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Frequency of consumption of coffee beverages in the city of Mostar and caffeine intake

Aiša Širbegović¹, Aida Šukalić^{1*}, Maida Đapo-Lavić², Alma Mičijević¹, Alma Leto¹

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Abstract

The aim of this study was to examine the frequency of consumption of coffee beverages in the city of Mostar. In 2019, an analysis of caffeine content was performed on HPLC in 10 different samples of coffee beverages.

Samples of coffee were taken from the market of the city of Mostar by random selection. In addition to the High-performance liquid chromatography (HPLC) method, the study was conducted using empirical and descriptive methods. An assessment of daily (EDI) and weekly intake (EWI) was also performed were on the base of determined values of caffeine content in 10 different coffee samples.

The acute toxic dose of caffeine is not well defined, but it is considered more than 10 grams of caffeine per day for adults, while in most countries it is not recommended that more than 450 mg of caffeine be consumed per day.

The samples were found to be in accordance with the EFSA Scientific Opinion (European Food Safety Authority) stating that a single dose of 200 mg of caffeine from all sources does not pose a risk to the health of healthy adults (EFSA, 2015).

Key words: Coffee, caffeine, acute toxic dose, risk.

Introduction

Coffee is a universal product, represents a special category of beverages and can be consumed on all occasions (Fujioka and Shibamoto, 2008; Ferraz et al., 2010; Martins and Gloria, 2010; Misik et al., 2010). Coffee has long been valued for its taste and, more importantly, stimulating effect. Given the tradition of drinking coffee in our society and the large number of different types of coffee available

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on the domestic market, determining the amount of caffeine intake is of great importance (Kaloper, 2017).

Caffeine is the most popular natural stimulant, a plant alkaloid that has a positive effect on mental and physical functions. Although it is found in about 60 plant species, caffeine is most often ingested by consuming coffee, tea, Coca-Cola, products with guarana extract, and more recently by consuming energy drinks, the consumption of which is continuously growing. However, due to the potential health risks of caffeine consumption, it is extremely important to take care of the amounts consumed (Ivančić, 2017).

Caffeine, a natural alkaloid in coffee

Caffeine is an alkaloid that we consume daily in the form of coffee, tea, cola drinks and chocolate. Caffeine has been found (identified) in about 60 plant species, and is most prevalent in coffee, tea, and cocoa beans. Caffeine is the most widely used psychoactive substance in the world (Ogawa et al., 2007). It belongs to a group of compounds known as alkaloids. It is one of the most diverse groups of secondary metabolites found in living organisms and has a wide range of types of structures, biosynthetic pathways, and pharmacological activities (Roberts, 2013). Alkaloids are complex organic heterocyclic and basic compounds that contain nitrogen in their structure and after introduction into the body exhibit specific pharmacological and toxicological action.

Caffeine is the most widely used central nervous system (CNS) stimulant in the world (Institute of Medicine Staff, 2001).

Although 400 mg of caffeine a day is a "safe" amount for adults, it does not have to be "safe" for children and adolescents (Health Canada, US. Food and Drug Administration (FDA 2012), European Food Safety Authority, U.S. Dietary 4 Guidelines for Americans). The biggest problem with caffeine is that it will dehydrate the body anyway, and that dehydration can be serious, even deadly. In addition, caffeine is addictive, so the more it is consumed, the more it is needed to maintain the "excited" state of the body (Parker, 2008).

The mass of caffeine in one cup of coffee (volume about 240 mL) is usually about 80 mg, although it can vary from 5 to 190 mg depending on the method of preparation as well as depending on the size of the cup itself. Regular coffee consumers usually take in about 256 mg of caffeine a day (on average 4.3 mg of caffeine per 1 kg of body weight (bw or BW) for a person who weighs 60 kg), although this number for 90 % of coffee consumers is between 5 and 7 mg per kg body weight. Most studies indicate that caffeine intake of 400 mg or less per day does not have a negative impact on health for most consumers. Since caffeine occurs naturally in tea and coffee, it is difficult to determine the maximum allowable levels of caffeine for them. But for products where caffeine is not naturally present, there are some limitations in most countries. Interestingly, there is no upper limit for caffeine in the European Union for products with the same, but products containing more than 150 mg/L must be mentioned to have a high caffeine content (Kaloper, 2017).

Different methods of preparing a coffee beverage affect the caffeine content in the beverage. For example, filter coffee contains 0.67 g of caffeine in 1 liter of beverage, flour 2.36 g/L, and a beverage obtained by brewing ground coffee, such as "Turkish" coffee, contains 0.57 g/L of caffeine. When preparing an espresso beverage, the extraction of caffeine from coarsely ground coffee in the filtration process is not complete. The reason for this is the short period of time for the separation of caffeine from the cell structure. Therefore, the concentration of caffeine in espresso varies from 1.2 g/L to 4 g/L, depending on the size of the cup and the composition of the mixture (Clarke and Vitzthum, 2001). The acute toxicity of caffeine is not well defined, but it is considered to be worrying more than 10 grams of caffeine per day for adults, while in most countries does not recommend consuming more than 450 mg of caffeine a day (Heckman et al., 2010).

