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A study on adulteration in cereals and bakery products from Poland including a review of definitions

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1	A study on adulteration in cereals and bakery products from Poland including a review
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14	Abstract
15	The aim of the study was to critique the food adulteration trends associated with cereals and
16	bakery products from Poland. The methodological approach was to firstly review existing
17	literature to define and outline the challenge of food adulteration and the degree of
18	harmonisation, or not, of definitions, and then to analyse local and European data on the
19	prevalence of food adulteration and mislabelling in the cereals and bakery sector more
20	generally, and specifically in Poland. Analysis of general RASFF notifications of cereal and
21	bakery products linked to Poland (n=177) revealed that most non-compliances were due to
22	mycotoxins, undeclared allergens and undeclared genetically modified materials. Key notable
23	trends included an increase in incorrect allergen labelling with only two incidents directly
24	associated with adulteration firstly with melamine and also suspicion of deliberate
25	contamination of milk powder with rodenticide. Data from IJHARS share similar trends where
26	most reported irregularities associated with cereal and bakery products were related to
27	mislabelling. The definition of adulterated foodstuffs in Poland concentrates on mislabelling
28	particularly regarding product composition rather than being differentiated by the motivation

of the perpetrator. This is not in step with other definitions where intent is seen an inherent aspect of a determination of an instance of food fraud or adulteration. This work demonstrates that even in harmonized regulatory areas such as the EU there are local definitions of adulteration that due to the lack of consistency could influence collective approaches to determining the extent of or addressing the problem of mislabelling, misrepresentation and misbranding as a form of adulteration.

35 Highlights

- Most commonly reported adulterated cereal and bakery products in Poland were bread
 and pasta.
- 38 Most cases of food adulteration were related to mislabelling
- 39 More research needed to contextualise drivers for mislabelled and misrepresented
 40 products.
- 41 Key words: adulteration, mislabelling, motivation, misbranded, bread, misrepresented
- 42
- 43 Abbreviations non-standard
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49

50 **1. Introduction**

51 Following the 2013 horsemeat scandal, there has been resurgence in public and business interest in food fraud. Indeed, assuring food authenticity and mitigating adulteration have been 52 major drivers for establishing food regulations worldwide (Kölbener, Bieri & St-Gallen, 2016). 53 54 Food fraud is defined by the United Kingdom (UK) Food Standards Agency (FSA) as: "deliberately placing food on the market, for financial gain, with the intention of deceiving the 55 consumer" (Elliott Review, 2014), although food safety concerns exist (Moore, Spink, & Lipp, 56 57 2012). Food fraud includes the subcategory of economically motivated adulteration (EMA) i.e. deception for economic gain using food products, ingredients and packaging including 58 activities such as substitution especially with substandard or inferior products, unapproved 59 additions or enhancements, misbranding or misrepresentation, tampering, counterfeiting, using 60 stolen goods and others (Spink & Moyer, 2011; GFSI, 2014; Manning & Soon, 2014; BRC, 61 62 2015; Manning, 2016).

However, there is a lack of harmonisation of definitions and uses of the term 63 "adulteration". The previous definition refers to EMA, but food adulteration can be simply be 64 when a product contains an element or ingredient which is fraudulent (Spink & Moyer, 2011) 65 or else adulteration can be described as the actions that are taken to add or adjust a food item 66 or composite food product by the use of extraneous, substandard, or inferior ingredients 67 (Manning & Soon, 2014). Bansal, Singh, Mangal, et al. (2017) in their work on the problems 68 with adulterated food products in India state that "food adulteration can be defined as lowering 69 70 the quality of food by intentional or unintentional substitution of food with some inferior foreign particle or by removal of some value added food substitute from main food item". This 71 72 latter definition contests that both intentional and unintentional actions which can affect quality, and safety may be classed as adulteration. This demonstrates an inconsistency in the way terms 73

74 are derived and used when considering food adulteration.

75 The challenge of food adulteration is complex with multiple factors of influence including market competition, supply chain pressure and power dynamics, resource scarcity, 76 inadequate governance, lack of sanctions and low probability of discovery, rapid development 77 of systems, logistics and technology, data swamping and opacity (Charlebois, Schwab, Henn, 78 & Huck, 2016; Manning, Smith & Soon, 2016; Marvin et al., 2016). Food adulteration has been 79 associated with high value food such as olive oil (Garrido-Delgado, Munoz-Perez & Arce, 80 2018), honey (Amiry, Esmaiili & Alizadeh, 2017) and herbs and spices (Silvis, van Ruth, van 81 der Fels-Klerx & Luning, 2017; Galvin-King, Haughey & Elliott, 2017). Although luxury items 82 are perceived to be more likely to be targeted by fraudsters, generally they are not eaten in the 83 84 same quantity as cereal-derived products. Indeed, the very first piece of public health legislation passed in the UK was the 1757 "Act for the due making of Bread; and to regulate the Price and 85 Assize thereof; and to punish Persons who shall adulterate Meal, Flour, or Bread." (Scally, 86 2013, p. 346). Thus, it can be argued that there is potentially a greater risk of cumulative 87 financial and personal harm from adulterated foods that are eaten and purchased more often 88 and in larger amounts. This forms the research rationale for why cereal-derived products are 89 the focus of this research. 90

