



FOODINTEGRITY

Ensuring the Integrity of the European food chain

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Report on future research needs

Author(s): S. van Ruth¹, F. Butler², C. Fauhl-Hasek³, K. Holst Laursen⁴, R. Home⁵, A. Maquet⁶, G. Melzer⁷, J. Riedl³, H. Stolz⁵

¹ RIKILT Wageningen University and Research, P.O. box 230, 6700 AE Wageningen, the Netherlands

² University College Dublin, UCD School of Biosystems Engineering, Belfield, Dublin 4, Ireland

³ Federal Institute for Risk Assessment, Unit Product Identity, Supply Chain and Traceability, Department Safety in the Food Chain, Max-Dohrn-Straße 8-10, 10589 Berlin, Germany

⁴ University of Copenhagen, Faculty of Science, Department of Plant and Environmental Sciences, Plant and Soil Science Section and Copenhagen Plant Science Centre, Thorvaldsensvej 40, DK-1871, Frederiksberg C, Denmark

⁵ FiBL, Research Institute of Organic Agriculture, Ackerstrasse, P.O. Box, CH 5070 Frick, Switzerland

⁶ European Commission, DG JRC-Geel, Retieseweg 111, 2440 Geel, Belgium

⁷ Eutema GmbH, Lindengasse 43-13, A 1070 Vienna, Austria

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Abstract

Consumers are becoming increasingly concerned about the integrity of food products and considerable efforts are being made to guarantee food integrity. Such efforts must be underpinned by scientific results if they are to be successful. However, knowledge gaps still exist, which hampers the implementation of measures to guarantee food integrity. This report describes a mixed methods approach to identify existing and future food integrity knowledge gaps. Some of the gaps identified in the initial gap analysis have been included for research in the EU project FoodIntegrity. The remaining/emerging food integrity research needs can be divided into three main themes: Fraud prevention, methods and information to consumers. The results show that the priority research needs for the theme fraud prevention are: Fraud risk analysis; non-analytical prevention tools; and food fraud prevention integration in Food Safety Management Systems. With regard to the theme fraud detection methods, the priority research needs are rapid fraud detection tools; methods harmonization; and authentication of complex foods. Regarding the theme information to consumers, methods to provide the information needed by consumers and to increase consumer confidence also remain a priority. These identified remaining and emerging research needs provide funding bodies and researchers with a systematic framework to address future food integrity research.

1 Introduction

In an age of ready access to information in which food scares can rapidly gain a high profile, consumers are becoming increasingly concerned about the integrity of food products. Countries or regions that are considered to be trustworthy sources of safe food are experiencing high demand for their food products, which, coupled with the size of the food industry, makes the industry an attractive target for fraudulent activity [1]. Food industries worldwide suffer huge economic losses through food fraud because of the direct losses they face if they are the victim of fraud, and subsequently the investment required to prevent and prosecute fraudsters [2]. Furthermore, the food industry can also be the source of fraud.

Considerable efforts have been made to guarantee food integrity, such as by the enactment of legislation and by consumer awareness campaigns. However any efforts to guarantee food integrity must be underpinned by scientific efforts if they are to be successful. Given the potential gains by fraudsters, and the dynamic nature of fraud prevention measures, knowledge gaps still exist, which hampers the optimal use of scientific knowledge for the benefit of the food industry, official food control, and consumers world-wide. Therefore, the work package 'Prioritisation' of the EU project FoodIntegrity (www.foodintegrity.eu) aimed to determine and prioritise present and future food integrity gaps.

The process and results from each individual step towards prioritization of the future needs is described in the following sections.

2 The process

The gap analysis process and identification of current and future research needs is illustrated in Figure 1. In this work package an initial gap analysis was carried out in 2014. In 2016/2017 new research work in the food integrity area was inventoried. In workshops and other consultations continuing/emerging gaps were identified. Comparison of the initial gaps, the solutions resulting from new research work, and further consultations resulted in a list of future needs. Those were prioritized in the final FoodIntegrity conference in Nantes in 2018. In the following sections the various steps are detailed.

