LGC AXIO PROFICIENCY TESTING

Fighting Food Fraud

The role of proficiency testing in protecting product integrity

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ISO/IEC 17043

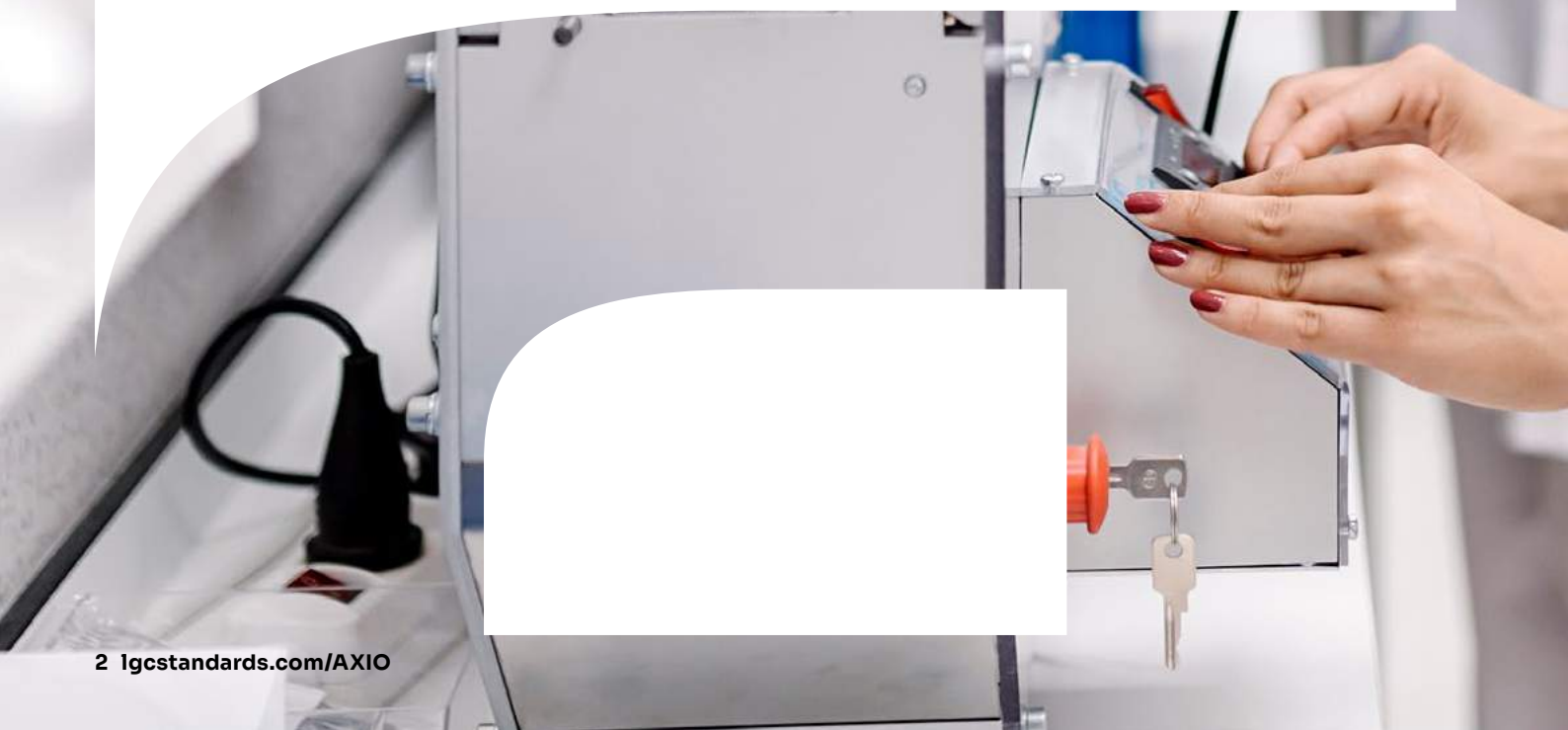
Introduction

Consumers need to have access to safe and high quality food. Foods such as dairy products, olive oil, honey, herbs and spices, meat and fish have historically been the target of fraud because of their high commercial value.

The prevention of fraud and promotion of pure/authentic products is vital to guarantee commercial success of products on the market and thus to protect business and of course, consumers. As outlined in the paper by Fera et al. 2020[1], the COVID-19 pandemic has caused a dramatic increase in food fraud events, including an 800% increase for honey and other sweeteners events.

Fraudsters are more technologically savvy and increasingly using more sophisticated approaches to adulterate food, making it more difficult to detect the fraud. This means that a wider range of methods are required in the analytical toolkit used to combat food fraud including new approaches and technologies.

Measurement results of high quality are vital to inform risk assessments and enable the design of programmes to help secure global food supply chains and protect consumers and legitimate businesses from food fraud.



The role of proficiency testing in the fight against food fraud

Fraudulent adulteration of products can often only be detected and fully established by analytical laboratory testing. Therefore, it is critical that laboratories carrying out testing to establish the authenticity and integrity of food and beverage products have confidence in their measurement results. That confidence extends to the reliability and consistency of the methods they are using.

Proficiency Testing (PT) is a quality assurance tool that provides a vital “helping hand” in the fight against food fraud - ensuring that measurement results are reliable and that analytical methods provide the required accuracy, precision and specificity.

The primary objective of participating in PT is to help assess the validity of the laboratory’s routine testing. Food testing laboratories make critical conclusions based on their measurement results. If unreliable measurement results are produced this can lead to poor or inappropriate decisions, including the potential for the mislabelling of products or the failure to detect fraudulent activities. This has the potential to have an impact on the trade of the product, the health and safety of consumers, and the reputation of producers and brands.

