

The Setup of the National Reference Centre for Authentic Food (NRZ-Authent) in Germany

Sabine Kulling, Diana Bunzel, Lara Frommherz, Joachim Molkentin, Iris Lehmann, Stefan Engert, and Pablo Steinberg*

The present report addresses the challenges in the fight against food fraud, discusses the definition of food fraud as a legal concept, the point in time at which policy makers in Europe became aware of food fraud, i.e., the horsemeat scandal in 2013, and the policy responses of the EU as well as Germany to that scandal. Moreover, the establishment, structure, and objectives of the recently established National Reference Centre for Authentic Food (NRZ-Authent) in Germany are described.

Practical Applications: The suggested structure of the German National Centre for Authentic Food (NRZ-Authent) can be used as a blueprint when wanting to build up European Union centers for the authenticity and integrity of the agri-food chain in the member states.

1. Food Fraud and Its Definition in the Legal Context

Food fraud is the deliberate act of the adulteration of food for financial gain by, e.g., substitution, addition, dilution, tampering, concealment, mislabeling, counterfeiting, or misrepresentation of food and/or its ingredients.^[1–3] Consumer trust is hurt because of the mismatch between the advertised food product claims and its actual characteristics or quality.^[4] Food fraud exists whenever individuals or businesses intentionally deceive consumers and harm their trust, gaining an unfair advantage, and violating the agri-food chain legislation.^[5] Given the fact that fraud is a form of deceptive criminal behavior, it is also (and more increasingly so) labeled “food crime.”^[6] Moreover, food fraud may also constitute a risk to human, animal, or plant health.^[1] The key motivation behind food fraud remains, however, economic gain: A harm to human health – a food

safety incident caused by fraudulent practises – is usually not intended, as the former increases the risk of detection. Although fraudsters accept the harm – in particular if it goes undetected – the harm as such is not the motivation (as opposed to a food defence incident).

An internationally accepted and established legal definition of food fraud does not exist so far, not even at the European legislation level (as a result of different national perspectives). The European Commission refers to four “key operative criteria” for distinguishing whether a case should be considered as fraud:^[5] 1) violation of EU law or rules codified in the EU agri-food chain legislation; 2) intention or

strong grounds to believe that certain non-compliances are not happening by chance (such as the replacement of a high quality ingredient by one with a lower quality); 3) economic gain, i.e., some form of direct or indirect economic advantage, which should not be marginal; 4) deception of customers, which may also be accompanied by a public health risk.

Whenever food fraud occurs, it is the consumer that foots the bill, e.g., when chlorophyll-colored vegetable oil is sold as a higher priced olive oil “extra virgin,” when conventionally produced food is sold as organic food or when farmed salmon is sold as higher priced wild salmon (fraudulent certification). The mechanism behind the economic gain on the side of the individual producer or sub-contractor is the so-called “economies of scale”-effect and is related to the sheer quantity of particular foods that is produced these days: The annually produced amount of an average food item is nowadays ten to a hundred times higher than about 50 years ago. The following example will illustrate this aspect: If dried oregano, a very popular culinary herb, is mixed with up to 30% leaves from olive or myrtle trees, this may initially sound negligible: The small 13-gram supermarket box containing dried oregano costs about 1.80 €, and the material damage (0.54 €) seems to be an amount of money that can easily be coped with by many consumers. However, if one takes into account that the annual production of oregano worldwide amounts to about 12 000 tons,^[7] it can easily be deduced that fraudsters may achieve extremely high profit margins by simply “diluting” dried oregano with cheap tree leaves. Based on the fact that the EU market for herbs and spices amounts to over 500 000 tons with a value of 1.8 billion €, ^[8] the business consultant group *PricewaterhouseCoopers* estimates that food fraud with its 52 billion US\$ worth globally each year easily

Prof. S. Kulling, Dr. D. Bunzel, Dr. L. Frommherz, Dr. J. Molkentin, Dr. I. Lehmann, Dr. S. Engert, Prof. P. Steinberg
Max Rubner-Institut
Federal Research Institute of Nutrition and Food
Haid-und-Neu-Str. 9, 76131 Karlsruhe, Germany
E-mail: pablo.steinberg@mri.bund.de

