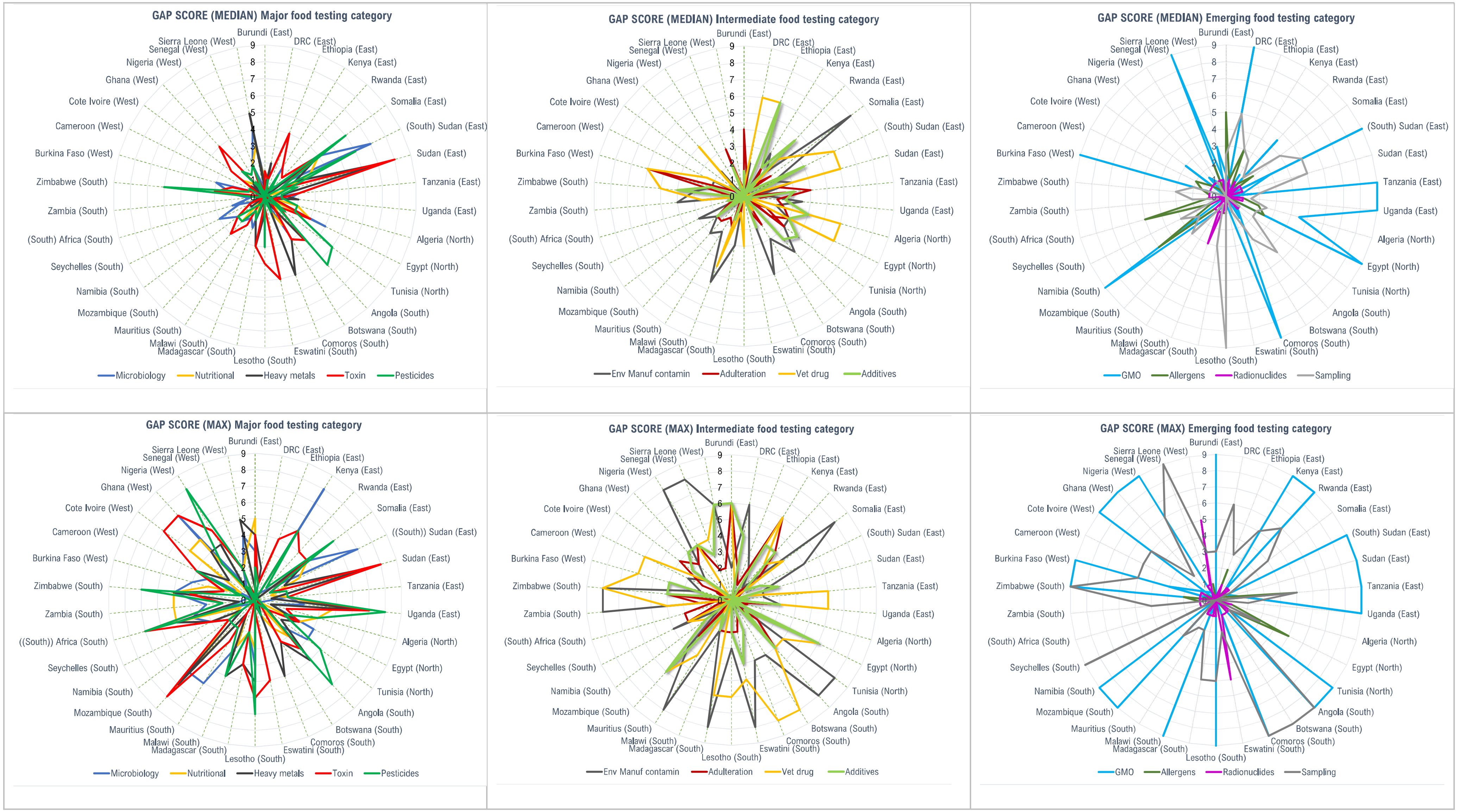
In terms of identifying gaps and needs, it is anticipated, that existing services will need to be maintained, and those yet to be established, would need support to be developed and implemented, not only for setting up (training) but also for implementing metrological traceability, method validation and continued competency assessment through relevant certified reference materials (CRMs) and Proficiency Testing schemes (PTs).



	Microbiology	Nutritional content	Heavy metals	Natural Toxins	Pesticides	Environment/ manufacturing cont.	Food Adulteration & Authenticity	Veterinary drug residues	Additives/ preservatives	Allergens	GMO testing	Sampling	Radionuclides
6 - 10 years	2	1	3	1	2	3	5	1	6	5	6	3	4
3 - 5 years	7	5	7	6	9	11	17	10	12	13	10	6	7
Develop capability in 0 - 2 years	6	12	13	9	16	10	14	16	12	14	15	15	2
Offering but not accredited	29	43	33	39	28	21	11	20	16	0	3	0	1
ISO/IEC 17025 Accredited	216	141	86	72	39	9	16	6	11	6	2	10	2
%Growth	17%	30%	39%	43%	59%	83%	75%	89%	81%	84%	94%	71%	88%

Figure 8 Accredited Food testing services, including those that are offered but not accredited, and plans to offer service in the next 10 years.

Table 4 Median and Maximum combined GAP scores for each country (region) grouped according to major and emerging food testing categories



19. GAP SCORES

The GAP score was determined from each of the responses received (113 laboratories). *Thus, GAPs presented here are not an accurate reflection of the entire country, but only of the respondents in those countries*. Laboratories were asked to indicate on a scale of one to ten (1 – 10) how important the need is for this type of measurement in their country. A score of 1 is not important, and a score of 10 is very important. This was followed by a second question where the laboratory had to indicate on a scale of one to ten (1-10) to what extent the measurement capability has been established in their laboratory. A score of 1 indicates not yet implemented, and a score of 10 indicates fully implemented. The gap score is calculated as follows:

GAP SCORE = COUNTRY NEED IMPORTANCE – LABORATORY IMPLEMENTATION

A large positive score would indicate a big measurement gap. A small positive score indicates that methods are implemented but not fully established yet. While a negative score would indicate that the measurement capability is purportedly not a priority in that country.

Scores from each country were combined using the average, the median and the maximum values of the country's laboratory scores, in order to provide a consolidated score for the country and to also identify any trends linked to the regions in Africa. Table 4 presents a summary of the scores according to each country (region also indicated). These are grouped into the Major (microbiology, nutrition, heavy metals, toxins and pesticides), intermediate (environmental/manufacturing contaminants, veterinary drug residues, additives and preservatives) and emerging food testing categories (GMOs, allergens, radionuclides, sampling).

Median value charts for the three food categories indicate the mid-point of GAP score responses received for each country. There are very few countries that exceed a GAP score of 4 in the Major food testing category. This indicates that most methods are implemented but not fully established.

As expected, the GAP score increases in magnitude when moving to the intermediate and emerging food testing categories. A GAP score of 4 was exceeded for Pesticides, Environmental/Manufacturing contaminants (12%), Sampling (15%), Veterinary drug residues (26%) and GMOs by 32%.

The maximum value charts indicate countries where individual laboratories have a maximal GAP score, highlighting at a national level, that there may be some labs that are not fully established for these services but are intending to do so in the near future, and would therefore require further metrological support. They further confirm the median GAP score trends observed. Test categories that exceeded a GAP score of 5, were toxins and pesticides (both by 21%), sampling (26%), Environmental/Manufacturing contaminants by 35%; veterinary drug residues by 41% and GMOs by 56%.

Individual countries with large MAX GAP scores are randomly distributed across all four regions, thus no region with specific challenges could be grouped. Countries with maximal GAP scores for toxins include Mozambique, Lesotho, South Africa, Cotê d'Ivoire, Ghana, Sudan and Uganda. For pesticides: South Africa, Lesotho, Zimbabwe, Angola, Nigeria, Somalia and Uganda. For environmental and manufacturing contaminants: Nigeria, Senegal, Somalia, Tunisia, Angola, Eswatini, Madagascar, Mauritius, Zambia and Zimbabwe. For veterinary drug residues: Botswana, Comoros, Tanzania, Uganda, Kenya, Cameroon, Burkina Faso and Zimbabwe. For GMO testing there appears to be a big GAP consistently across the four regions and for sampling to a lesser extent. The GAP scores for radionuclide and allergen testing appear to indicate that these are not immediate priorities within the region.

20. METROLOGICAL TRACEABILITY AND QUALITY ASSURANCE

Laboratories were invited to indicate their frequency of PT participation and use of neat and matrix certified reference materials. Eighty-one (81) laboratories responded in this section. Figure 9, presents the summary of PT scheme participation and service providers. Eight percent (8%) of respondents indicated "Other", which included service providers such as: Quasimeme (WEPAL)[1], Trilogy, GD Animal Health, FAO GLOSOLAN[2], FOFSA[3], GAFTA[4], AOCS[5], Botswana Bureau of Standards, Uganda Bureau of Standards, EUPT-FV[6], AAPCO[7], APTECA[8] and the AOAC Laboratory Performance Benchmarking Programme and CCQM comparisons and RMO comparisons and parallel PT schemes.

Approximately 104 laboratories responded to the CRM section. The summary of CRM service providers is presented in Figure 10 Summary of CRM (neat and matrix) sources indicated by respondents. Suppliers listed as "Other" include: the IAEA, the Association of Cereals Sciences (AOCS), the East Africa Community (EAC), and materials from instrument suppliers (e.g. Perkin Elmer, Agilent, Anton Paar). It appears that several matrix materials are predominantly QC reference materials or prepared in-house, that are fit-for-purpose for routine use though would not meet the traceability requirements stipulated in the ISO/IEC 17025 standard for accreditation purposes during method validation processes.

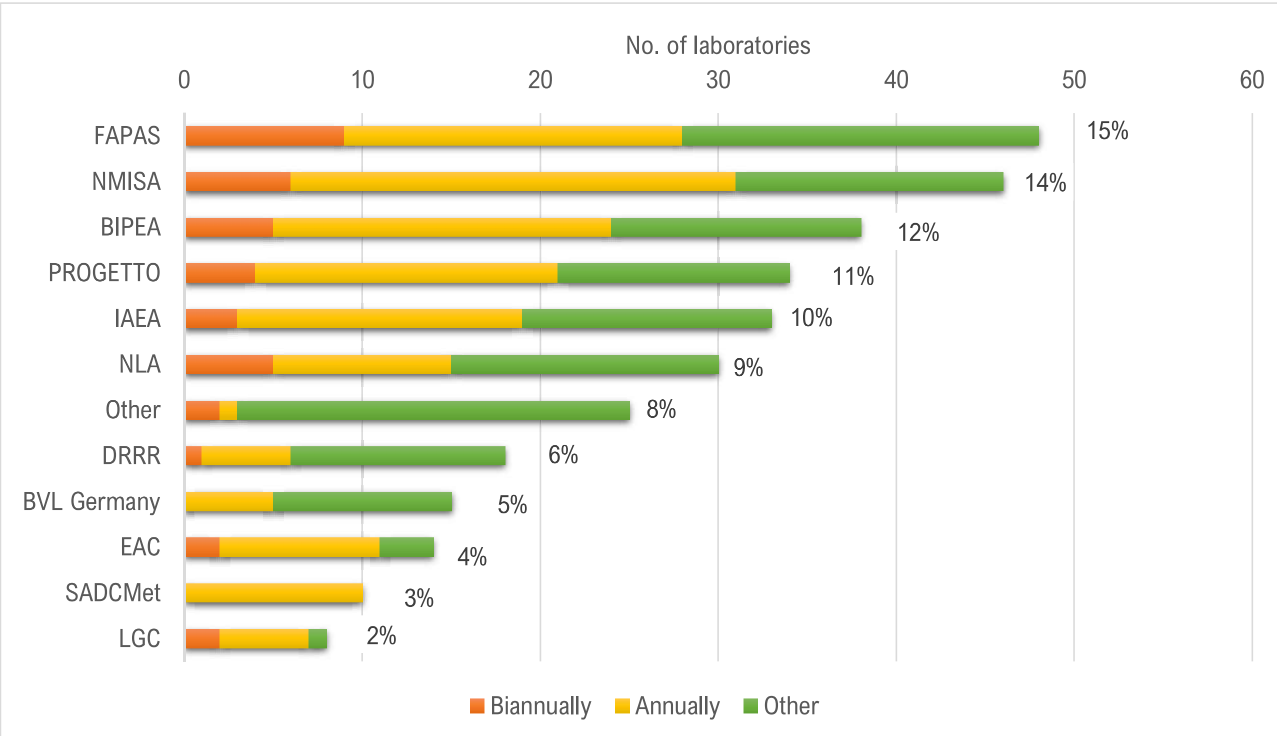


Figure 9 Frequency of PT scheme participation and service providers

[1] WEPAL/QUASIMEME, WEPAL covers proficiency tests related to the terrestrial environment (e.g. soil, plants, manure, compost and biomass) and freshwater sediment. QUASIMEME organises proficiency tests for compounds and matrices in the marine environment (e.g. sea water, marine sediment, biota and shellfish toxins). https://www.wepal.nl/en/wepal/About-us.htm
[2] The FAO Global Soil Laboratory Network (GLOSOLAN) Proficiency test (https://www.fao.org/global-soil-partnership/resources/highlights/detail/en/c/1476332/)
[3] Federation of Oils, Seeds and Fats Associations (FOSFA) (https://www.fosfa.org/)
[4] Grain and Feed Trade Association (https://www.gafta.com/Analysts)
[5] American Oil Chemists Society (https://www.aocs.org/info/about-aocs)
[6] European Union Proficiency Test for Fruits and Vegetables
[7] Association of American Pesticide Control Officials (https://aapco.org/)
[8] Aflatoxin Proficiency Testing and Control in Africa (APTECA)

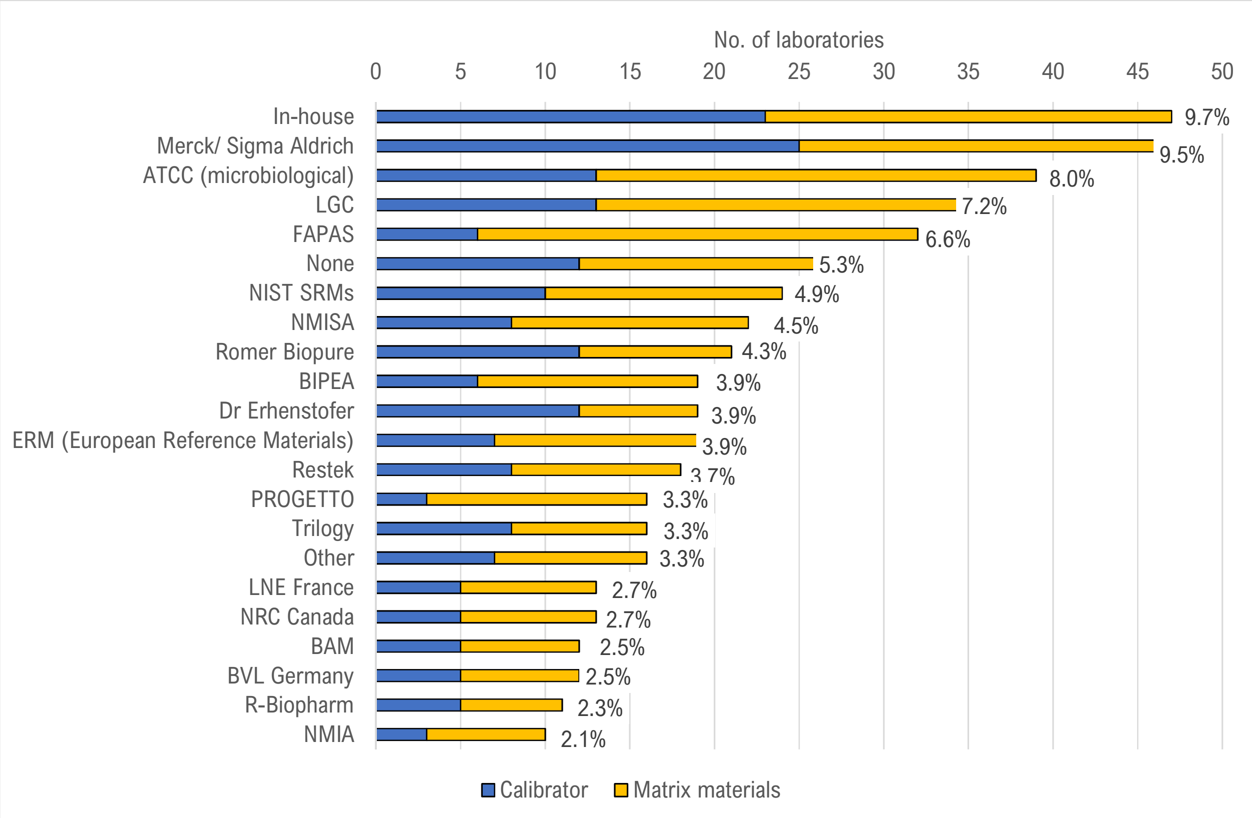


Figure 10 Summary of CRM (neat and matrix) sources indicated by respondents.

21. FOOD TESTING SAMPLE VOLUMES

Laboratories were invited to indicate the monthly volume of samples analysed, and if sample preparation automation is implemented in the laboratory. These responses are summarised in Table 5 Monthly sample volumes analysed by on-line survey participants.

The number of responses received are highlighted in red, indicating that about 66 responding laboratories are testing mainly for the major "big 5" categories. The top 10% of sample volume ranges are highlighted in dark green for each category. Approximately 23% of microbiology laboratories are testing between 100-200 samples per month. Thirty-eight (38%) of food additives and preservatives testing respondents analyse between 51-100 samples per month. While labs involved with nutritional content, toxins, heavy metals and pesticide residue testing, are analysing approximately 11-50 samples per month. Independent commercial food testing laboratories, forming part of global networks, are predominantly analysing the larger sample volumes > 500 samples per month, across the microbiological, nutritional content, pesticide residues, preservatives and additives categories.

On average, laboratory sample testing volumes for the remaining (emerging food safety) categories (veterinary drug residues, environmental/manufacturing contaminants, adulteration & authenticity testing, allergens, radionuclides and GMOs) are in the range of only 1-10 samples per month. This implies a low demand at the moment for these tests.

A small percentage of laboratories currently apply automated sample preparation techniques, which appear to be mainly for heavy metal and allergen testing.

Table 5 Monthly sample volumes analysed by on-line survey participants

#samples analysed per month	Microbiology	Nutritional content	Toxins	Heavy metals	Pesticides	Env/Manuf. Cont.	Vet drug residue	Additives/Preservatives	Adulteration/Authenticity	Allergens	Radionuclides	GMO
1 - 10	7%	11%	19%	14%	17%	54%	42%	24%	35%	50%	50%	50%
11 - 50	11%	27%	31%	25%	23%	23%	38%	24%	30%	16%	25%	25%
51 - 100	17%	29%	18%	20%	21%	17%	8%	38%	20%	17%	0%	25%
100 - 200	23%	12%	17%	15%	15%	3%	8%	5%	15%	0%	0%	0%
201 - 300	7%	9%	6%	9%	8%	0%	0%	0%	0%	0%	0%	0%
301 - 500	17%	6%	6%	9%	6%	3%	4%	0%	0%	17%	25%	0%
501 - 1000	9%	6%	3%	3%	6%	0%	0%	9%	0%	0%	0%	0%
more than 1000	9%	0%	0%	5%	4%	0%	0%	0%	0%	0%	0%	0%
# Responses	66	66	65	65	48	30	26	21	20	6	4	4
% using auto sample prep	2	3	2	19	4	4	0	0	4	33	0	0

22. AGRICULTURAL COMMODITY/ FOOD MATRIX SUMMARY

In addition to the food testing category, respondents were also requested to indicate the foodstuffs that are routinely tested. Foodstuff matrices were based on the categorisations used in the EU RASFF (European Commission, 2022). A summary of food hazard categories versus the food matrix tested for the responses received, combined with the ISO/IEC 17025 accredited laboratory information obtained from the SoAs, is presented in Table 6.

The top 10% of food hazard matrices are highlighted in dark green and are arranged in descending percentage. The staple commodities, cereals and grains (8%), such as maize, wheat, rice, oats, barley, rye, millet and sorghum, are tested by the largest number of laboratories across the top five major food testing categories, within the AfCFTA. At the next level (5%) are: nuts, milk, fruits and vegetables and potable water. This is followed by the third level (4%) which includes processed fruits and vegetables, fish and fish products, animal feed and pet food, meat and meat products and infant foods. The food matrix is linked to the food category being tested and is further detailed in the subsequent sections.

To identify gaps and needs within food hazard classes and food commodities, the process should not only be viewed in isolation against the survey results, but also against other elements such as:

1) The regulatory and SPS environment at continental, regional and national level, that require monitoring and inspection (Figure 6). These are typically the major food testing categories (Microbiology, Heavy Metals, Toxins, Pesticides)

2) The strategic commodities (food and non-food) that have been identified at the continental level at the 2006 Abuja Food Security Summit, such as rice, legumes, maize, cotton, palm oil, beef, dairy, poultry and fishery products, cassava, sorghum and millet (AUC, 2008).
3) Major import and export commodities (Figure 11)

Major African import and export agricultural commodities for the period 2015-2017 are presented in Figure 11 (FAO and AUC, 2021). It has been shown that the export of higher value-added products made in Africa is greater in regional markets than in external markets outside Africa, which are typically dominated by raw material exports (FAO and AUC, 2021). The major exports to the rest of the world are cocoa, cocoa preparations, edible fruit and nuts, coffee, tea and spices, fish and crustaceans. Commodities with the largest percentage originating from intra-regional trade are sugar and sugar confectionery (at 59% of the total export value), beverages, spirits and vinegar (at 58%), animal or vegetable fats and waxes (at 50%). Tobacco and tobacco substitutes, although not foodstuffs, account for 57% of the total tobacco exports through intra-regional trade.

Apart from a small number of nations such as Egypt and South Africa, agriculture on the African continent remains structurally underdeveloped. It is characterized by low levels of diversification and the production of primarily raw materials, food, and other agricultural products for both domestic consumption and export markets. The AfCFTA regional trade integration process and some countries' participation in regional agricultural value chains are likely to be slowed down by the generally low level of industrialization in those nations (AUC, 2008). In 2018, more than half of the total African workforce was employed by the agricultural sector (Figure 6). By subregion, the agricultural employment share is low in Southern Africa (7 percent) and in Northern Africa (25 percent). Eastern Africa, at 65 percent, holds the highest share of agricultural employment. Despite its vast agricultural potential, Africa is a net importer of agricultural products, and this appears to be an increasing trend. The top agricultural food imports are dominated by basic foodstuffs such as cereals, vegetable oils, sugar, meat and dairy products. Most imports are sourced from outside the continent (e.g. wheat, sunflower oil and dairy products from Europe; rice and palm oil from Asia; maize, poultry and beef from Latin America). Dependence on extra-regional imports for food makes African countries vulnerable to 1) dumping of lower quality goods, and 2) disruptions in international logistics and distribution.

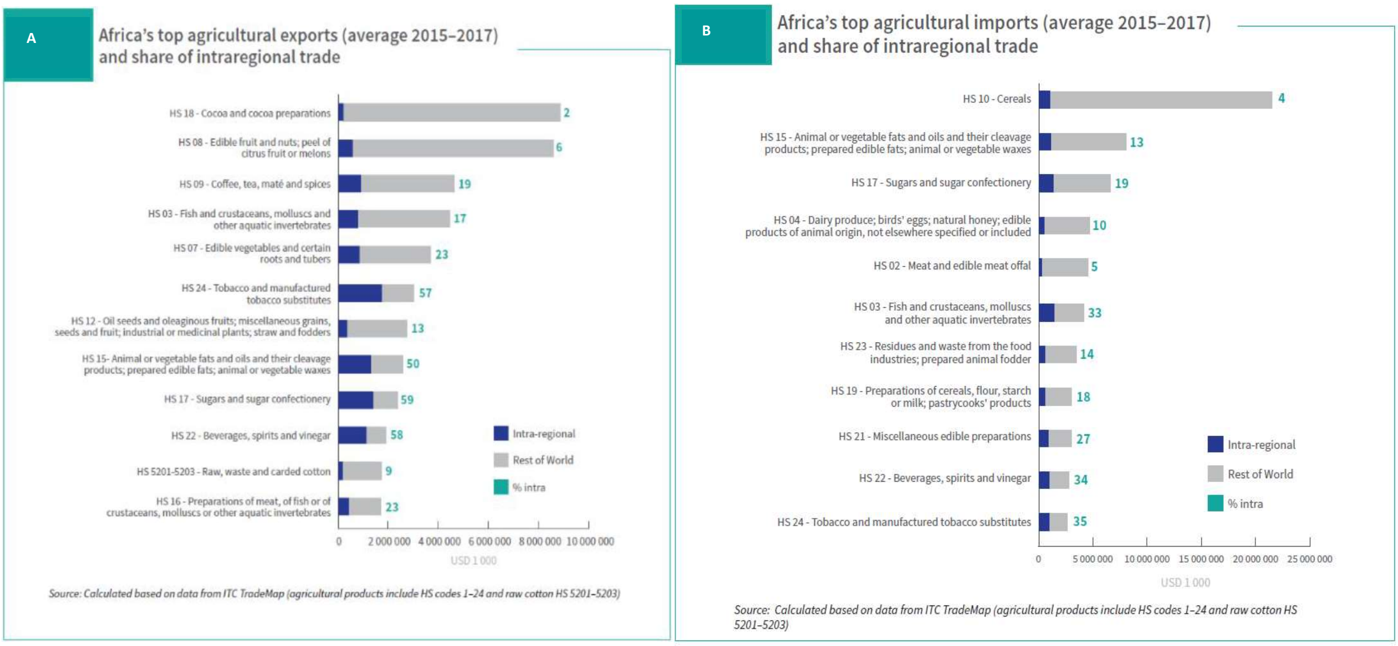


Figure 11 Africa's top agricultural exports (A) and imports (B) - (average 2015-2017) and share of intraregional trade. Source: FAO/AU Framework for boosting Intra-African trade in agricultural commodities and services (FAO and AUC, 2021)

Table 6 Matrices tested for each food testing category. Veterinary drug residues and allergens are not included.

Matrix		Microbiological	Nutritional content	Toxic elements/ heavy metals	Natural toxins	Pesticide residues	Radionuclides	Additives/ preservatives	Food adulteration/authenticity	Environmental/ manufacturing	GMO testing
	%	27%	21%	19%	11%	10%	4.4%	4.2%	2.7%	0.9%	0.2%
Cereals/ Grains (Maize, wheat, rice, oats, barley, rye, millet, sorghum)	**8.0%**	57	58	49	57	32	16	7	7	3	3
Nuts, nut products and seeds	**5.7%**	37	45	39	42	23	9	7	3	1	1
Milk and milk products (cheese, cream, yoghurt)	**5.7%**	53	43	34	31	17	7	8	9	3	0
Fruits and vegetables	**5.3%**	45	40	34	18	34	8	8	2	2	1
Water (for human consumption, mineral water)	**5.1%**	53	31	45	10	18	13	6	3	3	0
Processed fruits and vegetables	**4.9%**	45	38	33	15	24	6	9	5	2	1
Fish and Fish products	**4.5%**	44	34	33	9	16	15	6	2	3	0
Animal Feed and Pet food	**4.4%**	39	37	27	31	12	5	4	3	2	0
Meat and meat products	**4.3%**	45	35	31	10	11	7	8	6	1	0
Infant foods	**4.2%**	37	34	25	25	13	4	11	3	1	0
Fats and oils	**3.9%**	38	32	26	12	12	4	9	8	1	0
Non-alcoholic beverages	**3.9%**	43	33	23	11	5	4	11	9	1	0
Poultry meat and poultry meat products	**3.8%**	42	29	24	10	13	6	7	5	1	0
Herbs and spices	**3.8%**	37	25	25	18	18	5	5	4	0	0
Honey and royal jelly	**3.6%**	35	26	23	11	17	4	5	7	2	0
Alcoholic beverages (wine, beer, spirits)	**3.4%**	39	24	23	15	5	5	5	8	0	0
Animal Feed pre-mixtures, compound feeds, additives	**3.4%**	29	31	20	19	9	5	7	1	0	0
Cocoa and cocoa preparations, coffee and tea	**3.3%**	31	22	27	18	12	4	4	2	0	0
Cassava and cassava products	**3.2%**	29	29	24	12	12	5	2	1	0	0
Eggs and egg products	**3.0%**	39	22	19	8	7	4	5	3	0	0
Food additives, stocks, soups and flavourings	**2.8%**	32	22	20	8	7	3	7	2	1	0
Fortified, dietetic foods and food supplements	**2.7%**	32	26	18	8	7	3	5	0	0	0
Agricultural input testing (elements in soil, fertilizer, growing media and compost)	**2.4%**	18	13	28	4	10	8	1	1	2	0
Seafood (Crustaceans, Cephalopods, Molluscs)	**2.3%**	23	18	22	3	4	4	5	1	2	0
Food contact materials	**1.6%**	28	8	13	4	4	2	0	0	0	0
OTHER	**0.6%**	6	0	3	1	6	3	0	1	0	0

The FAO-WHO CODEX Committee for Africa conducted a survey of food safety and quality across selected laboratories and presented this feedback at 23rd CODEX meetings. The following emerging issues were raised by 23 of the (then) 49 countries (FAO/WHO, 2019):

- Antimicrobial resistance (AMR) and antimicrobial use (AMU),
- Pesticide residues,
- Food Fraud,
- Contamination of water used in food production,
- Aflatoxins and climate change.

With reference to the above, one should also consider the typical foodstuffs that would need to be tested under the food testing categories described in the next section.

The monitoring of AMR and AMU is linked to the implementation of One Health into food control systems. AMR and AMU are directly linked to the laboratory's capability to test for veterinary drug residues and microbiological pathogens. In the One Health approach, there is an expectation that all elements that could impact the food value chain would need to be considered and monitored. The AU is adopting the One Health approach in the Food Safety Strategy for Africa 2022-2036 (AU DARBE, 2022).

23. FOOD TESTING CATEGORIES

Decisions by laboratories to undertake food testing in specific categories are routinely informed by:

1) The regulatory environment for both the government mandated (publicly funded) inspection and monitoring laboratories but also for the private/ in-house laboratories that perform testing on behalf of the client: manufacturer/ producer/retailer/distributors.
2) The demand for the analysis. Where insufficient volumes of samples for analysis drive up the analytical costs, fewer laboratories would be able to sustainably offer the service. This is typically the case for analyses which are not strictly regulated (voluntary standards) or where frequency of testing is only required when the formulation changes/ once every five years. E.g. food labelling.

In the absence of National Food Legislation, regulators will refer to the Codex Alimentarius.

The General Standard for Contaminants and Toxins in Food and Feed - CODEX STANDARD CDX 193-1995, contains the main principles which are recommended by the Codex Alimentarius in dealing with contaminants and toxins in food and feed. It lists the maximum levels (MLs) and associated sampling plans of contaminants and natural toxicants in food and feed which are recommended by the Codex Alimentarius Commission (CAC) to be applied to commodities moving in international trade. This standard includes only MLs of contaminants and natural toxicants in feed in cases where the contaminant in feed can be transferred to food of animal origin and can be relevant for public health.

23.1 MICROBIOLOGICAL

Foodborne illnesses cause a significant financial burden in society, from medical expenses to product recalls, liability, calling for disease surveillance, and outbreak response. The Codex provides guidelines for microbiological tests and risk assessments at a national level (CAC/GL-30, 1999). It is advised that finished goods, raw materials, and related machinery all undergo thorough inspections for the presence of foodborne pathogens. For implementation of proper controls and risk mitigation, as described through Hazard Analysis and Critical Control Point (HACCP) application guidelines (US FDA, 2022), this would involve extensive microbiological testing on a routine basis, thus the significantly higher analysis volumes and established capabilities for this food testing category. Several types of pathogens may occur, depending on the hygiene of individuals handling high-risk food and the food itself. The most common food poisoning pathogens globally include Salmonella (from undercooked food and cross-contamination), Campylobacter (largely from undercooked poultry), Escherichia coli (from under cooked meat), Listeria (predominantly in raw milk and milk products and and processed meats), Clostridium Perfringens (from meals that are warmed for an extended period of time before serving).

Over 200 laboratories are performing microbiological food testing on the continent. In the survey, this category encompassed the 3 pathogen subcategories for food spoilage, food poisoning and other pathogen testing such as antimicrobial/disinfectant efficacy. Figure 12 presents a summary of the number of laboratories and types of pathogens being tested. As expected, the most hazardous food poisoning bacteria causing acute illness are tested for by most laboratories. This includes the faecal coli forms, Escherichia coli, salmonella spp, staphylococcus aureus, listeria, and the food spoilage bacteria – determined through Yeast and Mould Counts and Total Bacterial Counts. From Table 5, typical analysis volumes are in the region of 100-200 samples per month, with fewer (mainly private) labs able to process more than 1000 samples per month, with only 2 laboratories indicating the use of automated sample preparation. High risk foods, include ready-to-eat meals, prepared salads, cooked meat and meat products, poultry, seafood, eggs, dairy (raw milk and cheese), leafy green vegetables and sprouts.

Laboratories are chiefly using ISO culture assays and microscopy for detection and enumeration of the pathogens. The lengthy incubation times associated with tests that use culturing techniques, particularly in Africa, increase the risk of contamination and human error. These delays impact food producers and the time taken to introduce new products to the market.

For nonculturable microorganisms, PCR and other genetic approaches are vital, and MS has been proven to be effective, quick, and simple for the identification of microbial samples and detection of microbial threats. Due to the possibility of background interference, complex samples cannot be used; it is only appropriate for pure isolates. By using chromatography-based techniques, this could be made simpler (e.g., HPLC, LC-MS) (Franco-Duarte, 2019). The adoption of advanced techniques has been limited on the continent due to the increased operational costs and skill level required.

From 113 responses received there are only 4 labs using advanced technologies such as real time PCR for pathogen testing.

Efforts at the International Committee for Weights and Measures to establish metrological traceability for microbiological measurements, require higher level technologies not currently applied within the region. Reference strains and materials are available through (amongst others) the long-established American Type Culture Collection- ATCC (ATCC, 2022), the UK National Collection of Industrial, Food and Marine Bacteria- NCIMB (NCIMB, 2022) and National Collection of Type Cultures- NCTC (UK Public Health, 2022), the EU Joint Research Commission- JRC (EC JRC, 2022), and Vitroids (Merck, 2022).

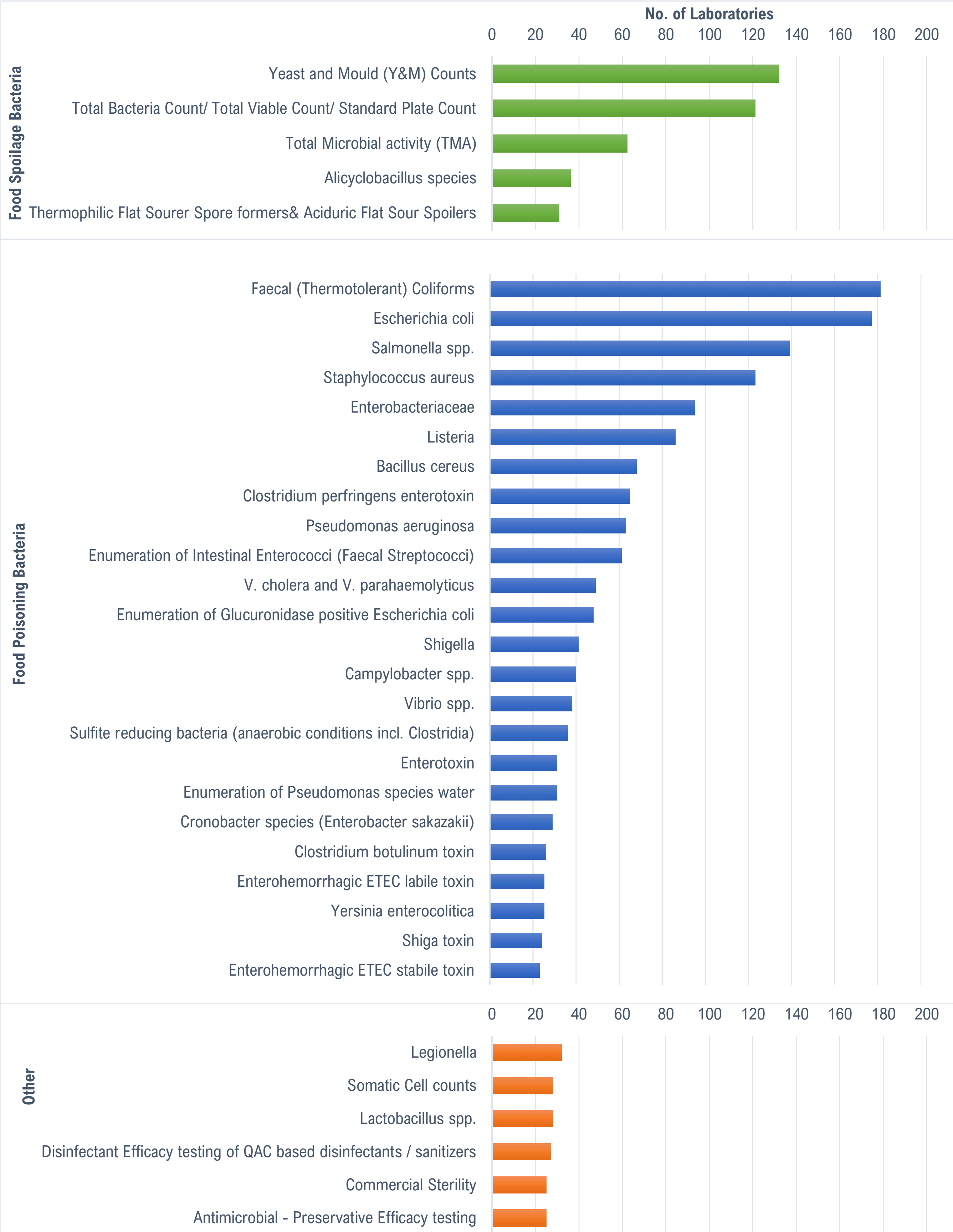


Figure 12 Summary of microbiological food pathogen testing categories

23.2 TOXINS

23.2.1 MYCOTOXINS

Mycotoxins are the toxic, secondary fungal metabolites produced by fungi that grow on agricultural commodities. Codex (CXS 193-1995, 1995. amended 2019) provides maximum levels (MLs) for mycotoxins in the following foodstuffs:

1) Total Aflatoxins in tree nuts, tree nuts for further processing: almonds, hazelnuts, peanuts, pistachios and shelled Brazil nuts, and dried figs, 2) Aflatoxin M1 in milk and milk products; 3) Deoxynivalenol in Cereal-based foods for infants and young children, Flour, meal, semolina, and flakes derived from wheat, maize, or barley, Cereal grains (wheat, maize, and barley) destined for further processing. 4) Fumonisin B1 and B2 in raw maize grain and maize flour and maize meal; 5) Ochratoxin-A in wheat, barley, and rye; 6) Patulin in apple juice

In contrast, the European Union, as one of Africa's largest export destinations, has significantly more mycotoxin regulation in a larger basket of agricultural commodities as established through the European Commission (EC No 1881/2006, 2006). Additional MLs are listed for: Aflatoxin B1, Zearalenone, Citrinin, HT2, and T2 toxin. Foodstuffs are extended to include all dried fruits, spices, alcoholic and non-alcoholic beverages, coffee, processed foods (incl. pasta and bread), rice, and red yeast food supplements.

From the survey and including the addition of information from the Schedules of Accreditation (SoAs), a total of 113 laboratories currently test for mycotoxins. The percentage breakdown for mycotoxins analysed is presented in Figure 13, confirming that the aflatoxins, specifically AFB1, and total aflatoxin as the most strictly regulated of the mycotoxins, are tested by more than 70% of these laboratories. While AFM1, Ochratoxin-A, Zearalenone, Deoxynivalenol, and the Fumonisins follow in decreasing testing capacity. The matrices in which these tests are conducted (Table 6) are predominantly cereals, nuts, milk, animal feed, and infant foods. The number of samples routinely analysed in this category are in the order of 11-50 samples per month (31%) with a smaller number of respondents analysing 51-100 (18%) and 100-200 (17%) samples per month (Table 5).

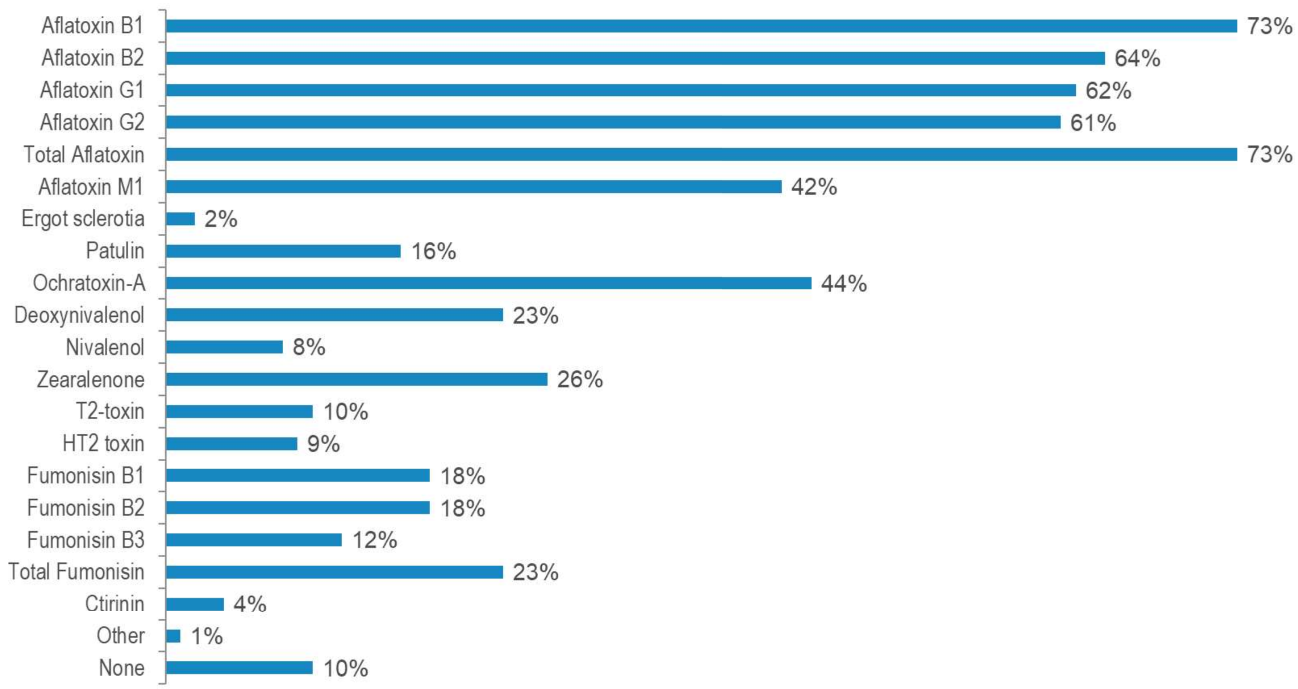


Figure 13 Summary of mycotoxins – food category

23.2.2 ALGAL/ PHYCOTOXINS

Phycotoxins (including marine biotoxins such as ciguatoxin and shellfish toxins) are chemical substances produced by toxic algae that may accumulate in edible aquatic organisms such as fish and shellfish.

Thirty-four (34) laboratories test for these toxins. It is concerning that for a continent surrounded by 30,500 km of coastline, contributing 9% of the global catch for exports (FAO, 2022), that such limited testing capacity is available for the algal toxins in shellfish and marine life. Since 1985, Africa has been a net exporter of fish and fishery products (Tall, 1999), with at least 50% traded intra-regionally (Figure 11).

These are also challenging to analyse, with most laboratories moving away from mouse bioassays in preference of LC-MS/MS analysis. This also requires the use of costly (and difficult to import) CRMs currently only available from NRC Canada and participation in international PT schemes through Quasimeme. Recently both Namibia and Senegal have become accredited for these services. At the 2nd Africa Food Safety Workshop 2022, held in South Africa, the recommendation was to consider producing these RMs locally due to prohibitive costs and logistics challenges with importing fishery products.

Analysis of histamine (scombrotoxin) is performed by the majority (62%) of the respondents. Histamine, is a toxic bacterial metabolite, produced during spoilage and fermentation of fish and fish products, and may accumulate before any off odours/ tastes are observed. It is therefore routinely monitored to ensure that temperatures (below 4ºC or at -18ºC) and storage timeframes within the food chain have been maintained (Jung, 2019), as also advised in the Codex code of practise for Fish and Fishery Products (CAC/RCP 52-2003).

Fewer labs are able to test for shellfish toxins (15%) and other acids (3%), with none that are able to test for the ciguatoxins (0%). The phytotoxin test capability is also limited to 18% for glycosides and alkaloids, and 3% for toxin hypoglycin A.

The Codex also lists MLs for hydrocyanic acid (HCN) in gari and cassava flour, this is accompanied by a code of practice for the reduction of hydrocyanic acid (HCN) in cassava and cassava products, and the commodity standard CXS 176-1989. HCN is sometimes considered a processing contaminant as it is a function of the processing conditions used in plant-based foods containing cyanogenic glycosides as the main source of cyanide.

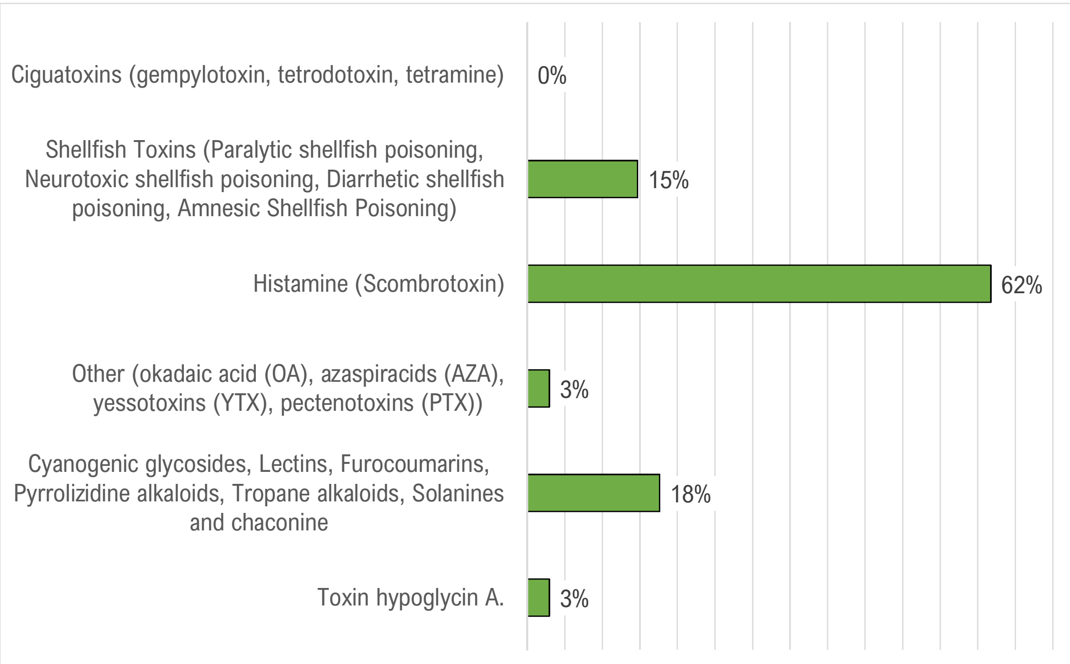


Figure 14 Summary of algal and phytotoxins – food category

23.3 PESTICIDES

Seventy (70) laboratories are performing pesticide analysis. Organochlorine and organophosphate pesticides dominate at 87% and 83% of all laboratory services respectively. Following on this are the pyrethroid (57%) and carbamate (56%) pesticide classes. As expected, the matrices tested by most laboratories are fruits and vegetables, cereals/grains, processed fruits and vegetables. Typical number of samples analysed per month are in the range of 11-50 samples (23% of laboratories), and 51-100 (21% of laboratories), refer to Table 5.

The Codex Committee on Pesticide Residues (CCPR) is responsible for establishing Codex Maximum Residue Limits (MRLs) for pesticide residues in food or feed that are traded internationally. Over 4,800 Codex MRLs are established for over 200 pesticides in agricultural commodities of both plant and animal origin, animal feed and processed foods of plant and animal origin (Joint FAO/WHO, 2022). The EU Commission lists a larger number of MRLs, as they also include banned pesticides where the CODEX references only the “current use” pesticides. These MRLs can be viewed and searched through the Codex Pesticides Residues in Food Online Database (Joint FAO/WHO, 2022). MRLs are continuously being reviewed as more risk assessments are completed/ new pesticides introduced to replace those that have been banned.

The introduction of new pesticides for use, developed according to good manufacturing practises, would also require the relevant reference materials for the pesticide and breakdown products, where applicable. While several laboratories are developing their own in-house methods of analysis for this category, these require proficiency test participation to confirm the method is fit-for-purpose during routine operation as described in the Codex guidelines on good laboratory practice in pesticide residue analysis (CAC/GL 40, 1993) and guidelines on performance criteria for methods of analysis for the determination of pesticide residues in food and feed (CXG 90, 2017).

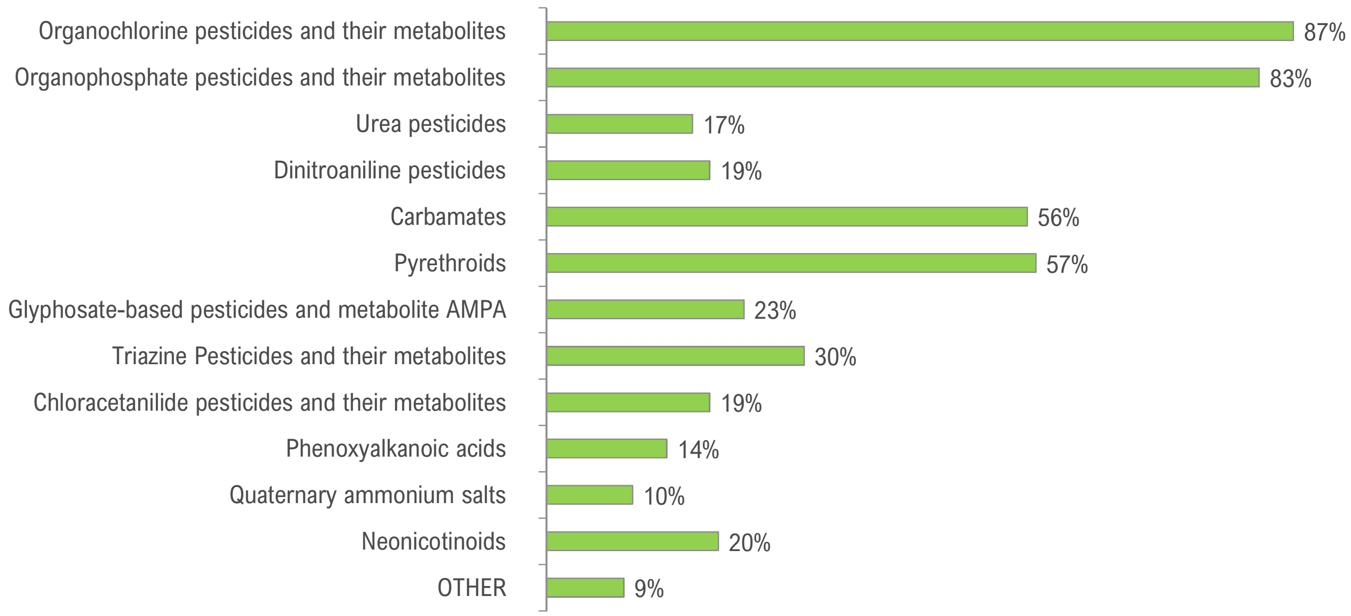


Figure 15 Summary of pesticides - food category

23.4 TOXIC ELEMENTS (HEAVY METALS)

One hundred and twenty-one laboratories (121) are testing for toxic elements in food. Figure 16 summarises the toxic element testing categories. As expected, the analysis of heavy metals is conducted by an overwhelming majority of laboratories (98%), as the elements (Arsenic, Chromium, Cadmium, Lead, Mercury and Methylmercury and Tin) are strictly regulated. Food control measures have typically only included total metal measurements. Once thresholds are exceeded, then chemical forms are to be investigated. The chemical form in which an element is present affects the element's biological activity, mobility, bioavailability, and toxicity. Speciation analysis is needed to obtain accurate information regarding these factors (Hedegaard & Sloth, 2011). However, speciation analysis demands more specialised analytical techniques and staff skills and are therefore conducted by fewer laboratories. “Other” elements were described by respondents in the survey as: “All trace elements except arsenic, selenium”, “isotopes” and “major elements (K, Ca, Mg, Na) in soils and fertilizers, boron and sulphur in fertilizers”. The most frequently tested commodities include: cereals and grains, nuts and nut products, water (for human consumption), milk and dairy products, fruits and vegetables, fish and fish products (refer to Table 6). The volume of samples routinely analysed are in the range of 11-50 samples per month (25% of laboratories in this range), and 51-100 samples per month (21%), refer to Table 5.

Within the Codex (CXS 193-1995, 1995. amended 2019), MLs are listed for these metals:

1) Arsenic, in edible fats and oils, mineral water, rice and salt.

2) Cadmium, in vegetables, pulses, rice, wheat, molluscs and cephalopods, natural mineral water, salt and chocolate.

3) Lead, in fruits and berries, vegetables and mushrooms, pulses, processed fruits and vegetables, fruits juices, cereals, infant formula, fish and meat, edible fats and oils including fat spreads, natural mineral water, sale, milk, wine and fortified wine/liqueurs.

4) Mercury, in natural mineral waters and salt.

5) Methylmercury in fish (Tuna, Alfonsino, Marlin and Shark)

6) Tin, in canned foods and beverages, and cured meats.

These MLs are further supported by codes of practice for source directed measures to reduce contamination of foods with chemicals (CXC 49-2001); the prevention and reduction of arsenic contamination in rice (CXC 77-2017); lead contamination in foods (CXC 56-2004), inorganic tin contamination in canned foods (CXC 60-2005).

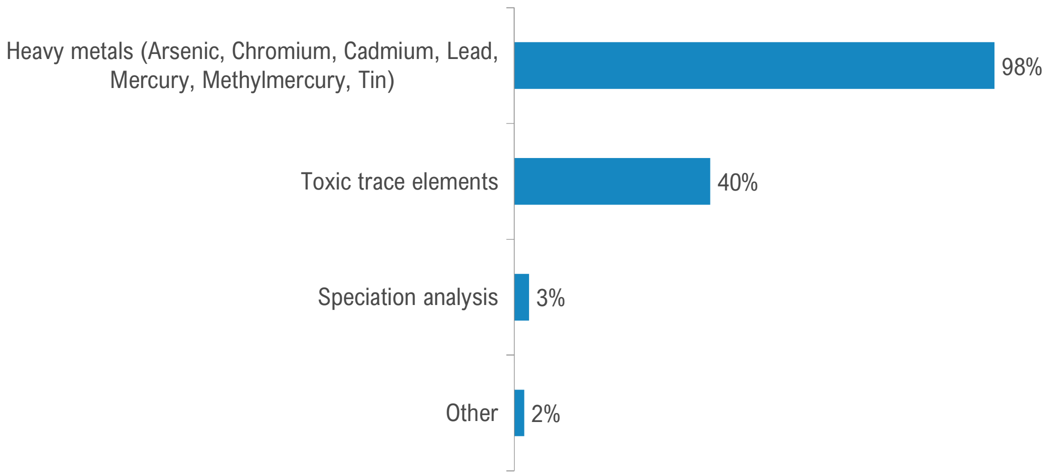


Figure 16 Summary of toxic and nutritional elements - food category

23.5 VETERINARY DRUG RESIDUES

Twenty-seven (27) laboratories have indicated services for veterinary drug residue testing. There is an extensive veterinary health and zoonosis laboratory network across the continent that is managed largely through the Organisation for Animal Health (OIE). These services may not appear as ISO/IEC 17025 accredited and would require further engagement with these laboratories to obtain a full estimate of drug residue testing capacity in the region. Testing in these laboratories would typically focus on live animals and diagnosis of illnesses, while drug residue testing is performed on slaughtered animals, where meat is intended for further human consumption.

The Committee on Residues of Veterinary Drugs in Foods (CCRVDF) is responsible for establishing MRLs for this contaminant category. Codex MRLs (CX/MRL 2-2018, 2018) are listed for 66 veterinary drugs in animal tissues and risk management recommendations (RMRs) for 13 veterinary drugs. Based on the available scientific information, the Joint Expert Committee on Food Additives (JECFA) concluded that there is no safe level of certain drug residues and their metabolites in food that would represent an acceptable risk to consumers. Thus, for the thirteen drugs listed with RMRs, the competent authorities should prevent residues from occurring in the food by banning their use in food-producing animals. They are: Carbadox, Chloramphenicol, Chloropromazine, Dimetridazole, Furazolidone, Gentian Violet, Ipronidazole, Malachite Green, Metronidazole, Nitrofural, Olaquindox, Ronidazole, Stilbens. This recommendation requires the establishment of analytical testing capability for monitoring the use and presence of these banned drugs in meats for human consumption.

Chronic exposure to veterinary drug residues may also lead to antimicrobial resistance. This is a concern within Africa and high on the Agenda within the WHO and the AUC (FAO/WHO, 2019), with the uncontrolled use of drugs in the animal production industry. Furthermore, antifungal and antiprotozoal agents such as malachite green have been used for managing infections in aquaculture (farmed fish) production. As a result of global over-fishing, farmed fish is on the increase, and one should anticipate more widespread use of this banned drug and the need for increased testing capacity.

Figure 17, presents the summary of veterinary drug residues that are being tested by respondents and ISO/IEC 17025 accredited laboratories. The predominant testing capacity is in antimicrobial testing (96%), with some insecticide testing (26%) and testing for anthelmintic (15%) and antiprotozoal (11%) drug residues. The antimicrobial testing category could be further detailed, as presented in Figure 18, into primarily the tetracyclines (85%), sulphonamides and amphenicols (73%), and penicillin (50%). Radio-immunoassays and immunoassays are often used for cost-effective screening.

For quantitative analyses the tests are more challenging and require extensive method development and validation. This would include optimisation of extraction conditions, taking care not to destroy the incurred drugs, conjugated drugs and/or drug metabolites, then applying high-end instrumentation, typically LC-UV, LC-FLD and LC-MS/MS, often with the use of matrix-matched calibration standards or costly isotopes to compensate for matrix effects for analysis (Joint FAO/IAEA, 2016). Matrix reference materials of animal products are notoriously difficult to import from overseas due to permits required, making routine quality assurance for these tests challenging.

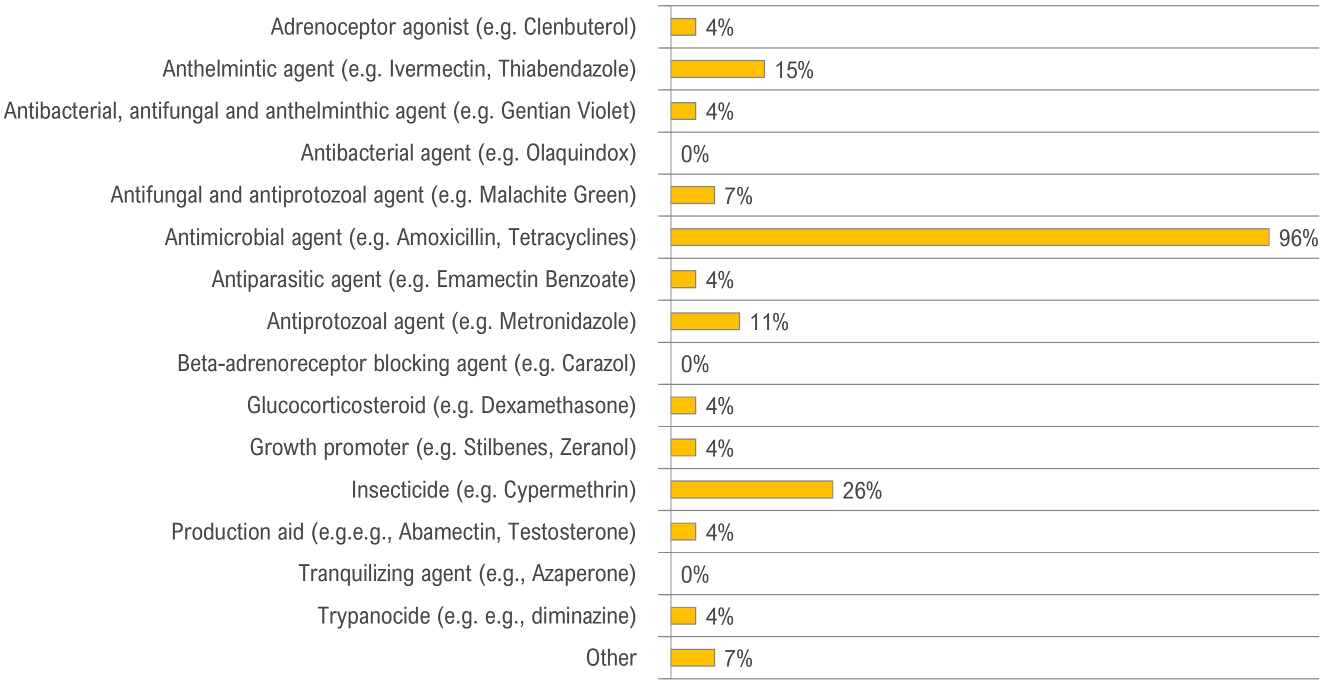


Figure 17 Summary of veterinary drug residues

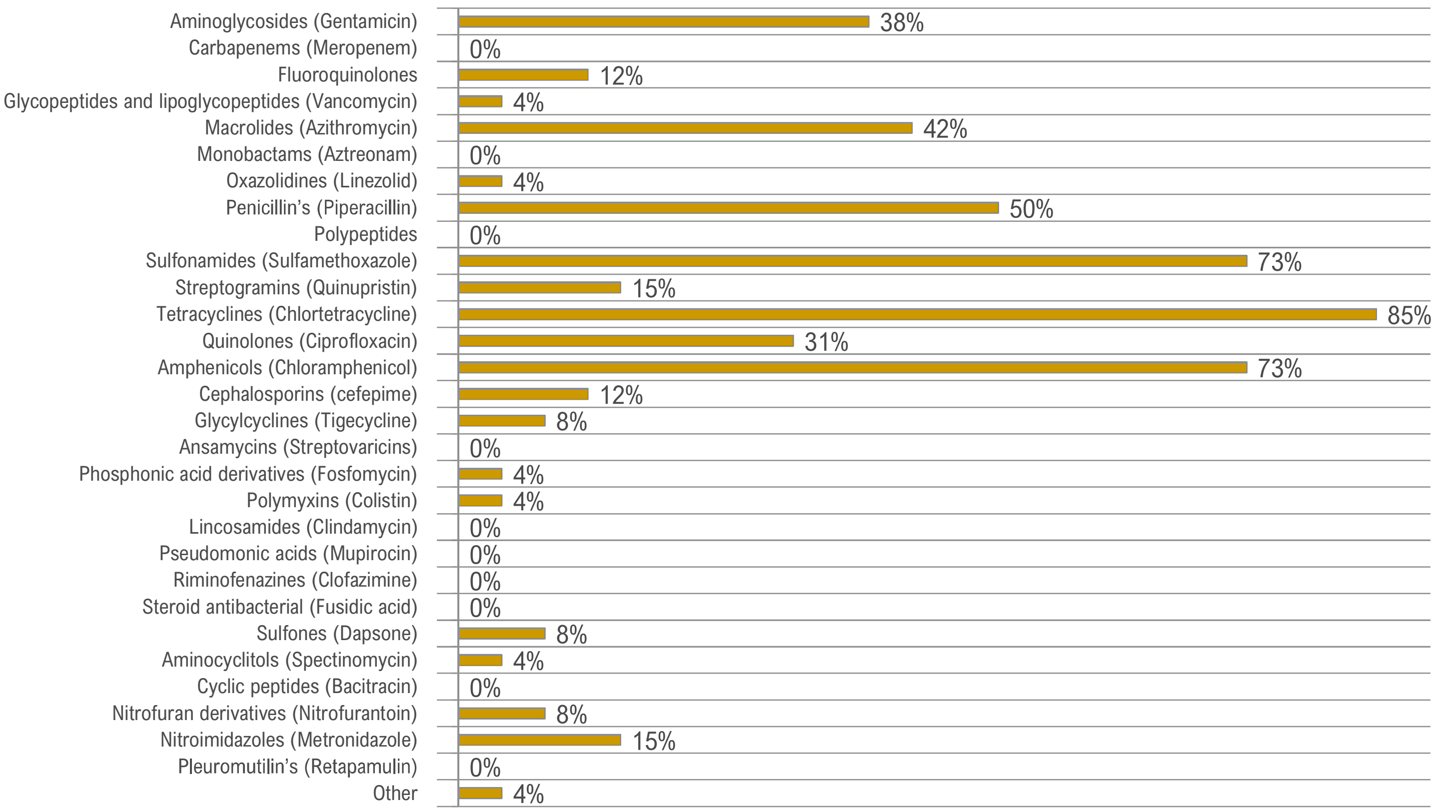


Figure 18 Summary of antimicrobial agents

The foodstuff categories that are analysed by laboratories for veterinary drug residues, are presented in Figure 19, where chicken (85%), cattle (67%), other poultry (67%) and fish (41%) lead as commodities tested most often. Foodstuff categories listed as “Other” included honey, milk, eggs and water.

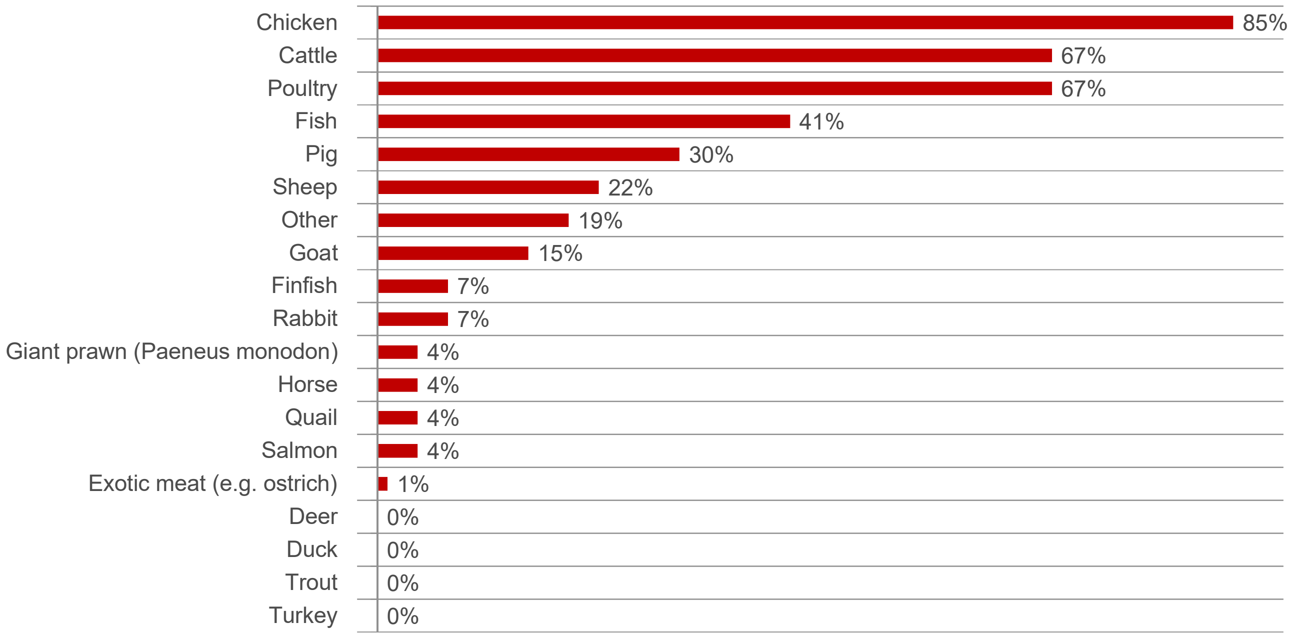


Figure 19 Summary of veterinary drug residue matrices

23.6 ENVIRONMENTAL AND MANUFACTURING CONTAMINANTS

Thirty-one (31) laboratories completed this section of the survey. Polyaromatic hydrocarbons (PAHs) at 55% and polychlorinated biphenyls (PCBs) at 39% are the main contaminants tested in this category. This type of contamination in the food chain occurs mainly through foods of animal origin that are exposed to air and soil pollution and through artificial drying and smoking of foodstuffs (e.g., smoked fish). . For example, power generation from coal-fired plants leads to higher levels of PAHs in the environment, PCBs find their way into the food chain through contaminated oils used in animal feed and are often used as indicator compounds for the presence of dioxins in the foodstuffs at ultra-trace levels (Malisch, 2014).

Dioxins are notoriously expensive to analyse as they require high-end analytical instrumentation, advanced skills and costly reagents. To operate routinely and sustainably, large sample analysis volumes are needed. Due to their persistent and toxic nature of accumulating in the environment, Codex has developed a Code of practice for the prevention and reduction of dioxins, dioxin-like PCBs and non-dioxin-like PCBs in food and feed (CXC 62-2006, 2006). Similarly, perfluorinated substances (PFAS) and Mineral Organic Saturated Hydrocarbons and Aromatics (MOSH-MOAH), are recent contaminants for which capabilities are yet to be established, thus there are a limited number of laboratories that are currently able to perform these tests.

The main foodstuffs analysed by survey respondents, as presented in Table 6 are cereals and grains (55%), fish and fish products (52%) and potable water (48%). Contaminants listed in the "Other" option, included heavy metals in environmental samples such as soils and plants; waste originating from the leather industry (this would typically include heavy metals (e.g. arsenic and chromium) and chemicals such as the chlorides, sulphates, hydrocarbons, amines, aldehydes) (N.M. Sivaram, 2019). The determination of biochemical oxygen demand (BOD) and chemical oxygen demand (COD) in water was also listed, these tests are used to measure the total level of chemical contamination in water/ wastewater, and the amount of oxygen needed for bacteria to breakdown the organic components present.

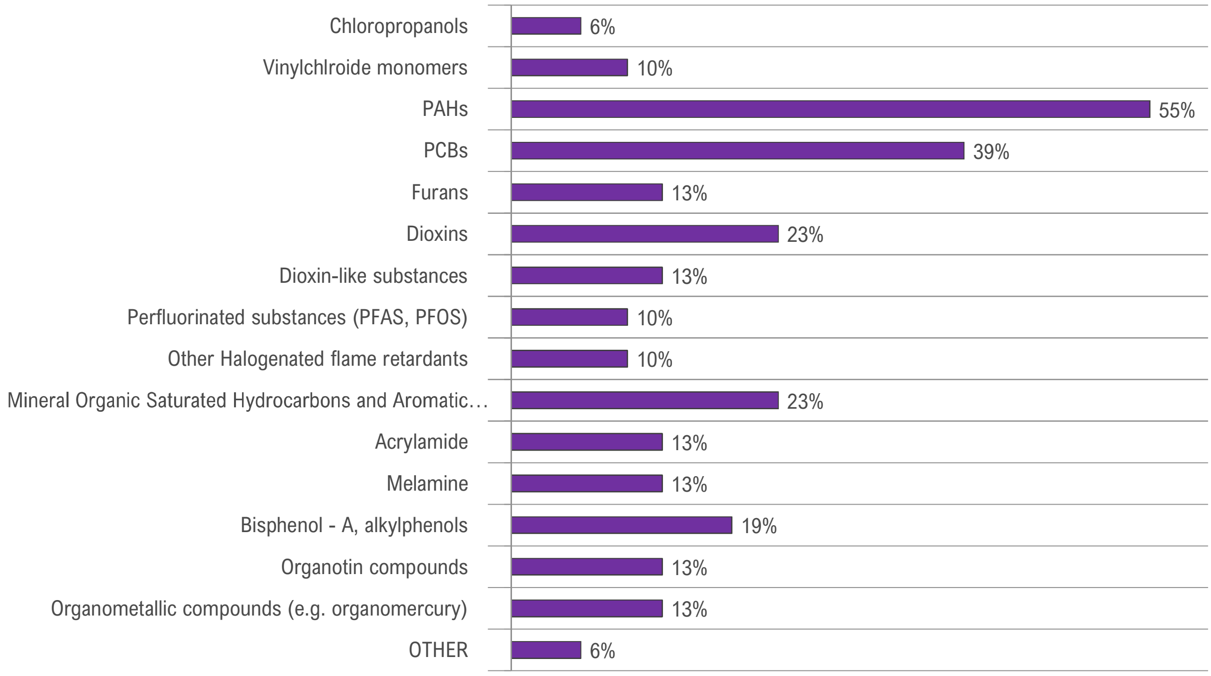


Figure 20 Summary of manufacturing/ environmental contaminants

Interestingly emerging contaminants that have escalated globally, food contact materials, and migration of contaminants, e.g. acrylonitrile, into food through packaging materials was not listed. The presence of phthalates, polymers and nanomaterials is not described as elements that are tested for within this category, emphasising that this is not a priority in the region yet. The Codex (CXS 193-1995, 1995. amended 2019) currently lists GLs for food contact materials/migration contaminants as: 1) acrylonitrile in food; 2) Vinyl chloride monomer in food and packaging material 3) chloropropanols (including 3 – monochloropropoane-1,2-diol (3-MCPD) and 1,3-dichloro-2-propanol (1,3-DCP)) in liquid condiments containing acid hydrolysed vegetable proteins.

23.7 ADDITIVES AND PRESERVATIVES

Food additives are substances that are not normally consumed as a food on its own, and are intentionally added to food for a technological (including organoleptic) purpose during the manufacturing, processing, preparation, treatment, packing, packaging, transport or holding of foods, which "may be reasonably expected to result (directly or indirectly), in it or its by-products becoming a component of or otherwise affecting the characteristics of such foods" (CDX-192:1995 amended 2021, 1995). To date, the Codex Committee on Food Additives (CCFA) has compiled 4596 Codex MLs covering 376 food additives or groups of food additives. The primary objective of establishing maximum use levels for food additives in various food groups is to ensure that the intake of an additive from all its uses does not exceed its Allowable Daily Intake (ADI) over a lifetime, for which there would be no appreciable health risk.

Twenty-eight laboratories completed this section of the survey. Fifty percent of the laboratories are testing water-soluble antioxidants such as ascorbic acid and citric acid (typically applied in fruit juices and non-alcoholic beverages), followed by preservatives (43%) such as sulphur dioxide and sulphites (used in dried fruits and wines). Twenty-five percent are testing fat-soluble antioxidants (Tocopherols, used in edible oils) and nitrates and nitrites (25%, preservatives used in processed meat and meat products).

The major foodstuffs tested are infant foods and non-alcoholic beverages (Table 6). Typical sample volumes analysed (38% of laboratories) are in the range of 51-100 samples per month (Table 5).

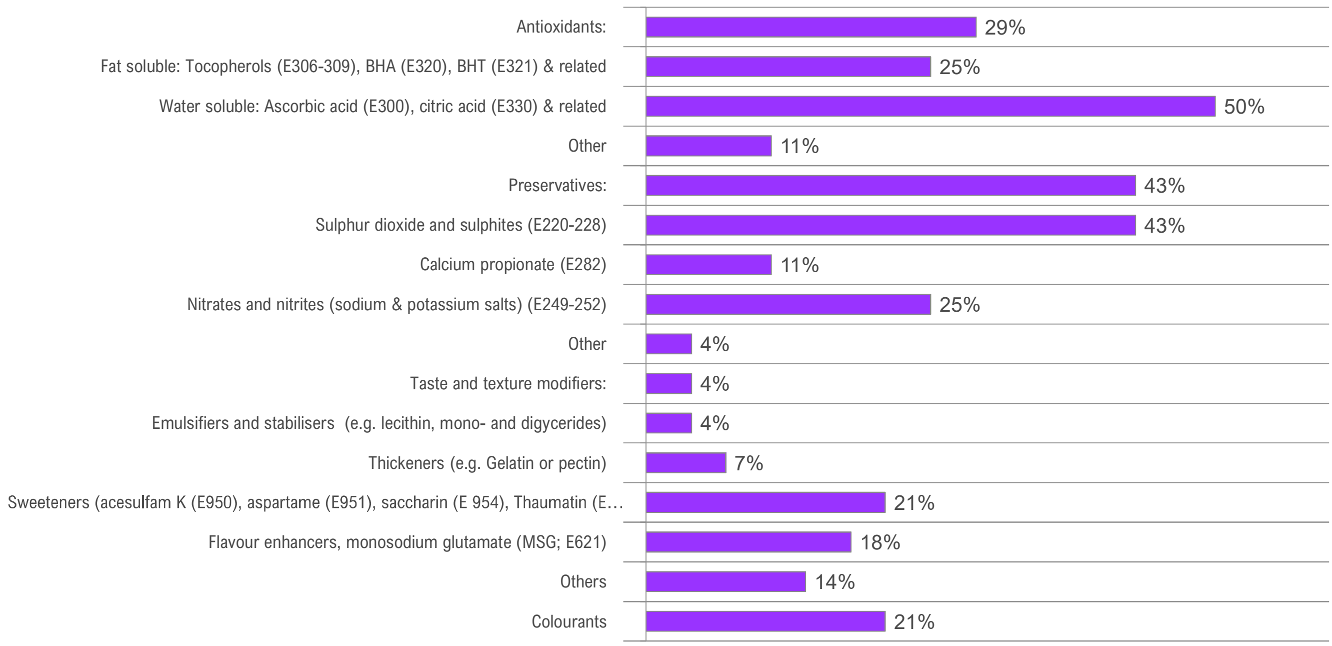


Figure 21 Summary of additives and preservatives

23.8 FOOD FRAUD AND ADULTERATION

Twenty-nine (29) laboratories indicated services in the area of food fraud and adulteration testing. Although currently no official definition for food fraud exists, it is most recently described as the economically motivated action "intentionally causing a mismatch between food product claims and actual food product characteristics, either by deliberately making claims known to be false or by deliberately omitting to make claims that should have been made." (The Food Integrity Project, 2018). Fraud may on occasion also negatively impact human health, as was the case with the melamine scandal in 2007, but generally does not have the same risk as the major food safety categories for which MLs and MRLs are established. There are 7 different types of food fraud of which adulteration, i.e., "the intentional addition of a foreign or inferior substance or element; especially to prepare for sale by replacing more valuable with less valuable or inert ingredients" is the most common. (The Food Integrity Project, 2018)

The EU currently provides a harmonised framework for selecting, testing, and assessing the quality characteristics of food products (EC Directorate-General Joint Research Centre, 2022). This transparent process for detecting cases where products do not meet the required sensory and composition analysis based on information provided on the food product labels, would allow cases of food fraud and food adulteration to be exposed. Food products with the highest risk of fraud include: olive oil, fish, "organic" foods, milk, grains, honey and maple syrup, coffee and tea, spices, wine, spirits, and selected fruit juices.