91 **2.** Methodology and research rationale

Cereal grains such as wheat and derived flour are major ingredients for the most important staple foods in the EU such as breads, pasta, cakes, and biscuits (Murniece & Straumite, 2014; Cozzolino, 2016; Geng, Harnly, & Chen, 2016). Poland is one of the major cereal producers in the EU and in 2015 exported more than 20% of the total cereal produced (CSO, 2016a) highlighting the risk to illicit activity associated with Polish cereals and bakery products and the impact within Poland and also for other countries. Appropriate prevention

98 measures can only be implemented if the nature and type of illicit activity is understood 99 (Tähkäpää, Maijala, Korkeala, & Nevas, 2015). Thus, this research aims to determine and 100 analyse the extent of reported food adulteration cases in cereals and baked goods in Poland in 101 order to identify potential trends and frame the development of future empirical research in this 102 area.

103 Food adulteration cases were analysed at two reporting and control system levels (EU 104 and national levels in Poland) and iterative analysis identified potential patterns of incidence. The EU Rapid Alert System for Food and Feed (RASFF) database was searched using the 105 106 product category 'cereals and bakery products' and hazard category 'adulteration/fraud', 107 'labelling absent/incomplete/incorrect', and 'composition'. A further search in RASFF using 108 'Poland' under the country origin was also conducted. Similarly, we retrieved and analysed all 109 'Adulterated agri-food items' notified in the Agricultural Food and Quality Inspection (IJHARS) site from 2010 – 2017. A previous study by Kowalczyk (2015) used IJHARS food 110 inspection data to assess the main areas of food fraud, but was not specific to cereals and bakery 111 112 products, thus making the research described herein of interest. We have structured the paper as follows: Section 1 is an introduction and a brief overview of food adulteration terminology; 113 114 and Section 2 provides the underlying rationale and the methodology employed. Section 3 115 synthesizes existing literature and considers secondary data to review cereal production and 116 manufacture of cereal based and bakery products in Poland and the resultant value to the Polish 117 economy. Section 4 provides a brief review of the local (IJHARS) and international (RASFF) databases and reviews the data derived in this research. In Section 5 results are presented and 118 119 discussed. Section 6 concludes the paper and seeks to identify potential trends and frame the 120 development of future empirical research.

121

3. Background to the Polish cereal sector

122 **3.1** Agricultural cereal production in Poland and associated exports

123 Globally, wheat is the most important cereal for bread making, however rye bread has 124 an established place in food culture in Northern and Eastern Europe (Pohjanheimo, Paasovaara, Luomala & Sandell, 2010; Murniece & Straumite, 2014). In 2015, Poland exported 21.8% of 125 126 its total cereal production, which accounted for 2.7% of Polish GDP. The main export product was wheat and spelt with key export markets being Germany, Egypt, Saudi Arabia, Algeria, 127 and Morocco. The value of Polish cereal products exports (bread, pastry, cakes, biscuits, wafers 128 etc.) accounted for 99.8% of the total value of cereal exports in 2015 (CSO, 2016a). Poland is 129 130 the third largest cereal producer in the EU-28 after France and Germany. Analysing the structure of utilised agricultural area (UAA) identifies the dominant role of cereals in national 131 production (Czyżewski & Staniszewski, 2016) with Denmark (55%), Poland (52%) and a 132 significantly lower share in Germany (39%) and France (35%) producing the majority of cereal 133 in EU. Common organisation of the cereals market was initiated in the late 60s of the 20th 134 135 century and EU Member States benefited from intervention buying, storage and sale of cereals through the evolution of the Common Agricultural Policy (CAP). In 2015, the quantities of rve 136 137 and meslin produced in Poland account for 28.5% of the total EU production of those cereals 138 (Europa, nd). The combined volume of cereal production places Poland second among other EU Member States in terms of output. Moreover, Poland is the largest oats producer 139 contributing 16% of 2015 EU production. In Poland, oats are used in industrial processing e.g. 140 141 for energy purposes (Kawka & Achremowicz, 2014; Głowacka, Zych & Żołnierczuk, 2016), 142 and are a valuable source of nutrients and multiple bioactive compounds, being used widely in gluten-free products (Pinto-Sánchez et al.; 2017). More recently, spelt is of particular interest 143 in Poland with organic farmers, because of its high nutrient content, lower habitat requirements 144 and impact (Knapowski et al., 2017) and cost-effectiveness of production (Kowalska, 2010). 145

146

147 3.2 The influence of socio-economic changes in Poland on consumption and supply 148 chain structure

149

150 The socio-economic transformation of Poland has contributed to qualitative and 151 quantitative changes in the national food consumption. National data from 2003-2015 suggests 152 Poles are eating less, but better food (the caloric content is reducing, while the nutritional value of the average portion size is increasing) and more expensively while eating more frequently 153 154 outside the home (Świetlik, 2017). Despite consumption systematically decreasing across all socioeconomic groups of the Polish population (Stanisławska & Kurzawa, 2016), bakery and 155 156 cereal products still hold a key position, as average monthly per capita consumption in Polish households is only second to the consumption of vegetables, including potatoes (CSO, 2016b). 157 Moreover, on the basis of Polish history, culture and prevalent religion, bread is culturally 158 159 respected within the diet but despite this, bread is one of the most often wasted food in Polish 160 households (Śmiechowska & Chrzanowska, 2015; Kowalska, 2017).