© 2019 The Authors. *European Journal of Lipid Science and Technology* published by Wiley-VCH Verlag GmbH & Co. KGaA. This is an open access article under the terms of the Creative Commons Attribution-NonCommercial License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

DOI: 10.1002/ejlt.201900023

outflanks the illegal trade in firearms and heroin (with 8.5 billion and 30 billion US\$ a year, respectively).^[9]

Opportunities to cheat for economic gain – either to cut costs or to maximize revenues – are additionally catalyzed by regional free-trade markets without borders, an increasingly globalized “just-in-time” production and highly complex supply chains from farm-to-fork: The food and retail industry buys raw materials and ingredients for processed foods worldwide – costs being an important driver of sourcing decisions (depending on exchange rates and prices on the global commodity markets). The higher the value per kilogram, the likelier the motivation for fraud.^[6] The longer and the more global the chain, the likelier the opportunity for fraud, i.e., that the chain’s integrity might suffer by a fraudulent intervention.

Moreover, some experts consider the general risk of detection as “pretty low”: for example, in counterfeiting organic food, neither consumers nor experts can tell with the naked eye whether a product is really organic. In this context, it has to be pointed out that there are not many food safety incidents associated with products that have been misrepresented as organic food, which would result in an official inquiry.^[9] Analytical detection methods, even though they are increasingly sophisticated, run behind the ever more complex fraudster technologies. The fight against food fraud is similar to the dilemma the experts face when fighting against doping in sports,^[10] simply because the control authorities can only detect what they search for, and that in turn depends on knowing (or rather suspecting) what product is likely the next to be falsified. New and so far unknown fraud strategies are not easily identified: Such deviations from accepted standards can only be detected by non-targeted technologies, which, however, require access to sophisticated and rather costly databases with detailed information on the typical composition of the specific food product and the influence of factors such as the geographic origin. Finally, it is quite difficult to legally document food fraud in court, and if so, the complex court proceedings are often suspended or end up with comparably low fines.

In sum, the risk of detection of food fraud at the moment seems rather low, while the motivation or opportunities for and revenues from fraud are rather high.^[6] According to a statistical analysis of reported food fraud incidents by Moore et al.^[11] and a report to the European Parliament in 2013,^[12] the Top Ten of foods with the highest risk of fraud at the present time are olive oil, fish, organic food, milk, grain/cereals, honey, coffee and tea, spices (saffron, chili), wine, and fruit juices. Here as well, a point of critique is that clear-cut empirical data on the full extent of food fraud is missing: According to the 2018 Annual Report of the Food Fraud Network of the European Commission, meat and meat products, fish as well as fats and oils are among the product categories that exhibit the largest number of frauds. The data are based on the cases reported in the Administrative Assistance and Cooperation-Food Fraud (AAC-FF) system. However, the European Commission points out that “the list of requests exchanged in the system does not represent the entirety of food fraud incidents occurring in the EU” as the AAC-FF system on the one hand works on a voluntary basis and on the other hand the reported cases neither include the activities at the national level nor can each suspicion – officially labeled “request” – thereafter be re-confirmed as a case of violation.^[13] Therefore the

widely used and quite illustrative top ten food fraud rankings have to be looked at with caution.

2. The Starting Point: The Horsemeat Scandal in 2013

Although food fraud is “an old problem”,^[14] e.g., the addition of water to wine or sand to flour in bread, food authenticity suddenly hit the international headlines in mid-January 2013 when food inspectors in the Irish Republic and the United Kingdom unexpectedly identified undeclared horsemeat in foods officially advertised as containing beef, mostly frozen ready meals such as beef lasagna, spaghetti Bolognese, and beef burger.^[15] After public authorities, suppliers and retailers had carried out further tests, the analytical results demonstrated that the incident was by no means geographically restricted to the British Isles or a specific retailer, but that horse and pork DNA was detected in a range of beef-containing food items in other European countries.^[16] The so-called “horsemeat scandal” in 2013 clearly showed that there were considerable flaws regarding the traceability of the food industry’s supply chain and the vulnerability of public food control and management systems in Europe, which were not originally designed to prevent food fraud.