From the survey, fatty acid profiles for oils and alcohol profiles for alcoholic beverages are the parameters tested by most laboratories, followed by the sugar profiling of beverages and honey. Milk, honey and olive oils were indicated under "other" as well as quality parameters for beer produced on site. E.g., Brix. pH, CO_2 gas, turbidity and foam. Interestingly, there appears to be limited activity in the area of profiling protein-based foods for authenticity testing and foods based on geographical origin, which would utilise the more complex DNA testing, isotope ratio mass spectrometry or NMR spectroscopic techniques.

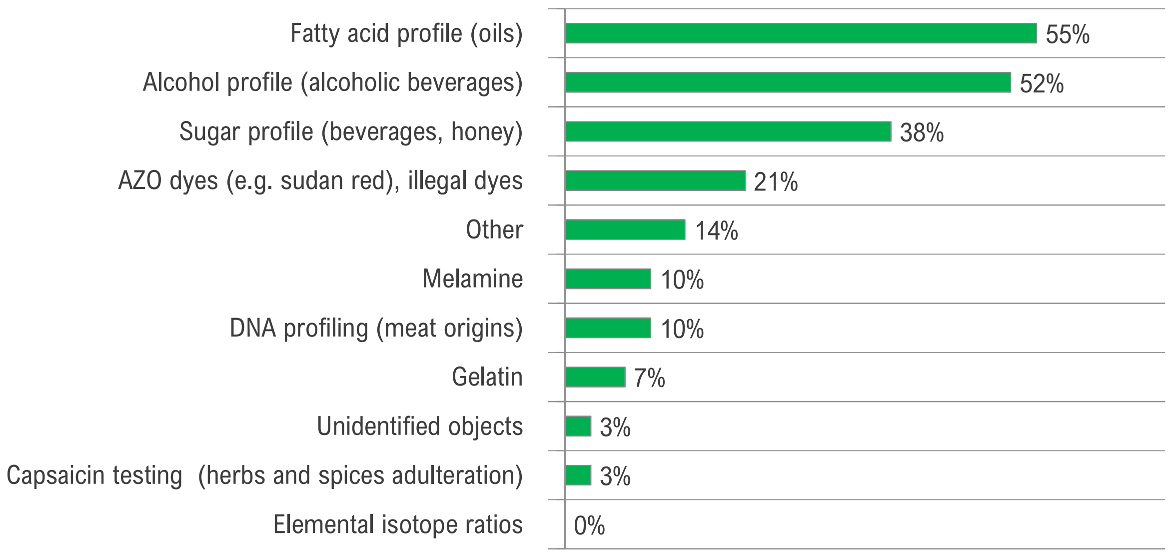


Figure 22 Summary of food adulteration/ authenticity tests

23.9 ALLERGENS

Food allergies originate from adverse immune reactions (hypersensitivities) to certain “food proteins” or allergens. Although they affect a small segment of the population the effect of allergens on the individual is severe and sometimes fatal. There is currently limited information concerning the prevalence of food allergies in Africa (Open Access Government, 2022).

Seven laboratories (7) are able to test for food allergens. Testing foodstuffs for allergens is required for several reasons. Firstly, to confirm the absence of specific allergens, i.e., the validity of a "free-from" claim, like "gluten-free.", which critically informs consumers with allergies of the safety risks associated with consuming the product. Secondly, to check for unintentional allergen contamination as part of due diligence, and finally, and also most frequently to validate and confirm the effectiveness of allergen removal, as indicated in the Codex code of practice on food allergen management for food business operators (CXC 80-2020, 2020). Food allergen management would also include appropriate allergen labeling of food products. The main food categories that are known to cause hypersensitivity, and must always be declared are: cereals containing gluten (i.e. wheat, rye, barley, oats); crustaceans; eggs; fish; milk; peanuts; soybeans; and tree nuts (which includes almonds, Brazil nuts, cashews, hazelnuts, macadamias, pecans, pistachios and walnuts).

From the survey, the predominant allergens that are being tested are gluten (86%) followed by peanuts and fish, both at 57%. While ELISA is suitable for allergen screening and relatively simple to use, these tests suffer from an underestimation of the target analyte resulting in false negatives. Recommended methods of analysis are generally more complex such as PCR analysis (which also suffers from underestimation) or targeted proteomics by LC-MS/MS requiring analysts with extensive experience (FACTSSA, 2022).

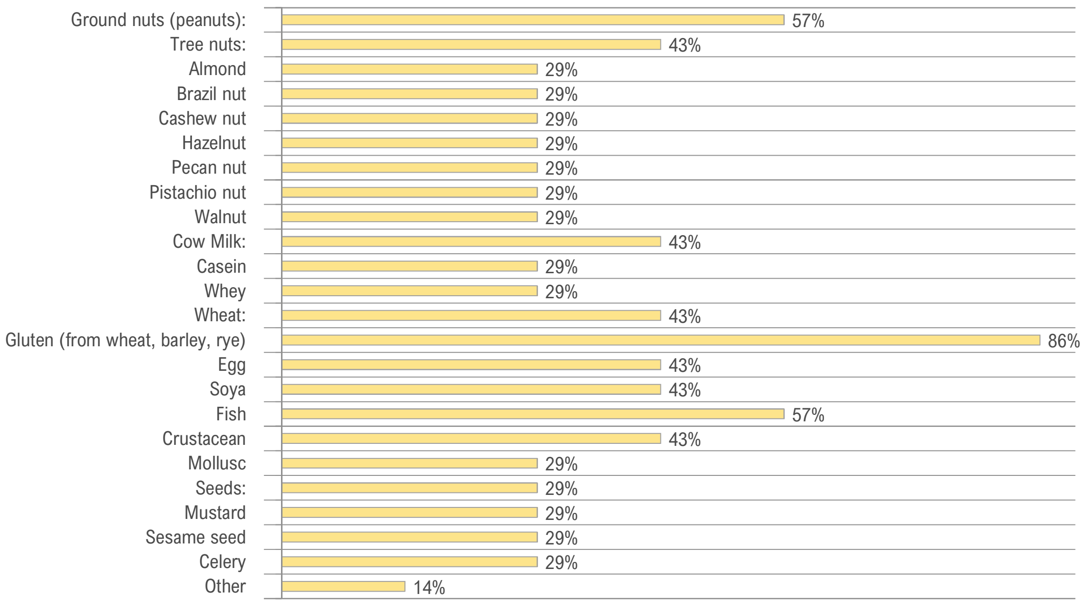


Figure 23 Summary of allergens - food category

23.10 RADIONUCLIDES

Four (4) labs indicated testing services for radionuclides in food. The Codex presents guideline levels (GL) for important radionuclides that may be taken up in the food chain, and that are destined for human consumption or traded globally. These include Pu-238, Pu-239, Pu-240, Am-241, Sr-90, Ru-106, I-129, I-131, U-235, S-35(organically bound), Co-60, Sr89, Ru-103, Cs-134, Cs-137, Ce-144, Ir-192, H-3 (organically bound), C-14 and Tc-99. Contamination with these radionuclides would originate from nuclear installations or large enough radiation sources that were accidentally or malevolently leaked. Naturally occurring radionuclides were not included. GLs are classified into 2 foodstuff commodities: infant foods and "other foods", as infants are more sensitive to these radionuclides. When GLs are not exceeded the foodstuffs are considered safe for human consumption. Unlike the Codex MLs, because the foodstuff categories are broad when GLs are exceeded, the national government may decide the conditions under which the food may be distributed within their jurisdiction (CXS 193-1995, 1995. amended 2019).

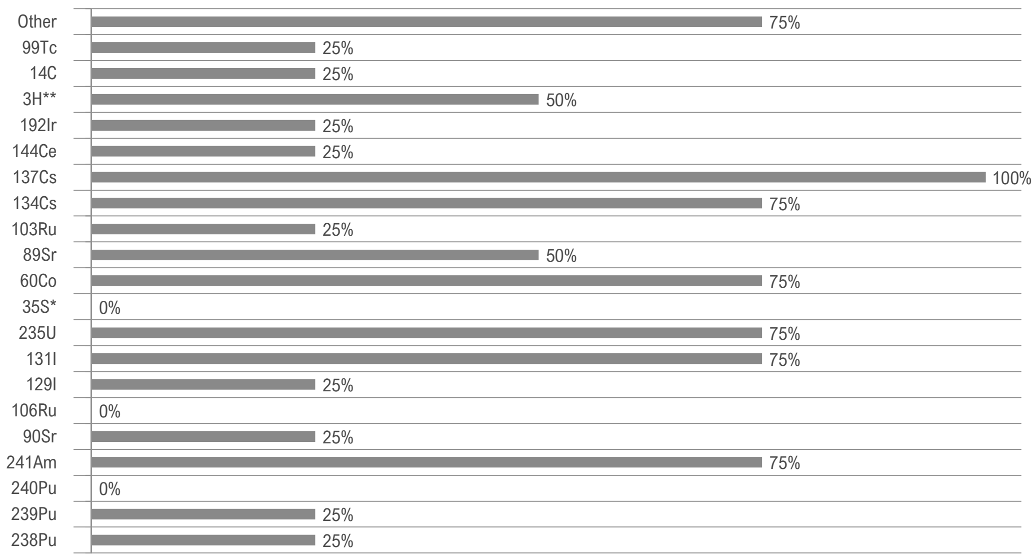


Figure 24 Summary of radionuclides - food category

23.11 NUTRITIONAL CONTENT

One hundred and eighty-five (185) laboratories are currently delivering test results for nutritional content/ food composition. Parameters are summarised in Figure 25. The larger percentage of analyses (58-69%) are on the bulk parameters for food composition such as total protein (determined as total nitrogen), water and fat. While, 32% to 39% of labs test for carbohydrates/energy, the macro and micro elements and dietary fibre. Less analytical capability (4-24%) is established for reporting on the more complex (fat and water-soluble) vitamin content, amino acids, trans fats, saturated fats, cholesterol and artificial sweeteners in foodstuffs.

The foodstuffs tested most often (Table 6), include: Cereals/ grains (58%); nuts, nut products and seeds (45%); milk and milk products; (43%); fruits and vegetables (40%); processed fruits and vegetables (38%); animal feed and pet food (37%). Most laboratories are applying ISO and AOAC methods of analysis, with typical volumes tested per month in the range of 51-100 samples, with commercial labs able to test 501-1000 samples (Table 5).

"Other" parameters not listed, included several tests applied to the quality assurance of vegetable/edible oils such as acid value, acidity, rancidity, peroxide value, iodine index, fatty acids, permanganate value, oil index and saponification value, sterolic composition, tocopherols and stigmastadienes.

Edible oils are a major commodity both for imports and intraregional exports in Africa (Figure 11), which explains the extended testing capacity for this commodity from a quality and fraud perspective. Additionally, fish spoilage indicator compounds such as total volatile basic nitrogen (TVBN) and hydroxyproline, which indicates the collagen levels (ligament proteins) in meat products were sited (Alaa El-Din A. Bekhit, 2021).

Other composition parameters mentioned, included ash and crude fibre, pH, absorbance, anions (chlorides, bromide, fluoride, sulphates, phosphates, nitrates, nitrites) and cations (Mn^{2+}, Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}). The anions and cations may overlap with food additives and preservatives category.

Due to micronutrient malnutrition, poor food security and diversity of diets within Africa, there are mandatory food fortification regulations for staple foods such as maize flour and wheat flour within the region. The WHO identified nutrient shortages of iodine, iron, vitamin A and zinc as those leading to serious health risks. In some regions, additional nutrients such as folate, the other B-vitamins, vitamin C and D, calcium, selenium and fluoride are also fortified (WHO/FAO, 2006).

Thirty countries (30) in Africa enforce mandatory fortification of wheat flour and (12) for maize, while 4 countries have voluntary fortification regulations for wheat and one voluntary for maize (FFI, 2022). Some countries also fortify other commodities such as salt, vegetable oil and sugar. Fortification is achieved using pre-mixes and blended according to WHO guidelines (WHO/FAO, 2006). Levels within the final fortified food products should also be confirmed analytically (Guamuch, Makhumula, & Dary, 2007). Suitable reference materials are needed for these confirmatory analyses.

From a food labelling perspective, regulations do not require routine testing to confirm food composition as presented on the label. In South Africa, for example, the results must be produced by an ISO/IEC 17025 accredited laboratory, and reconfirmed label contents every 5 years or only when the recipe has changed (National Department of Health, 2010, amended 2012). The sample volumes for analysis are significantly less, explaining also why there are so few labs performing vitamin analysis in the region.

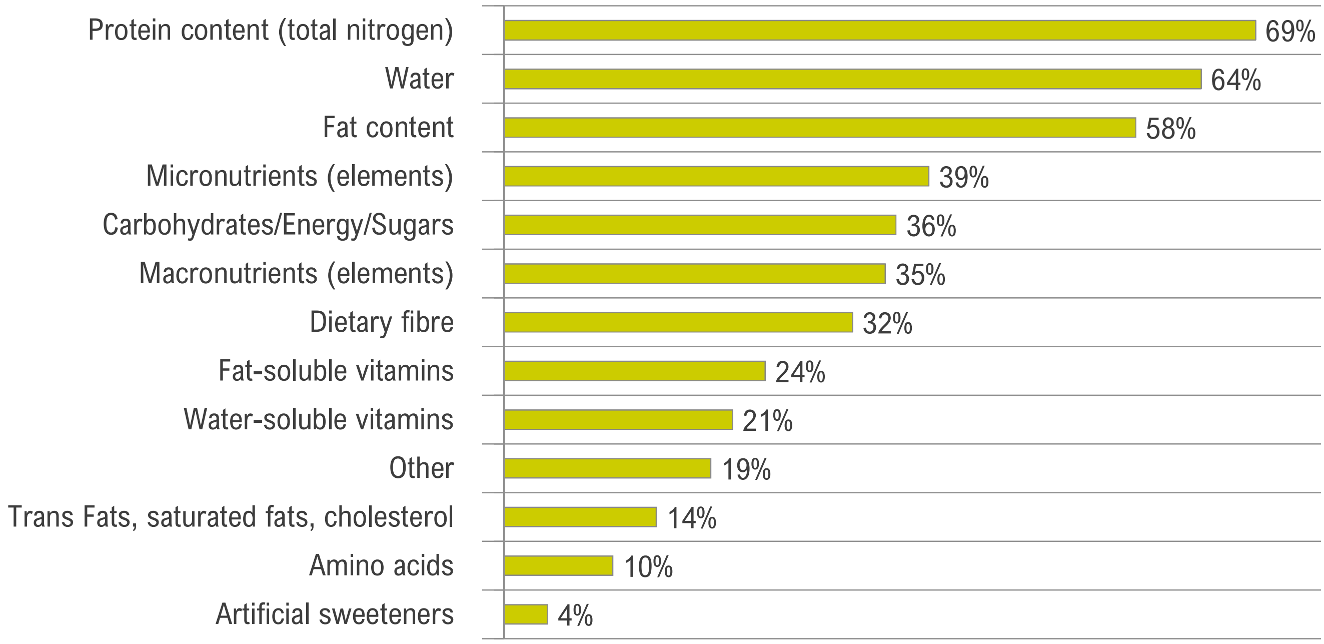


Figure 25 Summary of nutritional content - food category

23.12 GENETICALLY MODIFIED ORGANISMS (GMOs)

While biotechnology has contributed to global food security, it is widely acknowledged that there is not enough information with regard to possible future health and environmental consequences. Only five laboratories are performing GMO testing based on participant/ accreditation information available. This may be attributed to 2 main factors: 1) The limited adoption of GMO crop production within Africa (AUDA-NEPAD, 2020) and 2) the complexity of the analysis demanding increased operational costs and the analyst skills (FACTSSA, 2022). Laboratories are either testing to confirm the absence of GMO in commodities exported into countries that currently ban GMO seeds/ foodstuffs in their country, or to indicate the percentage of GMO within the commodity, for which national GMO food labelling regulations exist.

To date, there are only 4 African countries: South Africa, Burkina Faso, Egypt and Sudan, that are growing genetically engineered crops. In South Africa the commodities include drought tolerant maize, soybean and cotton.

Total sample volumes that are analysed on a monthly basis are in the range of 1-10 samples (50% of laboratories) or 11-50 (25%) and 51-100 (25%).

23.13 SAMPLING

Thirty-eight (38) laboratories provide representative sampling services. The impact of sampling on the overall comparability of laboratory results, both on-site, and for subsequent testing should not be underestimated. It is well established that, when all other competency elements for ISO/IEC 17025 are met, the root cause of result variation between laboratories originates from representative sampling inconsistencies, in particular for test results for export and inspection commodities. In the absence of National representative sampling guidelines for agricultural commodities, the Codex Alimentarius does provide sampling guidelines (CAC/GL 50, 2004).

Seventy-three (73) respondents completed this section of the survey, of which 52% indicated they do perform sampling for customers, and 43% indicated their intention to establish this capability in the next 2 years (Figure 8). Of those laboratories currently offering the service, only 11% are ISO/IEC 17025 accredited. The sampling protocols applied are predominantly CODEX, CAC/GL 50-2004, and CAC/GL 33-1999 (pesticide residues), however, other sampling protocols included the international standards: ISO 19458, ISO 17604 and ISO 18593:2018, ISO 5667, and the East African Community: EAC 900:2017, the European Union (EU), World Animal Health Organisation (OIE) and Grain and Feed Trade Association (GAFTA).

Temperature monitoring and sample traceability are critical elements of this service. Of the 38 responses, 82% of laboratories are collecting the samples themselves, while 34% are using couriers. 60% are making use of manual temperature monitoring and control systems, 15% are making use of data loggers and 13% use real-time track-and-trace devices. No additional information was provided where “other” was selected.

24. OTHER NON-LISTED FOOD TESTING CATEGORIES

Respondents were given the opportunity to list any other food testing services that were not already addressed in the survey. These were listed as below:

- Total solids in dairy products (milk, cheese, yogurt, etc); fat determination in food dressings and dairy products; compositional testing for vinegar, honey, fruit juices; total solids and sulphur dioxide in dried fruits.
- Grading of grains and oilseeds according to national grading regulations
- Micronutrients in fortified food products like maize meal and wheat flour.
- Bottled water testing.
- Environmental controls in the food processing line (temperature and humidity)
- Analysing nitrates and nitrites in fruits and vegetables by HPLC-DAD.
- Preparation and characterizations of pure and matrix reference materials for food testing and control
- Estimation of Bisphenol A in products
- Caffeine

25. RECOMMENDATIONS

Food safety and quality testing has a very broad scope. In identifying gaps and needs, it is important to also consider the needs at a national level and prioritise accordingly (refer to country GAP scores in Table 4). Within the AfCFTA and the FSSA, there are overarching challenges and areas that should be considered and prioritised for metrology and capacity building support that would enable intra-regional trade. Where metrological support may be disseminated through reference measurements, reference materials and proficiency testing schemes. The following recommendations are proposed:

- Training support for an increased number of mandated monitoring and inspection labs to obtain ISO/IEC 17025 accreditation, implementation of a QMS (laboratory management and leadership), and additionally for specific technical elements within the standard that are needed (e.g. method validation and use of standard methods of analysis (ISO, AOAC, etc), establishing metrological traceability for chemical measurements and estimation of UoM for chemical test results).
- Training on instrument operation, maintenance, and troubleshooting.

- The major food testing group 1 are those for which several laboratories are accredited microbiological, nutritional, heavy metals, pesticide residues, and mycotoxin content testing. Although the majority of participating labs are accredited there are still several labs intending to become accredited in the next 2-5 years in this category (Figure 8) making this the main category for metrological support within the AfCFTA.
- Microbiology testing is challenging, and not currently a metrologically traceable measurement, NMIs/DIs, are unlikely to be able to provide support beyond assisting with the sustainable supply of microbiological strains that were challenging to import during COVID and prepare for implementation of AMR testing needed going forward under the One Health umbrella.
- Support is needed for laboratories wishing to implement molecular biology platforms for microbiological testing.
- Testing of the staple commodities: Cereals and regionally boosted cereal commodities, for
    - Mycotoxins: those currently regulated and monitoring for the anticipated changes in mycotoxin profiles and concentration levels resulting from climate change.
    - Heavy metal contamination which may occur through contaminated water supplies from possible mining activities and contaminated fertiliser usage. This water is then used for irrigation and in food production, including bottled water.
    - Banned, current use and newly introduced pesticides
    - Mandatory fortification of the staples for vitamins and macro/micronutrients (elements).
- Testing of animal and animal products: boosted agriculture sectors for fish, poultry and meat:
    - Sustainable supply of reference materials and PT schemes is needed for this foodstuff category. The import and clearance of animal products poses several challenges, ranging from maintaining the cold chain, costs for clearance and obtaining all relevant permits, to avoid the materials from being detained and destroyed at customs.
    - Characterised parameters for naturally incurred animal materials would include veterinary drug residues, algal toxins (marine biotoxins, shellfish toxins) and heavy metals. For marine animals, this would also include freshwater and seawater fish.
    - For veterinary drug residues, there is a growing concern about antimicrobial resistance (AMR) and controlled drug use in the animal & fish production industry.
    - The One Health approach would require metrological support to extend to the testing of animal feed quality and contamination of animal feed that impacts safe food production.
- Testing of new, current use and banned pesticides in regionally relevant fruits and vegetables for intraregional trade, but also those identified as AU major export commodities at risk of trade bans. Those that are analytically challenging (highly polar pesticides, pigment-rich matrices) for which additional training and guidance support should be provided.
- Testing of fats and oils including all associated parameters for edible oils, for which limited QC materials are available.
- Consider establishing a centralised AfCFTA training hub and reference laboratory for food fraud and adulteration testing, these are typically the more niche types of testing services for public protection laboratories. Furthermore, reference methods for emerging contaminants could be addressed through the hub in collaboration with academic institutions and NMIs/DIs. For microplastics for example, where the prevalence, baseline levels and impact are yet to be determined in Africa.

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APPENDIX 1

PAN AFRICAN SURVEY QUESTIONNAIRE

Welcome to our Pan African Food Safety Testing Capacity Survey.
Please select your preferred langauge.

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Overview

Let's join hands to enable Food Safety Testing in Africa!

Dear Food Safety Testing Partners,

We are conducting a survey aimed at determining the capacity and technical infrastructure needs of food testing laboratories within the Africa Continental Free Trade Area. Due to the comprehensive nature of this survey, we would prefer for it to be completed by the head of the laboratory or the QC manager.

Depending on your laboratory scope, this survey will take a maximum of 40 minutes to complete. In return for your time and kind assistance, we will be sharing an anonymised result summary report with all laboratories that have fully completed and submitted the survey. Survey responses submitted by the 31st of March 2022 will also be entered into a prize draw for five free online NMISA training courses, and one €100 Amazon Gift Voucher.

NMISA, in compliance with the Protection of Personal Information Act 4 of 2013 (POPI), hereby ensures that:
* This survey is anonymous.
Responses will be merged anonymously with the responses of over 500 other laboratories to draw non-individual conclusions. It will be impossible to pick your laboratory responses out of all responses received.
* Your responses will be treated strictly confidentially.
* No contact details will be shared without your prior written consent.
* Participation is voluntary. There is no penalty for refusing to participate.

Would you like to continue?
By completing and submitting the survey you are agreeing to the above.

The survey submission deadline is 31 March 2022.

Guidance on completing the survey:
1) The questions marked with an asterisk(*) need to be completed to proceed. A brown reminder message box will appear at the top of the page when such a question is not fully completed.
2) The "SAVE LINK" button at the bottom of the page, will save your inputs on the system, for submission later.
3) Please use only the <<previous page or the next page >> buttons at the bottom of the page to move in the survey. Do not use the web browser back and forward buttons.
For further guidance on how to complete this survey please contact Dr. Maria Fernandes-Whaley at mfwhaley@nmisa.org.

This survey is supported by the Physikalisch-Technische Bundesanstalt (PTB), the National Metrology Institute of Germany, and coordinated through the National Metrology Institute of South Africa (NMISA).

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Contact details

1 Contact details *

Enter response/ reference information

Name of Laboratory/ Institution

Enter response/ reference information

Country

Enter response/ reference information

Main Contact Name

Enter response/ reference information

Main contact: Designation within your organisation (Laboratory manager, Quality Coordinator, Analyst)

Enter response/ reference information

Main contact email

Enter response/ reference information

Main contact phone number

Enter response/ reference information

Alternative contact person name

Enter response/ reference information

Alternative contact email

2 To avoid duplication of submission. Please check that you are authorised by your institution as the designated representative to complete the survey. This is required in order to continue with the survey.
If not, please forward the link to the relevant person in your institution.

- ◯ Yes, I am the designated laboratory representative (e.g. Laboratory manager, QC manager)
- ◯ No

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Please indicate your type of laboratory

3 Please indicate your laboratory type *

More than one option is possible.

- ☐ Academic Research Laboratory
- ☐ National Research Institute
- ☐ Public Laboratory or Metrology Institute (State/ Government funded)
- ☐ Private/ Commercial Testing Laboratory
- ☐ Designated Laboratory for exports
- ☐ Other

Comment

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Staff

4 Number of staff in lab involved in food safety testing *

Enter response/ reference i

Input number - total

5 Qualifications (in Chemistry/Biochemistry/Microbiology/Food Science and relevant fields)

Insert number of staff with this qualification

Enter response/ reference i

Technician (3-4 year undergraduate)

Enter response/ reference i

Bachelor (3-4 year univeristy degree)

Enter response/ reference i

Master (1-2 year postgraduate researcher)

Enter response/ reference i

PhD

Enter response/ reference i

Other (Please specify in comment section)

Comment

6 How often do staff receive training, please indicate if the training is presented in-house, or through an external service provider?

If "Other " selected , please indicate in the comment section

	In -house	External
Annually	☐	☐
Monthly	☐	☐
Every 2 years	☐	☐
Other	☐	☐

Comment

7 Training that would be most needed (ranked 1 less needed, 5 most needed)

	1 (**1 pts**)	2 (**2 pts**)	3 (**3 pts**)	4 (**4 pts**)	5 (**5 pts**)
Method development	☐	☐	☐	☐	☐
Method validation	☐	☐	☐	☐	☐
Establishing/ implementing a quality system for ISO/IEC 17025	☐	☐	☐	☐	☐
Implementing metrological traceability for chemical tests	☐	☐	☐	☐	☐
Estimating Uncertainty of Measurement (UoM)	☐	☐	☐	☐	☐
Qualitative analysis (screening analysis) training	☐	☐	☐	☐	☐
Microbiological tests for Food spoilage microorganisms - training	☐	☐	☐	☐	☐
Microbiological tests for Food poisoning bacteria - training	☐	☐	☐	☐	☐
Gas Chromatography (GC) training	☐	☐	☐	☐	☐
Liquid Chromatography (LC) training	☐	☐	☐	☐	☐
Mass Spectrometry (MS) training	☐	☐	☐	☐	☐
Inductively Coupled Plasma - Optical Emission Spectroscopy (ICP-OES) training	☐	☐	☐	☐	☐
Inductively Coupled Plasma - Mass Spectrometry (ICP-MS) training	☐	☐	☐	☐	☐
Titration training	☐	☐	☐	☐	☐

	1 (**1 pts**)	2 (**2 pts**)	3 (**3 pts**)	4 (**4 pts**)	5 (**5 pts**)
Sample preparation training - Organic Analysis (GC, LC, GC-MS, LC-MS, titration)	☐	☐	☐	☐	☐
Sample preparation training - Inorganic Analysis (ICP-OES, ICP-MS, AAS, AES, ion chromatography)	☐	☐	☐	☐	☐
Sample preparation training - Bioanalysis (DNA, RNA, Proteomics)	☐	☐	☐	☐	☐
Representative sampling training	☐	☐	☐	☐	☐
Hazardous chemical management (Storage, disposal, and use)	☐	☐	☐	☐	☐

8 Please share other training needs (not mentioned above)

Enter response/ reference information

9 Is your laboratory collaborating on Food safety Capacity building initiatives funded through one or more of the following: *

Please select from options below and indicate project reference number.

- ☐ African Development Bank
- ☐ African Regional Economic Communities
- ☐ African Union
- ☐ African Union – Interafrican Bureau for Animal Resources (AU-IBAR)
- ☐ Bill & Melinda Gates Foundation
- ☐ Canadian Food Safety Inspection Agency (CFIA)
- ☐ CGIAR - International Institute of Tropical Agriculture (IITA)
- ☐ CGIAR - International Livestock Research Institute (ILRI)
- ☐ Consultative Group on International Agricultural Research (CGIAR) centers in Africa - OTHER
- ☐ Donor Agencies - China
- ☐ Donor Agencies - Europe (excl. PTB)
- ☐ Donor Agencies - Japan
- ☐ Donor Agencies - UK
- ☐ Donor Agencies - USA
- ☐ FAO (United Nations - Food and Agriculture Organization)
- ☐ Global Food Safety Initiative (GFSI)
- ☐ IAEA - Regional Africa food safety project (e.g. IAEA RAF5084)
- ☐ Pan African Quality Infrastructure (PAQI)
- ☐ PTB Germany (Physikalisch-Technische Bundesanstalt)

- ☐ STDF (World Trade Organization - Standards and Trade Development Facility)
- ☐ UNIDO (United Nations Industrial Development Organization)
- ☐ USAID (Agency for International Development)
- ☐ US Department of Agriculture Foreign Agricultural Service
- ☐ WHO (United Nations - World Health Organization)
- ☐ World Organisation for Animal Health (OIE)
- ☐ Other
- ☐ None

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Food Monitoring Programmes

10 Does your lab participate in national food monitoring programmes? *

- Yes
- No

11 State which database is the data contributing to e.g. CODEX/ GEMS/ National databases *

Enter response/ reference information

12 Which parameters are being tested for the food monitoring programme? *

- [ ] Natural toxins (incl Mycotoxins)
- [ ] Pesticide residues
- [ ] Veterinary drug residues
- [ ] Heavy metals and toxic elements
- [ ] Microbiological (pathogens)
- [ ] Food adulteration
- [ ] Food authenticity
- [ ] Nutritional content (vitamins, protein, ash, dietary fibre etc.)
- [ ] Environmental/manufacturing contaminants
- [ ] Radionuclides
- [ ] Allergens
- [ ] GMO testing
- [ ] Other

13 Indicate in which matrix (e.g. Fish, Meat, Dairy, Eggs, Maize, Wheat, Nuts)

Enter response/ reference information

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Laboratory information management system (LIMS)

14 Does your laboratory have an implemented LIMS?

- Yes
- No

15 Do you plan to implement a LIMS System in the future?

- Yes
- No

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Laboratory Quality Management System (QMS)

16 Has your laboratory implemented a QMS?

If yes, indicate which standards (e.g., ISO/IEC 17025, ISO 9001)

- Yes
- No

17 Do you plan to implement a QMS System in the future?

- Yes
- No

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Accreditation

18 Is your laboratory ISO/IEC 17025 accredited? *

- Yes
- No

19 Does the laboratory plan to become accredited to ISO/IEC 17025 in the future?

- Yes
- No

20 Please indicate the Laboratory Accreditation number *

Enter response/ reference information

21 Accreditation body

Select which items (Can select more than one)

- ☐ African Accreditation Cooperation (AFRAC)
- ☐ Algerian Accreditation Body (ALGERAC)
- ☐ Arab Accreditation Cooperation (ARAC)
- ☐ Centre Régional d'Evaluation en Education, Environnement, Santé et d'Accréditation en Afrique (CRESAC)
- ☐ Comité Francais d'Accreditation (COFRAC)
- ☐ Egyptian Accreditation Council (EGAC)
- ☐ Ethiopian National Accreditation Office (ENAO)
- ☐ Ghana National Accreditation Service (GhaNAS)
- ☐ Instituto Portugues De Acreditacao (IPAC)
- ☐ Kenya Accreditation Service (KENAS)
- ☐ Mauritius Accreditation Service (MAURITAS)
- ☐ MLSCN Accreditation Service (MLSCN)
- ☐ Moroccan Accreditation Service (SEMAC)
- ☐ Nigeria National Accreditation System (NiNAS)
- ☐ Système Ouest Africain d'Accréditation (SOAC)
- ☐ Southern African Development Community Accreditation Service (SADCAS)
- ☐ South African National Accreditation Service (SANAS)
- ☐ Tunisian Accreditation Council (TUNAC)
- ☐ American Association for Laboratory Accreditation (A2LA)
- ☐ Deutsche Akkreditierungsstelle (DAkkS)

- [ ] European Accreditation (EA)
- [ ] United Kingdom Accreditation Service (UKAS)
- [ ] Other

22 Please provide link to Schedule of accreditation

Please copy and paste link to SoA here, alternatively upload the file.

Enter response/ reference information

Paste link/ Coller le lien/ Colar link

23 Please upload the schedule of accreditation here.
Supported file types JPG, PNG, GIF, PDF up to 16 MB

Try dropping some files here,
or **click here** to select files to upload.

24 Does the laboratory have any other accreditations or certifications?
If yes, please indicate which standards

ISO/IEC 17043; ISO 17034; ISO 9001:

Enter response/ reference information

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Laboratory Operation

25 Analytical techniques/ instruments used to provide services.
Please indicate the number of instruments available. For techniques using consumables (e.g. ELISA), indicate 1.

If the instrument/technique is not listed, please include it in the comment box.

Enter response/ reference i

AAS

Enter response/ reference i

AES

Enter response/ reference i

ICP-HRMS

Enter response/ reference i

ICP-MS

Enter response/ reference i

ICP-MS/MS

Enter response/ reference i

ICP-OES

Enter response/ reference i

Ion chromatography

Enter response/ reference i

Isotope ratio mass spectrometry

Enter response/ reference i

Energy Dispersive X-Ray

Enter response/ reference i

Scanning Electron Microscopy

Enter response/ reference i

Microscopes

Enter response/ reference i

GC-ECD

Enter response/ reference i

GC-FID

Enter response/ reference i

GC-HRMS

Enter response/ reference i

GC-MS

Enter response/ reference i

GC-MS/MS

Enter response/ reference i

GC-NPD

Enter response/ reference i

GC-TCD

Enter response/ reference i

GC-TOFMS

Enter response/ reference i

GCXGC-TOFMS

Enter response/ reference i

LC-FLD

Enter response/ reference i

LC-HRMS

Enter response/ reference i

LC-MS/MS

Enter response/ reference i

LC-UV

Enter response/ reference i

NMR

Enter response/ reference i

Multiplex PCR

Enter response/ reference i

PCR

Enter response/ reference i

Qualitative - Near Infrared Spectroscopy

Enter response/ reference i

Qualititative analysis - PCR

Enter response/ reference i

Quantitative real-time PCR

Enter response/ reference i

Titration

Enter response/ reference i

Karl Fischer Titration

Enter response/ reference i

TLC

Enter response/ reference i

Extraction chromatography and liquid scintillation counting

Enter response/ reference i

Extraction chromatography with alpha spectrometry

Enter response/ reference i

Gamma-ray spectrometry using HPGe detectors

Enter response/ reference i

Gamma-ray spectrometry using NaI detectors

Enter response/ reference i

Kinetic Phosphorescence Analysis

Enter response/ reference i

Liquid scintillation counter for tritium

Enter response/ reference i

Liquid scintillation counting

Enter response/ reference i

Oxford LB instruments

Enter response/ reference i

CHARM

Enter response/ reference i

Lateral Flow tests

Enter response/ reference i

Strip test (Lateral Flow Device or Dipstick)

Enter response/ reference i

ELISA: Enzyme-Linked Immuosorbent Assay

Enter response/ reference i

Microfabricated devices/ microchips/biosensors

Enter response/ reference i

Ashing

Enter response/ reference i

DUMAS

Enter response/ reference i

Kjehldal

Comment

26 Are the instruments dedicated for specific analyses or shared with other testing services (e.g. pesticides and antibiotics etc)

- Yes - dedicated instruments
- No - shared instruments

Comment

27 Please rank technical or supply difficulties experienced in the execution of laboratory duties (1 being least difficult and 5 most difficult) *

	1 (1 pts)	2 (2 pts)	3 (3 pts)	4 (4 pts)	5 (5 pts)
Delays caused by importing chemicals, reagents and equipment, instrument spares/ repairs	○	○	○	○	○
Lack of instrument supplier's maintenance and training support	○	○	○	○	○
Lack of access to relevant PT schemes, reference materials	○	○	○	○	○
Operational expenses are too high	○	○	○	○	○
Training and retaining of analysts	○	○	○	○	○
Technology and digitalisation limitations	○	○	○	○	○
OTHER (please describe in comment box)	○	○	○	○	○

Comment

28 PT schemes

	Biannually	Anually	Other
BIPEA	○	○	○
BVL Germany	○	○	○
DRRR	○	○	○
FAPAS	○	○	○
IAEA	○	○	○
NLA	○	○	○
NMISA	○	○	○
PROGETTO	○	○	○
Other	○	○	○

29 If Other was selected, please specify which PT providers are used and test frequency.

Enter response/ reference information

30 CRMs/ QCs

	Calibrator	Matrix materials
ATCC (microbiological)	☐	☐
BAM	☐	☐
BIPEA	☐	☐
BVL Germany	☐	☐
Dr Erhenstofer	☐	☐
ERM (European Reference Materials)	☐	☐
FAPAS	☐	☐
LGC	☐	☐
LNE France	☐	☐
Merck/ Sigma Aldrich	☐	☐
NIST SRMs	☐	☐
NMIA	☐	☐
NMISA	☐	☐
NRC Canada	☐	☐
PROGETTO	☐	☐

	Calibrator	Matrix materials
R-Biopharm	☐	☐
Restek	☐	☐
Romer Biopure	☐	☐
Trilogy	☐	☐
In-house	☐	☐
Other (please indicate in next section)	☐	☐
None	☐	☐

Comment

31 If Other was selected, please specify supplier

Enter response/ reference information

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Food Testing Categories

32 Food Testing categories *

Please indicate which tests are accredited, not accredited or planning to be established. The questions that follow are linked to these responses. Please indicate if the services are not offered.

	ISO/IEC 17025 Accredited	NOT accredited OR planning to offer in future	Not offered/ no plans to offer
Microbiological	○	○	○
Natural Toxins (Incl. Mycotoxins)	○	○	○
Pesticides	○	○	○
Veterinary drug residues	○	○	○
Heavy metals	○	○	○
Food Adulteration & Authenticity	○	○	○
Nutritional content (vitamins, protein, ash, dietary fibre etc.)	○	○	○
Environmental/manufacturing contaminants	○	○	○
Radionuclides	○	○	○
Allergens	○	○	○
GMO testing	○	○	○
Additives/ preservatives	○	○	○
Sampling	○	○	○

	ISO/IEC 17025 Accredited	NOT accredited OR planning to offer in future	Not offered/ no plans to offer
Other (please indicate in comment section)	○	○	○

Comment

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Microbiological - Intro

33 Does your lab test for Microbiological content *

- Yes
- No

34 Is your laboratory planning to establish this capability in

- 0 - 2 years
- 3 - 5 years
- 6 - 10 years
- No plans to establish this capability

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Microbiological - Services offered

35 Food spoilage microorganisms:

Does your laboratory perform the following tests? Please indicate methods used for detection or enumeration, or both.

	Detection	Enumeration	Method
Alicyclobacillus species	Select answer...	Select answer...	Select answer...
Thermophilic Flat Sourer Spore formers and Aciduric Flat Sour Spoilers	Select answer...	Select answer...	Select answer...
Total Bacteria Count/ Total Viable Count/Standard Plate Count	Select answer...	Select answer...	Select answer...
Total Microbial activity (TMA)	Select answer...	Select answer...	Select answer...
Yeast and Mould (Y&M) Counts	Select answer...	Select answer...	Select answer...

Comment

36 Please specify technique and method used if "Other" option was selected

Enter response/ reference information

37 Food Poisoning Bacteria:

Does your laboratory perform the following tests? Please indicate methods used for detection or enumeration, or both.

	Detection	Enumeration	Method
Bacillus cereus	Select answer...	Select answer...	Select answer...
Campylobacter spp.	Select answer...	Select answer...	Select answer...
Clostridium botulinum toxin	Select answer...	Select answer...	Select answer...
Clostridium perfringens enterotoxin	Select answer...	Select answer...	Select answer...
Cronobacter species (Enterobacter sakazakii)	Select answer...	Select answer...	Select answer...
Enterobacteriaceae	Select answer...	Select answer...	Select answer...
Enterohemorrhagic ETEC labile toxin	Select answer...	Select answer...	Select answer...
Enterohemorrhagic ETEC stabile toxin	Select answer...	Select answer...	Select answer...
Enterotoxin	Select answer...	Select answer...	Select answer...
Enumeration of Glucuronidase positive Escherichia coli	Select answer...	Select answer...	Select answer...
Enumeration of Intestinal Enterococci (Faecal Streptococci)	Select answer...	Select answer...	Select answer...
Enumeration of Pseudomonas species water	Select answer...	Select answer...	Select answer...

	Detection	Enumeration	Method
Escherichia coli	Select answer...	Select answer...	Select answer...
Faecal (Thermotolerant) Coliforms	Select answer...	Select answer...	Select answer...
Listeria	Select answer...	Select answer...	Select answer...
Pseudomonas aeruginosa	Select answer...	Select answer...	Select answer...
Salmonella spp.	Select answer...	Select answer...	Select answer...
Shiga toxin	Select answer...	Select answer...	Select answer...
Shigella	Select answer...	Select answer...	Select answer...
Staphylococcus aureus	Select answer...	Select answer...	Select answer...
Sulfite reducing bacteria growing under anaerobic conditions (Incl. Clostridia)	Select answer...	Select answer...	Select answer...
V. cholera and V. parahaemolyticus	Select answer...	Select answer...	Select answer...
Vibrio spp.	Select answer...	Select answer...	Select answer...
Yersinia enterocolitica	Select answer...	Select answer...	Select answer...

38 Please specify technique and method used if "Other" option was selected

Enter response/ reference information

39 Other:

Does your laboratory perform the following tests? Please indicate methods used for detection or enumeration, or both.

	Detection	Enumeration	Method
Somatic Cell counts	Select answer...	Select answer...	Select answer...
Lactobacillus spp.	Select answer...	Select answer...	Select answer...
Commercial Sterility	Select answer...	Select answer...	Select answer...
Antimicrobial - Preservative Efficacy testing	Select answer...	Select answer...	Select answer...
Disinfectant Efficacy testing of QAC based disinfectants / sanitizers	Select answer...	Select answer...	Select answer...
Lactic acid Bacteria	Select answer...	Select answer...	Select answer...
Legionella	Select answer...	Select answer...	Select answer...

40 Number of samples analysed per month *

- 1 - 10
- 11 - 50
- 51 - 100
- 100 - 200
- 201 - 300
- 301 - 500
- 501 - 1000
- more than 1000

41 Automated sample preparation

- Yes
- No

42 Sample types (matrix) *

- [ ] Cereals/ Grains (Maize, wheat, rice, oats, barley, rye, millet, sorghum)
- [ ] Cassava and cassava products
- [ ] Nuts, nut products and seeds
- [ ] Fruits and vegetables
- [ ] Processed fruits and vegetables
- [ ] Milk and milk products (cheese, cream, yoghurt)
- [ ] Meat and meat products
- [ ] Poultry meat and poultry meat products
- [ ] Eggs and egg products
- [ ] Fish and Fish products
- [ ] Seafood (Crustaceans, Cephalopods, Molluscs)
- [ ] Infant foods
- [ ] Alcoholic beverages (wine, beer, spirits)
- [ ] Non-alcoholic beverages
- [ ] Water (for human consumption, mineral water)
- [ ] Cocoa and cocoa preparations, coffee and tea
- [ ] Fats and oils
- [ ] Honey and royal jelly
- [ ] Herbs and spices
- [ ] Food additives, stocks, soups and flavourings
- [ ] Fortified, dietetic foods and food supplements

- ☐ Animal Feed and Pet food
- ☐ Animal Feed pre-mixtures, compound feeds, additives
- ☐ Food contact materials
- ☐ Agricultural input testing (elements in soil, fertilizer, growing media and compost)
- ☐ OTHER

43 Analysis for clients *

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1 (**1 pts**)	2 (**2 pts**)	3 (**3 pts**)	4 (**4 pts**)	5 (**5 pts**)
Private clients	☐	☐	☐	☐	☐
Inspection	☐	☐	☐	☐	☐
Monitoring	☐	☐	☐	☐	☐
Exports	☐	☐	☐	☐	☐
Imports	☐	☐	☐	☐	☐
Internal testing	☐	☐	☐	☐	☐

44 The importance of the need (ability) to perform these analyses in your country *

Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority

○ 1 (least priority) (**1 pts**) ○ 2 (**2 pts**) ○ 3 (**3 pts**) ○ 4 (**4 pts**) ○ 5 (**5 pts**)

○ 6 (**6 pts**) ○ 7 (**7 pts**) ○ 8 (**8 pts**) ○ 9 (**7 pts**) ○ 10 (highest priority) (**10 pts**)

45 The degree to which the measurement capability for this analysis is established in your institute *

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established

- 1 (not yet established) (**1 pts**)
- 2 (**2 pts**)
- 3 (**3 pts**)
- 4 (**4 pts**)
- 5 (**5 pts**)
- 6 (**6 pts**)
- 7 (**7 pts**)
- 8 (**8 pts**)
- 9 (**9 pts**)
- 10 (well established) (**10 pts**)

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Natural toxins - Introduction

46 Does your lab test for Natural toxins (Mycotoxins, Phycotoxins, Algal toxins)? *

- Yes
- No

47 Is your laboratory planning to establish this capability in

- ◯ 0 - 2 years
- ◯ 3 - 5 years
- ◯ 6 - 10 years
- ◯ No plans to establish this capability

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Natural Toxins - Services offered

48 Select which toxins your laboratory is able to test for: *

Mycotoxins

- [ ] Aflatoxin B1
- [ ] Aflatoxin B2
- [ ] Aflatoxin G1
- [ ] Aflatoxin G2
- [ ] Total Aflatoxin
- [ ] Aflatoxin M1
- [ ] Ergot sclerotia
- [ ] Patulin
- [ ] Ochratoxin-A
- [ ] Deoxynivalenol
- [ ] Nivalenol
- [ ] Zearalenone
- [ ] T2-toxin
- [ ] HT2 toxin
- [ ] Fumonisin B1
- [ ] Fumonisin B2
- [ ] Fumonisin B3
- [ ] Total Fumonsin
- [ ] Ctirinin
- [ ] Other
- [ ] None

49 Algal Toxins *

Select the toxins your laboratory is able to test for:

- ☐ Ciguatoxins (gempylotoxin, tetrodotoxin, tetramine)
- ☐ Shellfish Toxins (Paralytic shellfish poisoning, Neurotoxic shellfish poisoning, Diarrhetic shellfish poisoning, Amnesic Shellfish Poisoning)
- ☐ Histamine (Scombrotoxin)
- ☐ Other
- ☐ None

50 Phytotoxins *

Select which toxins your laboratory is able to test for:

- ☐ Cyanogenic glycosides, Lectins, Furocoumarins, Pyrrolizidine alkaloids, Tropane alkaloids, Solanines and chaconine
- ☐ Other
- ☐ None

51 Other toxins *

- ☐ Toxin hypoglycin A.
- ☐ Other
- ☐ None

52 Analytical methods

- [ ] AOAC method
- [ ] ISO\CEN\DIN standard methods
- [ ] In-house method
- [ ] Literature
- [ ] Manufacturer's application note/ Test kit instruction
- [ ] Other

Comment

53 Number of samples analysed per month *

- ( ) 1 - 10
- ( ) 11 - 50
- ( ) 51 - 100
- ( ) 101 - 200
- ( ) 201 - 300
- ( ) 301 - 500
- ( ) 501-1000
- ( ) greater than 1000

54 Automated sample preparation

- ◯ Yes
- ◯ No

55 Select the applicable food categories tested in your laboratory (for mycotoxins) *

- [ ] Cereals/ Grains (Maize, wheat, rice, oats, barley, rye, millet, sorghum)
- [ ] Cassava and cassava products
- [ ] Nuts, nut products and seeds
- [ ] Fruits and vegetables
- [ ] Processed fruits and vegetables
- [ ] Milk and milk products (cheese, cream, yoghurt)
- [ ] Meat and meat products
- [ ] Poultry meat and poultry meat products
- [ ] Eggs and egg products
- [ ] Fish and Fish products
- [ ] Seafood (Crustaceans, Cephalopods, Molluscs)
- [ ] Infant foods
- [ ] Alcoholic beverages (wine, beer, spirits)
- [ ] Non-alcoholic beverages
- [ ] Water (for human consumption, mineral water)
- [ ] Cocoa and cocoa preparations, coffee and tea
- [ ] Fats and oils
- [ ] Honey and royal jelly
- [ ] Herbs and spices
- [ ] Food additives, stocks, soups and flavourings
- [ ] Fortified, dietetic foods and food supplements

- [ ] Animal Feed and Pet food
- [ ] Animal Feed pre-mixtures, compound feeds, additives
- [ ] Food contact materials
- [ ] Agricultural input testing (elements in soil, fertilizer, growing media and compost)
- [ ] OTHER

56 Analysis for clients *

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1 (**1 pts**)	2 (**2 pts**)	3 (**3 pts**)	4 (**4 pts**)	5 (**5 pts**)
Private clients	☐	☐	☐	☐	☐
Inspection	☐	☐	☐	☐	☐
Monitoring	☐	☐	☐	☐	☐
Exports	☐	☐	☐	☐	☐
Imports	☐	☐	☐	☐	☐
Internal testing	☐	☐	☐	☐	☐

57 The importance of the need (ability) to perform these analyses in your country *

Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority

- 1 (least priority) (**1 pts**)
- 2 (**2 pts**)
- 3 (**3 pts**)
- 4 (**4 pts**)
- 5 (**5 pts**)
- 6 (**6 pts**)
- 7 (**7 pts**)
- 8 (**8 pts**)
- 9 (**6 pts**)
- 10 (highest priority) (**10 pts**)

58 The degree to which the measurement capability for this analysis is established in your institute *

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established

- 1 (not established) (**1 pts**)
- 2 (**2 pts**)
- 3 (**3 pts**)
- 4 (**4 pts**)
- 5 (**5 pts**)
- 6 (**6 pts**)
- 7 (**7 pts**)
- 8 (**8 pts**)
- 9 (**9 pts**)
- 10 (well established) (**10 pts**)

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Pesticides - Introduction

59 Does your lab test for Pesticides *

- Yes
- No

60 Is your laboratory planning to establish this capability in

- 0 - 2 years
- 3 - 5 years
- 6 - 10 years
- No plans to establish this capability

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Pesticide analysis services offered

61 Select which pesticide categories your laboratory is able to test for *

- ☐ Organochlorine pesticides and their metabolites
- ☐ Organophosphate pesticides and their metabolites
- ☐ Urea pesticides
- ☐ Dinitroaniline pesticides
- ☐ Carbamates
- ☐ Pyrethroids
- ☐ Glyphosate-based pesticides and metabolite AMPA
- ☐ Triazine Pesticides and their metabolites
- ☐ Chloracetanilide pesticides and their metabolites
- ☐ Phenoxyalkanoic acids
- ☐ Quaternary ammonium salts
- ☐ Neonicotinoids
- ☐ OTHER

62 Analytical methods

- [ ] AOAC method
- [ ] ISO\CEN standard methods
- [ ] Sample preparation
- [ ] In-house method
- [ ] Literature
- [ ] Manufacturer's application note/ Test kit instruction
- [ ] Other

Comment

63 Number of samples analysed *

- ( ) 1 - 10
- ( ) 11 - 50
- ( ) 51 - 100
- ( ) 100 - 200
- ( ) 201 - 300
- ( ) 301 - 500
- ( ) 501 - 1000
- ( ) Greater than 1000

64 Automated sample preparation

- Yes
- No

65 Please select sample types for pesticide analysis *

- [ ] Cereals/ Grains (Maize, wheat, rice, oats, barley, rye, millet, sorghum)
- [ ] Cassava and cassava products
- [ ] Nuts, nut products and seeds
- [ ] Fruits and vegetables
- [ ] Processed fruits and vegetables
- [ ] Milk and milk products (cheese, cream, yoghurt)
- [ ] Meat and meat products
- [ ] Poultry meat and poultry meat products
- [ ] Eggs and egg products
- [ ] Fish and Fish products
- [ ] Seafood (Crustaceans, Cephalopods, Molluscs)
- [ ] Infant foods
- [ ] Alcoholic beverages (wine, beer, spirits)
- [ ] Non-alcoholic beverages
- [ ] Water (for human consumption, mineral water)
- [ ] Cocoa and cocoa preparations, coffee and tea
- [ ] Fats and oils
- [ ] Honey and royal jelly
- [ ] Herbs and spices
- [ ] Food additives, stocks, soups and flavourings
- [ ] Fortified, dietetic foods and food supplements

- ☐ Animal Feed and Pet food
- ☐ Animal Feed pre-mixtures, compound feeds, additives
- ☐ Food contact materials
- ☐ Agricultural input testing (elements in soil, fertilizer, growing media and compost)
- ☐ OTHER

66 Analysis for clients *

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1 (**1 pts**)	2 (**2 pts**)	3 (**3 pts**)	4 (**4 pts**)	5 (**5 pts**)
Private clients	☐	☐	☐	☐	☐
Inspection	☐	☐	☐	☐	☐
Monitoring	☐	☐	☐	☐	☐
Exports	☐	☐	☐	☐	☐
Imports	☐	☐	☐	☐	☐
Internal testing	☐	☐	☐	☐	☐

67 The importance of the need (ability) to perform these analyses in your country *

Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority

◯ 1 (least priority) (**1 pts**) ◯ 2 (**2 pts**) ◯ 3 (**3 pts**) ◯ 4 (**4 pts**) ◯ 5 (**5 pts**)

◯ 6 (**6 pts**) ◯ 7 (**7 pts**) ◯ 8 (**8 pts**) ◯ 9 (**7 pts**) ◯ 10 (highest priority) (**10 pts**)

68 The degree to which the measurement capability for this analysis is established in your institute *

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established

- 1 (not yet established) (**1 pts**)
- 2 (**2 pts**)
- 3 (**3 pts**)
- 4 (**4 pts**)
- 5 (**5 pts**)
- 6 (**6 pts**)
- 7 (**7 pts**)
- 8 (**8 pts**)
- 9 (**9 pts**)
- 10 (well established) (**10 pts**)

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Veterinary drug residues - Introduction

69 Does your lab test for Veterinary drug residues and metabolites *

Résidus et métabolites de médicaments vétérinaires

- Yes
- No

70 Is your laboratory planning to establish this capability in

- 0 - 2 years
- 3 - 5 years
- 6 - 10 years
- No plans to establish this capability

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Veterinary drug residue analysis services offered

71 Please indicate which class of veterinary drugs your laboratory is able to test for *

- [ ] Adrenoceptor agonist (e.g. Clenbuterol)
- [ ] Anthelmintic agent (e.g. Ivermectin, Thiabendazole)
- [ ] Antibacterial, antifungal and anthelminthic agent (e.g. Gentian Violet)
- [ ] Antibacterial agent (e.g. Olaquindox)
- [ ] Antifungal and antiprotozoal agent (e.g. Malachite Green)
- [ ] Antimicrobial agent (e.g. Amoxicillin, Tetracyclines)
- [ ] Antiparasitic agent (e.g. Emamectin Benzoate)
- [ ] Antiprotozoal agent (e.g. Metronidazole)
- [ ] Beta-adrenoreceptor blocking agent (e.g. Carazol)
- [ ] Glucocorticosteroid (e.g. Dexamethasone)
- [ ] Growth promoter (e.g. Stilbenes, Zeranol)
- [ ] Insecticide (e.g. Cypermethrin)
- [ ] Production aid (e.g.e.g., Abamectin, Testosterone)
- [ ] Tranquilizing agent (e.g., Azaperone)
- [ ] Trypanocide (e.g. e.g., diminazine)
- [ ] Other

Comment

72 Please indicate which antimicrobials/antibiotics your lthe laboratory is able to test. *

- [ ] Aminoglycosides (Gentamicin)
- [ ] Carbapenems (Meropenem)
- [ ] Fluoroquinolones
- [ ] Glycopeptides and lipoglycopeptides (Vancomycin)
- [ ] Macrolides (Azithromycin)
- [ ] Monobactams (Aztreonam)
- [ ] Oxazolidines (Linezolid)
- [ ] Penicillin’s (Piperacillin)
- [ ] Polypeptides
- [ ] Sulfonamides (Sulfamethoxazole)
- [ ] Streptogramins (Quinupristin)
- [ ] Tetracyclines (Chlortetracycline)
- [ ] Quinolones (Ciprofloxacin)
- [ ] Amphenicols (Chloramphenicol)
- [ ] Cephalosporins (cefepime)
- [ ] Glycylcyclines (Tigecycline)
- [ ] Ansamycins (Streptovaricins)
- [ ] Phosphonic acid derivatives (Fosfomycin)
- [ ] Polymyxins (Colistin)
- [ ] Lincosamides (Clindamycin)
- [ ] Pseudomonic acids (Mupirocin)

- [ ] Riminofenazines (Clofazimine)
- [ ] Steroid antibacterial (Fusidic acid)
- [ ] Sulfones (Dapsone)
- [ ] Aminocyclitols (Spectinomycin)
- [ ] Cyclic peptides (Bacitracin)
- [ ] Nitrofuran derivatives (Nitrofurantoin)
- [ ] Nitroimidazoles (Metronidazole)
- [ ] Pleuromutilin’s (Retapamulin)
- [ ] Other

Comment

73 Analytical methods

- [ ] AOAC method
- [ ] ISO\CEN standard methods
- [ ] In-house method
- [ ] Literature
- [ ] Manufacturer's application note/ Test kit instruction
- [ ] Other

Comment

74 Number of samples analysed per month *

- 1 - 10
- 11 - 50
- 51 - 100
- 100 - 200
- 201 - 300
- 300 - 500
- 500 - 1000
- Greater than 1000

75 Automated sample preparation

- Yes
- No

76 Sample matrix *

Please indicate which samples are extracted for drug residues

- [ ] Cattle
- [ ] Chicken
- [ ] Deer
- [ ] Duck
- [ ] Finfish
- [ ] Fish
- [ ] Giant prawn (Paeneus monodon)
- [ ] Goat
- [ ] Horse
- [ ] Exotic meat (e.g. ostrich)
- [ ] Pig
- [ ] Poultry
- [ ] Quail
- [ ] Rabbit
- [ ] Salmon
- [ ] Sheep
- [ ] Trout
- [ ] Turkey
- [ ] Other

77 Analysis for clients *

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1 (**1 pts**)	2 (**2 pts**)	3 (**3 pts**)	4 (**4 pts**)	5 (**5 pts**)
Private clients	☐	☐	☐	☐	☐
Inspection	☐	☐	☐	☐	☐
Monitoring	☐	☐	☐	☐	☐
Exports	☐	☐	☐	☐	☐
Imports	☐	☐	☐	☐	☐
Internal testing	☐	☐	☐	☐	☐

78 The importance of the need (ability) to perform these analyses in your country *

Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority

○ 1 (least priority) (**1 pts**) ○ 2 (**2 pts**) ○ 3 (**3 pts**) ○ 4 (**4 pts**) ○ 5 (**5 pts**)

○ 6 (**6 pts**) ○ 7 (**7 pts**) ○ 8 (**8 pts**) ○ 9 (**7 pts**) ○ 10 (highest priority) (**10 pts**)

79 The degree to which the measurement capability for this analysis is established in your institute *

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established

- 1 (not yet established) (**1 pts**)
- 2 (**2 pts**)
- 3 (**3 pts**)
- 4 (**4 pts**)
- 5 (**5 pts**)
- 6 (**6 pts**)
- 7 (**7 pts**)
- 8 (**8 pts**)
- 9 (**9 pts**)
- 10 (well established) (**10 pts**)

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Heavy metals - introduction

80 Does your lab test for heavy metals (toxic elements)? *

Métaux lourds et éléments toxiques

- ○ Yes
- ○ No

81 Is your laboratory planning to establish this capability in:

- ○ 0 - 2 years
- ○ 3 - 5 years
- ○ 6 - 10 years
- ○ No plans to establish this capability

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Heavy metals analysis services offered

82 Select which heavy metals/toxic elements your lab is able to test for: *

- [ ] Heavy metals (Arsenic, Chromium, Cadmium, Lead, Mercury, Methylmercury, Tin)
- [ ] Toxic trace elements
- [ ] Speciation analysis
- [ ] Other

Comment

83 Analytical methods

- [ ] AOAC method
- [ ] ISO\CEN standard methods
- [ ] In-house method
- [ ] Literature
- [ ] Manufacturer's application note/ Test kit instruction
- [ ] Other

Comment

84 Number of samples analysed per month *

- 1 - 10
- 11 - 50
- 51 - 100
- 100 - 200
- 201 - 300
- 301 - 500
- 501 - 1000
- Greater than 1000

85 Automated sample preparation

- Yes
- No

86 Select applicable food categories for heavy metal analysis by your laboratory *

- ☐ Cereals/ Grains (Maize, wheat, rice, oats, barley, rye, millet, sorghum)
- ☐ Cassava and cassava products
- ☐ Nuts, nut products and seeds
- ☐ Fruits and vegetables
- ☐ Processed fruits and vegetables
- ☐ Milk and milk products (cheese, cream, yoghurt)
- ☐ Meat and meat products
- ☐ Poultry meat and poultry meat products
- ☐ Eggs and egg products
- ☐ Fish and Fish products
- ☐ Seafood (Crustaceans, Cephalopods, Molluscs)
- ☐ Infant foods
- ☐ Alcoholic beverages (wine, beer, spirits)
- ☐ Non-alcoholic beverages
- ☐ Water (for human consumption, mineral water)
- ☐ Cocoa and cocoa preparations, coffee and tea
- ☐ Fats and oils
- ☐ Honey and royal jelly
- ☐ Herbs and spices
- ☐ Food additives, stocks, soups and flavourings
- ☐ Fortified, dietetic foods and food supplements

- ☐ Animal Feed and Pet food
- ☐ Animal Feed pre-mixtures, compound feeds, additives
- ☐ Food contact materials
- ☐ Agricultural input testing (elements in soil, fertilizer, growing media and compost)
- ☐ OTHER

87 Analysis for clients *

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1 (**1 pts**)	2 (**2 pts**)	3 (**3 pts**)	4 (**4 pts**)	5 (**5 pts**)
Private clients	☐	☐	☐	☐	☐
Inspection	☐	☐	☐	☐	☐
Monitoring	☐	☐	☐	☐	☐
Exports	☐	☐	☐	☐	☐
Imports	☐	☐	☐	☐	☐
Internal testing	☐	☐	☐	☐	☐

88 The importance of the need (ability) to perform these analyses in your country *

Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority

○ 1 (least priority) (**1 pts**) ○ 2 (**2 pts**) ○ 3 (**3 pts**) ○ 4 (**4 pts**) ○ 5 (**5 pts**)

○ 6 (**6 pts**) ○ 7 (**7 pts**) ○ 8 (**8 pts**) ○ 9 (**7 pts**) ○ 10 (highest priority) (**10 pts**)

89 The degree to which the measurement capability for this analysis is established in your institute *

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established

- 1 (not yet established) (**1 pts**)
- 2 (**2 pts**)
- 3 (**3 pts**)
- 4 (**4 pts**)
- 5 (**5 pts**)
- 6 (**6 pts**)
- 7 (**7 pts**)
- 8 (**8 pts**)
- 9 (**9 pts**)
- 10 (well established) (**10 pts**)

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Allergens introduction

90 Does your laboratory test for Allergens? *

- Yes
- No

91 Is your laboratory planning to establish this capability in:

- 0 - 2 years
- 3 - 5 years
- 6 - 10 years
- No plans to establish this capability

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Allergens - testing services offered

92 Indicate which Allergens your laboratory is able to test for: *

- [ ] Ground nuts (peanuts):
- [ ] Tree nuts:
- [ ] Almond
- [ ] Brazil nut
- [ ] Cashew nut
- [ ] Hazelnut
- [ ] Pecan nut
- [ ] Pistachio nut
- [ ] Walnut
- [ ] Cow Milk:
- [ ] Casein
- [ ] Whey
- [ ] Wheat:
- [ ] Gluten (from wheat, barley, rye)
- [ ] Egg
- [ ] Soya
- [ ] Fish
- [ ] Crustacean
- [ ] Mollusc
- [ ] Seeds:
- [ ] Mustard

- [ ] Sesame seed
- [ ] Celery
- [ ] Other

Comment

93 Analytical methods

- [ ] AOAC method
- [ ] ISO\CEN standard methods
- [ ] In-house method
- [ ] Literature
- [ ] Manufacturer's application note/ Test kit instruction
- [ ] Other

Comment

94 Number of samples analysed per month *

- 1 - 10
- 11 - 50
- 51 - 100
- 100 - 200
- 201 - 300
- 301 - 500
- 501 - 1000
- Greater than 1000

95 Automated sample preparation

- Yes
- No

96 Analysis for clients *

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1 (**1 pts**)	2 (**2 pts**)	3 (**3 pts**)	4 (**4 pts**)	5 (**5 pts**)
Private clients	☐	☐	☐	☐	☐
Inspection	☐	☐	☐	☐	☐
Monitoring	☐	☐	☐	☐	☐
Exports	☐	☐	☐	☐	☐
Imports	☐	☐	☐	☐	☐
Internal testing	☐	☐	☐	☐	☐

97 The importance of the need (ability) to perform these analyses in your country *

Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority

○ 1 (least priority) (**1 pts**) ○ 2 (**2 pts**) ○ 3 (**3 pts**) ○ 4 (**4 pts**) ○ 5 (**5 pts**)

○ 6 (**6 pts**) ○ 7 (**7 pts**) ○ 8 (**8 pts**) ○ 9 (**7 pts**) ○ 10 (highest priority) (**10 pts**)

98 The degree to which the measurement capability for this analysis is established in your institute *

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established

- 1 (not yet established) (**1 pts**)
- 2 (**2 pts**)
- 3 (**3 pts**)
- 4 (**4 pts**)
- 5 (**5 pts**)
- 6 (**6 pts**)
- 7 (**7 pts**)
- 8 (**8 pts**)
- 9 (**9 pts**)
- 10 (well established) (**10 pts**)

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Environmental/ manufacturing contaminants - introduction

99 Does your laboratory analyse for environmental/ manufacturing/ processing contaminants *

- Yes
- No

100 Is your laboratory planning to establish this capability in

- 0 - 2 years
- 3 - 5 years
- 6 - 10 years
- No plans to establish this capability

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Environmental/ manufacturing contaminant analysis services

101 Indicate which contaminants your laboratory is able to test for: *

- [ ] Chloropropanols
- [ ] Vinylchlroide monomers
- [ ] PAHs
- [ ] PCBs
- [ ] Furans
- [ ] Dioxins
- [ ] Dioxin-like substances
- [ ] Perfluorinated substances (PFAS, PFOS)
- [ ] Other Halogenated flame retardants
- [ ] Mineral Organic Saturated Hydrocarbons and Aromatic Hydrocarbons (MOSH-MOAH)
- [ ] Acrylamide
- [ ] Melamine
- [ ] Bisphenol - A, alkylphenols
- [ ] Organotin compounds
- [ ] Organometallic compounds (e.g. organomercury)
- [ ] OTHER

Comment

102 Analytical methods

- ☐ AOAC method
- ☐ ISO\CEN\DIN standard methods
- ☐ In-house method
- ☐ Literature
- ☐ Manufacturer's application note/ Test kit instruction
- ☐ Other

Comment

103 Number of samples analysed per montth *

- ○ 1 - 10
- ○ 11 - 50
- ○ 51 - 100
- ○ 100 - 200
- ○ 201 - 300
- ○ 301 - 500
- ○ 501 - 1000
- ○ Greater than 1000

104 Automated sample preparation

- Yes
- No

105 Select food categories applicable to the samples analysed in your laboratory *

- [ ] Cereals/ Grains (Maize, wheat, rice, oats, barley, rye, millet, sorghum)
- [ ] Cassava and cassava products
- [ ] Nuts, nut products and seeds
- [ ] Fruits and vegetables
- [ ] Processed fruits and vegetables
- [ ] Milk and milk products (cheese, cream, yoghurt)
- [ ] Meat and meat products
- [ ] Poultry meat and poultry meat products
- [ ] Eggs and egg products
- [ ] Fish and Fish products
- [ ] Seafood (Crustaceans, Cephalopods, Molluscs)
- [ ] Infant foods
- [ ] Alcoholic beverages (wine, beer, spirits)
- [ ] Non-alcoholic beverages
- [ ] Water (for human consumption, mineral water)
- [ ] Cocoa and cocoa preparations, coffee and tea
- [ ] Fats and oils
- [ ] Honey and royal jelly
- [ ] Herbs and spices
- [ ] Food additives, stocks, soups and flavourings
- [ ] Fortified, dietetic foods and food supplements

- [ ] Animal Feed and Pet food
- [ ] Animal Feed pre-mixtures, compound feeds, additives
- [ ] Food contact materials
- [ ] Agricultural input testing (elements in soil, fertilizer, growing media and compost)
- [ ] OTHER

106 Analysis for clients *

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1 (**1 pts**)	2 (**2 pts**)	3 (**3 pts**)	4 (**4 pts**)	5 (**5 pts**)
Private clients	☐	☐	☐	☐	☐
Inspection	☐	☐	☐	☐	☐
Monitoring	☐	☐	☐	☐	☐
Exports	☐	☐	☐	☐	☐
Imports	☐	☐	☐	☐	☐
Internal testing	☐	☐	☐	☐	☐

107 The importance of the need (ability) to perform these analyses in your country *

Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority

- ○ 1 (least priority) (**1 pts**)
- ○ 2 (**2 pts**)
- ○ 3 (**3 pts**)
- ○ 4 (**4 pts**)
- ○ 5 (**5 pts**)
- ○ 6 (**6 pts**)
- ○ 7 (**7 pts**)
- ○ 8 (**8 pts**)
- ○ 9 (**7 pts**)
- ○ 10 (highest priority) (**10 pts**)

108 The degree to which the measurement capability for this analysis is established in your institute *

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established

- ○ 1 (not yet established) (**1 pts**)
- ○ 2 (**2 pts**)
- ○ 3 (**3 pts**)
- ○ 4 (**4 pts**)
- ○ 5 (**5 pts**)
- ○ 6 (**6 pts**)
- ○ 7 (**7 pts**)
- ○ 8 (**8 pts**)
- ○ 9 (**9 pts**)
- ○ 10 (well established) (**10 pts**)

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Radionuclides introduction

109 Does your laboratory test for Radionuclides in food? *

- Yes
- No

110 Does your laboratory plan to establish this capability in

- 0 - 2 years
- 3 - 5 years
- 6 - 10 years
- No plans to establish this capability

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Radionuclide analysis services offered

111 Please indicate which radionuclides your laboratory is able to test for: *

Veuillez indiquer quelles

- [ ] 238Pu
- [ ] 239Pu
- [ ] 240Pu
- [ ] 241Am
- [ ] 90Sr
- [ ] 106Ru
- [ ] 129I
- [ ] 131I
- [ ] 235U
- [ ] 35S*
- [ ] 60Co
- [ ] 89Sr
- [ ] 103Ru
- [ ] 134Cs
- [ ] 137Cs
- [ ] 144Ce
- [ ] 192Ir
- [ ] 3H**
- [ ] 14C
- [ ] 99Tc
- [ ] Other

Comment

112 Analytical methods

- [ ] IAEA method
- [ ] ISO\CEN standard methods
- [ ] EPA
- [ ] In-house method
- [ ] Literature
- [ ] Manufacturer's application note/ Test kit instruction
- [ ] Other method

Comment

113 Number of samples analysed per month *

- 1 - 10
- 11 - 50
- 51 - 100
- 100 - 200
- 201 - 300
- 301 - 500
- 501 - 1000
- Greater than 1000

114 Automated sample preparation

- Yes
- No

115 Select the applicable food categories analysed in your laboratory *

- [ ] Cereals/ Grains (Maize, wheat, rice, oats, barley, rye, millet, sorghum)
- [ ] Cassava and cassava products
- [ ] Nuts, nut products and seeds
- [ ] Fruits and vegetables
- [ ] Processed fruits and vegetables
- [ ] Milk and milk products (cheese, cream, yoghurt)
- [ ] Meat and meat products
- [ ] Poultry meat and poultry meat products
- [ ] Eggs and egg products
- [ ] Fish and Fish products
- [ ] Seafood (Crustaceans, Cephalopods, Molluscs)
- [ ] Infant foods
- [ ] Alcoholic beverages (wine, beer, spirits)
- [ ] Non-alcoholic beverages
- [ ] Water (for human consumption, mineral water)
- [ ] Cocoa and cocoa preparations, coffee and tea
- [ ] Fats and oils
- [ ] Honey and royal jelly
- [ ] Herbs and spices
- [ ] Food additives, stocks, soups and flavourings
- [ ] Fortified, dietetic foods and food supplements

- ☐ Animal Feed and Pet food
- ☐ Animal Feed pre-mixtures, compound feeds, additives
- ☐ Food contact materials
- ☐ Agricultural input testing (elements in soil, fertilizer, growing media and compost)
- ☐ OTHER

116 Analysis for clients *

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1 (**1 pts**)	2 (**2 pts**)	3 (**3 pts**)	4 (**4 pts**)	5 (**5 pts**)
Private clients	☐	☐	☐	☐	☐
Inspection	☐	☐	☐	☐	☐
Monitoring	☐	☐	☐	☐	☐
Exports	☐	☐	☐	☐	☐
Imports	☐	☐	☐	☐	☐
Internal testing	☐	☐	☐	☐	☐

117 The importance of the need (ability) to perform these analyses in your country *

Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority

○ 1 (least priority) (**1 pts**) ○ 2 (**2 pts**) ○ 3 (**3 pts**) ○ 4 (**4 pts**) ○ 5 (**5 pts**)

○ 6 (**6 pts**) ○ 7 (**7 pts**) ○ 8 (**8 pts**) ○ 9 (**7 pts**) ○ 10 (highest priority) (**10 pts**)

118 The degree to which the measurement capability for this analysis is established in your institute *

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established

- 1 (not yet established) (**1 pts**)
- 2 (**2 pts**)
- 3 (**3 pts**)
- 4 (**4 pts**)
- 5 (**5 pts**)
- 6 (**6 pts**)
- 7 (**7 pts**)
- 8 (**8 pts**)
- 9 (**9 pts**)
- 10 (well established) (**10 pts**)

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Adulteration and authenticity testing introduction

119 Does your laboratory test food for adulteration/ authenticity? *

- Yes
- No

120 Does your laboratory plan to establish this capability in

- 0-2 years
- 3-5 years
- 6-10 years
- No plans to establish this capability

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Food adulteration & authenticity analysis services

121 Indicates which adulterants your laboratory is able to test for: *

- [ ] AZO dyes (e.g. sudan red), illegal dyes
- [ ] Melamine
- [ ] DNA profiling (meat origins)
- [ ] Alcohol profile (alcoholic beverages)
- [ ] Sugar profile (beverages, honey)
- [ ] Fatty acid profile (oils)
- [ ] Elemental isotope ratios
- [ ] Unidentified objects
- [ ] Gelatin
- [ ] Capsaicin testing (herbs and spices adulteration)
- [ ] Other