In 2015, there were 154 Polish pasta production plants (CSO, 2016c). Consolidation of the 161 162 pasta and noodles market has occurred, but national demand is still showing an upward volume trend. Whilst being a leading producer of bread and cereals compared with other EU countries, 163 on the supply side, there were 8543 bakeries and confectioneries in Poland in 2015 (CSO, 164 2016c). Mostly small local enterprises they hold a relatively weak business position in the 165 166 context of global supply chains being at a competitive disadvantage with both large-format 167 stores and material suppliers, and as a result the number of small bakeries is continuously decreasing. However, these businesses often have good reputation in the communities in which 168 169 they operate. Such a difficult commercial situation is not unique in the Polish food industry. 170 Therefore, a law on prevention of unfair use of contract advantage in marketing of agricultural and food products was adopted in 2016 (The Act on the Prevention... 2016). Consideration of 171 172 these small bakeries shows worse financial performance, but at the same time a higher social and environmental performance when compared with global businesses. 173

174 Although adoption was a legal requirement, two years after the accession of Poland to the 175 EU, the level of hazard analysis critical control point (HACCP) system implementation in bakeries, confectionaries and cereal-miller production plants was relatively low being 10-40% 176 177 of those businesses legally required to implement HACCP (Kowalska, 2010). Generally, small and medium enterprises in Poland had economic difficulties when implementing HACCP 178 (Trafiałek & Kołożyn-Krajewska, 2011). However, by 2015, about 80% of bakeries, 179 confectionaries and cereal-miller production plants were compliant (CSO, 2016c). National 180 181 data from 2005-2015 demonstrates the sanitary state of these establishments (disgualified samples as a percentage of samples tested), suggesting that sanitary and food hygiene 182 183 conditions have also improved (CSO 2016c).

The strategic national aim is to build competitive advantage for Polish cereals and 184 bakery on the global market, thus demonstrating consistent, excellent food safety standards, 185 product integrity and authenticity and engendering supply chain and consumer trust underpin 186 this ambition. Effective Polish legislation regarding the issue of food adulteration and also the 187 Polish food control institutions' activities in this area will significantly contribute to ensuring 188 legal compliance. Protecting consumer health and life is a major concern addressed by both EU 189 190 food law and Member State food control activities as well as mitigating fraudulent, deceptive 191 and other misleading practices that could harm the economic interests of consumers, national 192 GDP and the wider food industry. These are now explored.

193

4. Databases analysed and derived data

194

4.1 Agricultural and Food Quality Inspection (IJHARS), Poland

Article 9.1(b) of Regulation EU 2017/625 on official controls and other official activities performed to ensure the application of food and feed law of 15th March 2017 states that: Competent authorities shall perform official controls on all operators regularly, on a risk basis and with appropriate frequency, taking account of: .. any information indicating the

likelihood that consumers might be misled, in particular as to the nature, identity, properties,
composition, quantity, durability, country of origin or place of provenance, method of
manufacture or production of food. Two Polish laws aim to protect the consumer in the food
chain:

- The Act on the Safety of Food and Nutrition (2006) which lays down rules and
 procedures in order to ensure food and nutrition safety regarding any health
 implications for consumers, and
- 206
 2. The Act on Commercial Quality of Agricultural and Food Products (2000) which
 regulates quality issues and their economic implications for consumers (u.j.h.).

The definitions of fraudulent foodstuffs introduced by the two aforementioned Acts 208 concentrates on mislabelling, mostly regarding product composition. Under Article 3 of the 209 Polish Act on Safety of Food and Nutrition, adulterated foodstuff is determined in these 210 211 regulations as a foodstuff whose composition or other properties were changed without 212 informing the consumer about it, or a foodstuff changed in order to conceal its intrinsic 213 composition or other properties, and affecting the safety of the foodstuff. Under Article 3 of 214 u.j.h., adulterated agricultural and food product is defined as a product whose composition does not comply with the provisions of regulations regarding commercial quality of individual 215 216 foodstuffs, or a product changed (including mislabelling) in order to conceal its intrinsic composition or other properties, as long as the mentioned non-compliances or changes 217 significantly violate consumer interests. Herein the term adulterated focuses on the inherent, 218 219 intrinsic state of the food rather than the motivation of the perpetrator, which differs from the definitions outlined in the introduction. This lack of harmonisation is a very important point 220 because in Poland, the business operator that produces or places adulterated food on the market, 221 222 carries administrative, criminal and/or civil liability for the action (The Act on Commercial

Quality... 2000; The Act on the Safety of Food... 2006), irrespective of there being an intentto mislead.