Laboratories can utilise PT in their fight against food fraud by participating in PT schemes that provide samples in matrixes of common food fraud targets along with analytes closely aligned to their analytical methods and, where appropriate, support their scope of accreditation. A laboratory’s PT data can be used to demonstrate competency to customers and regulatory bodies, benchmark analytical performance with laboratory peers around the world, educate and train staff and verify methods and instrumentation.

Regular participation in relevant PT schemes will help a laboratory to ensure it is playing its critical role in establishing food and beverage authenticity, helping secure global food supply chains and prevent fraudulent products reaching consumers.

What is food authenticity and food fraud?

What is food authenticity?

According to CWA (CEN Workshop Agreement) 17369:2019, an authentic food product is "a food product where there is a match between the actual food product characteristics and the corresponding food product claims; when the food product actually is what the claim says that it is."

What is food fraud?

The definition of food fraud, as described in CWA is: "intentionally causing a mismatch between food product claims and food product characteristics."

Based on the FAO/CODEX definition [2], food fraud is any deliberate action of businesses or individuals to deceive others in regards to the integrity of food to gain undue advantage.

Types of food fraud include:

- Adulteration
- Substitution
- Dilution (e.g. olive oil diluted with other oils)
- Simulation (e.g. fake copy of popular product)
- Counterfeiting and misrepresentation

Food fraud is a deliberate, economically motivated activity, and is therefore different to food integrity or food authenticity. A common subcategory of food fraud is Economically Motivated Adulteration (EMA), which is the intentional substitution or addition of a substance for the purpose of increasing the value or reducing the cost of its production, to generate increased profit.

At a European level, the Knowledge Centre for Food Fraud and Quality (KC-FFQ) is a platform for sharing scientific knowledge and coordinating market surveillance, and is operated by the European Commission's Joint Research Centre (JRC) and departments regulating the food and feed chain.

The KC-FFQ complements the activity of the EU Food Fraud Network, which assists the EU Member States and other European countries in working together in accordance to the rules laid out in the Official Controls Regulations.

The EU Food Fraud Network also promotes international cooperation with:

- Standardization Committees (CEN and National bodies)
- Food Agriculture Organisation (FAO)
- International Orgnization for Standardization (ISO)
- The European Union Agency for Law Enforcement Cooperation (EUROPOL)
- International Criminal Police Organisation (INTERPOL). [3]

In 2019 Europol and Interpol organised Operation OPSON VIII (2019), targeting food and drink fraud, as well as the organised crime networks behind this illegal trade. This has resulted in blocking 16,000 tonnes of unsafe products, including 30m+ litres of unsafe liquids, worth an estimated €100m. The products ranged from alcohol to cereals and grains, meat and other fake food products. [4]

16,000
tonnes of unsafe products

30m+
Litres of unsafe liquids

€100m
Estimated worth of goods

In the USA, food fraud is covered under the FDA Food Safety Modernization Act (FSMA). As of 2018, the Global Food Safety Initiative (GFSI) requires a Food Fraud Vulnerability Assessment (FFVA) and Food Fraud Mitigation Plan (FFMP) for all types of fraud and for all products. [4,5] The latest food fraud data and information is accessible via subscription to the Food Fraud Database, developed by the U.S. Pharmacopeia Convention (USP) and operated by Decernis.

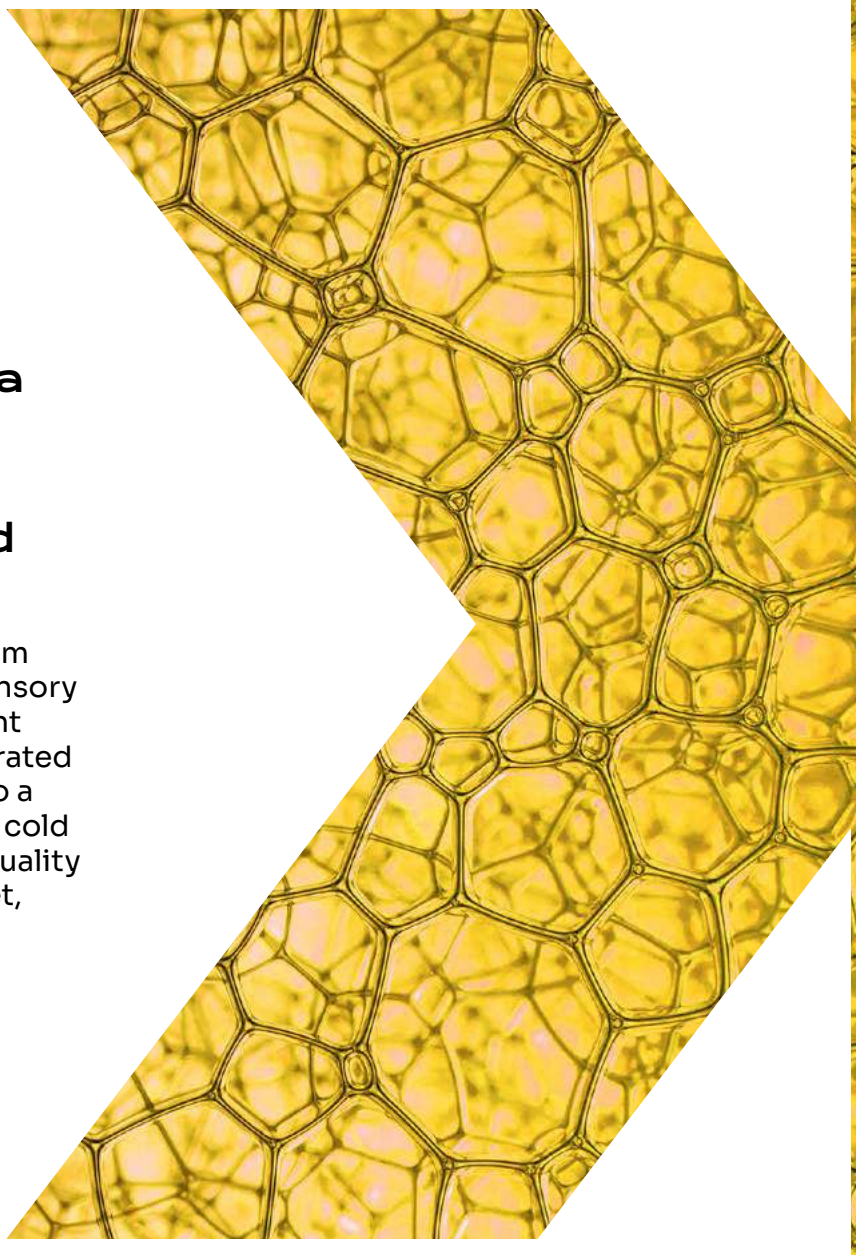
The global standards organisation, BRCGS, part of the LGC Group, have published a complete guideline explaining how to complete a vulnerability assessment for food fraud. [6]