Comment

122 Analytical methods

- [ ] AOAC method
- [ ] ISO\CEN standard methods
- [ ] In-house method
- [ ] Literature
- [ ] Manufacturer's application note/ Test kit instruction
- [ ] Other

Comment

123 Number of samples analysed per month *

- ○ 1 - 10
- ○ 11 - 50
- ○ 51 - 100
- ○ 100 - 200
- ○ 201 - 300
- ○ 301 - 500
- ○ 501 - 1000
- ○ Greater than 1000

124 | Automated sample preparation

- Yes
- No

125 Select food categories based on samples analysed in your laboratory *

- [ ] Cereals/ Grains (Maize, wheat, rice, oats, barley, rye, millet, sorghum)
- [ ] Cassava and cassava products
- [ ] Nuts, nut products and seeds
- [ ] Fruits and vegetables
- [ ] Processed fruits and vegetables
- [ ] Milk and milk products (cheese, cream, yoghurt)
- [ ] Meat and meat products
- [ ] Poultry meat and poultry meat products
- [ ] Eggs and egg products
- [ ] Fish and Fish products
- [ ] Seafood (Crustaceans, Cephalopods, Molluscs)
- [ ] Infant foods
- [ ] Alcoholic beverages (wine, beer, spirits)
- [ ] Non-alcoholic beverages
- [ ] Water (for human consumption, mineral water)
- [ ] Cocoa and cocoa preparations, coffee and tea
- [ ] Fats and oils
- [ ] Honey and royal jelly
- [ ] Herbs and spices
- [ ] Food additives, stocks, soups and flavourings
- [ ] Fortified, dietetic foods and food supplements

- ☐ Animal Feed and Pet food
- ☐ Animal Feed pre-mixtures, compound feeds, additives
- ☐ Food contact materials
- ☐ Agricultural input testing (elements in soil, fertilizer, growing media and compost)
- ☐ OTHER

126 Analysis for clients *

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1 (**1 pts**)	2 (**2 pts**)	3 (**3 pts**)	4 (**4 pts**)	5 (**5 pts**)
Private clients	☐	☐	☐	☐	☐
Inspection	☐	☐	☐	☐	☐
Monitoring	☐	☐	☐	☐	☐
Exports	☐	☐	☐	☐	☐
Imports	☐	☐	☐	☐	☐
Internal testing	☐	☐	☐	☐	☐

127 The importance of the need (ability) to perform these analyses in your country *

Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority

○ 1 (least priority) (**1 pts**) ○ 2 (**2 pts**) ○ 3 (**3 pts**) ○ 4 (**4 pts**) ○ 5 (**5 pts**)

○ 6 (**6 pts**) ○ 7 (**7 pts**) ○ 8 (**8 pts**) ○ 9 (**7 pts**) ○ 10 (highest priority) (**10 pts**)

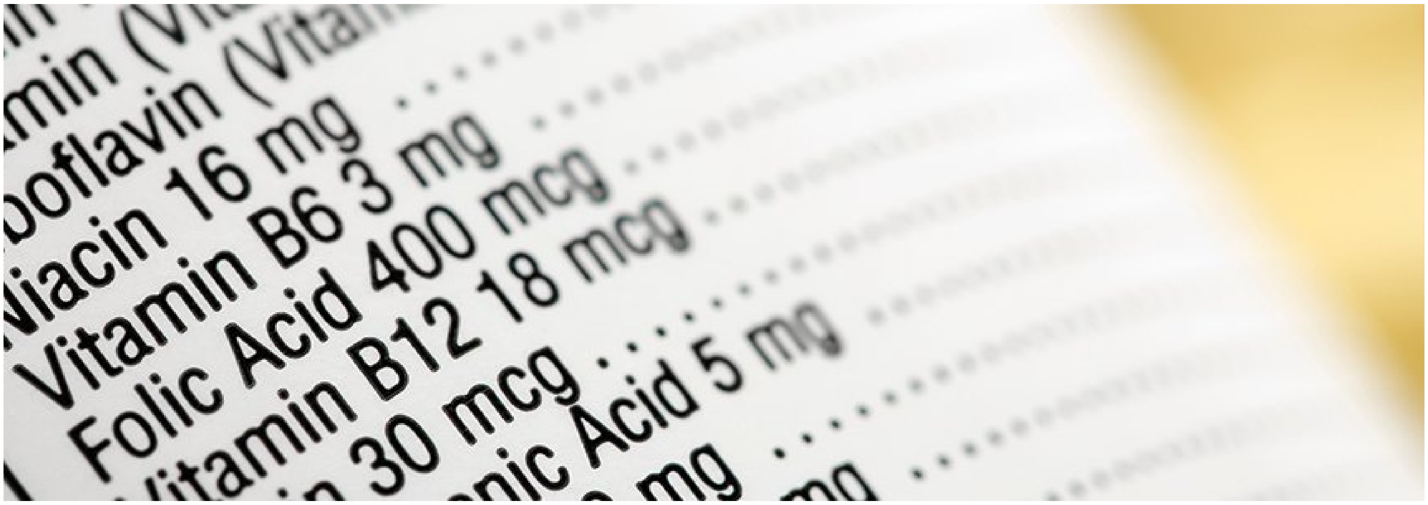
128 The degree to which the measurement capability for this analysis is established in your institute *

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established

- 1 (not yet established) (**1 pts**)
- 2 (**2 pts**)
- 3 (**3 pts**)
- 4 (**4 pts**)
- 5 (**5 pts**)
- 6 (**6 pts**)
- 7 (**7 pts**)
- 8 (**8 pts**)
- 9 (**9 pts**)
- 10 (well established) (**10 pts**)

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Nutritional content introduction



129 Does your labroatory test for nutritional content in food? *

- Yes
- No

130 Does your laboratory plan to establish this capability in

- 0 - 2 years
- 3 - 5 years
- 6 - 10 years
- No plans to establish this capability

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Nutritional content analysis services

131 Please indicate which nutritional parameters your laboratory is able to analyse: *

- [ ] Macronutrients (elements)
- [ ] Micronutrients (elements)
- [ ] Fat-soluble vitamins
- [ ] Water-soluble vitamins
- [ ] Water
- [ ] Fat content
- [ ] Trans Fats, saturated fats, cholesterol
- [ ] Protein content (total nitrogen)
- [ ] Amino acids
- [ ] Carbohydrates/Energy/Sugars
- [ ] Artificial sweeteners
- [ ] Dietary fibre
- [ ] Other

132 Analytical methods

- ☐ AOAC method
- ☐ ISO\CEN standard methods
- ☐ In-house method
- ☐ Literature
- ☐ Manufacturer's application note/ Test kit instruction
- ☐ Other

Comment

133 Number of samples analysed per month *

- ○ 1 - 10
- ○ 11 - 50
- ○ 51 - 100
- ○ 100 - 200
- ○ 201 - 300
- ○ 301 - 500
- ○ 501 - 1000
- ○ Greater than 1000

134 | Automated sample preparation

- Yes
- No

135 Select the relevant food categories based on samples analysed in your laboratory *

- [ ] Cereals/ Grains (Maize, wheat, rice, oats, barley, rye, millet, sorghum)
- [ ] Cassava and cassava products
- [ ] Nuts, nut products and seeds
- [ ] Fruits and vegetables
- [ ] Processed fruits and vegetables
- [ ] Milk and milk products (cheese, cream, yoghurt)
- [ ] Meat and meat products
- [ ] Poultry meat and poultry meat products
- [ ] Eggs and egg products
- [ ] Fish and Fish products
- [ ] Seafood (Crustaceans, Cephalopods, Molluscs)
- [ ] Infant foods
- [ ] Alcoholic beverages (wine, beer, spirits)
- [ ] Non-alcoholic beverages
- [ ] Water (for human consumption, mineral water)
- [ ] Cocoa and cocoa preparations, coffee and tea
- [ ] Fats and oils
- [ ] Honey and royal jelly
- [ ] Herbs and spices
- [ ] Food additives, stocks, soups and flavourings
- [ ] Fortified, dietetic foods and food supplements

- [ ] Animal Feed and Pet food
- [ ] Animal Feed pre-mixtures, compound feeds, additives
- [ ] Food contact materials
- [ ] Agricultural input testing (elements in soil, fertilizer, growing media and compost)
- [ ] OTHER

136 Analysis for clients *

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1 (**1 pts**)	2 (**2 pts**)	3 (**3 pts**)	4 (**4 pts**)	5 (**5 pts**)
Private clients	☐	☐	☐	☐	☐
Inspection	☐	☐	☐	☐	☐
Monitoring	☐	☐	☐	☐	☐
Exports	☐	☐	☐	☐	☐
Imports	☐	☐	☐	☐	☐
Internal testing	☐	☐	☐	☐	☐

137 The importance of the need (ability) to perform these analyses in your country *

Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority

- 1 (least priority) (**1 pts**)
- 2 (**2 pts**)
- 3 (**3 pts**)
- 4 (**4 pts**)
- 5 (**5 pts**)
- 6 (**6 pts**)
- 7 (**7 pts**)
- 8 (**8 pts**)
- 9 (**7 pts**)
- 10 (highest priority) (**10 pts**)

138 The degree to which the measurement capability for this analysis is established in your institute *

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established

- 1 (not yet established) (**1 pts**)
- 2 (**2 pts**)
- 3 (**3 pts**)
- 4 (**4 pts**)
- 5 (**5 pts**)
- 6 (**6 pts**)
- 7 (**7 pts**)
- 8 (**8 pts**)
- 9 (**9 pts**)
- 10 (well established) (**10 pts**)

NMISA-PTB Pan African Food Safety Testing Capacity Survey

GMO introduction

139 Does your laboratory conduct GMO testing? *

- Yes
- No

140 Does your laboratory plan to establish this capability in

- 0 - 2 years
- 3 - 5 years
- 6 - 10 years
- No plans to establish this capability

NMISA-PTB Pan African Food Safety Testing Capacity Survey

GMO analytical services

141 Select applicable food categories based on samples analysed *

- [ ] Cereals/ Grains (Maize, wheat, rice, oats, barley, rye, millet, sorghum)
- [ ] Cassava and cassava products
- [ ] Nuts, nut products and seeds
- [ ] Fruits and vegetables
- [ ] Processed fruits and vegetables
- [ ] Milk and milk products (cheese, cream, yoghurt)
- [ ] Meat and meat products
- [ ] Poultry meat and poultry meat products
- [ ] Eggs and egg products
- [ ] Fish and Fish products
- [ ] Seafood (Crustaceans, Cephalopods, Molluscs)
- [ ] Infant foods
- [ ] Alcoholic beverages (wine, beer, spirits)
- [ ] Non-alcoholic beverages
- [ ] Water (for human consumption, mineral water)
- [ ] Cocoa and cocoa preparations, coffee and tea
- [ ] Fats and oils
- [ ] Honey and royal jelly
- [ ] Herbs and spices
- [ ] Food additives, stocks, soups and flavourings
- [ ] Fortified, dietetic foods and food supplements

- [ ] Animal Feed and Pet food
- [ ] Animal Feed pre-mixtures, compound feeds, additives
- [ ] Food contact materials
- [ ] Agricultural input testing (elements in soil, fertilizer, growing media and compost)
- [ ] OTHER

142 Analytical methods

- [ ] AOAC method
- [ ] ISO\CEN standard methods
- [ ] In-house method
- [ ] Literature
- [ ] Manufacturer's application note/ Test kit instruction
- [ ] Other

Comment

143 Number of samples analysed per month *

- ○ 1 - 10
- ○ 11 - 50
- ○ 51 - 100
- ○ 101 - 200
- ○ 201 - 300
- ○ 301 - 500
- ○ 501 - 1000
- ○ Greater than 1000

144 Automated sample preparation

- ○ Yes
- ○ No

145 Analysis for clients *

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1 (**1 pts**)	2 (**2 pts**)	3 (**3 pts**)	4 (**4 pts**)	5 (**5 pts**)
Private clients	☐	☐	☐	☐	☐
Inspection	☐	☐	☐	☐	☐
Monitoring	☐	☐	☐	☐	☐
Exports	☐	☐	☐	☐	☐
Imports	☐	☐	☐	☐	☐
Internal testing	☐	☐	☐	☐	☐

146 The importance of the need (ability) to perform these analyses in your country *

Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority

○ 1 (least priority) (**1 pts**) ○ 2 (**2 pts**) ○ 3 (**3 pts**) ○ 4 (**4 pts**) ○ 5 (**5 pts**)

○ 6 (**6 pts**) ○ 7 (**7 pts**) ○ 8 (**8 pts**) ○ 9 (**7 pts**) ○ 10 (highest priority) (**10 pts**)

147 The degree to which the measurement capability for this analysis is established in your institute *

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established

- 1 (not yet established) (**1 pts**)
- 2 (**2 pts**)
- 3 (**3 pts**)
- 4 (**4 pts**)
- 5 (**5 pts**)
- 6 (**6 pts**)
- 7 (**7 pts**)
- 8 (**8 pts**)
- 9 (**9 pts**)
- 10 (well established) (**10 pts**)

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Additives_preservatives introduction

148 Does your laboratory test food additives/ preservatives? *

- ◯ Yes
- ◯ No

149 Does your laboratory have plans to establish this capability in

- ◯ 0 - 2 years
- ◯ 3 - 5 years
- ◯ 6 - 10 years
- ◯ No plans to establish this capability

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Additives_preservatives analysis services offered

150 Please indicate which parameters your laboratory is able to test for: *

- [ ] Antioxidants:
- [ ] Tocopherols (E 306-309), BHA (butylated hydroxyanisole or E 320) and BHT (butylated hydroxytoluene or E 321) and related fat-soluble antioxidants
- [ ] Ascorbic acid (E 300) and citric acid (E 330) and related water-soluble antioxidants
- [ ] Other
- [ ] Preservatives:
- [ ] Sulphur dioxide and sulphites (E 220-228)
- [ ] Calcium propionate (E 282)
- [ ] Nitrates and nitrites (sodium and potassium salts) (E 249-252)
- [ ] Other
- [ ] Taste and texture modifiers:
- [ ] Emulsifiers and stabilisers (e.g. lecithin, mono- and digycerides)
- [ ] Thickeners (e.g. Gelatin or pectin)
- [ ] Sweeteners (e.g. acesulfam K (E 950), aspartame (E 951) and saccharin (E 954), Thaumatin (E 957), sorbitol (E 420), isomalt (E 953) and maltitol (E 965)
- [ ] Flavour enhancers (e.g. monosodium glutamate (MSG; E 621))
- [ ] Others
- [ ] Colourants

151 Select food categories applicable to your laboratory samples *

- [ ] Cereals/ Grains (Maize, wheat, rice, oats, barley, rye, millet, sorghum)
- [ ] Cassava and cassava products
- [ ] Nuts, nut products and seeds
- [ ] Fruits and vegetables
- [ ] Processed fruits and vegetables
- [ ] Milk and milk products (cheese, cream, yoghurt)
- [ ] Meat and meat products
- [ ] Poultry meat and poultry meat products
- [ ] Eggs and egg products
- [ ] Fish and Fish products
- [ ] Seafood (Crustaceans, Cephalopods, Molluscs)
- [ ] Infant foods
- [ ] Alcoholic beverages (wine, beer, spirits)
- [ ] Non-alcoholic beverages
- [ ] Water (for human consumption, mineral water)
- [ ] Cocoa and cocoa preparations, coffee and tea
- [ ] Fats and oils
- [ ] Honey and royal jelly
- [ ] Herbs and spices
- [ ] Food additives, stocks, soups and flavourings
- [ ] Fortified, dietetic foods and food supplements

- [ ] Animal Feed and Pet food
- [ ] Animal Feed pre-mixtures, compound feeds, additives
- [ ] Food contact materials
- [ ] Agricultural input testing (elements in soil, fertilizer, growing media and compost)
- [ ] OTHER

152 Analytical methods

- [ ] AOAC method
- [ ] ISO\CEN standard methods
- [ ] In-house method
- [ ] Literature
- [ ] Manufacturer's application note/ Test kit instruction
- [ ] Other

Comment

153 Number of samples analysed per month *

- 1 - 10
- 11 - 50
- 51 - 100
- 101 - 200
- 201 - 300
- 301 - 500
- 501 - 1000
- Greater than 1000

154 Automated sample preparation

- Yes
- No

155 Analysis for clients *

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1 (**1 pts**)	2 (**2 pts**)	3 (**3 pts**)	4 (**4 pts**)	5 (**5 pts**)
Private clients	☐	☐	☐	☐	☐
Inspection	☐	☐	☐	☐	☐
Monitoring	☐	☐	☐	☐	☐
Exports	☐	☐	☐	☐	☐
Imports	☐	☐	☐	☐	☐
Internal testing	☐	☐	☐	☐	☐

156 The importance of the need (ability) to perform these analyses in your country *

Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority

◯ 1 (least priority) (**1 pts**) ◯ 2 (**2 pts**) ◯ 3 (**3 pts**) ◯ 4 (**4 pts**) ◯ 5 (**5 pts**)

◯ 6 (**6 pts**) ◯ 7 (**7 pts**) ◯ 8 (**8 pts**) ◯ 9 (**7 pts**) ◯ 10 (highest priority) (**10 pts**)

157 The degree to which the measurement capability for this analysis is established in your institute *

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established

- 1 (not yet established) (**1 pts**)
- 2 (**2 pts**)
- 3 (**3 pts**)
- 4 (**4 pts**)
- 5 (**5 pts**)
- 6 (**6 pts**)
- 7 (**7 pts**)
- 8 (**8 pts**)
- 9 (**9 pts**)
- 10 (well established) (**10 pts**)

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Sampling introduction

158 | Does your laboratory perform sampling for customers? *

◯ Yes ◯ No

159 | Does your laboratory have plans to establish this capability in

◯ 0 - 2 years

◯ 3 - 5 years

◯ 6 - 10 years

◯ No plans to establish this capability

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Sampling - services offered

160 Is your laboratory ISO/IEC 17025 accredited for sampling? *

Yes No

161 Which sampling protocols are currently applied *

e.g. CODEX, EU, Literature

Enter response/ reference information

Please provide reference

162 Please provide examples of commodities that are being sampled *

e.g. Bottled water, ground nuts etc.

Enter response/ reference information

List sample types

163 Analysis for clients *

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1 (**1 pts**)	2 (**2 pts**)	3 (**3 pts**)	4 (**4 pts**)	5 (**5 pts**)
Private clients	☐	☐	☐	☐	☐
Inspection	☐	☐	☐	☐	☐
Monitoring	☐	☐	☐	☐	☐
Exports	☐	☐	☐	☐	☐
Imports	☐	☐	☐	☐	☐
Internal testing	☐	☐	☐	☐	☐

164 What types of logistics are used for sample transport?

- ☐ Self collection (own)
- ☐ Courier
- ☐ Other

165 How are sample temperatures monitored on-route?

- ☐ Data loggers
- ☐ Manual temp monitoring & control
- ☐ Real time tracking and tracing
- ☐ Other

166 The importance of the need (ability) to perform these analyses in your country *

Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority

○ 1 (least priority) (**1 pts**) ○ 2 (**2 pts**) ○ 3 (**3 pts**) ○ 4 (**4 pts**) ○ 5 (**5 pts**)

○ 6 (**6 pts**) ○ 7 (**7 pts**) ○ 8 (**8 pts**) ○ 9 (**7 pts**) ○ 10 (highest priority) (**10 pts**)

167 The degree to which the measurement capability for this analysis is established in your institute *

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established

○ 1 (not yet established) (**1 pts**) ○ 2 (**2 pts**) ○ 3 (**3 pts**) ○ 4 (**4 pts**) ○ 5 (**5 pts**)

○ 6 (**6 pts**) ○ 7 (**7 pts**) ○ 8 (**8 pts**) ○ 9 (**9 pts**) ○ 10 (well established) (**10 pts**)

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Other Food Safety Testing Services

168 If "Other" food safety testing category was selected as services offered:

Please provide more information about other services offered, that did not fall in the listed categories

Enter response/ reference information

Other Food Safety services (e.g. Cannabis in Food)

Comment

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Communication

169 Which scientific meetings/ conferences/workshops do you regularly participate in?

E.g. Rapid Advances in Food Analysis (RAFA), AOAC International, Analytika, LabAfrica, Africa Food Safety Workshop

Enter response/ reference information

Please specify

170 Which social media platforms are you active on:

- ☐ FaceBook
- ☐ LinkedIn
- ☐ Twitter
- ☐ Instagram
- ☐ YouTube
- ☐ Other

171 Which Food Safety platforms (Journals/ Magazines) do you subscribe to/ publish in?

Enter response/ reference information

Please specify

NMISA-PTB Pan African Food Safety Testing Capacity Survey

Thank you for participating

172 Dear Food Safety Partner,

Thank you for taking the time to complete this survey.
We truly value the information you have provided. Your responses will contribute to our analyses of the capacity and technical infrastructure needs of food testing laboratories within the Africa Continental Free Trade Area.

As mentioned in the survey, we will be sharing the result summary report with all laboratories that complete and submit the survey after the project has been completed. If you have any comments on the survey or the project, please contact mfwhaley@nmisa.org

Regards
Dr Maria Fernandes-Whaley
Section Head: Organic & Bio-Analysis
National Metrology Institute of South Africa (NMISA)

Please let us know if you would like to:

	Yes	No
Receive the final report (yes/no)	○	○
Be entered into the prize draws (yes/no)	○	○

APPENDIX 2

SURVEYLAB SUMMARY (113 ON-LINE RESPONSES)

Pan African Food Safety Testing Capacity Survey 2022

Coordinated by the National Metrology Institute of South Africa (NMISA), on behalf of the Africa Regional Metrology Organisation (AFRIMETS), and supported by the Physikalisch Technische Bundesanstalt (PTB)

Pan African Food Safety Survey overview

This survey was conducted with the aim of determining the capacity and technical infrastructure needs of food testing laboratories within the Africa Continental Free Trade Area. This survey was supported by the Physikalisch-Technische Bundesanstalt (PTB), the National Metrology Institute of Germany, and coordinated through the National Metrology Institute of South Africa (NMISA) on behalf of AFRIMETS.

The survey was completed by the laboratory manager or quality system manager. A total of 113 laboratory responses were received. Participation was voluntary.

NMISA, in compliance with the Protection of Personal Information Act 4 of 2013 (POPI), ensured that:

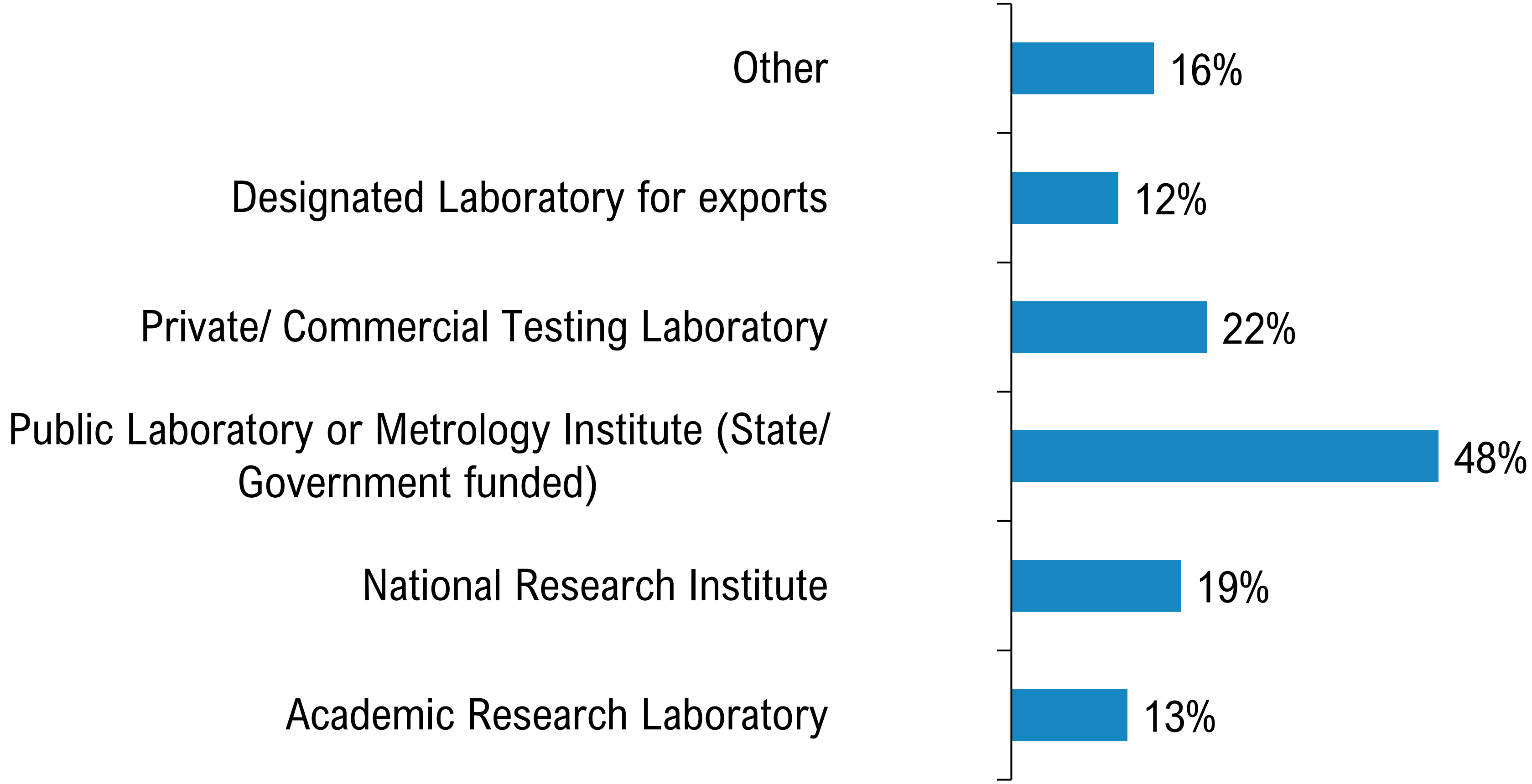
- This survey is anonymous. Responses were treated strictly confidentially. No contact details were shared without participant's prior written consent.
- The survey was circulated on 15 March 2022 with submission deadline of 18 April 2022 extended to end of Aprril 2022.

The result summary report, for the 113 responses received, was shared with all participants.

For any queries please contact Dr. Maria Fernandes-Whaley at mfwhaley@nmisa.org

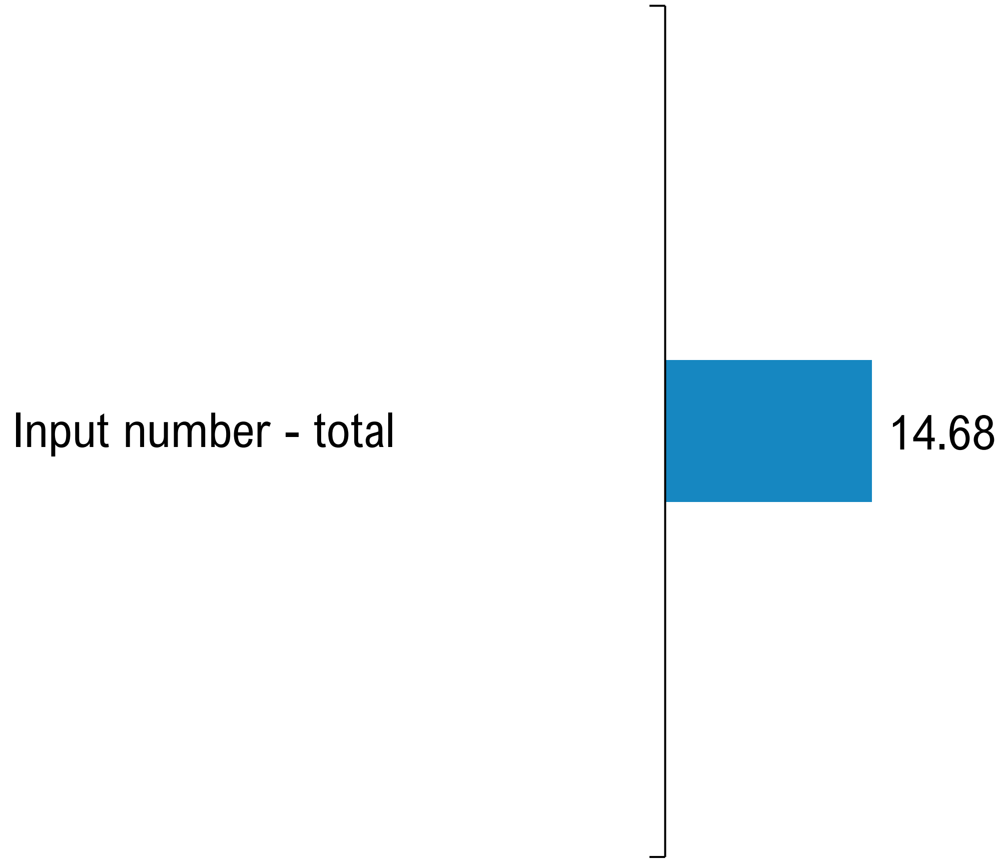
Q259: Please indicate your laboratory type

More than one option is possible.



Answered questions: 116 | Skipped questions: 0

Q11: Number of staff in lab involved in food safety testing



Answered questions: 116 | Skipped questions: 0

Q12: Qualifications (in Chemistry/Biochemistry/Microbiology/Food Science and relevant fields)

Insert number of staff with this qualification

Answered questions: 114 | Skipped questions: 2

Q89: How often do staff receive training, please indicate if the training is presented in-house, or through an external service provider?

If "Other " selected , please indicate in the comment section

	In -house	External	#
Annually	55% (60)	45% (50)	110
Monthly	94% (31)	6% (2)	33
Every 2 years	15% (5)	85% (29)	34
Other	42% (23)	58% (32)	55

Answered questions: 114 | Skipped questions: 2

Q28: Training that would be most needed (ranked 1 less needed, 5 most needed)

	1	2	3	4	5	#
Method development	20% (22)	8% (9)	12% (13)	15% (16)	45% (49)	109
Method validation	19% (22)	6% (7)	11% (12)	19% (22)	44% (50)	113
Establishing/ implementing a quality system for ISO/IEC 17025	25% (29)	10% (11)	17% (20)	19% (22)	29% (33)	115
Implementing metrological traceability for chemical tests	17% (19)	9% (10)	19% (21)	17% (18)	38% (41)	109

Answered questions: 116 | Skipped questions: 0

Q28: Training that would be most needed (ranked 1 less needed, 5 most needed)

	1	2	3	4	5	#
Estimating Uncertainty of Measurement (UoM)	18% (20)	8% (9)	12% (13)	18% (20)	45% (50)	112
Qualitative analysis (screening analysis) training	14% (15)	17% (19)	19% (21)	23% (26)	27% (30)	111
Microbiological tests for Food spoilage microorganisms - training	25% (26)	9% (10)	12% (13)	21% (22)	33% (35)	106
Microbiological tests for Food poisoning bacteria - training	22% (24)	8% (9)	16% (17)	18% (19)	36% (38)	107

Answered questions: 116 | Skipped questions: 0

Q28: Training that would be most needed (ranked 1 less needed, 5 most needed)

	1	2	3	4	5	#
Gas Chromatography (GC) training	21% (23)	10% (11)	11% (12)	21% (23)	38% (43)	112
Liquid Chromatography (LC) training	17% (19)	9% (10)	15% (16)	14% (15)	45% (49)	109
Mass Spectrometry (MS) training	20% (22)	7% (8)	9% (10)	16% (17)	48% (52)	109
Inductively Coupled Plasma - Optical Emission Spectroscopy (ICP-OES) training	24% (25)	8% (8)	22% (23)	15% (16)	31% (32)	104

Answered questions: 116 | Skipped questions: 0

Q28: Training that would be most needed (ranked 1 less needed, 5 most needed)

	1	2	3	4	5	#
Inductively Coupled Plasma - Mass Spectrometry (ICP-MS) training	25% (26)	8% (8)	15% (16)	16% (17)	36% (38)	105
Titration training	29% (31)	15% (16)	20% (21)	15% (16)	21% (23)	107
Sample preparation training - Organic Analysis (GC, LC, GC-MS, LC-MS, titration)	20% (22)	8% (9)	16% (18)	24% (26)	32% (35)	110
Sample preparation training - Inorganic Analysis (ICP-OES, ICP-MS, AAS, AES, ion chromatography)	22% (24)	8% (9)	14% (15)	21% (23)	35% (38)	109

Answered questions: 116 | Skipped questions: 0

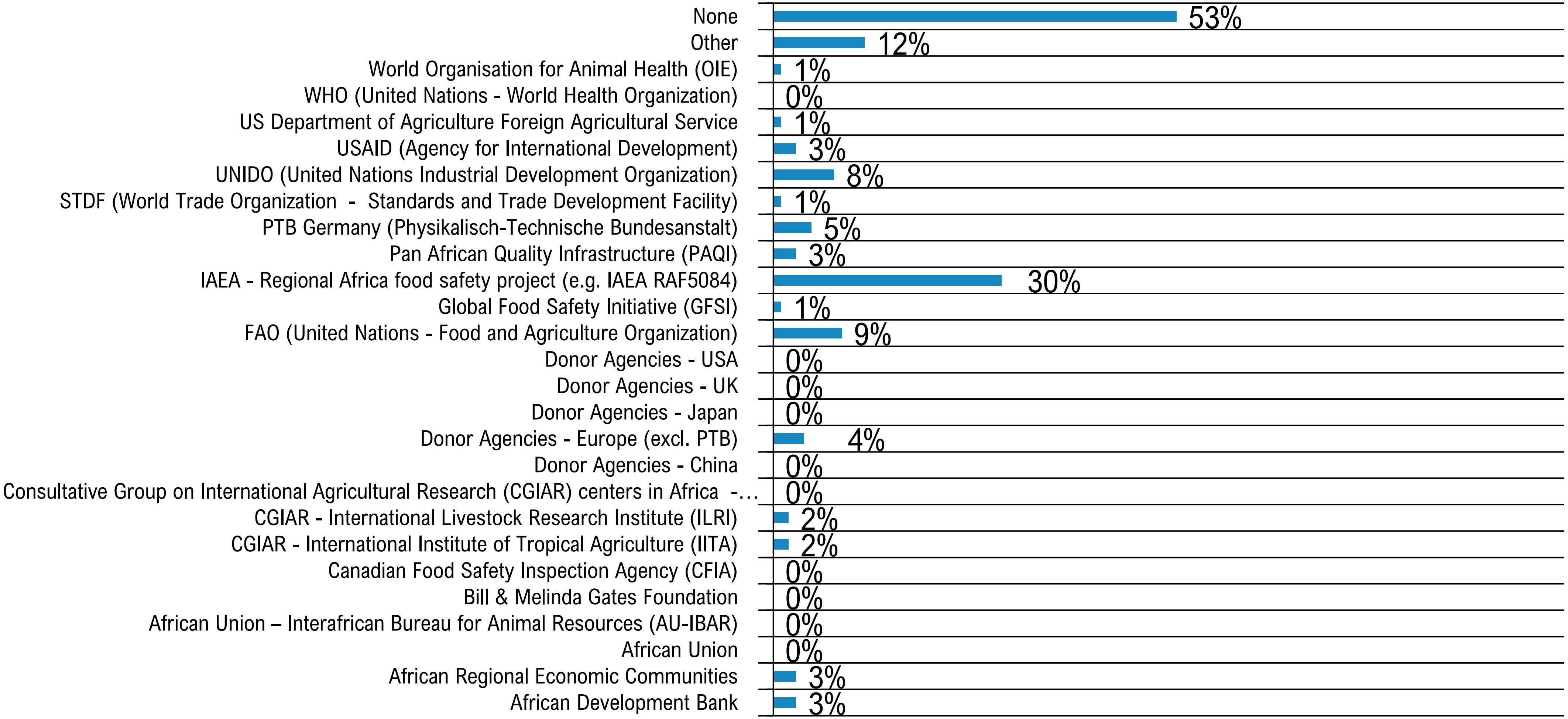
Q28: Training that would be most needed (ranked 1 less needed, 5 most needed)

	1	2	3	4	5	#
Sample preparation training - Bioanalysis (DNA, RNA, Proteomics)	30% (32)	11% (12)	15% (16)	14% (15)	29% (31)	106
Representative sampling training	19% (21)	14% (15)	16% (17)	19% (21)	31% (34)	108
Hazardous chemical management (Storage, disposal, and use)	19% (21)	12% (13)	17% (19)	17% (19)	36% (40)	112

Answered questions: 116 | Skipped questions: 0

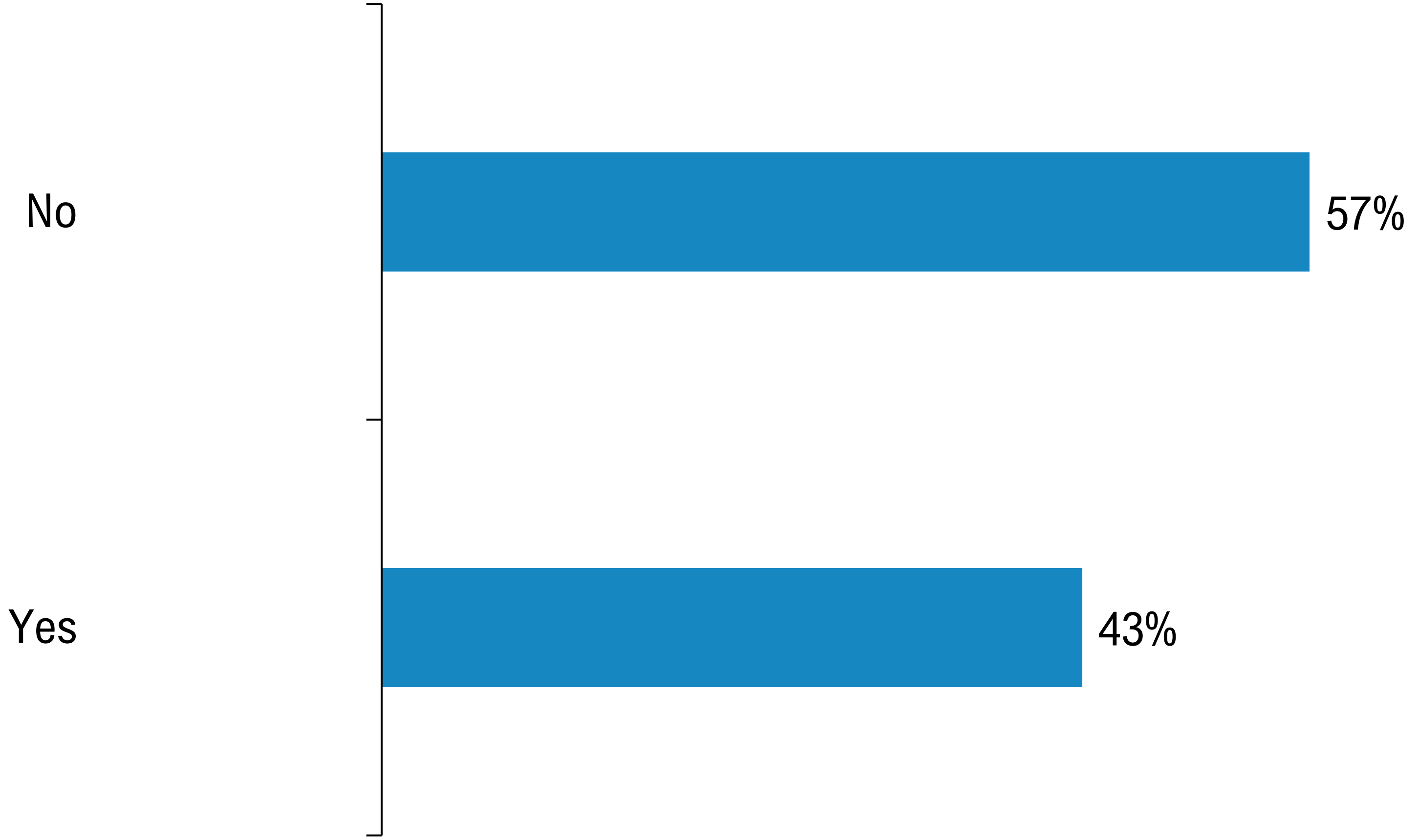
Q211: Is your laboratory collaborating on Food safety Capacity building initiatives funded through one or more of the following:

Please select from options below and indicate project reference number.



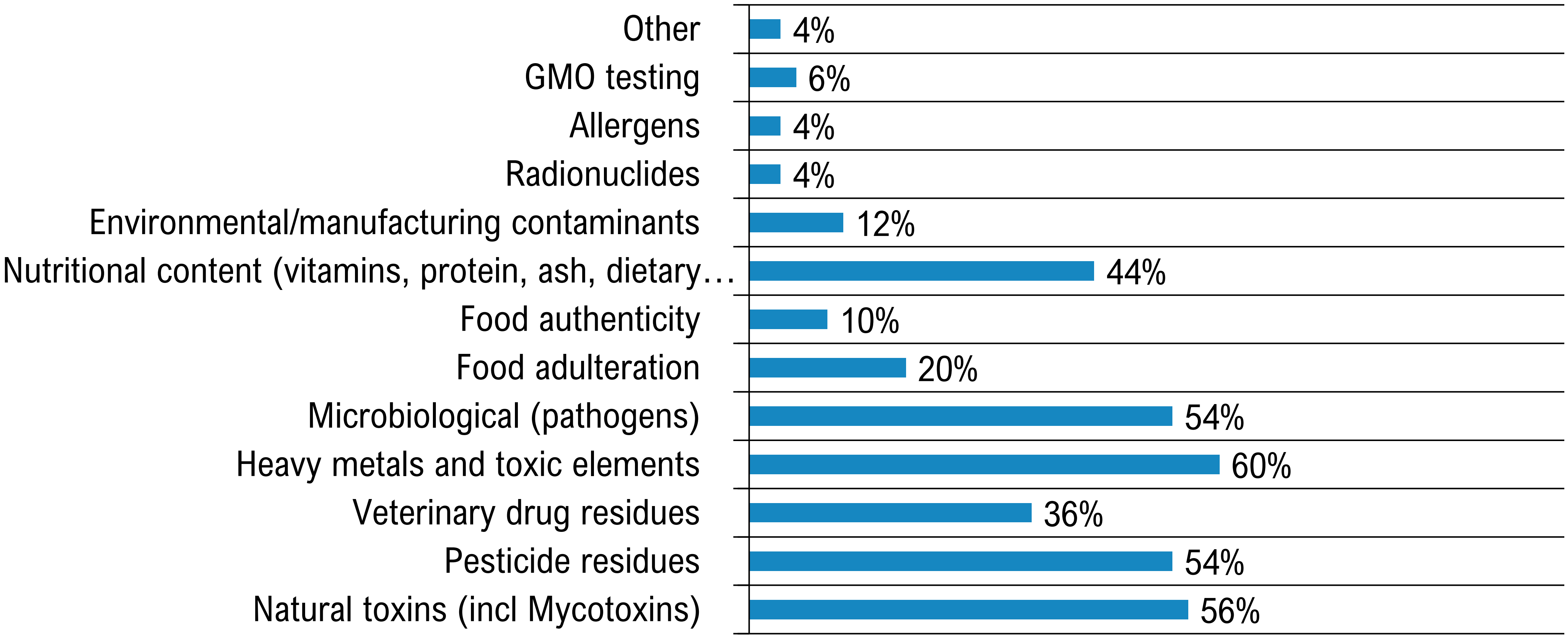
Answered questions: 116 | Skipped questions: 0

Q29: Does your lab participate in national food monitoring programmes?



Answered questions: 116 | Skipped questions: 0

Q31: Which parameters are being tested for the food monitoring programme?



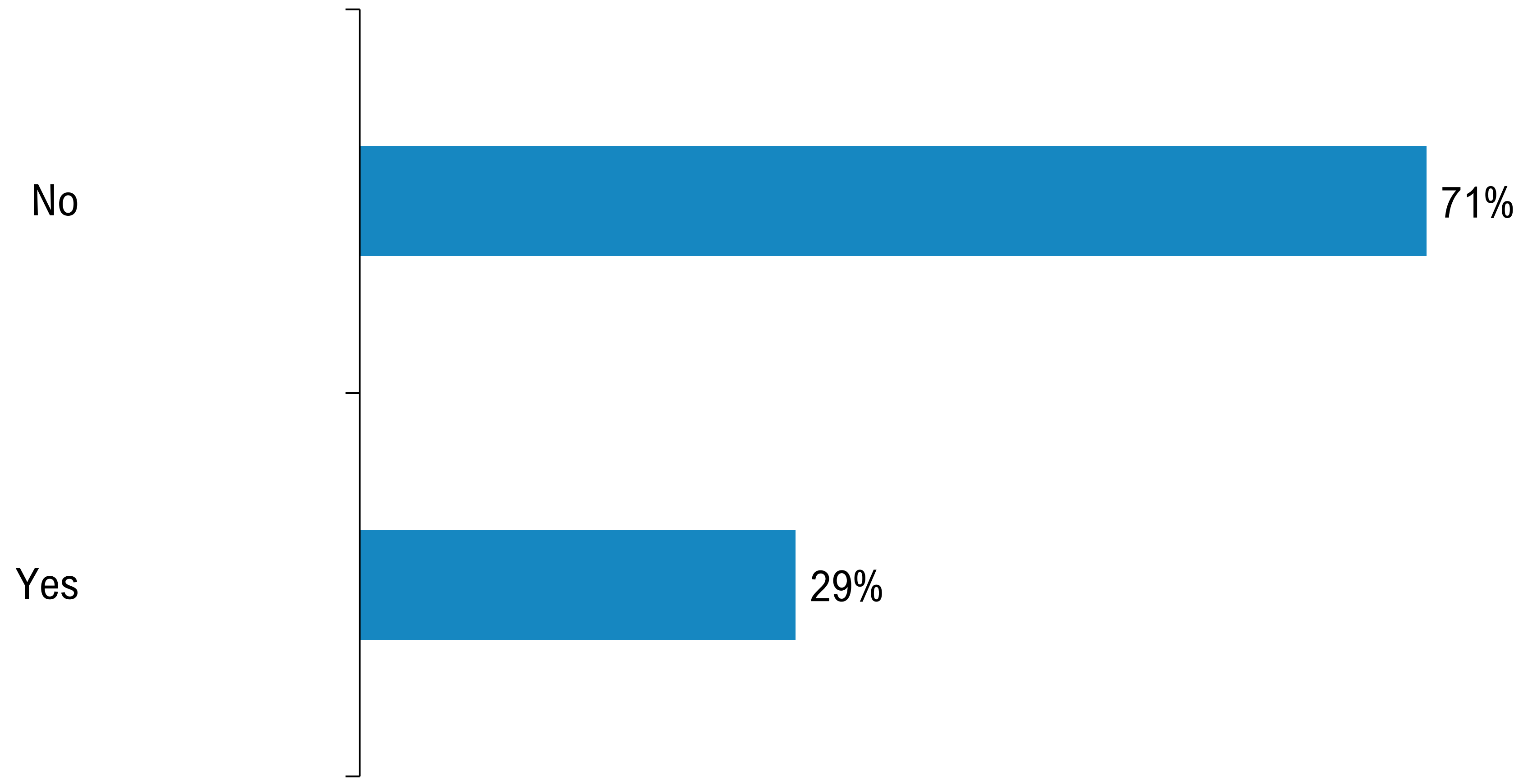
Answered questions: 50 | Skipped questions: 66

Q32: Indicate in which matrix (e.g. Fish, Meat, Dairy, Eggs, Maize, Wheat, Nuts)

- Fish, Meat, Dairy, Eggs, Maize, Wheat, Nuts, Milk, Fruits, Roasted & Ground coffee, Animal feeds, Beverages etc
- FISH
- Cocoa
- Animal offal
- Nuts, fruits and vegetables
- various products including maize, tea, nuts, honey
- maize, wheat, nuts
- Lait, viande, miel, oeufs, blé
- In horticultural produce mainly Fruits and vegetable
- Fish, milk, eggs, cereals, meat, honey
- poisson, viande, produits laitiers, œufs, maïs, blé
- BLE
- Maize, Dairy, wheat, meat and nuts
- Fish, meat, dairy, maize, wheat, nuts, oils, fats, honey, bakeries, wines, fruit juices, vegetables, black tea, cereals, legumes,
- Poisson, légumes

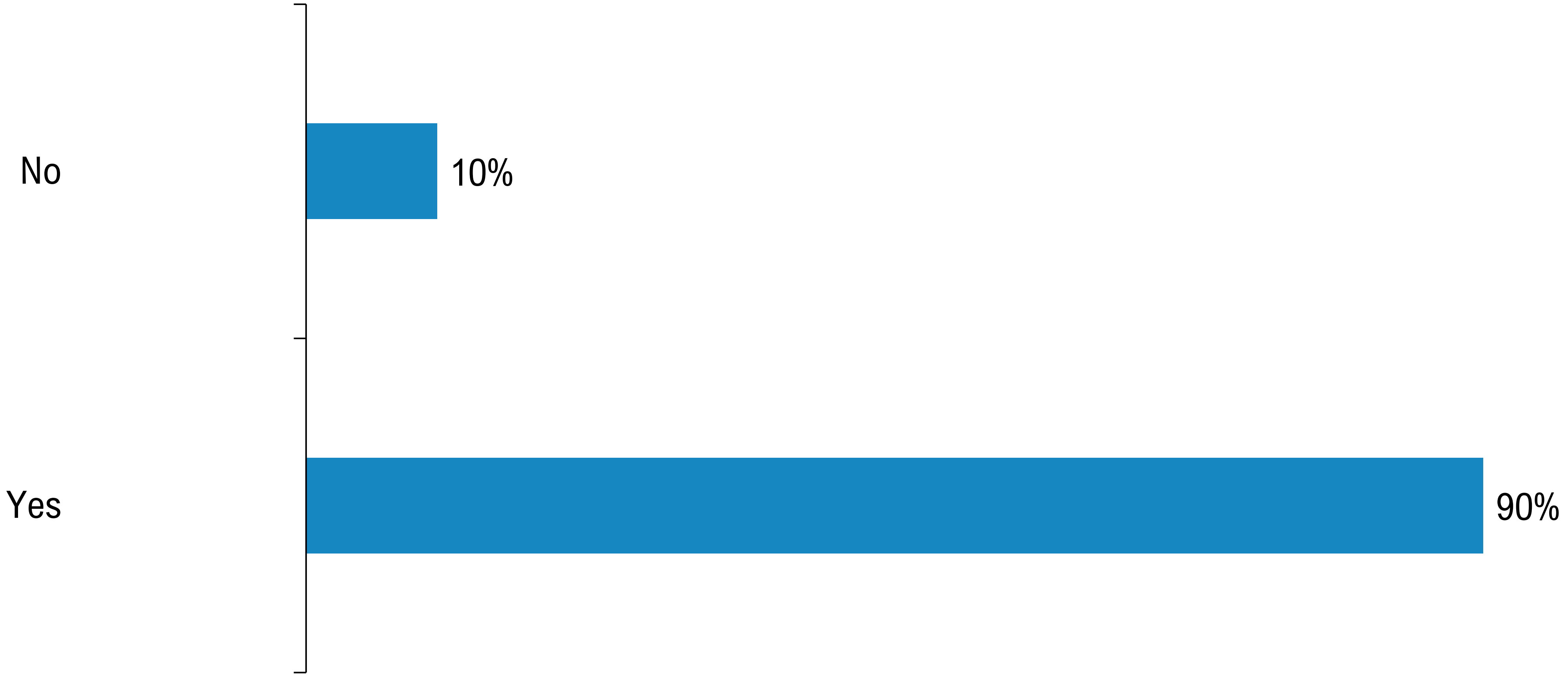
Answered questions: 49 | Skipped questions: 67

Q16: Does your laboratory have an implemented LIMS?



Answered questions: 114 | Skipped questions: 2

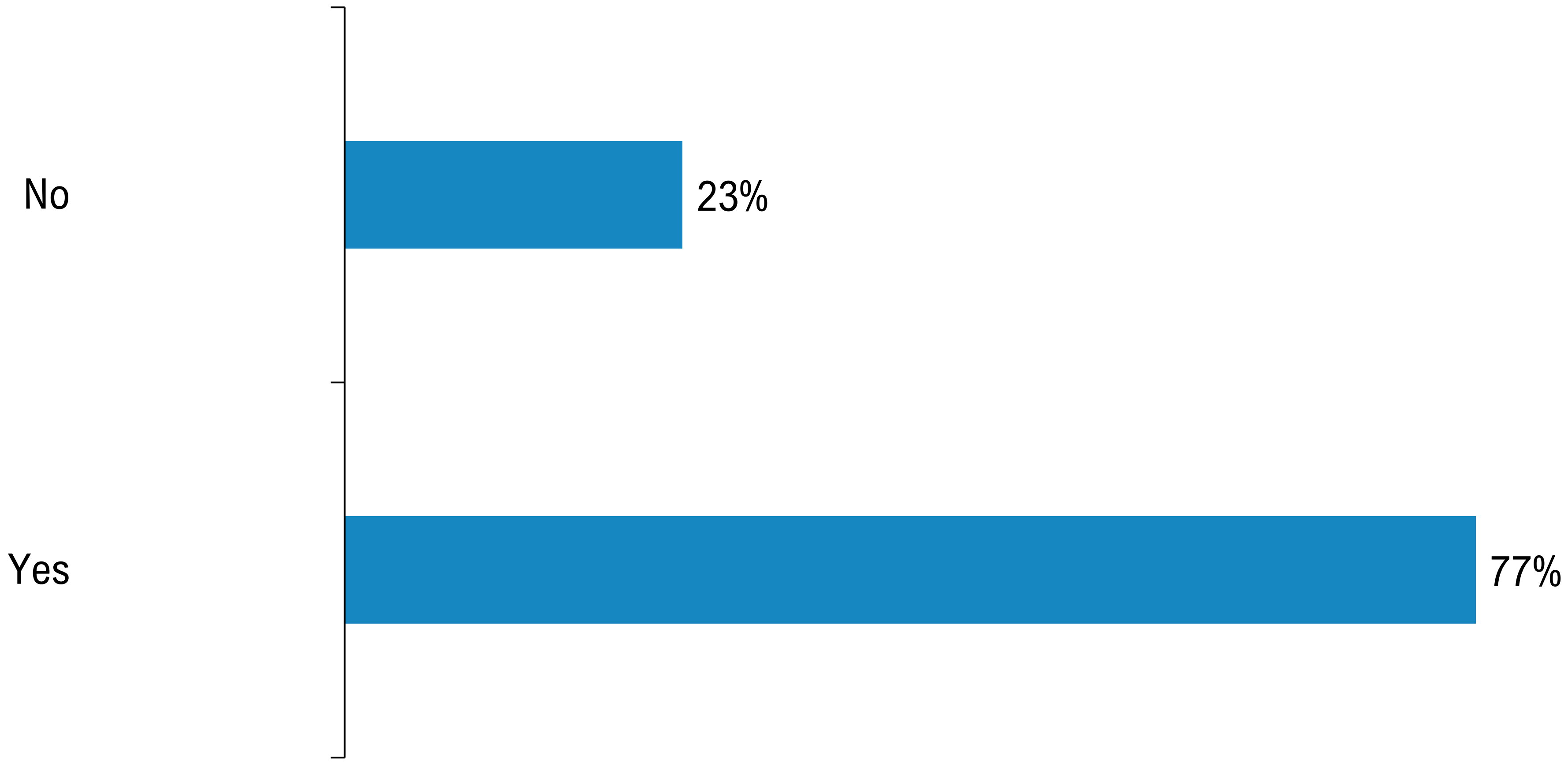
Q17: Do you plan to implement a LIMS System in the future?



Answered questions: 80 | Skipped questions: 36

Q14: Has your laboratory implemented a QMS?

If yes, indicate which standards (e.g., ISO/IEC 17025, ISO 9001)

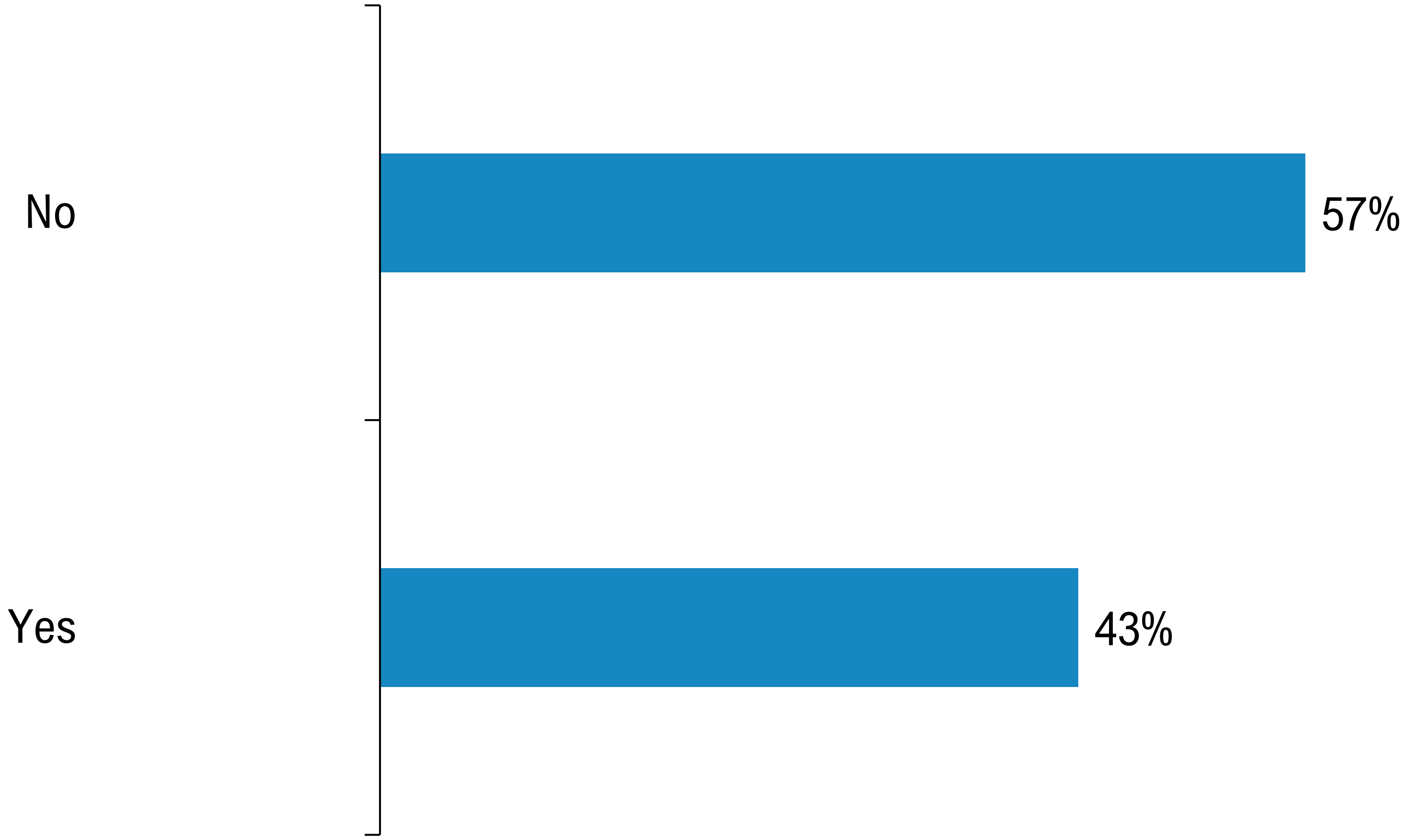


Answered questions: 116 | Skipped questions: 0

Q15: Do you plan to implement a QMS System in the future?

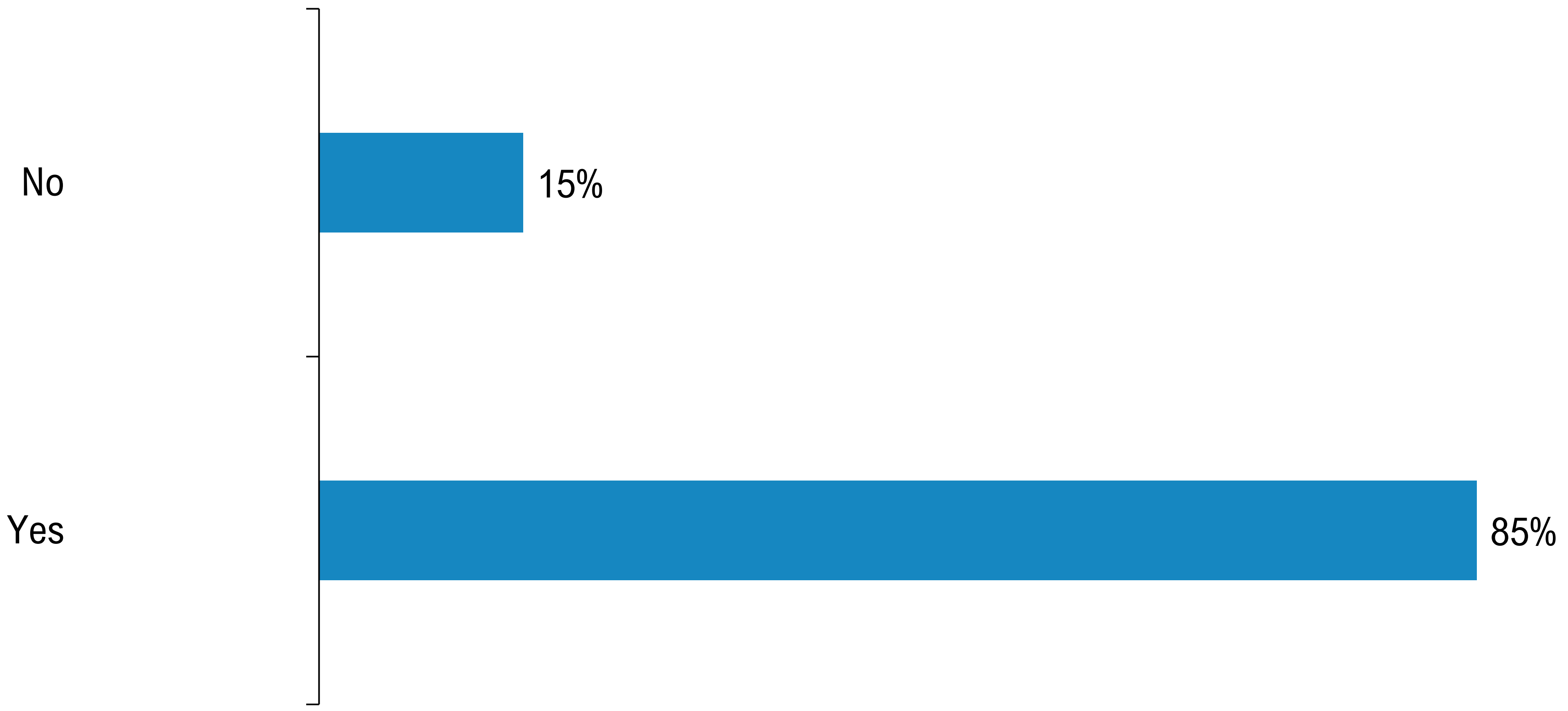
Answered questions: 27 | Skipped questions: 89

Q18: Is your laboratory ISO/IEC 17025 accredited?



Answered questions: 116 | Skipped questions: 0

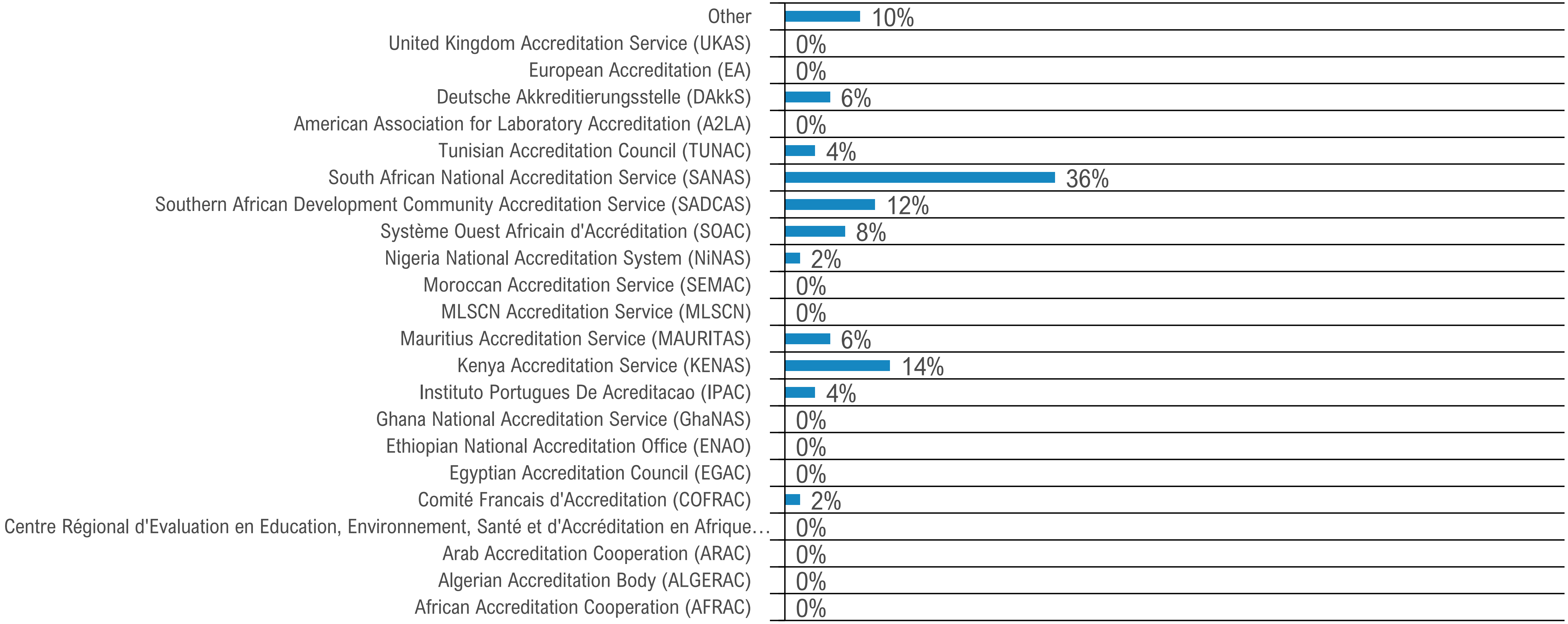
Q19: Does the laboratory plan to become accredited to ISO/IEC 17025 in the future?



Answered questions: 65 | Skipped questions: 51

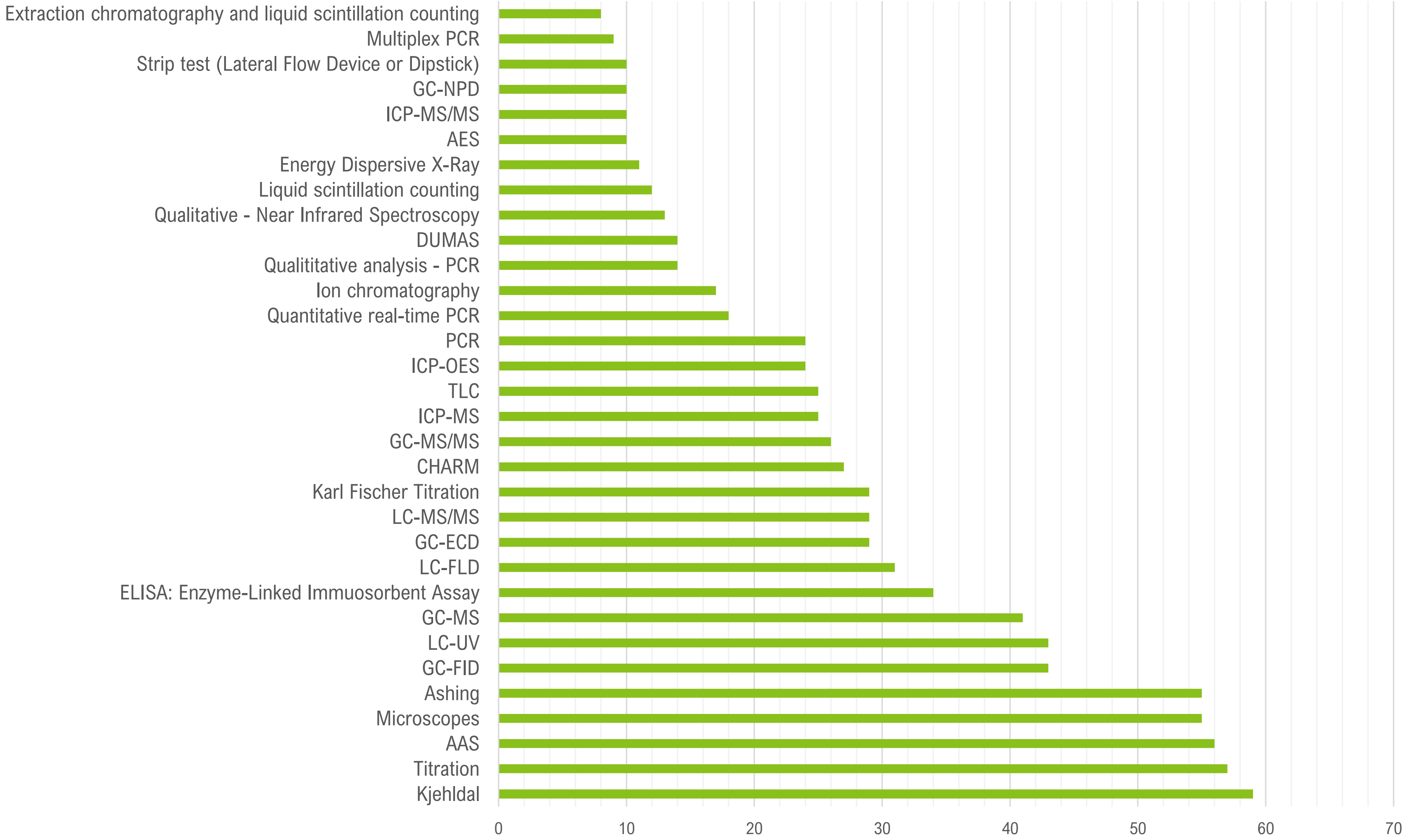
Q22: Accreditation body

Select which items (Can select more than one)



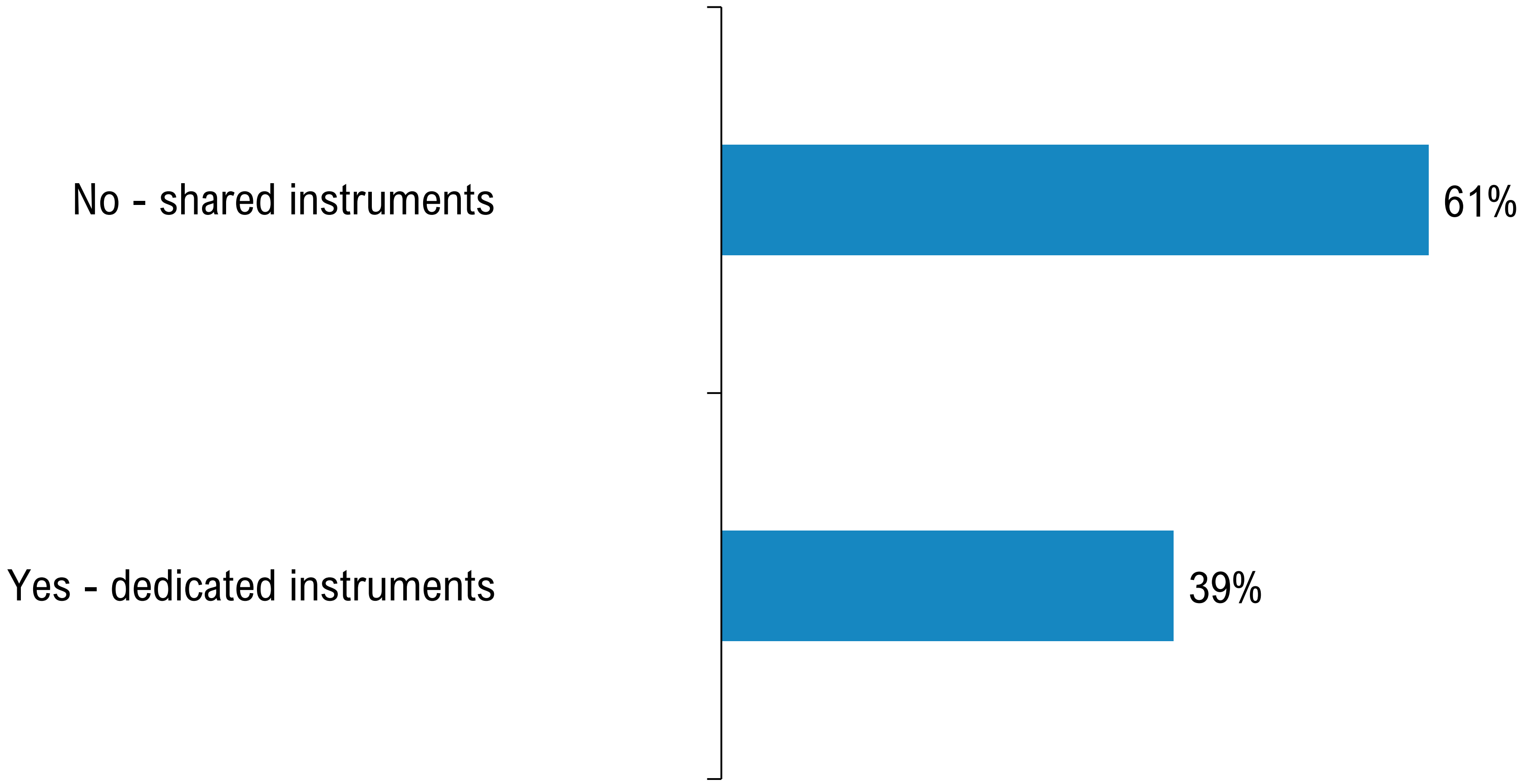
Answered questions: 50 | Skipped questions: 66

Q58: Analytical techniques/ instruments used to provide services. Please indicate the number of instruments available. For techniques using consumables (e.g. ELISA) indicate 1.



Answered questions: 109 | Skipped questions: 7

Q91: Are the instruments dedicated for specific analyses or shared with other testing services (e.g. pesticides and antibiotics etc)



Answered questions: 111 | Skipped questions: 5

Q33: Please rank technical or supply difficulties experienced in the execution of laboratory duties (1 being least difficult and 5 most difficult)

	1	2	3	4	5	#
Delays caused by importing chemicals, reagents and equipment, instrument spares/ repairs	4% (5)	5% (6)	15% (17)	24% (28)	52% (60)	116
Lack of instrument supplier's maintenance and training support	11% (13)	12% (14)	15% (17)	22% (26)	40% (46)	116
Lack of access to relevant PT schemes, reference materials	14% (16)	16% (18)	29% (34)	20% (23)	22% (25)	116
Operational expenses are too high	7% (8)	7% (8)	23% (27)	23% (27)	40% (46)	116

Answered questions: 116 | Skipped questions: 0

Q33: Please rank technical or supply difficulties experienced in the execution of laboratory duties (1 being least difficult and 5 most difficult)

	1	2	3	4	5	#
Training and retaining of analysts	5% (6)	15% (17)	24% (28)	29% (34)	27% (31)	116
Technology and digitalisation limitations	8% (9)	9% (10)	27% (31)	29% (34)	28% (32)	116
OTHER (please describe in comment box)	45% (52)	7% (8)	7% (8)	9% (11)	32% (37)	116

Answered questions: 116 | Skipped questions: 0

Q46: PT schemes

	Biannually	Anually	Other	#
BIPEA	13% (5)	50% (19)	37% (14)	38
BVL Germany	0% (0)	33% (5)	67% (10)	15
DRRR	6% (1)	28% (5)	67% (12)	18
FAPAS	19% (9)	40% (19)	42% (20)	48

Answered questions: 103 | Skipped questions: 13

Q46: PT schemes

	Biannually	Anually	Other	#
IAEA	9% (3)	48% (16)	42% (14)	33
NLA	17% (5)	33% (10)	50% (15)	30
NMISA	13% (6)	53% (24)	33% (15)	45
PROGETTO	12% (4)	48% (16)	39% (13)	33

Answered questions: 103 | Skipped questions: 13

Q48: CRMs/ QCs

	Calibrator	Matrix materials	#
ATCC (microbiological)	33% (13)	67% (26)	39
BAM	42% (5)	58% (7)	12
BIPEA	32% (6)	68% (13)	19
BVL Germany	42% (5)	58% (7)	12

Answered questions: 104 | Skipped questions: 12

Q48: CRMs/ QCs

	Calibrator	Matrix materials	#
Dr Erhenstofer	63% (12)	37% (7)	19
ERM (European Reference Materials)	37% (7)	63% (12)	19
FAPAS	19% (6)	81% (26)	32
LGC	37% (13)	63% (22)	35

Answered questions: 104 | Skipped questions: 12

Q48: CRMs/ QCs

	Calibrator	Matrix materials	#
LNE France	38% (5)	62% (8)	13
Merck/ Sigma Aldrich	54% (25)	46% (21)	46
NIST SRMs	42% (10)	58% (14)	24
NMIA	30% (3)	70% (7)	10

Answered questions: 104 | Skipped questions: 12

Q48: CRMs/ QCs

	Calibrator	Matrix materials	#
NMISA	36% (8)	64% (14)	22
NRC Canada	38% (5)	62% (8)	13
PROGETTO	19% (3)	81% (13)	16
R-Biopharm	45% (5)	55% (6)	11

Answered questions: 104 | Skipped questions: 12

Q48: CRMs/ QCs

	Calibrator	Matrix materials	#
Restek	44% (8)	56% (10)	18
Romer Biopure	57% (12)	43% (9)	21
Trilogy	50% (8)	50% (8)	16
In-house	49% (23)	51% (24)	47

Answered questions: 104 | Skipped questions: 12

Q48: CRMs/ QCs

	Calibrator	Matrix materials	#
Other (please indicate in next section)	44% (7)	56% (9)	16
None	46% (12)	54% (14)	26

Answered questions: 104 | Skipped questions: 12

Q24: Food Testing categories

Please indicate which tests are accredited, not accredited or planning to be established. The questions that follow are linked to these responses. Please indicate if the services are not offered.