Health Canada has recommended a maximum caffeine intake of 2,5 mg/kg body weight / day for children under 12 (Health Canada 2012).

Bühler et al. in 2013, they conducted a study on the content of caffeine in food and beverage samples. For the first time, a tool (a questionnaire with a calculation program) was developed and validated to assess caffeine intake among adolescents and young adults. This has been shown to be applicable in surveys of more than 200 students. The average caffeine intake during the working day was between 105 mg and 130 mg. Coffee was the main source.

Total daily caffeine intake has remained stable in the last 10–15 years, and coffee, tea and soft drinks are the most important caffeine sources (Verster, Joris C et al., 2018).

Although there are cases where consumption of very high dosages of caffeine has led to seizures, transient cardiovascular problems, and even deaths (Cappelletti et al. 2018., vKRR et al. 2018.) comprehensive reviews have concluded that consumption of < 400 mg/day is generally safe, enhances certain aspects of mental, physical, and occupational performance, and may confer other health benefits (Dietary Guidelines Advisory Committee, 2016., Nawrot et al., 2003., Wikoff et al. 2017).

Scientific Opinion on the Safety of Caffeine (EFSA, 2015)

At the request of the European Commission, EFSA's Scientific Committee on Dietary Products, Nutrition and Allergies (NDA) has developed a Scientific Opinion on the Safety of Caffeine (EFSA, 2015), which assessed acute and daily caffeine intake that does not pose a risk to general healthy population.

The main source of caffeine in the diet of adults is coffee, it is estimated that the daily intake in EU member states ranges from 0.5 to 4.6 mg of caffeine / kg bw, in adolescents it is chocolate (0.4 to 1.4 mg / kg bw), and in children chocolate, teas and soft drinks (from 0.2 to 2 mg / kg bw).

Given the available data from studies on the effects of caffeine on the cardiovascular system, central nervous system (e.g., insomnia and nervousness) and possible risks to fetal health in pregnant women, the EFSA Committee reached the following conclusions:

Table 1. *Different doses of caffeine intake and health risks*

A single dose of caffeine of 100 mg (about 1.4 mg / kg bw)	may affect the length of sleep in some adults, especially when consumed just before bedtime
Daily intake of up to 400 mg (about 5.7 mg / kg bw)	does not pose a risk to the health of healthy adults, except pregnant women
Daily intake of caffeine from all sources up to 200 mg	does not pose a risk to the fetus, i.e., pregnant, and lactating women
A single dose of caffeine of 200 mg (about 3 mg / kg bw) from all sources	does not pose a risk to the health of healthy adults

Consumption of other ingredients of energy drinks in concentrations common to such beverages does not affect the safety of consuming a single dose of caffeine up to 200 mg.

Materials and methods

Laboratory analyses

The analysis of caffeine content was performed in the laboratory of the Faculty of Teacher Education of the University "Džemal Bijedić" in Mostar by the method of the High-performance liquid chromatography (HPLC). The analysis was performed on a chromatograph model SHIMADZU USA: SCL - 10A VP during 2019 on 10 samples of coffee beverages. For this purpose, 10 different samples of coffee and coffee beverages were selected from the market.

Samples

As material, 10 samples of coffee from the stores of the city of Mostar were used:

1. Sample No.1: JACOBS 3 IN 1, Country of origin: Amsterdam, The Netherlands, Usable until: 14.11.2020, Amount: 15.2 g
2. Sample No.2: NESCAFE MACCHIATO 3 IN 1, Country of origin: Romania, Usable until: 2 months 2020., Quantity: 15.00 g
3. Sample No.3: NESCAFE 3 in 1 Classic, Country of origin: Romania, Usable up to: 6 months. 2020, Amount: 17.5 g
4. Sample No.4: NESCAFE classic strong and rich, Country of origin: Spain, Usable until: 4 months 2020., Quantity: 2 g} × 2
5. Sample No.5: NESCAFE 3 In 1 strong, Country of origin: Hungary, Usable until: 10 months 2020., Quantity: 18 g
6. Sample No.6: Franck I LOVE CAFE 3 IN 1 INSTANT MIX, Country of origin: Croatia, Usable until: 24.10.2020, Quantity: 18 g
7. Sample No.7: El Cafe classic 3 in 1, Country of origin: Turkey, Usable until: 12 months 2020., Quantity: 18 g

8. Sample No. 8: Franck CREMA, Country of origin: Croatia, Usable until: 15.12.2019., Quantity: 9 g
9. Sample No. 9: Zlatna Džezva, Country of origin: BiH, Usable until: 4 month 2020., Quantity: 8 g
10. Sample No.10: Grand black and easy, Country of origin: Serbia, Usable until: 11.04.2020., Quantity: 8 g.

