

## Article

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*Kowalska, Aleksandra, Soon, Jan Mei ORCID: 0000-0003-0488-1434 and Manning, Louise (2018) A study on adulteration in cereals and bakery products from Poland including a review of definitions. Food Control . ISSN 0956-7135*

It is advisable to refer to the publisher's version if you intend to cite from the work.  
<http://dx.doi.org/10.1016/j.foodcont.2018.05.007>

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# Accepted Manuscript

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PII: S0956-7135(18)30232-9  
DOI: 10.1016/j.foodcont.2018.05.007  
Reference: JFCO 6131  
To appear in: *Food Control*  
Received Date: 16 March 2018  
Revised Date: 03 May 2018  
Accepted Date: 05 May 2018

Please cite this article as: Aleksandra Kowalska, Jan Mei Soon, Louise Manning, A study on adulteration in cereals and bakery products from Poland including a review of definitions, *Food Control* (2018), doi: 10.1016/j.foodcont.2018.05.007

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

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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

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

### 35 **Highlights**

- 36 - Most commonly reported adulterated cereal and bakery products in Poland were bread  
37 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**

44 **None**

### 45 **Funding**

46 **This research did not receive any specific grant from funding agencies in the public,**  
47 **commercial or not for profit sectors**

48

49

## 50 1. Introduction

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

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

74 are derived and used when considering food adulteration.

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

## 91           **2. Methodology and research rationale**

92           Cereal grains such as wheat and derived flour are major ingredients for the most  
93 important staple foods in the EU such as breads, pasta, cakes, and biscuits (Murniece &  
94 Straumite, 2014; Cozzolino, 2016; Geng, Harnly, & Chen, 2016). Poland is one of the major  
95 cereal producers in the EU and in 2015 exported more than 20% of the total cereal produced  
96 (CSO, 2016a) highlighting the risk to illicit activity associated with Polish cereals and bakery  
97 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 (Tähhkää, 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.  
105 The EU Rapid Alert System for Food and Feed (RASFF) database was searched using the  
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  
110 (IJHARS) site from 2010 – 2017. A previous study by Kowalczyk (2015) used IJHARS food  
111 inspection data to assess the main areas of food fraud, but was not specific to cereals and bakery  
112 products, thus making the research described herein of interest. We have structured the paper  
113 as follows: Section 1 is an introduction and a brief overview of food adulteration terminology;  
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)  
118 databases and reviews the data derived in this research. In Section 5 results are presented and  
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,  
125 Luomala & Sandell, 2010; Murniece & Straumite, 2014). In 2015, Poland exported 21.8% of  
126 its total cereal production, which accounted for 2.7% of Polish GDP. The main export product  
127 was wheat and spelt with key export markets being Germany, Egypt, Saudi Arabia, Algeria,  
128 and Morocco. The value of Polish cereal products exports (bread, pastry, cakes, biscuits, wafers  
129 etc.) accounted for 99.8% of the total value of cereal exports in 2015 (CSO, 2016a). Poland is  
130 the third largest cereal producer in the EU-28 after France and Germany. Analysing the  
131 structure of utilised agricultural area (UAA) identifies the dominant role of cereals in national  
132 production (Czyżewski & Staniszewski, 2016) with Denmark (55%), Poland (52%) and a  
133 significantly lower share in Germany (39%) and France (35%) producing the majority of cereal  
134 in EU. Common organisation of the cereals market was initiated in the late 60s of the 20<sup>th</sup>  
135 century and EU Member States benefited from intervention buying, storage and sale of cereals  
136 through the evolution of the Common Agricultural Policy (CAP). In 2015, the quantities of rye  
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  
139 EU Member States in terms of output. Moreover, Poland is the largest oats producer  
140 contributing 16% of 2015 EU production. In Poland, oats are used in industrial processing e.g.  
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  
143 gluten-free products (Pinto-Sánchez et al.; 2017). More recently, spelt is of particular interest  
144 in Poland with organic farmers, because of its high nutrient content, lower habitat requirements  
145 and impact (Knapowski et al., 2017) and cost-effectiveness of production (Kowalska, 2010).

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  
153 of the average portion size is increasing) and more expensively while eating more frequently  
154 outside the home (Świetlik, 2017). Despite consumption systematically decreasing across all  
155 socioeconomic groups of the Polish population (Stanisławska & Kurzawa, 2016), bakery and  
156 cereal products still hold a key position, as average monthly per capita consumption in Polish  
157 households is only second to the consumption of vegetables, including potatoes (CSO, 2016b).  
158 Moreover, on the basis of Polish history, culture and prevalent religion, bread is culturally  
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).