	ISO/IEC 17025 Accredited	NOT accredited OR planning to offer in future	Not offered/ no plans to offer	#
Microbiological	32% (37)	44% (51)	24% (28)	116
Natural Toxins (Incl. Mycotoxins)	22% (26)	51% (59)	27% (31)	116
Pesticides	16% (19)	51% (59)	33% (38)	116
Veterinary drug residues	5% (6)	46% (53)	49% (57)	116

Answered questions: 116 | Skipped questions: 0

Q24: Food Testing categories

Please indicate which tests are accredited, not accredited or planning to be established. The questions that follow are linked to these responses. Please indicate if the services are not offered.

	ISO/IEC 17025 Accredited	NOT accredited OR planning to offer in future	Not offered/ no plans to offer	#
Heavy metals	27% (31)	53% (61)	21% (24)	116
Food Adulteration & Authenticity	6% (7)	46% (53)	48% (56)	116
Nutritional content (vitamins, protein, ash, dietary fibre etc.)	19% (22)	58% (67)	23% (27)	116
Environmental/manufacturing contaminants	7% (8)	47% (54)	47% (54)	116

Answered questions: 116 | Skipped questions: 0

Q24: Food Testing categories

Please indicate which tests are accredited, not accredited or planning to be established. The questions that follow are linked to these responses. Please indicate if the services are not offered.

	ISO/IEC 17025 Accredited	NOT accredited OR planning to offer in future	Not offered/ no plans to offer	#
Radionuclides	2% (2)	21% (24)	78% (90)	116
Allergens	4% (5)	35% (41)	60% (70)	116
GMO testing	1% (1)	34% (39)	66% (76)	116
Additives/ preservatives	3% (4)	46% (53)	51% (59)	116

Answered questions: 116 | Skipped questions: 0

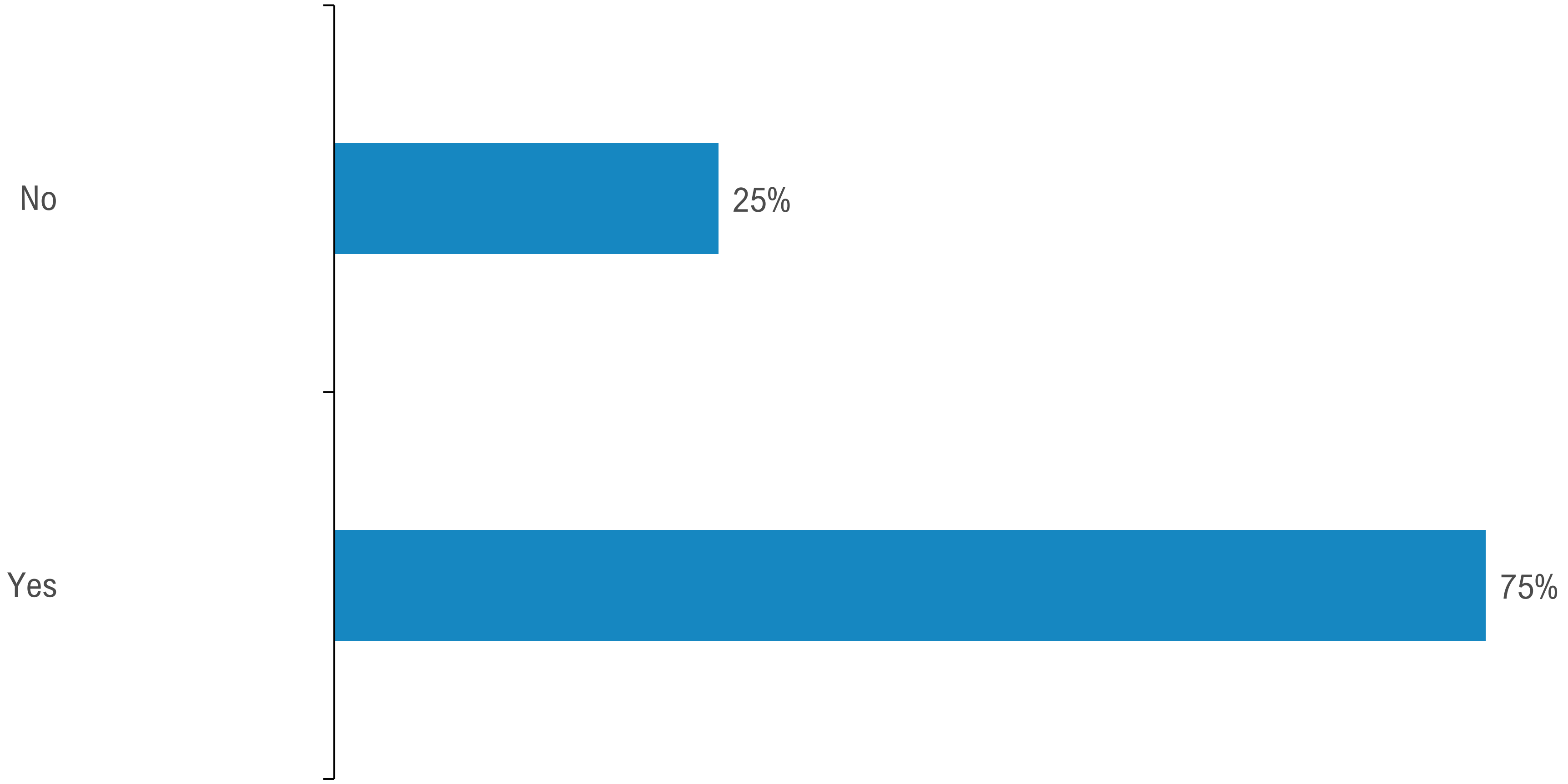
Q24: Food Testing categories

Please indicate which tests are accredited, not accredited or planning to be established. The questions that follow are linked to these responses. Please indicate if the services are not offered.

	ISO/IEC 17025 Accredited	NOT accredited OR planning to offer in future	Not offered/ no plans to offer	#
Sampling	7% (8)	54% (63)	39% (45)	116
Other (please indicate in comment section)	9% (10)	33% (38)	59% (68)	116

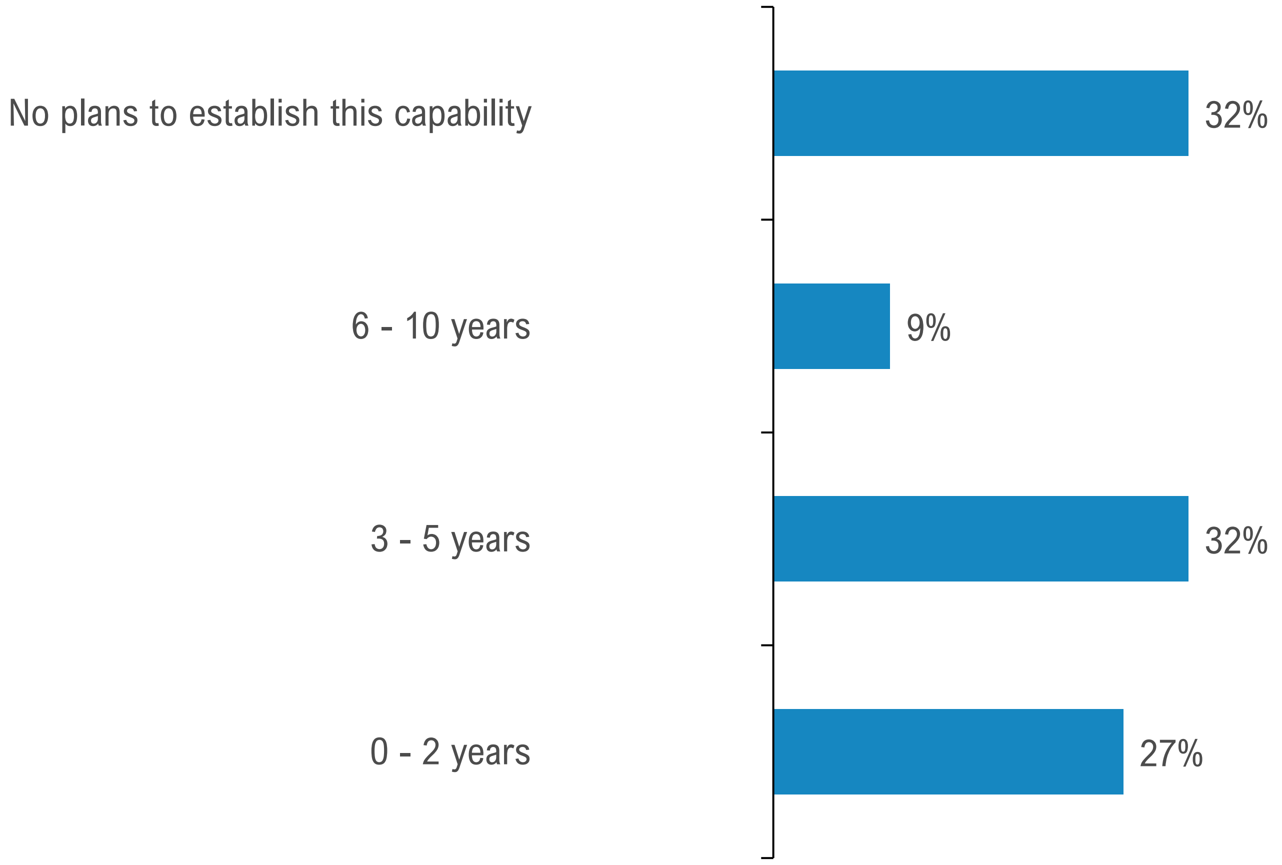
Answered questions: 116 | Skipped questions: 0

Q35: Does your lab test for Microbiological content



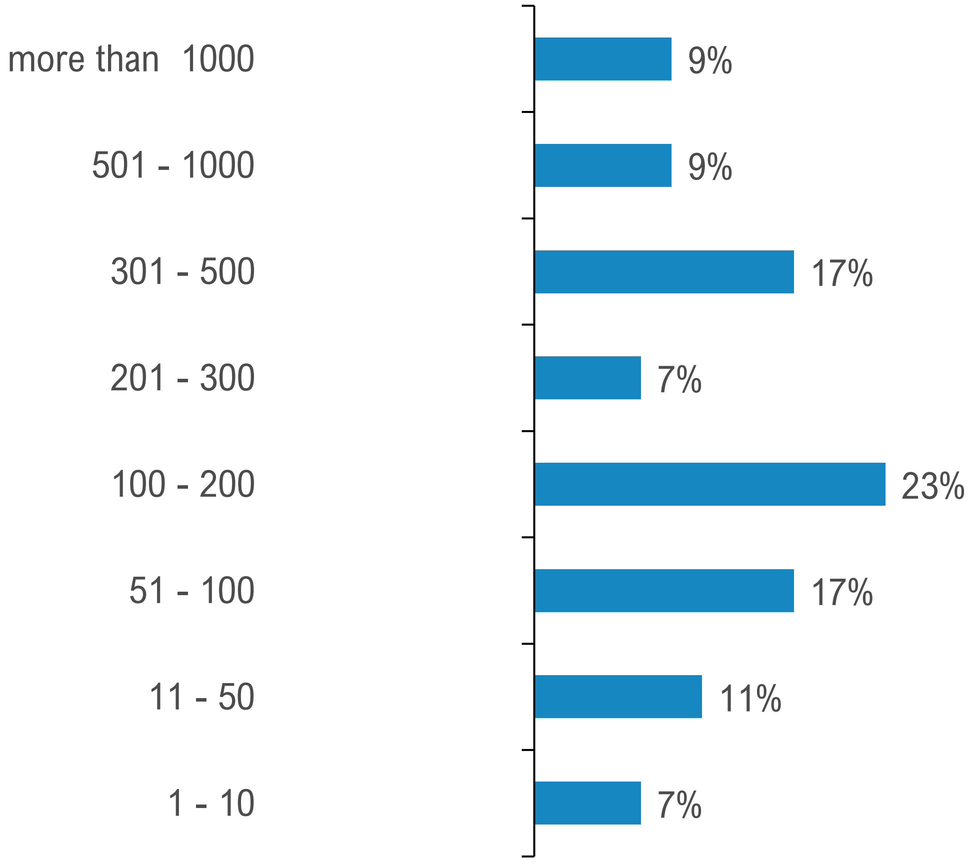
Answered questions: 88 | Skipped questions: 28

Q36: Is your laboratory planning to establish this capability in



Answered questions: 22 | Skipped questions: 94

Q107: Number of samples analysed per month

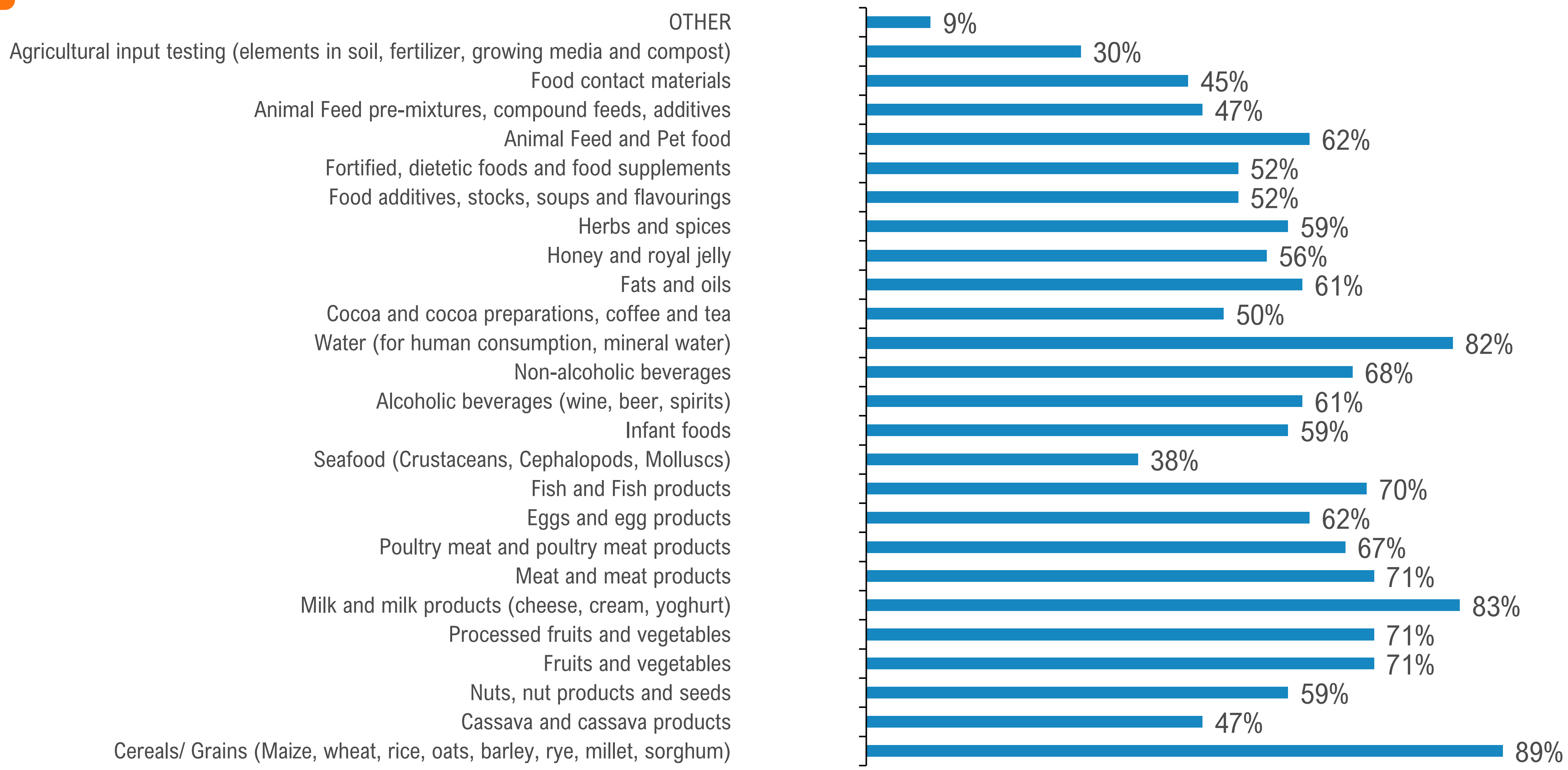


Answered questions: 66 | Skipped questions: 50

Q43: Automated sample preparation

Answered questions: 64 | Skipped questions: 52

Q44: Sample types (matrix)



Answered questions: 66 | Skipped questions: 50

Q106: Analysis for clients

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Private clients	13% (9)	7% (5)	18% (12)	10% (7)	51% (34)	67
Inspection	18% (12)	15% (10)	26% (17)	18% (12)	23% (15)	66
Monitoring	24% (16)	11% (7)	23% (15)	21% (14)	21% (14)	66
Exports	30% (20)	23% (15)	23% (15)	17% (11)	8% (5)	66

Answered questions: 66 | Skipped questions: 50

Q106: Analysis for clients

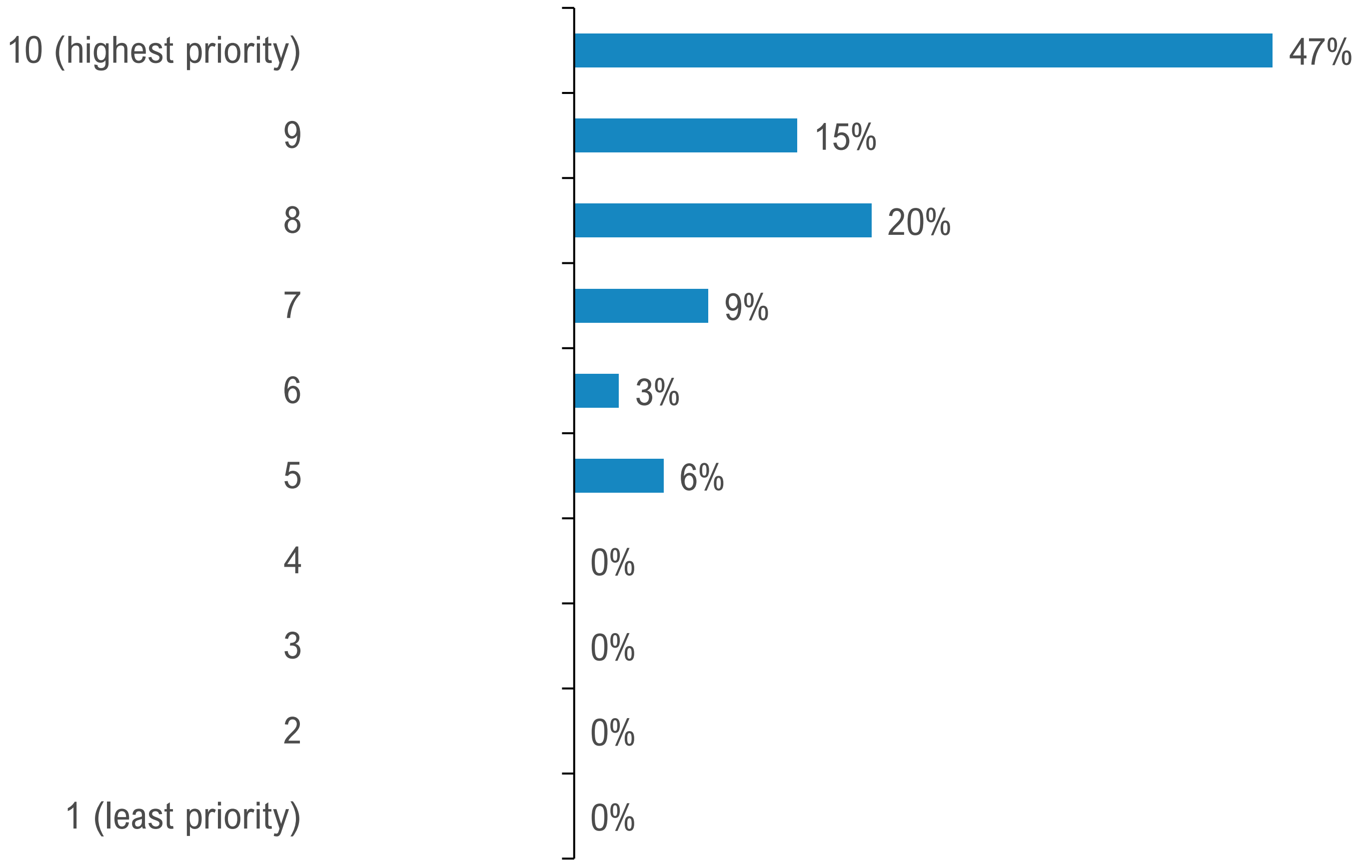
Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Imports	36% (24)	17% (11)	20% (13)	11% (7)	17% (11)	66
Internal testing	24% (16)	14% (9)	18% (12)	15% (10)	29% (19)	66

Answered questions: 66 | Skipped questions: 50

Q50: The importance of the need (ability) to perform these analyses in your country

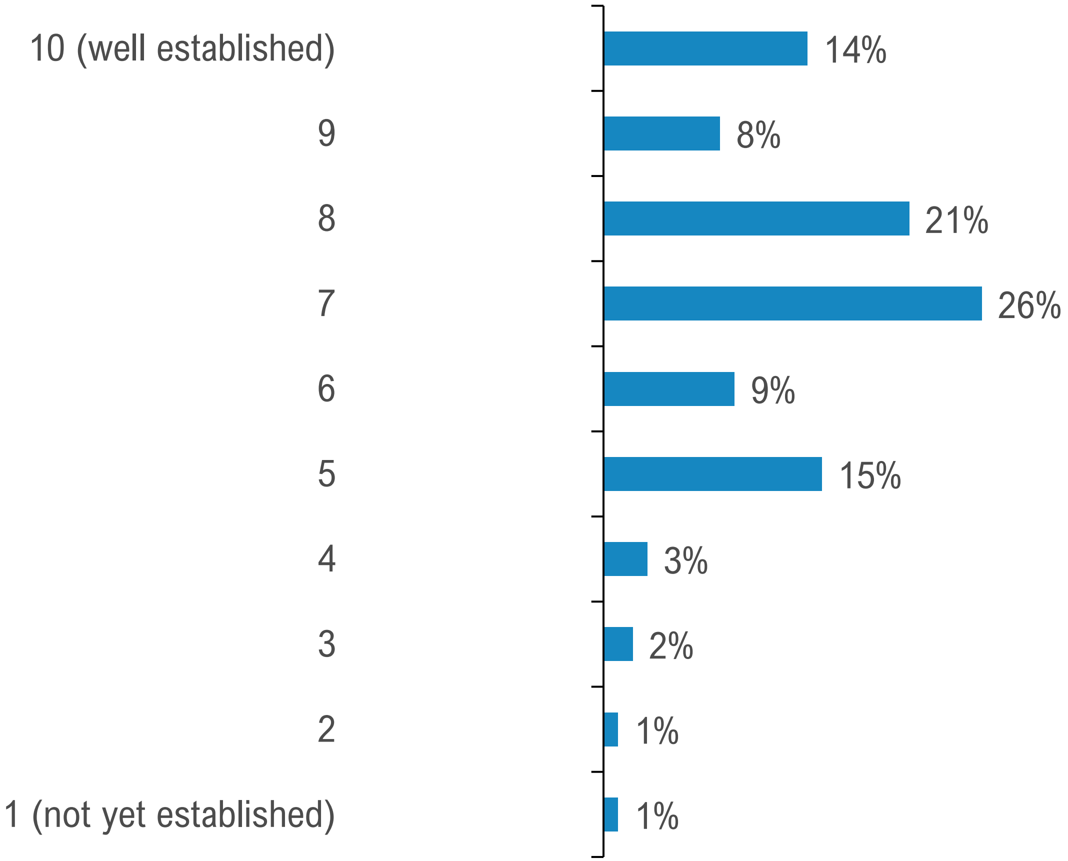
Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority



Answered questions: 66 | Skipped questions: 50

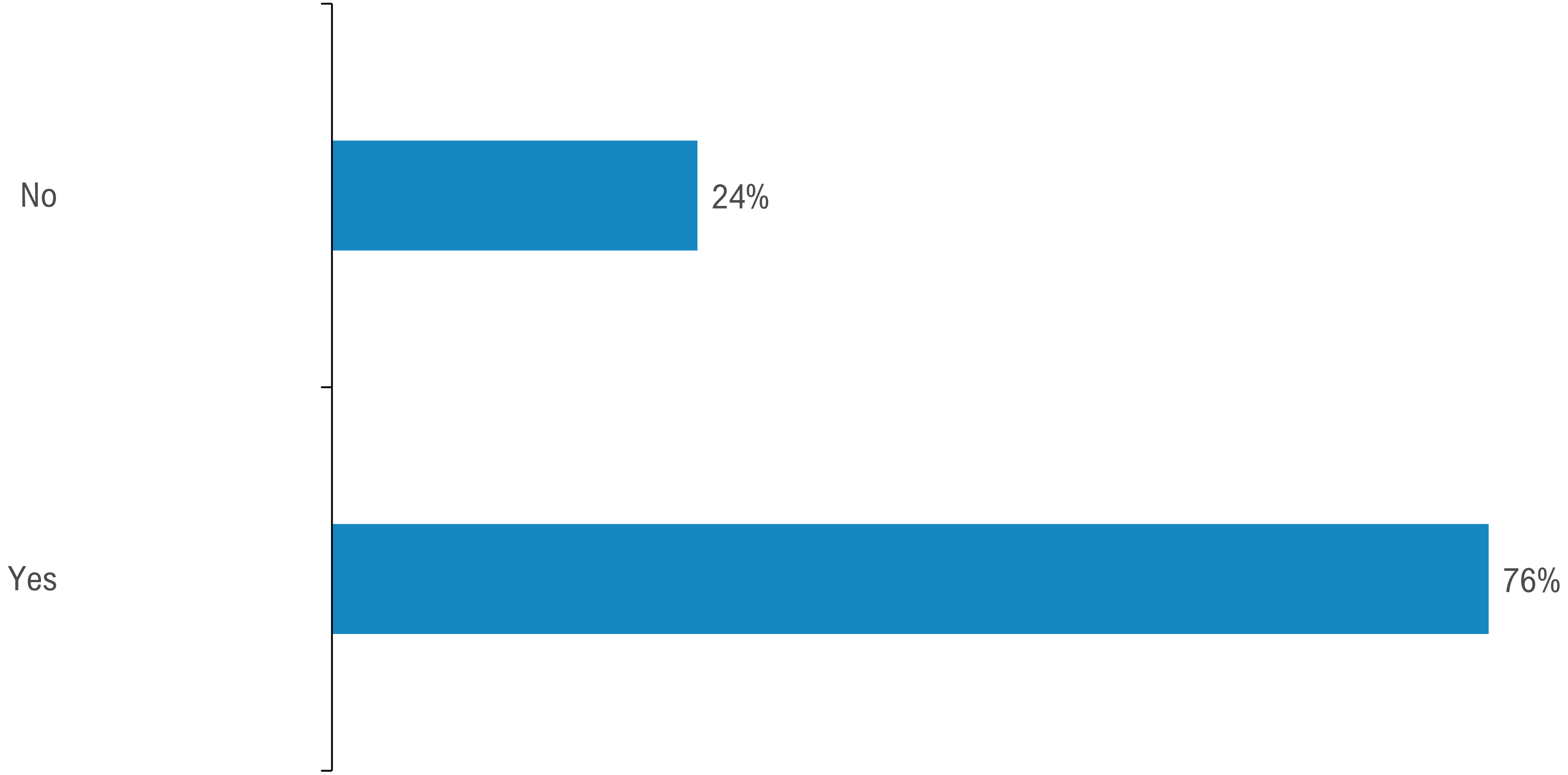
Q51: The degree to which the measurement capability for this analysis is established in your institute

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established



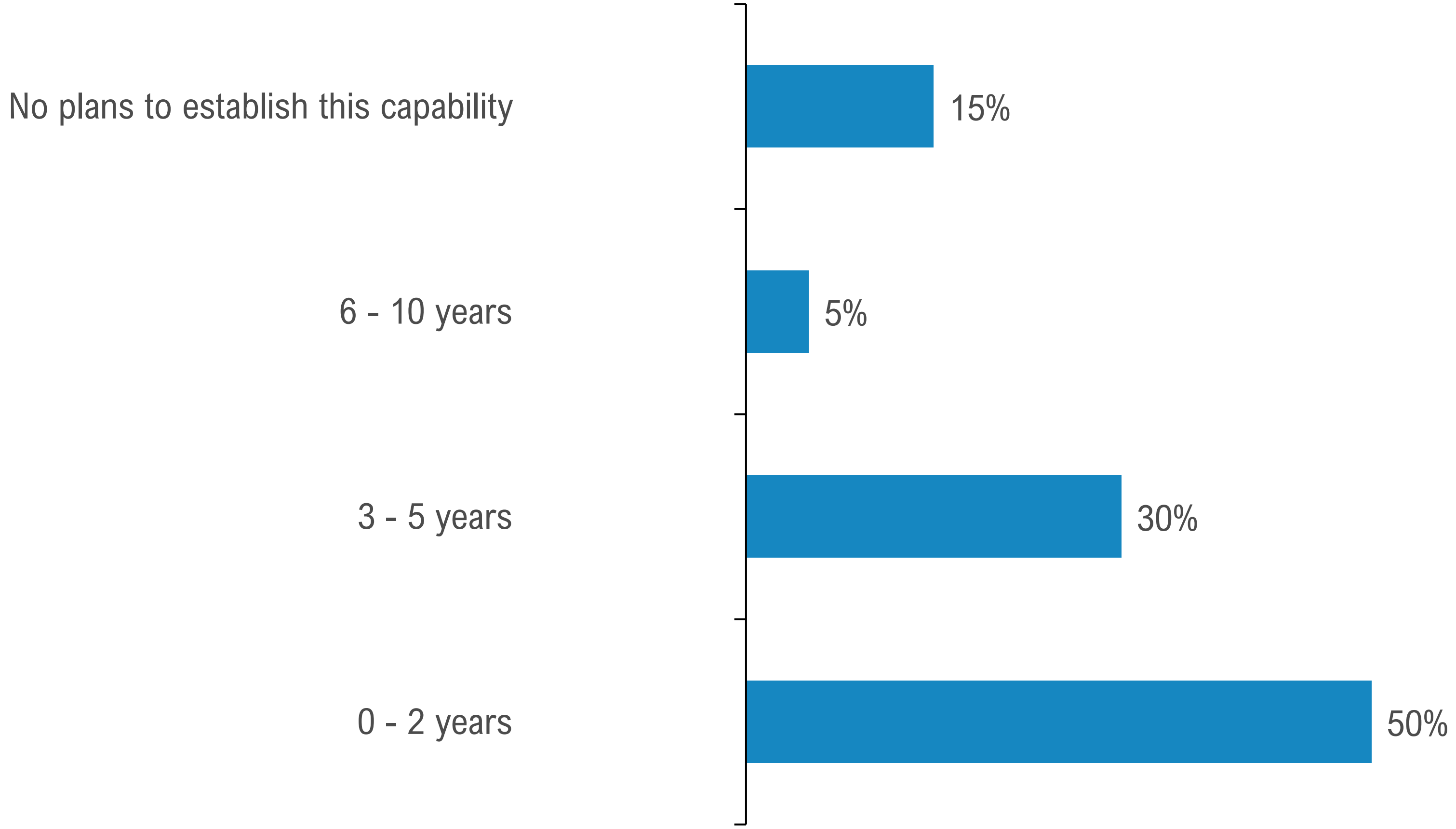
Answered questions: 66 | Skipped questions: 50

Q52: Does your lab test for Natural toxins (Mycotoxins, Phycotoxins, Algal toxins)?



Answered questions: 85 | Skipped questions: 31

Q53: Is your laboratory planning to establish this capability in



Answered questions: 20 | Skipped questions: 96

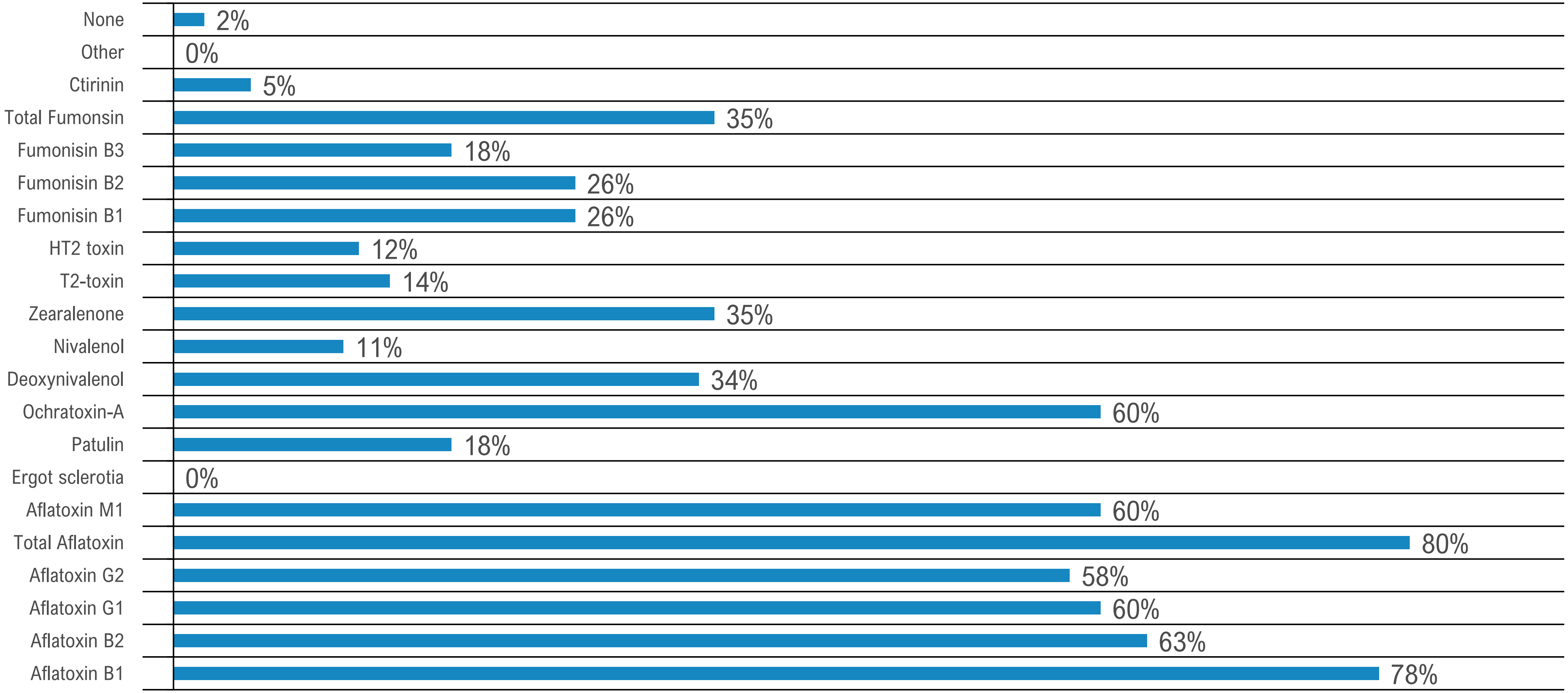
PTB
Physikalisch-Technische Bundesanstalt
National Metrology Institute

nmisa
National Metrology Institute of South Africa

AFRIMETS
Intra-Africa Metrology System
Système Intra-Africain de Métrologie

Q54: Select which toxins your laboratory is able to test for:

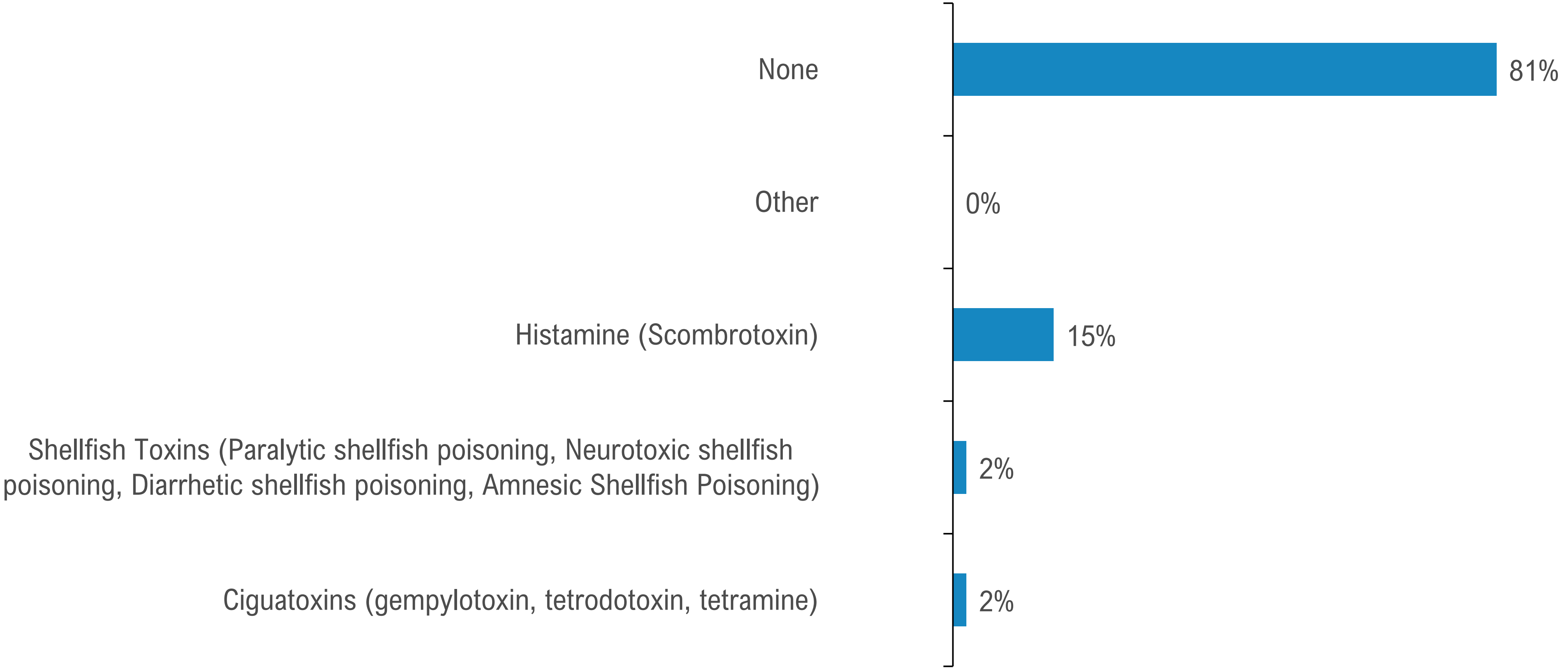
Mycotoxins



Answered questions: 65 | Skipped questions: 51

Q55: Algal Toxins

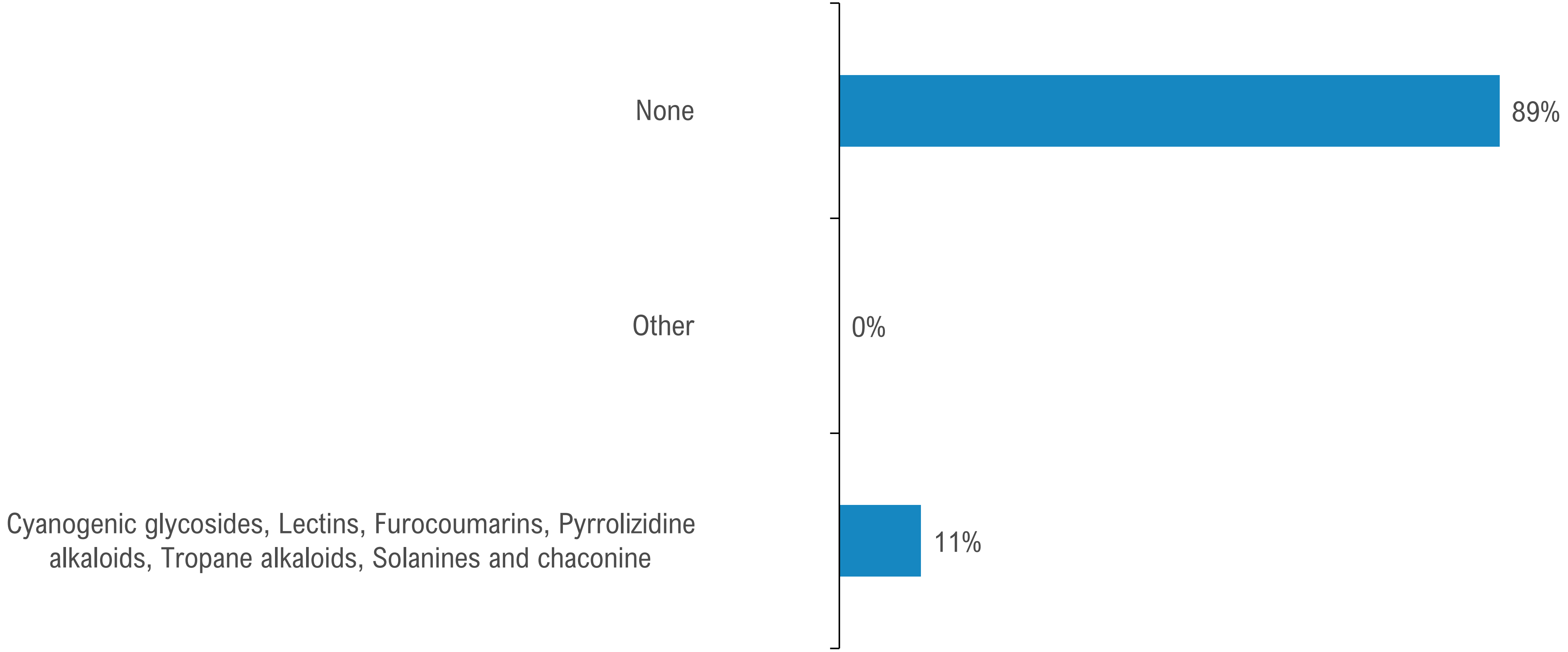
Select the toxins your laboratory is able to test for:



Answered questions: 65 | Skipped questions: 51

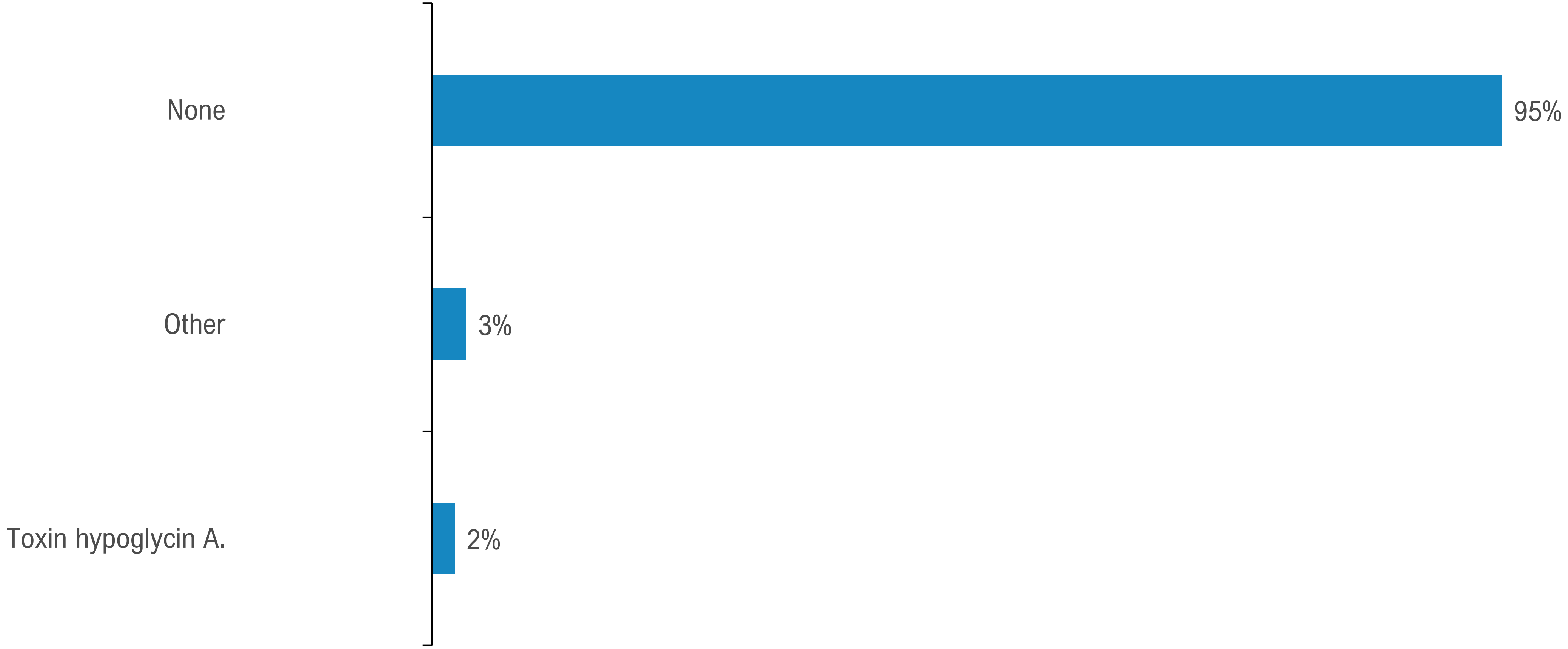
Q56: Phytotoxins

Select which toxins your laboratory is able to test for:



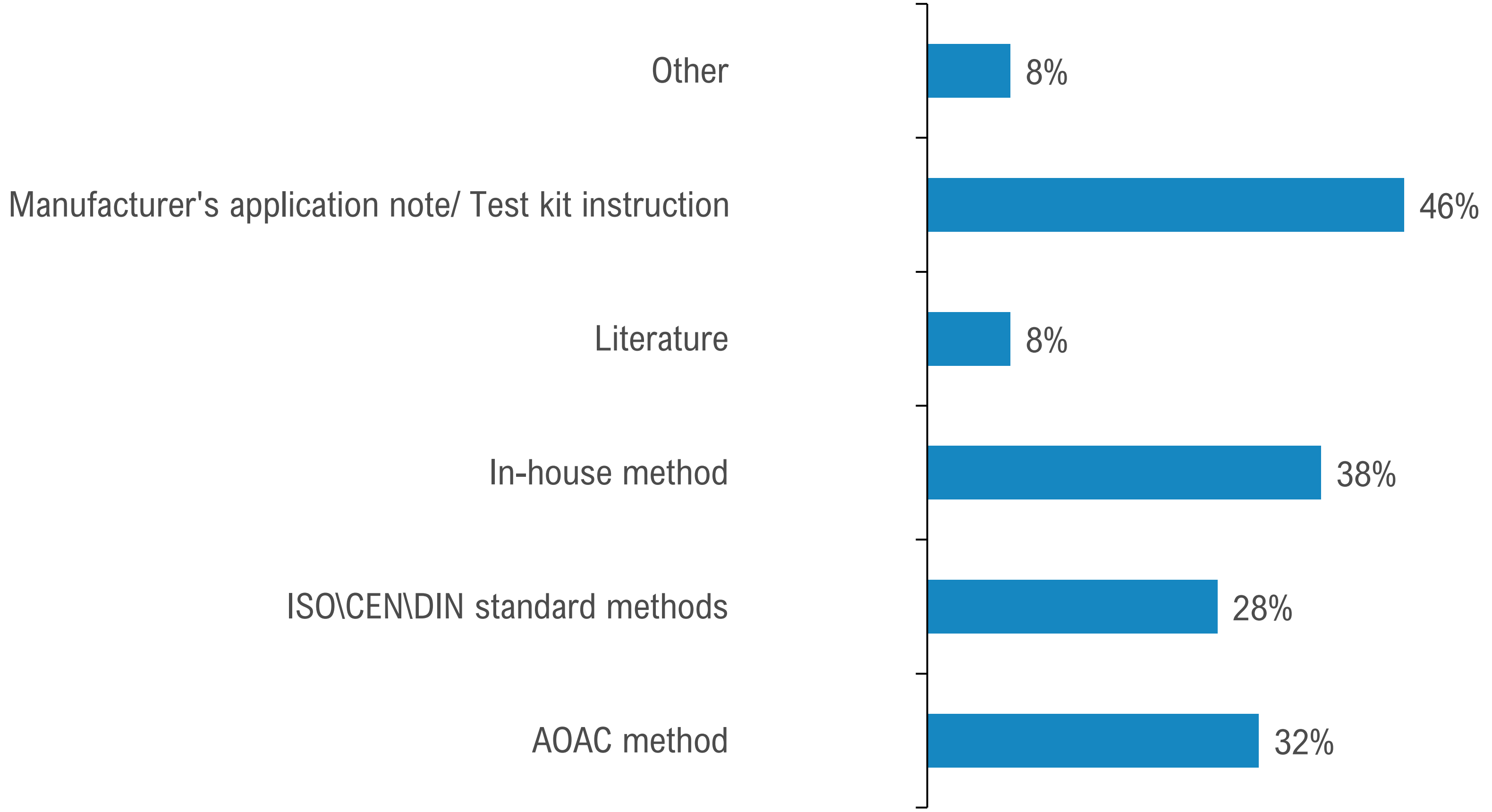
Answered questions: 65 | Skipped questions: 51

Q57: Other toxins



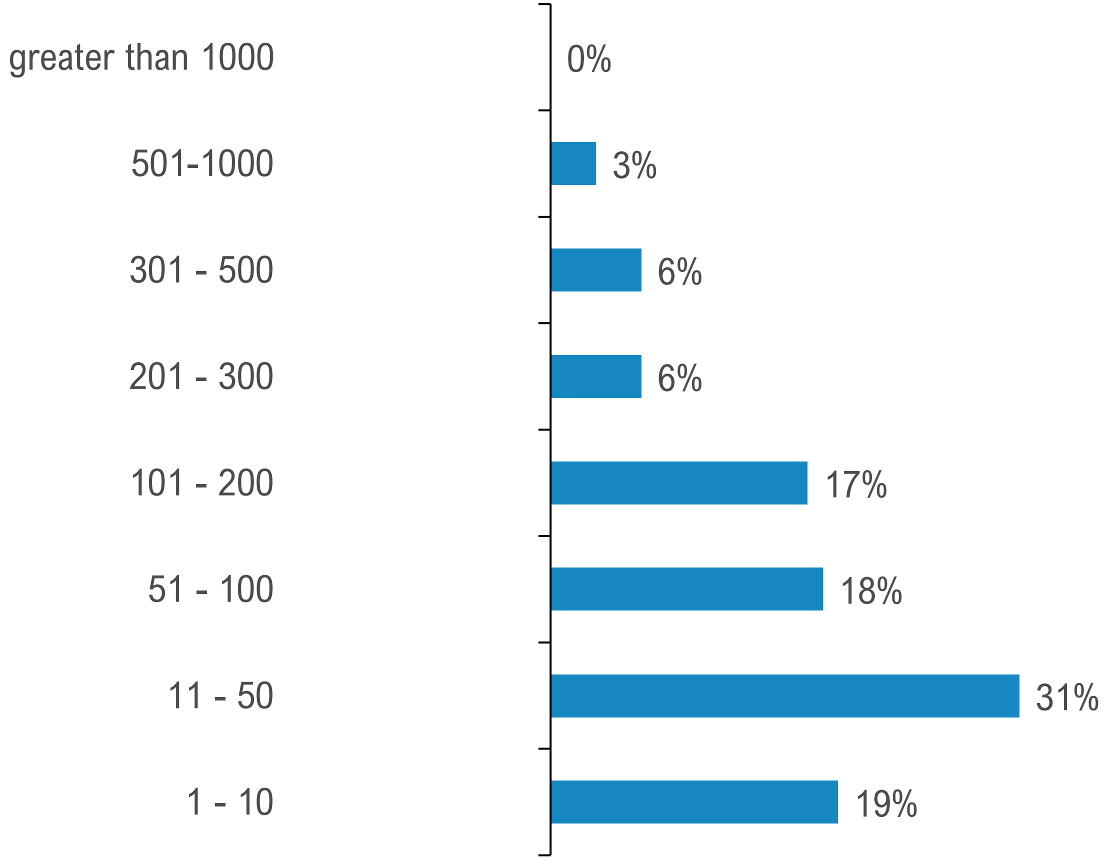
Answered questions: 65 | Skipped questions: 51

Q59: Analytical methods



Answered questions: 65 | Skipped questions: 51

Q98: Number of samples analysed per month

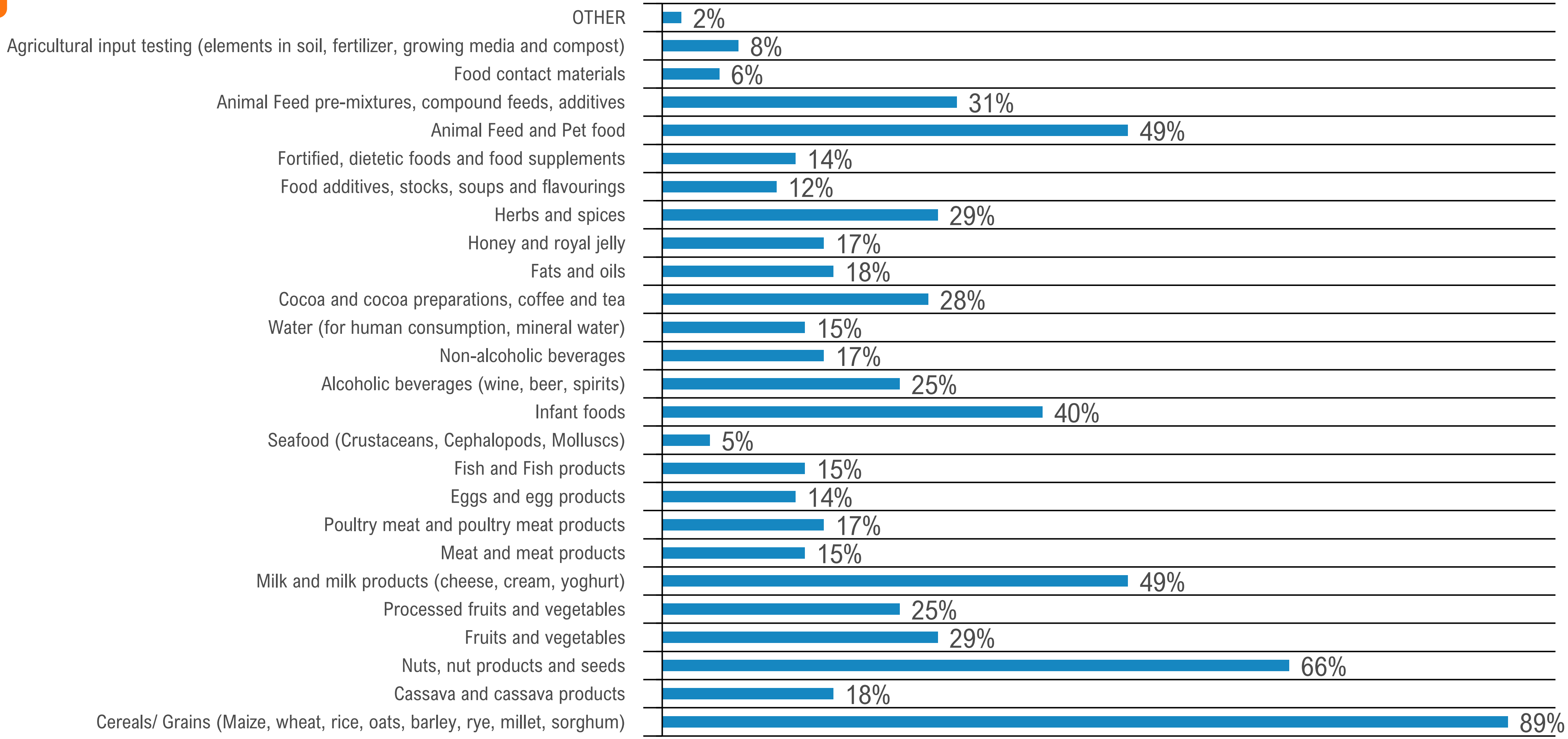


Answered questions: 65 | Skipped questions: 51

Q61: Automated sample preparation

Answered questions: 64 | Skipped questions: 52

Q90: Select the applicable food categories tested in your laboratory (for mycotoxins)



Answered questions: 65 | Skipped questions: 51

Q240: Analysis for clients

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Private clients	15% (10)	18% (12)	11% (7)	8% (5)	48% (31)	65
Inspection	29% (19)	25% (16)	18% (12)	17% (11)	11% (7)	65
Monitoring	25% (16)	20% (13)	18% (12)	20% (13)	17% (11)	65
Exports	38% (25)	24% (16)	18% (12)	11% (7)	9% (6)	66

Answered questions: 65 | Skipped questions: 51

Q240: Analysis for clients

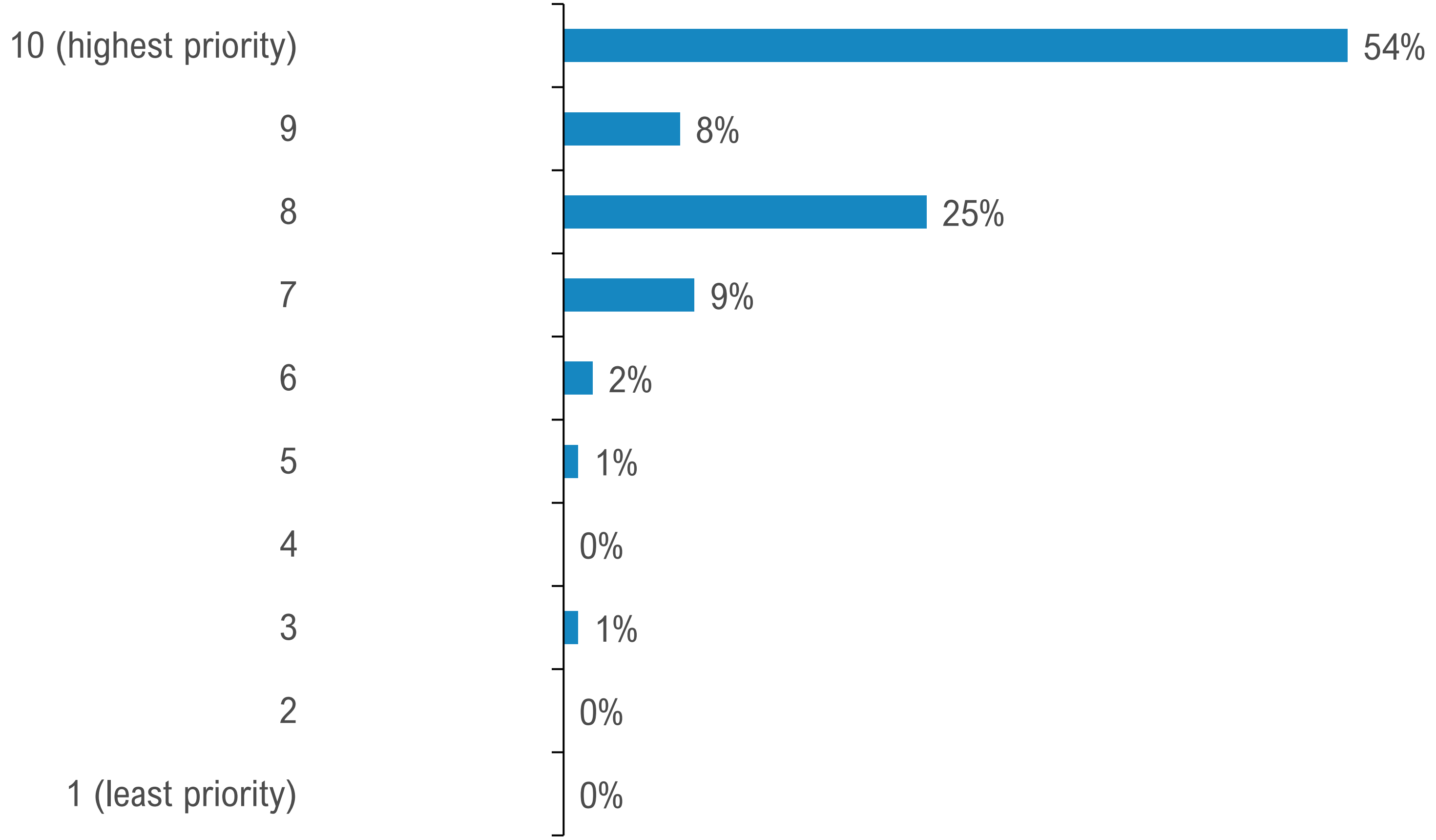
Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Imports	42% (27)	22% (14)	8% (5)	14% (9)	15% (10)	65
Internal testing	26% (17)	18% (12)	15% (10)	11% (7)	29% (19)	65

Answered questions: 65 | Skipped questions: 51

Q66: The importance of the need (ability) to perform these analyses in your country

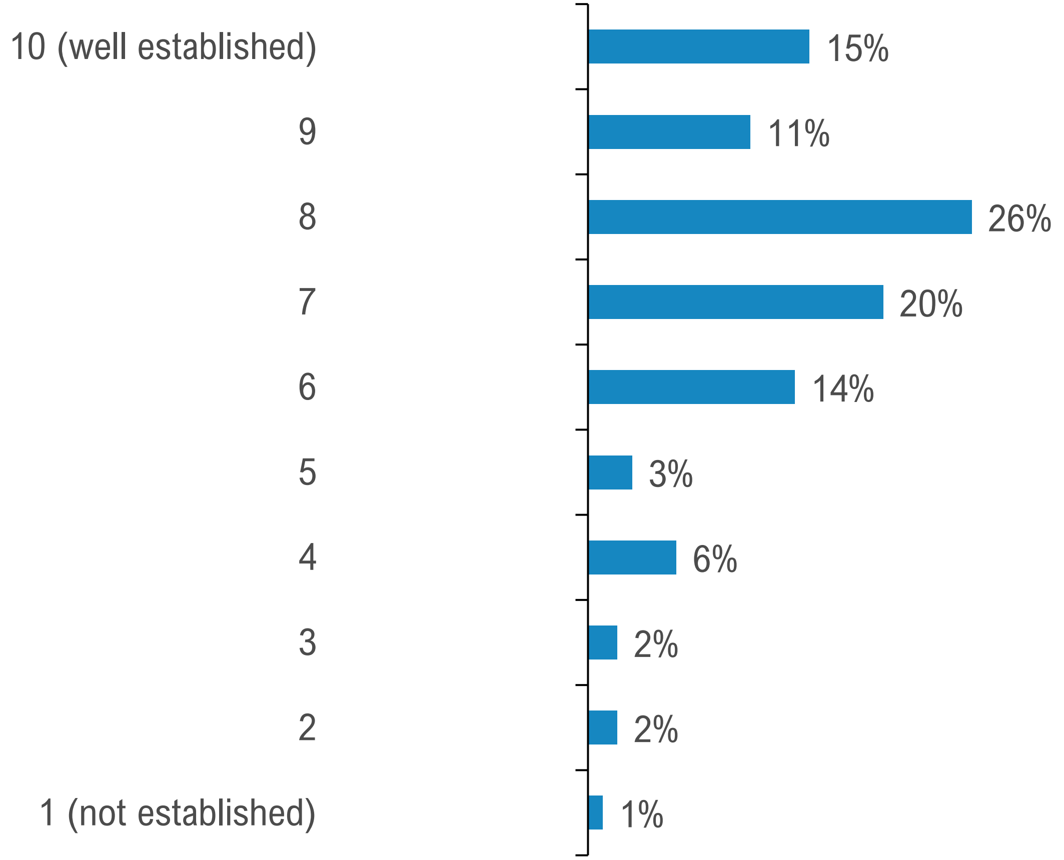
Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority



Answered questions: 65 | Skipped questions: 51

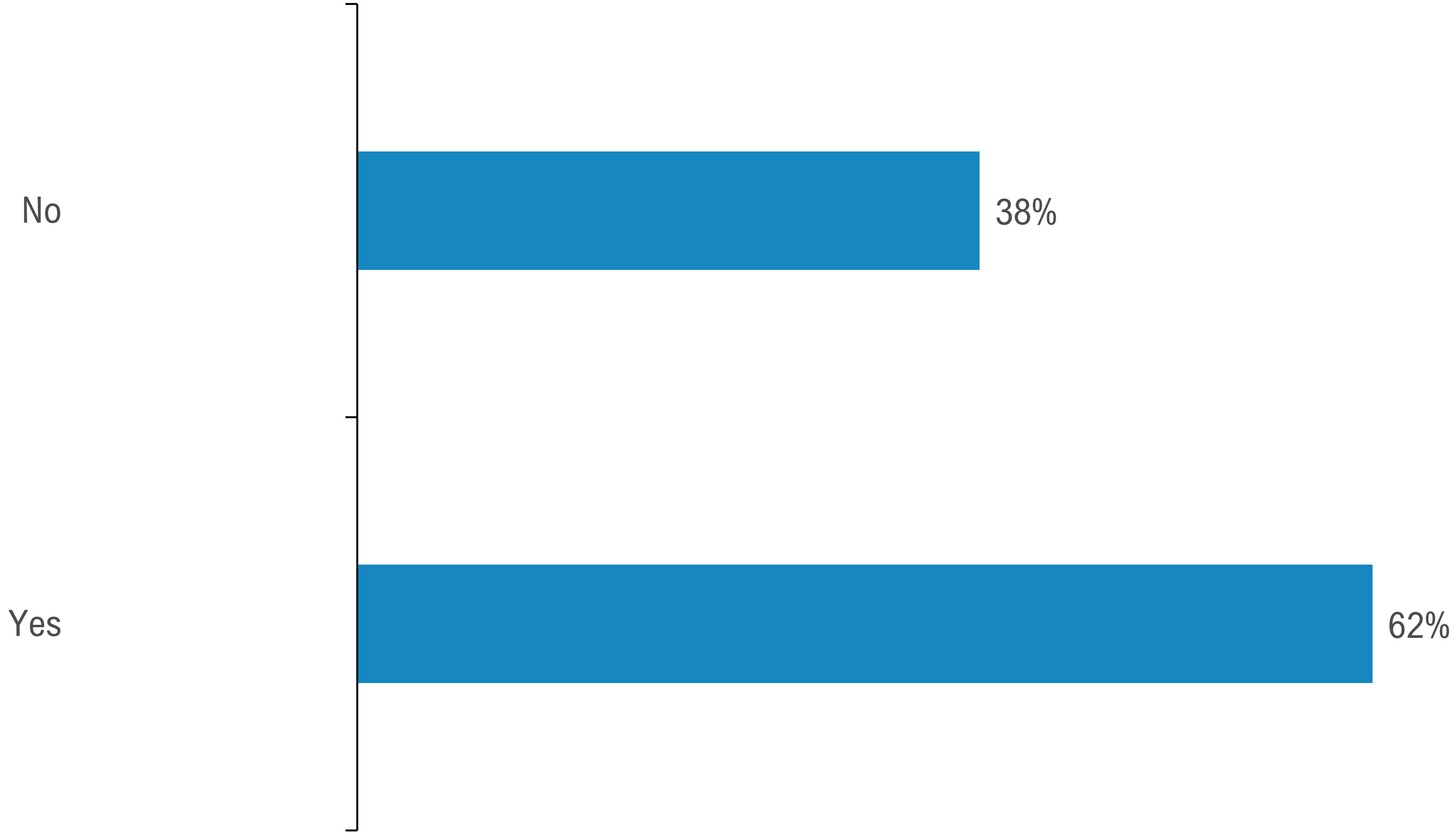
Q67: The degree to which the measurement capability for this analysis is established in your institute

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established



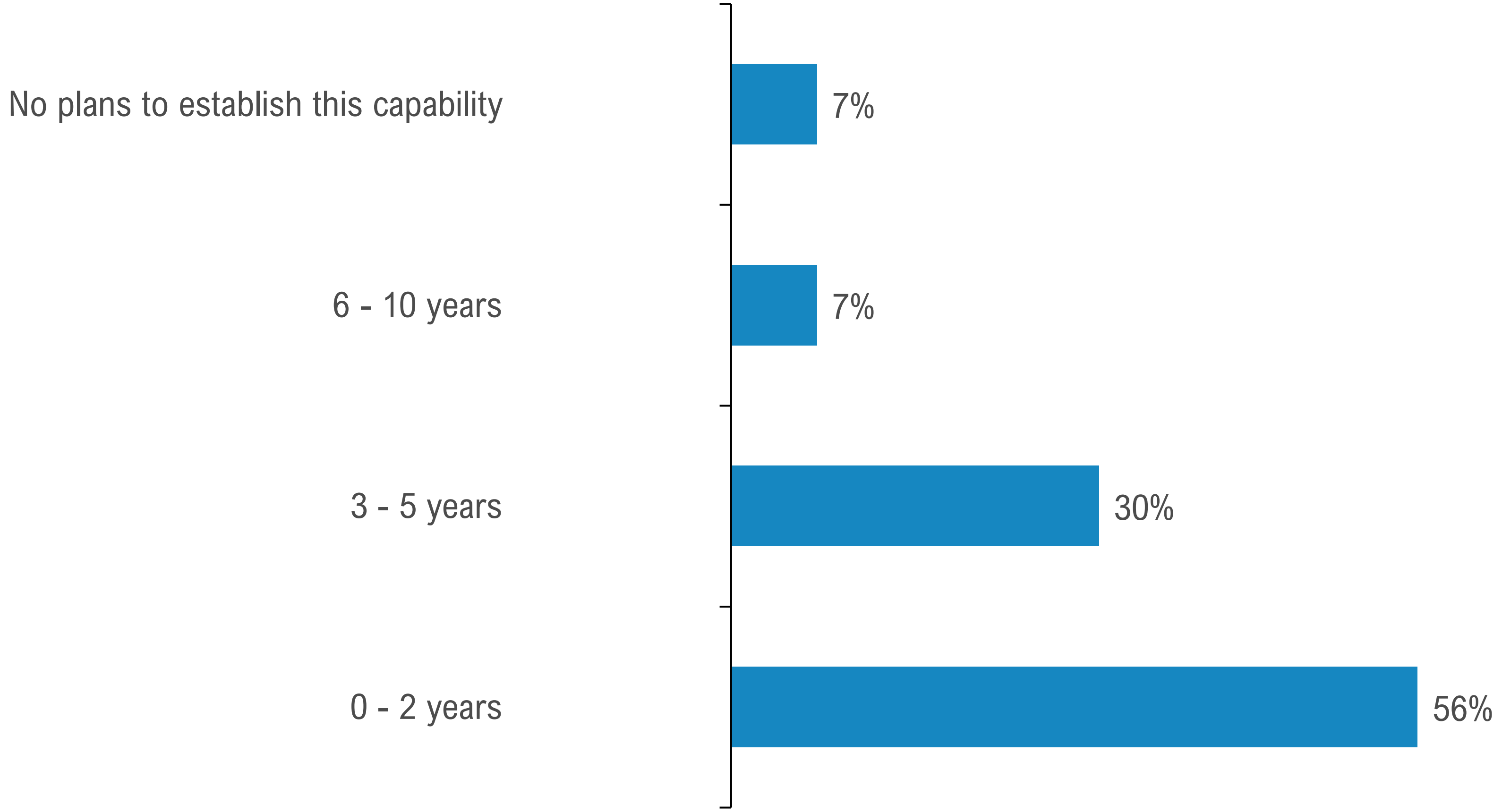
Answered questions: 65 | Skipped questions: 51

Q68: Does your lab test for Pesticides



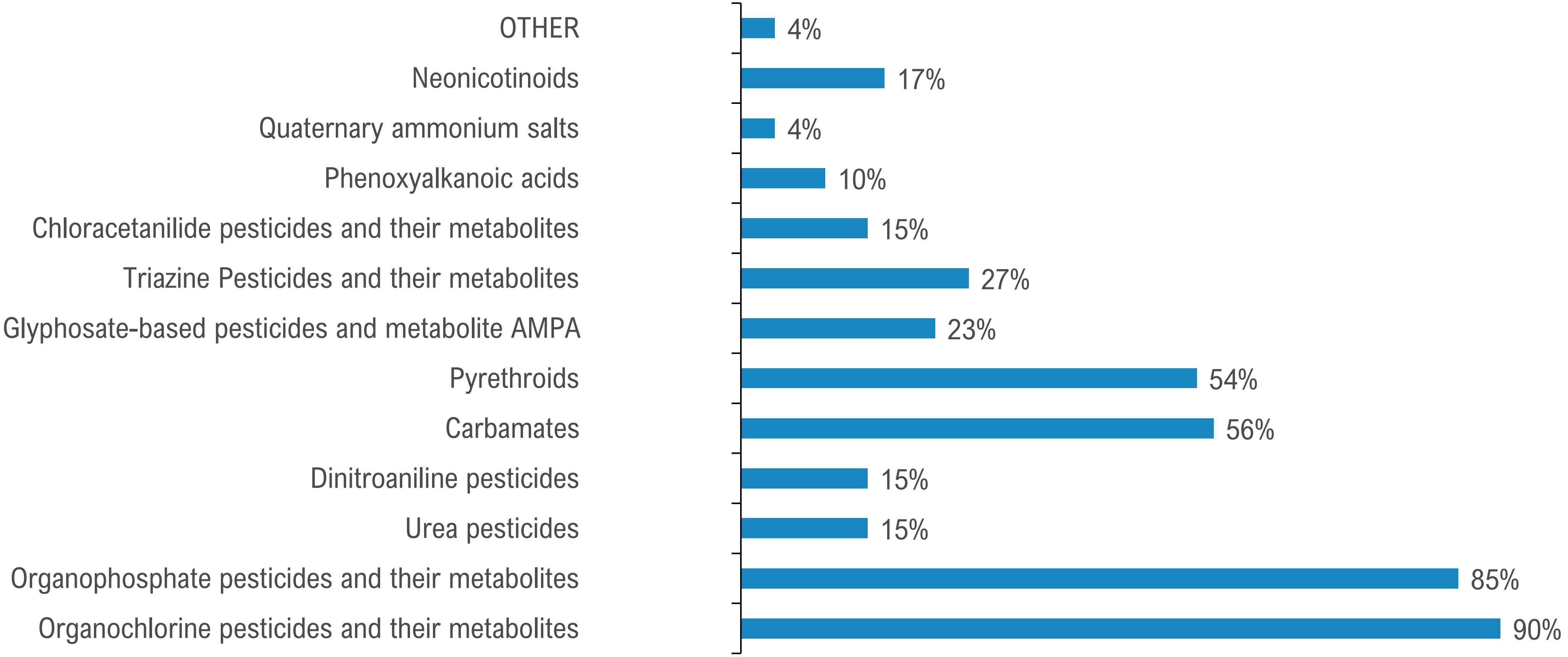
Answered questions: 78 | Skipped questions: 38