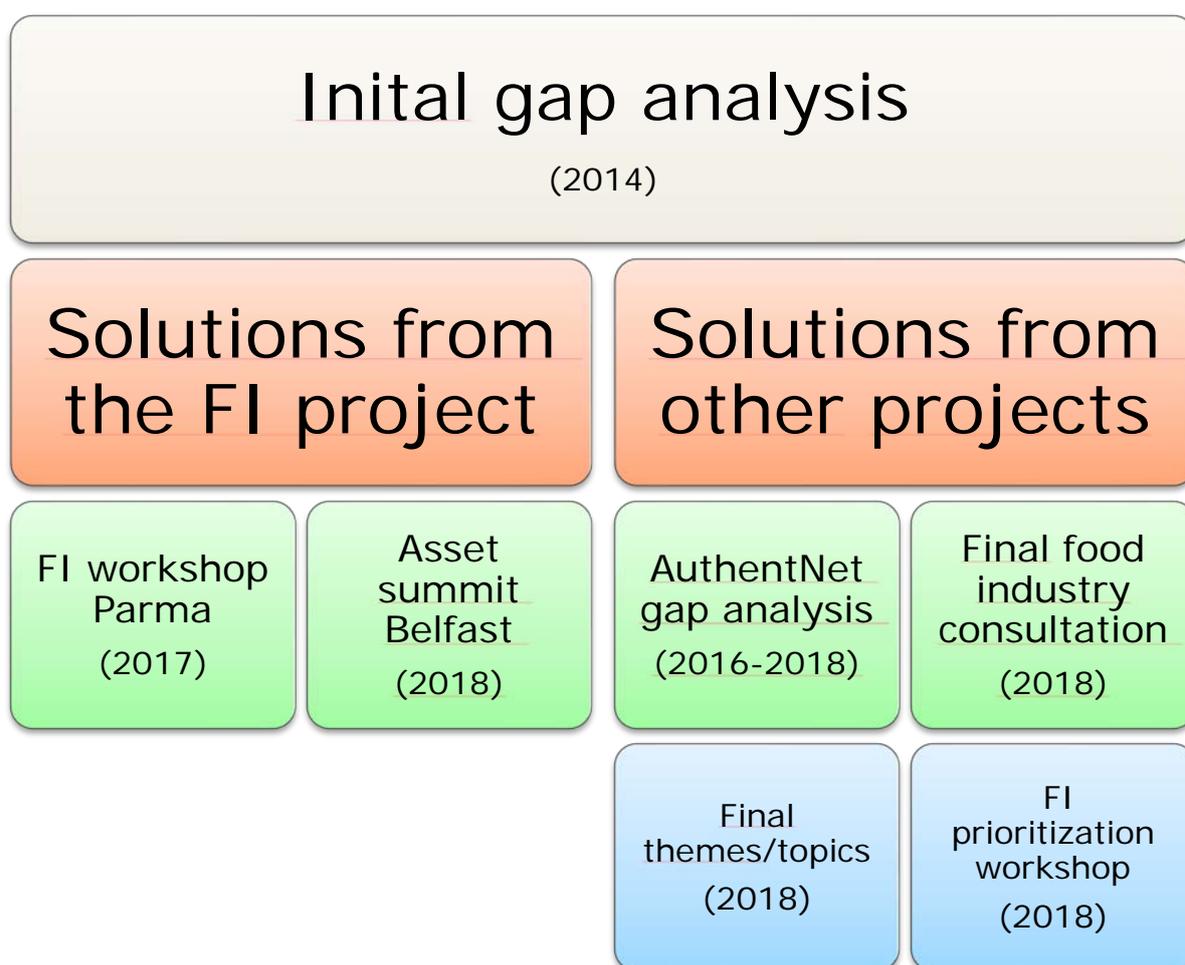


Figure 1. Various components of the gap analysis process and identification of current and future food integrity (FI) research needs.

3 Initial gap analysis

Between March 2014 and December 2014, research gaps were identified and prioritised to guide the procurement of new research sub-projects as part of the FoodIntegrity project.

Identified research gaps were collated, with the ten most frequently mentioned gaps subsequently being prioritised by a group of expert stakeholders.