Food fraud is a critical topic in many countries around the world, such as India, where the FSSAI (Food Safety and Standards Authority of India) analysed more than 100,000 samples of food in 2018-19, and found 16% were of lower standard, 3.7% unsafe, and 9% mislabelled. [7]

In this paper we focus on three food products that are frequently targeted by fraudsters:

- Olive oil
- Honey
- Cheese

Olive Oil



Introduction

Adulteration of extra virgin olive oil is still listed among the most common food frauds worldwide.

Extra virgin olive oil is a premium product and has distinctive sensory characteristics. It is an excellent source of healthy monounsaturated fat and its processing is kept to a minimum by solely mechanical cold pressing. Due to its premium quality and the high price in the market, it has always been a target for fraudsters.

LGC AXIO Proficiency Testing offers a range of PT samples supporting olive oil testing, including QFCS 790 (Extra virgin olive oil analysis), QFCS 791 (Olive oil analysis) and FIRMS 01 (Forensic Isotope Ratio Mass Spectrometry for Olive Oil).

What is olive oil?

Olive is the common name of several species of evergreen trees, of the genus Olea in the Oleaceae family and is native to warm temperate regions and especially those around the Mediterranean sea. Olea Europaea is cultivated for its edible fruits and the production of olive oil. The trees are native to Greece, Italy, Palestine and Syria with the species varying in different areas. [8,9,10]

On average, 3 million tonnes of olive oil is produced globally every year. Around 2 million tonnes is produced in European countries. [11]

The 2m tonnes produced in European countries is broken down into

- Spain 66%
- Italy 15%
- Greece 13%
- Portugal 5%

According to the International Olive Council (IOC), "Virgin olive oils are the oils obtained from the fruit of the olive tree, solely by mechanical or other physical means under conditions, particularly thermal conditions, that do not lead to alterations in the oil, and which have not undergone any treatment other than washing, decantation, centrifugation and filtration".

Olive pomace oil is olive oil that is extracted from olive pulp after the first press. Once the mechanical oil extraction of olive oil is complete, approximately 5–8% of the oil remains in the pulp, which then needs to be extracted with the help of solvents, an industrial technique used in the production of most other edible oils including canola, peanut, sunflower, etc. Although the oil extracted in this manner is still olive oil, at retail it may not simply be called "olive oil".

How is it regulated?

Three of the most important standards are those specified by the European Union (EU), the International Olive Council (IOC) and the CODEX Alimentarius. Within the EU, olive oil legislation is comprised of mandatory rules, which is not always the case with the IOC or CODEX if there is no national legislation in place. The European Commission regulation (EU) 2568/91 sets out the characteristics of olive oils and olive pomace oils and the relevant methods of analysis and it covers all parameters detailed by the IOC. [13,14].

Other published standards include:

- 75 FR 22363, United States Department of Agriculture (USDA)
- AS 5264-2011, Australia
- ICS 67.200.10, China (based on ISO standards for animal and vegetable fats and oils)

Broad categories of olive oil

Olive oil is defined into three broad categories:

- Virgin olive oil
- Refined olive oil
- Olive oil

Extra virgin olive oil is a virgin olive oil which has a free acidity, expressed as oleic acid, of less than 0.8 grams per 100 grams. It also bears other characteristics as stated in the IOC standard and the European legislation. [13]

The authenticity challenge

Authenticity has many aspects, from adulteration and mislabelling to the misrepresentation of Protected Designations of Origin (PDO) or Protected Geographical Indication (PGI) products. The most commonly adulterated olive oil is extra virgin olive oil because it has the highest commercial value of all the olive oils. Fraudsters sometimes use sophisticated methods of adulteration and they frequently have a good understanding of the chemistry of olive oil. [15]

In May 2019, Europol's Intellectual Property Crime Coordinated Coalition and the Italian NAS Carabinieri, and the Tribunal of Darmstadt in Germany arrested 20 individuals and seized 150,000 litres of fake olive oil—sunflower oil with added chlorophyll, beta-carotene, and soybean oil.

Extra virgin olive oil is of superior quality and may be adulterated with lower grades of olive oil that do not meet the chemical or organoleptic characteristics of authentic extra virgin olive oil. Refined olive oils and cheaper seed oils such as rapeseed and sunflower oils are also used. Sometimes chlorophyll is deliberately added to seed oils to resemble the green colour of the olive oil. Nut oils have also been used, with hazelnut oil favoured, due to the difficulty of its detection at low levels.