Procedure

Preparation of the mobile phase

We prepared a 20:80 (v / v) solution of methanol, and chromatographic conditions were set. LC pump flow was set as follows: 1 mL / min., UV wavelength VIS 278nm, injection volume 10 μ L, column C 18250x4.6 mm.i.d.

After setting all the conditions, the pump was started, the method was loaded and the mobile phase was left to pass through the column for at least 10 min. The baseline had to be stable before injecting standards and samples.

1. Preparation of standard solutions

A baseline caffeine standard of 0.02 g was prepared by dissolving the analytical standard of caffeine in 100 mL of deionized water.

Solutions of standard concentrations were used for calibration purposes and were prepared with contractions of 5, 20, 15, 20 and 25 ppm by diluting the stock solution in a 100 mL volumetric vessel.

2. Sample preparation

For the purpose of the analytical balance the weight of 3-5 g of the sample has to be weighted.

This amount of weighted sample has to be transferred to a 250 mL beaker and poured with 200 mL of boiling water and allowed to stand in a covered vessel for 5 min. Then it should be filtered into a 250 mL beaker.

3. Determination of caffeine content in samples

A series of standards and samples in triplicates in the HPLC system has to be injected and recorded in the chromatograms.

The height and area of the peaks from the chromatograms was determined. Based on the data for standard solutions, two calibration curves were constructed: a) dependence of the peak area (cm²) on the concentration (mg / mL) and b) dependence of the peak height (cm) on the concentration (mg / mL). The direction equation for both calibration curves and the caffeine content in the samples were determined (Figure 1).

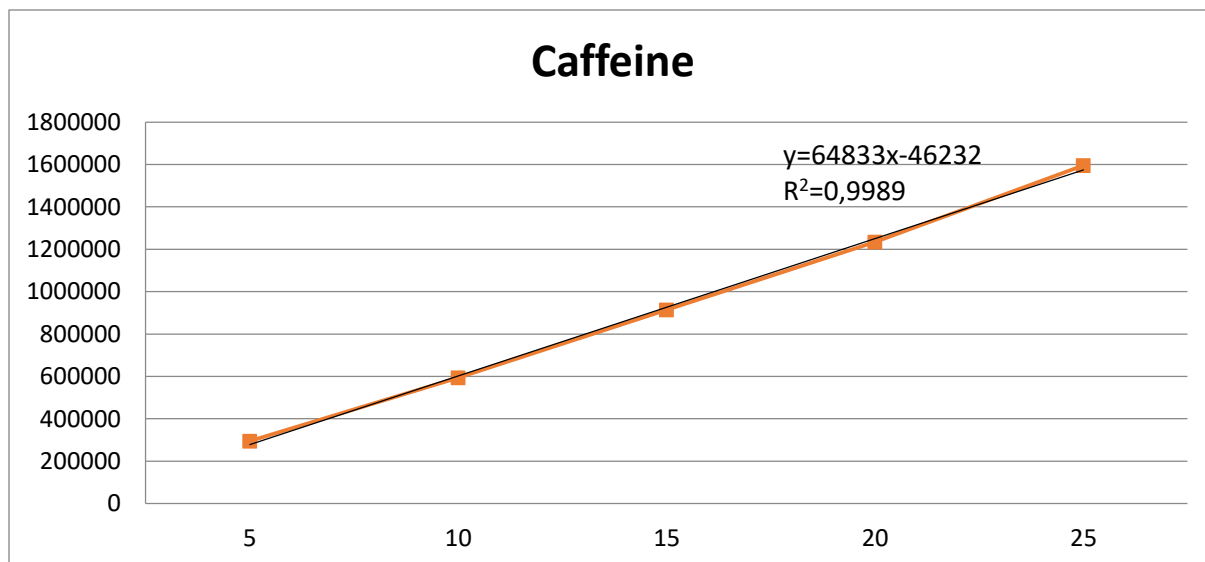


Figure1. Calibration curve of caffeine standard readings

Survey on coffee consumption

The survey was conducted in B&H on a sample of 328 respondents aged between 16 to more than 60 years old. Internet surveys were used in the form of filling out a questionnaire consisting of 9 questions. The survey on the frequency of caffeine consumption and knowledge of the negative effects of caffeine was conducted in 2019.