The ten identified major gaps were:

1. Lack of methods for complex foods
2. Lack of generic methods for geographical origin verification
3. Insufficiently available reliable methods for fraud detection in meat (note: other food categories such as seafood, fat/oils, and alcoholic beverages were mentioned, but they are already covered in the Food Integrity project)
4. Lack of standardized and harmonized (fingerprinting) methods
5. Lack of financially affordable methods
6. Insufficient EU systems and certification
7. Lack of implementation of existing traceability systems
8. Lack of communication of relevant information to consumers
9. Uncertainty about accuracy and honesty of information available to consumers
10. Lack of transparency of accountability and responsibility in the chain

The prioritisation resulted in a list of four gaps which were reformulated into broad topics and were further demarcated by the Management Committee of Food Integrity to make them suitable as research topics for procurement.

These four broad topics were:

1. Standardization and harmonization of untargeted food integrity methods
2. Approaches to assure the integrity of complex foods
3. Common platforms and tools for sharing information across stakeholders
4. Rapid, cost efficient methods for fraud detection

The process was reported in detail as Deliverable 3.1 of the project.

The gaps identified in the first year were transferred into research topics for procurement of new research projects for which competitive calls were launched by the Food Integrity project in 2015. The new projects were eventually integrated in the main Food Integrity project as new work packages.

4 Subsequent steps in the gap analysis

4.1 Inventory of new work in view of the initially identified gaps

In 2016-2017 new research within and outside the Food Integrity project was inventoried and compared with the initially identified gaps (Table 2).

Table 2. Inventory of new food integrity research and its relationship to the four main identified topics in the initial gap analysis. +/- indicates whether or not gaps were sufficiently addressed by new FoodIntegrity or other EU project activities

	New WPs in Food Integrity	Other new EU projects or other initiatives*
1. Standardization methods	untargeted+/-	+
2. Innovative methods foods	complex+/-	-
3. Information share in supply chain	+	+
4. Rapid on site fraud detection	+/-	+

*AuthentNet, EU China SAFE, Oleum, Phasmafood, Strength2food, standardisation initiatives.

The other 6 initial gaps were not addressed in the new projects of Food Integrity.

4.2 Workshop on unresolved and emerging gaps in Parma - 2017

In the 2017 annual FoodIntegrity meeting and conference in Parma, Italy, a workshop was dedicated to unresolved and remaining research gaps. The workshop included three presentations on the perceived gaps from different perspectives: The consumer, the industry, and the authority perspective. The presentations were followed by a panel and audience discussion. In this workshop new gaps were identified. The lack of knowledge regarding the scale of occurrence of food fraud was mentioned repeatedly. Furthermore, the knowledge regarding criminal behaviour and differences between corporate and organised crime were identified as gaps, as well as fraud prevention in general.

4.3 Session in Asset summit in Belfast - 2018

In the Asset summit in Belfast in 2018, a session was dedicated to future research needs. A panel of experts discussed their views on the topics identified from the gap analysis described in sections 3, 4.1 and 4.2.

4.4 Transnational EU research needs from EU project AuthentNet 2016-2018

In the EU project AuthentNet (www.authent-net.eu) transnational research needs were identified by the funding bodies in the various EU member states. They were divided in three themes and included various topics:

A - Fraud prevention

- Risk analysis - vulnerable points, critical points, horizon scanning/early warning (internet sources, bringing data from different sources together, etc.)
- Behavioural aspects of fraudsters/industry/supply chain leading to fraud risks
- Other food fraud prevention tools (mass balance e.g. production/sale on global scale)
- Gaining insight into why fraud is happening and what its impact is
- Raising awareness (see communication to consumers below)

B - (Analytical) methods

- Complex foods - still gaps - systematic approach, broad range of approaches
- Reliable/rapid/cheap methods - point of use - non-targeted/targeted (in the field) - screening
- Policy coherence on harmonisation of methods (build on Food Integrity work related to standardisation of the validation of fingerprinting methods)
- Traceability/blockchain methods. For funding bodies: keep an overview, topic is more an industry priority.
- Geographical origin - application of emerging technologies e.g. A1/satellite mapping. Need to be more cost effective and 'future proof'

C - Communication to consumers (lower priority)

- Increasing confidence
- Education, raising awareness

4.5 Final consultation of the European food industry - 2018

In 2018, all food industry partners in the Food Integrity project and those registered for the final Food Integrity conference were contacted for their opinion on unresolved and emerging gaps. Issues such as how to integrate fraud control in HACCP procedures, global harmonisation of fraud detection methods, rapid measurement devices for non-targeted approaches, and how to engage with consumers from an industry perspective were raised.