Other methods of adulteration include the addition of "soft-deodorised" virgin olive oil to extra virgin olive oil. [15]

Following a request to the EU Administrative Assistance and Cooperation System (AAC) by the UK National Food Crime Unit, a case of food fraud was uncovered with products sold as extra virgin olive oil from Spain, distributed to UK restaurants and supermarkets, without meeting the regulatory standards or matching the required high quality. The Spanish Authorities acted against the food operators and discovered a total of 24,000 Litres of "olive oil" labelled as "extra virgin olive oil", a clear case of food fraud for economic gain. [16]

Analytical testing

The analytical methods for the analysis of olive oil are described by the IOC and the European regulation for the quality of olive oil. Some of them are based on wet chemistry techniques, while others are based on High Performance Liquid Chromatography (HPLC) or Gas Chromatography (GC) methods.

Examples of relevant methods [9, 14 15] are shown in **figure 1**. Different analytical methods can show possible adulteration or assist in the determination of the grade of olive oil as defined in legislation and international standards.

Figure 1: Olive oil analytical methods and what they indicate

Isotope Ratio Mass Spectrometry (IRMS)

There are hundreds of extra virgin olive oils which are Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI) products. Studies have shown that 13C/12C, 18O/16O and 2H/1H stable isotope ratios change depending on the latitude and altitude and so can give an indication of the geographical origin of olive oils. Factors that may affect the variability range from distance from the sea, to type of soil and other environmental and climatic conditions. [12] The isotopes are measured both in the bulk but also in the sub-components (e.g. individual fatty acids).

It is worth noting that IR-MS involves the use of expensive laboratory equipment, expert scientists and construction of / access to a database of authentic samples to compare unknown samples with.

150, 000 Litres Of Fake Extra Virgin Olive Oil Seized From ‘Well-Oiled’ Gang

https://www.europol.europa.eu/newsroom/news/150-000-litres-of-fake-extra-virgin-olive-oil-seized-%E2%80%98well-oiled%E2%80%99-gang

Honey

Introduction

Honey is a high value product and as a result is a frequent subject of food fraud.

Honey has become a target of adulteration with sugar syrups from cheaper sources such as high fructose corn syrup. Sometimes the adulteration starts from feeding the bees with syrup when it is not required.

Adulterated honey is fraudulently labelled as pure to deceive consumers and derive economic gain. In addition, honey may be sold as monofloral when in reality they contain mixes of poly-floral cheaper honeys.

LGC AXIO Proficiency Testing offers a range of PT samples supporting honey testing, including QFCS 801 (Essential Composition and Quality Factors in Honey), QFCS 847 (Authenticity of Honey by NMR Profiling) and FIRMS 03 (Forensic Isotope Ratio Mass Spectrometry for Honey).

What is honey?

The European Union's legal definition of honey can be found in Council Directive 2001/110/EC, Annex 1, which is in line with the International CODEX standard for honey. It is defined as "the natural sweet substance produced by Apis mellifera bees from the nectar of plants or from secretions of living parts of plants, or excretions of plant-sucking insects on the living parts of plant, which the bees collect, transform by combining with specific substances of their own, deposit, dehydrate, store and leave in honeycombs to ripen and mature."

With a production of around 280,000 tonnes per year in 2019, the EU is the second largest producer of honey after China (447,000 tonnes). However, the EU is not self-sufficient and imports, mainly from China and Ukraine, outweigh exports from the EU. [19]

Categories of honey

According to the International CODEX standard, there are two types of honey:

- Blossom Honey, or Nectar Honey, is the honey that comes from nectars of plants.
- Honeydew Honey is the honey that comes mainly from excretions of insects (aphids).

How is honey regulated?

Honey quality is defined at international level by the FAO/WHO Codex Alimentarius (CODEX STAN 12-1981, and at European level by the Directive 2001/110/EC establishing methods for their analysis. This directive makes the addition of any additives other than honey, illegal. The same directive prohibits the removal of any constituent apart from the unavoidable removal of foreign matter such as insects, plants or soil.

The International Honey Commission (IHC) published "Harmonised methods of the European Honey Commission" in 1997 and revised the document in 2009. [20]

Honey Fraud

During a technical round meeting on honey adulteration at the European Commission's JRC in 2018, five main types of honey fraud were identified [17]:

- Addition of sugar and syrups (most frequent form of fraud)
- Mislabelling (mono-floral, poly-floral, blossom and honeydew)
- Synthetic resins and ultrafiltration followed by addition of pollen
- Bee feeding (feeding is acceptable but when the bee nectar flow starts, feeding must stop)
- Immature honey

In 2015 the European Commission organised an EU coordinated control plan to assess the prevalence on the market of honey adulterated with sugars and honeys mislabelled with regard to their botanical source or geographical origin. All 28 EU countries plus Norway and Switzerland participated in the plan and results between 2015 and 2017 indicated that the addition of sugars to honey is taking place both within and outside the EU. The European Commission's JRC found that 14 % of the samples tested contained added sugar [16].

Scientific knowledge about the chemistry of honey and processing methods does not consistently maintain pace with the creativity of fraudsters. Honey adulteration has evolved from the basic addition of syrup (sucrose in water) to bespoke produced syrups that mimic the sugar composition of pure honey [22].

Detecting exogenous sugars is challenging and though reasonably effective methods to detect cane sugar adulteration are available, this is not the case for commodities such as beet sugar, where the problem is much more challenging and existing methods are complex and time-consuming. In recent years, scientists have begun to employ nuclear magnetic resonance (NMR) based methods to combat such adulteration.

