ADULTERATION IN FOOD INDUSTRY IN 2023 - OVERVIEW

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ABSTRACT

This review focuses on food fraud and shows a picture of the most critical notifications reported by the Knowledge Centre for Food Fraud and Quality worldwide during the year 2023. Knowledge4Policy (K4P) is the EU Commission's platform for evidence-based policymaking. This study aims to provide an overview of the cases of food fraud focused on specific food groups - (fish and seafood, oils and fats, fruit and vegetables, honey and sugar, meat and meat products, wine, alcohol, milk and dairy products, spices and herbs, grain-based food – cereals - bakery products, eggs, snacks, coffee, tea, cocoa, non-alcoholic beverages, dietic foods supplements, fortified food). The data on food fraud was divided based on world continents (Asia, Africa, South America, North- Central America, Australia, and Europe). The next part of our overview shows the count of food fraud incidents separately each month for 2023. Overall, 419 cases were registered worldwide in 66 countries in 2023. Most cases were registered in Europe, South America, Africa, North-Central America, and Australia. Based on our findings, we can conclude that the highest number of cases were registered in Pakistan, followed by Italy, Brazil, Nigeria, the Dominican Republic, and Australia. The most abundant was alcohol-beverages adulteration (18.13 % of the total number of cases reported in 2023 worldwide), followed by meat and meat products (15.03 %), fish and seafood (13.60 %), and grain-based food, cereals, and bakery products (11.69 %). Analysis of notification data showed that the most used type of fraud was grey market trading, mislabeling, document forgery, dilution/mixing, substitution, and unapproved enhancement. Food fraud databases serve as valuable tools for the food industry and regulatory bodies, aiding in mitigating food fraud risks.

Keywords: food fraud, adulteration, food safety, food crime, food fraud scandals

INTRODUCTION

Food fraud is commonly perceived as a not-allowed deliberate act of misrepresenting food for financial gain, frequently involving alterations to the food itself and its related documentation. Food fraud, in a more expansive sense, refers to the intentional substitution, adulteration, tampering, or misrepresentation of food, its ingredients, or packaging, along with the dissemination of false or misleading information about a product, all aimed at achieving economic advantages **(Kwasi Bannor et al., 2021; Spink & Moyer, 2011; Schirone & Visciano, 2021).**The most common types of food fraud/crime are dilution, substitution, concealment, mislabeling, unapproved enhancement, counterfeiting, grey market production/theft/diversion **(The Knowledge Centre for Food Fraud and Quality, KC-FFQ).** Between another types of food fraud authors states adulterant-substances (adulteration), stolen goods, tampering, diversion and smuggling, unauthorized product or unauthorized re-filling, misrepresentation or mislabeling, and intellectual property rights counterfeiting, Unapproved enhancements **(Spink *et al.,* 2017; 2019)**. Mislabeling is the most common type of food fraud in agri-food markets **(Giannakas & Yiannaka, 2023)**. Fraudulent food practices can be divided to two groups: the first group, no harmful to human health, is represented by a food or drink quality concern such as the dilution of spirits with water. The second group describes those type of adulteration, which can negatively impact health or cause dead. Biological, chemical, and physical are the most common food hazards **(Kendall *et al.,* 2019; Kemsawasd *et al.,* 2023)**. Food fraud, propelled by globalization, economic incentives, and the low likelihood of severe penalties, is a substantial and escalating issue. While economically driven, it poses potential health risks despite its primary motivation **(Pustjens *et al.,* 2016).** Meeting the worldwide demand for an ample, safe, quality, and nourishing food supply poses a challenge for participants within the food production system. It follows that addressing food fraud stands out as a pressing and dynamic subject within the realm of food research **(Marvin, *et al.,* 2016)**. Deceptive food practices have been occurring since ancient times. The issue of food fraud poses a significant threat to public health, consumer trust, and the credibility of the EU food sector. It stands as both an economic challenge and a potential hazard to food safety for industries, consumers, and governments on a global scale **(Manning, 2016; Spink & Moyer, 2011; Schirone & Visciano, 2021)**. Therefore, it is important having available systems or databases to detect fraudulent products at an early stage, so that preventative measures can be taken. Several of such systems exist (i.e.,

iRASFF, EMA, HorizonScan, AAC-FF, MedISys-FF). In the United States, the Economically Motivated Adulteration (EMA) database and the USP Food Fraud Database provide information on food fraud incidents. Numerous food fraud databases have been created, such as the USP Food Fraud Database, the National Center for Food Protection and Defense (NCFPD), Economically Motivated Adulteration (EMA) Incident Database, European Commission's Rapid Alert System for Food and Feed (RASFF), and China's FADB Food Adulteration Database. Unfortunately, only a limited number of these databases are openly accessible to the public **(Giannakas & Yiannaka, 2023; Kemsawasd et al., 2023; Marvin et at., 2022; Giannakas & Yiannaka, 2023)**. Numerous tools and methods have been created to tackle vulnerabilities and risks within supply chains, like Hazard Analysis Critical Control Points (HACCP), Hazard Analysis and Risk-Based Preventive Controls (HARPC), Rapid Alert System for Food and Feed (RASFF) **(Giannakas & Yiannaka, 2023)**. The Knowledge Centre for Food Fraud and Quality (KC-FFQ) states that the main key characteristics of food fraud are violation of EU food law, intention, economic gain, and customer deception **(The Knowledge Centre for Food Fraud and Quality, KC-FFQ).** Prominent instances of global food fraud encompass the utilization of Sudan Red colorant, the presence of melamine in infant formula and pet foods, species substitution in fish, or fraudulent branding of chocolate **(Spink *et al.,* 2017).** The widely publicized 2013 European horsemeat scandal, despite no being associated with health issues, triggered public concern, involved the detection of horse DNA in processed beef products across the United Kingdom, Ireland, and other European markets **(Giannakas & Yiannaka, 2023)**. In 2008, melamine-tainted infant powder milk formula scandal originating in China. In this case melamine was illicitly added to manipulate protein levels. This led to widespread repercussions, with 294,000 individuals falling ill, 50,000 infants being hospitalized, and six fatalities reported. Another lethal case involved methanol-adulterated spirits in Norway, from 2002 to 2004, resulting in 51 hospitalizations and nine deaths. A similar incident occurred in 2012 in Poland, the Czech Republic, and Slovenia, causing 42 deaths due to methanol poisoning **(Giannakas &Yiannaka, 2023; Xiu & Klein, 2010; Zakharov et al., 2014; Zhang & Xue, 2016)**. In 1981, Europe witnessed its gravest food fraud case when industrial fuel oil, masquerading as "olive oil," was illicitly distributed by street vendors. The repercussions included the toxic oil syndrome, causing 1200 fatalities and 20,000 hospitalizations **(Kendall *et al.,* 2019).** Verifying the authenticity of food is crucial in safeguarding food safety, quality, and consumer protection. It also plays a key role in meeting national laws,

international standards, and various guidelines **(Hong *et al.,* 2017)**. This paper was aims to undertake an available information database review focused on food frauds. It is necessary to develop global countermeasures, that are of value in reducing the overall risk of food fraud and consumer protection. Given the detrimental health consequences, ensuring food safety and quality assurance is imperative. In the context of a rapidly growing global food market, prioritizing the regulation and oversight of food quality becomes crucial.