225 The Agricultural and Food Quality Inspection (IJHARS) in Poland takes both control 226 and preventive actions for issues that could affect consumers' safety and food authenticity along the whole food supply chain, excluding retail trade (in the hands of Trade Inspection, IH). The 227 provincial inspector of IJHARS is entitled to issue administrative decisions concerning: a) 228 prohibiting the marketing of adulterated product, reprocessing or discarding adulterated 229 230 product, etc., (Article 29 paragraph 1 u.j.h).; and b) imposing a financial penalty on the operator that places adulterated food on the market (Article 40a u.j.h.). Both IJHARS and IH conduct 231 border inspections of exported/imported agri-food products. The IJHARS publishes 232 administrative decisions associated with food adulteration on-line including: number and date 233 of the decision regarding detected food adulteration, legal basis of the decision, the name of a 234 235 particular product concerned, the number of production batch and the date of production, batch volume, confirmed irregularities, and the name of an entity that places the food on the market. 236 237 The public is not informed about the details of actions undertaken in relation to food 238 adulteration detection. Further, the information (intelligence) and its source are not generally 239 known.

240 4.2 Rapid Alert System for Food and Feed (RASFF)

The EU RASFF database is a centralised platform developed to ensure the safety of food and animal feed in the EU. Members, including the EC, EU members, European Food Safety Authority (EFSA), European Free Trade Association [EFTA] Surveillance Authority, (i.e. Iceland, Liechtenstein and Norway) and Switzerland, are obliged to notify and to exchange information on food safety issues and measures (RASFF, 2017). The RASFF database provides members with a tool for exchanging information about measures taken in response to serious risks detected in relation to food and feed both internally within the country and at border

inspection points (Tähkäpää et al., 2015). An alert is the highest level of notification to inform 248 249 member countries that the food, feed or food contact material present a serious risk on the market and rapid action is or might be required (RASFF, 2017). The six food fraud categories 250 251 in the EU RASFF database are: improper, fraudulent, missing or absent health certificate; illegal 252 or unauthorised import, trade or transit; adulteration, fraud or tampering; improper, expired, 253 fraudulent or missing common entry document (CED), import declaration, or analytical report; expiration date; and mislabelling (Bouzembrak & Marvin, 2015). Within the hazard category 254 255 'labelling absent/incomplete or incorrect' categories include: insufficient labelling such as absence of allergen declaration, incorrect labelling e.g. incorrect or absent declaration of gluten 256 257 free status. The RASFF (2017) composition category includes categories such as unauthorised presence of colours or other materials, or excess content of vitamins, metals (such as 258 aluminium). 259

Multiple studies have analysed RASFF data for incident frequency and trends (Kleter, 260 Prandini, Filippi, & Marvin, 2009; Tähkäpää et al., 2015; Bouzembrak & Marvin, 2015; Marvin 261 et al., 2016; Djekic, Jankovic & Rajkovic, 2017). Analysis of RASFF data has focused on 262 microbiological and chemical hazards rather than physical hazards and of the foreign body 263 notifications analysed in their study for Eastern Europe (n=411), 93% were attributed to pest 264 265 contamination (Djekic et al., 2017). This work classified Eastern Europe as Bulgaria, Czech Republic, Hungary, Poland, Romania and Slovakia and across Europe as a whole, bakery 266 products were in the top three categories of products most likely to be contaminated with 267 268 foreign bodies.

With regard to fraud specifically, Tähkäpää et al. (2015) compared both RASFF fraud notifications and local Finnish fraud notifications. In order to develop a food fraud risk assessment tool, Marvin et al. (2016) developed a set of variables over and above food fraud type including **economic factors** (e.g. price, supply and demand); **national factors** associated

273 with the country of origin (e.g. governance) and specific incident related factors such as fraud 274 type, complexity and the potential for fraud detection. The two variables identified by Marvin et al. (2016) with the greatest influence on the type of food fraud committed were country of 275 276 origin and product. However, care should be taken with simple arithmetic analysis of incidents in RASFF as one incident can skew the frequency of notifications. For example in 2017, fipronil 277 use on egg farms resulted in multiple notifications in RASFF (115 notifications at the time of 278 writing). This creates a challenge when trying to objectively quantify particular types of 279 incidents using RASFF data alone (Bouzembrak & Marvin, 2016). The potential for a different 280 system of categorisation of incidents between member state databases and RASFF, either by 281 design or by individual inspector discretion, also needs to be considered when drawing 282 283 comparisons between the two levels of system.