The horsemeat scandal was not primarily a food safety incident – although, of course, health risks may also arise from fraudulent activities, as was the case of the 2008 Chinese melamine milk scandal, which led to numerous cases of infant illness and deaths.^[1] However, in the case of the horsemeat scandal it should be mentioned that some meat samples contained traces of the veterinary drug phenylbutazone, which should not be present in the human food chain, but the health risk derived from the ingestion of low amounts of phenylbutazone cannot be compared with that of melamine (i.e., it was much lower). The heart of the matter was the economically motivated mass-scale adulteration of food and its detection for the first time. Horsemeat is cheaper than other meats in some European countries, in which it is not a culturally recognized dish, as, e.g., is “viande de cheval” in France. The complex international supply chain between abattoir, meat and food processor, packager, retailer, and diverse subcontractors allowed for profit margins and a financial gain that would have not been otherwise attained.^[15] With sales for frozen hamburgers and other meals immediately dropping,^[17] consumers in shock and the general credibility of the public in the food control systems in Europe seriously shattered, food fraud moved upwards in the political agenda of the EU.

3. The Anti Food Fraud Response of the EU

In March 2013, the European Commissioner for Health announced a so-called five-point action plan of measures to be carried out over the short-, medium-, and long-term – not only to detect horsemeat^[18] but also to structurally improve the European control systems in the fight against food fraud in general. The plan included a variety of measures such as, e.g., advanced training for food inspectors, the police and customs

authorities, a new regulation (Regulation (EU) 2017/625),^[19] the launching of an electronic system to exchange data in a structured manner regarding non-compliances with food and feed legislation, the so-called *Administrative Assistance and Cooperation System*,^[20] as well as the creation of an EU Food Fraud Network composed of representatives from the European Commission, all EU countries, Switzerland, Norway, and Iceland for a more efficient cross-border administrative assistance and cooperation.

Since 2011, Europol coordinates the so-called OPSON operations, which take place annually. OPSON is a concerted effort of police, customs, and national food regulatory bodies with the aim to confiscate and destroy counterfeited foods and to identify the criminals behind these networks with a main campaign over the course of four months. For example, OPSON VII was conducted from December 2017 to March 2018 across 67 countries. More than 3600 tons and about 10 million liters of adulterated food and beverages were confiscated as a result of more than 40 000 checks carried out in shops, markets, airports, seaports, and industrial estates. About 750 individuals were arrested, with investigations continuing in many countries.^[21]

In line with the topic of this Special Issue, the European Commission reported in 2018 that 24 000 liters of olive oil mislabeled as extra virgin olive oil were sent to the United Kingdom.^[13] The latter is a superior category, i.e., olive oil that is solely extracted by mechanical or other physical means and neither blended nor heated. The quality parameters defined, e.g., by Regulation (EU) 1308/2013 establishing a common organization of the markets in agricultural products, the Commission Regulation (EEC) 2568/91 on the characteristics of olive oil and olive-residue oil and on the relevant methods of analysis and the Commission Implementing Regulation (EU) No. 29/2012 on marketing standards for olive oil (codification) are very strict in the sense that they guarantee the olive oil's highest quality. The price level of extra virgin olive oil makes it extremely attractive for fraudsters. In the above-mentioned case, the olive oil was shipped from Spain and sold to retailers and restaurants in the United Kingdom, where compulsory controls showed its inferior quality: about 30% of the oil was in fact blended with refined olive oil (lampante quality).^[13] The United Kingdom National Food Crime Unit informed the Spanish Guardia Civil, which in turn took action that is still ongoing. In May 2019, Europol reported another case: 150 000 liters of fake olive oil were identified in Germany^[22]; in this case, chlorophyll, β -carotene and soya oil were added to sunflower oil, in order to make it look like olive oil. It is estimated that around 8 million € were earned every year by buying one million liters of sunflower oil for 1 € per liter and selling the fake olive oil for 5–10 € per liter.^[22] It should be noted that the two above-mentioned cases are examples of adulteration activities that can quite easily be detected with existing standard analytical methods such as those based on liquid or gas chromatography. However, the fraudsters have meanwhile embarked on more sophisticated adulteration strategies – also discussed in this Special Issue – such as, e.g., spiking olive oil with soft-deodorized or tailored oil.^[23]