The UK Government Chemist (hosted at LGC), the Department for Environment, Food and Rural Affairs (Defra), the Food Standards Agency (FSA) and Food Standards Scotland (FSS) held a UK seminar on honey authenticity: determination of exogenous sugars by nuclear magnetic resonance (NMR) on 13 November 2019 to bring together stakeholders involved in honey production and discuss this topic. There was consensus support for NMR as a tool in verifying the authenticity of foods but also the view that, based on the available evidence, NMR methods are not yet suitable for the detection of exogenous sugars in honey for enforcement purposes. [28]

Parameters and measurement methods

Natural and authentic honey contains natural sugars that are present in varying amounts. It is a complex mixture of sugars of which the main ones are fructose and glucose. In the Directive 2001/110/EC relating to honey, the requirements for sugars are:

- The sum of fructose and glucose content must be greater than 60g/100g for blossom honey, and greater than 45g/100g for honeydew honey and blends
- Sucrose content must not exceed 5g/100g with some exceptions

Other physicochemical parameters **(figure 2)** that are being routinely tested include moisture, pH, the diastase number, electrical conductivity and hydroxymethylfurfural (HMF). According to Ling Chin et al. (2019) [17], the physicochemical properties of honey can change depending on the type of flowers, the season and the geographical conditions and therefore it is critical to monitor the levels to assist the fight against adulteration.

There are various other methods that are used in routine honey quality testing and are based on chromatography (HPLC, GC, LC-MS, GC-MS), NIR, FTIR, FT-Raman etc.

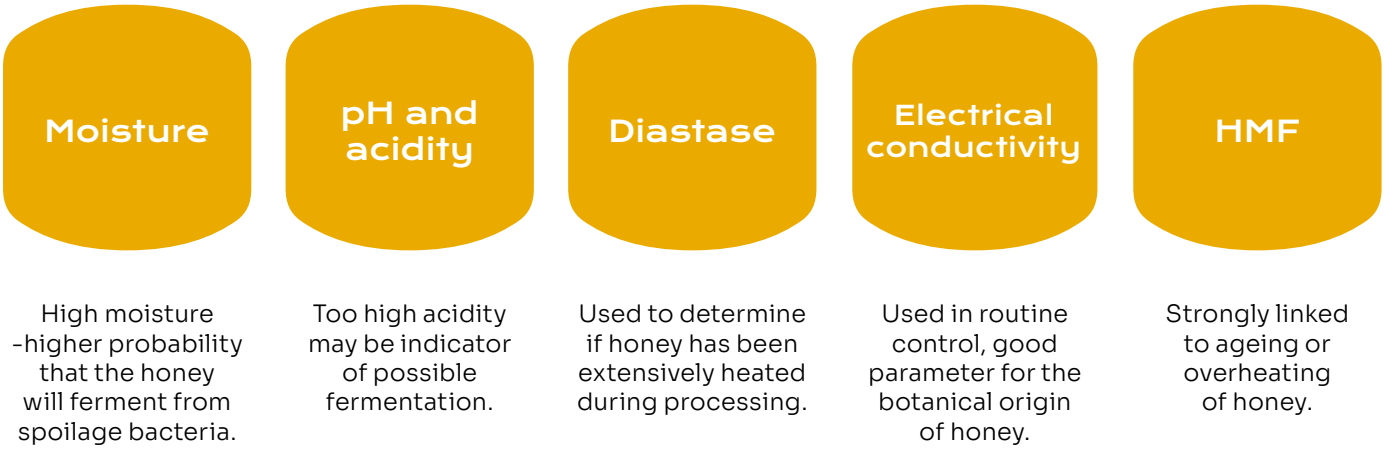


Figure 2: A selection of physicochemical properties of honey and what they indicate

NMR & IR-MS

The Isotope Ratio analysis using Mass Spectrometry (IR-MS) may be used to detect adulterated honey samples based on the principle of the δ13C value or 13C/12C ratio. Carbon isotope ratios are relevant to sugars and protein but the nitrogen isotope ratio has also been used in honey authenticity study regarding 271 samples from four different geographical regions of Slovenia. [21]

Nuclear Magnetic Resonance (NMR) spectroscopy, can give us useful structural information for marker chemical compounds, and is recognised as one of the emerging analytical techniques for ensuring authenticity of food products like honey.

Cheese

Introduction

Dairy products are another food commodity in which food fraud issues are prevalent.

Increasing concerns regarding cheese product integrity led to the European Union (EU) establishing a system to grant food products with quality logos. The logos are “Protected Designation of origin” (PDO), “Protected Geographical origin” (PGI) or “Traditional Speciality Guaranteed (TSG)”. A total of 245 cheese products are currently registered on the EU Database of Origin and Registration (DOOR).

LGC AXIO Proficiency Testing offers a range of PT samples supporting cheese testing, including QFCS 800 (Authenticity and Quality of Cheese) and a number of samples available in our full dairy PT scheme, QDCS.

What is cheese?

According to the CODEX General Standard for Cheese, CODEX STAN 283-1978 “Cheese is the ripened or unripened soft, semi-hard, hard, or extra-hard product, obtained through the coagulation of milk protein by rennet, other suitable coagulating agents or processing technologies, and in which the whey protein/casein ratio does not exceed that of milk”.

How is cheese generally classified?