Table 2. *Questionnaire*

1. Gender	M Ž
2. Age	a) 10-15 b) 16-20 c) 21-30 d) 31-40 e) 41-50 f) 51-60 g) more than 60
3. Degree of education	a) primary school b) high school c) bachelor e) Master of Science f) Doctor of Science
4. Status	a) student b) unemployed c) employed d) retiree
5. How often do you consume coffee or instant coffee drinks?	a) every day b) 3-5 times a week c) 1-3 times a week e) 3-5 times a week

6. The amount of coffee you drink per day (suppose one serving is 100 mL)	a. 100 mL b. 150 mL c. 200 mL d. 300 mL e. 400 mL
7. What is your reason for consuming coffee or instant coffee drinks?	a. improving physical endurance b. maintaining alertness c. increase mental and cognitive abilities d. I like the taste e. out of habit
8. Are you aware of the harmful effects of high caffeine intake?	a) Yes b) No.
9. What amount of daily caffeine intake do you consider harmful?	a) 50 mg b) 100 mg c) 200 mg d) 300 mg e) 500 mg f) 1000 mg d) I don't know

The frequency of consuming coffee and coffee beverages in the wider area of Mostar was determined through the realization of the set goals. The results of the survey indicated how familiar the respondents are with the amounts of caffeine that is harmful to acute and chronic coffee intake.

EDI and EWI of caffeine consumption

The formula recommended by the US EPA (1992) was used in the calculation of the average daily and weekly intake. The calculation of the risk assessment due to the exposure of the examined population was done based on a survey that included 328 respondents.

$$EDI = CxUd / BW$$

$$EWI = CxUW / BW$$

C- average concentration of caffeine

The calculation of EDI and EWI was done based on the responses from the survey on average daily acute (228,01mL) and average weekly chronic (852,88mL) intake.

$$Ud - 228,01 \text{ mL} *$$

$$Uw - 852,88 \text{ mL} *$$

BW- body weight for adults according to WHO

* Intake of coffee drinks daily and weekly based on survey responses.

Results and discussion

The caffeine content in the samples ranged from 205.96 – 701.68 g /L. The highest content of caffeine was read in the sample of coffee No. 9 Zlatna džezva 701.68 g/L, and in the sample no. 8 Franck creme 656.22 g/L. This is followed by sample no. 4 Nescafe strong and rich 512.84 g/L, sample no. 10 Grand black and easy 481.87 g/L, sample no. 1 Jacobs 490,15 g/L, sample no. 7 El Caffè classic 383.90 g/L, sample no. 5 Nescafe strong 371.63 g/L, sample no. 3 Nescafe 3in1 classic 282.77 g/L, sample no. 6 Franck 3in1 247.22 g/L, and sample no. 2 Nescafe 3in1 205.96 g/L.

In a study of the caffeine content of espresso coffee, Desbrow et al. in 2012, 131 samples of espresso coffee were collected in Australia, where caffeine values ranged from 107 ± 37 mg per serving, and caffeine concentrations were 2550 ± 1030 mg/L.

Table 3. Caffeine reading on HPLC (g /L), EDI and EWI

Samples	x(g/L)	g/mL	EDI mg / kg body weight	EWI mg / kg body weight
1.Jacobs	490.15	0.49	1.82	29.02
2.Nescafe 3u1	205.96	0.206	0.76	12.20
3.Nescafe 3u1 classic	282.76	0.283	1.05	16.76
4.Nescafe strong and rich	512.84	0.512	1.90	30.33
5.Nescafe strong	371.63	0.372	1.38	2.04
6.Franck 3u1	247.22	0.247	0.92	14.63
7.El Caffè classic	383.90	0.384	1.43	22.75
8.Franck creme	656.22	0.656	2.44	38.86
9.Zlatna džezva	701.68	0.702	2.61	41.58
10.Grand black and easy	481.87	0.482	1.79	28.55

The average daily intake of EDI was done based on a survey from all coffee beverage samples that do not exceed the recommended values prescribed by EFSA (2015) about 3 mg/kg bw. EDI values ranged from highest to lowest Zlatna džezva (2.60 mg/kg BW) > Franck creme (2.44 mg/kg BW) > Nescafe strong and rich (1.90 mg / kg BW) > Jacobs (1.82 mg/kg BW) > Grand black and easy (1.79 mg/kg BW) > El Caffè classic (1.43 mg/kg BW) > Nescafe strong (1.38 mg/kg BW) > Nescafe 3in1 classic (1.05 mg /kg BW) > Franck 3in1 (0.92 mg/kg BW) > Nescafe 3in1 (0.76 mg/kg BW).

EWI values followed the same principle. Zlatna džezva (41.58 mg /kg BW) > Franck creme (38.86 mg /kg BW) > Nescafe strong and rich (30.32 mg / kg BW) > Jacobs (29.02 mg / kg BW) > Grand black

and easy (28.55 mg/kg BW) > El Caffè classic (22.75 mg /kg BW) > Nescafe strong (22.03 mg/kg BW) > Nescafe 3in1 classic (16.76 mg/kg BW) > Franck 3in1 (14.63 mg/kg BW) > Nescafe 3in1 (12.20 mg / kg BW).