5 Final steps in the gap analysis

5.1 Collation of information from initial and subsequent gap analyses - 2018

The information on unresolved and emerging gaps from the various workshops and consultations (sections 3, 4.1-4.5) were collated and analysed. This resulted in three research themes which covered five main topics. The three themes were (A) Fraud prevention, (B) Methods, and (C) Communication to Consumers.

Theme A. Fraud prevention

- *A1. Food fraud occurrence*
Quantify food fraud: How big is the food fraud problem?
- *A2. Fraud risk analysis*
Food fraud risk analysis for continuous observation
- *A3. Food criminals behaviour*
Understanding behaviour of food criminals and criminal aspects of businesses/supply chains
- *A4. Non-analytical prevention tools*
Non-analytical food fraud prevention tools
- *A5. Food fraud prevention integration in a Food Safety Management Systems (FSMS)*
Integrating food fraud risk analysis into existing industry quality instruments

Theme B. Methods

- *B1. Geographic origin tests*
Modern, generic, cost-effective and future proof method for geographical origin determination
- *B2. Blockchain*
Blockchain developments and implementation
- *B3. Rapid fraud detection tools*
Rapid food fraud detection tools, on-site and in-line
- *B4. Methods harmonization*
Worldwide harmonization of methods (including validation, standardization and databases for fingerprinting)
- *B5. Authentication of complex foods*
Strategies for complex food verification

Theme C. Communication to consumers

- *C1. Consumer education*
Education of consumers, what can consumers expect?

- *C2. Information needed by consumers*
What information do consumers look for so they can make informed choices regarding
- *C3. Increasing consumer confidence*
What information do consumers need to increase their confidence?
- *C4. Accurate information to consumers*
What steps can be taken to ensure that information provided to consumers is accurate and honest?
- *C5. Methods for communication to consumers*
For industry to effectively engage with consumers, which methods of communication (including use of language) are most easily understood?

5.2 Final workshop on prioritization of future research needs in Nantes - 2018

In the final workshop in Nantes, the three themes and their associated five topics were presented to the audience. The audience could indicate their top three ranking topics with stickers (Figure 2). The audience had received stickers in different colours depending on their affiliations (food industry (~1/6), scientists (~1/2), authorities (~1/6), others (~1/6) of a total of ~30 participants. The results of the prioritization for each of the four stakeholder groups are presented in Figure 3 and the weighted means in Figure 4. Overall, in Theme A *Fraud prevention* the topics A2 *Risk analysis*, A4 *Non-analytical prevention tools*, and A5 *Food fraud prevention integration in FSMS* ranked highest. In Theme B *Methods*, the topics B3 *Rapid detection tools*, B4 *Methods harmonization*, and B5 *Strategies for complex food authentication* were prioritized. Furthermore, Theme C *Communication to consumers* presented two topics with high priority: C3 *Increasing consumer confidence* and C4 *Accurate information to consumers*.



Figure 2 Prioritization of topics within research need themes by the workshop audience in Nantes, 2018.