MATERIAL AND METHODS

Material

Data collection

The data for this paper were obtained from the Knowledge4Policy (K4P) platform. The criteria used in the notification search were the following: notifying country, country of origin, continent, year and months of notification, and food product category.

Methodology

Knowledge4Policy (K4P) serves as the EU Commission's platform and was used to gather relevant data. This database was chosen because it provides the widest coverage of summary food fraud examples. To accomplish relevant results, we followed the data collection processes in detail: selection of database, database screening and data processing. This study aims to provide an overview of the cases of food fraud focused on specific groups of food divided into seventeen groups (fish and seafood, oils and fats, fruit, and vegetables, honey and sugar, meat and meat products, wine, alcohol, milk and dairy products, spices and herbs, grain-based food, cereals - bakery products, eggs, snacks, coffee, tea, cocoa, non-alcoholic beverages, dietic foods supplement, fortified food) **(Hong *et al.,* 2017)**. The data on food fraud was divided based on world continents (Asia, Africa, South America, North- Central America, Australia, and Europe). The next part of our overview shows the count of food fraud incidents separately each month for 2023.

Statistical analysis

The data from The Knowledge4Policy (K4P) platform database were processed by Microsoft Excel. Subsequently, data filtering was applied to extract information exclusively related to the food category based on the year 2023, continent, country, and group food commodities.

RESULTS AND DISCUSSION

This section shows data summarizing food fraud in each continent carried out in 2023.
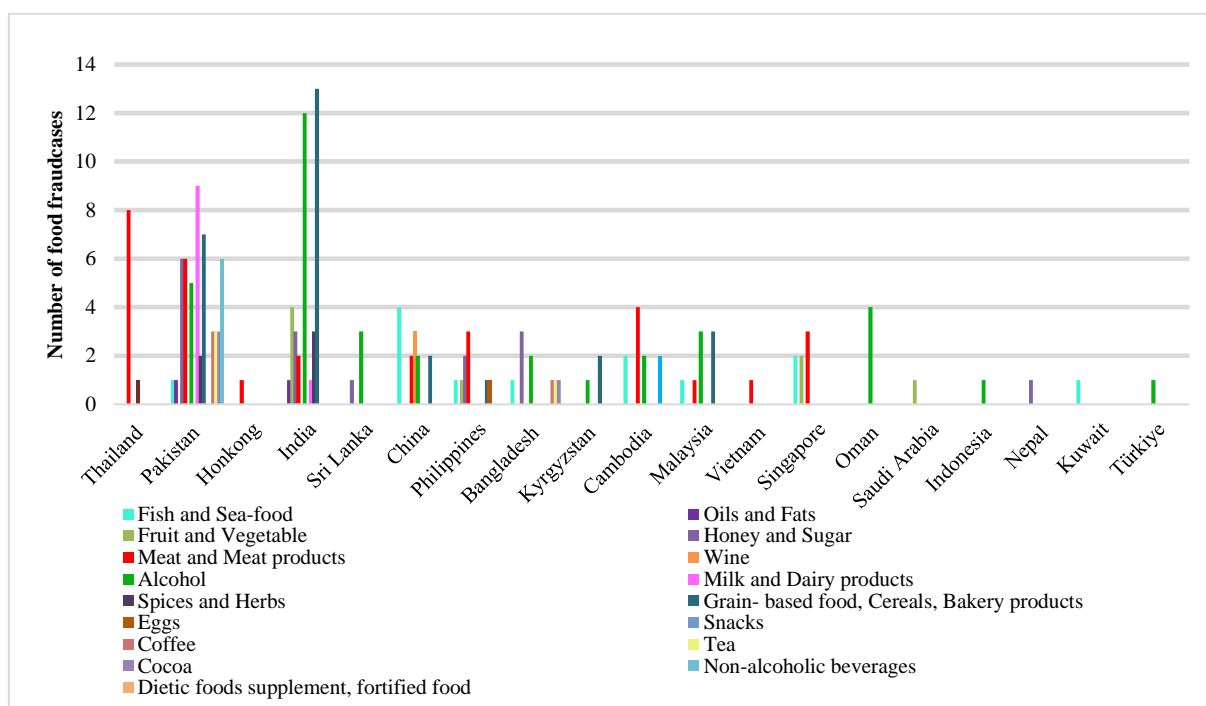

Figure 1 Food fraud cases in country in Asia in 2023

Figure 1 shows food fraud cases in Asia. In 2023, the database showed notifications regarding food fraud in nineteen countries. The most carried out food fraud was determined in Pakistan and India. Milk and dairy products, grain-based food (cereals, bakery products), and meat and meat products represented Pakistan's most common adulteration group of food commodities. Based on our data, alcohol, and grain-based food (cereals, bakery products) represented India's most common adulteration group of food commodities. Fish and seafood, wine, meat and meat products, alcohol, and grain-based food (cereals, bakery products) were China's most common adulterated commodities. Other food fraud cases were observed in Cambodia in commodities like meat and meat products, fish and seafood, alcohol, and eggs. The study by **Kemsawasd *et al.,* 2023** shows that the highest number of cases from 2011 to 2020, were, based on the RASFF database, in China (200), India (172), Türkiye (117), Iran (37), and Japan (28). On the contrary, the lowest number of food-fraud cases were in Oman (1), Kazakhstan (1), and Sri Lanka (2) **(Kemsawasd *et al.,* 2023)**. In Pakistan, the world's fifth-largest milk producer, authorities often seize milk containing urea, or milk tainted with contaminated water **(Anthes & De Schutter, 2017; Giannakas & Yiannaka, 2023)**. Milk and dairy products from Pakistan have also been found to be chemically adulterated with e.g., sodium chloride, dry milk powder, sugar, or contaminated with polluted water, urea formalin, and other hazardous ingredients. Studies report similar findings, where several of the milk samples were also tested-positive for multiple substances, including detergent **(Handford *et al.,* 2015)**. The next case in Pakistan represented a problem with poultry minced meat produced from unsafe chicken bones adulterated with red colorants. The susceptibility of meat and poultry to fraud is heightened by their significant nutritional and market value, coupled with various opportunities for fraudulent activities throughout the supply chain **(Lianou *et al.,* 2021)**. Analytical approaches for evaluating additive levels in meat encompass chromatography, mass spectrometry (MS), electrophoresis, electronic spin resonance, flow injection methods, and conventional enzymatic and immunoassays **(Surendran Nair *et al.,* 2020)**. Food fraud cases in India considered illicit liquor contraband whiskey; twenty-two people died after consuming spurious alcohol adulterated with methanol **(The Knowledge Centre for Food Fraud and Quality, KC-FFQ)**. Methanol is highly toxic to human beings and naturally exists in some beverages. Various techniques, including enzymatic, colorimetric, gas chromatography–Fourier transform infrared spectroscopy (FTIR), horizontal attenuated total reflectance (HATR), gas chromatography, and Raman spectroscopy, have been used for detecting methanol concentrations in alcoholic beverage **(Zamani *et al.,* 2019; Shemirani *et al.,* 2022)**. Milk faces widespread adulteration globally, potentially due to factors such as imbalances in demand and supply, the perishable nature of milk, limited purchasing power among consumers, and a lack of effective detection tests. Qualitative detection of milk adulterants can be easily achieved through chemical reactions, whereas quantitative detections are intricate and diverse. The choice of quantitative detection techniques depends on the nature of milk adulterants. For instance, Liquid Chromatography (LC) and Enzyme-Linked Immunosorbent Assay (ELISA) are the most common techniques used for detecting foreign proteins, while Polymerase Chain Reaction (PCR) and Polyacrylamide Gel Electrophoresis (PAGE) are typically employed for identifying milk from various species as counterfeits in a specific type of milk **(Azad & Ahmed 2016)**.
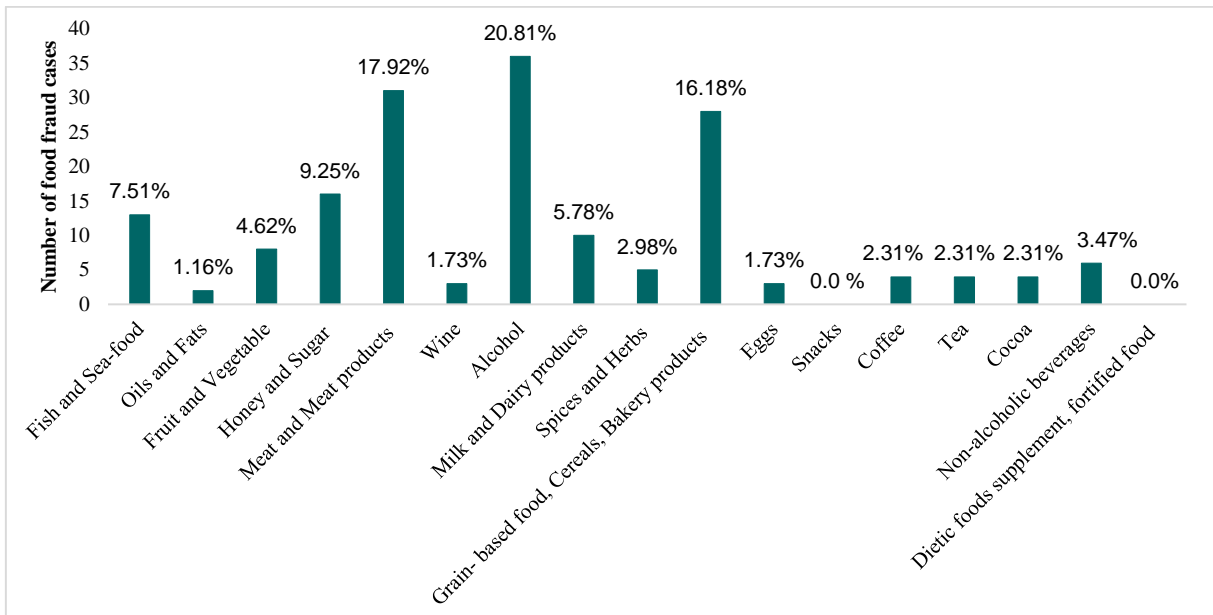
Figure 2 Food fraud cases group of commodities in Asia in 2023