Furthermore, the new Regulation (EU) 2017/625 focuses on enhancing the food control systems of the EU and its member states. The aim of this regulation, which replaced Regulation (EU) 882/2004, is to lay down the basic requirements for the

development and implementation of official food and feed controls within the EU for all Member States, in order to prevent that consumers are misled, in particular as to the nature and quality of food. In contrast to other previous regulations, the fight against food fraud comes into the focus. The former risk-oriented approach is no longer exclusively limited to food safety, but also includes the risk of food fraud. One important point of this new regulation is the statement that competent authorities “should have access to updated, reliable and consistent technical data, to research findings, new techniques and expertise necessary for the correct application of Union legislation”. With this point in mind, the European Commission for the first time recommended setting up so-called European Union reference centers for the authenticity and integrity of the agri-food chain in the Member States (Article 97 of the Regulation (EU) 2017/625). Article 98 of Regulation (EU) 2017/625 defines responsibilities and tasks of the European Union reference centers for the authenticity and integrity of the agri-food chain: (1) providing specialized knowledge in relation to the authenticity and integrity of the agri-food chain and to the methods for detecting violations of the rules; (2) providing specific analyses designed to identify the segments of the agri-food chain that are potentially subject to violations of the rules; (3) establishing and maintaining collections or databases of authenticated reference materials; (4) disseminating research findings and technical innovations.

4. The Anti Food Fraud Response of Germany

In October 2015 and on behalf of the Federal Ministry of Food and Agriculture in Germany (BMEL), the Expert Advisory Board for Food Fraud was established at the Federal Office of Consumer Protection and Food Safety (BVL). Its members are representatives of the federal government, federal states (“Länder”), federal research institutes, the customs administration, the Federal Criminal Police Office, the Federal Bureau of Statistics and public prosecutor's offices. Its objective is to structure and evaluate activities to counteract food fraud, and these include preventive strategies, measures for early food fraud identification and warning as well as the elucidation of food fraud cases along the food chain.

In May 2017, the BMEL decided to establish the National Reference Centre for Authentic Food (NRZ-Authent) at the Max Rubner-Institut (MRI), the Federal Research Institute of Nutrition and Food. The MRI advises the BMEL on the different aspects of consumer health protection in the nutrition and food sector. In addition to its headquarters in Karlsruhe, MRI also conducts research at Departments located in Kiel, Detmold, and Kulmbach. The MRI has comprehensive knowledge in food technology combined with various facilities for the production of different kinds of food, such as bakery products, edible oil, meat products, potato products as well as fish or milk products. The testing of food authenticity has been a research focus at MRI for many years, the key subjects being the development of methods to discriminate between organic and conventional agricultural products, to detect adulterations of milk fat and plant oils such as olive, argan, or cactus seed oil, to identify specific fruits, vegetables, spices, and herbs as well as animal species and to



Figure 1. Locations of the Max Rubner-Institut across Germany and focus of food authenticity research at the different locations.

detect undeclared/forbidden food ingredients. For these purposes, the MRI applies targeted and untargeted analytical procedures such as, e.g., gas chromatography/liquid chromatography coupled to mass spectrometry, isotope ratio mass spectrometry, and modern molecular biology techniques (among others, next generation sequencing and reverse-transcriptase polymerase chain reaction).

5. Institutional Structure of the NRZ-Authent

The NRZ-Authent is organized in a decentralized manner, and its central office is located at the Kulmbach site of the MRI (Figure 1). The head of the NRZ-Authent coordinates all activities related to food authenticity and integrity at all five MRI sites according to each site's individual focus area, i.e., meat and meat products in Kulmbach, vegetables, fruits and herbs in Karlsruhe, edible oils and cereals in Detmold and milk and fish in Kiel/Hamburg (Figure 1). The NRZ-Authent benefits of the long-term expertise of the different food-related Departments of

the MRI, and an intensive cooperation between the food-related Departments and the NRZ-Authent is foreseen.