Q69: Is your laboratory planning to establish this capability in



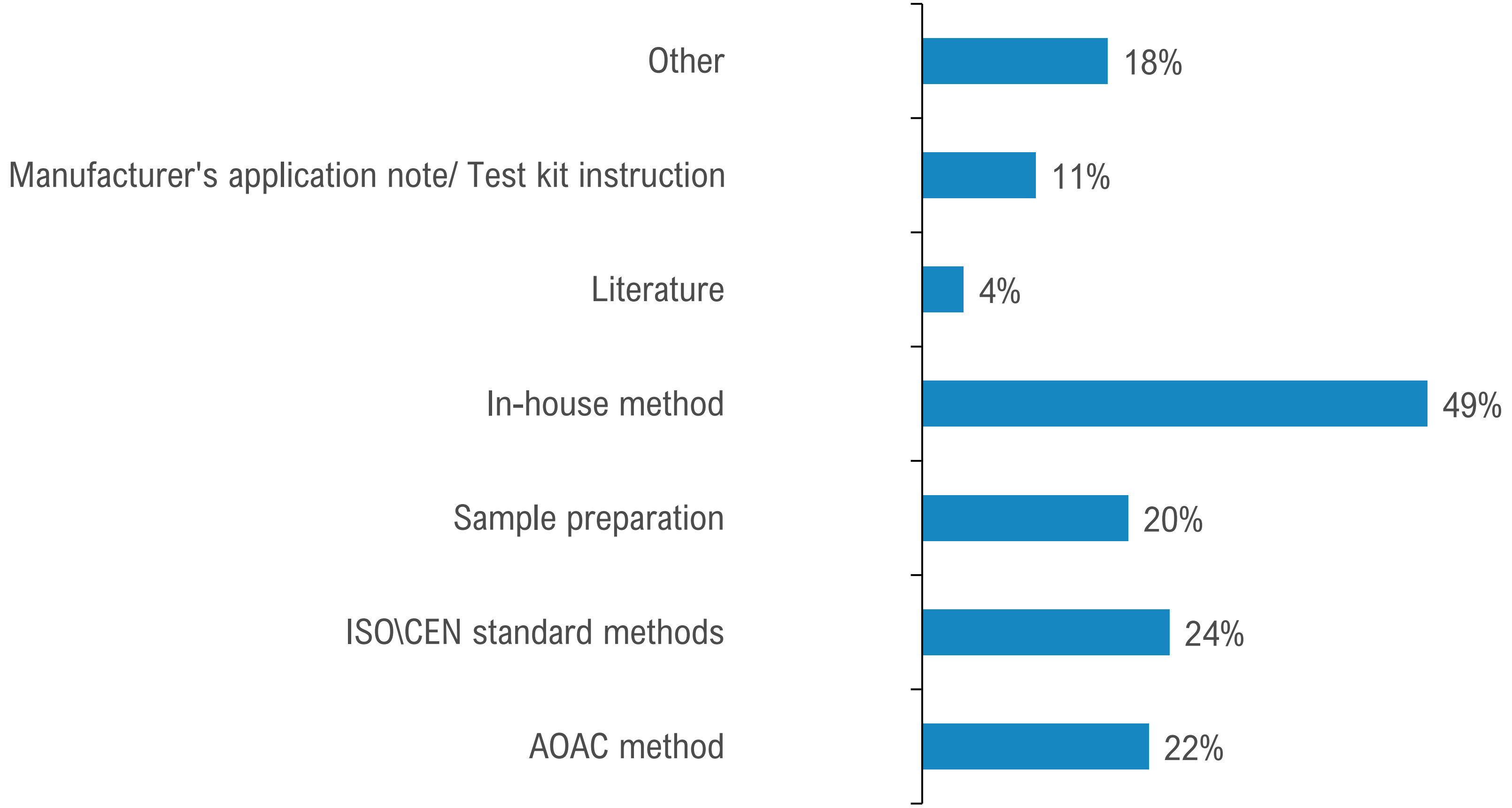
Answered questions: 30 | Skipped questions: 86

Q70: Select which pesticide categories your laboratory is able to test for



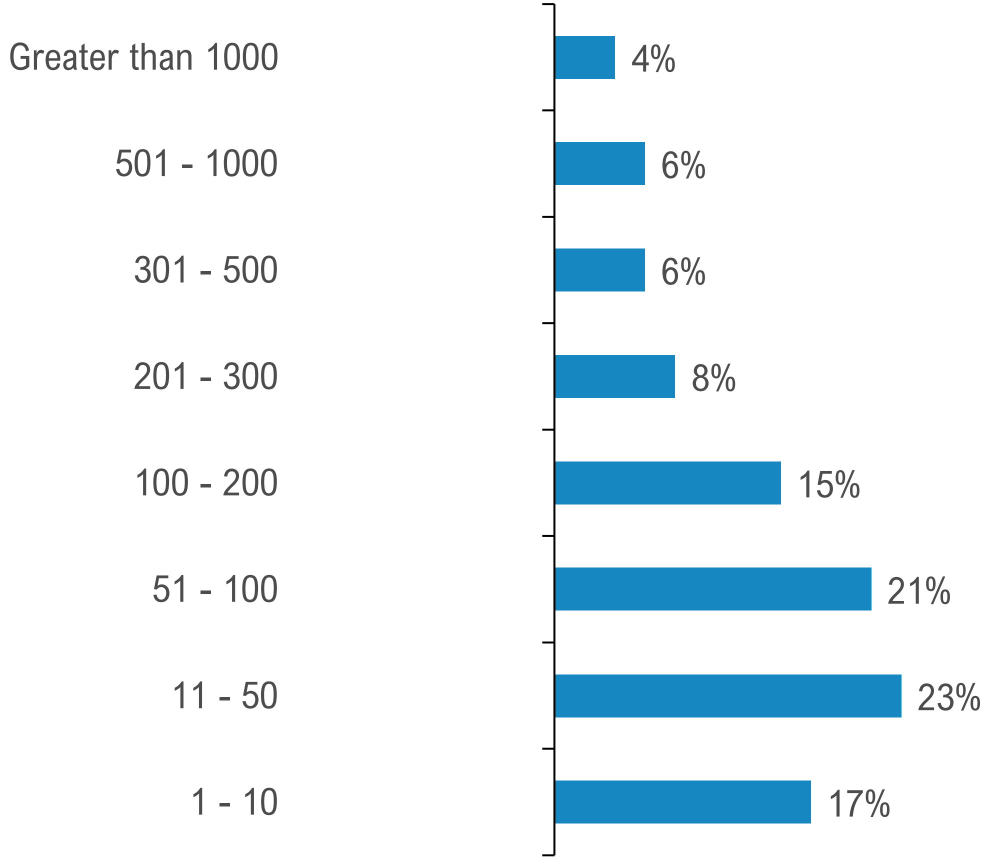
Answered questions: 48 | Skipped questions: 68

Q261: Analytical methods



Answered questions: 45 | Skipped questions: 71

Q100: Number of samples analysed

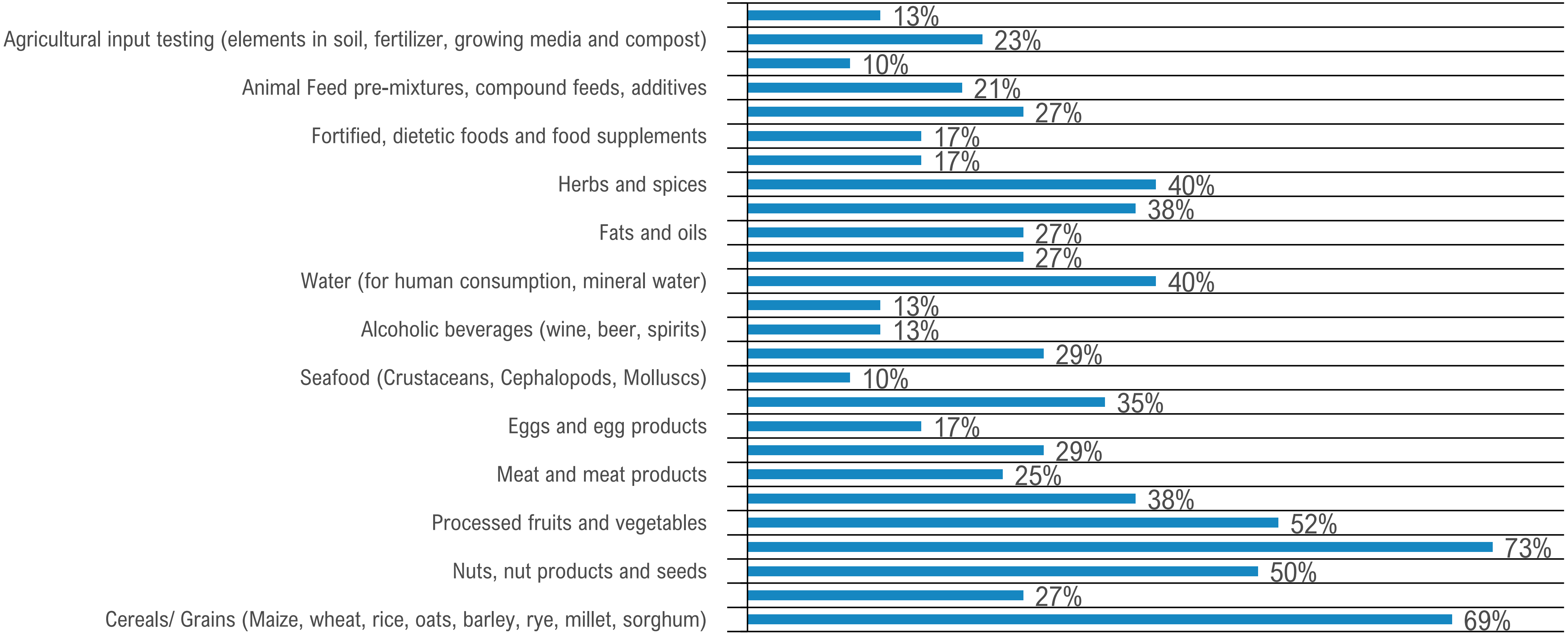


Answered questions: 48 | Skipped questions: 68

Q75: Automated sample preparation

Answered questions: 47 | Skipped questions: 69

Q76: Please select sample types for pesticide analysis



Answered questions: 48 | Skipped questions: 68

Q242: Analysis for clients

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Private clients	21% (10)	13% (6)	10% (5)	17% (8)	40% (19)	48
Inspection	33% (16)	12% (6)	24% (12)	20% (10)	10% (5)	49
Monitoring	27% (13)	17% (8)	23% (11)	13% (6)	21% (10)	48
Exports	27% (13)	21% (10)	19% (9)	17% (8)	17% (8)	48

Answered questions: 48 | Skipped questions: 68

Q242: Analysis for clients

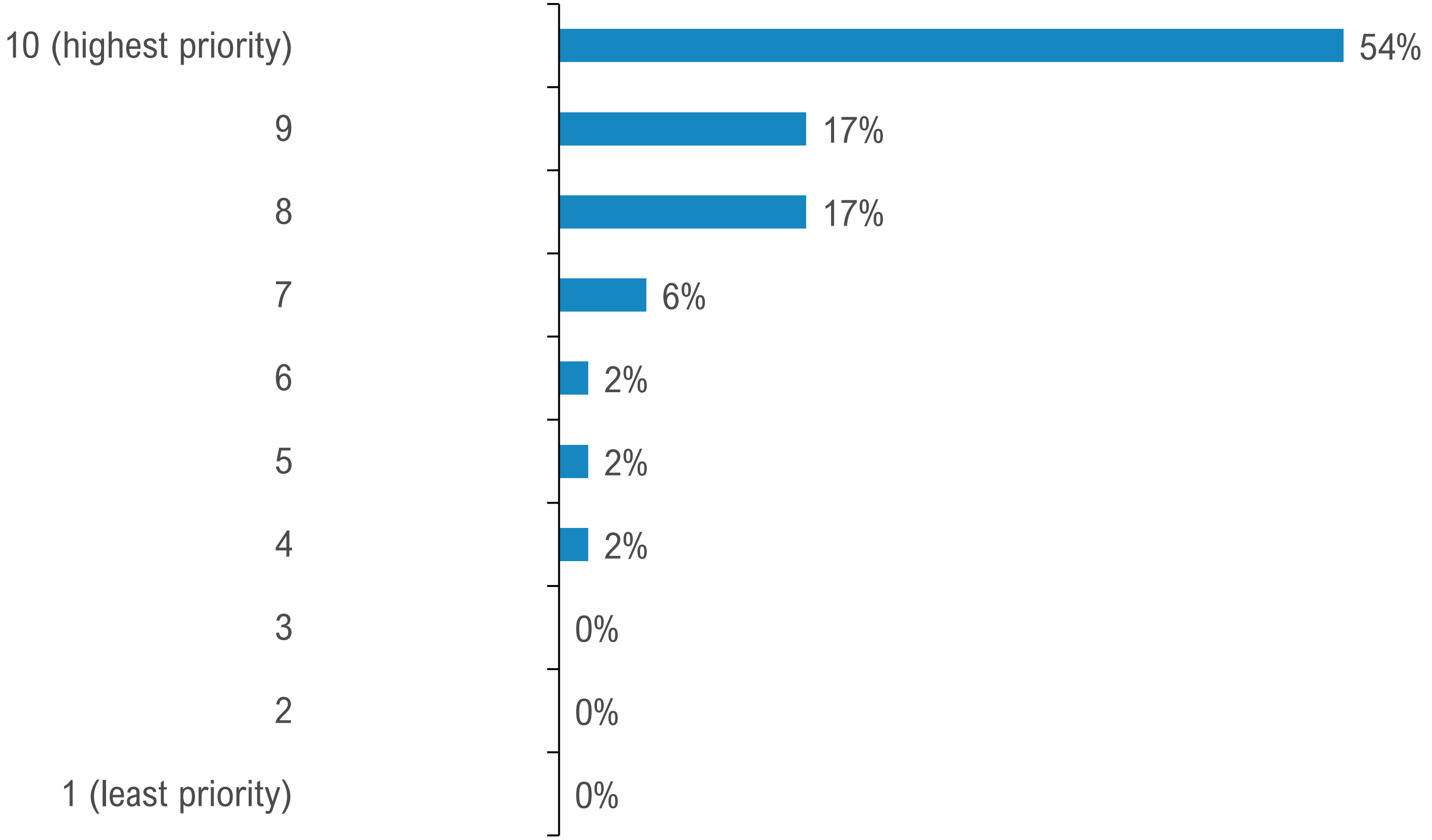
Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Imports	40% (19)	25% (12)	15% (7)	13% (6)	8% (4)	48
Internal testing	25% (12)	15% (7)	21% (10)	15% (7)	25% (12)	48

Answered questions: 48 | Skipped questions: 68

Q81: The importance of the need (ability) to perform these analyses in your country

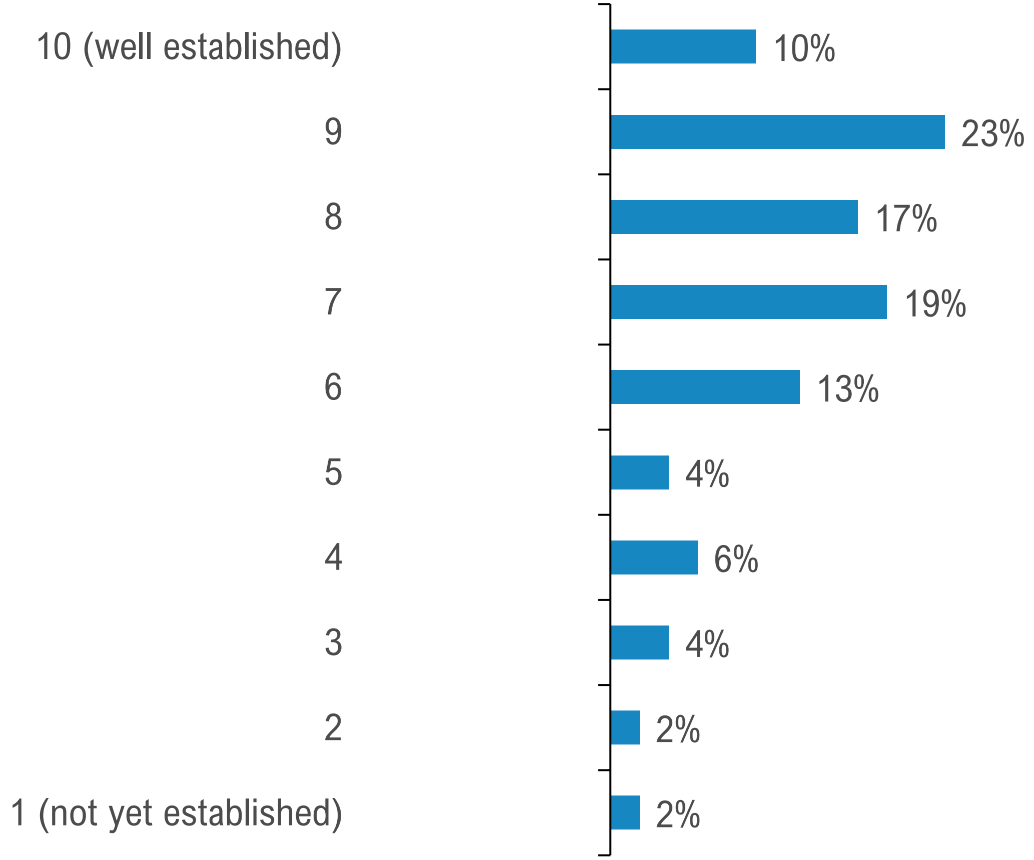
Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority



Answered questions: 48 | Skipped questions: 68

Q82: The degree to which the measurement capability for this analysis is established in your institute

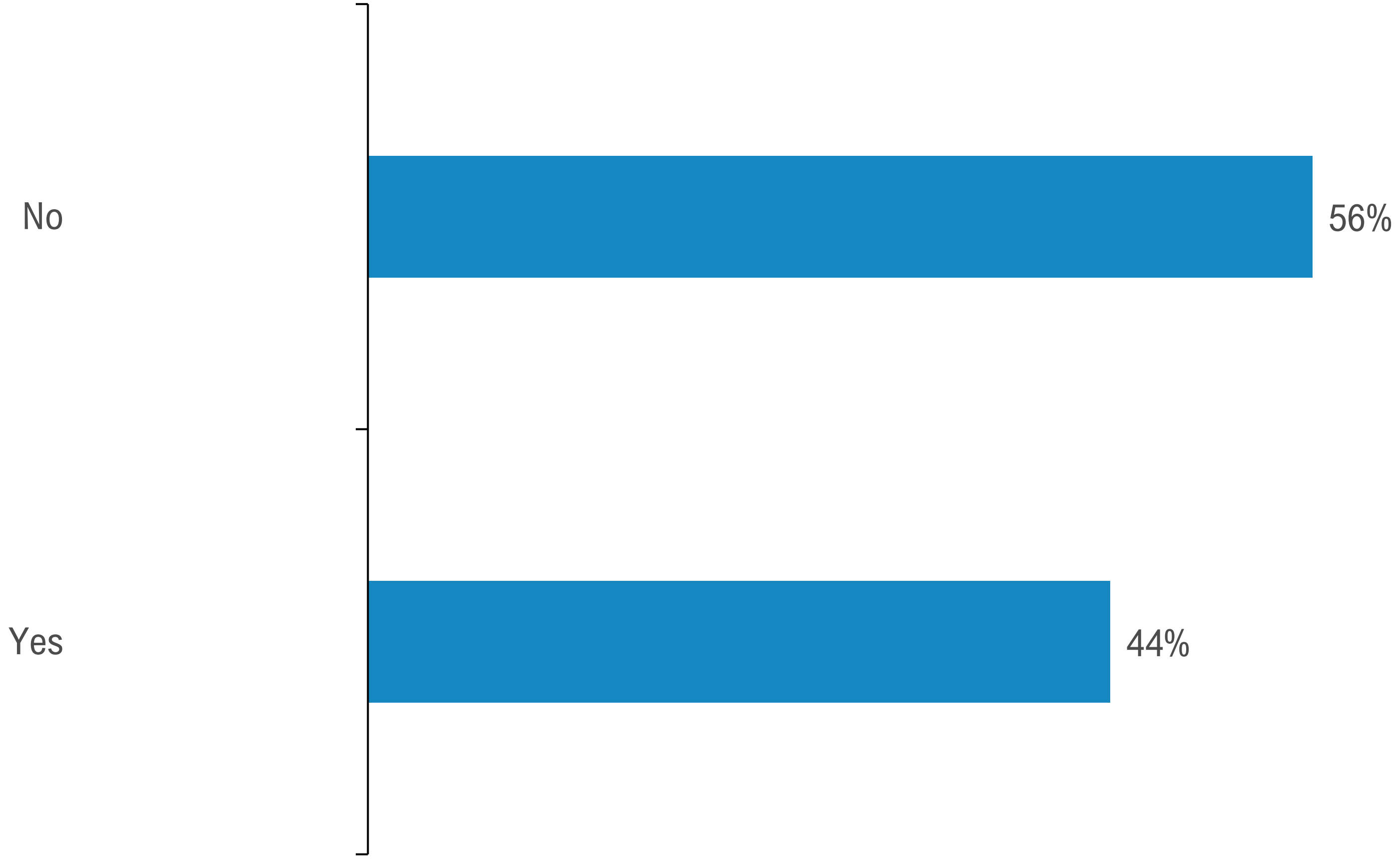
Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established



Answered questions: 48 | Skipped questions: 68

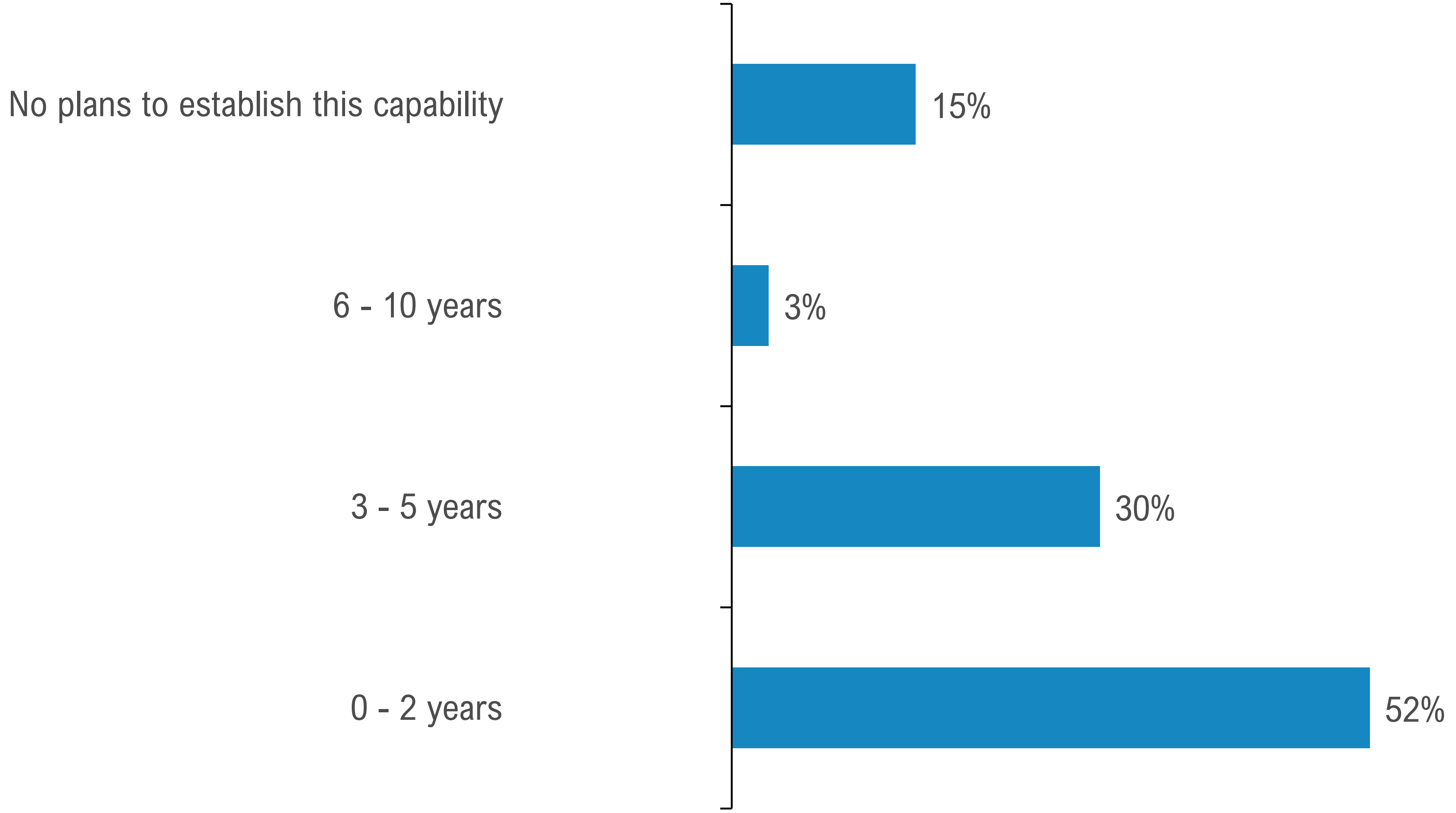
Q83: Does your lab test for Veterinary drug residues and metabolites

Résidus et métabolites de médicaments vétérinaires



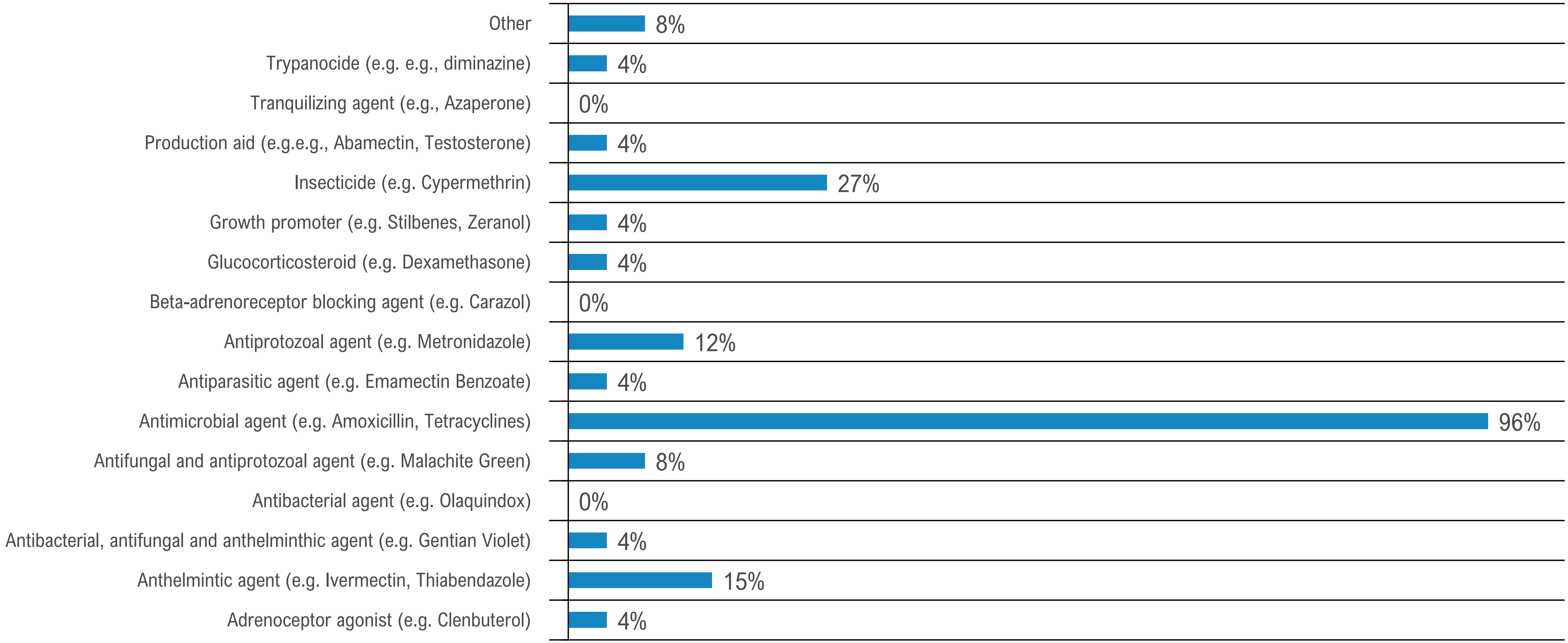
Answered questions: 59 | Skipped questions: 57

Q84: Is your laboratory planning to establish this capability in



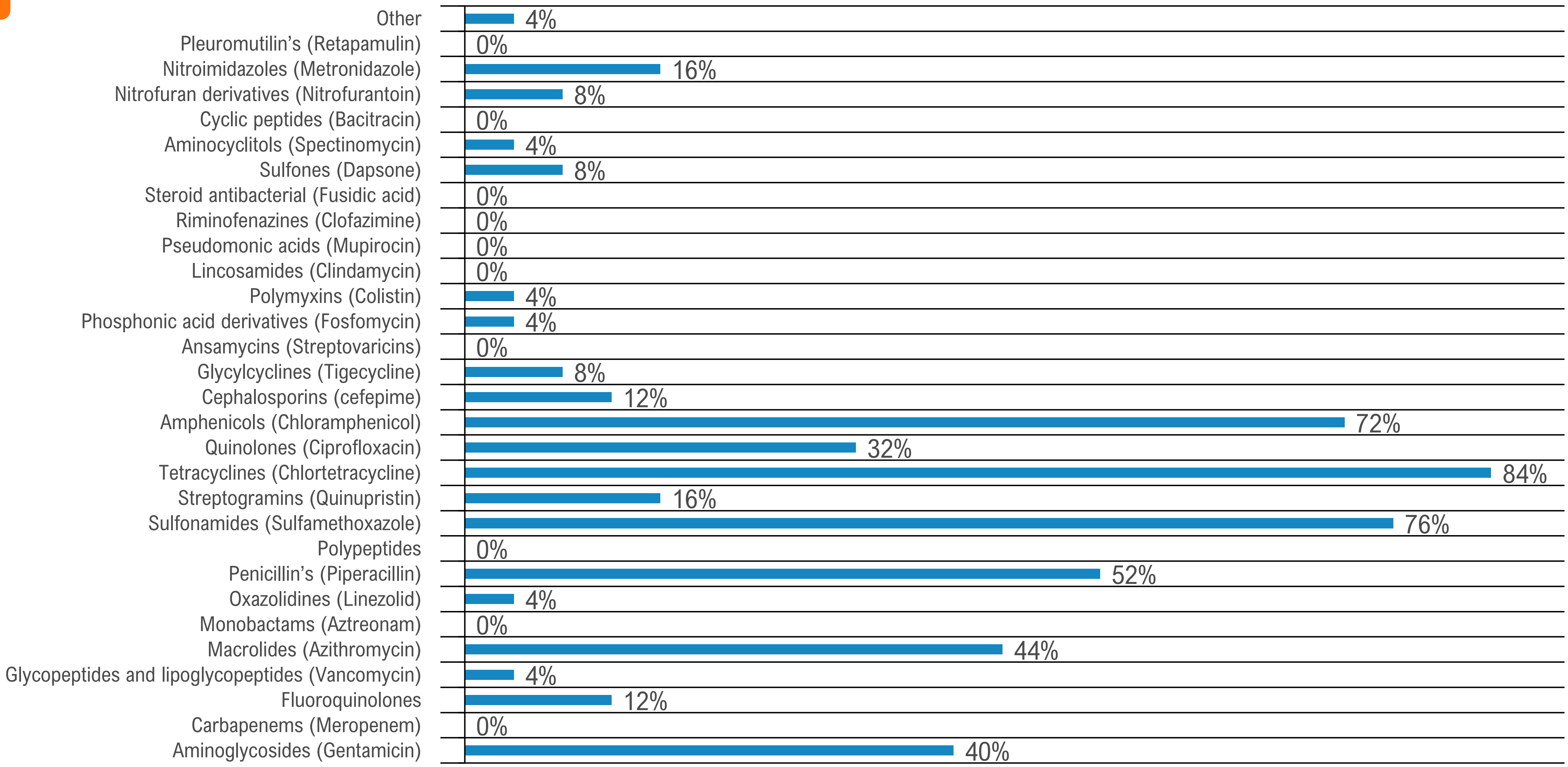
Answered questions: 33 | Skipped questions: 83

Q97: Please indicate which class of veterinary drugs your laboratory is able to test for



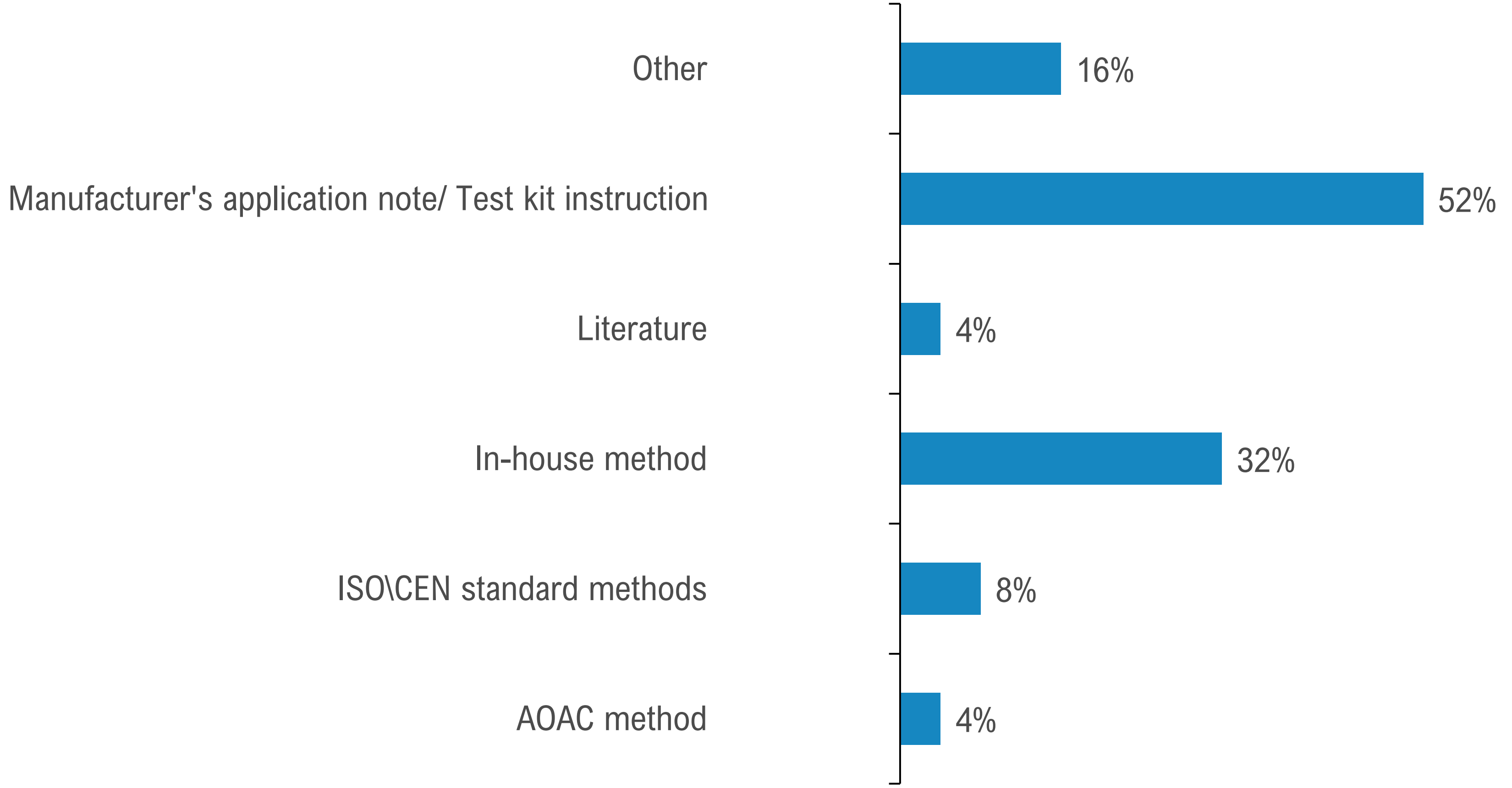
Answered questions: 26 | Skipped questions: 90

Q271: Please indicate which antimicrobials/antibiotics your laboratory is able to test.



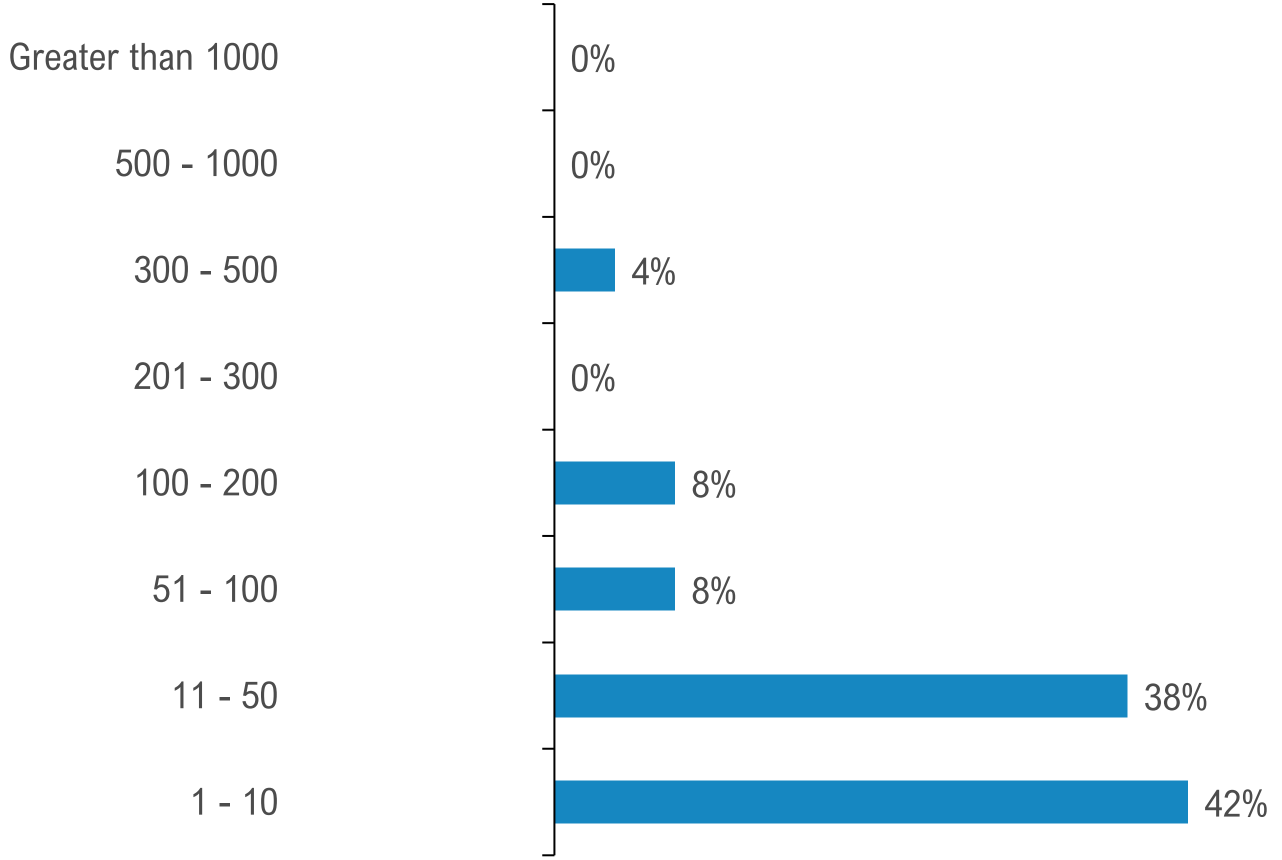
Answered questions: 25 | Skipped questions: 91

Q262: Analytical methods



Answered questions: 25 | Skipped questions: 91

Q87: Number of samples analysed per month



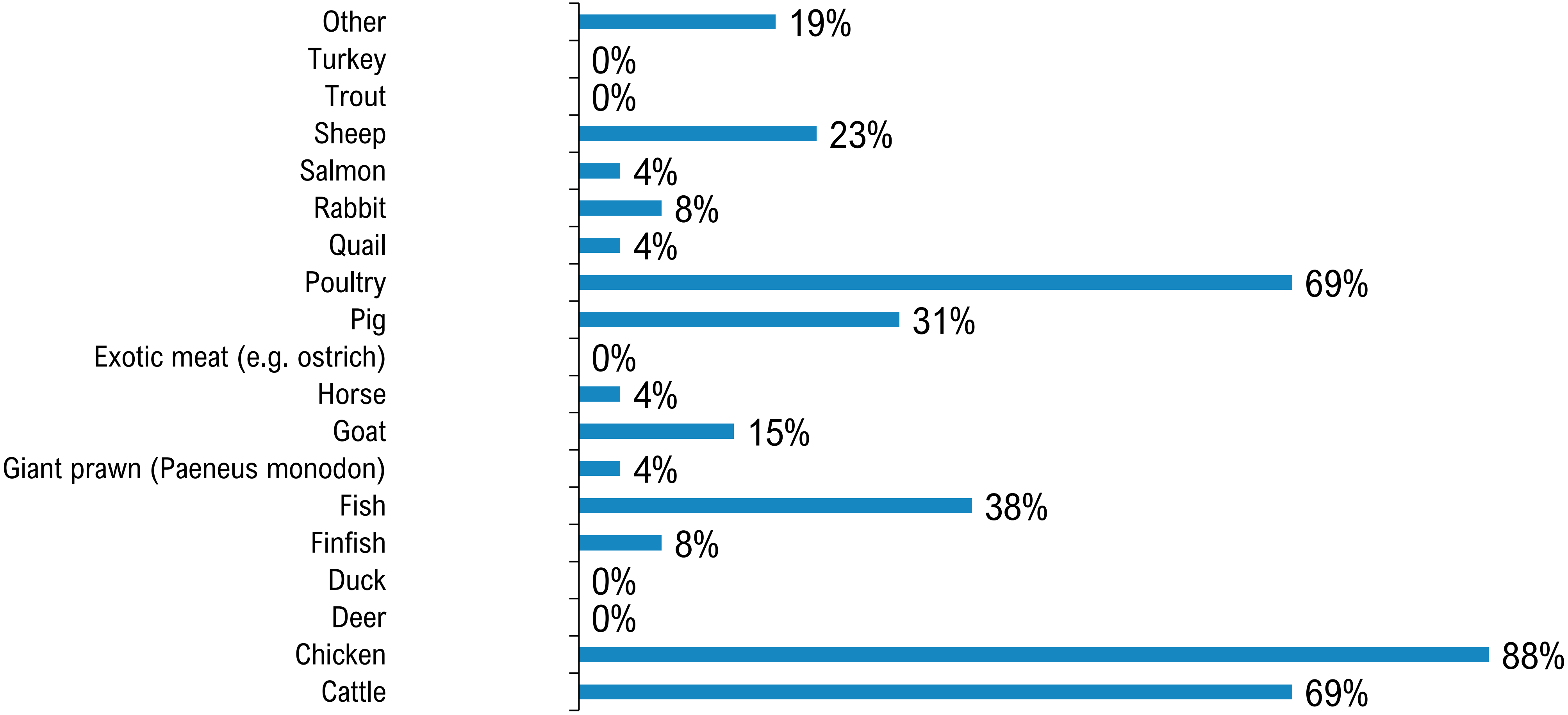
Answered questions: 26 | Skipped questions: 90

Q88: Automated sample preparation

Answered questions: 25 | Skipped questions: 91

Q95: Sample matrix

Please indicate which samples are extracted for drug residues



Answered questions: 26 | Skipped questions: 90

Q247: Analysis for clients

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Private clients	31% (8)	19% (5)	15% (4)	8% (2)	27% (7)	26
Inspection	35% (9)	19% (5)	19% (5)	12% (3)	15% (4)	26
Monitoring	27% (7)	12% (3)	27% (7)	12% (3)	23% (6)	26
Exports	58% (15)	19% (5)	15% (4)	8% (2)	0% (0)	26

Answered questions: 26 | Skipped questions: 90

Q247: Analysis for clients

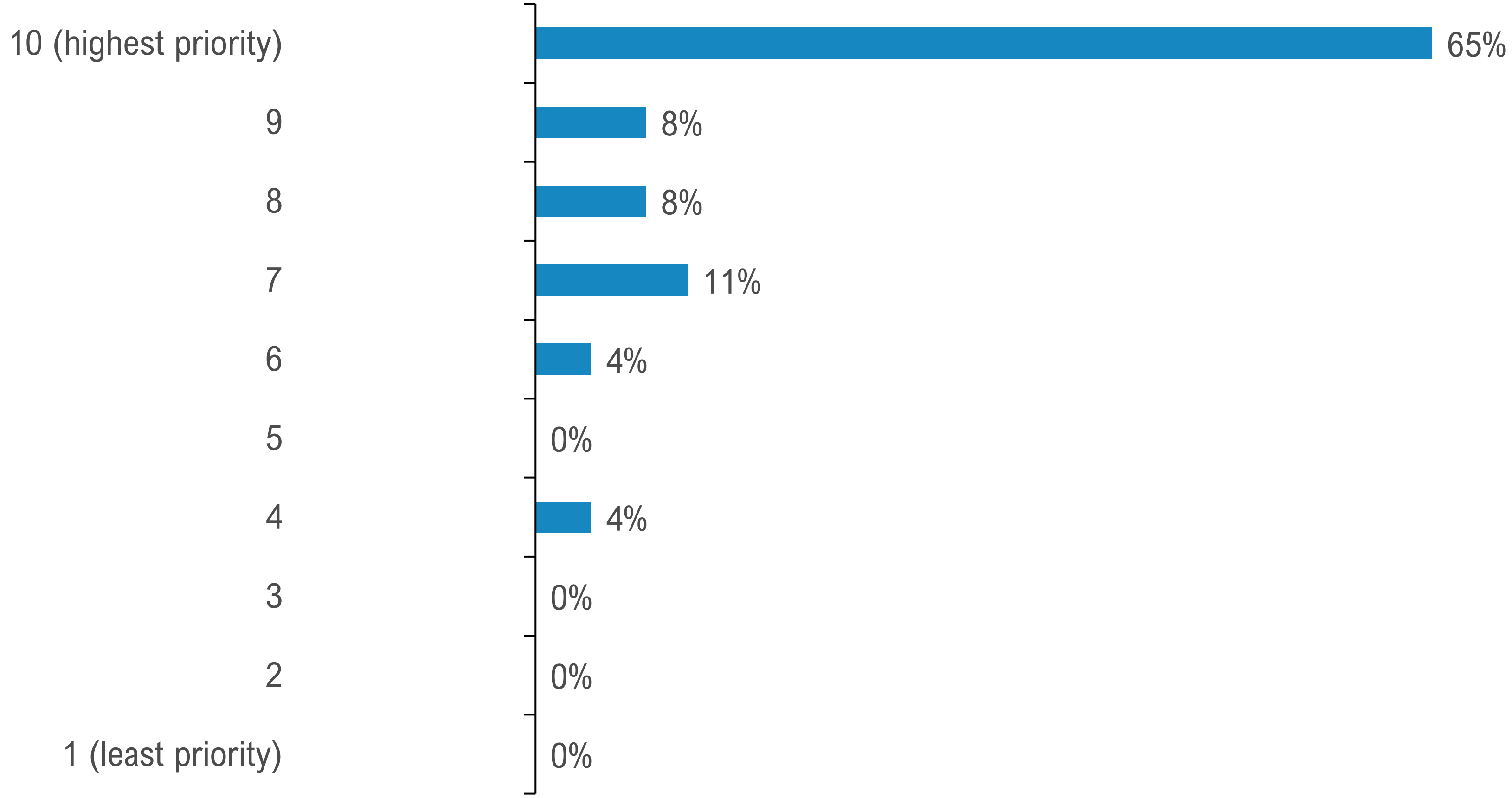
Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Imports	58% (15)	19% (5)	15% (4)	8% (2)	0% (0)	26
Internal testing	11% (3)	14% (4)	39% (11)	14% (4)	21% (6)	28

Answered questions: 26 | Skipped questions: 90

Q104: The importance of the need (ability) to perform these analyses in your country

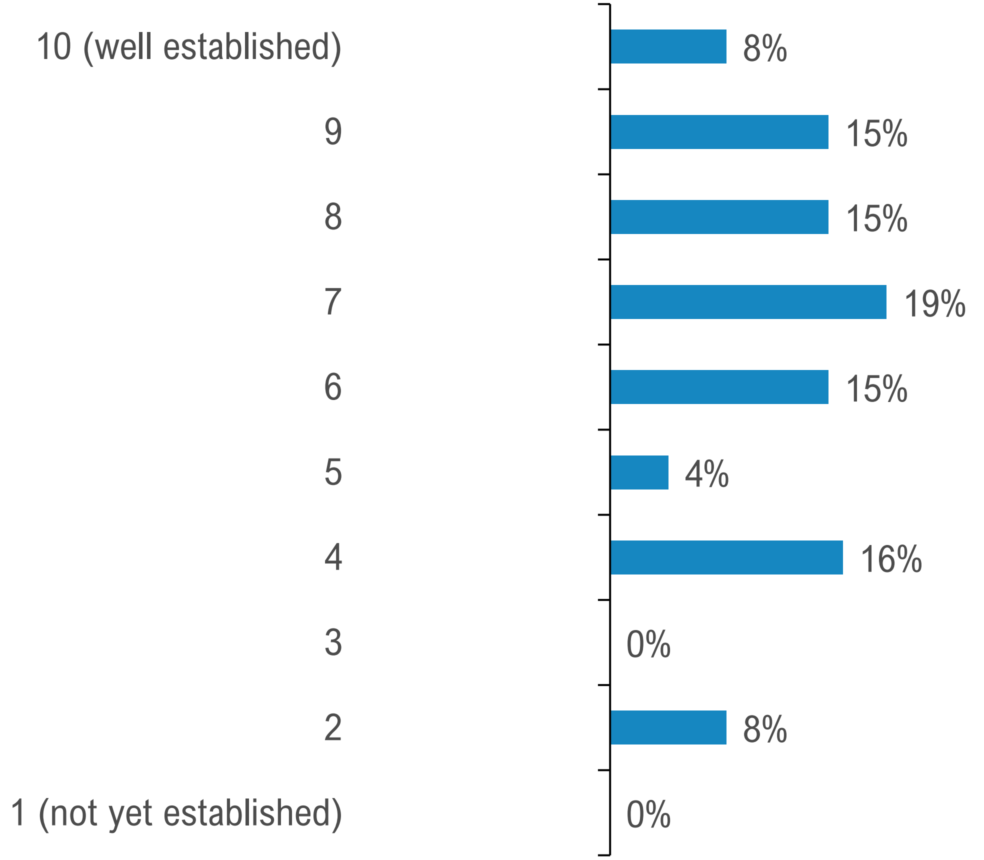
Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority



Answered questions: 26 | Skipped questions: 90

Q105: The degree to which the measurement capability for this analysis is established in your institute

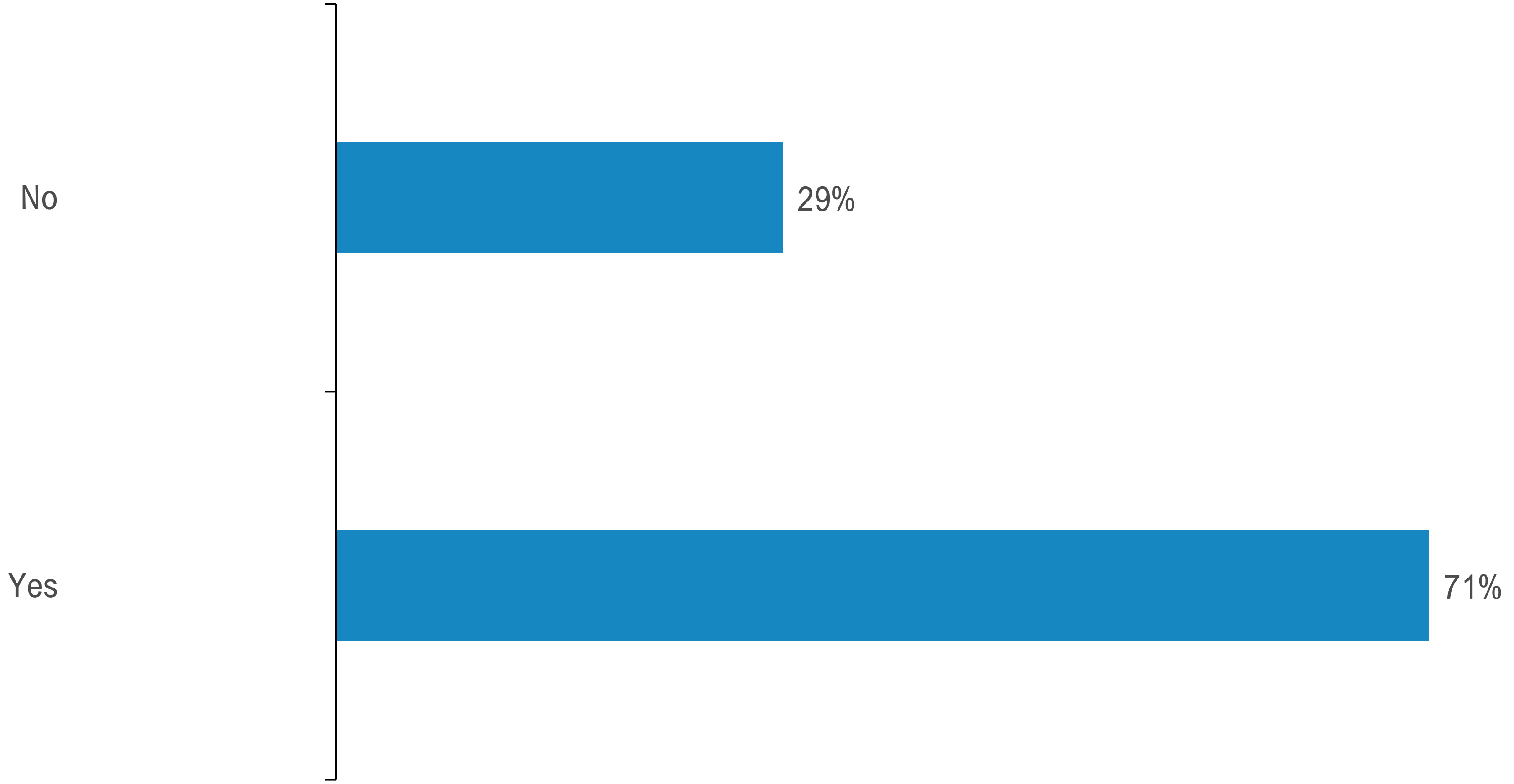
Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established



Answered questions: 26 | Skipped questions: 90

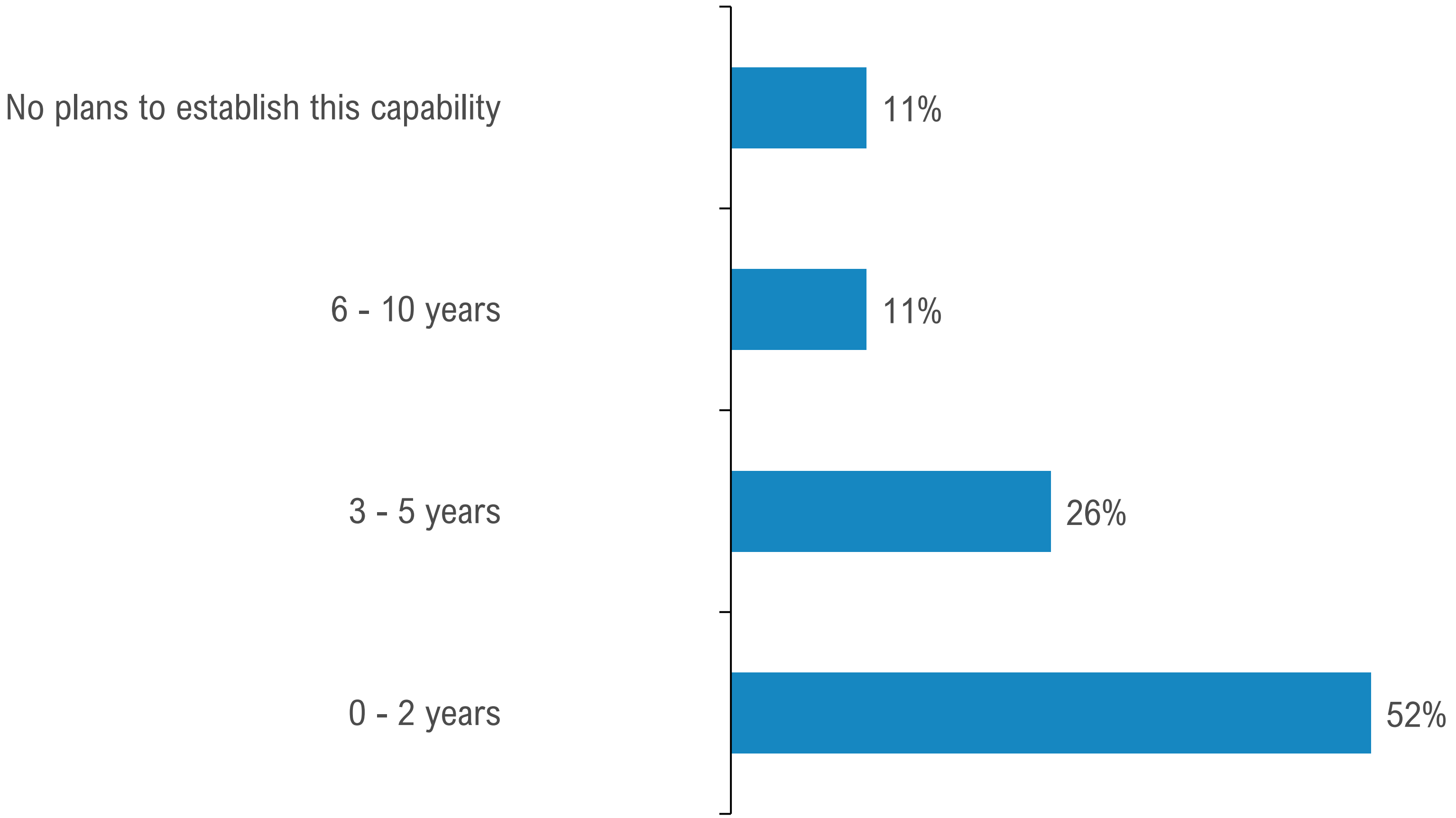
Q109: Does your lab test for heavy metals (toxic elements)?

Métaux lourds et éléments toxiques



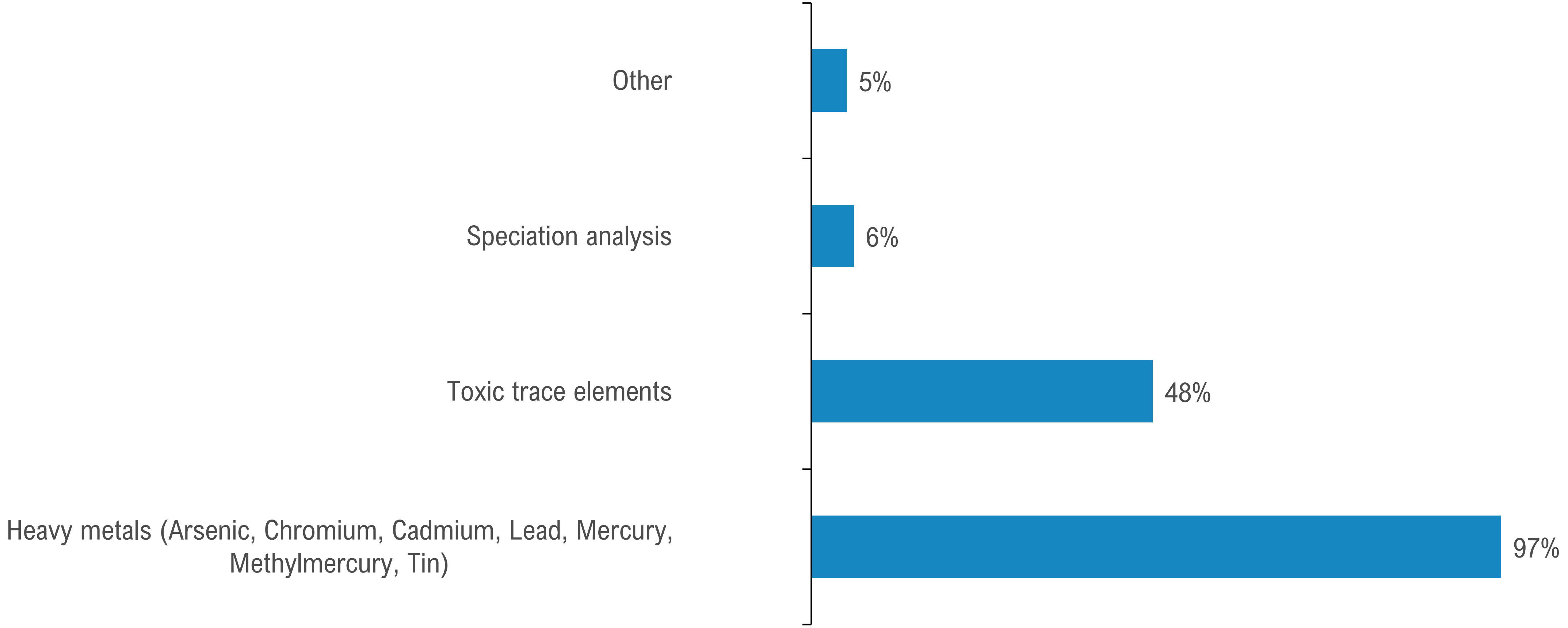
Answered questions: 92 | Skipped questions: 24

Q110: Is your laboratory planning to establish this capability in:



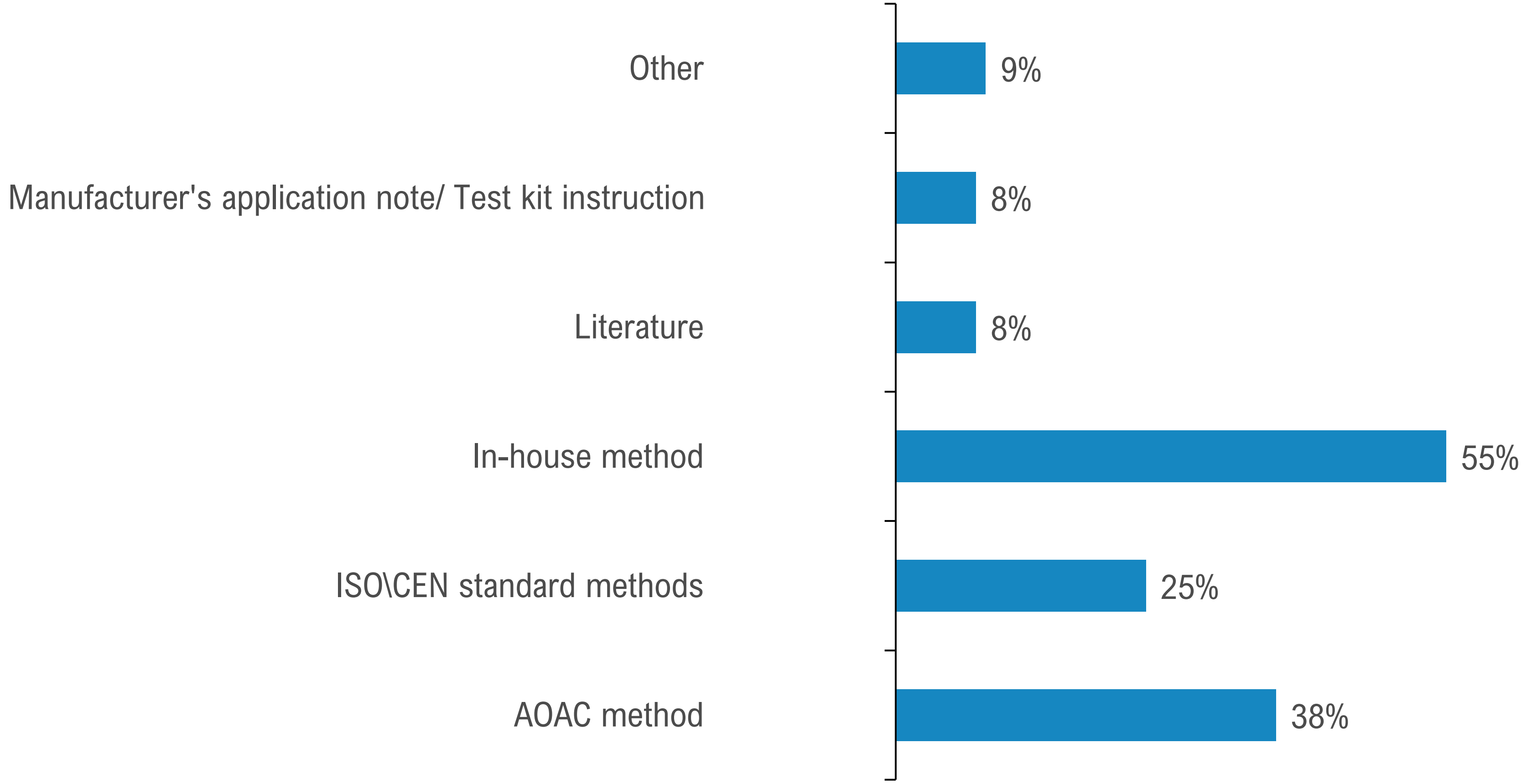
Answered questions: 27 | Skipped questions: 89

Q111: Select which heavy metals/toxic elements your lab is able to test for:



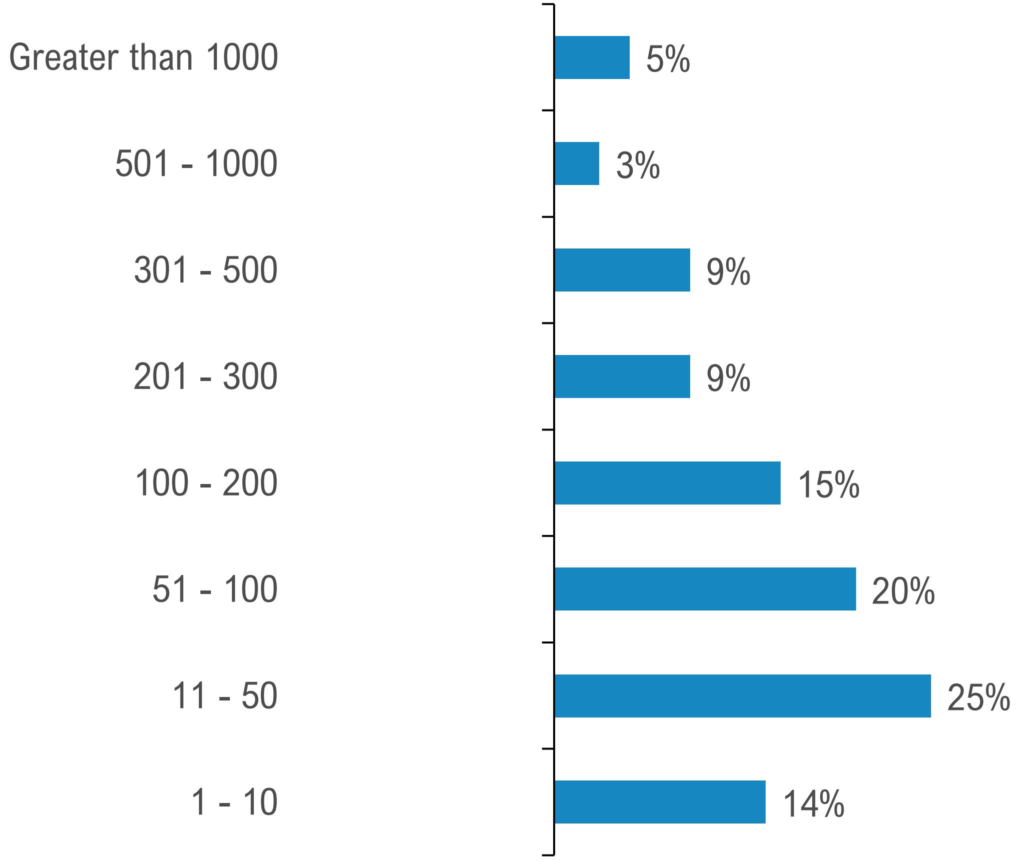
Answered questions: 65 | Skipped questions: 51

Q263: Analytical methods



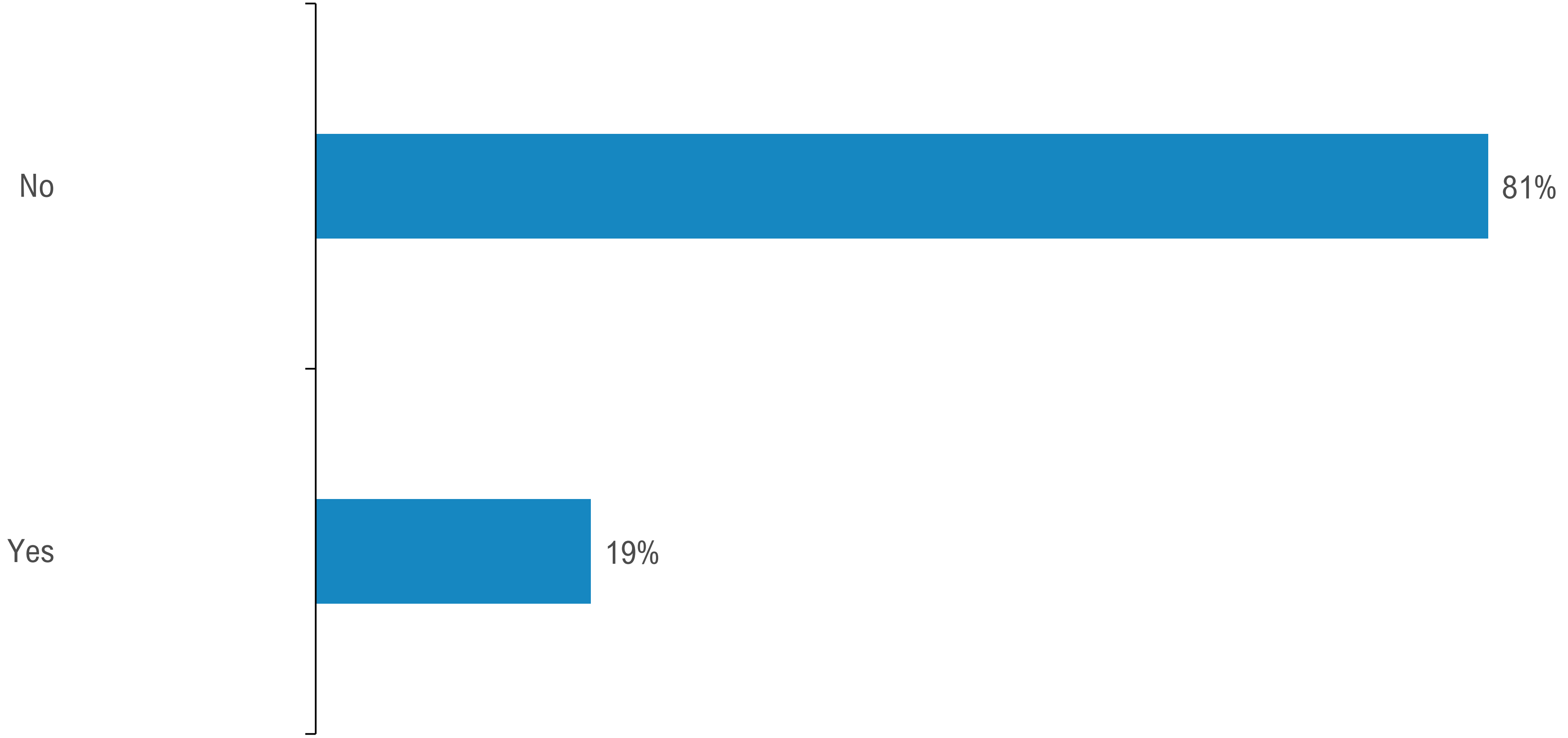
Answered questions: 64 | Skipped questions: 52

Q115: Number of samples analysed per month



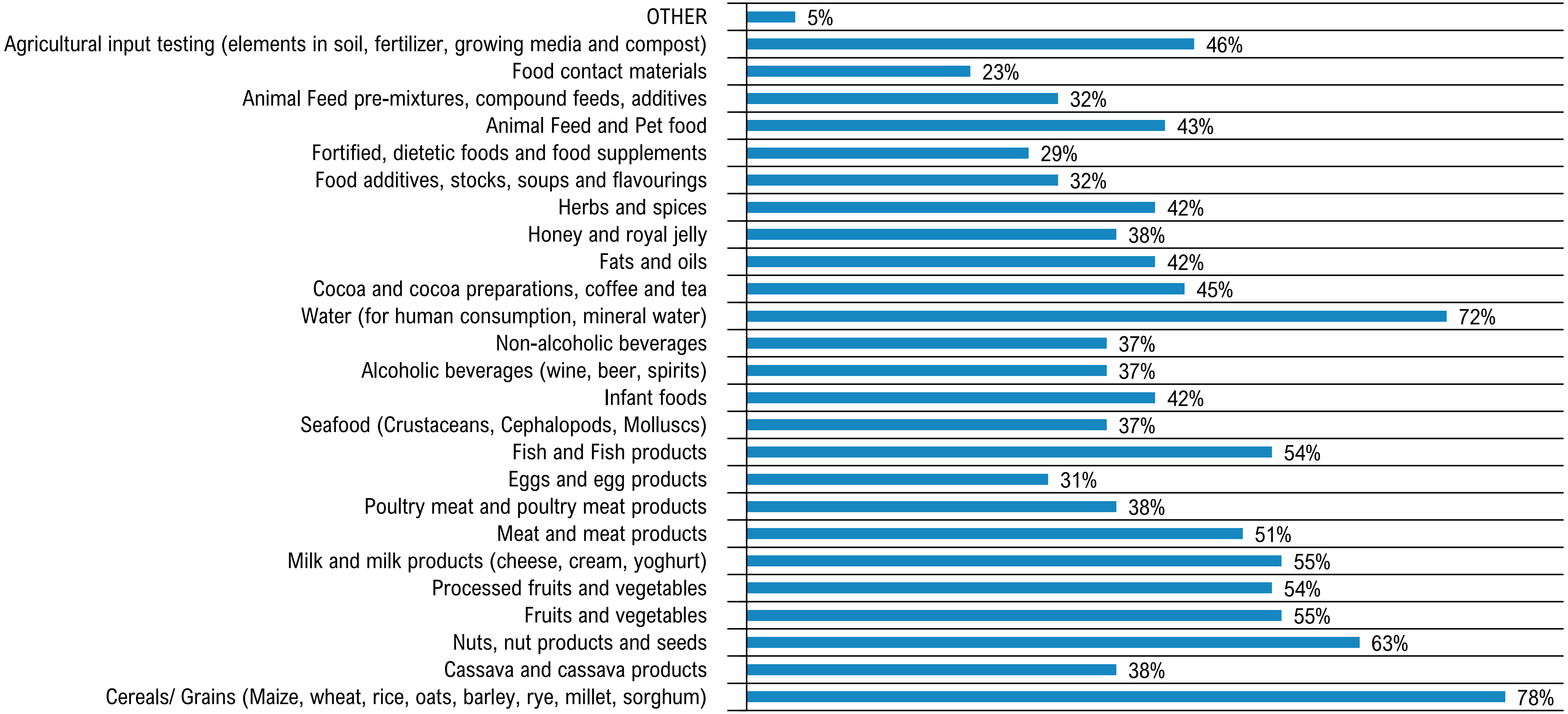
Answered questions: 65 | Skipped questions: 51

Q116: Automated sample preparation



Answered questions: 63 | Skipped questions: 53

Q117: Select applicable food categories for heavy metal analysis by your laboratory



Answered questions: 65 | Skipped questions: 51

Q248: Analysis for clients

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Private clients	15% (10)	8% (5)	21% (14)	9% (6)	47% (31)	66
Inspection	23% (15)	17% (11)	25% (16)	23% (15)	12% (8)	65
Monitoring	21% (14)	18% (12)	23% (15)	18% (12)	20% (13)	66
Exports	31% (20)	22% (14)	17% (11)	20% (13)	11% (7)	65