284 **4.3 Food fraud associated with cereals and bakery products**

The development of fraudulent practices in the food industry is mediated by supply and 285 demand dynamics, trends and current consumption models and any given dietary 286 recommendations. There are multiple examples of authenticity concerns associated with cereals 287 (Pegels, González, García, & Martín, 2015); and RASFF notifications for bakery (Tähkäpää et 288 al., 2015). Bakery products are characterised by a restricted shelf life, heterogeneity of 289 290 ingredients, and seasonal variability in product quality due to production and harvesting 291 conditions (Van der Spiegel, Luning, De Boer, Ziggers and Jongen, 2005) whereas dehydrated pasta products have a long shelf life. Adulteration may be motivated not only to mislead or for 292 293 economic gain, but also to meet stated customer (retailer or food service) requirements. 294 European legislation states that durum wheat pasta can contain a maximum of 3% of common 295 wheat, so this standard itself may actually incentivise the substitution in the pasta supply chain meeting minimum specifications and deriving best economic return, especially where durum 296 297 wheat is 25% more expensive than common wheat (Knödler, Most, Schieber, & Carle, 2010;

Righetti et al., 2018). Contemporary examples of tainted baked goods include steamed buns in
China produced using yellow coloring and sodium cyclamate, an artificial sweetener banned in
the United States of America (USA) see China.org.cn (2011) or steamed 'corn buns' sold
without corn, but containing flavouring and artificial colours (Everstine, Spink & Kennedy,
2013) and using dried bakery waste was associated with dioxin contamination in food and feed
(Hoogenboom et al., 2004) Thus, there is literature context for malpractice in the cereals supply
chain.

5. Results and discussion

5.1 RASFF Database

The product category cereals and bakery products on the RASFF database was searched for 307 notifications linked to the hazard category adulteration/fraud. There were 42 notifications 308 between 2004 and January 2018, the majority being border rejections (n=32) with information 309 notifications (n=8) and alerts (n=2). The non-compliances raised were absence of certified 310 analysis report (n=27), illegal or unauthorised import (n=6), fraudulent health certificate (n=4), 311 312 improper health certificate (n=2); expiry date change (n=2) and tampering (n=1) with 83% of 313 the products coming from China or Hong Kong and none linked to Poland. Analysis of incidence by product includes that 83% of the products were rice, rice products or noodles, with 314 frozen pastry or pies (n=3) and biscuits/cookies (n=2) and cake/cake mix (n=1). 315

There were 149 notifications for the hazard category **composition** between 1996 and Jan 2018, with border rejections (n=76), information notifications (n=35) and alerts (n=38). Three further notifications arose as a result of companies' own checks and additional two following customer complaints. The non-compliances raised were high content of aluminium (n=116) mainly associated with noodles and rice products from China, Hong Kong and Vietnam and unauthorised colours including Sudan 1 and Rhodamine B (n=27). Analysis of incidence by product highlights that 74% were rice, rice products or noodles, pasta (n=22),

bread/breadcrumbs or flour (n=7), cake/cake mix (n=3), biscuits/cookies (n=3), and frozen
pastry or pies (n=1) and three other notifications were for spelt/cereal (n=1) and one for multiple
products. There were five incidents associated with Poland.

There were 21 notifications for bakery and cereals products in the hazard category 326 327 labelling absent/ incomplete/ incorrect between 1996 and Jan 2018, with border rejections (n=3), information notifications (n=14) and alerts (n=4). Insufficient labelling notifications 328 329 included lack of allergen declaration (n=13); incorrect labelling e.g. gluten free declarations (n=6) and absence of labelling (n=2). Six notifications were associated with Poland (29%) 330 331 compared with 10% from China/Hong Kong (n=2). Analysis of incidence by product highlights 332 that whilst 24% of the products were rice, rice products or noodles, pasta (n=5), biscuits/cookies (n=8) showed the highest incidence of non-compliance, with cake/cake mix (n=3), muesli 333 (n=2), bread/breadcrumbs or flour (n=1), spelt/cereal (n=1) and one more notification for 334 multiple products. 335

336 There were 177 notifications for cereal and bakery products associated with Poland 337 between 2004 and January 2018 either because the products may have been notified to RASFF by Poland itself or there was the potential for distribution within Poland. These notifications 338 included both those in the hazard categories already described and other hazard categories 339 340 within the RASFF database. By notification type, alert was the largest group (n=92), 341 information (n=62) and border rejection (n=21). The notifications were by official controls 342 (n=105), border control rejections (n=29), companies' own checks (n=24), customer complaint 343 (n=18) and food poisoning (n=1). The non-compliances raised with the highest frequency were mycotoxins (n=47), undeclared allergens (n=24), undeclared genetically modified material 344 345 (n=19), pests generally insects and physical contamination from mice (n=13), mould contamination (n=12) and problems with gluten declarations (n=11), organoleptic issues (n=9), 346 347 metal contamination (n=7), high content of aluminium (n=5), glass contamination (n=5) and

glycol (n=5), other issues (collectively 30 notifications) had a lower frequency of occurrence. 348 349 Upon further analysis, there is a potential adulteration incident in 2008 where 3.5 ppm of melamine was found in salty sticks from Poland (RASFF, 2008). This incident coincides with 350 351 the Chinese melamine contamination of multiple product categories (Gossner et al., 2009). 352 Salty sticks are wheat based Polish snacks and it is speculated that wheat flour used was tainted 353 with melamine. The risk decision was undecided at that time as the adulteration and recall of 354 tainted food from China was beginning to occur. A second incident detected from the analysis 355 was the suspicion of rodenticide granules found in milk powder used to make waffles that were recalled from consumers and were categorised as serious risk although nothing further is 356 357 reported. Analysis of incidence by product highlights that 26% of the products were rice, rice products or noodles, pasta (n=46), bread/breadcrumbs or flour (n=34), biscuits/cookies (n=18), 358 359 cake/cake mix (n=8), linseed (linked to a specific incident n=8) and pasta products (n=8). All 360 other incidents were across a range of products all with lower incidence.