In 2015, Shatha et al investigated the caffeine content of beverages commonly consumed in Jordan. 167 samples were collected from the market in Amman. The caffeine content was determined by high performance liquid chromatography (HPLC). Caffeine concentrations ranged from 12.37 to 194.61 mg/100 mL in coffee samples which is in correspondence with the study conducted in this research. Espresso coffee and Turkish coffee had the highest caffeine content (194,6 and 146,6 mg/100 mL). This is the first study on caffeine content in the Arab world.

The intake of caffeine in the diet of the Hungarian population was estimated based on data from the National Nutrition Survey in 2009. The daily intake of caffeine in adult Hungarian men and women was $147 \pm 6,2$ mg per capita and $138 \pm 4,2$ mg per capita. There was no significant gender difference. The eldest men and women consumed significantly less caffeine than people aged between 35 to 64 years old. The main sources of caffeine are coffee and tea with 58-59 % and 35-37 % of the total intake in men and women (Lugasi et al. 2015).

Based on statistical data processing by one-factor analysis of the significance of differences (ANOVA), a statistically highly significant difference in caffeine content was found in different samples of coffee beverages ($F > F_{crit.}$) $F = 8.30$; $p = 4.57E-05$. After that, the Tukey - Kramer test was performed to confirm the statistical significance in the measurements. Sample no.9. compared to all other samples showed a statistically highly significant difference in caffeine content

Table 4. ANOVA statistical significance level of 0,05

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	74.72148	9	8.302387	8.302387	4.58E-05	2.392814108
Within Groups	20	20	1			
Total	94.72148	29				

The survey was conducted on a total of 328 respondents, 62 men (19 %) and 266 women (81 %). As many as 72 % (238) of the respondents are aged 21-30, i.e., younger.

Out of a total of 328 respondents, 179 or 54 % have a bachelor's degree, while 16 % have a master's degree in survey research, and it can be assumed that their knowledge of caffeine and its harmful effects on health should be at an enviable level.

As many as 74 % of respondents consume coffee every day, which shows that coffee is a beverage that is often consumed in our country, 241 respondents every day (74 %)

Considering that the trend of drinking coffee is very popular in Bosnia and Herzegovina, and that coffee is drunk from traditional cups, cups of various servings (from 50 mL - 200 mL), this question is formulated under the assumption of one serving of 100 mL. Most respondents drink 200 mL of coffee a day.

In order to get information of the reasons to why they drink coffee or instant coffee drinks, the most answers were related to habits, as many as 119 of them. 99 respondents said the reason for consumption was because they like the taste, and 57 to maintain alertness.

In the research of the ISIC Institute for Scientific Information on the habit of consuming coffee at the workplace from 2017, they state that the main reasons for drinking coffee at work were: taste (56 %); use time for breaks and rest to drink or prepare coffee (40 %); and to keep them awake (29 %). Given that more than a quarter of respondents said they drink coffee to feel more alert, this indicates that people choose coffee to keep them awake at work.

Regarding the question of how much the respondents are aware of the harmful effects of high caffeine intake, most of them are familiar with the harmful effects, which is 214 respondents or 65 %. Considering that the largest number of respondents were aged between 21-30, and that they have a university degree, it is a devastating fact that 35 % are not aware of the negative effects of caffeine on human health.

118 respondents answered that they do not know what daily amount of caffeine is harmful to health, which is 36 %. It is also a devastating fact that a large number of respondents are younger and highly educated people who consume the drink daily without knowing the harmful consequences of high caffeine intake. This is certainly a worrying fact because in 2015, EFSA issued a statement that a single dose of 200 mg of caffeine from all sources does not pose a risk to the health of healthy adults. (EFSA, 2015).

In Brazil, daily caffeine intake per person is estimated at 115.7 mg, ranging from 84.7 mg for children and adolescents aged 10 to 13, to 139.8 mg for the uneducated. The percentage of people whose daily caffeine intake is higher than 400 mg is up to 3.0 %, according to age groups. Men and individuals living in the northeastern or southern part of the region or in the states of Minas Gerais, Rio de Janeiro and Espírito Santo are likely to consume higher amounts of caffeine. The main food sources are coffee (63.1 %) and coffee with milk (24.9 %), soft drinks Cola (3.6 %) and yerba mate (1.9 %) Alan G. et al. 2016.).

Conclusion

A study on the frequency of consumption of coffee and caffeinated beverages was conducted during 2019 using the method of empirical research, descriptive research and HPLC method (high performance liquid chromatography method) to determine the caffeine content in various coffee samples.

The caffeine content in the samples ranged from 205,96 – 701,68 g /L. The highest content of caffeine was read in the sample of coffee Zlatna džezva 701,6755 g/l, and in the sample Franck creme 656,22 g /L.