In order to fulfill the tasks, the NRZ-Authent is subdivided in two infrastructure modules and four thematic modules supported by a steering committee and technical committees (Figure 2). The technical committees are advisory bodies for the steering committee and develop recommendations regarding the fields of work, determine the demands of the food control authorities, prioritize the topics, and identify cooperation partners. The composition of these groups is flexible depending on the topic, and the groups consist of representatives of the MRI, the BVL and/or the Federal Institute of Risk Assessment (BfR), food authorities, and research institutions as well as other experts. In the steering committee, the president of the MRI, the head of NRZ-Authent and representatives of BMEL and BVL decide on the relevant topics to be tackled, the prioritization of the topics in different fields of work and the cooperation between the NRZ-Authent and different extramural organizations. The Joint Research Centre in Geel (Belgium) (JRC) and the German Institute for Standardization (DIN) will act as guests in the Steering Committee of the NRZ-Authent.

The tasks are accomplished (depending on the needed expertise) at the different MRI sites. The main objective of the infrastructure module I is to assemble and process internal and external data sets and information, which are passed on to the investigation offices in charge of controlling the food market via a communication platform to be established on the NRZ-Authent homepage. The main tasks of the infrastructure module II are the conversion of the newly developed methods into standardized routine laboratory methods, the accreditation of these new methods as well as the provision of certified reference materials and authentic food samples. In addition to the two infrastructure modules, the NRZ-Authent is organized in four thematic modules: (1) verification of the geographic origin of food, (2) verification of production methods, (3) verification of adulterations/falsifications, and (4) species and variety differentiation. The tasks are processed in a demand-oriented way and by taking into account the expertise present at MRI or in

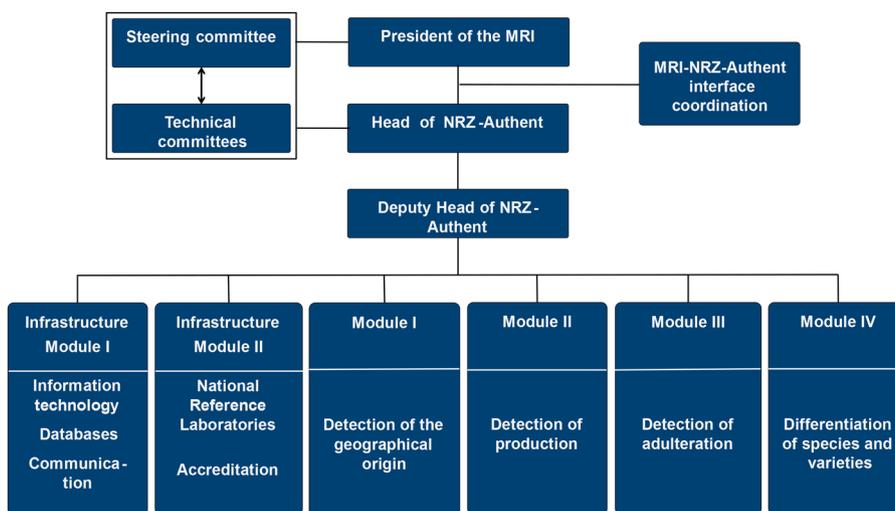


Figure 2. Organigram of the National Reference Centre for Authentic Food (NRZ-Authent).

cooperation with other organizations such as BVL or BfR in Germany.

6. Duties and Competences of the NRZ-Authent

The primary objective of the NRZ-Authent is to pool and coordinate the activities related to the testing of food authenticity in Germany, in order to guarantee an easy access to up-to-date and reliable information, data and research results for the official food control authorities in this particular knowledge area.

In an initial step, the NRZ-Authent started with the setup, support, and coordination of a network consisting of public authorities as well as organizations in the federal states and the federal government in Germany, all of them dealing with the detection and/or prevention of fraudulent and misleading practices along the food chain. In a second step, the NRZ-Authent will provide network partners with an easy access to information on, e.g., scientific publications, new analytical methods and scientific meetings in the area of food authenticity testing.