Analysis of the RASFF database allows for identification of bakery products of interest 361 362 and potential non-compliance that can be compared with the data from Poland. There are notable trends in the data, for example the rise in recent years for notification of incorrect 363 allergen labelling or problems with appropriate labelling of gluten free products perhaps as a 364 365 result of changes in EU Food Information for Consumers (FIC) Regulations that came into force in 2014, problems with health certification and in two cases a change of expiry date. Other 366 367 issues that have been identified were undeclared genetically modified material, which is not currently categorised under food fraud/adulteration in the RASFF database. 368

369 5.2 IJHARS Data

There are 427 administrative decisions publicised on the IJHARS webpage regarding adulterated agri-food items from 2013-2017. It is common that one decision covers several adulterated agri-food items from the same producer, and there are also instances of repeat

offence by a specific producer. Most non-compliances occur in the following product categories: meat and meat products, flour, cereal and bakery products, delicatessen (ready to serve) products (Figure 1). Other food categories contain 1 to 6 adulteration cases (e.g. food concentrates, non-alcoholic beverages, spices, chocolate products).

377 Take in Figure 1

Issues of adulteration of meat/meat products is typical of EU incident datasets that were 378 379 skewed directly by the 2013 Horsemeat Scandal and analysis of the data presented in the 2016 380 annual report of the EU Food Fraud Network and the System for Administrative Assistance & Food Fraud (AAC FF) shows that the most food fraud cases exchanged in the AAC FF concern 381 382 meat and meat products (26.7% of all 176 food fraud cases identified). Cereal and bakery 383 products are the second most frequently identified products for food fraud/adulteration in 384 Poland underpinning the rationale to focus on these products. Publicly available IJHARS administrative decisions from the years 2010-2017, comprising 209 adulterated cereal and 385 386 bakery products marketed by 108 operators were analysed in this study. The large majority of 387 items (94.7% of all cases) were flour and cereal products (including bread, pasta, baking flour and breadcrumbs), and only 11 agri-food items belonged to the category of pastry, cakes, 388 biscuits and other bakers' wares (including biscuits and waffles). The most commonly reported 389 390 adulterated cereal and bakery products in Poland were bread and pasta (Figure 2) and in most cases the problem related specifically to mislabelling. 391

Take in Figure 2

Mislabelling of this nature could be intentional or unintentional and due simply to human error, lack of verification during product / labelling change in production system or even an error in original artwork design. Other products where non-compliance occurred include corn crunchies, semolina, barley, buckwheat, muesli, matzah, bakery products different than bread

('small pizza'), sponge cakes, cupcakes, spit cake, puff pastry, and each one of these was notified only once. IJHARS detected food fraud/ adulteration in the category of cereal and bakery products in each of the 16 provinces in Poland, but most irregularities were identified in West Pomeranian, Kuyavian-Pomeranian and Lubusz Province. The main irregularities in adulterated bread and pasta detected by IJHARS in 2010-2017, from the most to the least frequent, are described in Table 1 and Table 2.

403 Take in Tables 1 and 2

The results of IJHARS inspections of cereal and bakery production in 2010-2017 reveal that 98% of adulterated products were mislabelled. Physicochemical parameters of 18% of the products were also incompatible with producer's declaration. IJHARS did not identify any problem with organoleptic properties of controlled cereal and bakery products. The most common violations were:

- mislabelling: composition missing items in the list of ingredients, declaration of
 ingredients not used in the production process,
- 411 mislabelling: misnomer incorrect/ incomplete/ no (descriptive) name of the product,
 412 and
- mislabelling: method of production unfounded claim 'no bread improvers', 'no preservatives', 'no chemical additives', 'rustic', 'home', 'traditional recipe', etc.

In Poland, mislabelling is a bigger problem than organoleptic and/or physicochemical noncompliance with a producer's label declaration or specification. The types of mislabelling have been differentiated by product (bread and pasta) and show that composition is the major area of non-compliance with bread whereas method of production was the main area of noncompliance with pasta (Figure 3).

420 Take in Figure 3

In 2016, every fifth production batch assessed by IJHARS was incorrectly labelled (see
www.ijhar-s.gov.pl) and with plant-based food products, bread and bakery products were the
most frequently mislabelled (Kowalczyk, 2016).