161           In 2015, there were 154 Polish pasta production plants (CSO, 2016c). Consolidation of the  
162 pasta and noodles market has occurred, but national demand is still showing an upward volume  
163 trend. Whilst being a leading producer of bread and cereals compared with other EU countries,  
164 on the supply side, there were 8543 bakeries and confectioneries in Poland in 2015 (CSO,  
165 2016c). Mostly small local enterprises they hold a relatively weak business position in the  
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  
168 decreasing. However, these businesses often have good reputation in the communities in which  
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  
171 and food products was adopted in 2016 (The Act on the Prevention... 2016). Consideration of  
172 these small bakeries shows worse financial performance, but at the same time a higher social  
173 and environmental performance when compared with global businesses.

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

184 The strategic national aim is to build competitive advantage for Polish cereals and  
185 bakery on the global market, thus demonstrating consistent, excellent food safety standards,  
186 product integrity and authenticity and engendering supply chain and consumer trust underpin  
187 this ambition. Effective Polish legislation regarding the issue of food adulteration and also the  
188 Polish food control institutions' activities in this area will significantly contribute to ensuring  
189 legal compliance. Protecting consumer health and life is a major concern addressed by both EU  
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**

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

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

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

208 The definitions of fraudulent foodstuffs introduced by the two aforementioned Acts  
209 concentrates on mislabelling, mostly regarding product composition. Under Article 3 of the  
210 Polish Act on Safety of Food and Nutrition, adulterated foodstuff is determined in these  
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  
215 not comply with the provisions of regulations regarding commercial quality of individual  
216 foodstuffs, or a product changed (including mislabelling) in order to conceal its intrinsic  
217 composition or other properties, as long as the mentioned non-compliances or changes  
218 significantly violate consumer interests. Herein the term adulterated focuses on the inherent,  
219 intrinsic state of the food rather than the motivation of the perpetrator, which differs from the  
220 definitions outlined in the introduction. This lack of harmonisation is a very important point  
221 because in Poland, the business operator that produces or places adulterated food on the market,  
222 carries administrative, criminal and/or civil liability for the action (The Act on Commercial

223 Quality... 2000; The Act on the Safety of Food... 2006), irrespective of there being an intent  
224 to 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  
227 the whole food supply chain, excluding retail trade (in the hands of Trade Inspection, IH). The  
228 provincial inspector of IJHARS is entitled to issue administrative decisions concerning: a)  
229 prohibiting the marketing of adulterated product, reprocessing or discarding adulterated  
230 product, etc., (Article 29 paragraph 1 u.j.h.); and b) imposing a financial penalty on the operator  
231 that places adulterated food on the market (Article 40a u.j.h.). Both IJHARS and IH conduct  
232 border inspections of exported/imported agri-food products. The IJHARS publishes  
233 administrative decisions associated with food adulteration on-line including: number and date  
234 of the decision regarding detected food adulteration, legal basis of the decision, the name of a  
235 particular product concerned, the number of production batch and the date of production, batch  
236 volume, confirmed irregularities, and the name of an entity that places the food on the market.  
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)**

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

248 inspection points (Tähkää et al., 2015). An alert is the highest level of notification to inform  
249 member countries that the food, feed or food contact material present a serious risk on the  
250 market and rapid action is or might be required (RASFF, 2017). The six food fraud categories  
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;  
254 expiration date; and mislabelling (Bouzemrak & Marvin, 2015). Within the hazard category  
255 'labelling absent/incomplete or incorrect' categories include: insufficient labelling such as  
256 absence of allergen declaration, incorrect labelling e.g. incorrect or absent declaration of gluten  
257 free status. The RASFF (2017) composition category includes categories such as unauthorised  
258 presence of colours or other materials, or excess content of vitamins, metals (such as  
259 aluminium).