Figure 2 represents the most adulterated commodities in Asia in 2023. Based on these data, we can observe that the most adulterated commodity was alcohol. Followed by meat and meats products, grain-based food (cereals, bakery products), honey and sugar. On the contrary, restaurant dishes, snacks, and dietic food supplements (fortified food) were groups of commodities that were not adulterated in Asia in 2023. Based on obtained data in our reserch we can conclude that alcohol, meat and meats products, grain-based food (cereals, bakery products) products posed a risk to the consumer. The study by **Kemsawasd *et al.,* (2023)** states that the most adulterated commodities in 2011 – 2020, based on RASFF database, were nuts and seeds, followed by fruits and vegetables, herbs and spices, cereals and bakery product, confectionery, fish, and fish products. On the other hand, fats and oils, alcohol and mineral water were commodities with lowest food fraud cases **(Kemsawasd *et al.,* 2023)**. Based on our finding's, adulteration of methanol addition and trading of illegal alcohol on the grey market were the most abundant type of cases. Adulterated alcoholic beverages refer to legally authorized alcohol products that undergo illicit tampering, such as criminal dilution with water, intentional repackaging in new containers to mask their true origin, or the addition of toxic substances to manipulate the beverage's characteristics **(Magnúsdóttir *et al.,* 2010)**. Emphasizing the safety management, it is crucial to mitigate potential hazards associated with the consumption of adulteration alcoholic beverages.
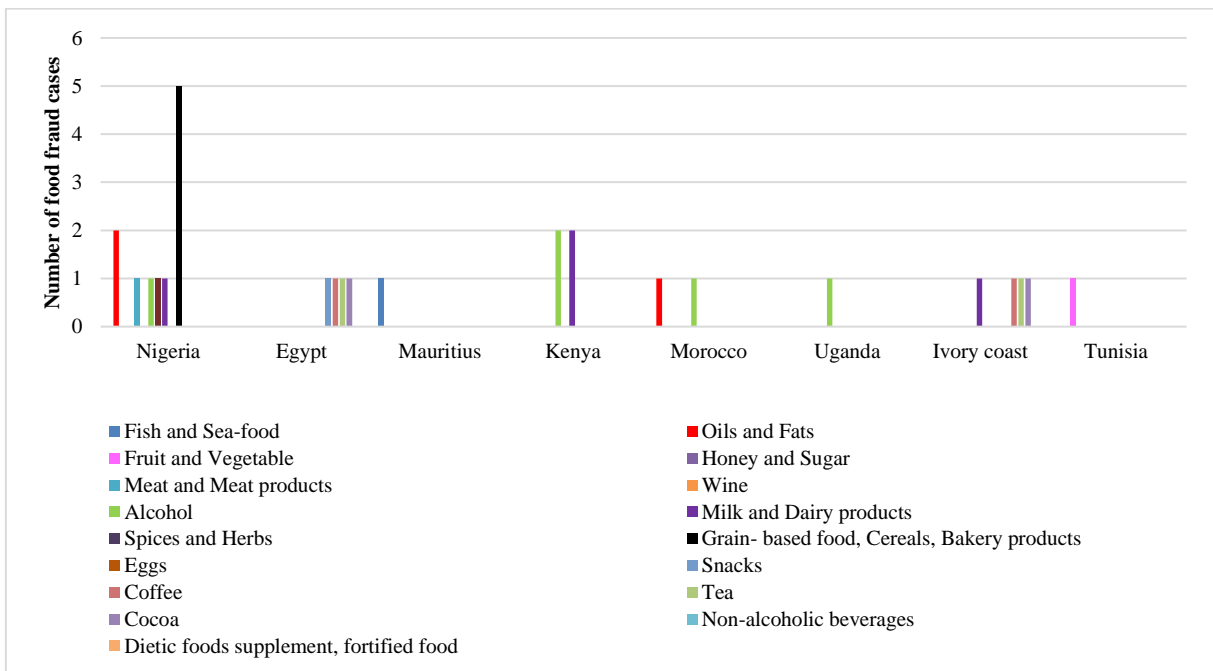

Figure 3 Food fraud cases in Africa in 2023

Figure 3 shows food fraud cases in Africa. Nigeria, Egypt, Mauritius, Kenya, Morocco, Uganda, Ivory Coast, and Tunisia where countries with registered food fraud cases in 2023. The highest number of food fraud cases was observed in Nigeria, specifically grain-based food (cereals and bakery products), oils and fats.