424 **5.3 Summary**

Analysis of the RASFF and IJHARS databases highlights some challenges when seeking to 425 426 compare and quantify the incidence of food adulteration. Commercial quality evaluation undertaken by IJHARS is based on three food quality attributes: organoleptic features, 427 physicochemical characteristics and labelling. All mislabelling cases detected by IJHARS are 428 treated as adulteration, but this is not the case with the RASFF system making comparison 429 difficult. The administrative liability of the operator that places adulterated food on the market 430 431 in Poland is objective (non-judgmental) and the only condition for imposing a sanction is the fact of placing such food on the market. The sanction is determined irrespective of guilt i.e. 432 both intentional and unintentional action are considered as adulteration (Supreme 433 Administrative Court, 2013). 434

It is important to consider whether the data that has been analysed here reflects the actual 435 436 level of adulteration in Poland or whether the non-compliance frequency is skewed by riskbased purposive sampling by the IJHARS as is required by legislation such as EU Regulation 437 438 2017/625. Therefore it is difficult to determine if mislabelling of cereals and bakery products 439 is becoming a more frequent problem in Poland as the number of inspections that were carried out by IJHARS varied over the time period analysed. There were 7 519 - 9 000 IJHARS 440 inspections carried out on the domestic market in 2010 - 2013, 11 675 inspections in 2014, 12 441 220 inspections in 2015, and 35 169 inspections in 2016 i.e. there were four times as many 442 inspections in 2016 than in 2010. On the other hand, the number of IJHARS inspections at 443

import and export stage decreased from 80 - 90 000 in 2010-2014 to 60 000 in 2015-2016.
There have been additional 3 - 4 000 IJHARS inspections carried out annually on request of
institutions cooperating with IJHARS (see <u>http://www.ijhar-s.gov.pl</u>) and the areas that
IJHARS covers by their planned inspections depended as previously described on purposive
risk-based analysis and the input of businesses they inspect.

The differences between food fraud/adulteration information published in the RASFF 449 database and the data regarding the decisions made by IJHARS arises from the essence of the 450 systems themselves. IJHARS carries out planned and ad hoc inspections on both the domestic 451 452 Polish market and at import and export stages. These inspections are particularly concerned 453 with the marketing quality of commonly consumed products dairy products, meat, fish, cereals, 454 processed fruit and vegetables, ready-to-cook food, honey, eggs, and fresh fruit and vegetables (see http://www.ijhar-s.gov.pl). There is some equivalent in EU member state in terms of 455 domestic databases such as the UK Food Surveillance System (UKFSS), see FSA (2018) or the 456 Finnish Food Safety Authority EVIRA system (Tähkäpää et al., 2015). However the data within 457 458 the RASFF database is in part driven by different regulatory criteria i.e. purposive risk-based import sampling of specific countries and products. Further the dataset within the RASFF 459 system for adulteration is relatively small so a few incidents can quickly change the overall 460 461 metrics that are derived and the categories used within RASFF are very broad and worthy of redefinition to aid better isolation of incidents and trend analysis. Where categories are not 462 463 aligned within national databases and the RASFF this means it is difficult to analyse the combined data for trends and emerging risk without undertaking an in-depth assessment of the 464 multiple datasets. 465

What are the key factors that can be drawn out here from the analysis of the IJHARS system? Bread, an integral part of the Polish diet, represents over 67% of the reported cereal and bakery incidents on the IJHARS database. The main irregularities highlighted were missing

items in the ingredients list, a lack of, or incorrect description of, the type of flour used;
misleading or no information at all on the percentage of some ingredients e.g. sunflower seeds,
and unfounded claims on the method of production. These findings undermine confidence in
the integrity of bakery products in Poland.

473 Further it is important to consider the definition of adulteration is actually of value here. Article 3 of the Polish Act on Safety of Food and Nutrition, states an adulterated foodstuff is 474 475 one whose composition or other properties are changed without informing the consumer about it, or a foodstuff changed in order to conceal its intrinsic composition or other properties, and 476 477 affecting the safety of the foodstuff. Global Food Safety Initiative (GFSI) Position Statement 478 on mitigating the public health risk of food fraud (July 2014) identifies both intentional 479 adulteration and unintentional/accidental adulteration whereas other sources state that for 480 adulteration to be considered as a subset of food fraud it can only be determined as being intentional (Elliott Review, 2014). This lack of harmonisation of definitions proves challenging. 481 The health implications of food adulteration are complex too. If it is an allergen that is used as 482 483 an adulterant and then undeclared on labelling this obviously will have health implications e.g. the use of peanut powder in almond powder as an a cheaper "filler". The multiple materials that 484 485 could be used to adulterate combined with the often lack of immediate, valid data on their health 486 impact when discovered e.g. melamine in wheat gluten means that any investigations are reactive in nature and thus response at regulatory and market level can appear slow to 487 488 consumers. The economic consequences are implicit in food adulteration. In a given food 489 supply chain there are normative, coercive and mimetic (economic) pressures from respectively 490 lobby groups, consumer, criminal groups, coercive and political pressures from government, 491 buyers and sellers etc. (Kilbourne, Beckmann & Thelen, 2002), and mimetic pressures which emerge from horizontal competition (Zhu, Sarkis & Geng, 2005; Aerts, Cormier, & Magnan, 492 493 2006; Sarkis, Gonzalez-Torre & Adenso-Diaz, 2010) that operate at individual levels primary,

secondary, tertiary production and also at the interfaces between levels. Mimetic pressure can 494 495 be specifically exerted where there is an asymmetry in supply chain power between two or more actors/stakeholders creating vulnerabilities where the potential for adulteration can occur giving 496 497 rise to illicit behaviour. There is limited independent data on the economic impact of food adulteration and much of that is contained within wider estimates of food fraud e.g. European 498 499 Epson activities or estimations are based on extrapolation of data from studies to the wider 500 supply chain which are limited as a result because of the embedded generalisations used. 501 Ultimately, placing adulterated food on the market is an action of unfair practice that promotes the competitiveness of the perpetrator whilst undermining the competitiveness of other 502 503 operators within the sector.