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

269 With regard to fraud specifically, Tähkää et al. (2015) compared both RASFF fraud  
270 notifications and local Finnish fraud notifications. In order to develop a food fraud risk  
271 assessment tool, Marvin et al. (2016) developed a set of variables over and above food fraud  
272 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  
275 et al. (2016) with the greatest influence on the type of food fraud committed were country of  
276 origin and product. However, care should be taken with simple arithmetic analysis of incidents  
277 in RASFF as one incident can skew the frequency of notifications. For example in 2017, fipronil  
278 use on egg farms resulted in multiple notifications in RASFF (115 notifications at the time of  
279 writing). This creates a challenge when trying to objectively quantify particular types of  
280 incidents using RASFF data alone (Bouzemrak & Marvin, 2016). The potential for a different  
281 system of categorisation of incidents between member state databases and RASFF, either by  
282 design or by individual inspector discretion, also needs to be considered when drawing  
283 comparisons between the two levels of system.

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

285 The development of fraudulent practices in the food industry is mediated by supply and  
286 demand dynamics, trends and current consumption models and any given dietary  
287 recommendations. There are multiple examples of authenticity concerns associated with cereals  
288 (Pegels, González, García, & Martín, 2015); and RASFF notifications for bakery (Tähkää et  
289 al., 2015). Bakery products are characterised by a restricted shelf life, heterogeneity of  
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  
292 pasta products have a long shelf life. Adulteration may be motivated not only to mislead or for  
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  
296 meeting minimum specifications and deriving best economic return, especially where durum  
297 wheat is 25% more expensive than common wheat (Knödler, Most, Schieber, & Carle, 2010;

298 Righetti et al., 2018). Contemporary examples of tainted baked goods include steamed buns in  
299 China produced using yellow coloring and sodium cyclamate, an artificial sweetener banned in  
300 the United States of America (USA) see China.org.cn (2011) or steamed ‘corn buns’ sold  
301 without corn, but containing flavouring and artificial colours (Everstine, Spink & Kennedy,  
302 2013) and using dried bakery waste was associated with dioxin contamination in food and feed  
303 (Hoogenboom et al., 2004) Thus, there is literature context for malpractice in the cereals supply  
304 chain.

## 305 **5. Results and discussion**

### 306 **5.1 RASFF Database**

307 The product category cereals and bakery products on the RASFF database was searched for  
308 notifications linked to the hazard category **adulteration/fraud**. There were 42 notifications  
309 between 2004 and January 2018, the majority being border rejections (n=32) with information  
310 notifications (n=8) and alerts (n=2). The non-compliances raised were absence of certified  
311 analysis report (n=27), illegal or unauthorised import (n=6), fraudulent health certificate (n=4),  
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  
314 incidence by product includes that 83% of the products were rice, rice products or noodles, with  
315 frozen pastry or pies (n=3) and biscuits/cookies (n=2) and cake/cake mix (n=1).

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

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

326 There were 21 notifications for bakery and cereals products in the hazard category  
327 **labelling absent/ incomplete/ incorrect** between 1996 and Jan 2018, with border rejections  
328 (n=3), information notifications (n=14) and alerts (n=4). Insufficient labelling notifications  
329 included lack of allergen declaration (n=13); incorrect labelling e.g. gluten free declarations  
330 (n=6) and absence of labelling (n=2). Six notifications were associated with Poland (29%)  
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  
333 (n=8) showed the highest incidence of non-compliance, with cake/cake mix (n=3), muesli  
334 (n=2), bread/breadcrumbs or flour (n=1), spelt/cereal (n=1) and one more notification for  
335 multiple products.

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  
338 by Poland itself or there was the potential for distribution within Poland. These notifications  
339 included both those in the hazard categories already described and other hazard categories  
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  
344 mycotoxins (n=47), undeclared allergens (n=24), undeclared genetically modified material  
345 (n=19), pests generally insects and physical contamination from mice (n=13), mould  
346 contamination (n=12) and problems with gluten declarations (n=11), organoleptic issues (n=9),  
347 metal contamination (n=7), high content of aluminium (n=5), glass contamination (n=5) and



348 glycol (n=5), other issues (collectively 30 notifications) had a lower frequency of occurrence.  
349 Upon further analysis, there is a potential adulteration incident in 2008 where 3.5 ppm of  
350 melamine was found in salty sticks from Poland (RASFF, 2008). This incident coincides with  
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  
356 recalled from consumers and were categorised as serious risk although nothing further is  
357 reported. Analysis of incidence by product highlights that 26% of the products were rice, rice  
358 products or noodles, pasta (n=46), bread/breadcrumbs or flour (n=34), biscuits/cookies (n=18),  
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.