Based on the study by **Visciano & Schirone (2021)**, Ghana 42.4%, Nigeria 11.9%, Guinea, and Senegal 10.2% were the countries with the highest number of registered cases.
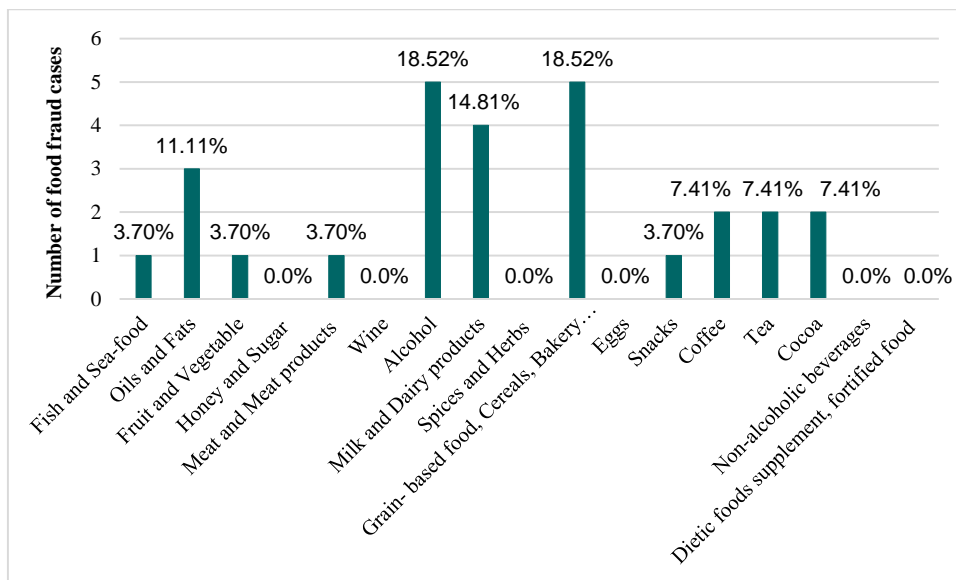
Figure 4 Food fraud cases regarding the group of commodities in Africa in 2023

Figure 4 represents the most adulerated commodities in Africa in 2023. Based on these data we can see that the most adulterated commodities were alcohol, grain-based food (cereals, bakery products), milk and dairy products, oils, and fats. However, available studies described another type of problem - contaminated ready-to-eat food that caused numerous devastating outbreaks in the African region, given the large proportion of this type of food are sold as street foods. The hygienic aspects of vending operations and the safety of these foods are problematic for food safety regulators **(Mensah *et al.,* 2012).** Other authors stated that the most adulterated commodity in Africa was meat. Meat is one of the most highly priced food commodities in this country, which places considerable financial pressure on a population where over 50% live below the poverty line. This fact creates space for fraudulent practices in meat commodities **(Cawthorn *et al.,* 2013). Cawthorn *et al.,* (2013) & Manning & Soon, (2014)** also found that unconventional species like donkey, goat, and water buffalo were identified as substitutes in processed meats, indicating widespread mislabeling in South Africa.

Not only breaching the food labeling regulations, this type of adulteration also raises concerns about economic, religious, ethical, and health consequences **(Cawthorn *et al.,* 2013; Manning & Soon, 2014). Aworth (2021)** in your study shows that animal-source foods and fresh fruits and vegetables are the leading cause of foodborne diseases in Africa region. It has a connection with the lowest hygiene quality and control, or manipulation with food. Thus, chemical, and microbial risks are the major problem in food quality. Strict food safety and the application of good agricultural practices and good hygienic practices in Africa will reduce fresh products contamination and would serve as an important factor in prevention of adulteration, food fraud, and ensure food safety**. The data regarding food fraud cases in America were divided into data from South and North- Central America. Results are shown in Figures **5, 6, 7,** and **8.** Based on collected information, we can say that more food-adulteration cases were registered in South America (83 cases) than North- Central America (13 cases).
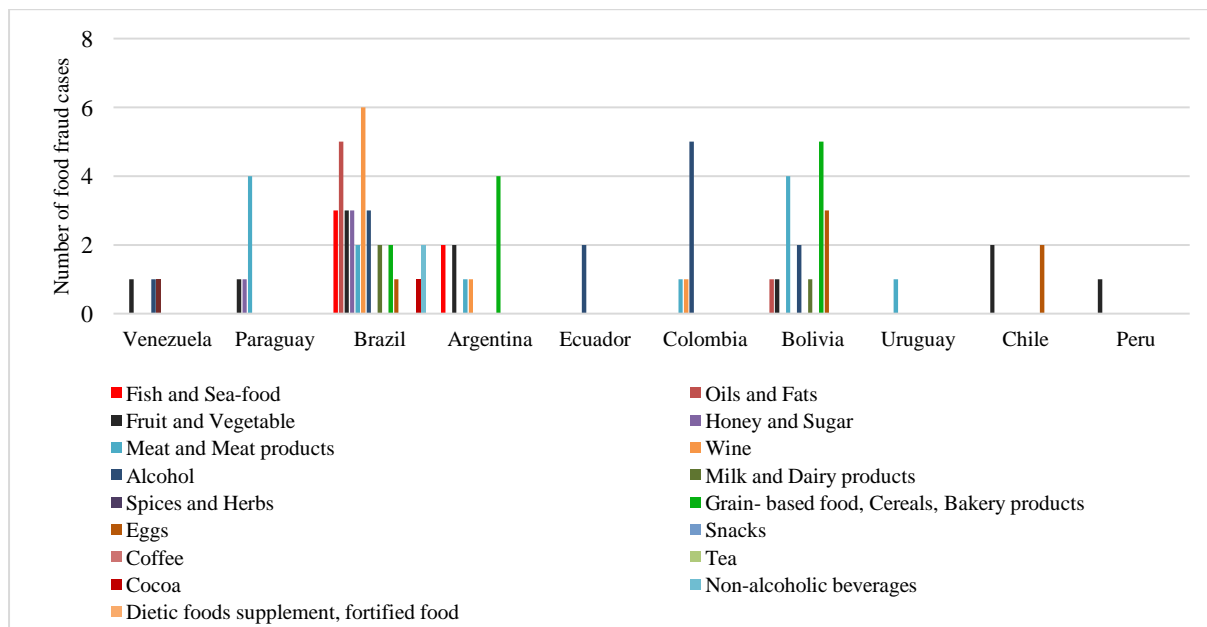