According to the International Dairy Federation, there are approximately 500 different types of cheese. In the EU, approximately 40% of milk is used for the production of cheese. Germany, Italy, France and the UK are the main EU cheese producing countries.[23]

Cheese classification is based on several criteria. These include the:

- Source of the milk (e.g. cow or buffalo, sheep or goat)
- Degree of softness (soft, semi-soft, semi-hard, and hard)
- Geographical origin (country or region)
- Production method
- Duration of ripening or degree of maturity
- Fat content

How is cheese regulated?

CODEX Alimentarius has developed specific standards for milk and dairy products. It includes the standards of milk, milk powders, condensed milks, creams, butter and all sorts of cheeses.

For example, a CODEX standard for Cheddar cheese was first published in 1966 (CODEX STAN 263-1966). It contains information about the essential composition and quality factors, dry matter, permitted food additives and rules on the declaration of the milk fat content.

The European Dairy Association (EDA) is a platform that brings together dairy companies, cooperatives and contains useful information for the European dairy sector.

Adulteration issues

Fraudsters target high value commodities or those consumed in high volumes world-wide, such as dairy products. This is why the United States Pharmacopoieia (USP) Food Fraud Database (now operated by Decernis), contains 474 entries on milk and milk products between 2000 to 2015, and milk adulteration is the second most frequently reported issue.

According to research, the determination of alkaline phosphatase and lactoperoxidase, two naturally occurring enzymes in raw milk, can be used to evaluate the use of thermal processing in milk.[24] AXIO Proficiency Testing offers QDCS Sample 31 for Phosphatase in Milk to support laboratories carrying out this type of analysis.

Vegetable oils and fats may be used as cheap substitutes for milk fat to manufacture imitation cheese or mixtures. The determination of butyric acid and other fatty acids may initially show that the cheese used is not dairy cheese and it is a cheese analogue product. AXIO Proficiency Testing QFCS Sample 800 for Authenticity and Quality in Cheese is offered to ensure the accuracy and reliability of cheese testing.

The main authenticity adulteration issues that have been identified in the dairy sector include:

- Adulteration with water
- Enhancing the nitrogen content by illegal methods e.g. addition of melamine
- Addition of reconstituted milk
- Adulteration of the fat content (major adulterants are vegetable oils in cheese)
- Milk species substitution
- Geographical indication issues

2016 News

In the UK, Trading Standards Officers uncovered some take-away restaurants were selling cheese and ham pizzas that contained neither! The Officers bought 40 pizzas from small independent take away restaurants across Warwickshire. It was found that five of the pizzas, contained ‘analogue cheese’, instead of dairy cheese or as advertised with 100% mozzarella cheese, and a further five did not contain the types of meat described on the menu.

Protecting the protected products

Since 1992, the EU has put in place a “name protection” scheme to protect the names of agricultural products and food products. This system provides legal protection throughout the EU for products which are distinctive due to their geographical origin, this being equivalent to a type of intellectual property. [25]

These ‘Geographical Indications’ (GIs) legally protect more than 3,400 names of products which helps promote unique product characteristics and traditional production methods. Agri-food and drink products whose names are protected by European Union GIs represent a sales value of €74.7 billion according to a study published in October 2019 by the EU Commission.[26]

Following the UK’s exit of the EU, all product names protected in the EU on 31 December 2020 following successful applications to the EU GI schemes are protected under the UK and EU GI schemes.

A UK GI scheme has been introduced for the protection of new UK products (https://www.gov.uk/guidance/protected-geographical-food-and-drink-names-uk-gi-schemes).

Protected Designation of Origin (PDO)

This is the strictest of all the denominations. It protects the origin of the product. Every part of the production, processing and preparation process must take place in the specific region and the product bears some very specific quality and essential composition characteristics.

Protected Geographical Indication (PGI)

This denomination stresses the correlation between the specific geographic region and the name of the product where a specific quality attribute can be traced to its geographical origin.

Traditional Speciality Guaranteed (TSG)

This denomination emphasizes the traditional aspects of the product such as the production method or its essential composition, without being traced or linked to a specific geographical origin.

Launched in 2019, the new EU public database **eAmbrosia** replaced the DOOR database and contains all the EU Geographical Indications registers, including the status (applied, published or registered), product specification, and links the regulation that covers the legal protection of the agri-food products. It contains all the protected products, including wine and spirits.

Cheese protected products

There are 245 cheeses (PDO, PGI) registered on the e-ambrosia, from various EU countries, with Italy, France, Spain and Greece having the higher number of products each (52, 55, 29 and 23 cheeses, respectively).

At the time of writing, the United Kingdom has registered 17 different cheese products. Examples include Yorkshire Wensleydale, Staffordshire cheese, White and Blue Stilton cheese.

Yorkshire Wensleydale

Yorkshire Wensleydale is a PGI product and has to be produced in Wensleydale, in North Yorkshire, UK. The product specifications for this to be included in the PGI list[26] includes some physicochemical properties of the cheese and these parameters need to be tested in the final products, including:

- pH: 4.4 to 5.4
- Dry matter: minimum 54%
- Fat content: minimum 48% of the dry matter
- Sodium chloride: maximum 2.2%

Mozzarella di Bufala Campana (PDO)

Mozzarella di Bufala Campana (PDO) is only produced with the fresh milk of water buffalos. The raw material is full fat, fresh buffalo milk. This is specifically mentioned to prevent the use of frozen or deep-frozen milk. The breed of buffalo is also specified as Italian Mediterranean buffalo. Other specified parameters include:

- Minimum fat content: 7.0% to 7.2%, minimum 52% of the dry matter
- Protein content: 4.2%
- The rennet is specifically natural calf's rennet
- Moisture content: minimum 65%

Olive oil protected products (extra virgin)

There are approximately 130 extra virgin olive oils, registered on the e-ambrosia, from various EU countries, with Greece, Italy and Spain having the higher number of products.