Answered questions: 65 | Skipped questions: 51

Q248: Analysis for clients

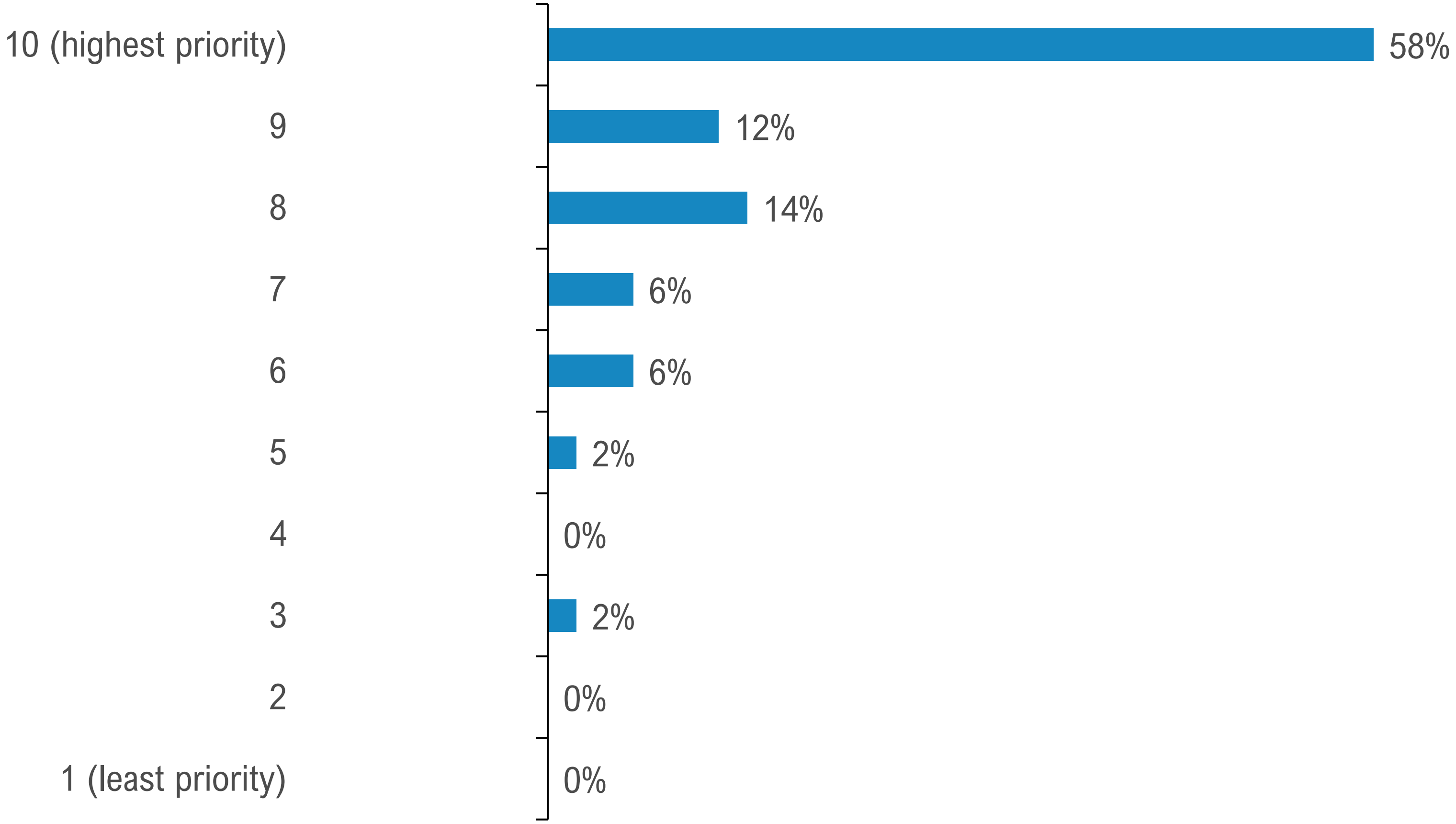
Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Imports	42% (27)	12% (8)	18% (12)	14% (9)	14% (9)	65
Internal testing	25% (16)	17% (11)	23% (15)	11% (7)	25% (16)	65

Answered questions: 65 | Skipped questions: 51

Q121: The importance of the need (ability) to perform these analyses in your country

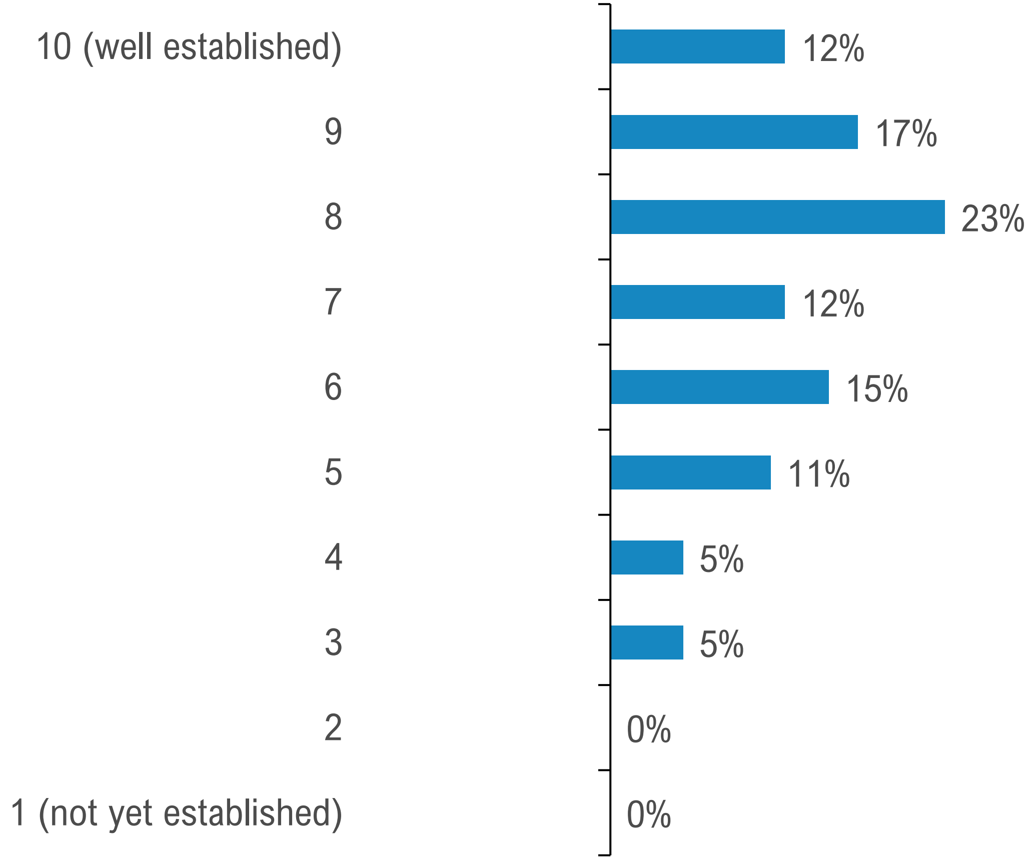
Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority



Answered questions: 65 | Skipped questions: 51

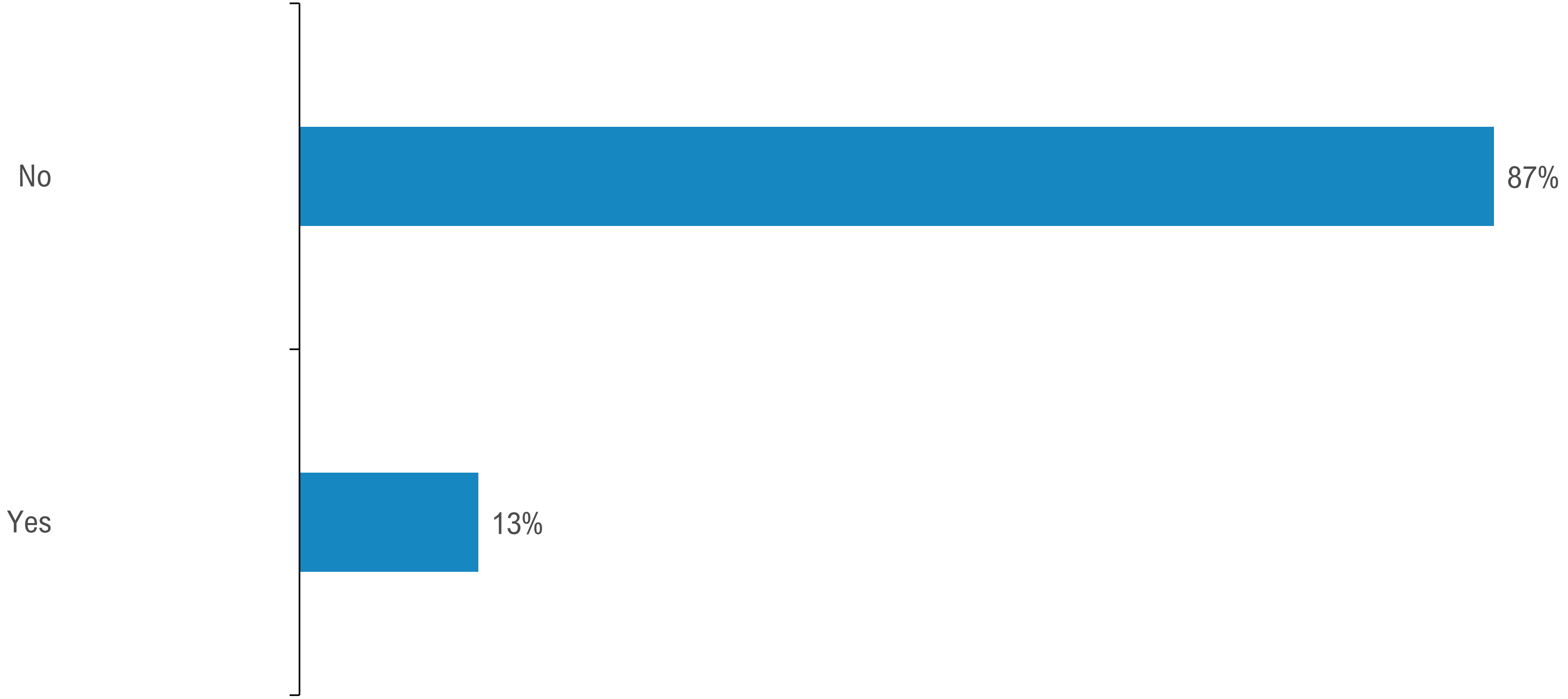
Q122: The degree to which the measurement capability for this analysis is established in your institute

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established



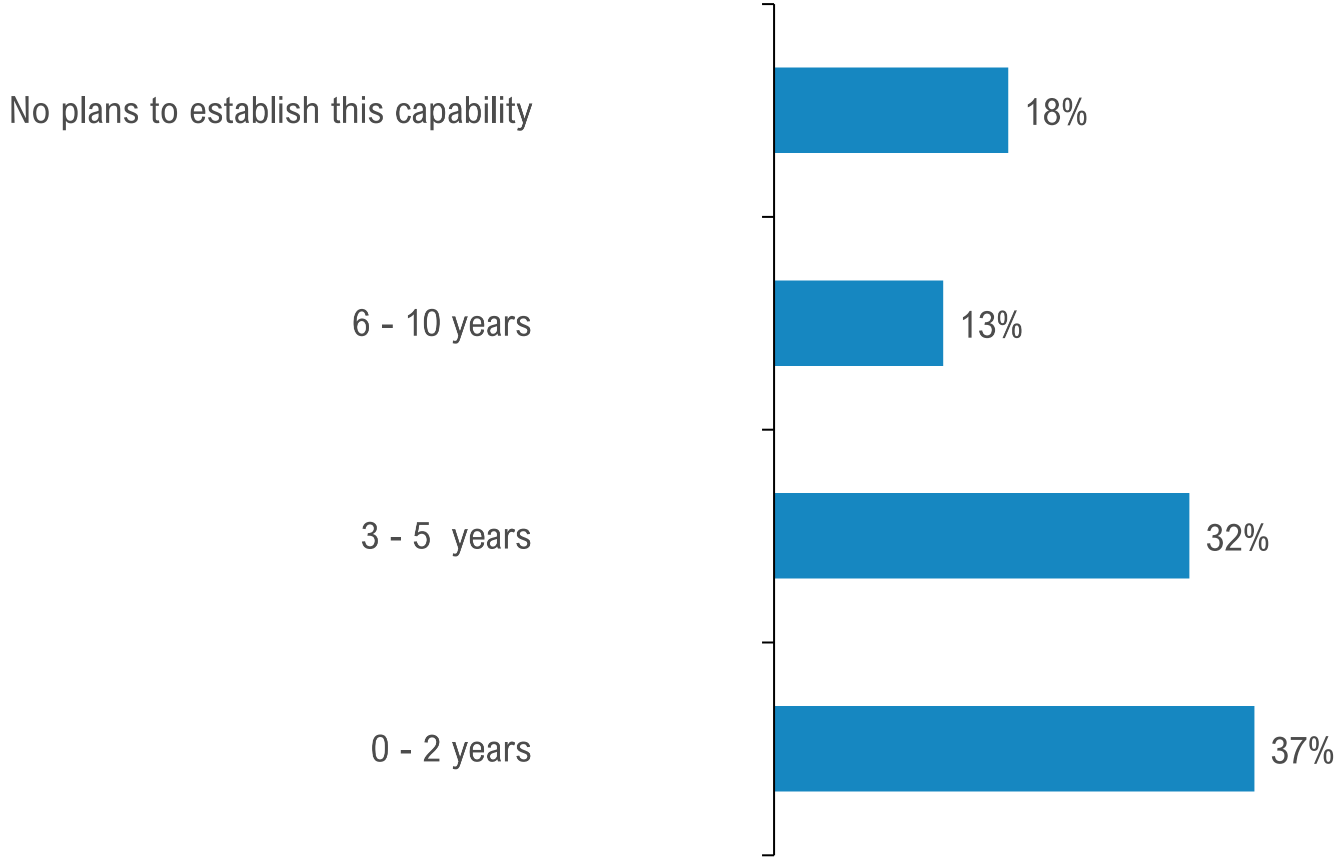
Answered questions: 65 | Skipped questions: 51

Q123: Does your laboratory test for Allergens?



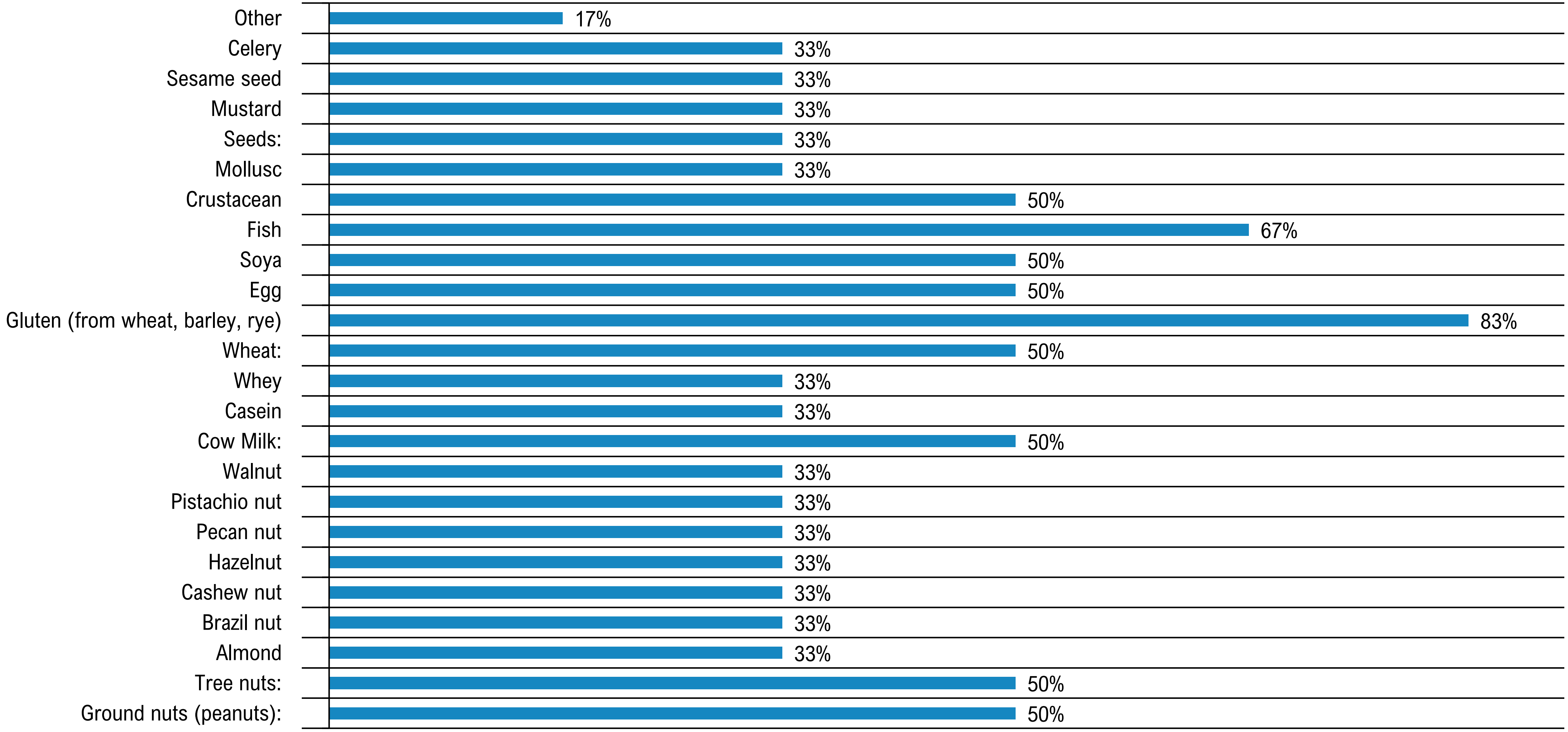
Answered questions: 46 | Skipped questions: 70

Q124: Is your laboratory planning to establish this capability in:



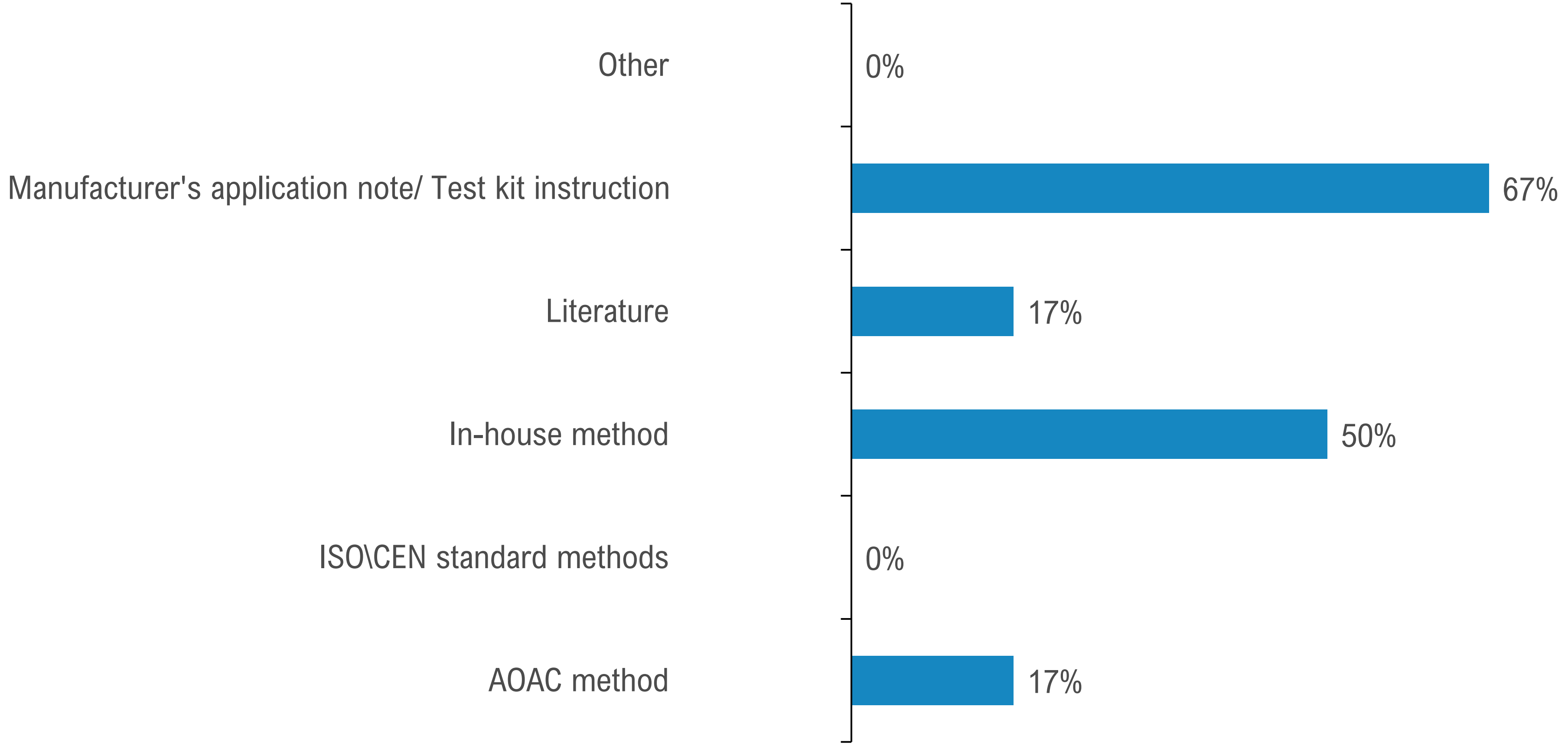
Answered questions: 40 | Skipped questions: 76

Q125: Indicate which Allergens your laboratory is able to test for:



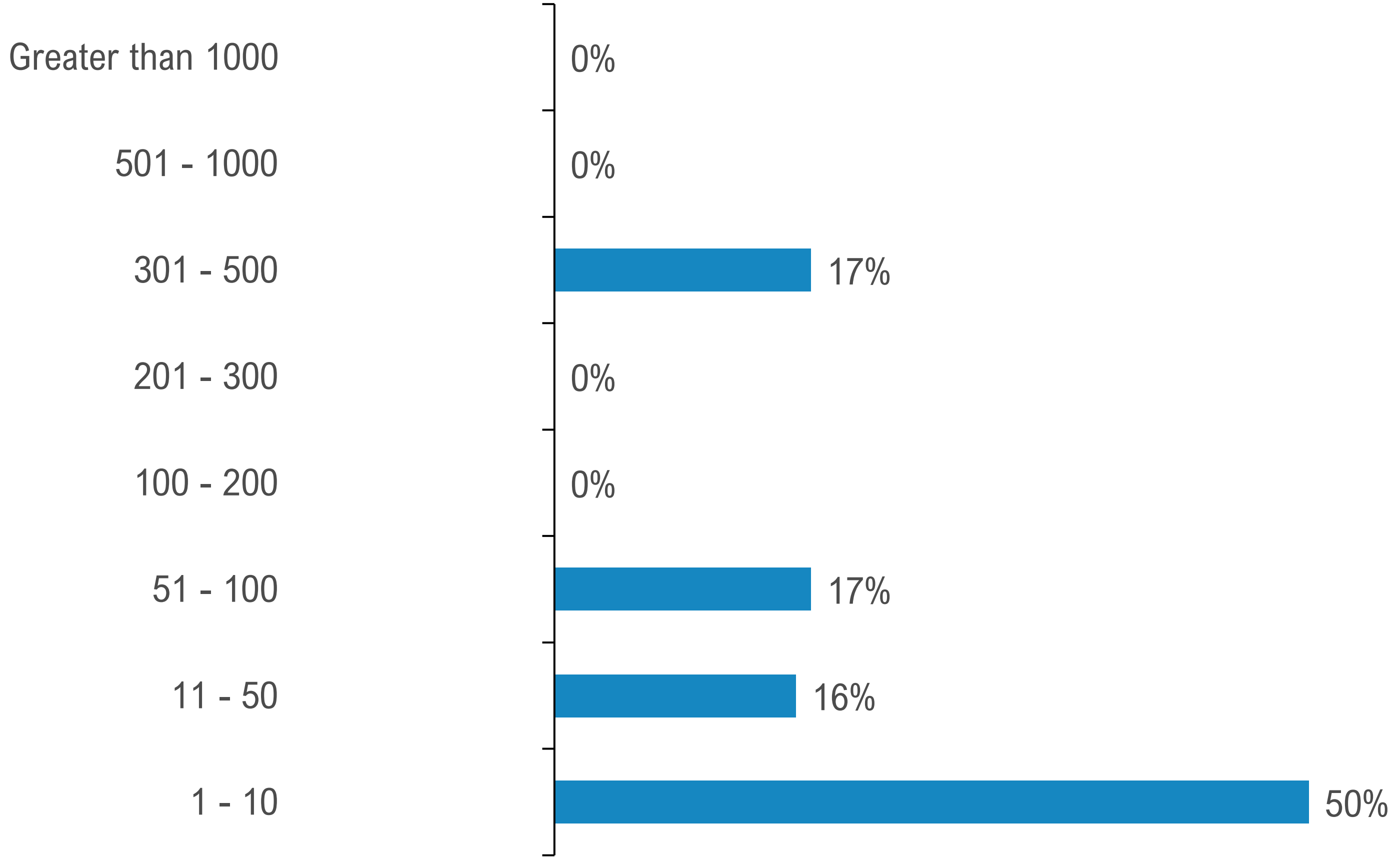
Answered questions: 6 | Skipped questions: 110

Q264: Analytical methods



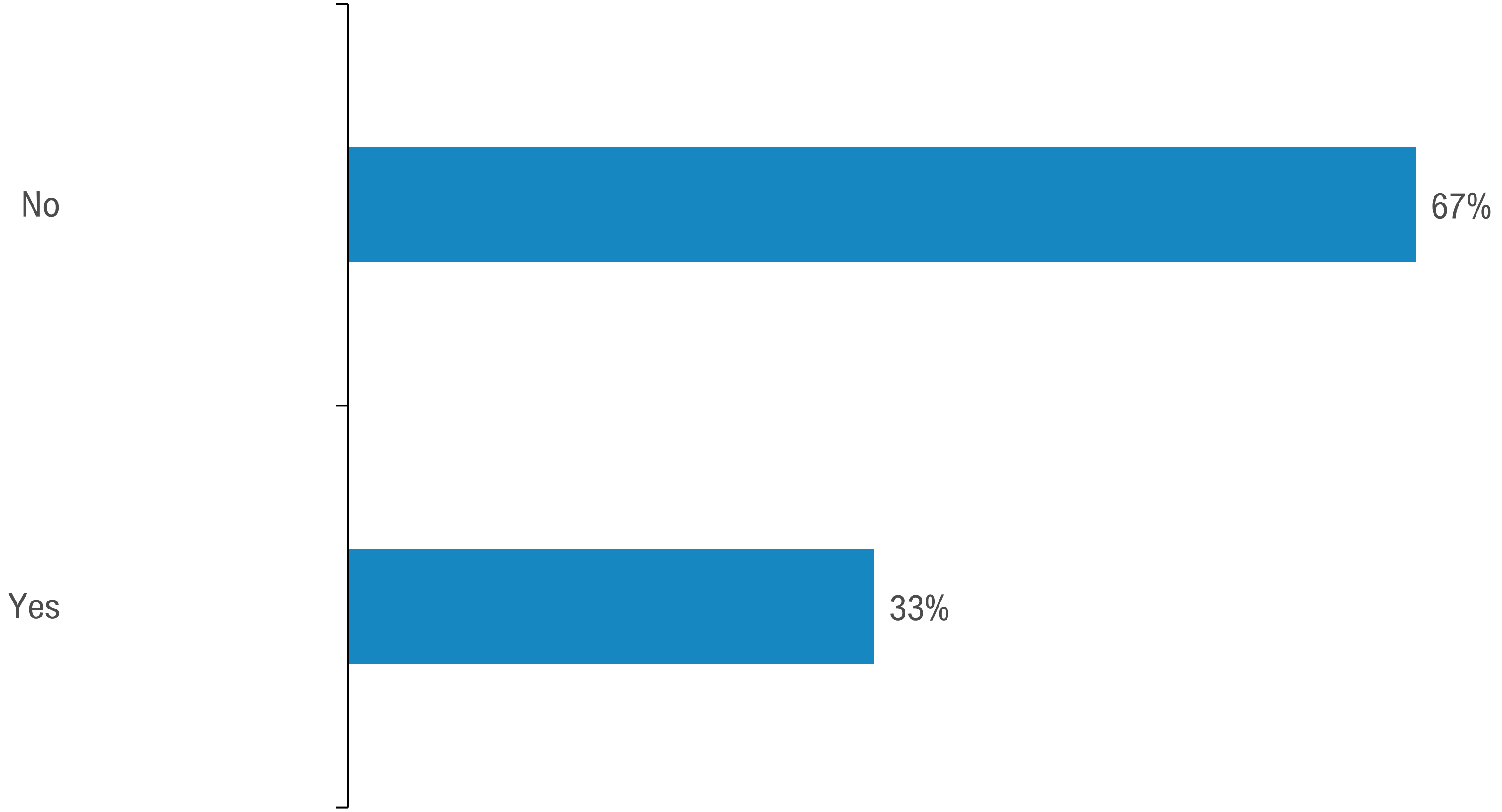
Answered questions: 6 | Skipped questions: 110

Q132: Number of samples analysed per month



Answered questions: 6 | Skipped questions: 110

Q133: Automated sample preparation



Answered questions: 6 | Skipped questions: 110

Q249: Analysis for clients

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Private clients	50% (3)	0% (0)	0% (0)	0% (0)	50% (3)	6
Inspection	67% (4)	17% (1)	0% (0)	0% (0)	17% (1)	6
Monitoring	50% (3)	17% (1)	0% (0)	0% (0)	33% (2)	6
Exports	83% (5)	17% (1)	0% (0)	0% (0)	0% (0)	6

Answered questions: 6 | Skipped questions: 110

Q249: Analysis for clients

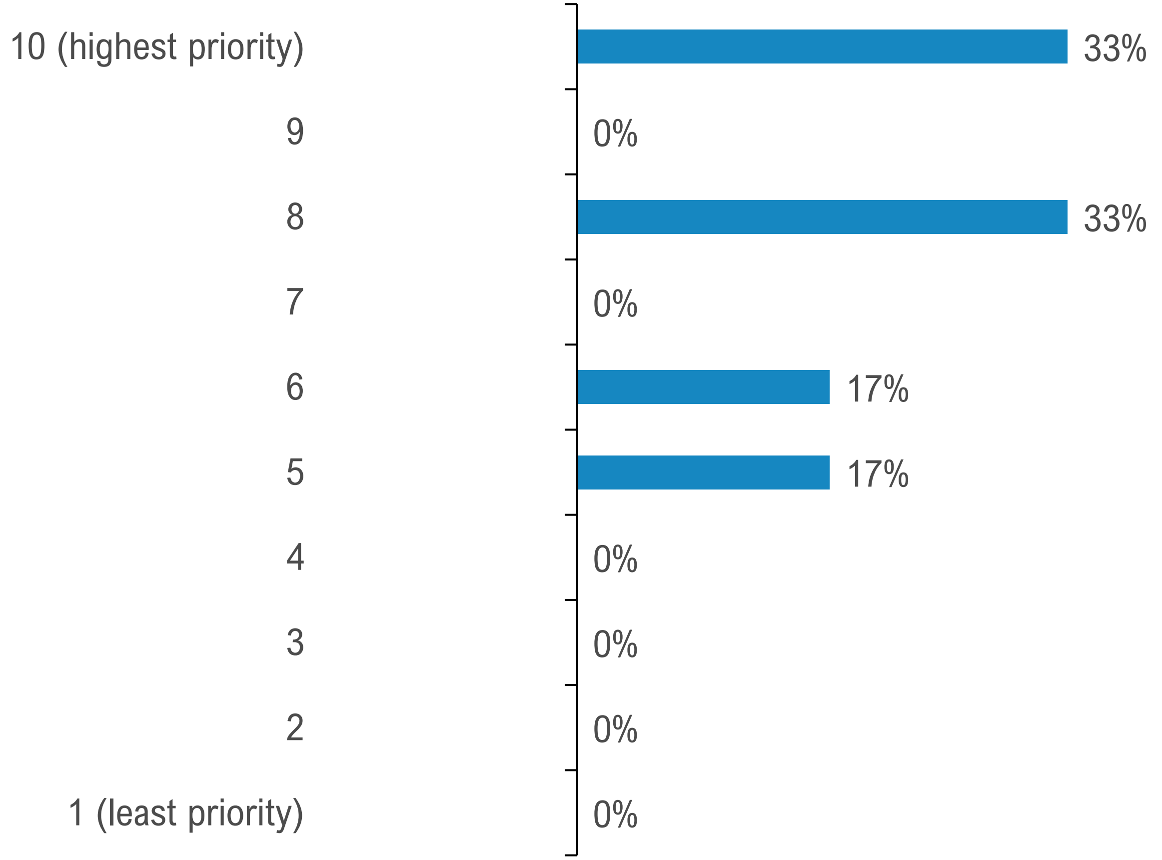
Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Imports	67% (4)	17% (1)	0% (0)	0% (0)	17% (1)	6
Internal testing	50% (3)	0% (0)	17% (1)	0% (0)	33% (2)	6

Answered questions: 6 | Skipped questions: 110

Q137: The importance of the need (ability) to perform these analyses in your country

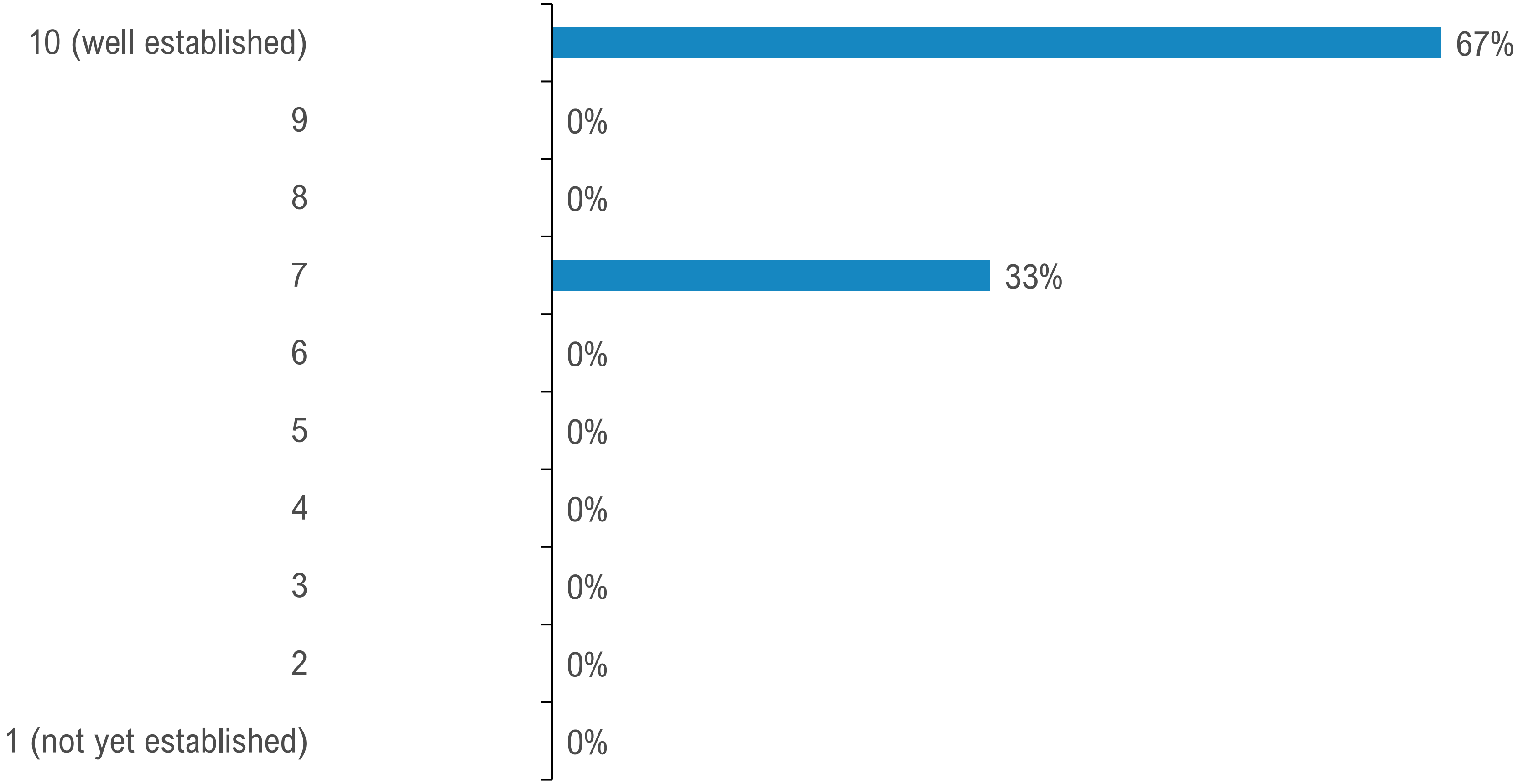
Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority



Answered questions: 6 | Skipped questions: 110

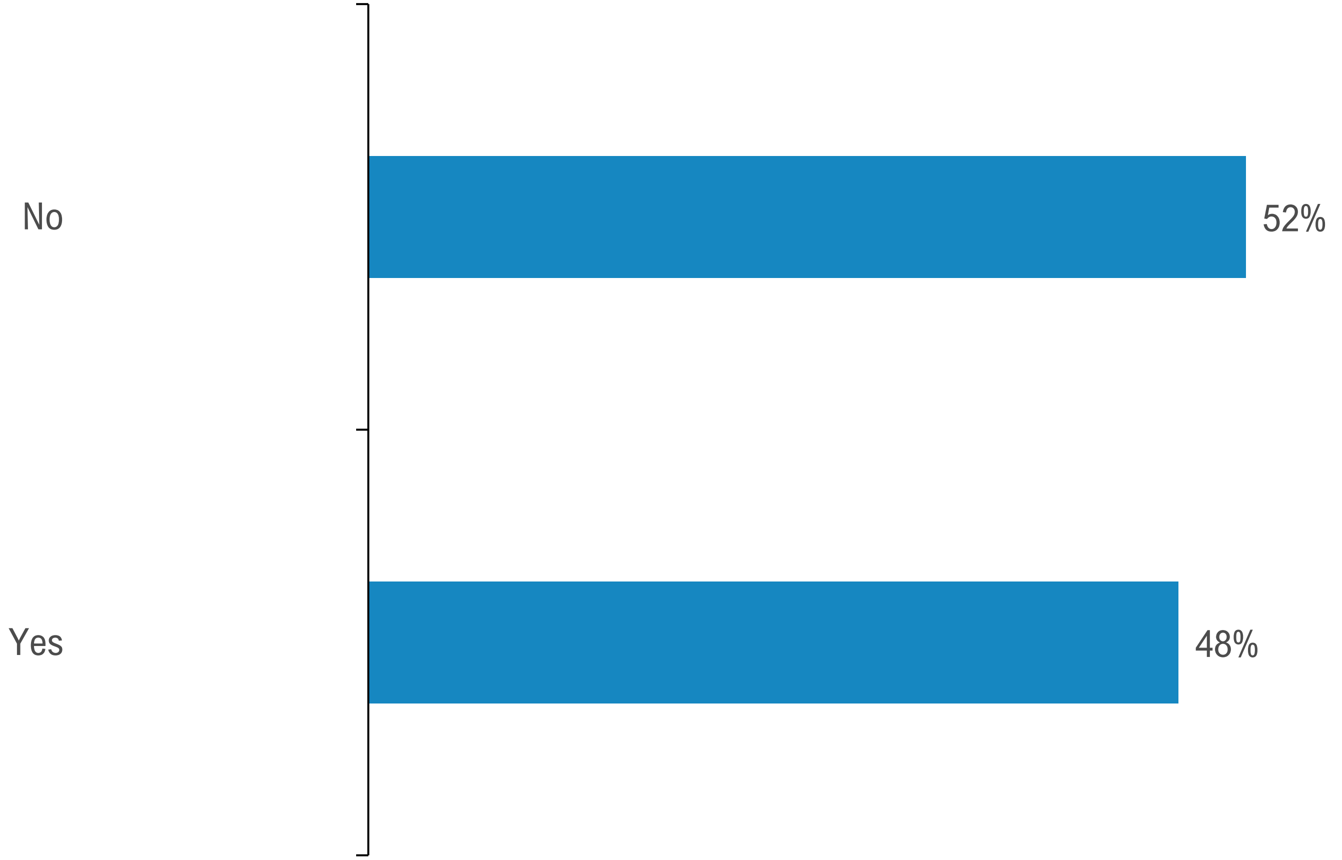
Q138: The degree to which the measurement capability for this analysis is established in your institute

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established



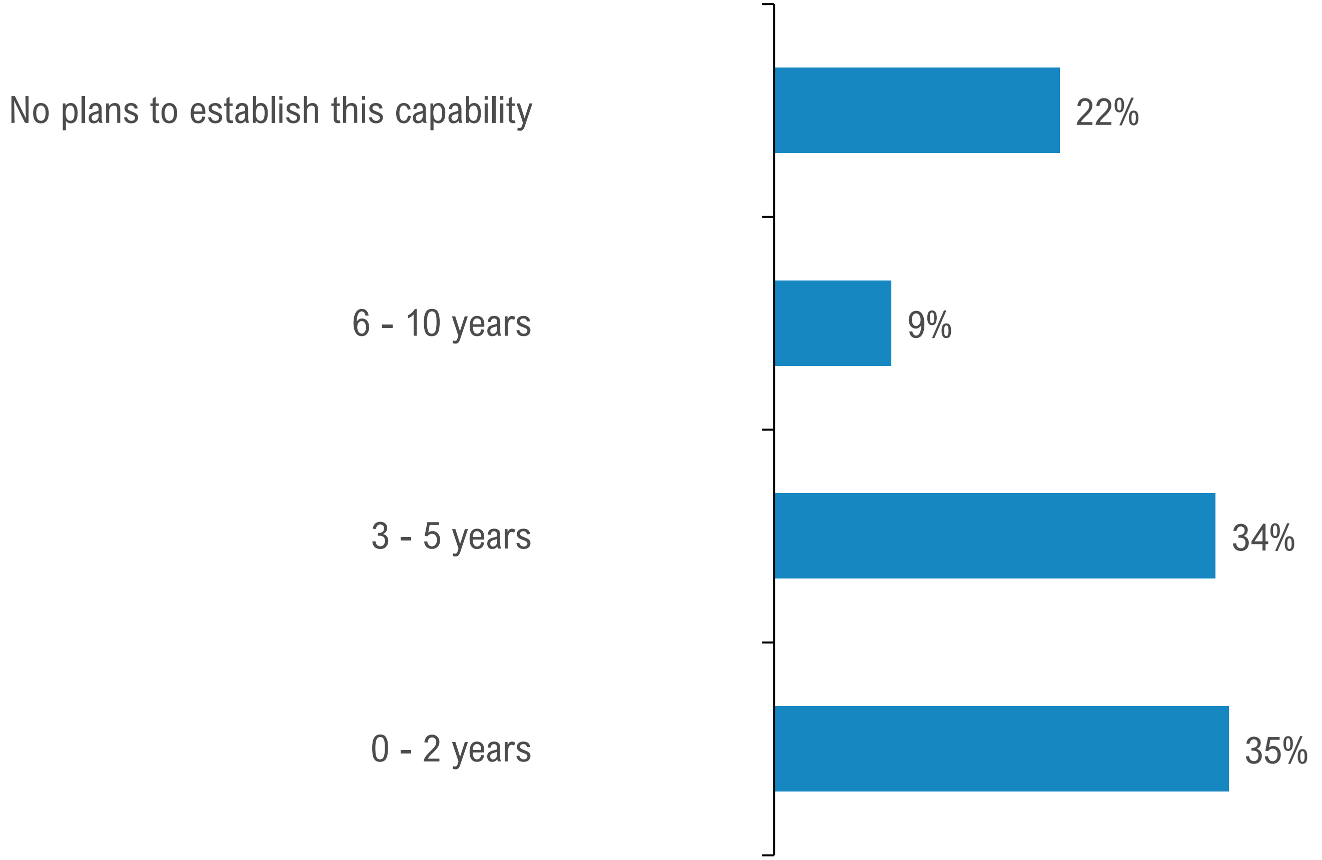
Answered questions: 6 | Skipped questions: 110

Q139: Does your laboratory analyse for environmental/ manufacturing/ processing contaminants



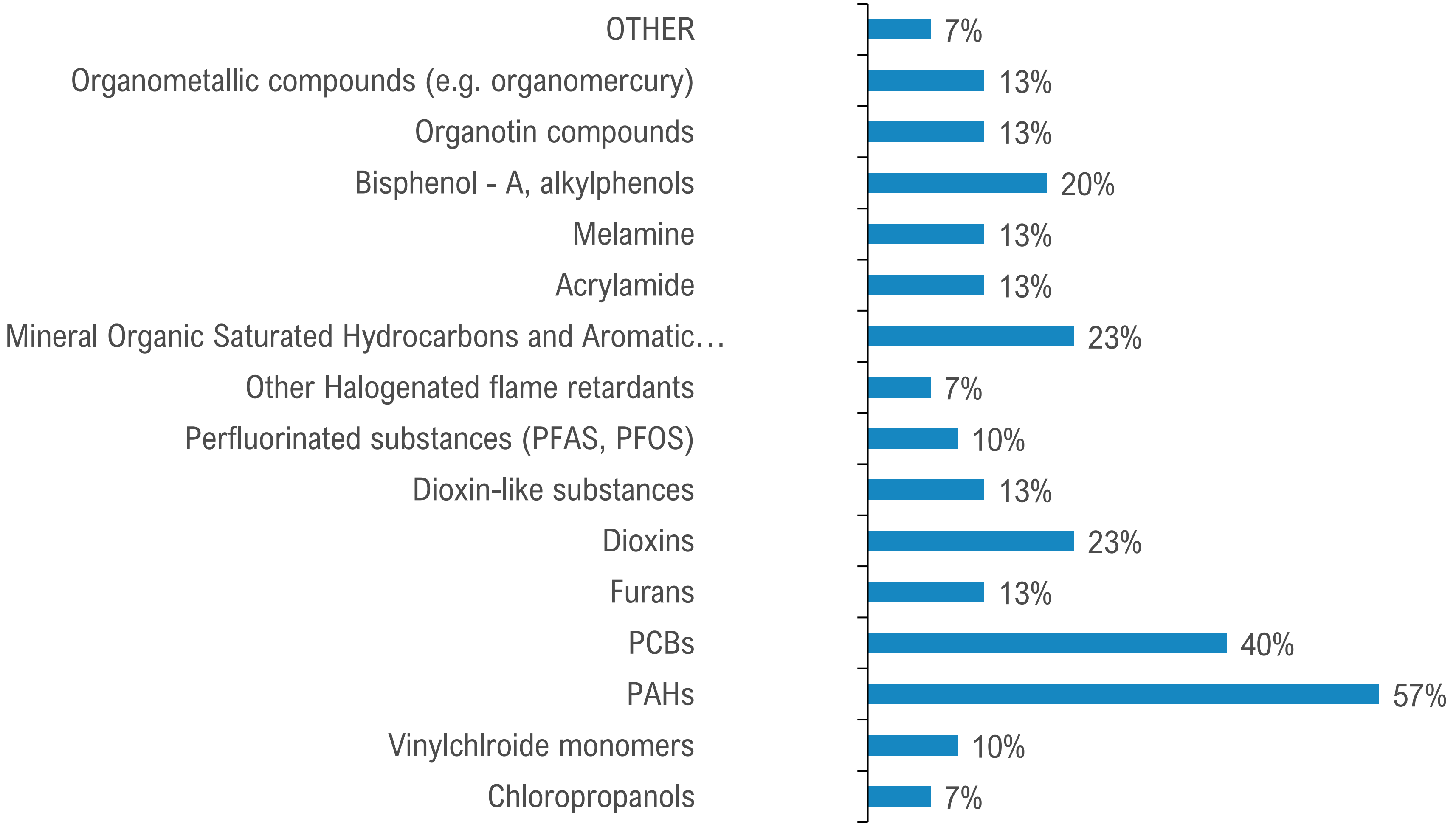
Answered questions: 62 | Skipped questions: 54

Q140: Is your laboratory planning to establish this capability in



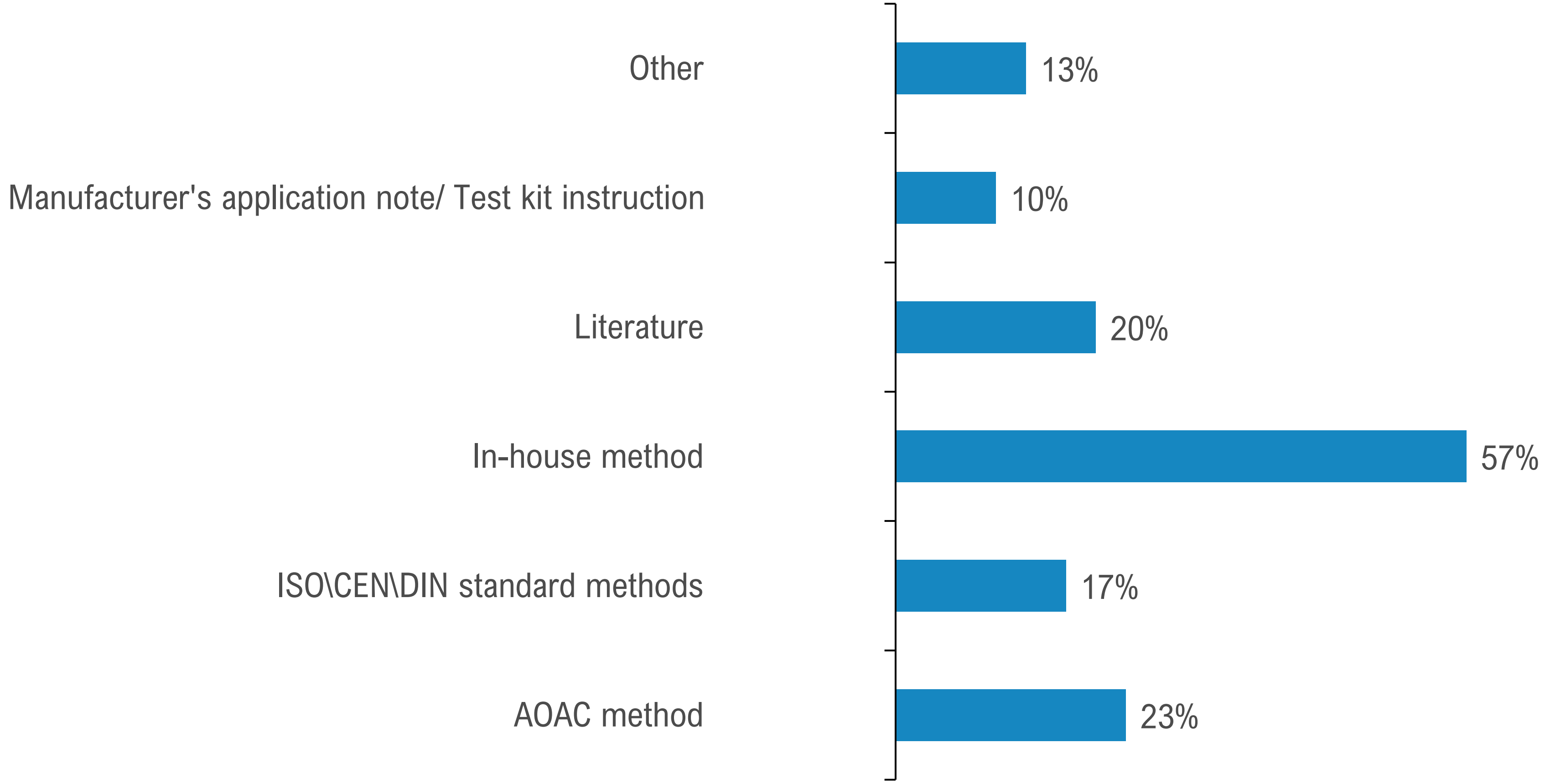
Answered questions: 32 | Skipped questions: 84

Q141: Indicate which contaminants your laboratory is able to test for:



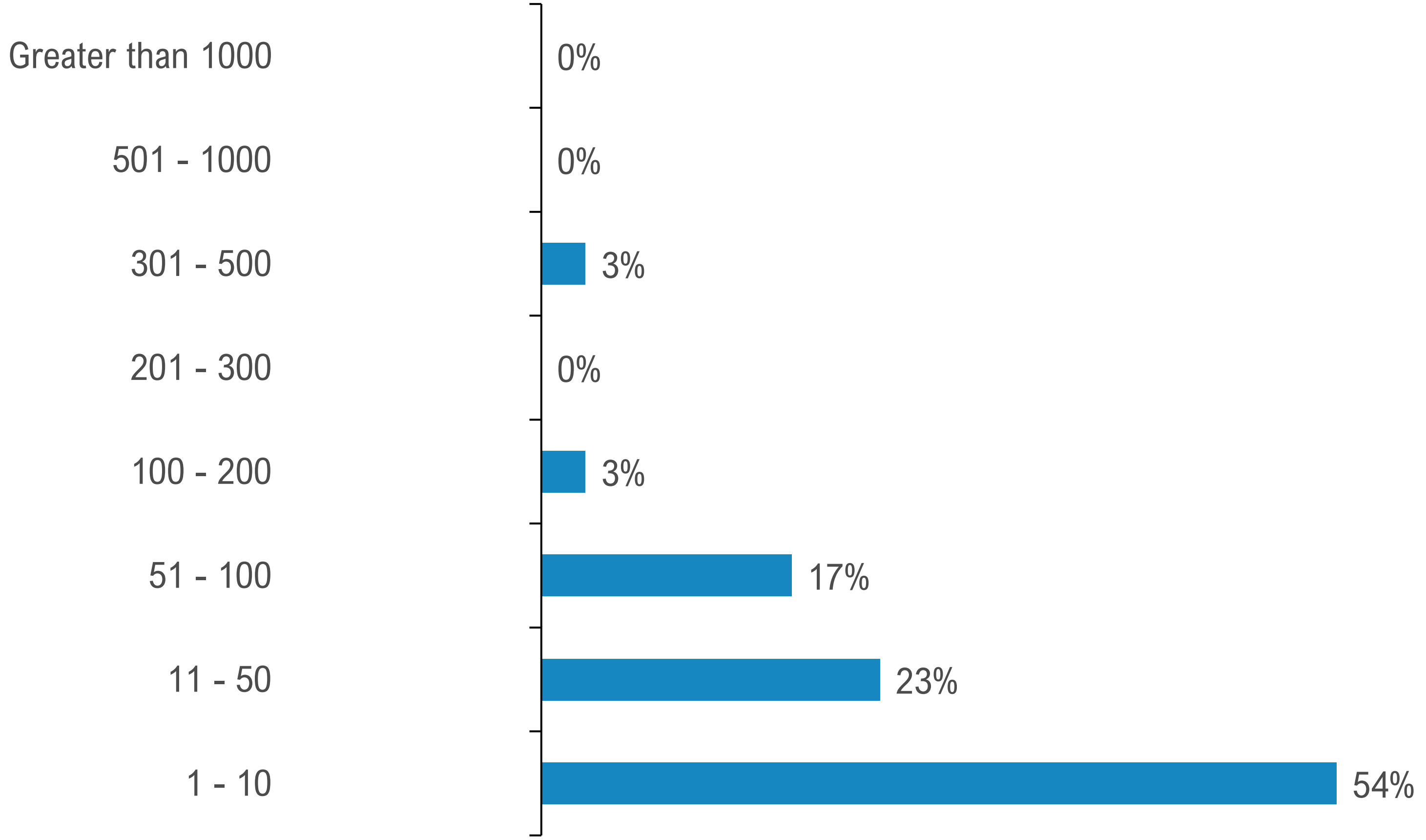
Answered questions: 30 | Skipped questions: 86

Q265: Analytical methods



Answered questions: 30 | Skipped questions: 86

Q145: Number of samples analysed per month

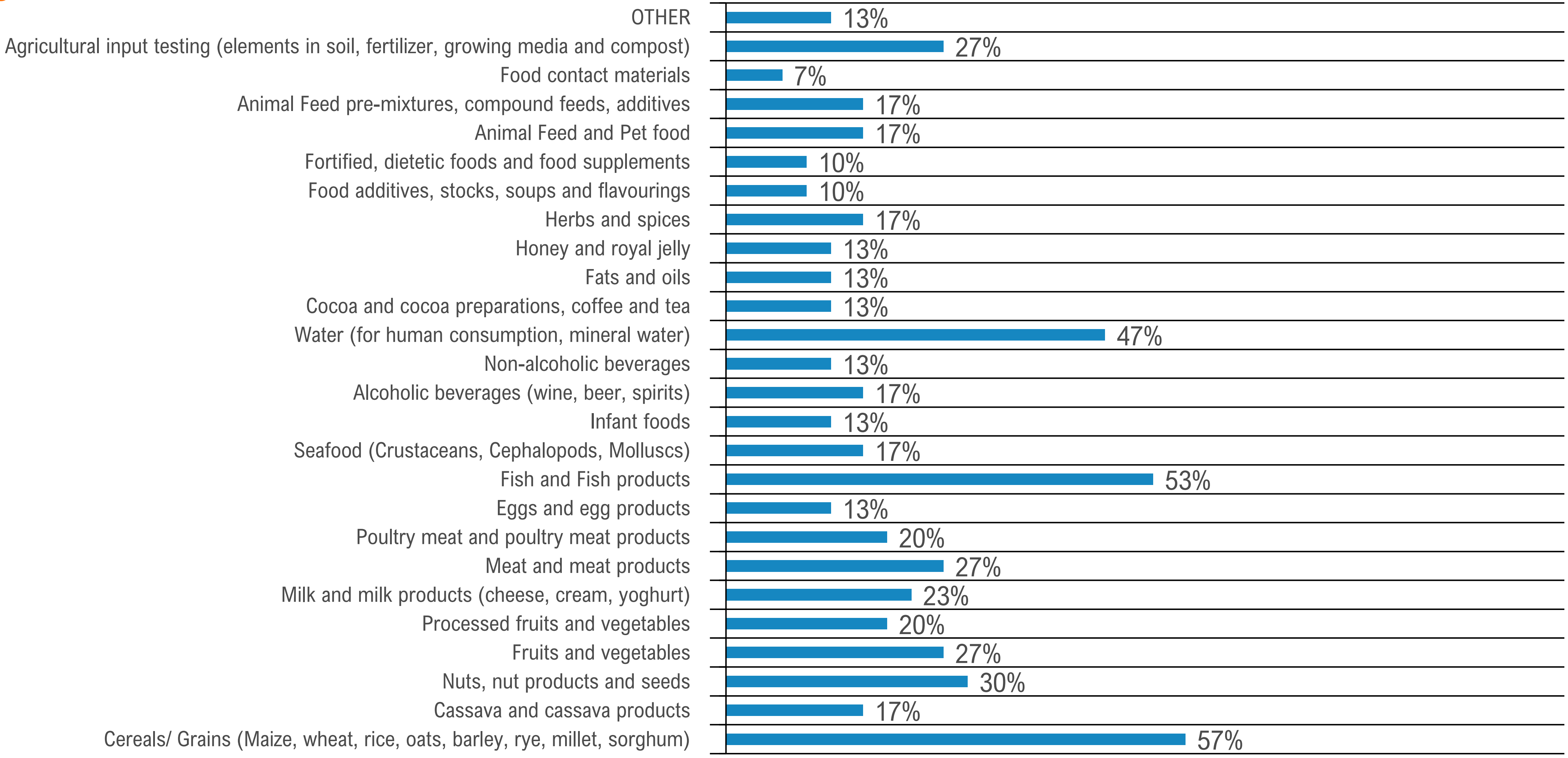


Answered questions: 30 | Skipped questions: 86

Q146: Automated sample preparation

Answered questions: 28 | Skipped questions: 88

Q147: Select food categories applicable to the samples analysed in your laboratory



Answered questions: 30 | Skipped questions: 86

Q250: Analysis for clients

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Private clients	20% (6)	27% (8)	10% (3)	10% (3)	33% (10)	30
Inspection	37% (11)	20% (6)	23% (7)	10% (3)	10% (3)	30
Monitoring	27% (8)	13% (4)	27% (8)	10% (3)	23% (7)	30
Exports	40% (12)	27% (8)	20% (6)	7% (2)	7% (2)	30

Answered questions: 30 | Skipped questions: 86

Q250: Analysis for clients

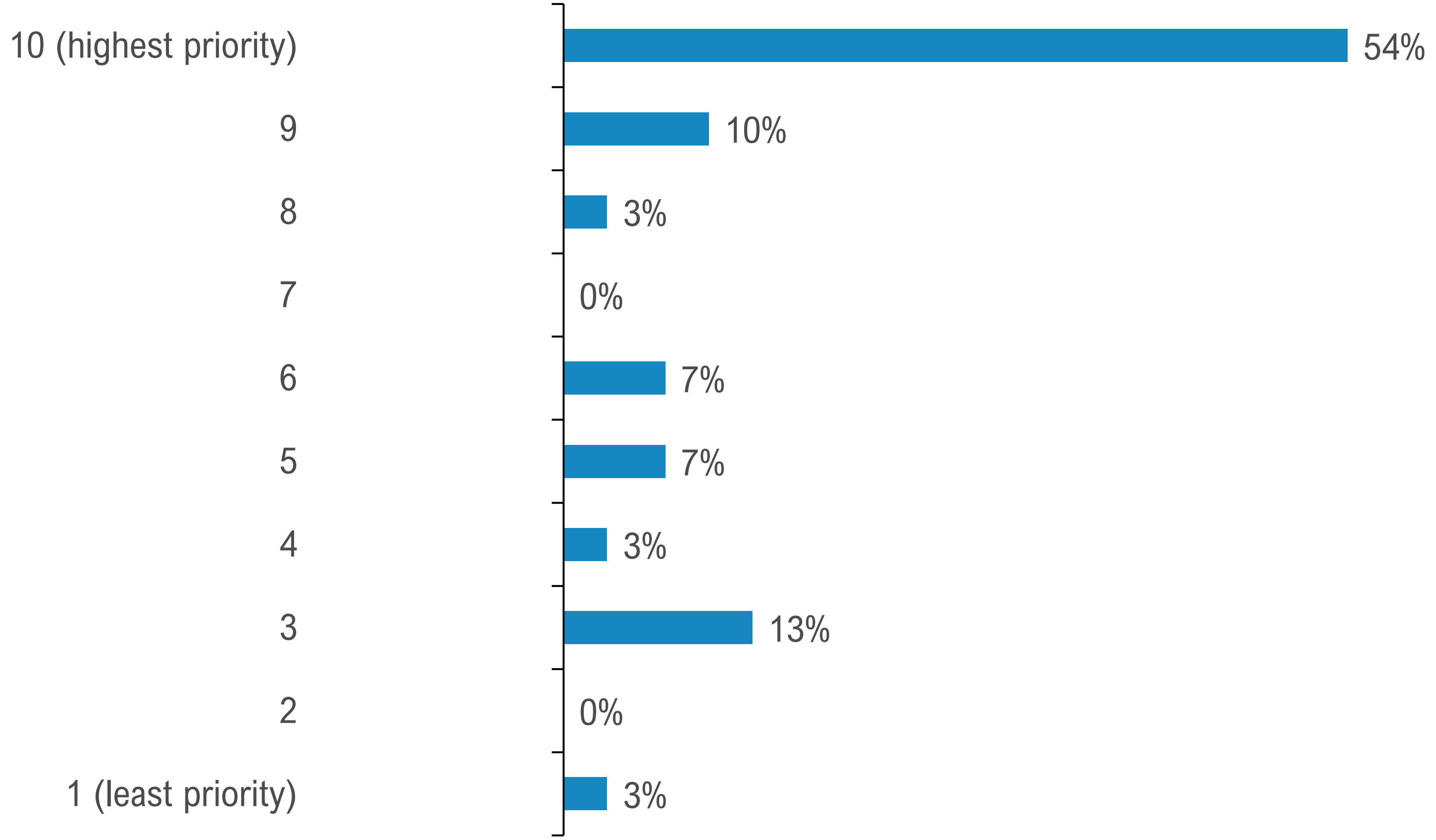
Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Imports	47% (14)	30% (9)	13% (4)	0% (0)	10% (3)	30
Internal testing	33% (10)	30% (9)	10% (3)	10% (3)	17% (5)	30

Answered questions: 30 | Skipped questions: 86

Q151: The importance of the need (ability) to perform these analyses in your country

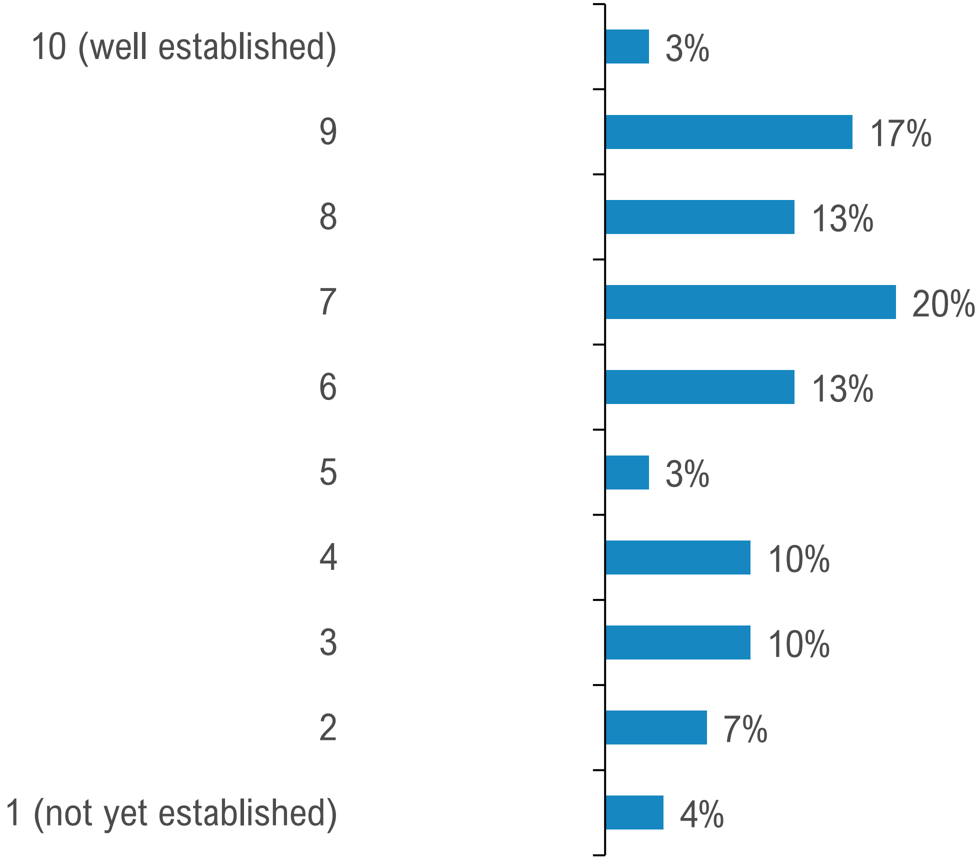
Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority



Answered questions: 30 | Skipped questions: 86

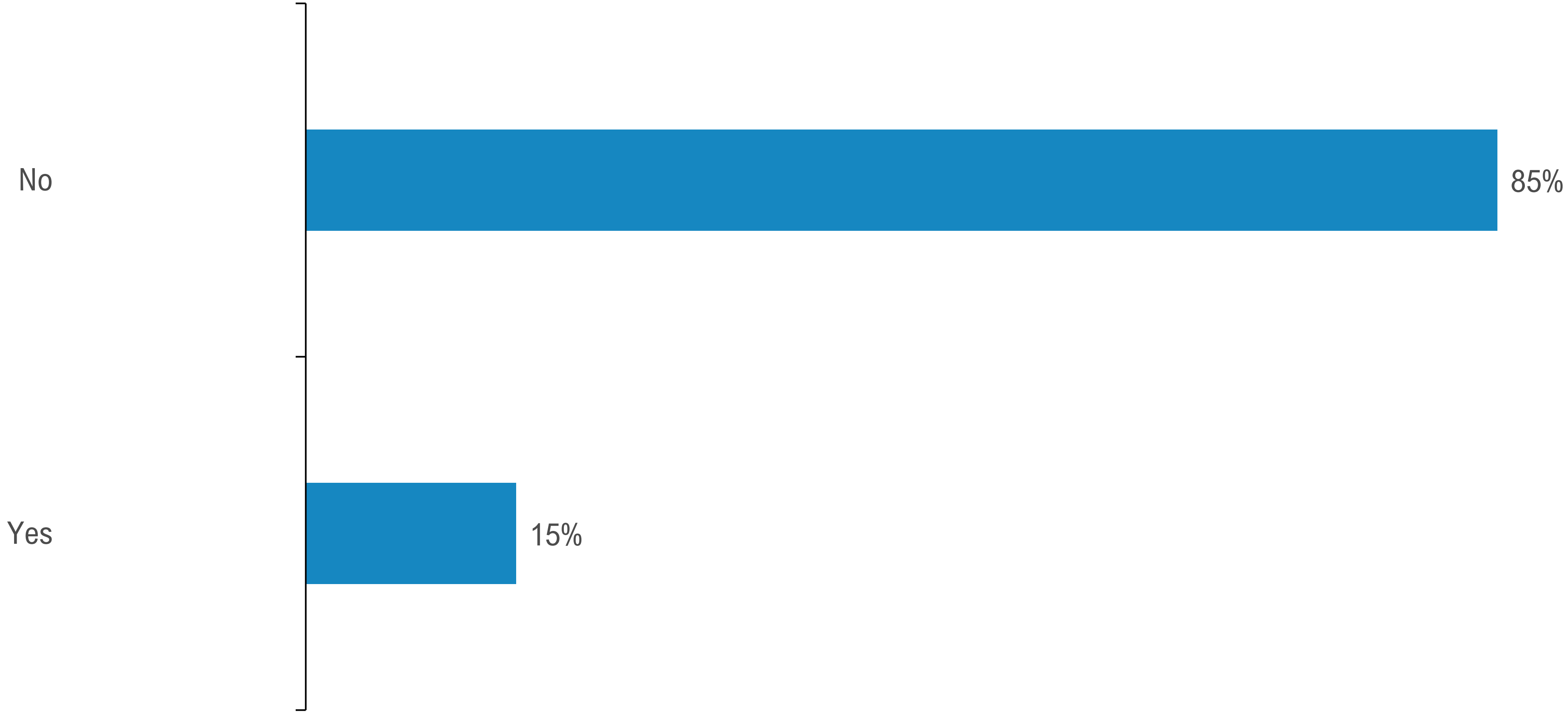
Q152: The degree to which the measurement capability for this analysis is established in your institute

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established



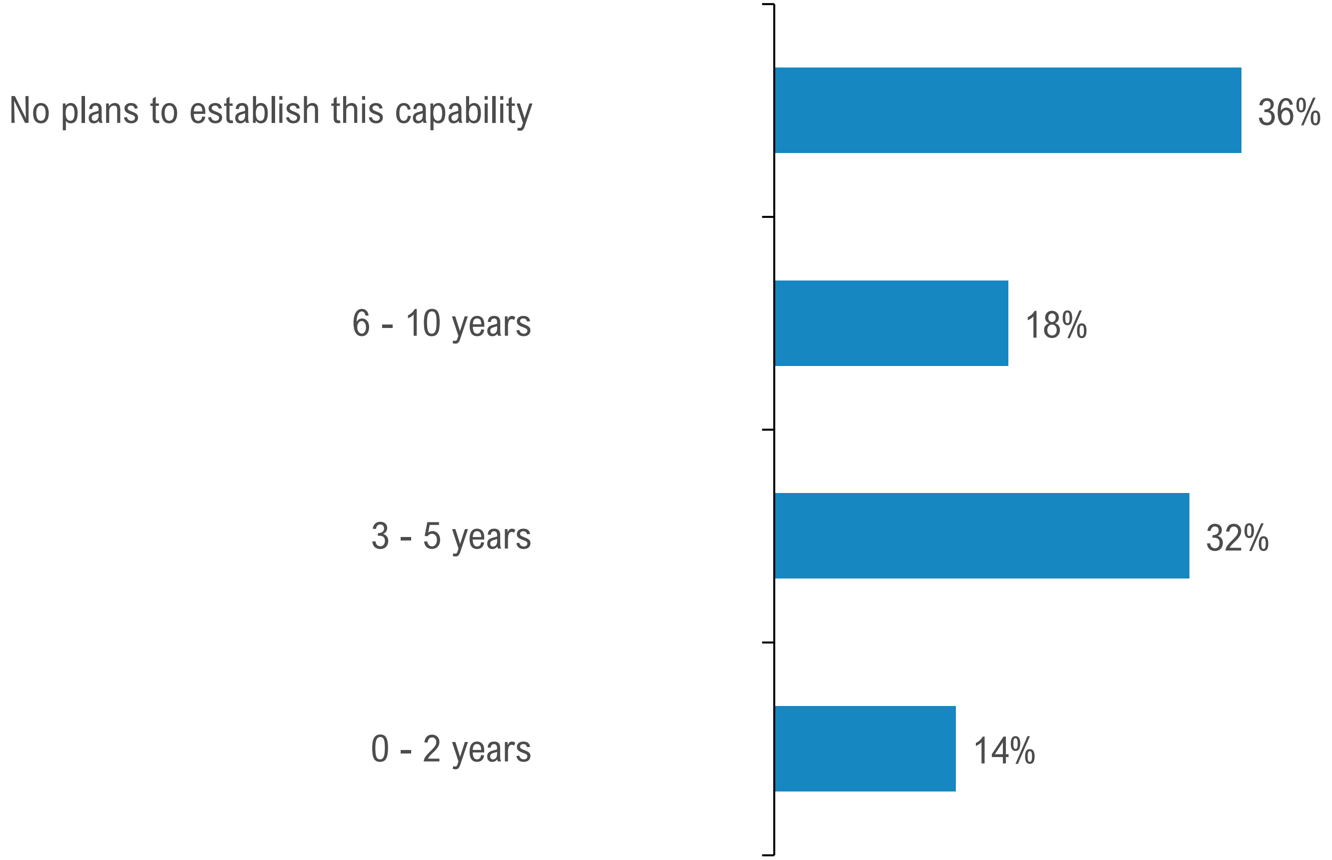
Answered questions: 30 | Skipped questions: 86

Q153: Does your laboratory test for Radionuclides in food?