Based on statistical data processing by one-factor analysis of the significance of differences (ANOVA), a statistically highly significant difference in caffeine content was found in different samples of coffee beverages ($F > F_{crit.}$) $F = 8,30$; $p = 4,57E-05$.

EDI values ranged from highest to lowest Zlatna džezva (2,60 mg / kg BW) > Franck creme (2,44 mg / kg BW) > Nescafe strong and rich (1,90 mg / kg BW) > Jacobs (1,82 mg/kg BW) > Grand black and easy (1,79 mg/kg BW) > El Caffè classic (1,43 mg / kg BW) > Nescafe strong (1,38 mg / kg BW) > Nescafe 3in1 classic (1,05 mg / kg BW) > Franck 3in1 (0,92 mg / kg BW) > Nescafe 3in1 (0,76 mg / kg BW).

The average daily intake of EDI was done by the basic research survey of all samples of coffee beverages that do not exceed the recommended values determined by the EFSA (2015), about 3 mg / kg BW.

A total dietary study has not been conducted in Bosnia and Herzegovina, and these data suggest the need for the same. There are many different types of coffee drinks, as well as the ways of their preparation and ritual of consumption, which primarily depends on the tradition and culture of society, but also on the habits of consumers. This data can serve as a basis for some other research in the field of food safety.

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Analysis of RASFF notifications on cereals and cereal-based products contaminated with mycotoxins in the period from 01/01/2015 to 31/12/2019

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Abstract

The Rapid Alert System for Food and Feed (RASFF) is designed to respond promptly to the health risks associated with food, food contact materials or feed by enabling fast exchange of information between bodies and institutions involved in the system. Mycotoxins, secondary metabolites produced by moulds, are common contaminants found in cereals and cereal-based product all over the world that can be harmful to human (and animal) health. The aim of this study was to analyse RASFF notifications on cereals and cereal-based products contaminated with mycotoxins in the period from 01/01/2015 to 31/12/2019. All data were downloaded from the RASFF database (RASFF portal) and processed in MS Excel 2010. The collected data provided information on the: notifying country, country(ies) of origin and distribution of the contaminated product, notification basis, notification type, risk decision, distribution status, action taken, type of mycotoxin and specific cereal or cereal-based product in which the mycotoxin has been determined. Nearly half of the reported food products originated from Italy, Pakistan, India, Serbia and Sri Lanka. More than half notifications were published by Germany, Switzerland, Italy and Belgium. Only in less than one-fifth of the notifications the country of origin of the contaminated product was also the notifying country. Contaminated products in more than two-thirds of cases were maize, rice and rye grains and their products. Aflatoxin B1 was the most frequent mycotoxin, present in more than two-fifths of contaminated cereals and cereal-based products. The majority of the notifications were classified as alert notifications and a large majority of total number of notifications were of serious risk. Regarding

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the distribution status, over two-fifths of contaminated products were distributed to other member countries and in almost half of the notifications contaminated products were withdrawn or recalled.

Key words: RASFF, notifications, cereals and cereal-based products, mycotoxins.

Introduction

The Rapid Alert System for Food and Feed (RASFF), run by the European Commission, is designed to respond promptly to the health risks associated with food, food contact materials or feed by enabling fast exchange of information between bodies and institutions involved in the system which in case of health risk initiate an immediate notification procedure (EC, 2020a; EC 2020b). Mycotoxins are secondary metabolites produced by moulds and are common contaminants of food and feed, found in cereals all over the world (Peraica et al. 2002; Pleadin et al., 2017). The production of mycotoxins is greatly influenced by environmental factors and physical and chemical properties of cereals too (Delaš, 2010; Cvjetković, 2014). The most significant mycotoxin producing moulds, especially on cereals, are species from the genera *Penicillium*, *Aspergillus* and *Fusarium* (Jašić, 2009; Cvjetković, 2014). Mycotoxins like aflatoxins, ochratoxin A, trichothecenes type A and B, fumonisins, zearalenone, ergot alkaloids and *Alternaria* toxins are commonly detected in cereal grains and their high levels have been reported in cereal grains and cereal-based products (van den Brand and Bulder, 2020). Mycotoxins can accumulate in the body through a longer period of consumption of lower concentrations of mycotoxin-contaminated food, or can be ingested with a single meal with a higher concentration of mycotoxins, both resulting in mycotoxicosis, chronic or acute, respectively. Mycotoxins can have cytotoxic, carcinogenic, mutagenic, genotoxic, teratogenic, immunotoxic, hematotoxic, hepatotoxic, nephrotoxic and dermatotoxic effects to humans and animals (Jašić, 2009; Delaš, 2010). Aflatoxins are produced by some moulds of the genus *Aspergillus*, *Penicillium* and *Fusarium* (Delaš, 2010). They represent a group of 20 related compounds, among which the most significant representatives are aflatoxins B1, B2, G1, G2, M1 and M2, of which aflatoxin B1 is a contaminant of various foods, very potent toxin, carcinogenic and genotoxic substance, and there is no actual safe level of intake (Peraica and Rašić, 2012; EC, 2020b). Ochratoxin A is produced by fungi of the genus *Aspergillus* and *Penicillium* and found as a contaminant in various foods. It is a not confirmed genotoxic carcinogen (EC, 2017) but is classified as "possibly carcinogenic to humans" and highly harmful to human health. *Fusarium* mould growth is typically linked to cereal products. The toxins produced are known as fumonisins, a group of 15 compounds of which three are the most common: fumonisins, B1, B2 and B3. The legal limits for these toxins are much higher than those for other mycotoxins because of their relatively lower toxicity (Delaš, 2010; EC, 2017). Type A trichothecene mycotoxins, such as T-2 toxin and its main metabolite HT-2 toxin, are produced by *Fusarium* moulds and are primarily found in cereals and cereal-based products and are commonly more toxic than type B trichothecenes, such as deoxynivalenol (DON) (Pleadin et al., 2017; Arcella et