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

## 369 **5.2 IJHARS Data**

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

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

### 377 **Take in Figure 1**

378 Issues of adulteration of meat/meat products is typical of EU incident datasets that were  
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 &  
381 Food Fraud (AAC FF) shows that the most food fraud cases exchanged in the AAC FF concern  
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  
385 administrative decisions from the years 2010-2017, comprising 209 adulterated cereal and  
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  
388 and breadcrumbs), and only 11 agri-food items belonged to the category of pastry, cakes,  
389 biscuits and other bakers' wares (including biscuits and waffles). The most commonly reported  
390 adulterated cereal and bakery products in Poland were bread and pasta (Figure 2) and in most  
391 cases the problem related specifically to mislabelling.

### 392 **Take in Figure 2**

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

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

### 403 **Take in Tables 1 and 2**

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

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

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

**420 Take in Figure 3**

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

**424 5.3 Summary**

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

435 It is important to consider whether the data that has been analysed here reflects the actual  
436 level of adulteration in Poland or whether the non-compliance frequency is skewed by risk-  
437 based purposive sampling by the IJHARS as is required by legislation such as EU Regulation  
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  
440 out by IJHARS varied over the time period analysed. There were 7 519 – 9 000 IJHARS  
441 inspections carried out on the domestic market in 2010 - 2013, 11 675 inspections in 2014, 12  
442 220 inspections in 2015, and 35 169 inspections in 2016 i.e. there were four times as many  
443 inspections in 2016 than in 2010. On the other hand, the number of IJHARS inspections at

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

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

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

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

473 Further it is important to consider the definition of adulteration is actually of value here.  
474 Article 3 of the Polish Act on Safety of Food and Nutrition, states an adulterated foodstuff is  
475 one whose composition or other properties are changed without informing the consumer about  
476 it, or a foodstuff changed in order to conceal its intrinsic composition or other properties, and  
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  
481 intentional (Elliott Review, 2014). This lack of harmonisation of definitions proves challenging.  
482 The health implications of food adulteration are complex too. If it is an allergen that is used as  
483 an adulterant and then undeclared on labelling this obviously will have health implications e.g.  
484 the use of peanut powder in almond powder as an a cheaper “filler”. The multiple materials that  
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  
487 reactive in nature and thus response at regulatory and market level can appear slow to  
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  
492 emerge from horizontal competition (Zhu, Sarkis & Geng, 2005; Aerts, Cormier, & Magnan,  
493 2006; Sarkis, Gonzalez-Torre & Adenso-Diaz, 2010) that operate at individual levels primary,

494 secondary, tertiary production and also at the interfaces between levels. Mimetic pressure can  
495 be specifically exerted where there is an asymmetry in supply chain power between two or more  
496 actors/stakeholders creating vulnerabilities where the potential for adulteration can occur giving  
497 rise to illicit behaviour. There is limited independent data on the economic impact of food  
498 adulteration and much of that is contained within wider estimates of food fraud e.g. European  
499 Epsilon 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  
502 the competitiveness of the perpetrator whilst undermining the competitiveness of other  
503 operators within the sector.

## 504 **6. Conclusion**

505 Cereal products especially bread and baked goods are an important part of the Polish  
506 economy especially for local producers and manufacturers underpinned by effective food safety  
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  
510 goods locally and at import/export interfaces. As the food chain becomes more global, it is  
511 crucial that IJHARS remains vigilant in ensuring the safety and legality of food products  
512 especially as has been highlighted in this paper with regard to product labelling. The official  
513 controls in Poland are also supported by the EU RASFF system that focuses on the entry and  
514 exit of safe and legal food into and across the European market.

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

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

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

<b>Bread (139 cases)</b>		
Type of irregularity	No of cases	Share of the bread cases
Missing items in the list of ingredients, i.e. bread improver, constituents of a compound ingredient (usually bread improver), ascorbic acid, food additives approved for use, anti-mould substance).	67	48.2%
A lack off, or incorrect description of bread type e.g. type of flour used, e.g. mixed, wheat or rye	44	31.7%
Storage conditions and durability - no information about 'use-by date'/storage conditions	16	11.5%
Method of production – unfounded claim 'no bread improvers', 'no preservatives', 'no chemical additives', 'rustic', 'home', 'traditional recipe', etc.	14	10.1%
Declaration of ingredients not used in the production process	13	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 flour, sunflower seeds, soybeans	11	7.9%
Understatement of net weight	9	6.5%