Figure 5 Food fraud cases on South America of 2023

As shown in **Figure 5**, Brazil was the country with the highest number of food fraud cases. The most adulterated commodities were wine, oils and fats. The widespread popularity of wine has led to increased scrutiny, with investigations focusing on fraud, encompassing adulteration, misleading age claims, and false geographical origin indications. The literature contains several reports on analytical approaches to establish the authenticity of wine according to its geographical origin and grape variety, e.g., liquid and gas chromatography, nuclear magnetic resonance spectroscopy, authentication based on the detection of

elements, electrophoretic methods, authentication based on the detection of amino acids and protein fractions, and gas chromatography-mass spectrometry, and others **(Geana *et al.,* 2016 & Vinciguerra *et al.,* 2021).** Based on our data, the country with the highest number of food frauds was Brazil, specifically groups of meat and meat products. These registered cases were about products, such as beef, sheep, goats, poultry of unknown origin with no traceability documentation. On the contrary, Peru and Uruguay had the lowest number of food fraud cases.
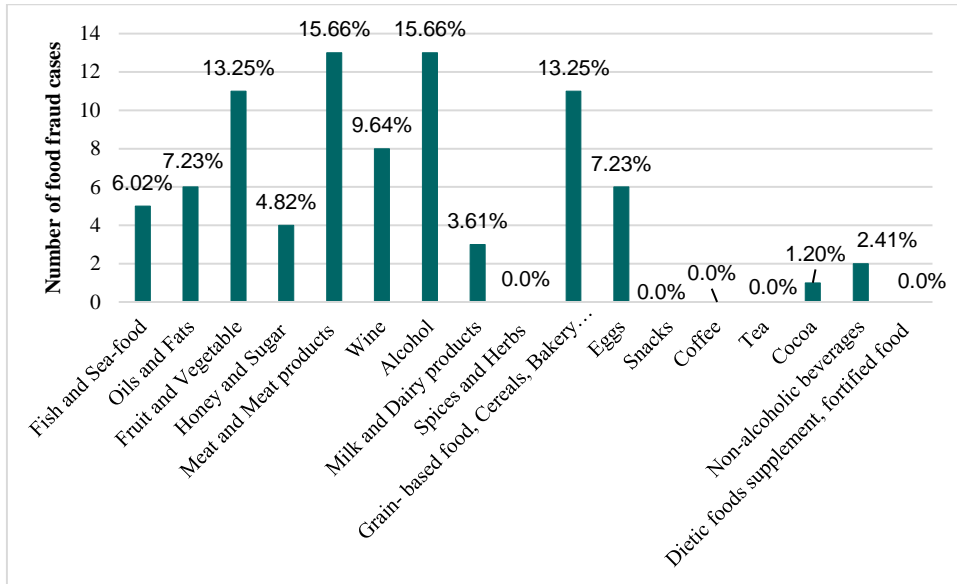
Figure 6 Food fraud cases regarding the group of commodities in South America in 2023

Figure 6 represents the most adulterated commodities in South America in 2023. This figure shows that most adulterated commodities were meat and meat products, alcohol, fruits and vegetables, and grain-based food (cereals, bakery products). Our detected data confirm on the. **Statista database (2022)**, which states that South America's alcoholic drinks market has grown substantially in the past few years. A study available on the Statista platform on global meat consumption between 2020-2022 shows that South America was the fourth place in the consumption of meat and meat products per kilogram per capita, and these facts create space for unfair practices in most consumed and produced food commodities.
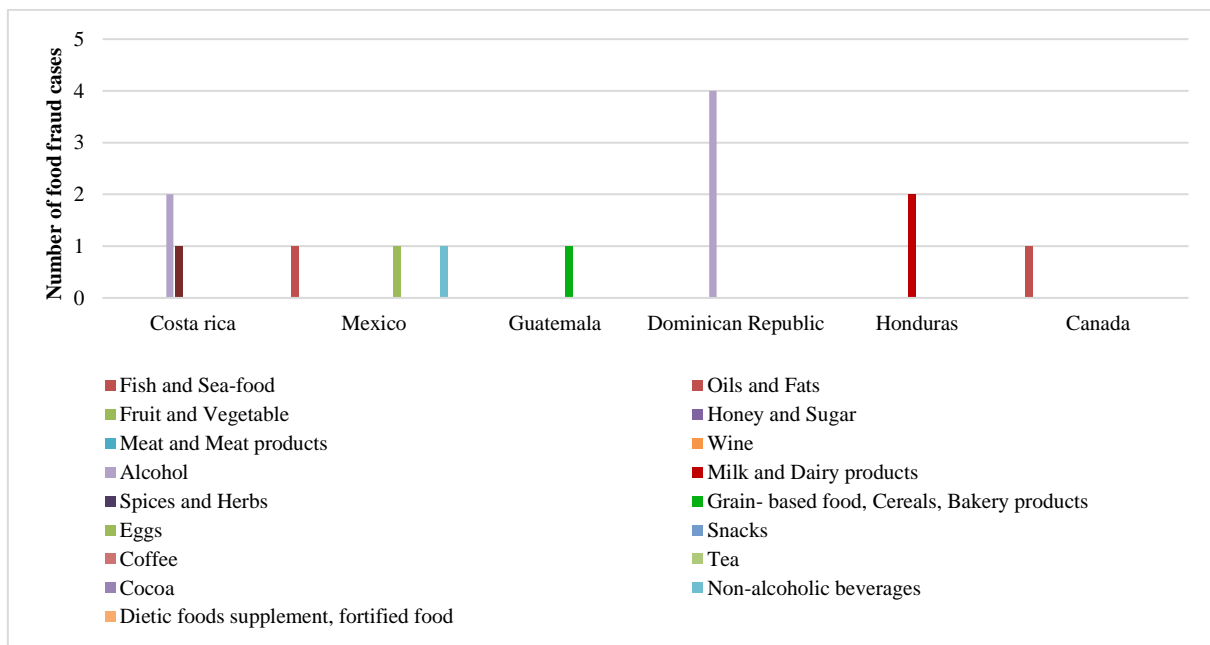

Figure 7 Food fraud cases in North- Central America in 2023

As we can see in **Figure 7**, the Dominican Republic was the country with the overall highest number of food frauds, concerning especially alcohol, followed by Mexico, Costa Rica, and Honduras. The lower number of food frauds were registered in Guatemala and Canada.
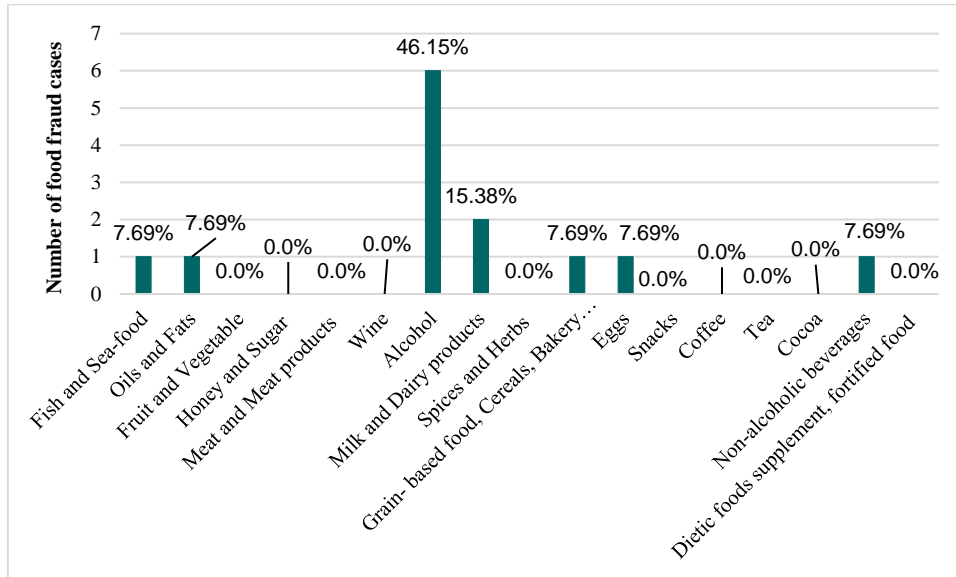
Figure 8 Food fraud cases group of commodities on North- Central America of 2023

Based on data from **Figure 8** we can say that alcohol was one of the mostly adulterated commodities in North- Central America. In the database were registered cases of alcohol contraband liquor, including beer, rum, rum with cola, tequila, and whiskey. In another case, two persons died after drinking illegal adulterated liquor; the following cases included one person who died after consuming alcohol adulterated with methanol. Based on our data, fewer food fraud cases were registered in milk and dairy products, fish and seafood, oils and fats, grain-based food (cereals, bakery products), eggs, and non-alcoholic beverages.