al., 2017). Zearalenone is mycotoxin produced by several species of *Fusarium* moulds. It has significant effects on female reproduction, causing hyperestrogenism, but it also has an impact on the male reproductive system. Zearalenone is classified in IARC group⁷ 3 but recent reports indicate that it poses a serious threat to human health (Gupta et al., 2018). Preventing the growth of moulds as well as the formation of mycotoxins can be achieved by applying a series of measures of good agricultural practice and good production practice (pre-harvest, harvest and post-harvest measures) (Delaš, 2010; Cvjetković, 2014). Physical and chemical methods of food and feed decontamination could be applied as well as processing that might have a different effect on the degradation, transformation, and modification of mycotoxins (Peraica et al. 2002; Sarmast et al., 2021). All decontamination techniques of food and feed, which are far from ideal due to possible occurrence of mycotoxin residues and metabolites as well as food and feed degradation, raise production costs and ought to only be used when preventive agro-technical measures, crucial for crop protection against contamination by mycotoxins, have failed (Peraica et al. 2002). According to European Commission (EC, 2016; EC, 2017; EC, 2019b; EC, 2020b) mycotoxins are the most reported type of hazard for products from non-member countries. Only for the year 2017 the number of notifications on pathogenic micro-organisms in food from non-member countries was higher than the number on mycotoxin contamination reported cases (EC, 2019a). The aim of this study was to analyse RASFF notifications on cereals and cereal-based products contaminated with mycotoxins in the period from 01/01/2015 to 31/12/2019.

Materials and methods

All data on notifications for the presence of mycotoxins in cereals and cereal-based products were downloaded from the RASFF portal database (EC, 2020c) and processed in MS Excel 2010 (univariate descriptive statistics) (Microsoft Corporation). The search criteria were as follows: "Product type: food", "Hazard category: mycotoxins", "Notified from: 01/01/2015", "Notified till: 31/12/2019" and "Product category: Cereals and bakery products". The collected data provided information on the: notifying country, country(ies) of origin and distribution of the contaminated product, notification basis, notification type, risk decision, distribution status, action taken, type of mycotoxin and specific cereal or cereal-based product in which the mycotoxin has been determined.

Results and discussion

In the period from 01/01/2015 to 31/12/2019 a total of 132 RASFF notifications were published on cereals and cereal-based products contaminated with mycotoxins. Germany was notifying country in 16.7 % of the published notifications, followed by Switzerland (15.9 %), Italy (11.4 %) and Belgium

⁷ International Agency for Research on Cancer: Group 1: carcinogenic; Group 2A: probably carcinogenic; Group 2B: possibly carcinogenic; Group 3: not classifiable; Group 4: probably not carcinogenic.

(9.1 %) what makes them notifying countries in more than half (53.1 %) of cases. Other countries that participated as notifying countries in more than 5% of published notifications each were Luxembourg (7.6 %), Slovenia (6.8 %) and France (5.3 %) (Table 1.). Contaminated products in question originated in 16 RASFF member countries and 16 RASFF non-member countries. The country of origin of cereals and cereal-based products contaminated with mycotoxins in 15.2 % of notifications was Italy, then Pakistan, India, Serbia and Sri Lanka in 9.1 %, 8.3 %, 8.3 % and 7.6 % of notifications, respectively. Only in 18.9 % of total notifications the country of origin of the contaminated product was also the notifying country. If we observe the same only for RASFF member countries, the result is better, 36.2 %, but still indicative suggesting that public health threats were not recognized in the shortest timeframe possible. In 8.3 % of cases two countries were countries of origin of the contaminated product and in 1.5 % of cases three countries were countries of origin. In 1.5 % of cases the county of origin of contaminated product was not determined (Table 2.).