These products are olive oils with added value, produced in specific geographical locations by using specific methods and thus, are prone to fraudulent practices.

Honey protected products

According to the European Commission in 2017, there are 23 PDO and 8 PGI honeys registered in the EU, with Portugal the country with the highest number (9 PDO honeys), followed by Spain (5 PDO and 1 PGI honeys) and France (2 PDO and 3 PGI honeys).

For example "Miel de Tenerife" is a PDO honey product. It has specific characteristics that are stated in the COUNCIL REGULATION (EC) No 510/2006 on the protection of geographical indications and designations of origin for agricultural products and foodstuffs, including:

- Moisture: not more than 18%
- Water activity: not more than 0.62
- Hydroxymethylfurfural: not more than 20mg/kg
- Diastase activity: not less than 12 Schade units
- pH: from 3.40 to 6.00
- Sucrose: less than 4g/100g honey

Conclusion

The global food market generates over $6,000bn in revenue per year, and therefore the economic incentives for fraudsters to commit food fraud are high. The increasing complexity of global food supply chains affords greater opportunities for fraudsters to commit fraud with relatively low probability of being caught. Specifically defined products such as olive oil, honey and cheese generate quality and value in the global marketplace – making them primary targets for fraudsters. Other commonly targeted products include coffee, meat and fish, herbs and spices.

There is an increasing level of sophistication being deployed in fraudulent practices that is making it difficult for authorities, regulators and analytical science to maintain pace with such practices. The challenge for those seeking to protect the integrity of the food chain and marketplace is to protect consumers from being misled, protect businesses from losing revenue to criminal practices, and protect the rights and traditional practices of producers.

As the global food market grows along with the opportunities for food fraud, the demands for vigilance in food testing and protection increase. Analytical laboratories are playing a critical part in the fight against food fraud, using science to both influence and enforce regulations. To continue to do this consistently and effectively, laboratories need to ensure that measurement procedures are up-to-date, reliable and fit-for-purpose. Quality assurance tools, including Proficiency Testing (PT), help to ensure that the analytical methods being used produce valid measurement results.

LGC AXIO Proficiency Testing continually develops food and beverage proficiency testing schemes and samples to support laboratories in their efforts to fight food fraud and verify authenticity. You can discover more about how we do this at **lgcstandards.com/AXIO**

LGC AXIO Proficiency Testing is a partner of the Food Authenticity Network. The Food Authenticity Network curates information on food authenticity testing and food fraud mitigation on its open access website, raising awareness of the tools available to check for mislabelling and food fraud. In this way, it contributes to the building of more resilient global food supply chains so that ultimately, consumers can have greater confidence in the food they buy. Discover more here: www.foodauthenticity.global

References

1. Fera et al. (2020) http://actimeat.com/pdf/efsa_covid_2021.pdf
2. http://www.fao.org/fao-who-codexalimentarius/sh-proxy/en/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FMeetings%252FCX-733-24%252FWorking%2BDocuments%252Ffc24_07e.pdf
3. https://ec.europa.eu/knowledge4policy/food-fraud-quality_en
4. https://www.europol.europa.eu/newsroom/news/over-%E2%82%AC100-million-worth-of-fake-food-and-drinks-seized-in-latest-europol-interpol-operation
5. https://mygfsi.com/wp-content/uploads/2019/09/Food-Fraud-GFSI-Technical-Document.pdf
6. vhttps://www.brcgs.com/brcgs/food-safety/food-fraud/
7. http://www.foodauthenticity.uk/blog/india-is-facing-a-serious-food-fraud-problem?xg_source=msg_user_blogpost
8. Fourati H., M. Cossentini, B. Karray, et al., Classification of Olive Trees According to Fruit and Oil Characterisation. Acta Hort. (ISHS) 586:141-145, (2002)
9. https://www.elsevier.com/books/olive-oil/boskou/978-1-893997-88-2
10. http://cms.herbalgram.org/BAP/pdf/BAPP-BABs-OliveOil-CC20new-012020-FINAL.pdf
11. https://ec.europa.eu/info/food-farming-fisheries/plants-and-plant-products/plant-products/olive-oil_en
12. https://www.researchgate.net/publication/24170351_Coast_and_year_effect_on_H_O_and_C_stable_isotope_ratios_of_Tyrrhenian_and_Adriatic_Italian_olive_oils
13. International Olive Oil Council, Document No 6, Madrid, (1984). https://www.internationaloliveoil.org/what-we-do/chemistry-standardisation-unit/standards-and-methods/
14. Commission Regulation (EEC) No 2568/91 of 11 July 1991 on the characteristics of olive oil and olive-residue oil and on the relevant methods of analysis
15. FI Handbook on Food Authenticity Issues and Related Analytical Techniques https://secure.fera.defra.gov.uk/foodintegrity/index.cfm?sectionid=83
16. https://ec.europa.eu/food/sites/food/files/safety/docs/food-fraud_network_activity_report_2018.pdf
17. https://ec.europa.eu/jrc/sites/jrcsh/files/ares181569074-1_technical_round_table_on_honey_adulteration_report.pdf
18. https://www.intechopen.com/online-first/a-review-on-analytical-methods-for-honey-classification-identification-and-authentication
19. https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/animals_and_animal_products/presentations/market-presentation-honey_en.pdf
20. http://www.ihc-platform.net/ihcmethods2009.pdf
21. Kropf U, Golob T, Necemer M, Kump P, Korosec M, Bertoncelj J, et al. Carbon and nitrogen natural stable isotopes in Slovene honey: Adulteration and botanical and geographical aspects. Journal of Agricultural and Food Chemistry. 2010;58:12794-12803
22. https://ec.europa.eu/food/sites/food/files/safety/docs/oc_control-progs_honey_jrc-tech-report_2016.pdf
23. https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20190314-1
24. Ritota M., Costanzo M.G., Mattera M. & Manzi P. (2017). - New trends for the evaluation of heat treatments of milk. J. Anal. Methods Chem., 2017, 1-12
25. https://ec.europa.eu/trade/policy/accessing-markets/intellectual-property/geographical-indications/index_en.htm
26. https://op.europa.eu/en/publication-detail/-/publication/a7281794-7ebe-11ea-aea8-01aa75ed71a1
27. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/271290/pfn-yorks-wensleydale-cheese-pgi.pdf
28. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/881297/UK_Honey_Authenticity_Seminar_Report_FINAL_for_GC_Website_23_04_2020.pdf)