Figure 9 Food fraud cases in Australia in 2023

Figure 9 represents food fraud cases in Australia in 2023. Overall, Australia registered only 3 types of adulterated products- fish and seafood, dietic supplement, and fortified food. Data on food fraud, which were stated by the Knowledge Centre for Food Fraud and Quality contained missing information about specific countries in Australia. The first registered report has analyzed the quality and accuracy of labels in 672 seafood products (hoki, prawns, sharks and rays, snapper, squid and cuttlefish, and tuna). The results uncovered a mislabeling rate of 11.8% through DNA barcoding. Again, by the DNA barcoding, the next case revealed failures to meet the standards in 104 retailers. The researchers also detected IUCN red list threatened sharks in fish and chip meals. The next case included sports protein-based products (powders, bars, snacks, ready-made shakes), carbohydrate-based products (powders, gels), and other products like creatine and beta-alanine. Around one third of products had incorrect nutrition information.
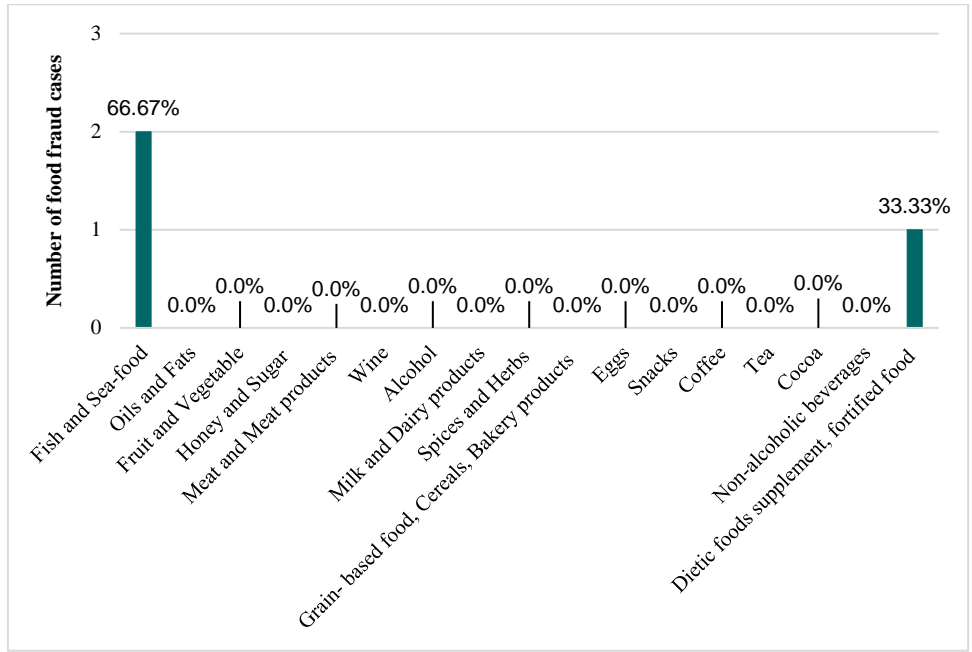
Figure 10 Food fraud cases group of commodities in Australia in 2023

As shown in **Figure 10**, fish, seafood, dietic supplements, and fortified food were the most adulterated groups in Australia. Honey is one of the most adulterated commodities in Australia, according to the Food and Agriculture Organization of the United Nations. Almost 20 percent of Australian honey is adulterated with cane sugar or corn syrup **(Report Food and Agriculture Organization of the United Nations, 2021).** Contrary to our study, no case of adulterated honey was reported in 2023.
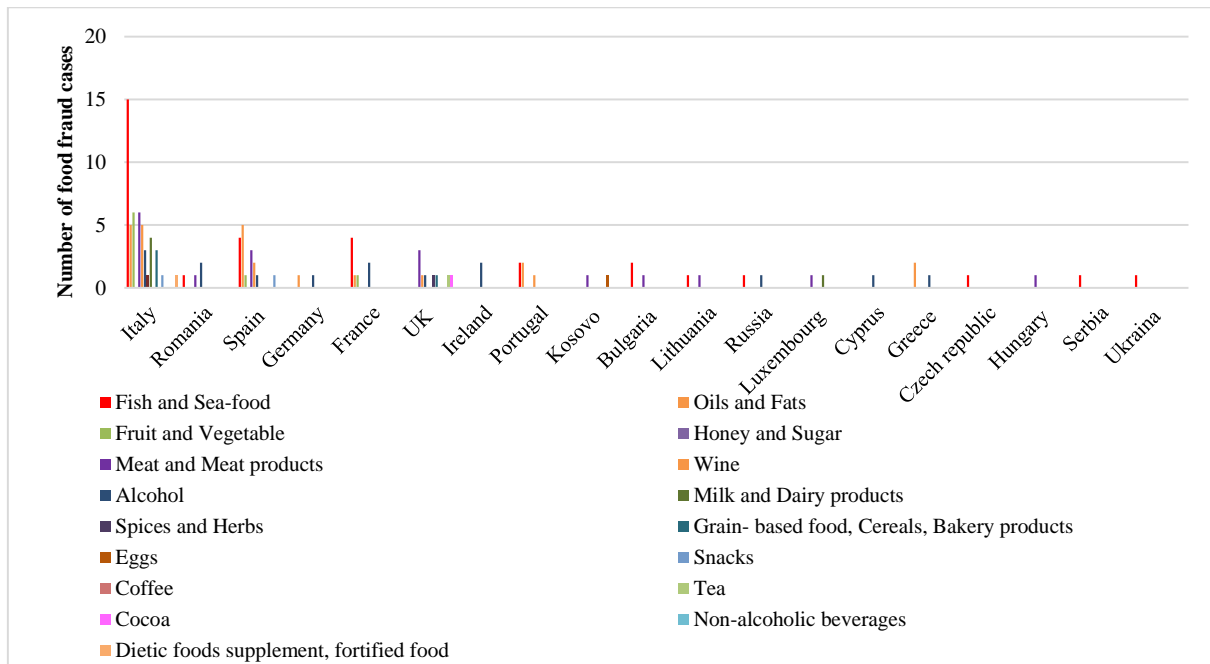