Answered questions: 26 | Skipped questions: 90

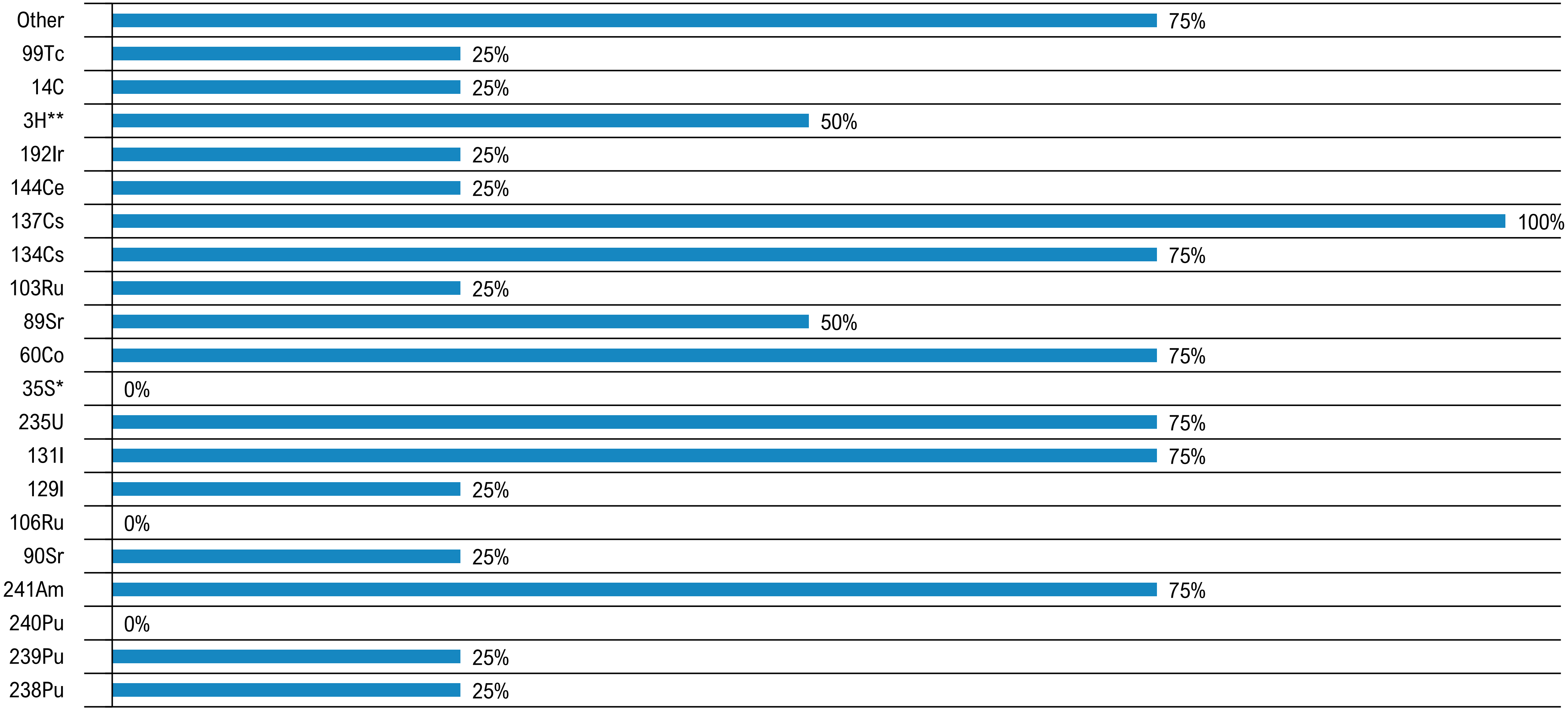
Q154: Does your laboratory plan to establish this capability in



Answered questions: 22 | Skipped questions: 94

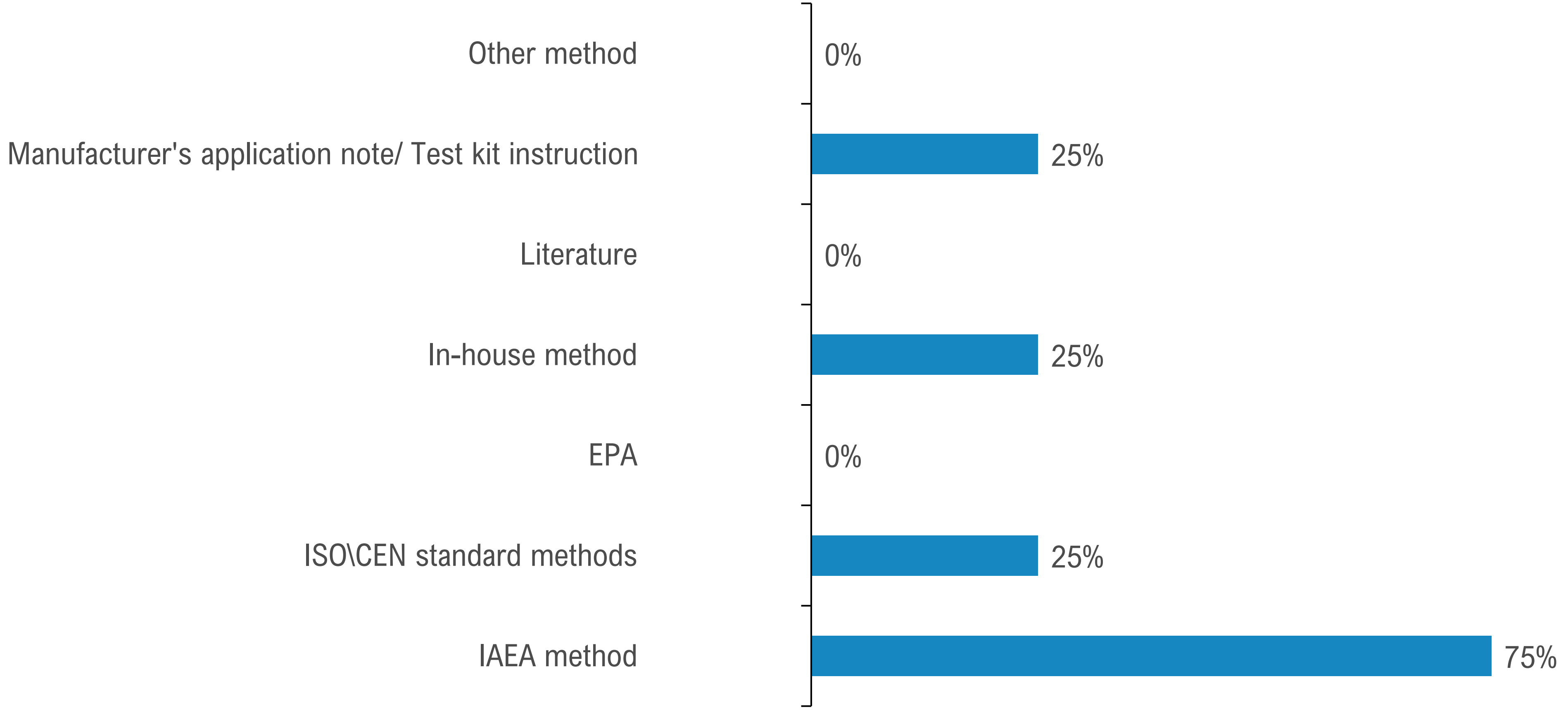
Q155: Please indicate which radionuclides your laboratory is able to test for:

Veuillez indiquer quelles



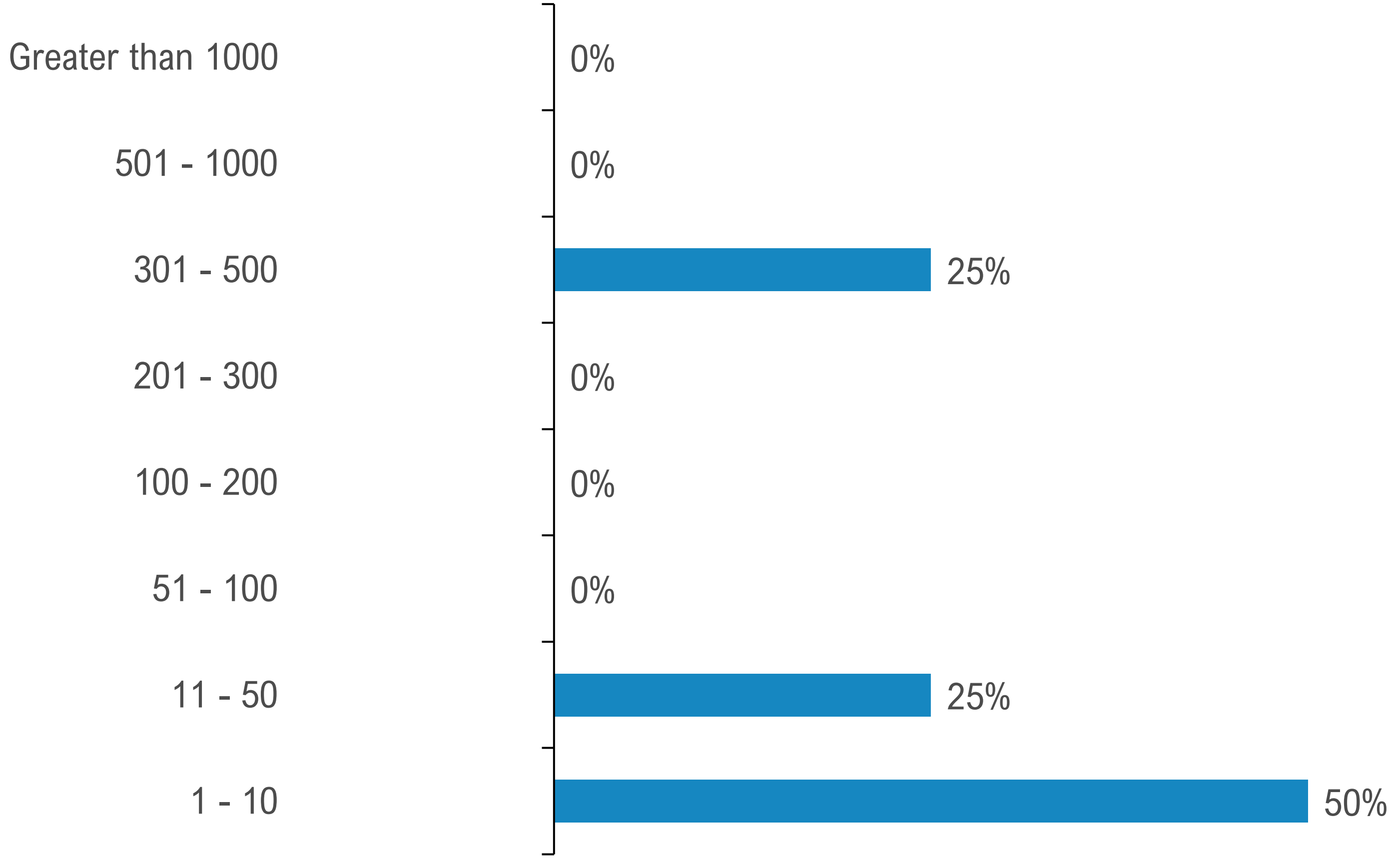
Answered questions: 4 | Skipped questions: 112

Q266: Analytical methods



Answered questions: 4 | Skipped questions: 112

Q159: Number of samples analysed per month

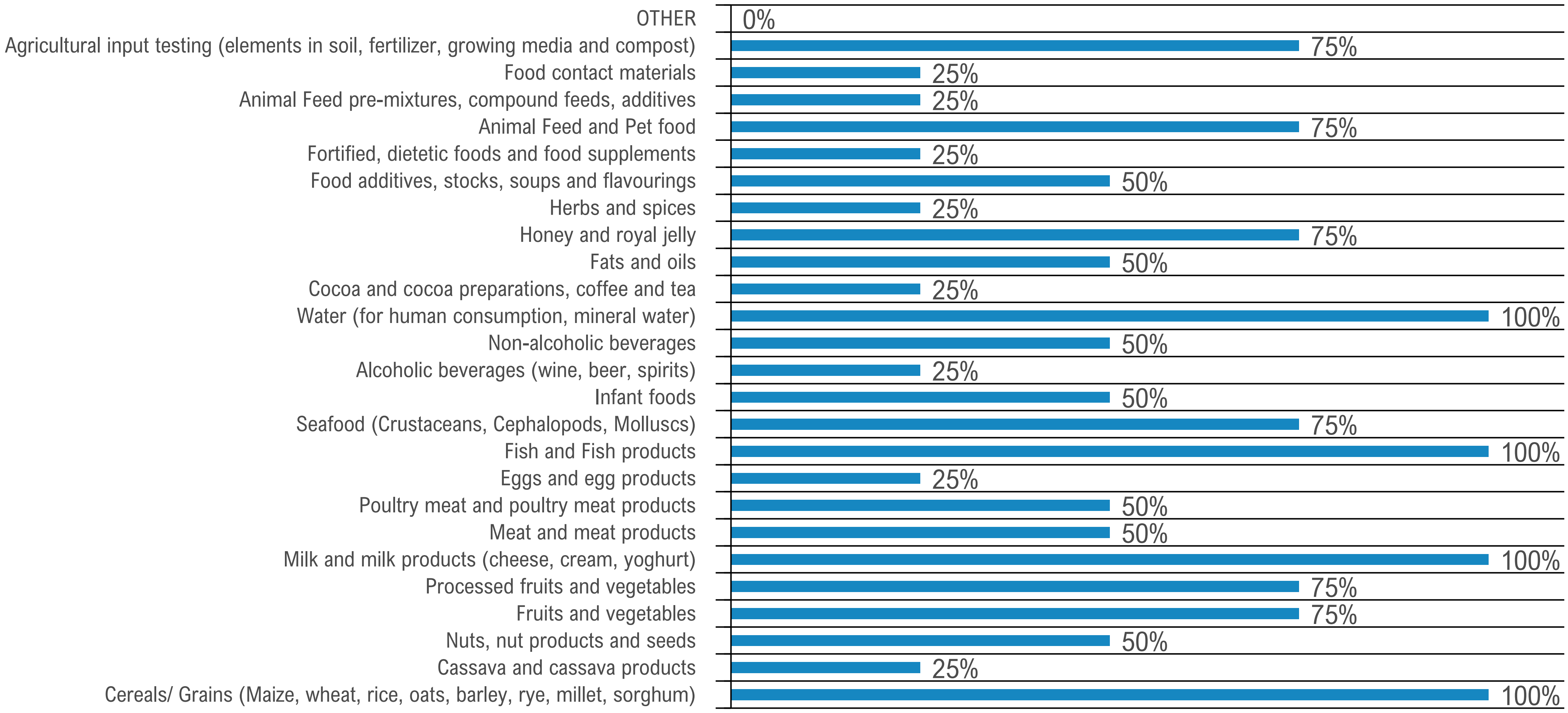


Answered questions: 4 | Skipped questions: 112

Q160: Automated sample preparation

Answered questions: 4 | Skipped questions: 112

Q161: Select the applicable food categories analysed in your laboratory



Answered questions: 4 | Skipped questions: 112

Q251: Analysis for clients

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Private clients	25% (1)	25% (1)	0% (0)	25% (1)	25% (1)	4
Inspection	0% (0)	25% (1)	0% (0)	50% (2)	25% (1)	4
Monitoring	0% (0)	0% (0)	25% (1)	25% (1)	50% (2)	4
Exports	25% (1)	25% (1)	50% (2)	0% (0)	0% (0)	4

Answered questions: 4 | Skipped questions: 112

Q251: Analysis for clients

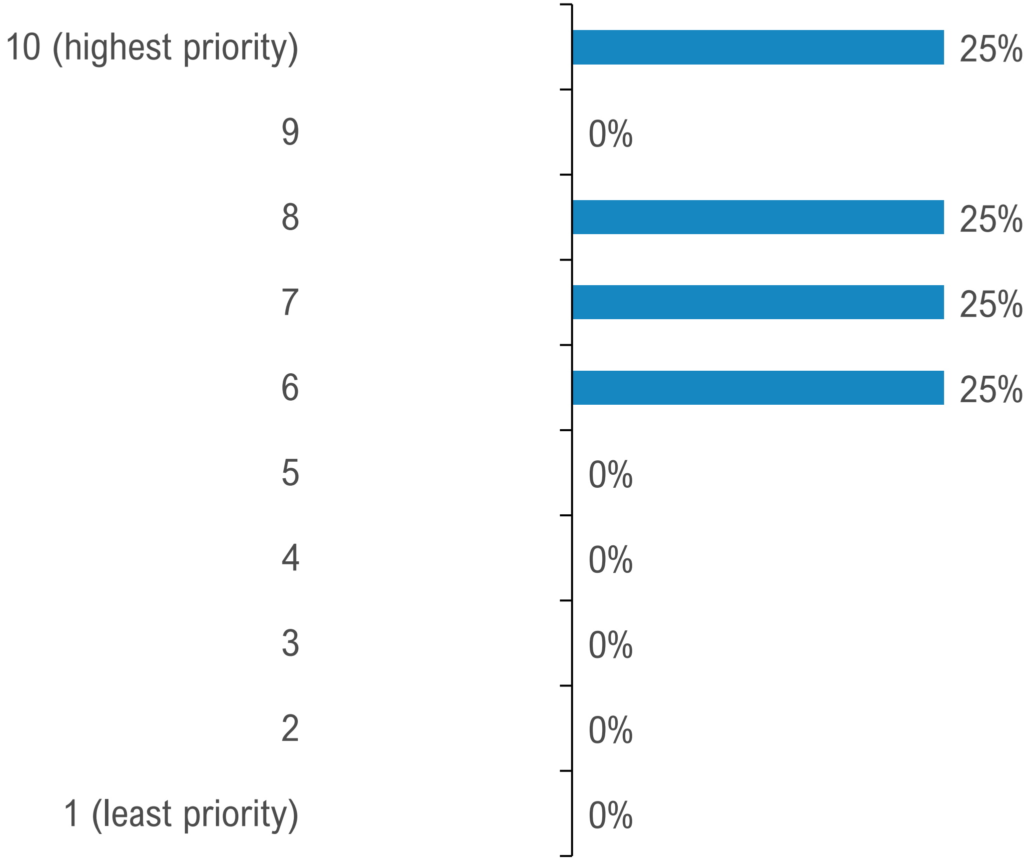
Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Imports	0% (0)	0% (0)	0% (0)	75% (3)	25% (1)	4
Internal testing	25% (1)	50% (2)	25% (1)	0% (0)	0% (0)	4

Answered questions: 4 | Skipped questions: 112

Q165: The importance of the need (ability) to perform these analyses in your country

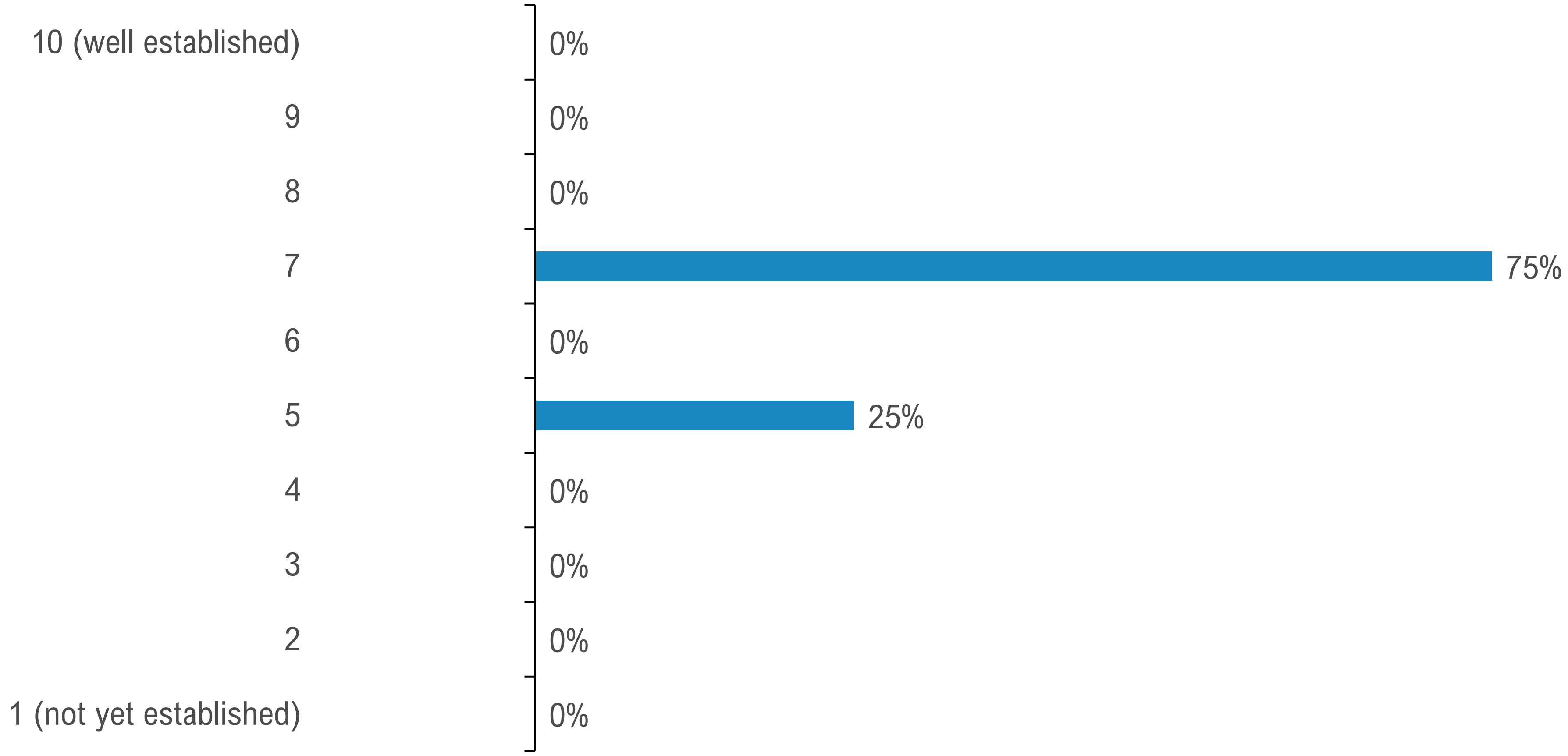
Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority



Answered questions: 4 | Skipped questions: 112

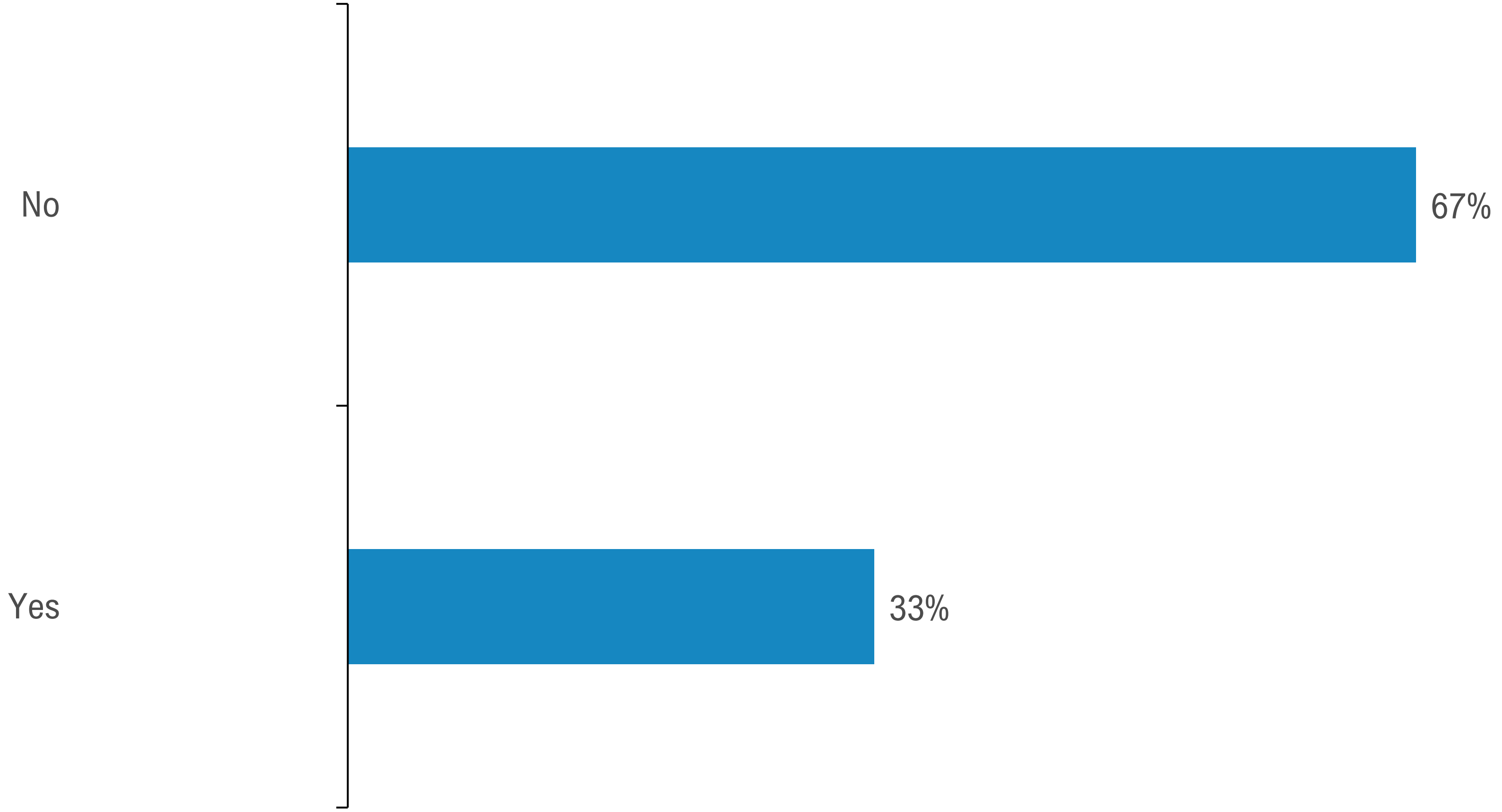
Q166: The degree to which the measurement capability for this analysis is established in your institute

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established



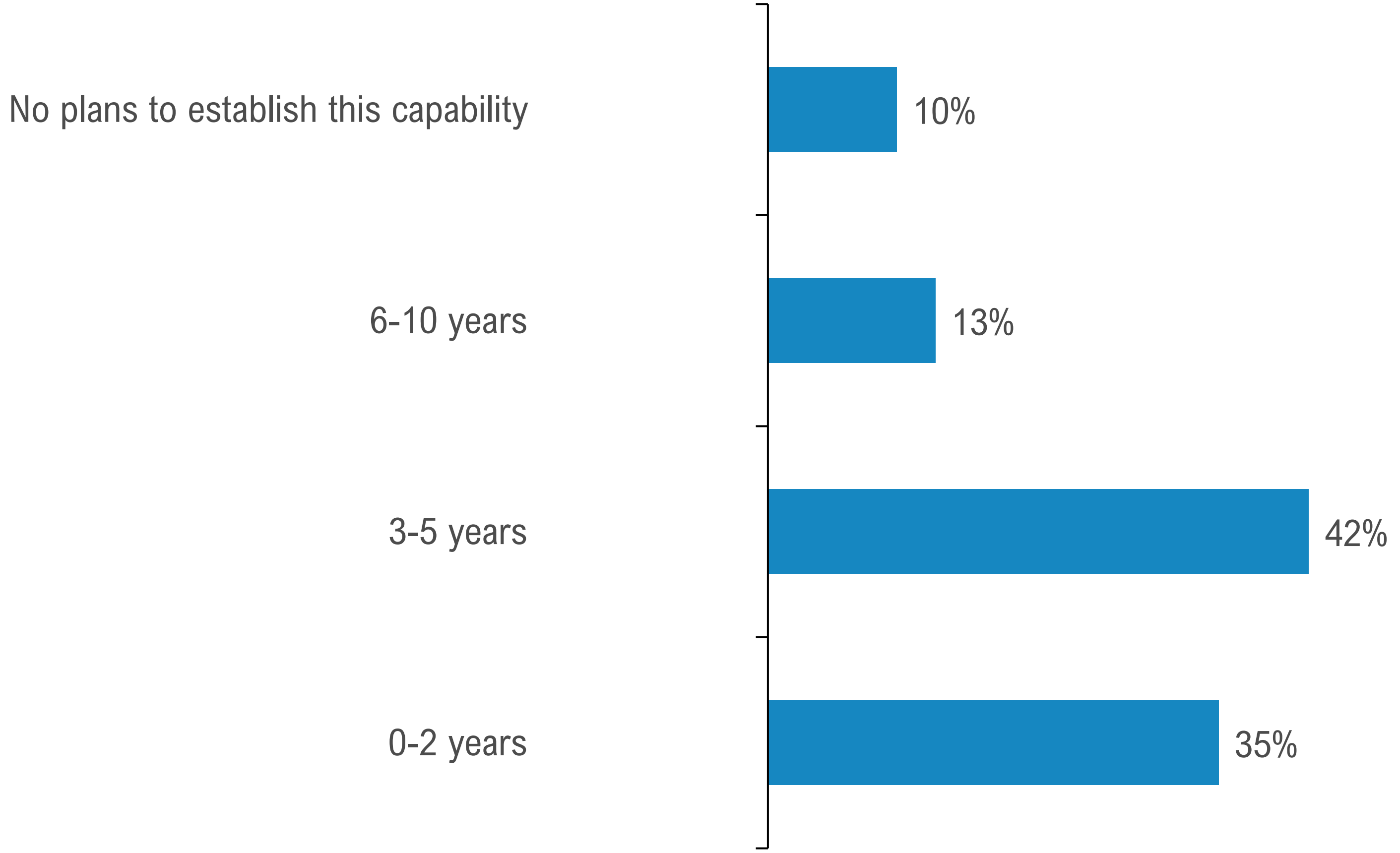
Answered questions: 4 | Skipped questions: 112

Q167: Does your laboratory test food for adulteration/ authenticity?



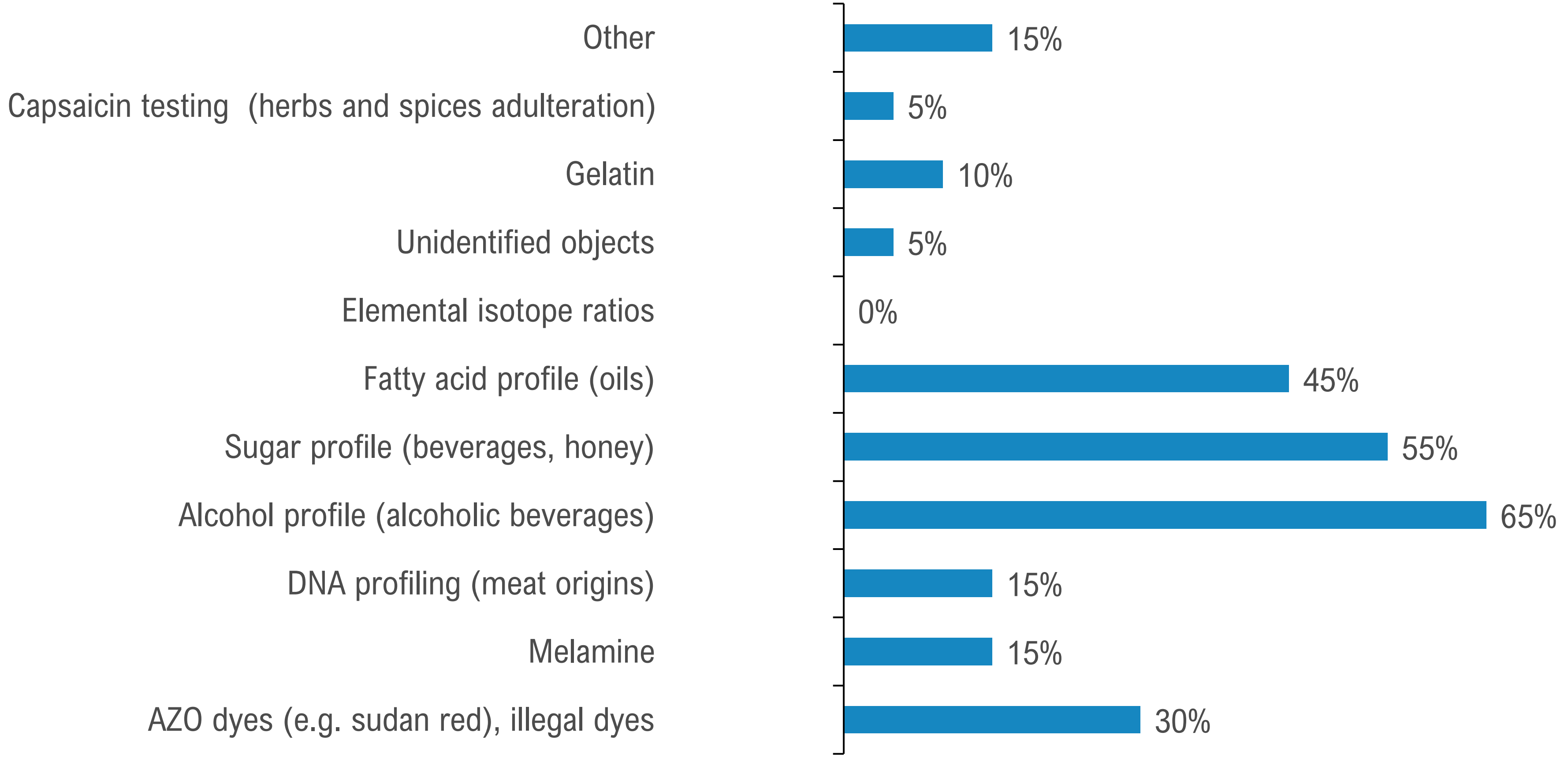
Answered questions: 60 | Skipped questions: 56

Q168: Does your laboratory plan to establish this capability in



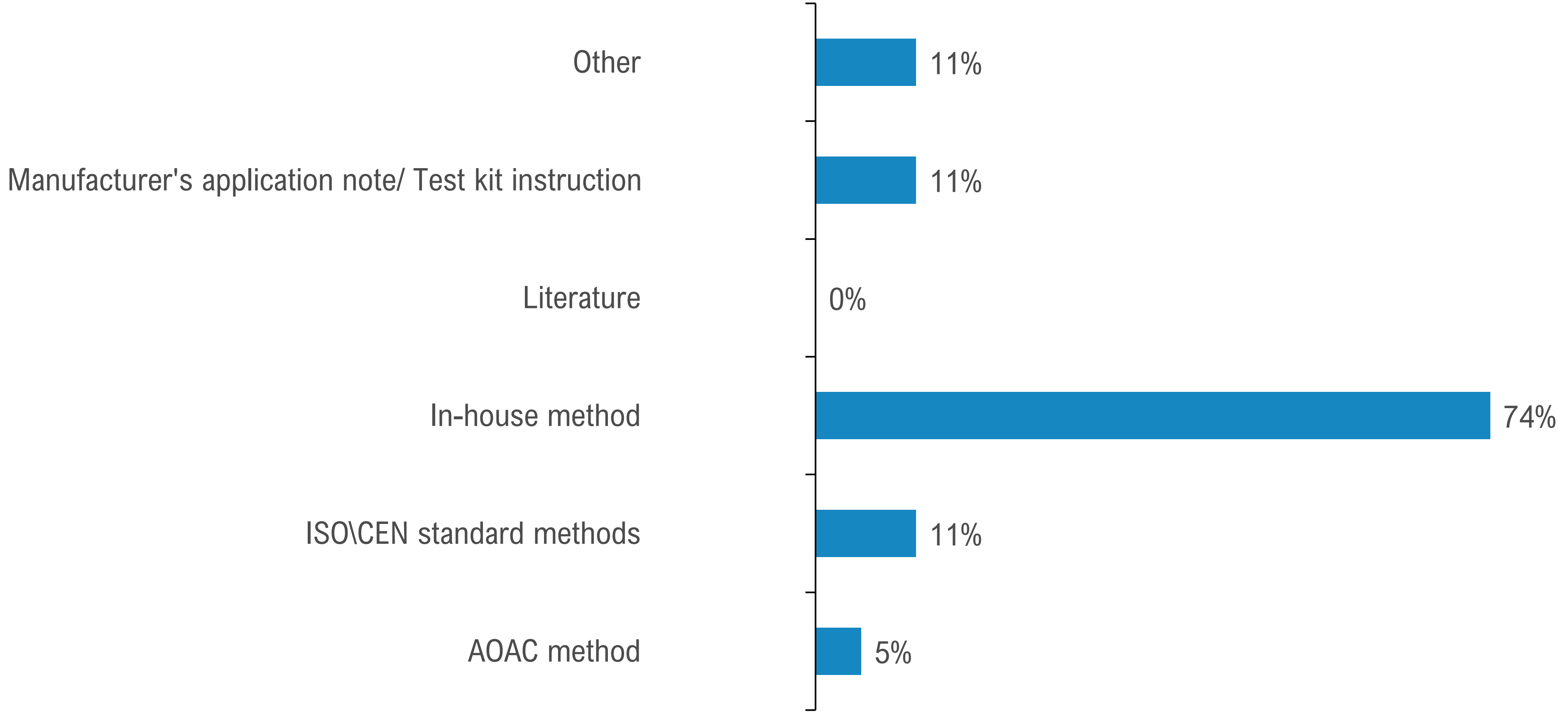
Answered questions: 40 | Skipped questions: 76

Q169: Indicates which adulterants your laboratory is able to test for:



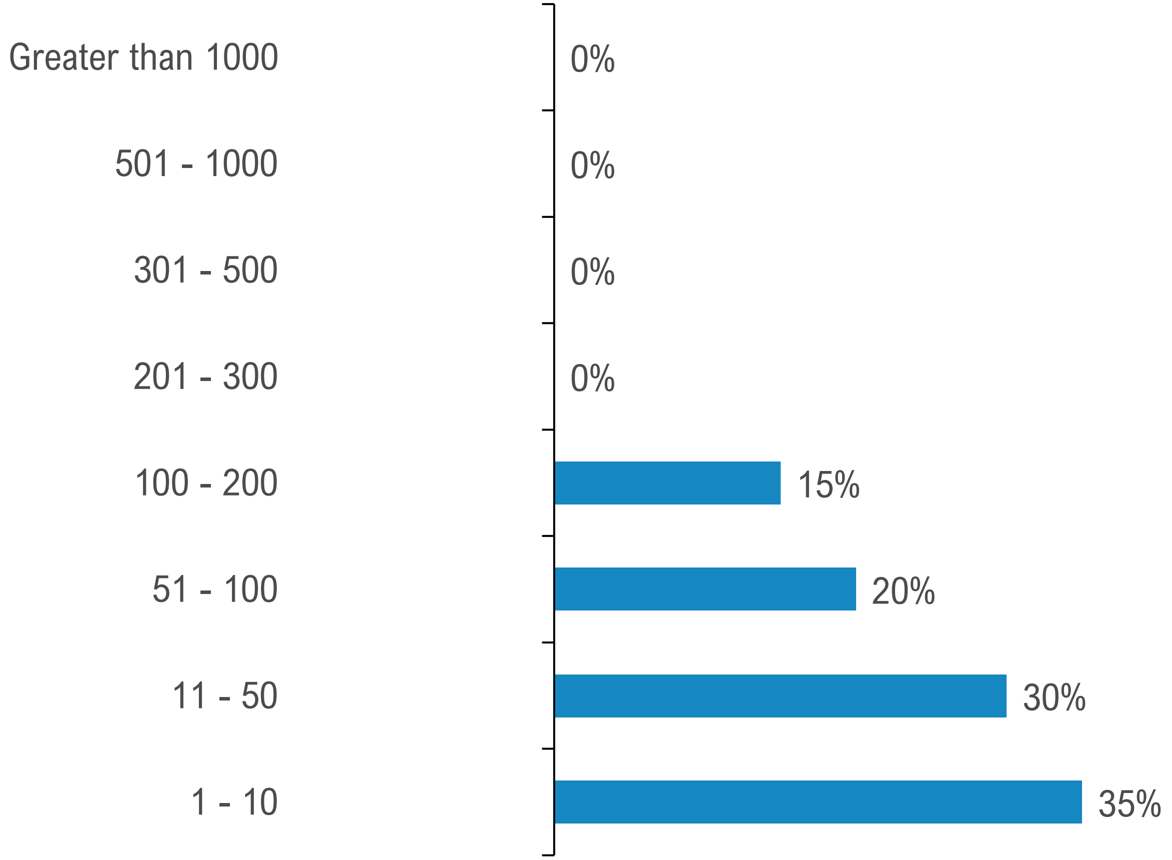
Answered questions: 20 | Skipped questions: 96

Q267: Analytical methods



Answered questions: 19 | Skipped questions: 97

Q173: Number of samples analysed per month

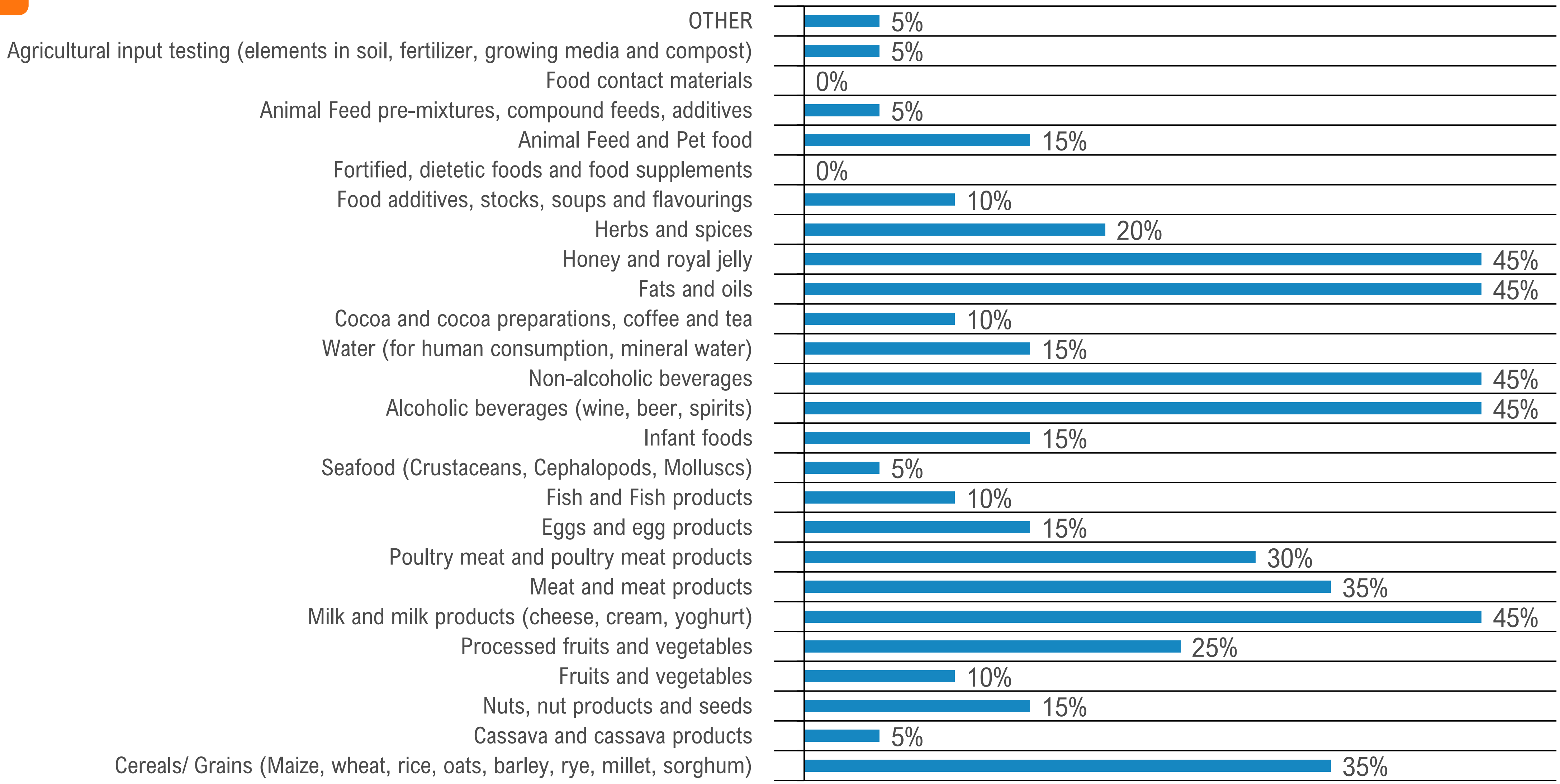


Answered questions: 20 | Skipped questions: 96

Q174: Automated sample preparation

Answered questions: 18 | Skipped questions: 98

Q175: Select food categories based on samples analysed in your laboratory



Answered questions: 20 | Skipped questions: 96

Q252: Analysis for clients

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Private clients	30% (6)	10% (2)	5% (1)	10% (2)	45% (9)	20
Inspection	45% (9)	10% (2)	10% (2)	30% (6)	5% (1)	20
Monitoring	40% (8)	20% (4)	15% (3)	10% (2)	15% (3)	20
Exports	40% (8)	25% (5)	10% (2)	15% (3)	10% (2)	20

Answered questions: 20 | Skipped questions: 96

Q252: Analysis for clients

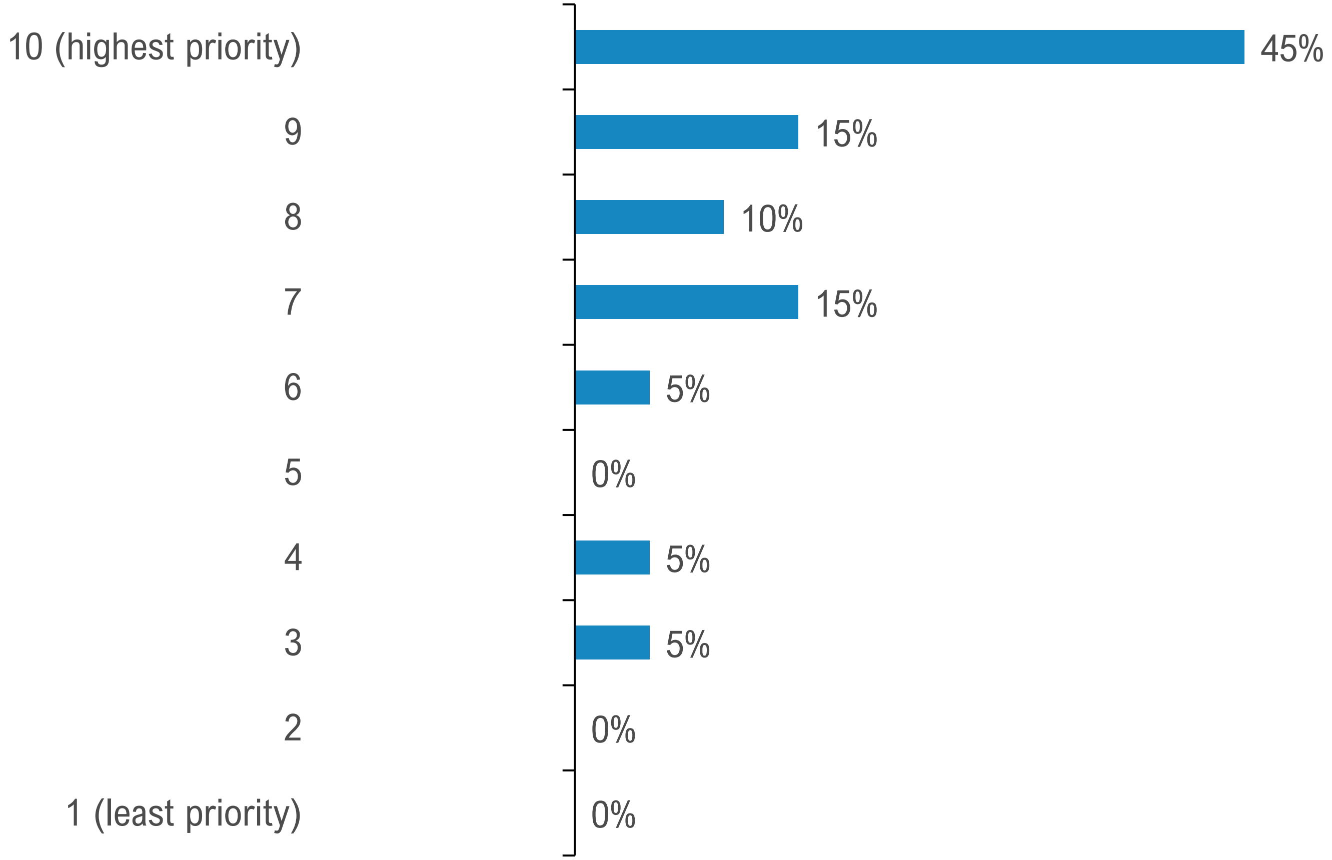
Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Imports	45% (9)	15% (3)	15% (3)	15% (3)	10% (2)	20
Internal testing	25% (5)	15% (3)	20% (4)	10% (2)	30% (6)	20

Answered questions: 20 | Skipped questions: 96

Q179: The importance of the need (ability) to perform these analyses in your country

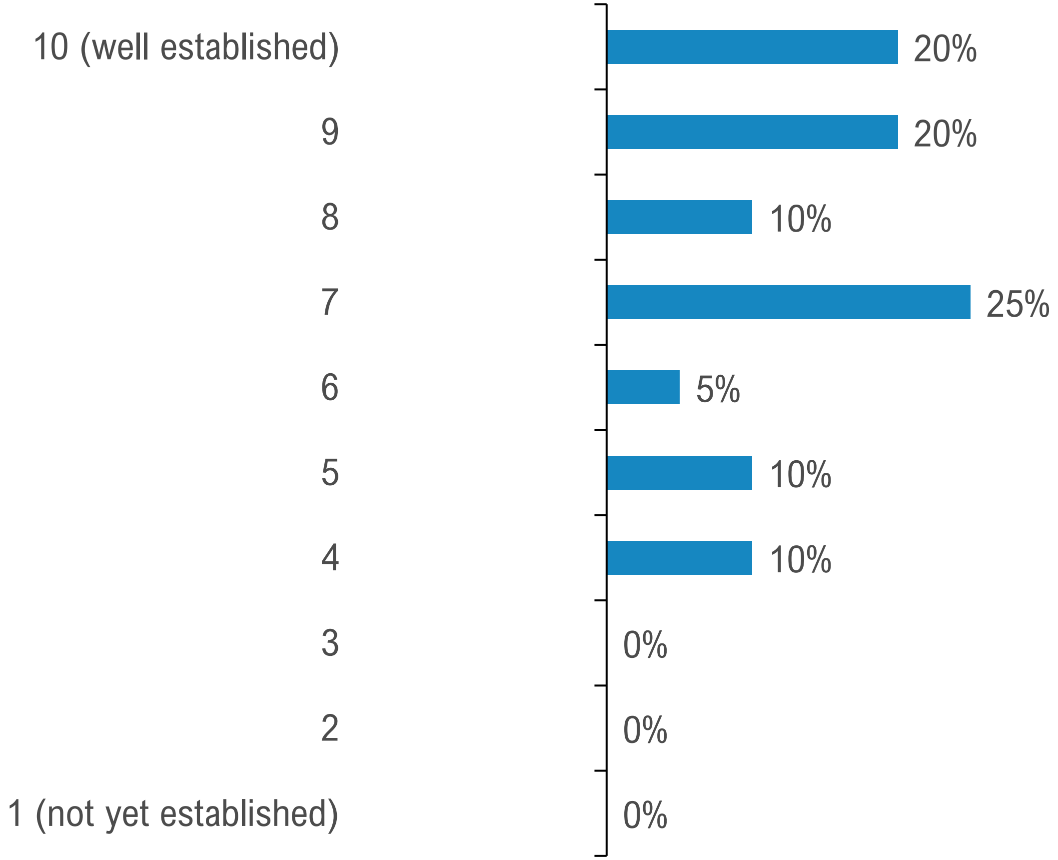
Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority



Answered questions: 20 | Skipped questions: 96

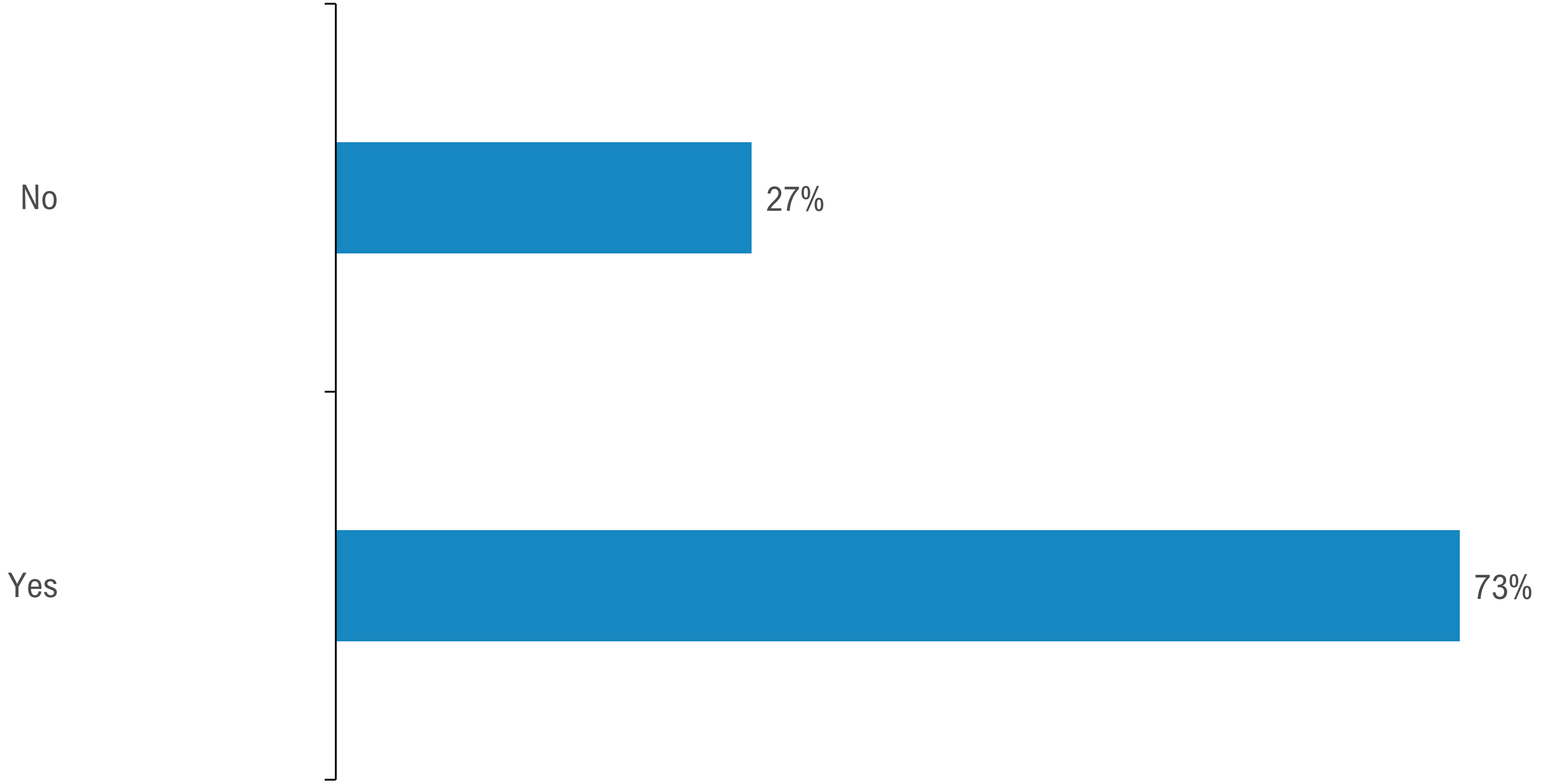
Q180: The degree to which the measurement capability for this analysis is established in your institute

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established



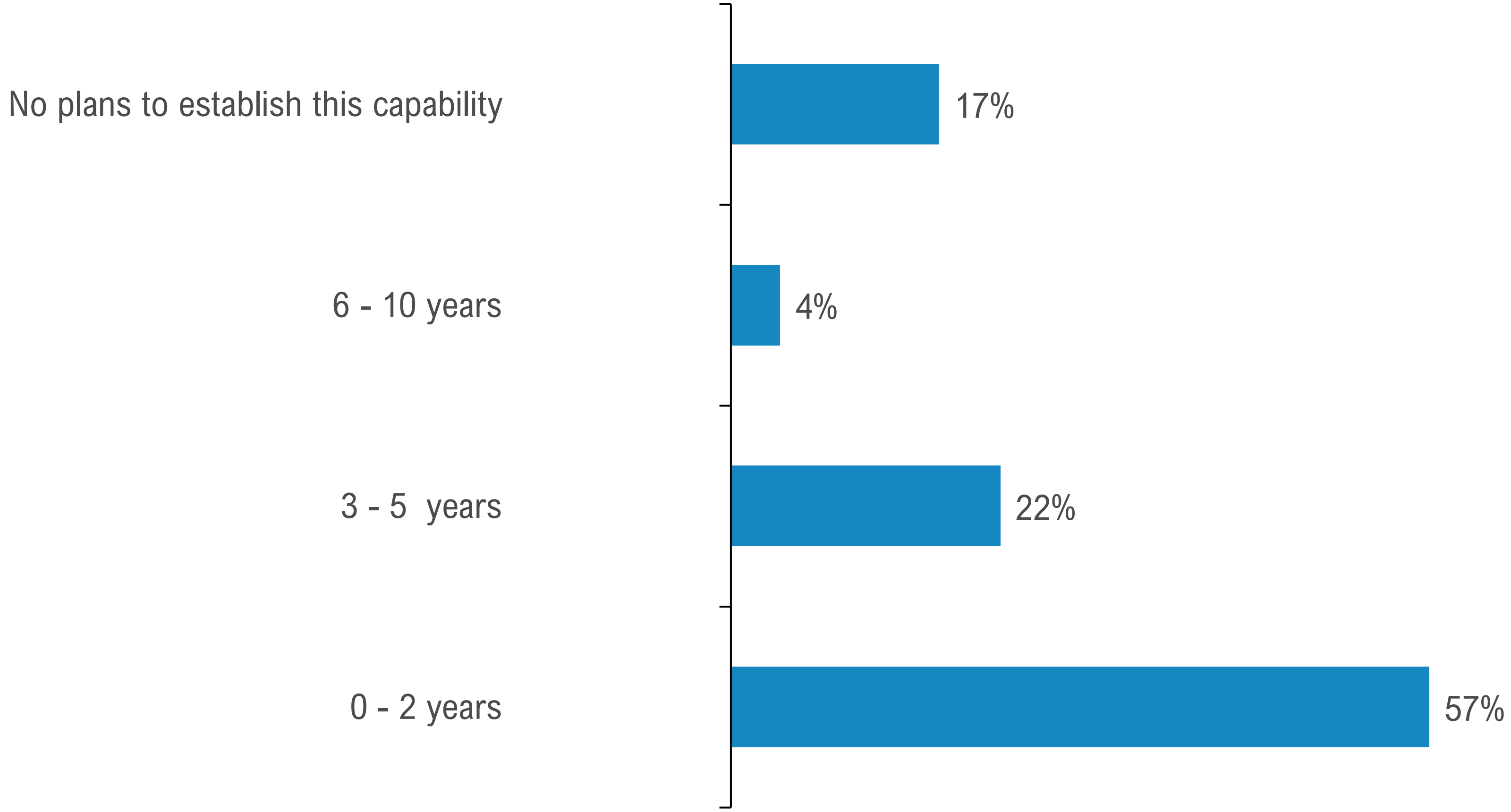
Answered questions: 20 | Skipped questions: 96

Q181: Does your laboratory test for nutritional content in food?



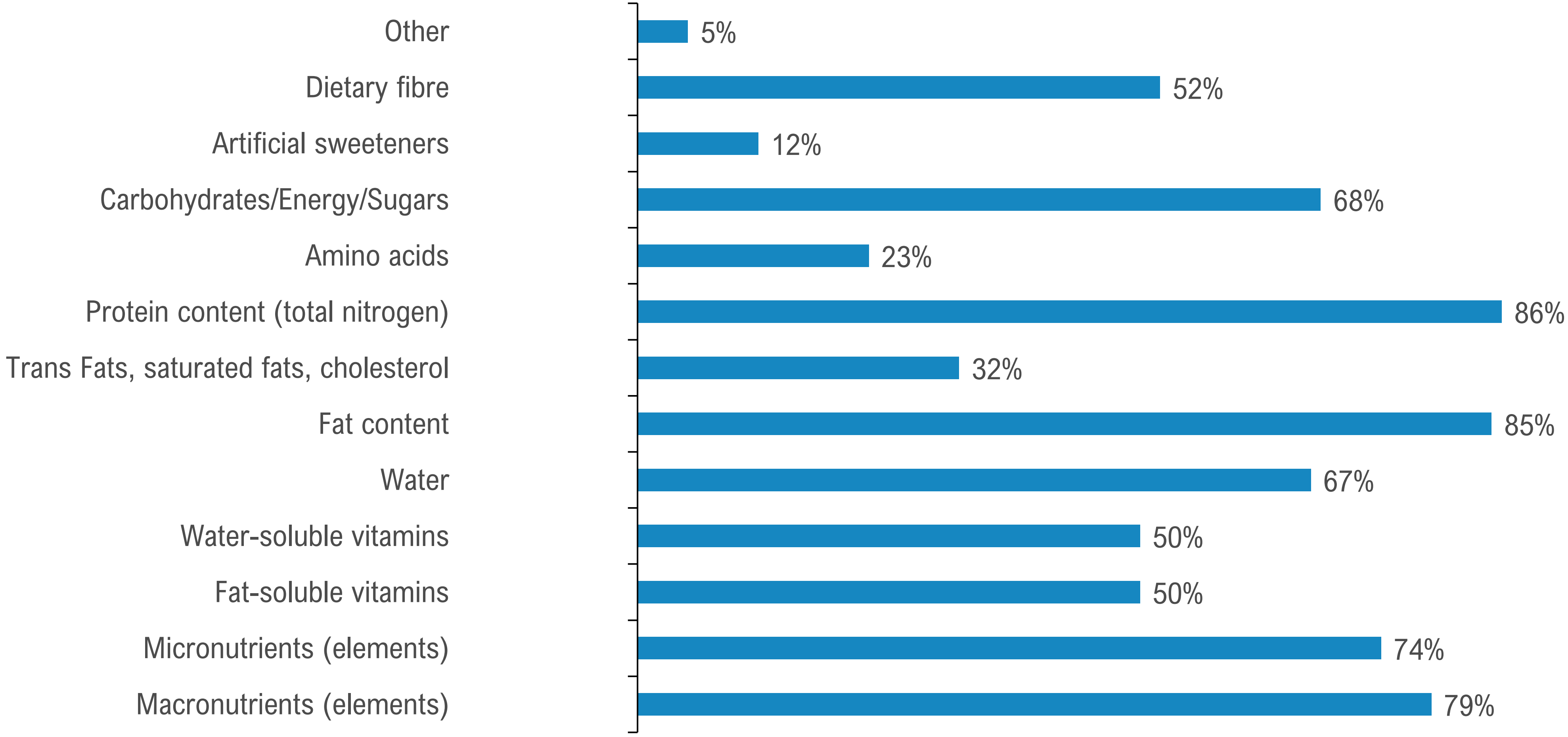
Answered questions: 89 | Skipped questions: 27

Q182: Does your laboratory plan to establish this capability in



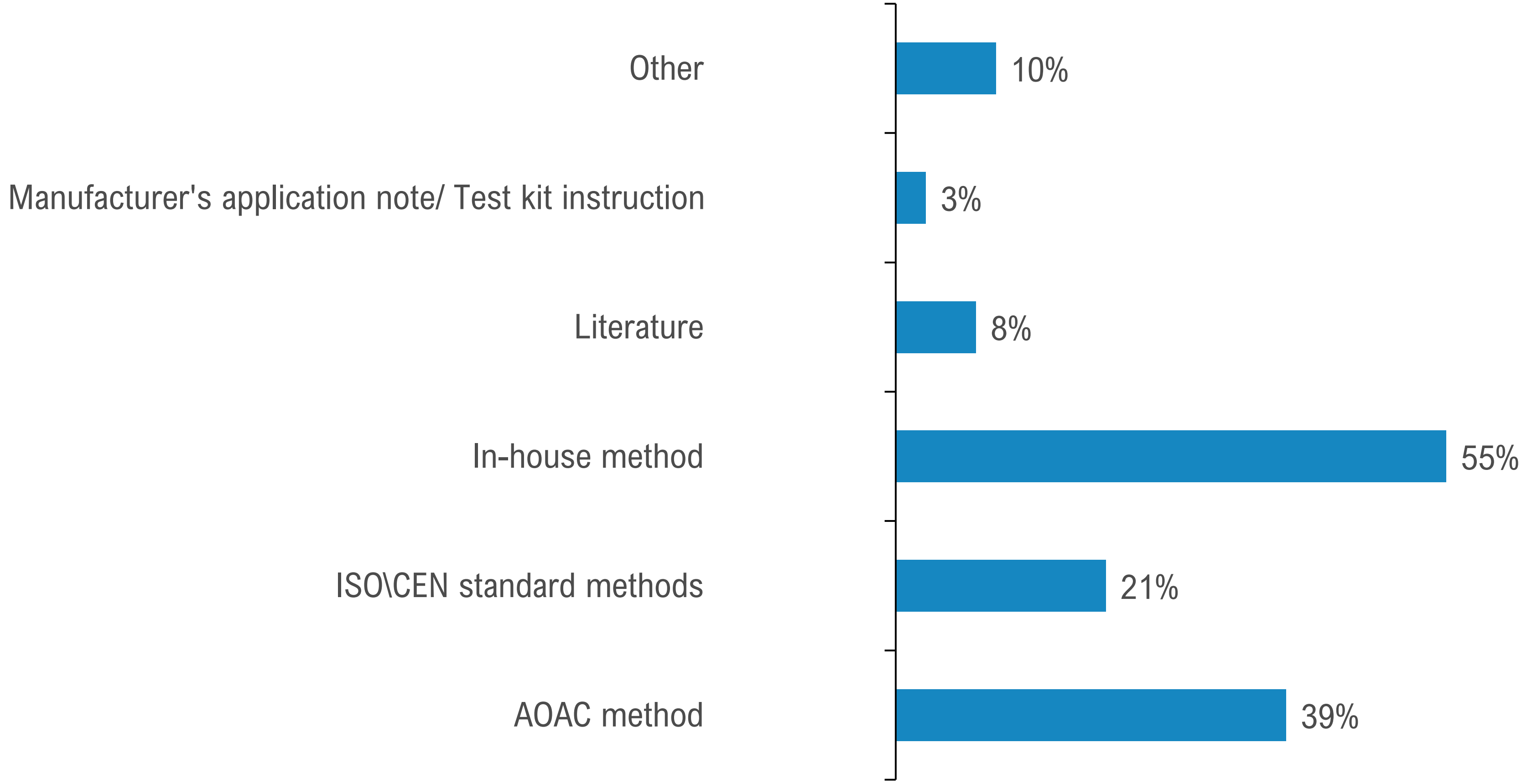
Answered questions: 23 | Skipped questions: 93

Q183: Please indicate which nutritional parameters your laboratory is able to analyse:



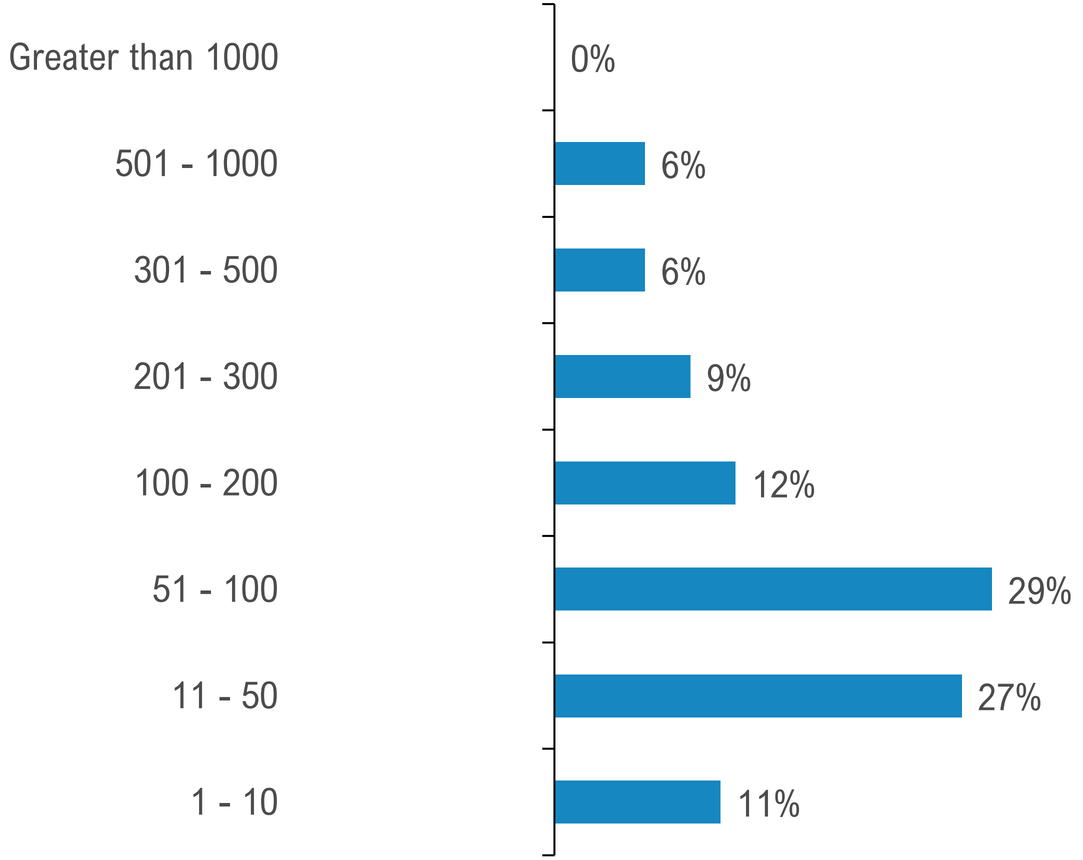
Answered questions: 66 | Skipped questions: 50

Q268: Analytical methods



Answered questions: 62 | Skipped questions: 54

Q187: Number of samples analysed per month

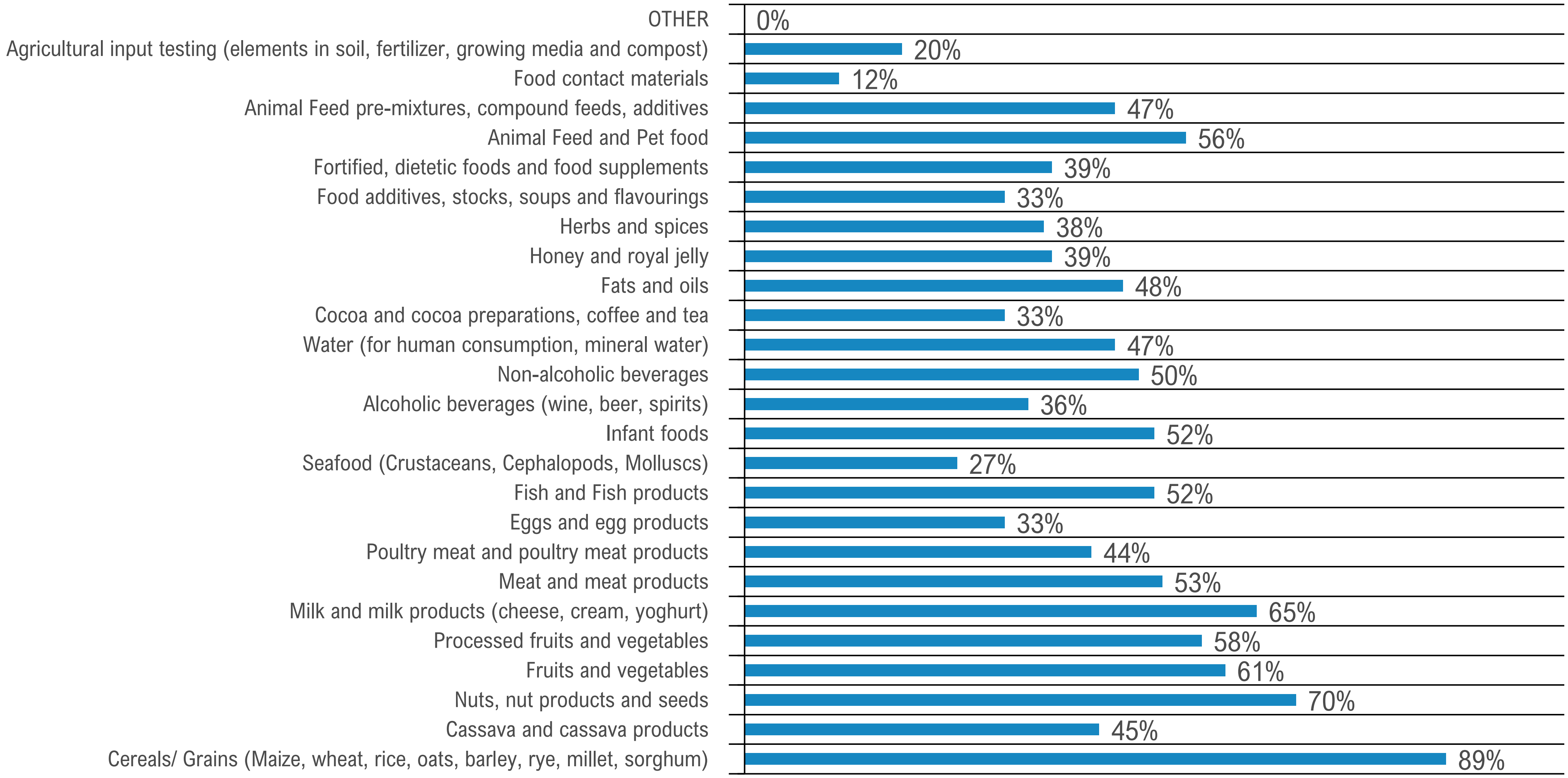


Answered questions: 66 | Skipped questions: 50

Q188: Automated sample preparation

Answered questions: 66 | Skipped questions: 50

Q189: Select the relevant food categories based on samples analysed in your laboratory



Answered questions: 66 | Skipped questions: 50

Q255: Analysis for clients

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Private clients	20% (13)	6% (4)	12% (8)	12% (8)	50% (33)	66
Inspection	29% (19)	15% (10)	26% (17)	18% (12)	12% (8)	66
Monitoring	27% (18)	11% (7)	39% (26)	9% (6)	14% (9)	66
Exports	38% (25)	14% (9)	29% (19)	11% (7)	9% (6)	66

Answered questions: 66 | Skipped questions: 50

Q255: Analysis for clients

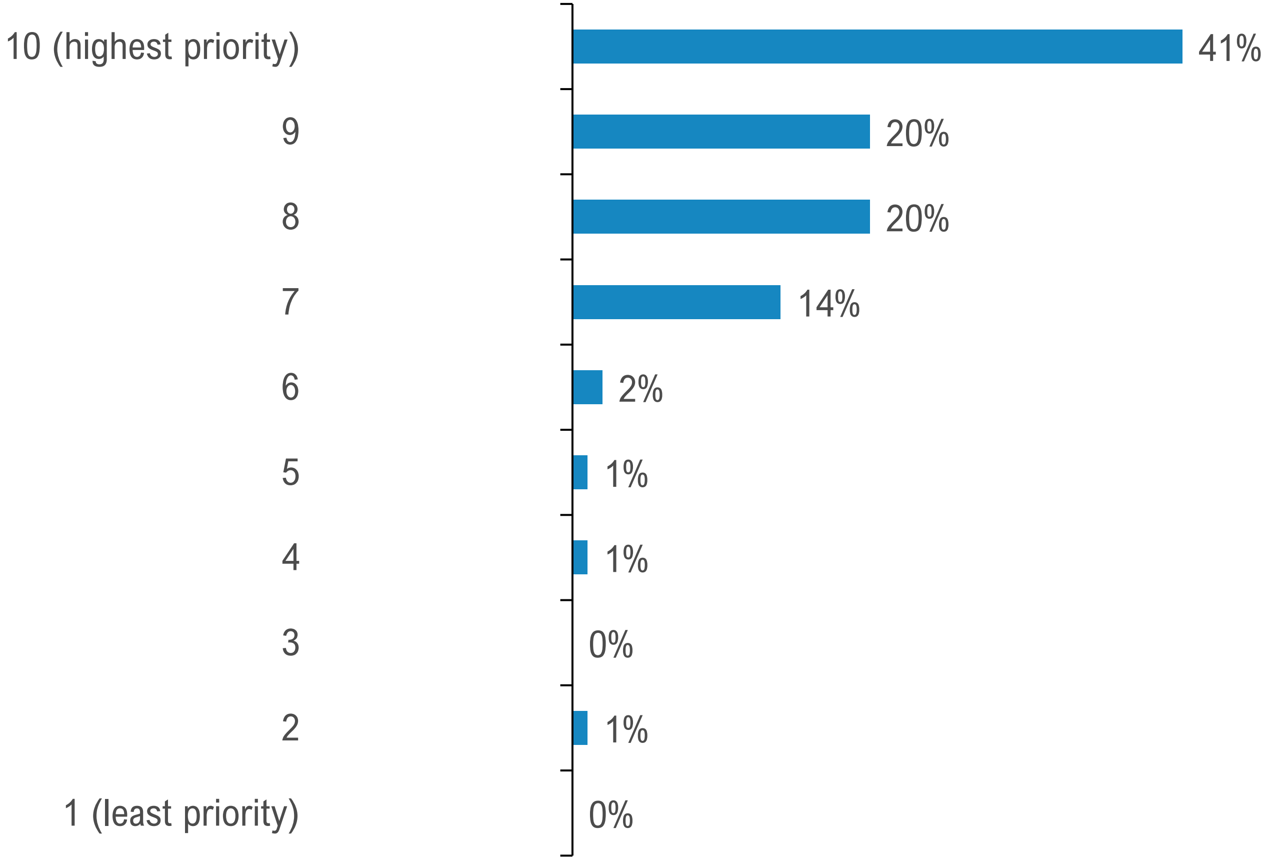
Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Imports	44% (29)	14% (9)	15% (10)	18% (12)	9% (6)	66
Internal testing	26% (17)	17% (11)	23% (15)	11% (7)	24% (16)	66

Answered questions: 66 | Skipped questions: 50

Q193: The importance of the need (ability) to perform these analyses in your country

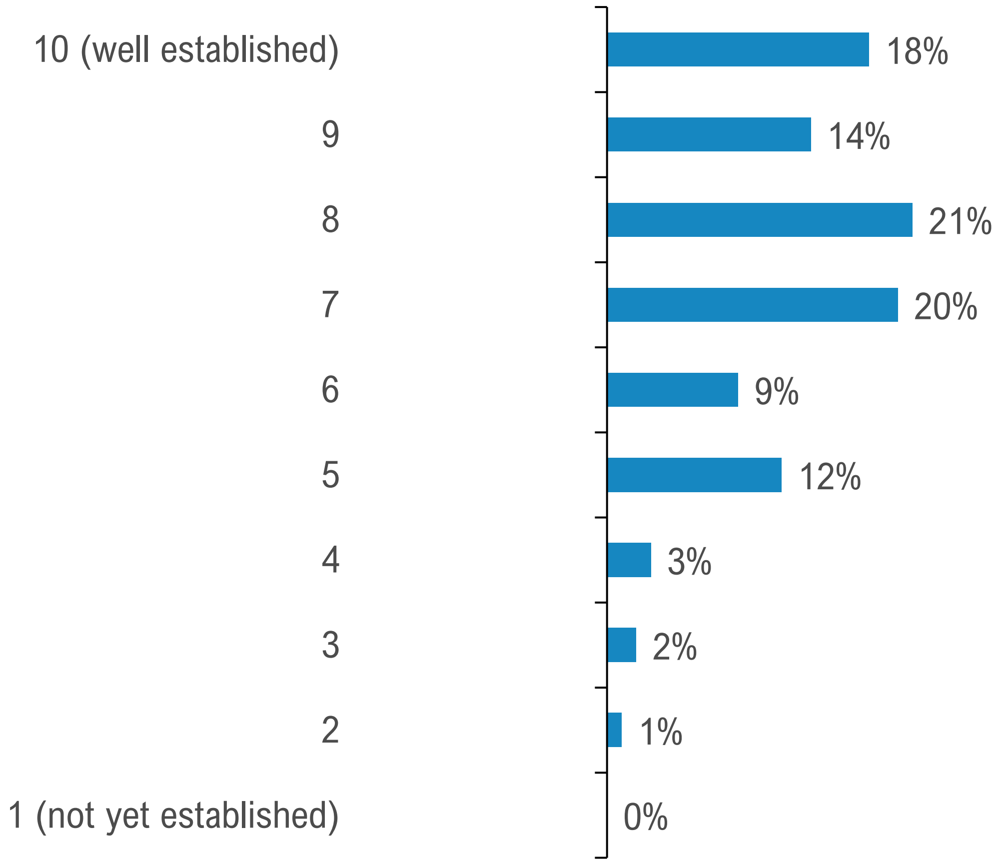
Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority



Answered questions: 66 | Skipped questions: 50

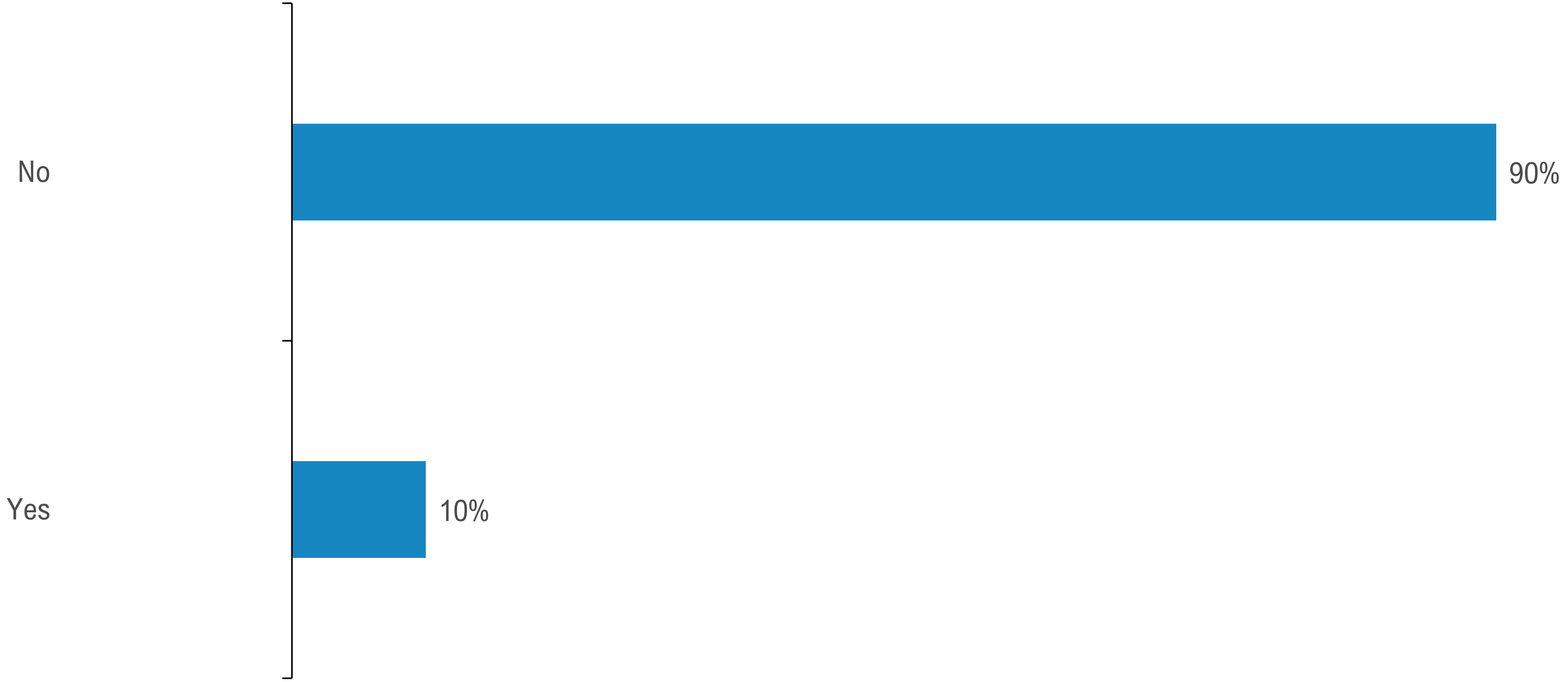
Q194: The degree to which the measurement capability for this analysis is established in your institute

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established



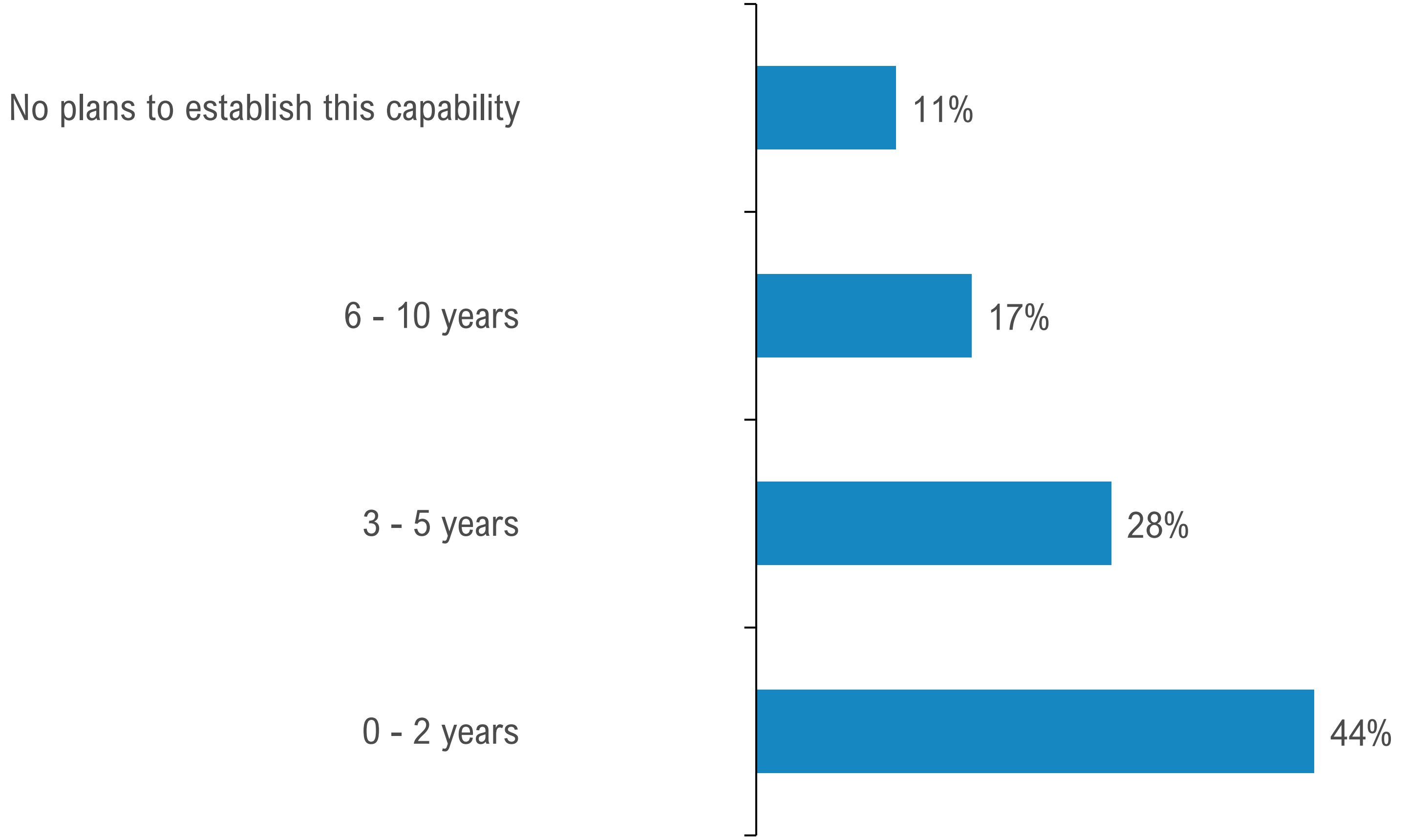
Answered questions: 66 | Skipped questions: 50

Q195: Does your laboratory conduct GMO testing?