About the author

Savvas Xystouris

Savvas Xystouris is the Technical and Development Manager at LGC Proficiency Testing where he is responsible for developing proficiency testing materials, primarily for Food Chemistry proficiency testing schemes, which support laboratories worldwide in their quality control and food testing efforts.

Savvas previously worked at the State Laboratory of Cyprus as an Analytical Chemist in Food products, was an active member of the National Reference Laboratory (NRL) of Cyprus for Mycotoxins, Heavy Metals, Nitrates and other contaminants in food and was involved in the European Food Safety Authority (EFSA) FoodEX II project for the classification and re-coding of different food products.

Savvas has a background in Chemistry (BSc in Chemistry, Aristotle University of Thessaloniki, Greece) and Food Science (MSc in Food Science and Nutrition, University of Leeds, U.K.).

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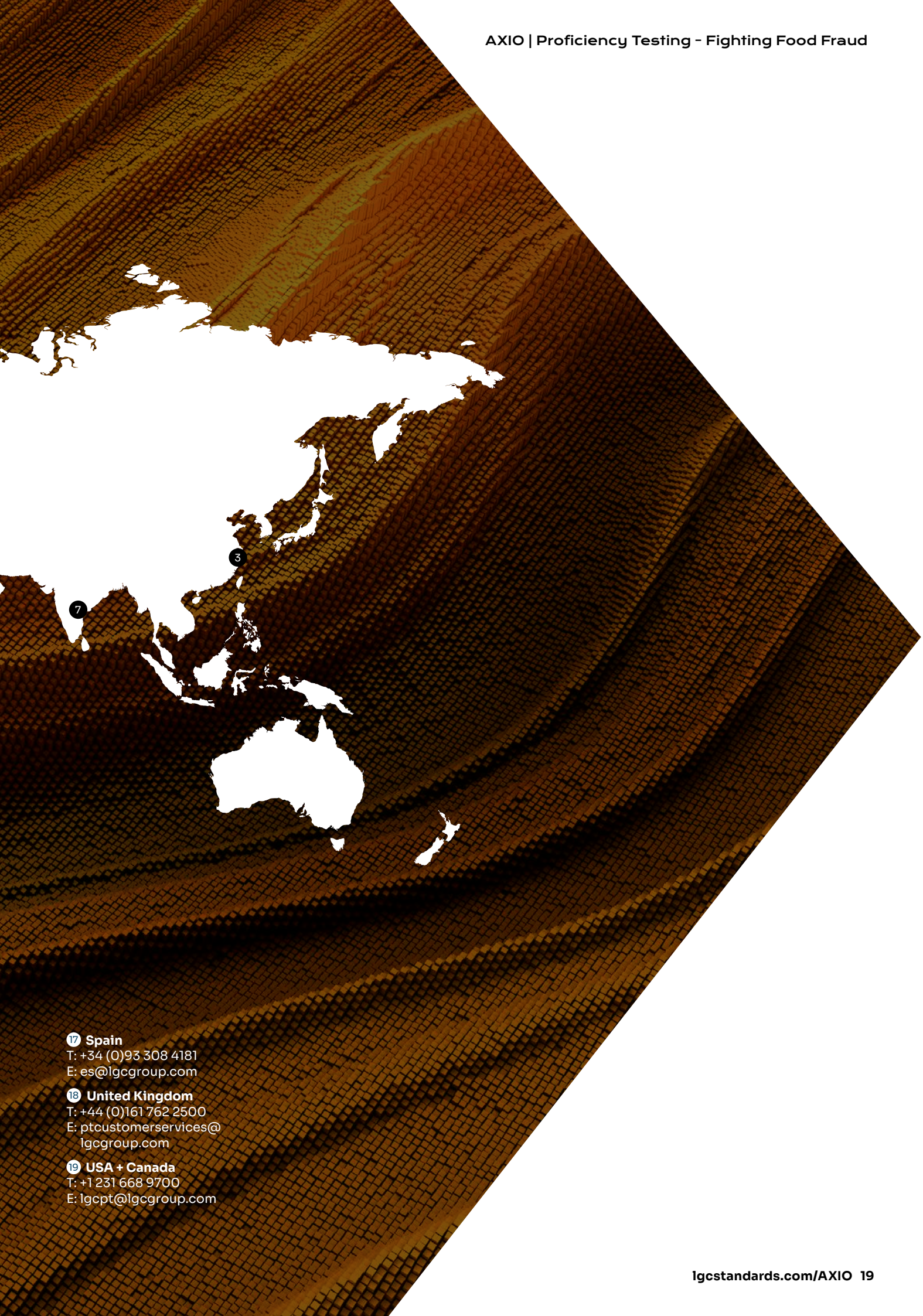

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