Figure 11 Food fraud cases in Europe in 2023

Figure 11 represents food fraud cases in Europe. As we can see, Italy had the most food fraud cases, followed by Spain. In Italy dominantly, adulterated commodities were fish and sea products, and in Spain, oils and fat. On the contrary, countries like Cyprus, the Czech Republic, Hungary, Serbia, and Ukraine recorded only one food fraud case. Spain, Italy, and the Netherlands are identified as having the highest reported food fraud cases in Europe. Fats, oils, fish, meat, fruits and vegetables, and poultry are the food product categories most frequently affected by adulteration. **(Report Food and Agriculture Organization of the United Nations, 2021).** These data agree with our findings. In Slovakia, there no cases recorded in this database.
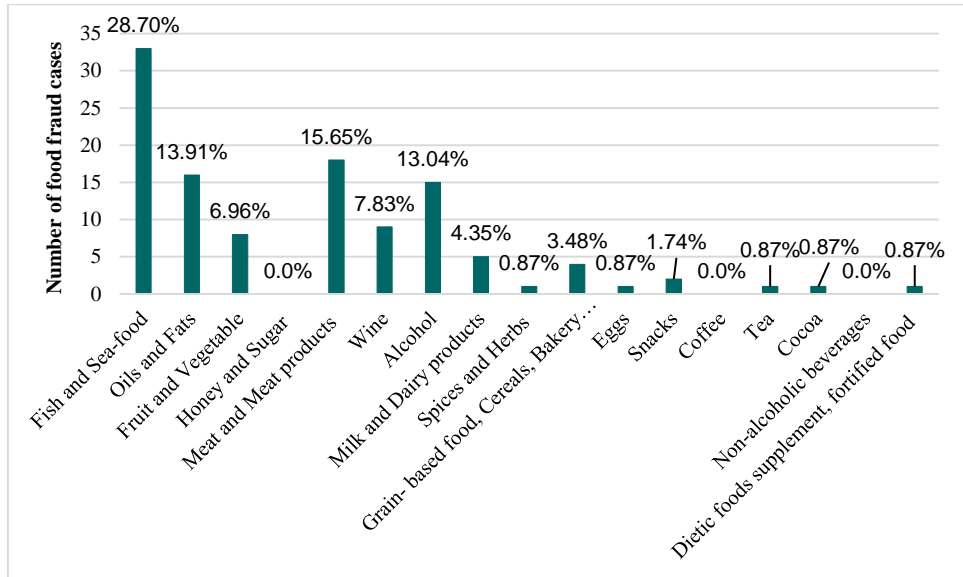
Figure 12 Food fraud cases group of commodities on Europe of 2023

As we can see in **Figure 12**, the most adulterated commodities in Europe in 2023 were fish and sea products, meat and meat products, alcohol, oils and fats. On the contrary, no food fraud cases were registered in commodities like honey and sugar, restaurant dishes, coffee, and non-alcoholic beverages. Rising demand for fish and seafood creates potential motivation of adulteration of these commodities. Fraud reports of fish and seafood were categorized by fraud type, due to the wide variety of ways in which fraud can be perpetrated in seafood. As reported, species substitution, illegal processing, and unauthorized import were the most frequent **(Lawrence et al., 2021).**
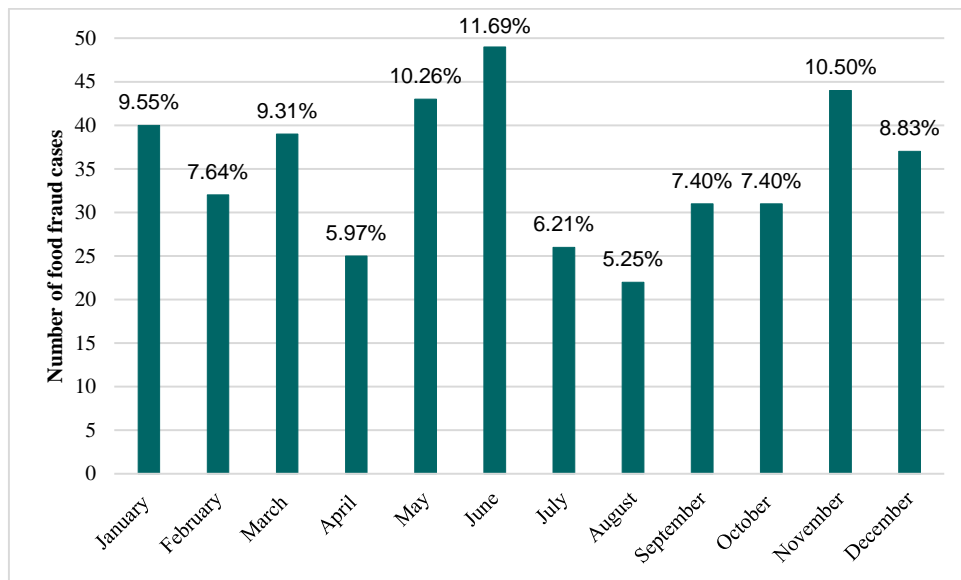

Figure 13 Total number of food fraud cases in the individual months of 2023 in the world

Figure 13 represents food fraud cases in the individual months of 2023. As we can see, the most food fraud cases were registered in June, November, and May. On the other hand, the lower number of food fraud were carried out in August and April. Together, used database contains data about 419 individual food fraud cases in the world.
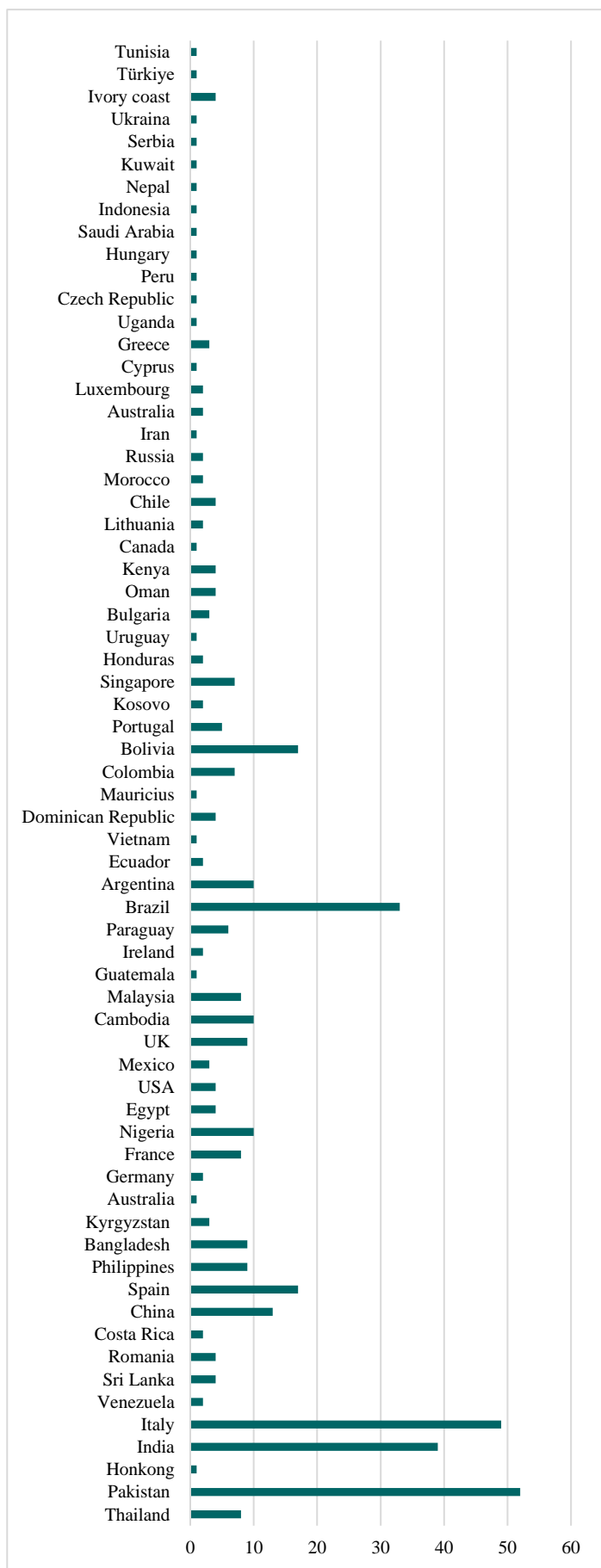
Figure 14 Total number of food fraud cases in the individual countries in 2023 worldwide