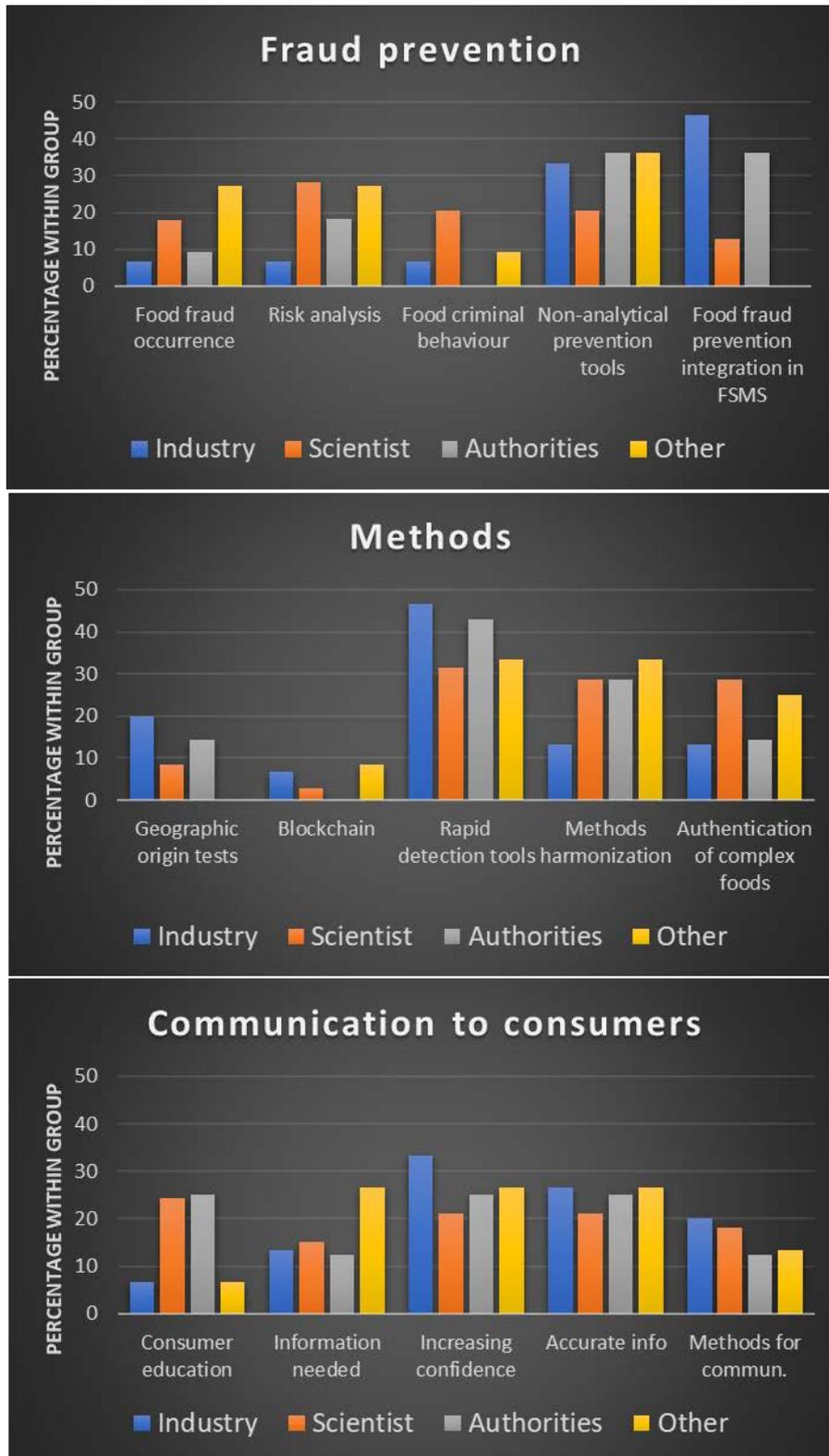


Figure 3 Results of prioritization of research needs for each theme (for four stakeholder groups) in the workshop in Nantes, 2018.