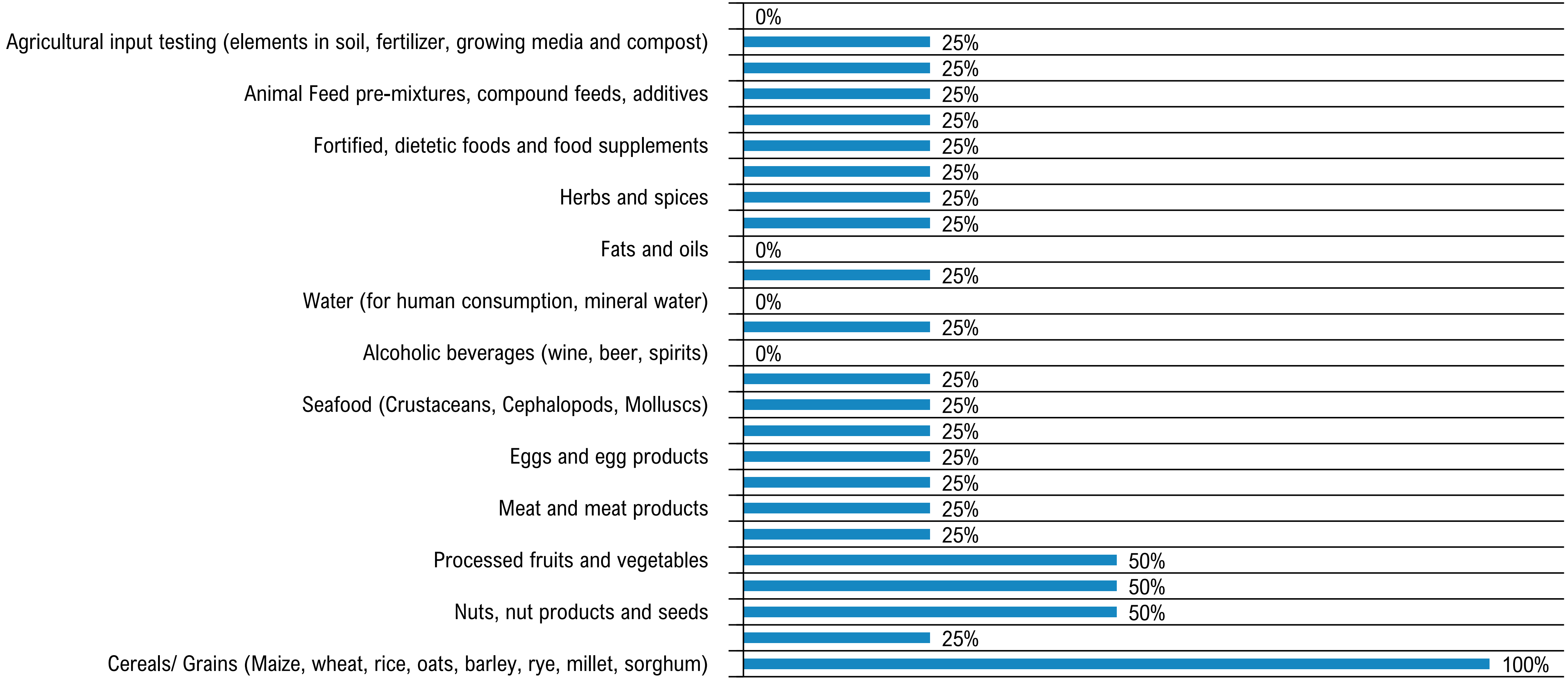
Answered questions: 40 | Skipped questions: 76

Q196: Does your laboratory plan to establish this capability in



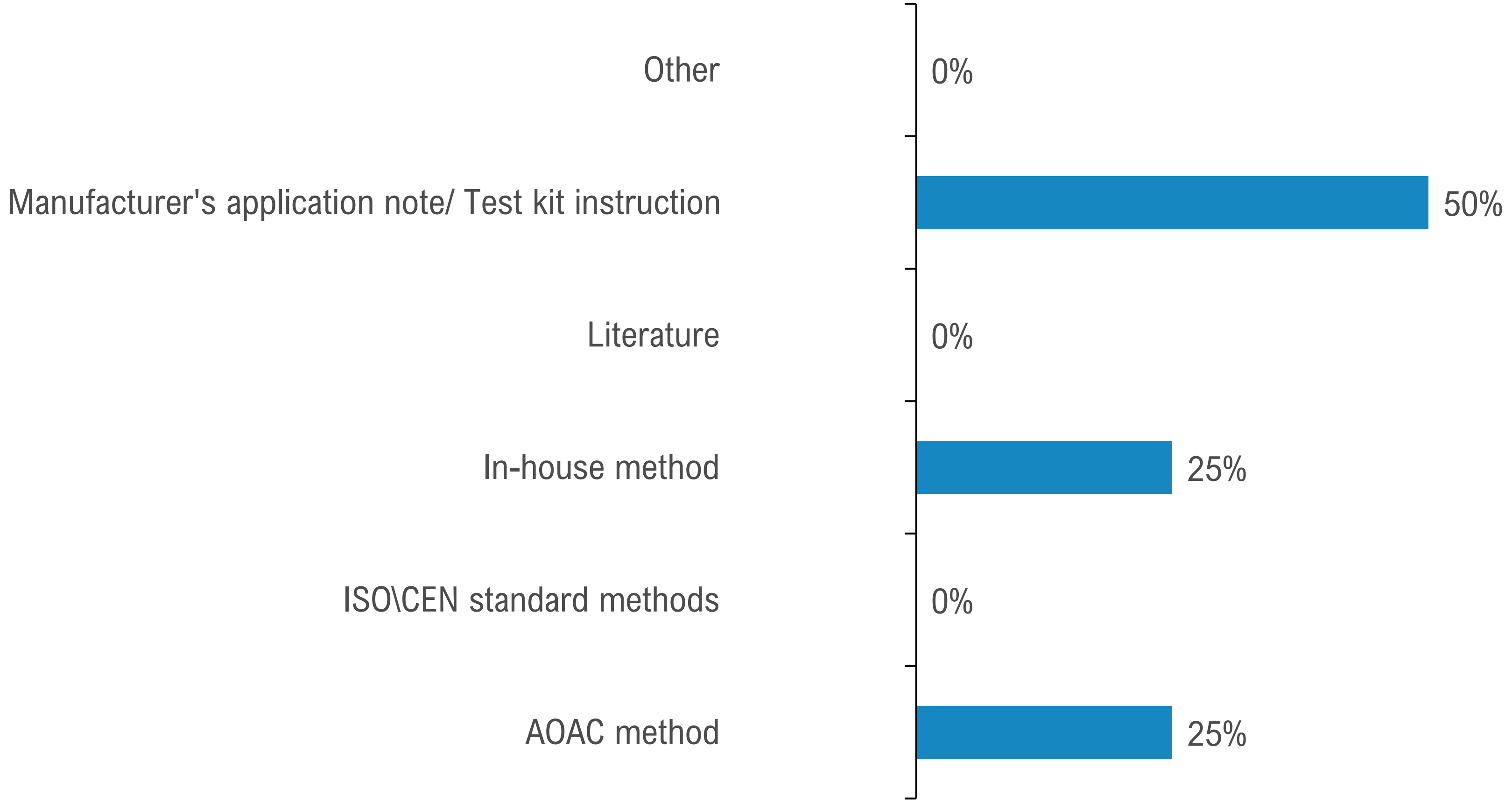
Answered questions: 36 | Skipped questions: 80

Q197: Select applicable food categories based on samples analysed



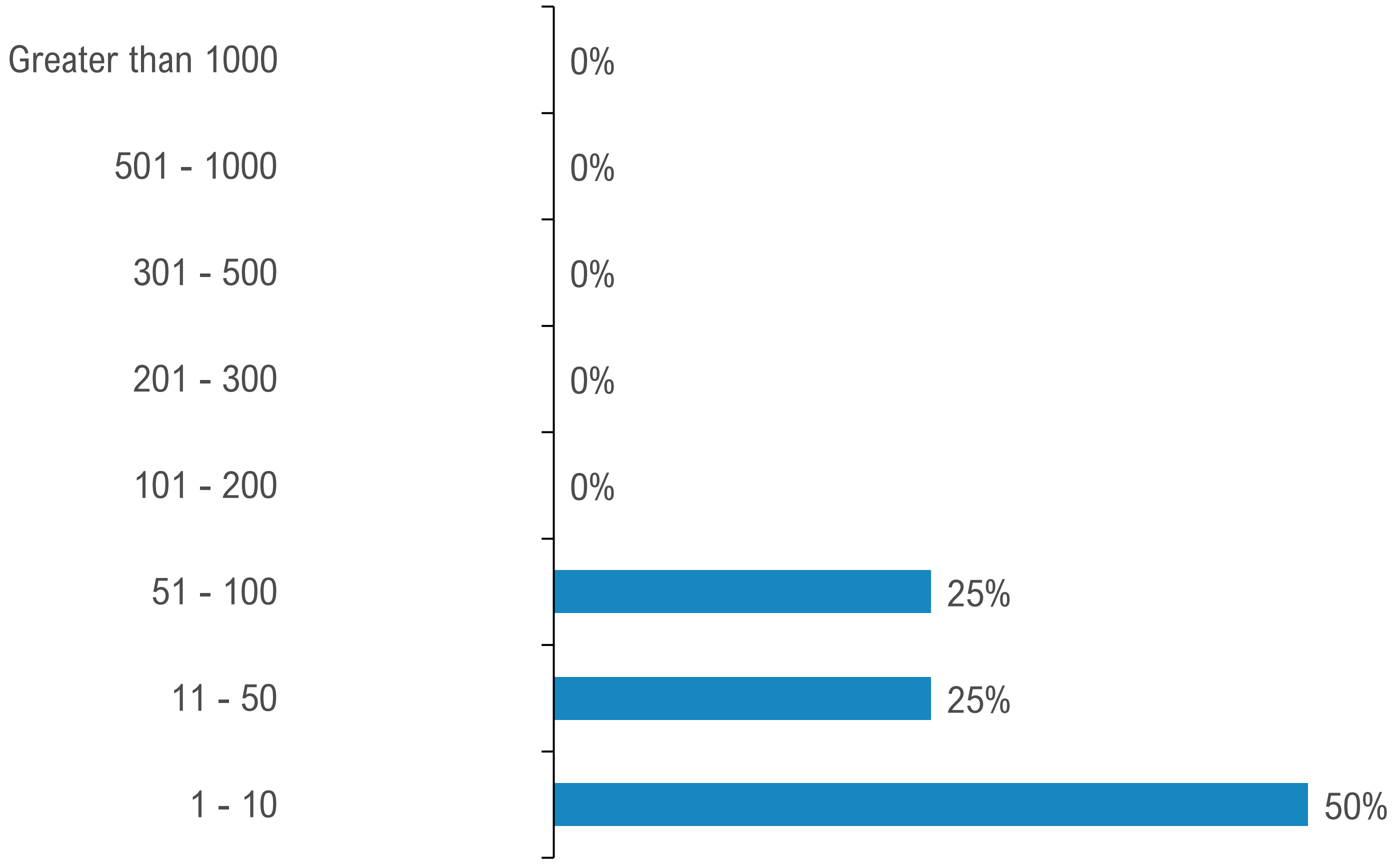
Answered questions: 4 | Skipped questions: 112

Q269: Analytical methods



Answered questions: 4 | Skipped questions: 112

Q200: Number of samples analysed per month



Answered questions: 4 | Skipped questions: 112

Q201: Automated sample preparation

Answered questions: 4 | Skipped questions: 112

Q256: Analysis for clients

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Private clients	25% (1)	25% (1)	0% (0)	0% (0)	50% (2)	4
Inspection	50% (2)	25% (1)	0% (0)	0% (0)	25% (1)	4
Monitoring	50% (2)	25% (1)	0% (0)	0% (0)	25% (1)	4
Exports	75% (3)	0% (0)	0% (0)	25% (1)	0% (0)	4

Answered questions: 4 | Skipped questions: 112

Q256: Analysis for clients

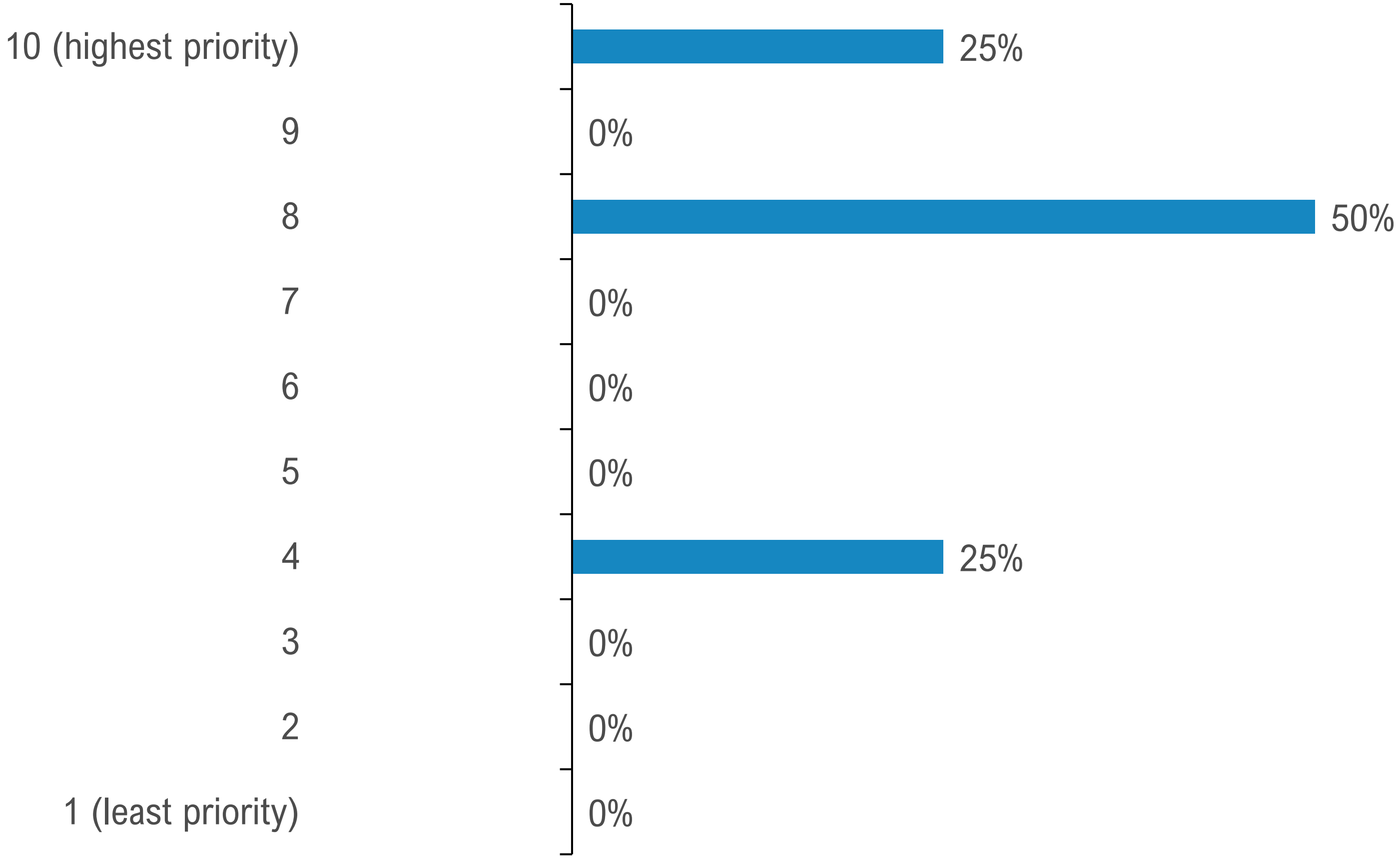
Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Imports	25% (1)	0% (0)	0% (0)	25% (1)	50% (2)	4
Internal testing	50% (2)	0% (0)	50% (2)	0% (0)	0% (0)	4

Answered questions: 4 | Skipped questions: 112

Q205: The importance of the need (ability) to perform these analyses in your country

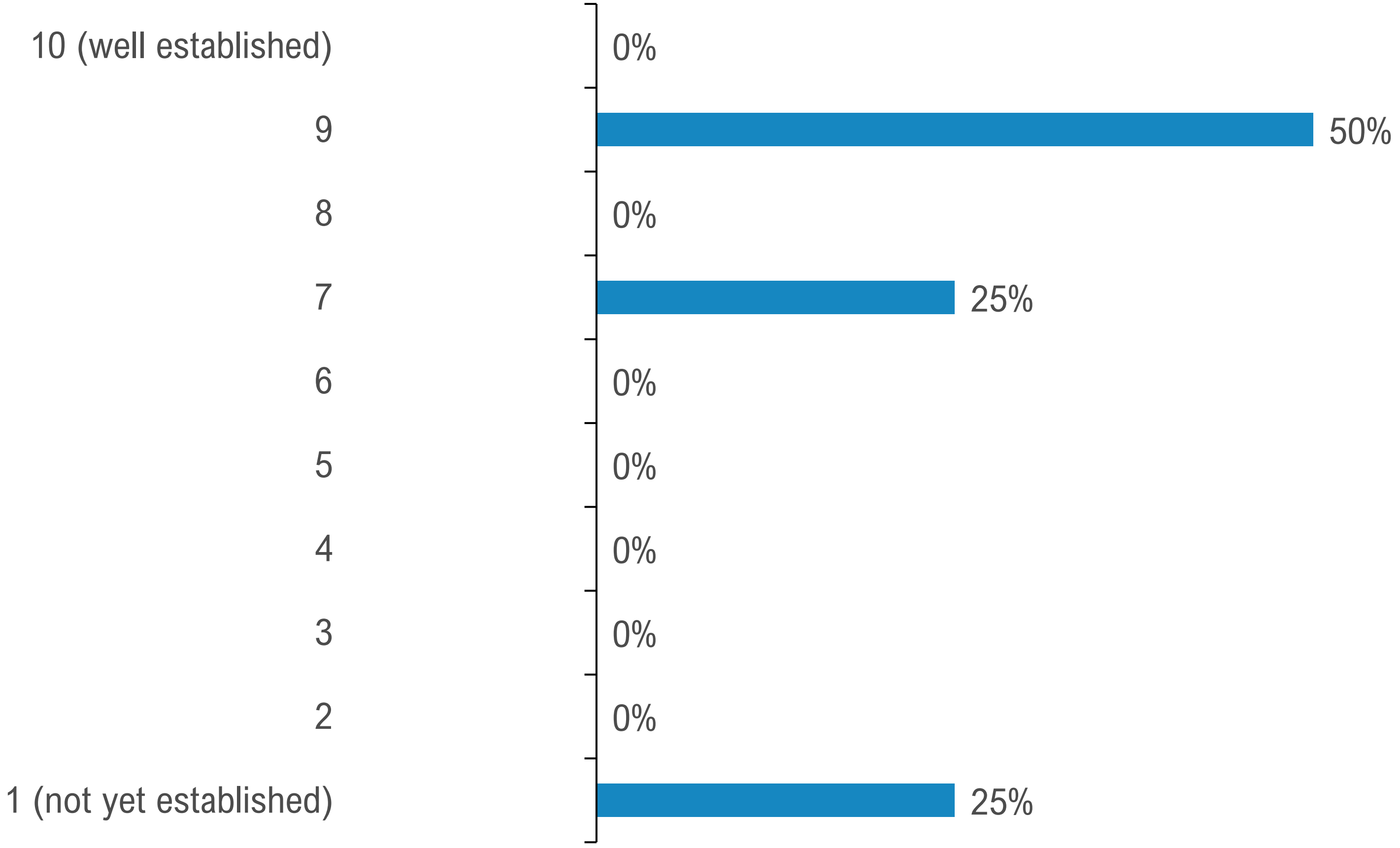
Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority



Answered questions: 4 | Skipped questions: 112

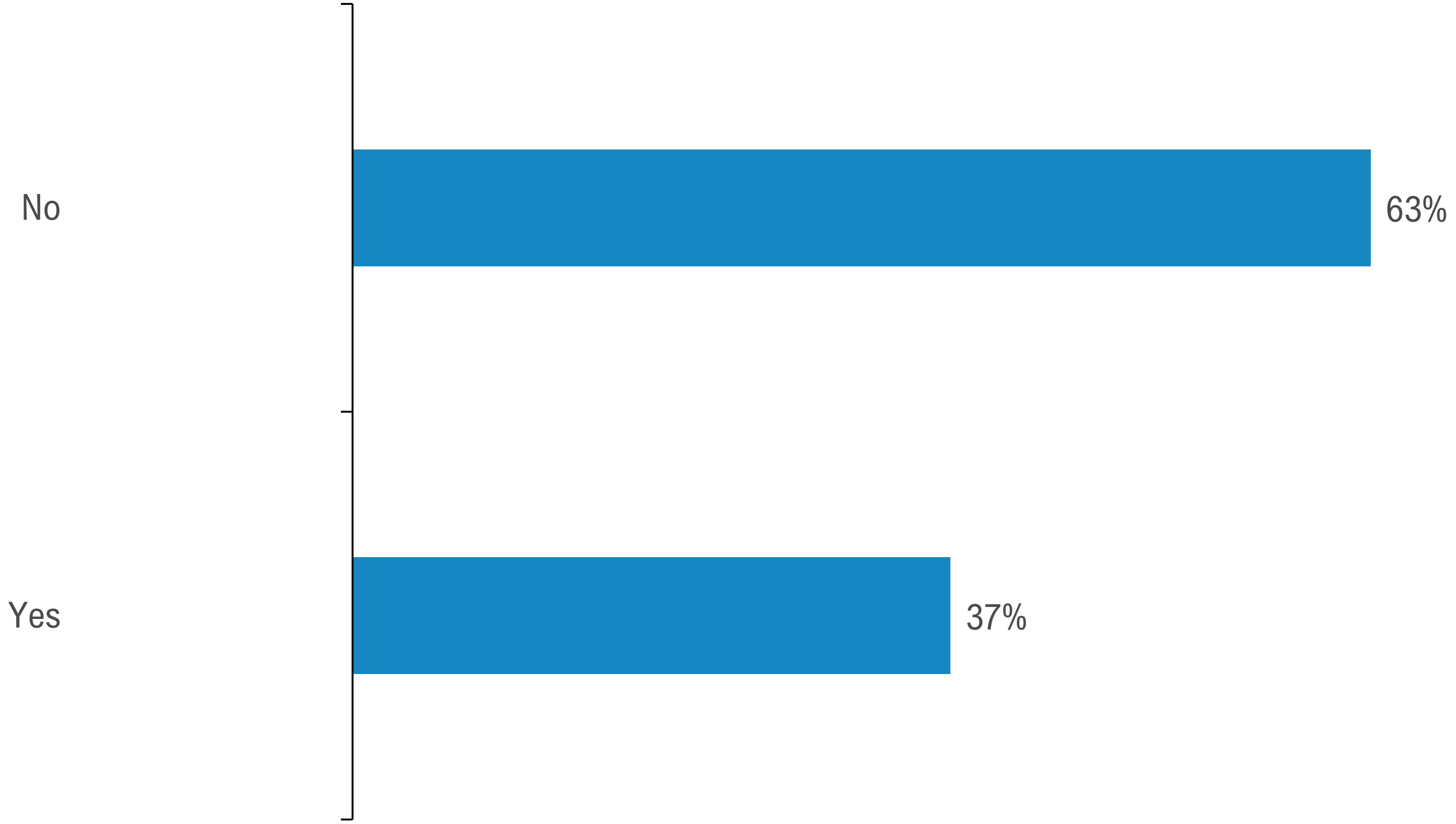
Q206: The degree to which the measurement capability for this analysis is established in your institute

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established



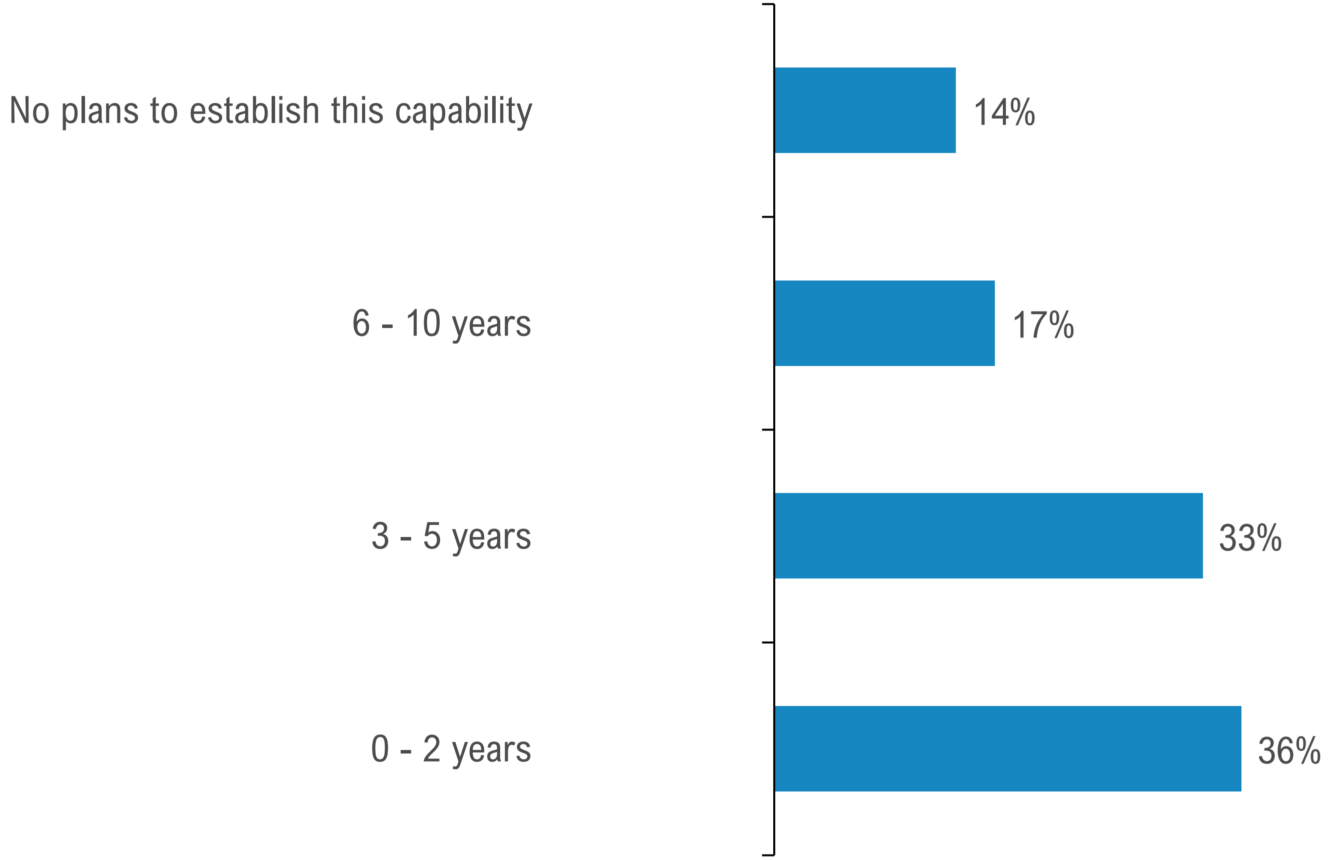
Answered questions: 4 | Skipped questions: 112

Q207: Does your laboratory test food additives/ preservatives?



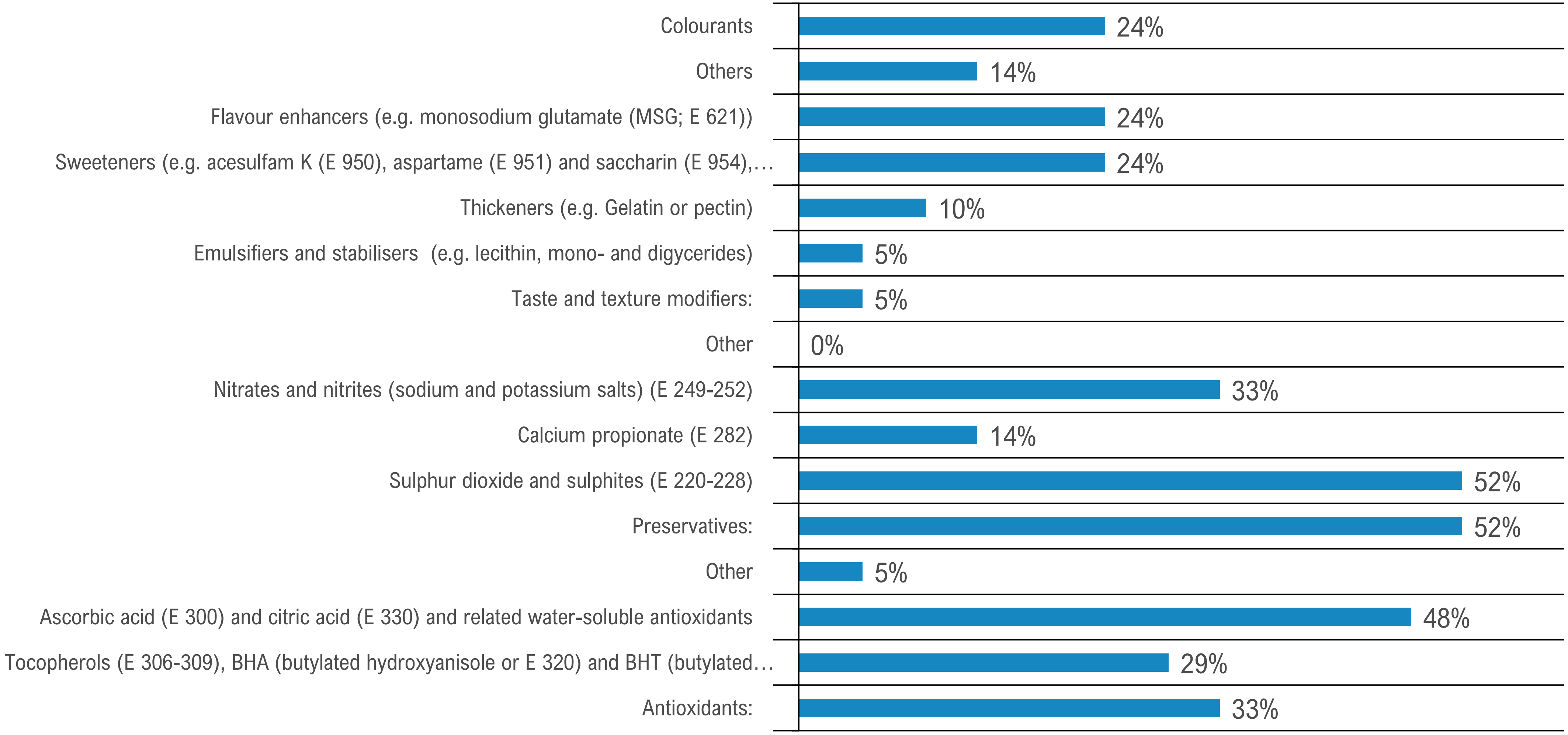
Answered questions: 57 | Skipped questions: 59

Q208: Does your laboratory have plans to establish this capability in



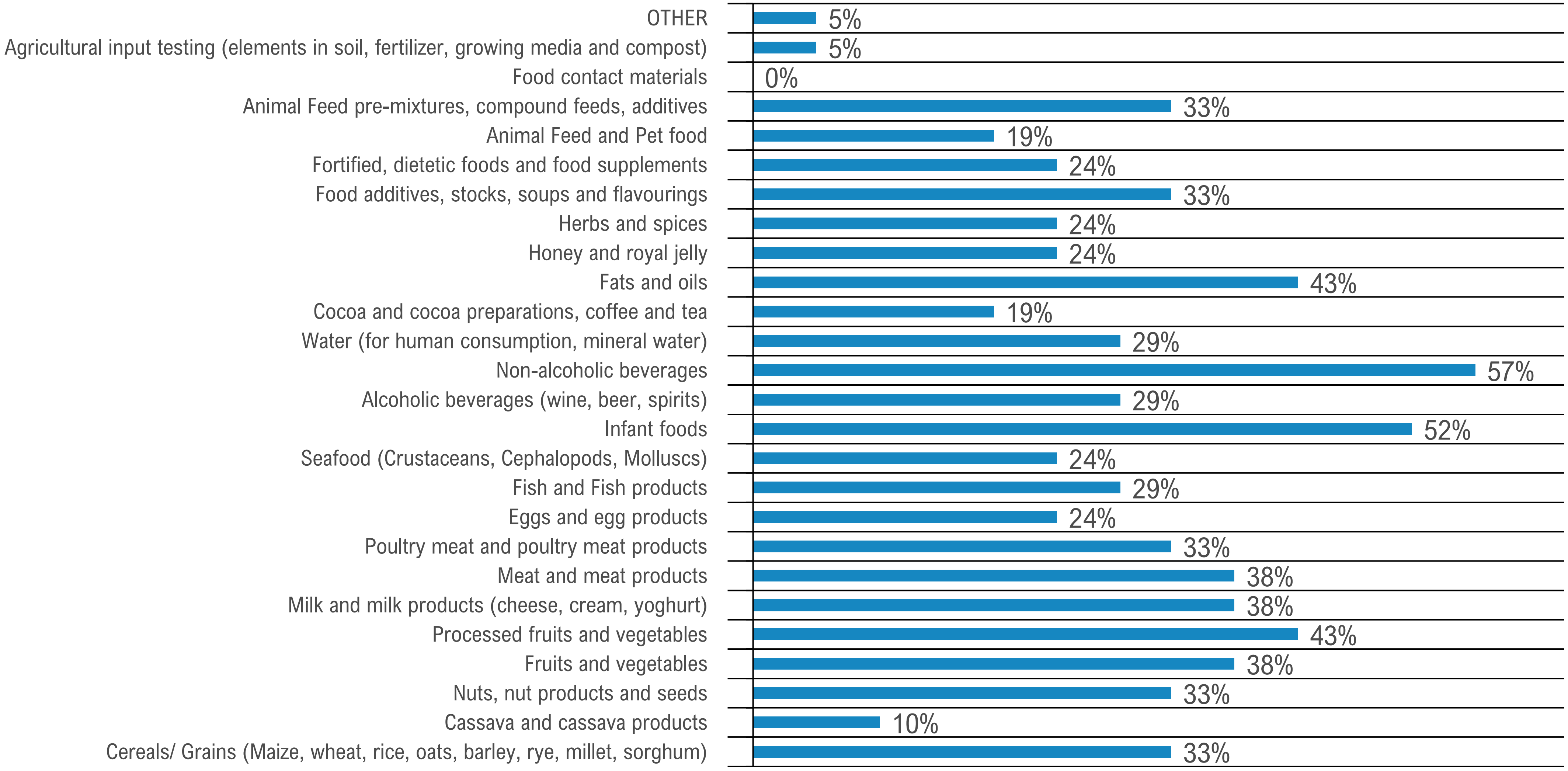
Answered questions: 36 | Skipped questions: 80

Q209: Please indicate which parameters your laboratory is able to test for:



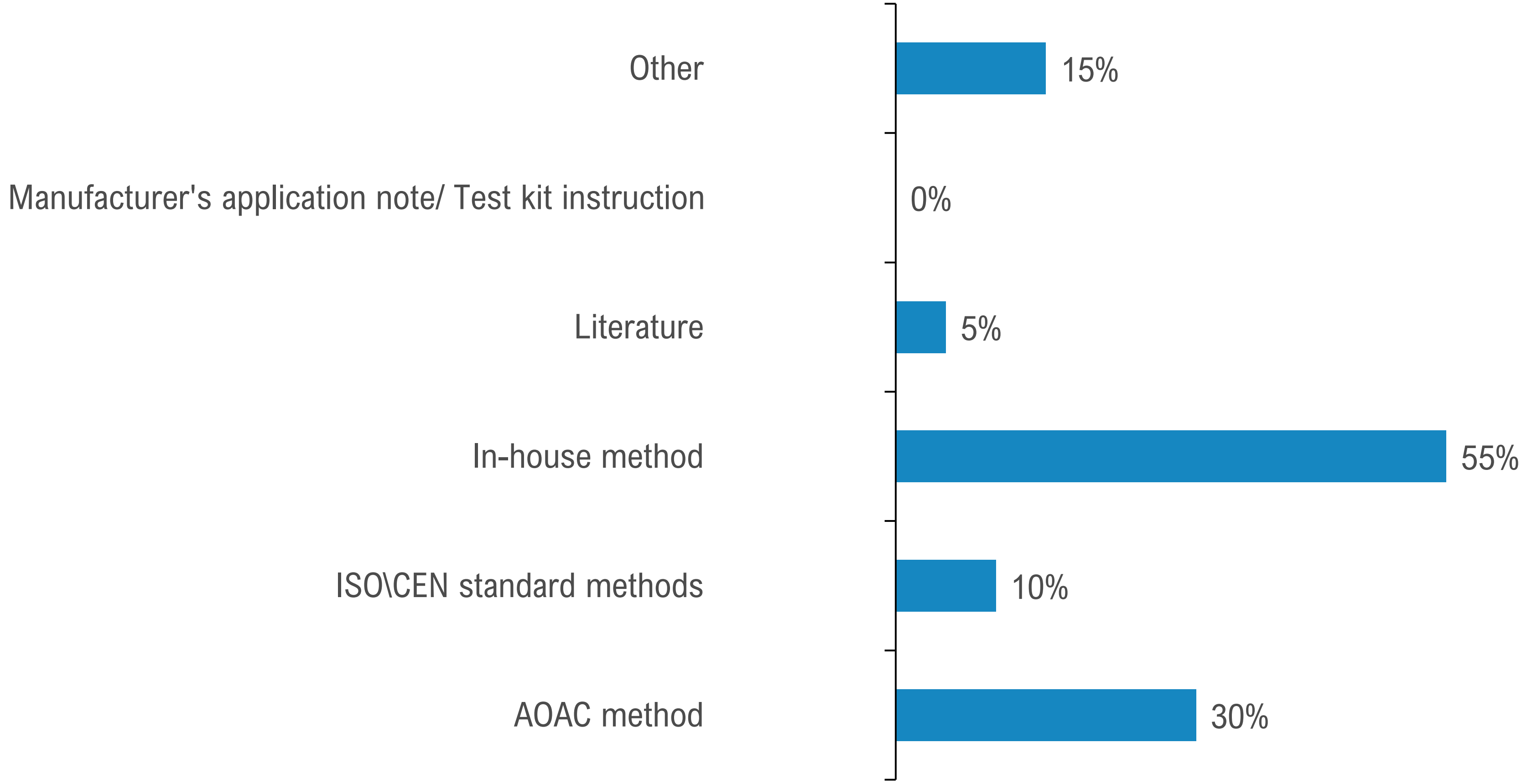
Answered questions: 21 | Skipped questions: 95

Q230: Select food categories applicable to your laboratory samples



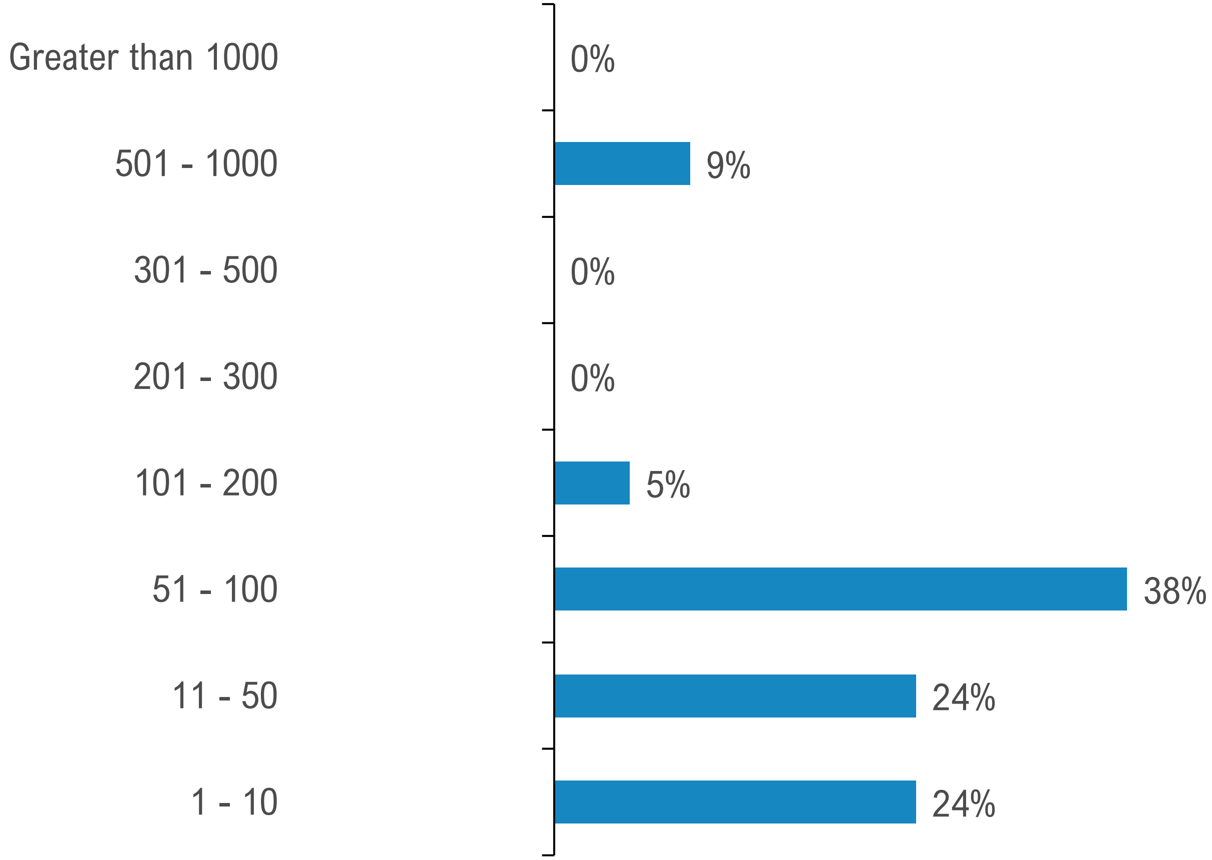
Answered questions: 21 | Skipped questions: 95

Q270: Analytical methods



Answered questions: 20 | Skipped questions: 96

Q231: Number of samples analysed per month



Answered questions: 21 | Skipped questions: 95

Q232: Automated sample preparation

Answered questions: 21 | Skipped questions: 95

Q257: Analysis for clients

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Private clients	19% (4)	5% (1)	19% (4)	19% (4)	38% (8)	21
Inspection	33% (7)	14% (3)	24% (5)	10% (2)	19% (4)	21
Monitoring	29% (6)	10% (2)	24% (5)	19% (4)	19% (4)	21
Exports	43% (9)	19% (4)	14% (3)	10% (2)	14% (3)	21

Answered questions: 21 | Skipped questions: 95

Q257: Analysis for clients

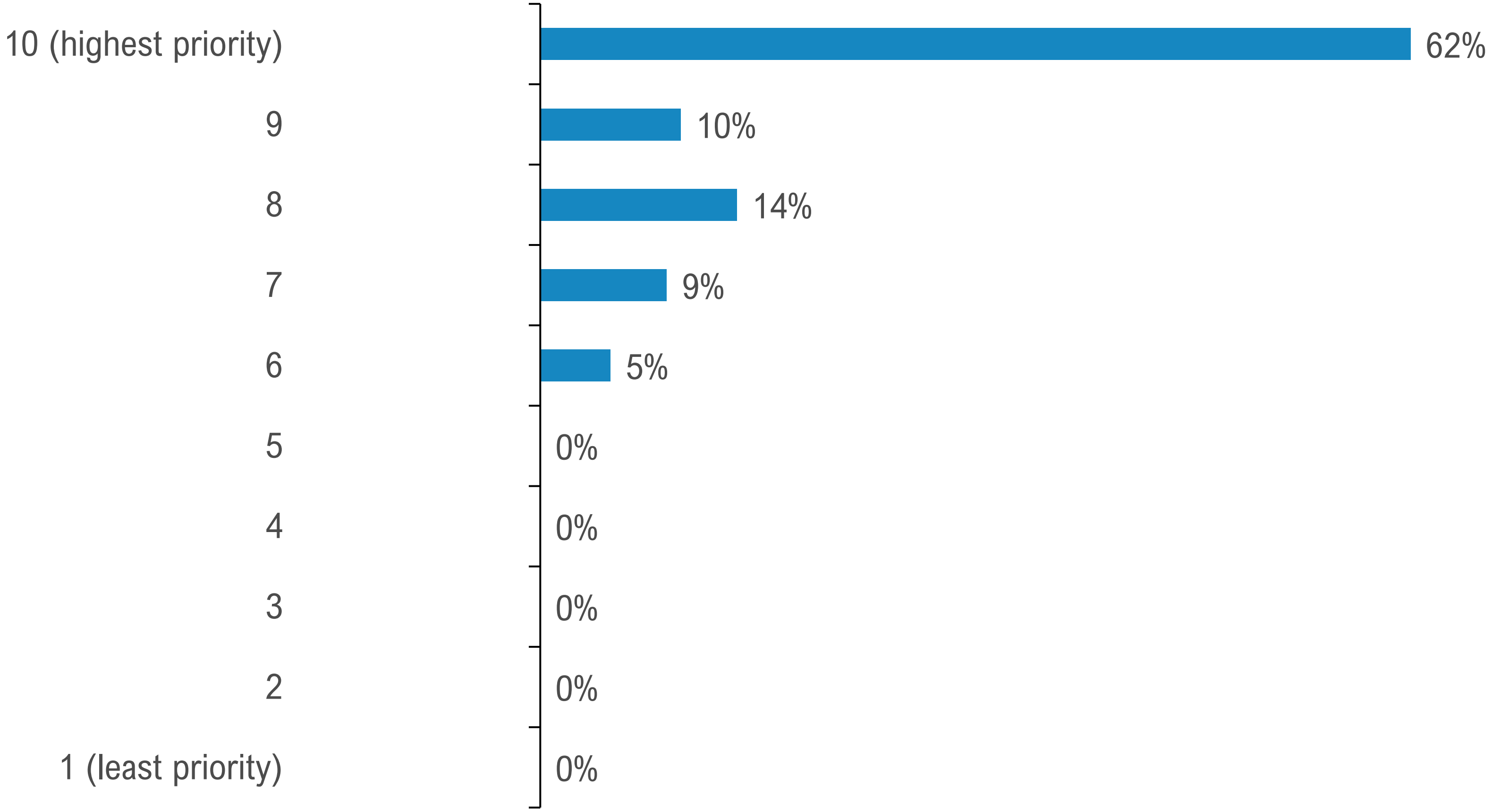
Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Imports	33% (7)	14% (3)	14% (3)	14% (3)	24% (5)	21
Internal testing	29% (6)	24% (5)	14% (3)	19% (4)	14% (3)	21

Answered questions: 21 | Skipped questions: 95

Q236: The importance of the need (ability) to perform these analyses in your country

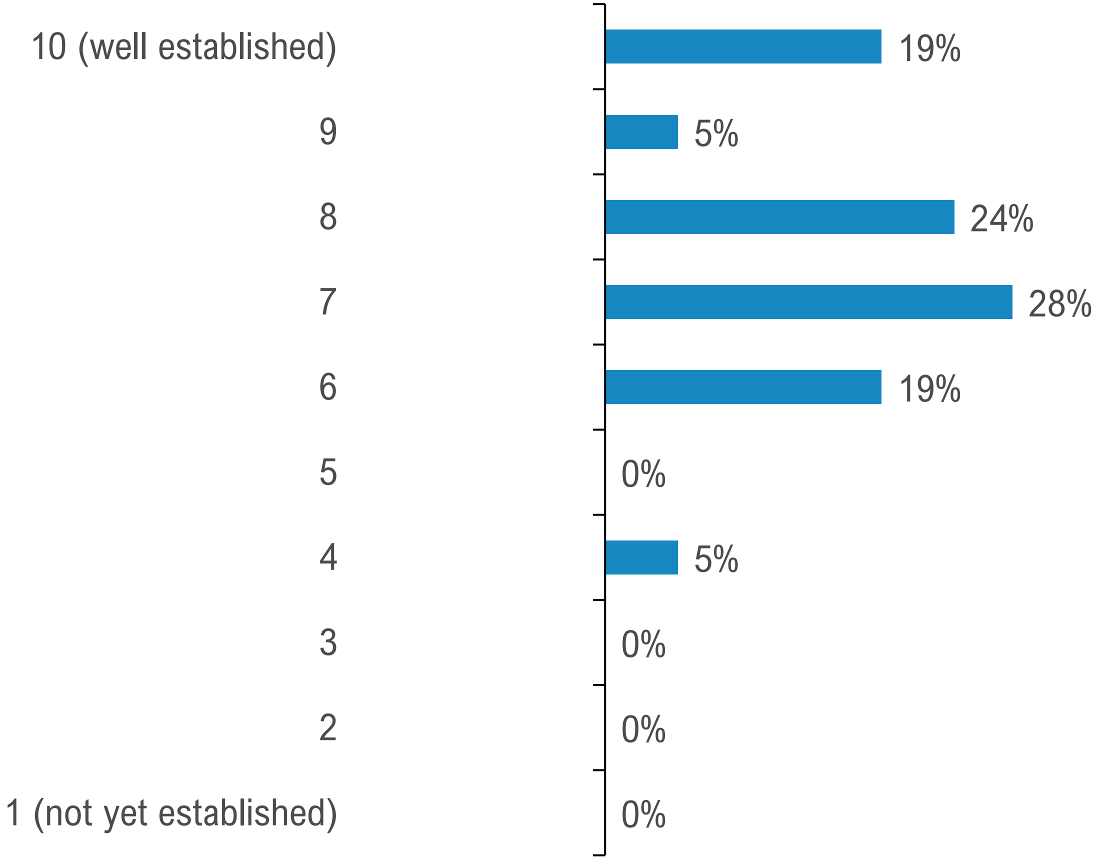
Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority



Answered questions: 21 | Skipped questions: 95

Q237: The degree to which the measurement capability for this analysis is established in your institute

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established

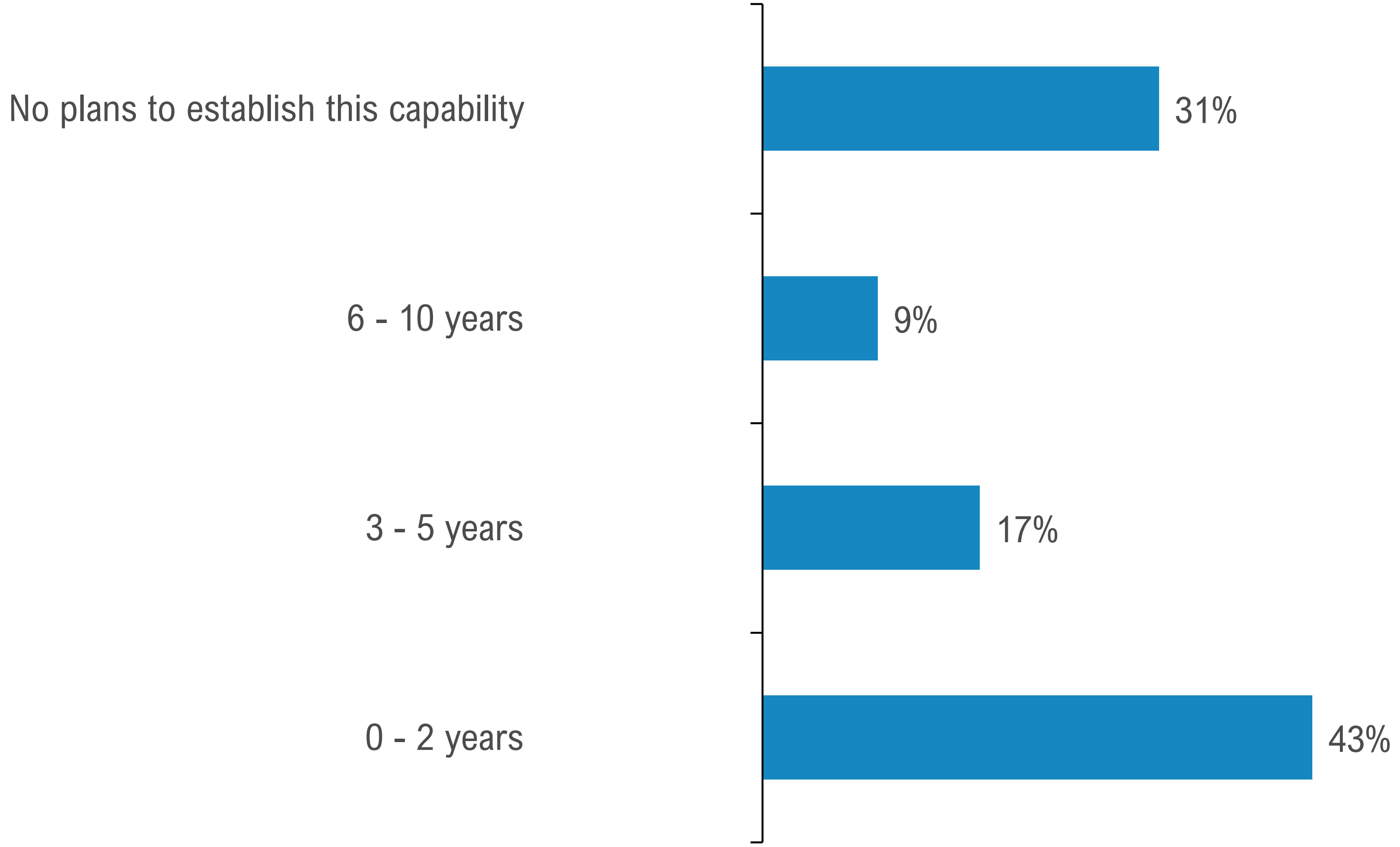


Answered questions: 21 | Skipped questions: 95

Q217: Does your laboratory perform sampling for customers?

Answered questions: 71 | Skipped questions: 45

Q218: Does your laboratory have plans to establish this capability in



Answered questions: 35 | Skipped questions: 81

Q219: Is your laboratory ISO/IEC 17025 accredited for sampling?

Answered questions: 36 | Skipped questions: 80

Q221: Please provide examples of commodities that are being sampled

- meat,eggs
- Meat, eggs, feed, fish
- CEREALS & PULSES, WATER, INFANT FOODS
- Agua dos furos, cereais, leguminosas,
- Raw Milk, Milk and Milk products
- riz, arachides,
- Bottled water, ground nuts, vegetables, cereals, etc.
- eaux, huiles, cerales
- water
- Tissue from animal offal, ground nut, milk
- Poultry meat, Milk, Feed, Water for animals consumption,
- WATER
- Raw agricultural produce and agricultural inputs e.g. soil, fertilizer and pesticides

Answered questions: 36 | Skipped questions: 80

Q258: Analysis for clients

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Private clients	8% (3)	8% (3)	6% (2)	17% (6)	61% (22)	36
Inspection	25% (9)	19% (7)	19% (7)	14% (5)	22% (8)	36
Monitoring	25% (9)	14% (5)	11% (4)	28% (10)	22% (8)	36
Exports	47% (17)	17% (6)	17% (6)	11% (4)	8% (3)	36

Answered questions: 36 | Skipped questions: 80

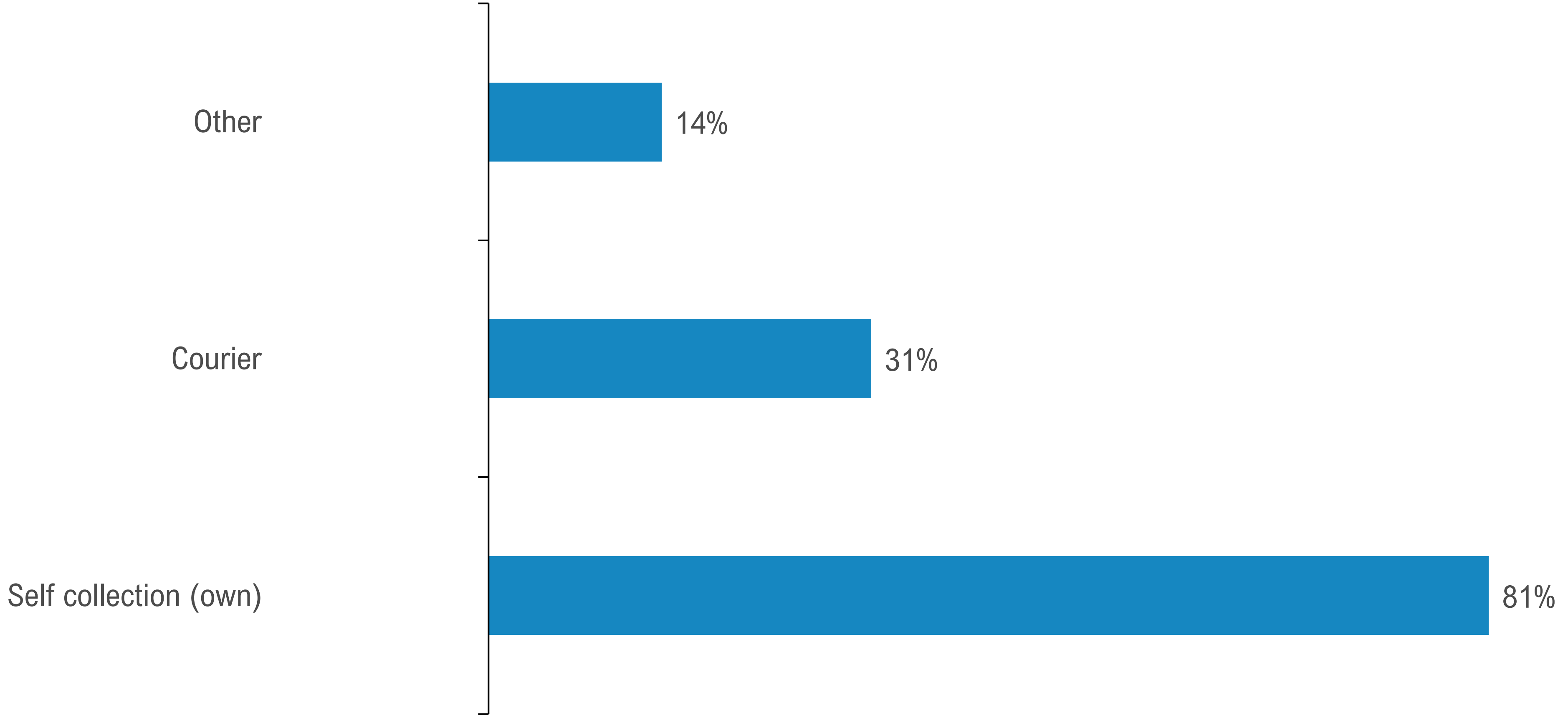
Q258: Analysis for clients

Please indicate clients where 1 = least amount of samples/ rarely analysed and 5 = majority of samples.

	1	2	3	4	5	#
Imports	58% (21)	11% (4)	14% (5)	3% (1)	14% (5)	36
Internal testing	33% (12)	6% (2)	17% (6)	11% (4)	33% (12)	36

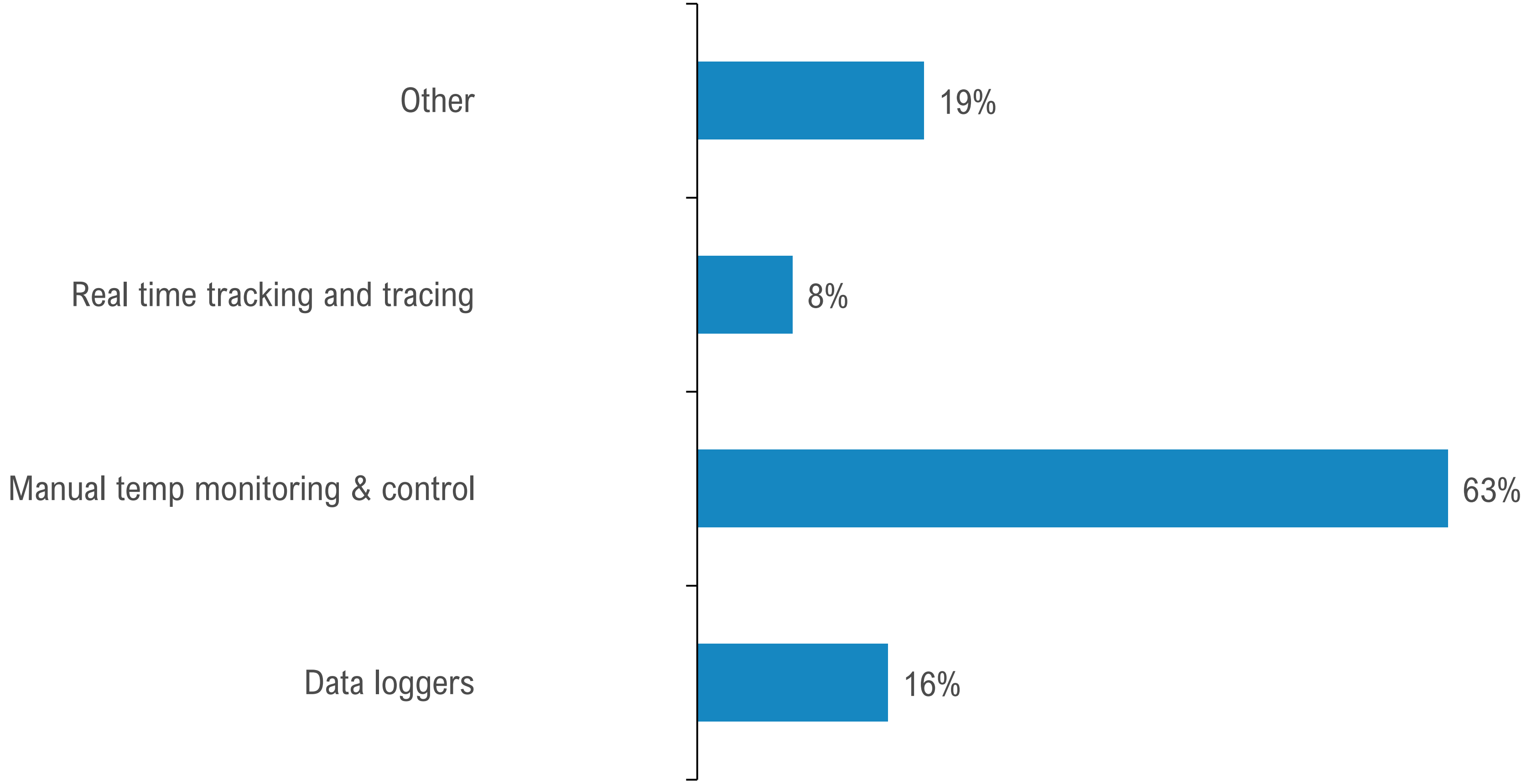
Answered questions: 36 | Skipped questions: 80

Q223: What types of logistics are used for sample transport?



Answered questions: 36 | Skipped questions: 80

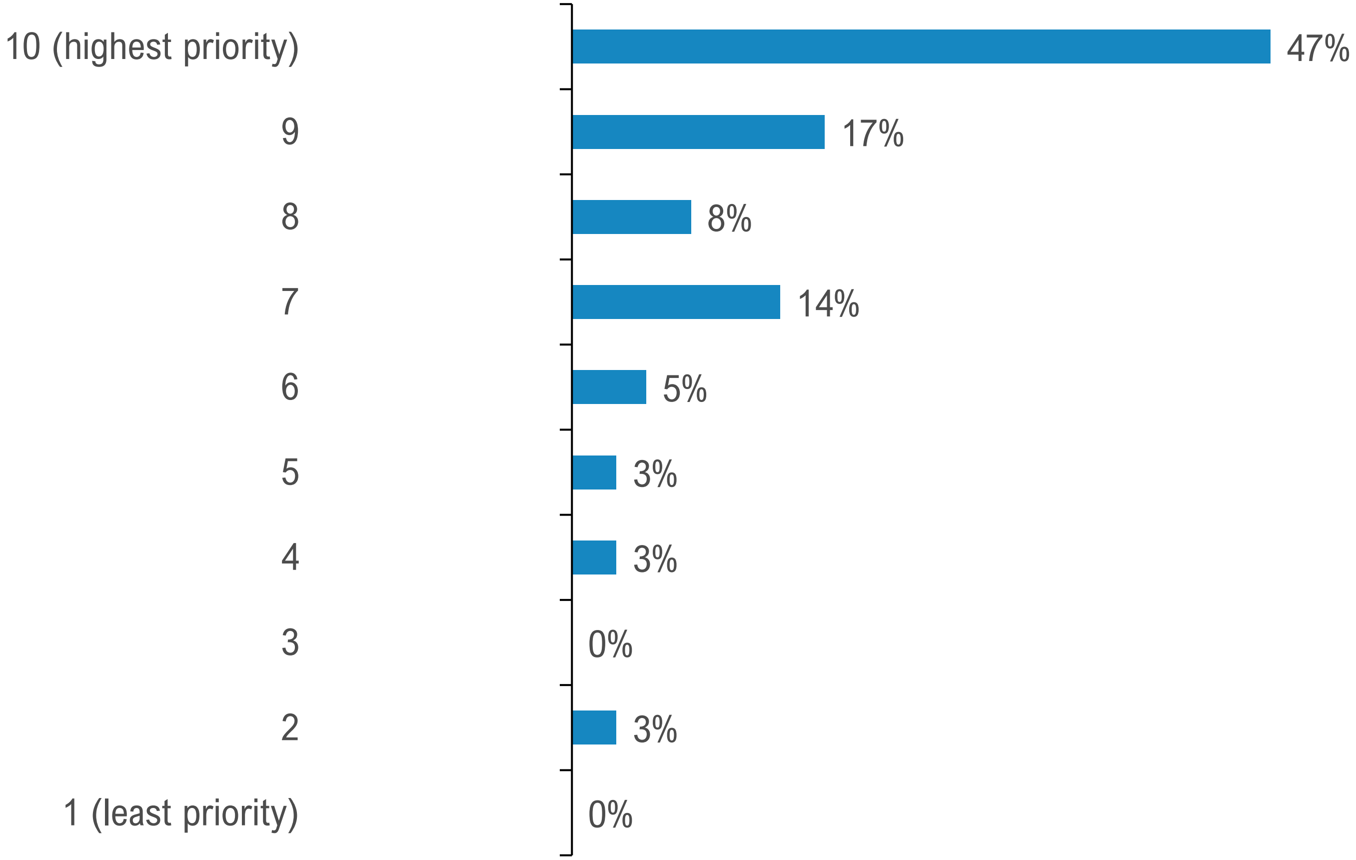
Q224: How are sample temperatures monitored on-route?



Answered questions: 36 | Skipped questions: 80

Q225: The importance of the need (ability) to perform these analyses in your country

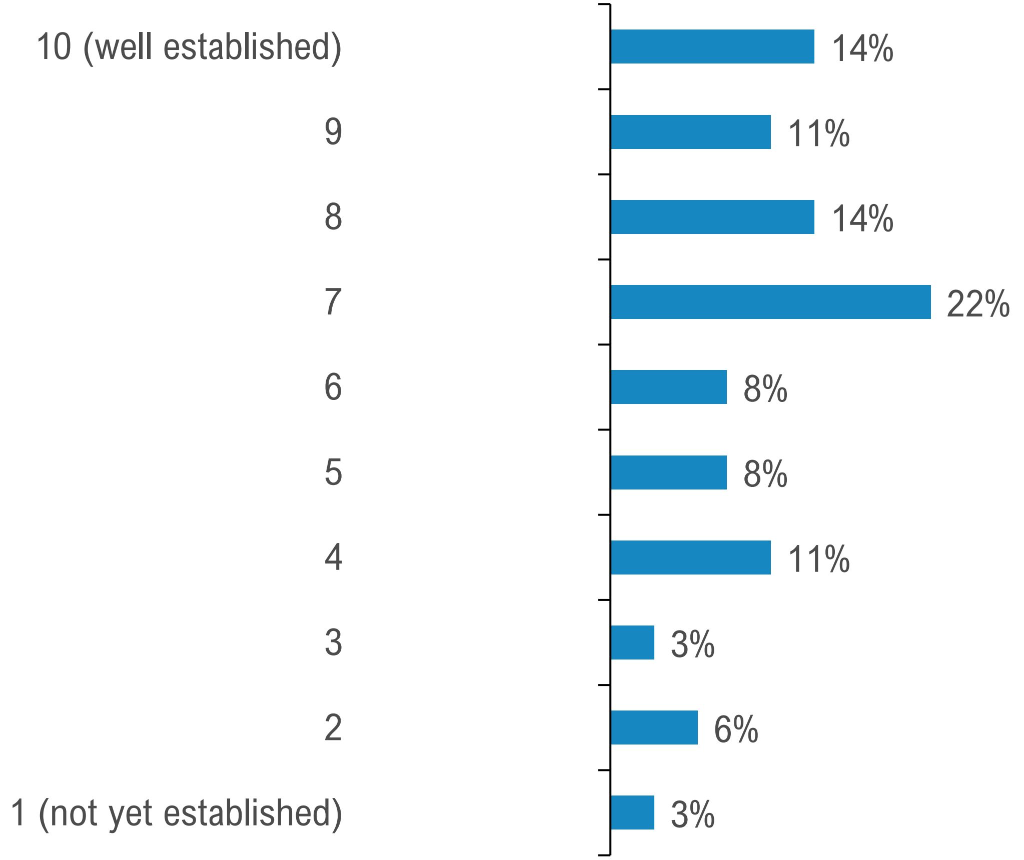
Please rank on a scoring of 1-10, where 10 is highest priority and 1 is least priority



Answered questions: 36 | Skipped questions: 80

Q226: The degree to which the measurement capability for this analysis is established in your institute

Please rank on a scoring of 1-10, where 10 is well established capability, and 1 is not yet established



Answered questions: 36 | Skipped questions: 80