Within the above-mentioned network, the NRZ-Authent will cooperate with different partners, such as the offices in the federal states in charge of food control, the BVL and the JRC, which is specialized on the production and storage of reference materials including food. Further partners are the BfR and a number of research groups at universities and non-university organizations in Germany, which address different aspects of food fraud. Further information exchange is made possible by organizing network partner meetings for all stakeholders. In this context, the MRI organizes regular workshops in order to bring together experts from the food control laboratories of the federal states, which build the core of the competence network. The 1st NRZ-Authent expert workshop took place in December 2017, and at this meeting the experts discussed the setup of comprehensive databases and the acquisition of authentic reference materials, among other issues. In May 2018, the NRZ-Authent organized a meeting on the analytical differentiation of organic and conventional agricultural products. Although methods to distinguish between organic and conventional products are available in the case of organic eggs (NMR analysis) and organic milk or organic carnivorous fish (stable isotope analysis), most of the analytical methods only determine the probability that an adulteration has taken place. Another aspect to be taken into account is the natural variability of characteristic features of certain food items, which often exceeds the difference between organic and conventional food, thereby making the differentiation based on analytical methods difficult. The 2nd NRZ-Authent expert workshop took place in November 2018 and focused on the handling of scientific databases, the concrete organization of the communication within the network as well as strategies and methods to test the authenticity of olive oil. The 3rd NRZ-Authent expert workshop, scheduled at the end of November 2019, will focus on the authenticity of meat and meat products as well as the challenges of species differentiation (e.g., fish).

A further key aspect of the NRZ-Authent is the ongoing development of analytical methods for the testing of the authenticity of food, e.g., the development of fast methods to be

used by the food control authorities in the course of routine controls. These methods will only be developed and set up at the NRZ-Authent if the food control authorities are of the opinion that they are absolutely necessary and not available at any laboratory of the local food control authorities. This is, for example, the case of the detection of undeclared extraneous proteins and added extraneous protein hydrolysates in meat products, fast methods for the differentiation of fish species or the authentication of organic milk and organic fish.^[24] An essential objective is the standardization and validation of these new methods, so that they can be included in the official collection of analytical methods according to paragraph 64 of the German Food, Commodity and Feed Act.^[25] The NRZ-Authent acts as the contact organization for local food control authorities that want to know which method can specifically be used to verify the authenticity of a certain food item. However, the NRZ-Authent is not a central testing facility that, e.g., will perform routine analyses for the federal states.

Another important task of the NRZ-Authent will be the development of a database on analytical methods, which will be at disposal of the food control authorities in the federal states. The aim is to build up a knowledge sitemap on food authenticity for Germany, which will include information on organizations (food control authorities, universities, private laboratories and/or private companies) and their respective expertise in food authenticity testing. In this way, it should be possible to obtain a complete overview on ongoing food authenticity research in Germany and thereby systematically identify research gaps. Based on this overview, the Steering Committee of the NRZ-Authent will be able to decide which steps need to be undertaken in order to fill in the identified research gaps.

Conflict of Interest

The authors declare no conflict of interest.

Keywords

adulteration, authenticity, food fraud, National Reference Centre for Authentic Food

Received: May 2, 2019

Revised: July 12, 2019

Published online:

-
- [1] J. Spink, D. C. Moyer, *J. Food Sci.* **2011**, *76*, R157.
 - [2] L. Manning, J. M. Soon, *J. Food Sci.* **2016**, *81*, R823.
 - [3] R. Johnson, *Food Fraud and "Economically Motivated Adulteration" of Food and Food Ingredients*, Congressional Research Service, Washington D.C. **2014**.
 - [4] J.-F. Morin, M. Leers, *Food Integrity Handbook: A guide to Food Authenticity Issues and Analytical Solutions*, Eurofins Analytics France, Nantes, France. ISBN 978-2-9566303-0-2.
 - [5] European Commission, "Food fraud: What does it mean?", https://ec.europa.eu/food/safety/food-fraud/what-does-it-mean_en (accessed: July 2019).