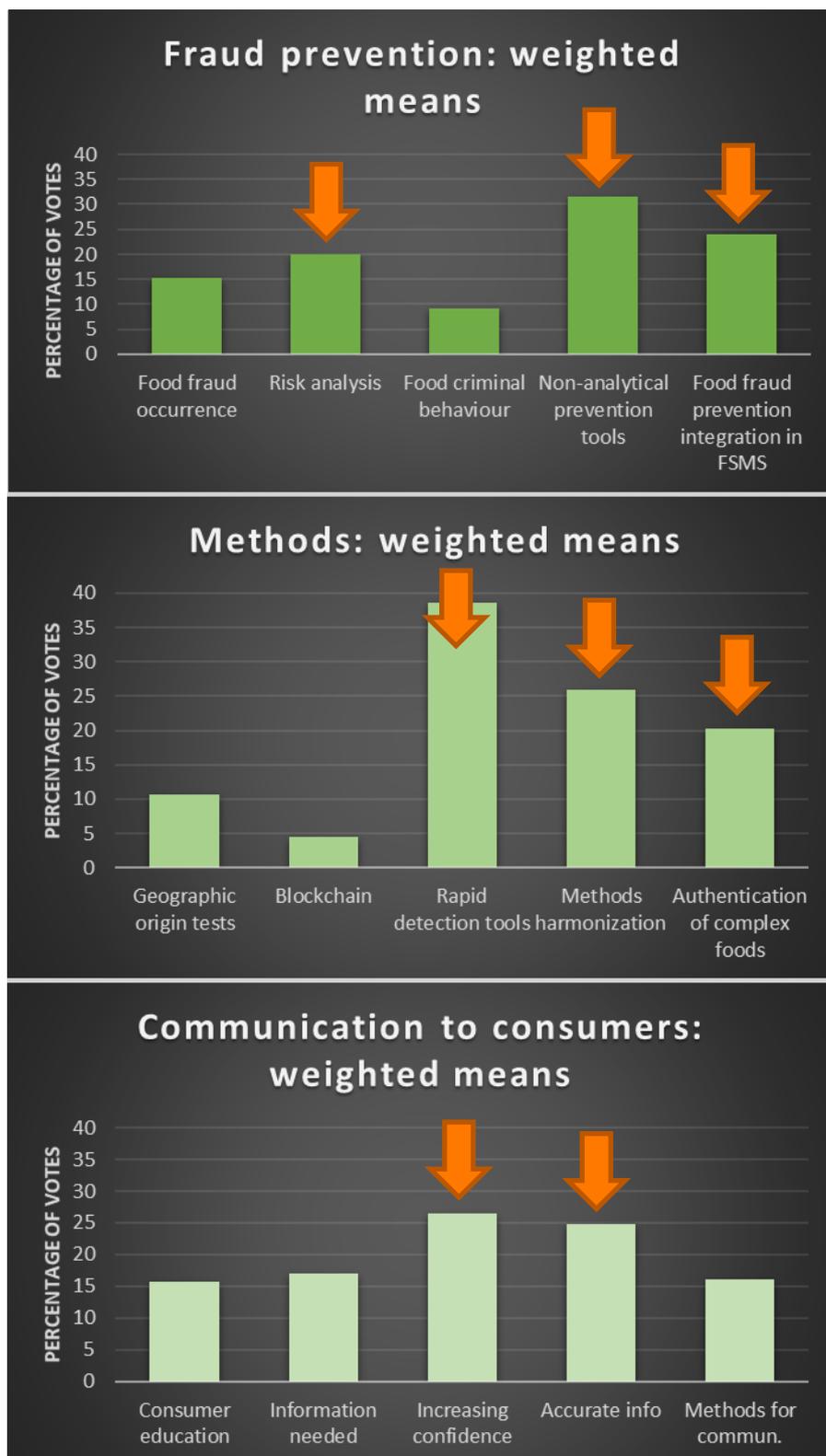


Figure 4 Results of prioritization of research needs for each theme (weighted means) in the workshop in Nantes, 2018. Orange arrows indicate key priorities.

6 Conclusions

In this study future food integrity research needs were identified. These needs can be categorized into three main themes: (A) fraud prevention, (B) methods and (C) information to consumers. The study showed that the priority research needs for theme (A) fraud prevention are: Fraud risk analysis; non-analytical prevention tools; and food fraud prevention integration in Food Safety Management Systems. For theme (B) fraud detection methods, the priority research needs are rapid fraud detection tools; methods harmonization; and authentication of complex foods. Furthermore, in view of consumer information topics, theme (C), methods to provide the information needed by consumers and to increase consumer confidence also remain a priority.

Overall, we believe that the work conducted by WP3 participants of the Food Integrity project will provide funding bodies and researchers with a systematic framework to address future food integrity research.

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