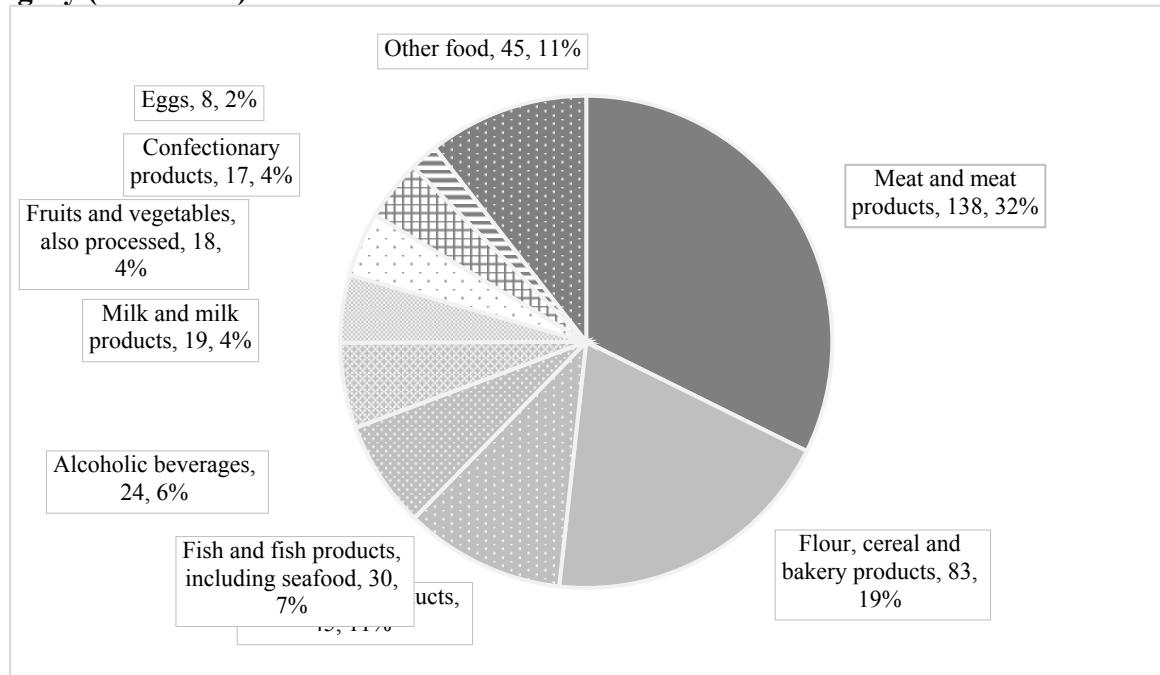
719 **Source: Own elaboration based on <http://www.ijhar-s.gov.pl>.**720 **Table 2. Main irregularities detected by IJHARS in adulterated pasta (2010-2017)**

<b>Pasta (34 cases)</b>		
Type of irregularity	No of cases	Share of the pasta 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	7	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	4	11.8%