- [6] S. M. van Ruth, W. Huisman, P. A. Luning, *Trends Food Sci. Technol.* **2017**, 67, 70.
- [7] 11th World Spice Congress, Herbs Market Report 2012, worldspicecongress.com/uploads/files/sess01-f.pdf (accessed: July 2019).
- [8] L. Drabova, G. Alvarez-Rivera, M. Suchanova, D. Schusterova, J. Pulkrabova, M. Tomaniova, V. Kocourek, O. Chevallier, C. Elliott, J. Hajslova, *Food Chem.* **2019**, 276, 726.
- [9] A. Sampson, Food fraud: high roller of the crime scene. In: *The Weekly Times*, 13th of April 2013, <https://www.weeklytimesnow.com.au/agribusiness/decisionag/food-fraud-high-roller-of-the-crime-scene/news-story/a9837a9f2232ec5c520e2997f03bb617> (accessed: May 2019).
- [10] R. Tucker, The doping dilemma: Doping in sport: impossible to control – time for a new mindset. In: *The Science of Sport*, 16th of November 2008, <https://sportsscientists.com/2008/11/the-doping-dilemma/> (accessed: July 2019).
- [11] J. Moore, J. Spink, M. Lipkus, *J. Food Sci.* **2012**, 77, R118.
- [12] Committee on the Environment, Public Health and Food Safety, Report to the European Parliament on the food crisis in the food chain and the control thereof, 2013/2091 (INI), 4th of December 2013, <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+REPORT+A7-2013-0434+0+DOC+XML+V0//EN> (accessed: July 2019).
- [13] The EU Food Fraud Network and the System for Administrative Assistance, Food Fraud: Annual Report 2018, https://ec.europa.eu/food/sites/food/files/safety/docs/food-fraud_network_activity_report_2018.pdf (accessed: July 2019).
- [14] P. Shears, *Brit. Food J.* **2010**, 112, 198.
- [15] Q&A Horsemeat scandal. In: *BBC News Online*, 13th of April 2013, <https://www.bbc.com/news/uk-21335872> (accessed: July 2019).
- [16] Horsemeat scandal: Withdrawn products and test results. In: *BBC News Online*, 22nd of March 2013, <https://www.bbc.com/news/world-21412590> (accessed: July 2019).
- [17] A. O'Hora, Horse meat discovery knocks £300m off the value of Tesco shares. In: *Independent Online*, 16th of March 2013, <https://www.independent.ie/sport/other-sports/horse-meat-discovery-knocks-300m-off-the-value-of-tesco-shares-28959295.html> (accessed: July 2019).
- [18] European Commission, Timeline – EU action, Horse meat – What has the EU done so far to address the horse meat scandal? https://ec.europa.eu/food/safety/official_controls/food_fraud/horse_meat/timeline_en, (accessed: July 2019).
- [19] Regulation (EU) 2017/625 of the European Parliament and of the Council of 15 March 2017 on official controls and other official activities performed to ensure the application of food and feed law, rules on animal health and welfare, plant health and plant protection products, <https://eur-lex.europa.eu/legal-content/DE/TXT/?uri=CELEX%3A32017R0625> (accessed: July 2019).
- [20] European Commission, Agri-Food Fraud, Administrative Assistance and Cooperation System, https://ec.europa.eu/food/safety/food-fraud/aas_en (accessed: July 2019).
- [21] Europol, Fraud on a plate: over 3600 tonnes of dangerous food removed from consumer market. Europol Press Release, 25th of April 2018, <https://www.europol.europa.eu/newsroom/news/fraud-plate-over-3-600-tonnes-of-dangerous-food-removed-consumer-market> (accessed: July 2019).
- [22] Europol, 150 000 litres of fake extra virgin olive oil seized from 'well-oiled' gang. Europol Press Release, 14th of May 2019, <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> (accessed: July 2019).
- [23] R. Aparicio-Ruiz, I. Romero del Río, D. Gonzalez, C. Oliver-Pozo, R. Aparicio, *Food Chem.* **2017**, 220, 42.
- [24] Nationales Referenzzentrum für authentische Lebensmittel, <https://www.mri.bund.de/de/nrz/forschung/> (accessed: July 2019).
- [25] Amtliche Sammlung von Untersuchungsverfahren, <https://www.methodensammlung-bvl.de> (accessed: July 2019).