504 **6.** Conclusion

505 Cereal products especially bread and baked goods are an important part of the Polish economy especially for local producers and manufacturers underpinned by effective food safety 506 507 and product standards management systems and controls. As Poland is one of the top producers 508 and exporters of cereal products in the EU, there is further potential for marketing and exporting 509 a variety of Polish origin bakery products. IJHARS carries out comprehensive inspections of goods locally and at import/export interfaces. As the food chain becomes more global, it is 510 511 crucial that IJHARS remains vigilant in ensuring the safety and legality of food products especially as has been highlighted in this paper with regard to product labelling. The official 512 513 controls in Poland are also supported by the EU RASFF system that focuses on the entry and exit of safe and legal food into and across the European market. 514

This paper has focused on definitions and interpretation of the term adulteration especially in the Polish context. Food can be placed on the market whereby its associated labelling is misleading either inadvertently or intentionally and this has been a challenge highlighted in this paper. Unintentional adulteration can occur as the result of a lack of

knowledge, facilities or resources. The definition of adulterated foodstuffs in Poland 519 520 concentrates on mislabelling particularly regarding product composition rather than being differentiated by the motivation of the perpetrator e.g. that an individual undertakes adulteration 521 for financial gain (EMA) or to overcome a challenge between the demand for a finished product 522 and the ability to access sufficient ingredients of the correct provenance. This study 523 demonstrates that even in harmonized regulatory areas such as the EU there are local legal 524 definitions of adulteration and these may, or may not, concur with definitions of adulteration in 525 private market standards. A lack of consistency and commonality in definitions could influence 526 collective approaches to determining the extent of or addressing the problem of mislabelling, 527 528 misrepresentation and misbranding as forms of adulteration at national level and across national border trading such as in the EU. This research shows that more empirical work needs to be 529 undertaken to contextualise the drivers for misbranding, mislabelling and misrepresentation in 530 531 the food supply chain and for this problem to be seen not just as a subset of food fraud (see Spink and Moyer, 2011), but as a problem worthy of study in its own right. Empirical work 532 needs to place particular attention on how data has been collected within existing regulatory 533 534 and private databases and the constraints this then places on generalising the results of study work on a range of products and contexts. Research on labelling integrity should be 535 multidisciplinary and focus on food labelling from both a legal and ethical perspective. 536

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- 716

718 Table 1. Main irregularities detected by IJHARS in adulterated bread (2010-2017)

Bread (139 cases)		Share of
Type of irregularity	No of	the bread
Type of meguianty		cases
Missing items in the list of ingredients, i.e. bread improver, constituents of a	67	48.2%
compound ingredient (usually bread improver), ascorbic acid, food additives		
approved for use, anti-mould substance).		
A lack off, or incorrect description of bread type e.g. type of flour used, e.g. mixed,	44	31.7%
wheat or rye		
Storage conditions and durability - no information about 'use-by date'/storage	16	11.5%
conditions		
Method of production – unfounded claim 'no bread improvers', 'no preservatives',	14	10.1%
'no chemical additives', 'rustic', 'home', 'traditional recipe', etc.		
Declaration of ingredients not used in the production process		9.4%
No reference to allergens e.g. wheat gluten, barley malt, soy flour, sesame seeds	12	8.6%
No/misleading information about content percentage of an ingredient, e.g. wholemeal		7.9%
flower, sunflower seeds, soybeans		
Understatement of net weight		6.5%

719 Source: Own elaboration based on <u>http://www.ijhar-s.gov.pl</u>.

720 Table 2. Main irregularities detected by IJHARS in adulterated pasta (2010-2017)

Pasta (34 cases)		Share of
Type of irregularity	No of	the pasta
	cases	cases
Underestimation of eggs content	17	50.0%
Underestimation of fat content	8	23.5%
Lack of term "with turmeric spices" in the name of a product		20.6%
Missing items in ingredients list	6	17.6%
Method of production, e.g. unfounded claim "home"	5	14.7%
Declaration of ingredients not used in the production process		11.8%

- 721 Source: Own elaboration based on <u>http://www.ijhar-s.gov.pl</u>.
- 722

Figure 1. IJHARS administrative decisions concerning adulteration per product category (2013-1017)



727 Source: Own elaboration based on <u>http://www.ijhar-s.gov.pl</u>

Figure 2. Reported types of cereal and bakery products in Poland in 2010-2017 within
 IJHARS administrative decisions concerning adulterated agri-food items



731 Source: Own elaboration based on http://www.ijhar-s.gov.pl.

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730



Figure 3. The percentage of the main mislabelling irregularities in adulterated bread and pasta (2010-2017)

736 Source: Own elaboration based on http://www.ijhar-s.gov.pl.

737 738