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

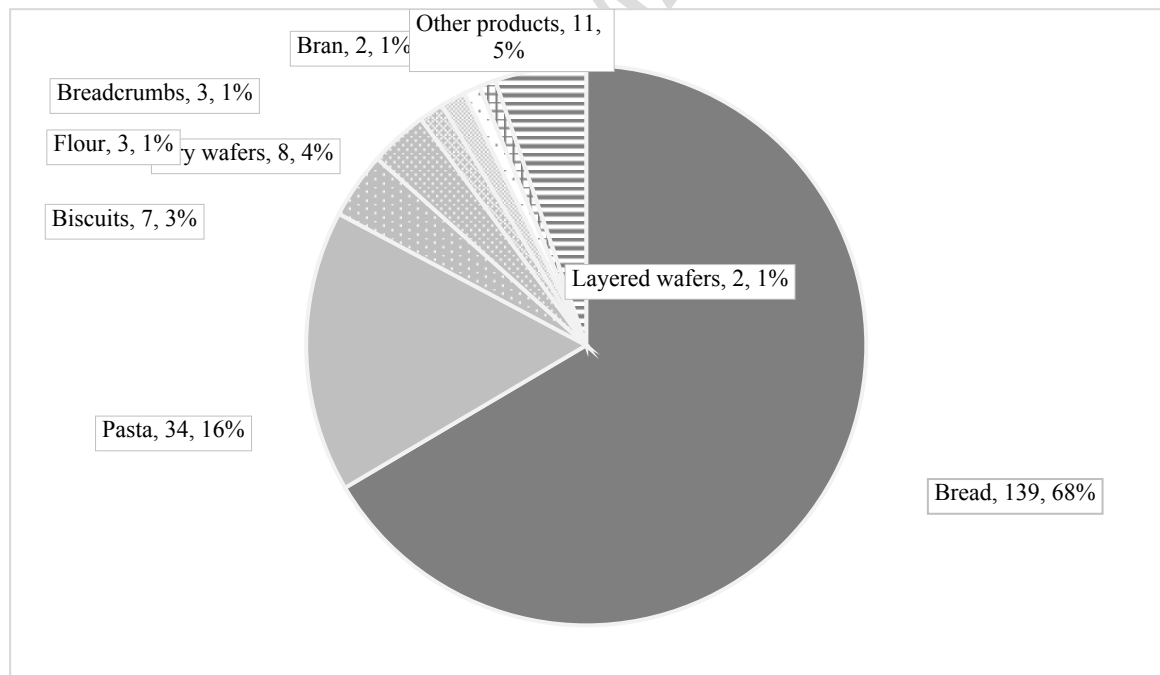
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724 **Figure 1. IJHARS administrative decisions concerning adulteration per product**  
 725 **category (2013-2017)**



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

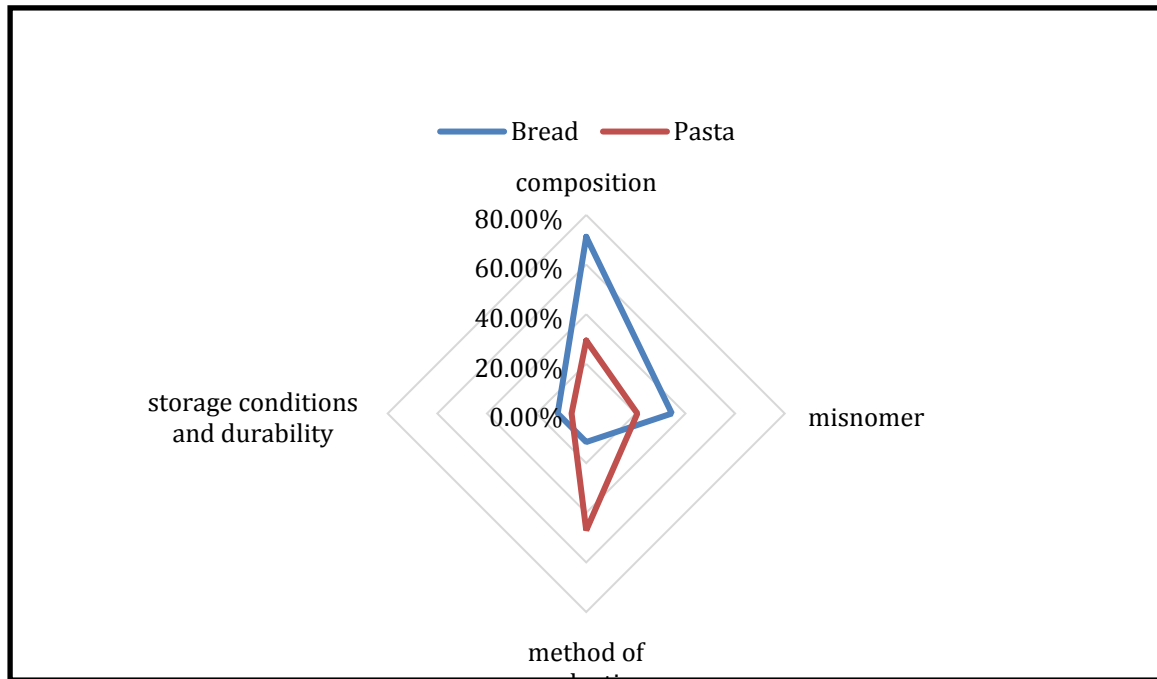
728 **Figure 2. Reported types of cereal and bakery products in Poland in 2010-2017 within**  
 729 **IJHARS administrative decisions concerning adulterated agri-food items**



730  
 731 **Source: Own elaboration based on <http://www.ijhar-s.gov.pl>.**

732

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



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

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