As we can see in **Figure 14** the most food fraud cases were registered in Pakistan (59 food fraud cases), Italy (49 food fraud cases), India (39 food fraud cases), Brazil (33 food fraud cases), and Bolivia and Spain (17 food fraud cases). On the other hand, the lowest number of food fraud was registered in Hong Kong, Australia, Guatemala, Vietnam, Mauritius, Uruguay, Canada, Iran, Cyprus, Uganda, Czech Republic, Peru, Hungary, Saudi Arabia, Indonesia, Nepal, Kuwait, Serbia, Ukraine, Ivory coast, Türkiye, and Tunisia.
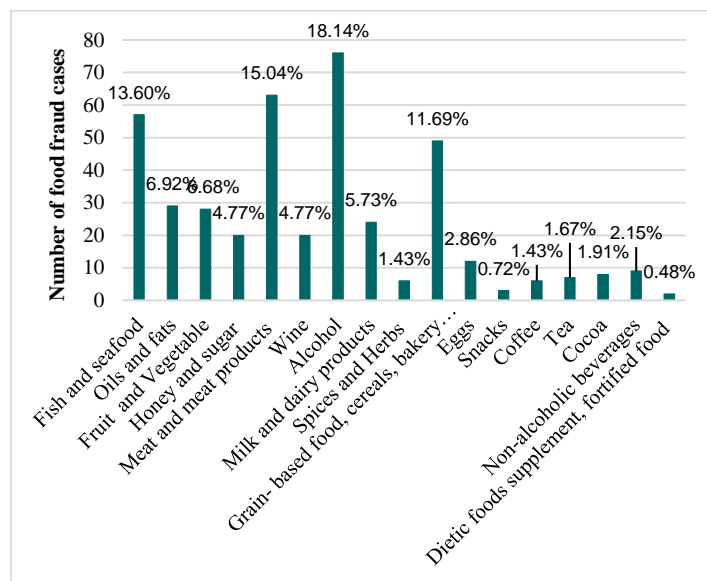

Figure 15 Total number of food fraud cases in the individual food commodities in 2023 worldwide

Figure 15 represents the total number of food fraud cases worldwide in 2023. Based on these data, we can see that alcohol was the most adulterated commodity (76 cases), meat and meat products (63 cases), fish and seafood (57 cases), and grain-based food, cereals, bakery products (49 cases). On the contrary, the lowest number of reported cases among groups showed foods supplements, fortified food, snacks, spices and herbs, and coffee. **Marvin *et al.*, (2022)** overview of products mentioned in food fraud articles published worldwide (2015–2020). Based on these data, **Marvin *et al.*, (2022)** state that the most adulterated commodities were, in order from the highest to lowest number of cases: meat and meat products, milk and milk products, cereals and bakery products, fish and fish products, fruits and vegetables, fats and oils, alcoholic beverages, and others. Certain commodities such as dairy ingredients, seafood, meat, alcoholic beverages, herbs, spices, vegetable oil, and honey were the most adulterated based on the Decernis Food Fraud Database (2010-2020) **(Hellber & Sklare, 2021)**. Food fraud incidents, notably involving adulteration and mislabeling, have gained attention in recent scholarly and popular media discussions. According to **Shears (2010)**, such incidents have been reported across various sectors in the United Kingdom, including beer, spirits, fish, beef, rice, olive oil, and organic food labeling. **Moore *et al.* (2012)** highlight olive oil, milk, honey, and saffron as common targets for adulteration, while **Kendall *et al.* (2019)**, **Giannakas &Yiannaka, (2023) Moore at al., (2012)** and **Kendall *et al.*, (2012)** identify wine, spirits, olive oil, fish, meat, cheese, honey, and herbs among the frequently reported adulterated food products. As revealed in the study of **Owolabi (2021)**, the food product with the most notifications in the Decernis Food Fraud Database is dairy products, followed by seafood, meat, and poultry products. Based on the Knowledge4Policy (K4P) the highest number of cases were recorded among alcohol, especially artisanally liquor adulterated with methanol, bottles of various brands of liquor without all the necessary documentation, illegal beer and whiskey, illegal rum and vodka, and smuggled liquor. **Kamiloglu (2019)**, states that alcohol is one of the most adulterated beverages. Specifically, the authors stated that wine is one of the most common alcoholic beverages subject to fraud and mislabeling, followed by beer, brandy, cider, whiskey, vodka, rum, and tequila are among the other alcoholic beverages that are susceptible to adulteration. The authors **Manning & Kowalska, (2021)** argue that unregulated alcohol, known as illicit or unrecorded alcohol, poses a significant global public health concern due to its production without proper regulatory and market supervision, leading to heightened risks of safety, quality, and adulteration issues. Fraud has the potential to occur at various stages of the production process and along the entire supply chain **(Lin &Salcido-Keamo, 2021)**.

CONCLUSION

Knowledge4Policy (K4P) data provides valuable insights into the trends and patterns of notification, and product categories in the food industry. This comprehensive review documents the food adulteration cases in various categories carried out worldwide in 2023. The food products were divided into seventeen

groups (fish and seafood, oils and fats, fruit and vegetables, honey and sugar, meat and meat products, wine, alcohol, milk and dairy products, spices and herbs, grain-based food – cereals - bakery products, eggs, snacks, coffee, tea, cocoa, non-alcoholic beverages, dietic foods supplement, fortified food). The data was further divided based on the continents (Asia, Africa, South America, North- Central America, Australia, and Europe). Overall, the database registered 419 cases in 66 countries worldwide in 2023. Most cases were registered in Asia, followed by Europe, South America, Africa, North- Central America, and Australia. Based on our findings, we can conclude that most frauds were registered in Pakistan followed, Italy, Brazil, Nigeria, and the Dominican Republic. Frauds with alcohol were frequently reported (18.13% from the total number of cases carried out worldwide in 2023), followed by meat and meat products (15.03%), fish and seafood (13.60%), grain-based food, cereals, and bakery products (11.69 %). Analysis of notification data showed the most used type of fraud was trading on the grey market, misdescription/ mislabeling/ misbranding, document forgery, dilution/mixing, substitution, and unapproved enhancement. Global concerns persist as the food industry grapples with widespread adulteration, posing significant threats to public health and economies. Beyond eroding consumer trust, such malpractices tarnish a nation's reputation. Motivated by economic gains, intricate adulteration methods defy easy detection through declared product information. Mitigating these risks demands rigorous control over raw materials, effective monitoring of food handling, processing, and distribution, and robust enforcement of safety regulations and manufacturing practices. Governments must target all stakeholders along the supply chain to curb fraudulent practices.

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