Table 1. RASFF notifications on cereals and cereal-based products contaminated with mycotoxins in the period from 01/01/2015 to 31/12/2019 by year and notifying country.

Notifying country		Year and number of notifications					Total	
		2015	2016	2017	2018	2019	No.	%
1. Austria		0	1	0	0	1	2	1.5
2. Belgium		5	0	2	2	3	12	9.1
3. Croatia		2	0	0	1	1	4	3.0
4. Czech Republic		0	0	1	0	0	1	0.8
5. Denmark		0	0	2	0	1	3	2.3
6. Finland		1	1	0	2	0	4	3.0
7. France		3	0	2	0	2	7	5.3
8. Germany		3	6	2	7	4	22	16.7
9. Hungary		0	1	0	2	2	5	3.8
10. Ireland		0	0	1	0	0	1	0.8
11. Italy		4	3	3	2	3	15	11.4
12. Luxembourg		4	5	0	0	1	10	7.6
13. Malta		1	0	0	0	0	1	0.8
14. Netherlands		0	1	0	0	0	1	0.8
15. Poland		1	0	1	3	4	9	6.8
16. Portugal		0	0	0	0	1	1	0.8
17. Slovakia		1	0	0	0	0	1	0.8
18. Slovenia		2	3	2	0	2	9	6.8
19. Spain		0	0	0	1	0	1	0.8
20. Sweden		0	1	0	0	0	1	0.8
21. Switzerland		3	3	6	7	2	21	15.9
22. United Kingdom		1	0	0	0	0	1	0.8
Total	No.	31	25	22	27	27	132	100
	%	23.5	18.9	16.7	20.5	20.5	100	

Table 2. Countries of origin of cereals and cereal-based products contaminated with mycotoxins in RASFF notifications in the period from 01/01/2015 to 31/12/2019 (% of cases).

Country of origin	% of cases
1. Argentina	0.8
2. Austria	0.8
3. Belgium	4.5
4. Bosnia and Herzegovina	0.8
5. Canada	1.5
6. Czech Republic	6.1
7. Ethiopia	0.8
8. France	5.3
9. Germany	6.1
10. Ghana	2.3
11. Greece	0.8
12. Hungary	2.3
13. India	8.3
14. Italy	15.2
15. Kosovo	0.8
16. Lithuania	0.8
17. Myanmar	1.5
18. Netherlands	1.5
19. Pakistan	9.1
20. Poland	5.3
21. Portugal	4.5
22. Romania	0.8
23. Russia	0.8
24. Serbia	8.3
25. Sri Lanka	7.6
26. Sweden	0.8
27. Switzerland	2.3
28. Syria	0.8
29. Thailand	0.8
30. Turkey	2.3
31. United Kingdom	3.0
32. United States of America	2.3
33. Unknown origin	1.5

RASFF notifications on the presence of mycotoxins in cereals and cereal-based products in the period from 01/01/2015 to 31/12/2019 mostly referred to maize and maize-based products (31.1 %), rice and rice-based products (30.3 %), then rye and rye-based products (8.3 %), wheat and wheat-based products (7.6 %), oat and oat-based products (4.5 %), buckwheat and buckwheat-based products (3.8 %), barley and barley-based products (2.3 %) and millet flour (0.8 %). In the remaining cases of contaminated cereal-based products the exact cereal was not specified (RASFF Portal, 2020). Aflatoxin B1 was the most frequent mycotoxin, present in 43.2 % of cases of contaminated cereals and cereal-based products, followed by ochratoxin A (28.8 % of cases), deoxynivalenol (DON) (18.9 % of cases), fumonisins (12.1 % of cases), zearalenone (3.8 % of cases) and T-2 with HT-2 toxin (3.8 % of cases). In addition to the already mentioned T-2 toxin and its metabolite HT-2 toxin, in ten more cases

food products were contaminated with two mycotoxins (aflatoxin B1 + ochratoxin A; aflatoxin B1 + fumonisins; DON + ochratoxin A; DON + fumonisins; DON + zearalenone) (Table 3.).

Table 3. Mycotoxins present in cereals and cereal-based products according to RASFF notifications in the period from 01/01/2015 to 31/12/2019 (% of cases).

Mycotoxin	% of cases		
	Total	In specific cereal or cereal-based products	
1. Aflatoxin B1	43.2	Rice and rice-based products	26.5
		Maize and maize-based products	11.4
		Biscuits and pastry	2.3
		Wheat-based products	0.8
		Millet flour	0.8
		Barley	0.8
		Muesli	0.8
2. Ochratoxin A	28.8	Rye and rye-based products	8.3
		Rice and rice-based products	4.5
		Buckwheat and buckwheat-based products	3.8
		Wheat and wheat-based products	3.8
		Maize and maize-based products	1.5
		Barley-based products	1.5
		Oat and oat-based products	1.5
		Breakfast cereals	1.5
		Porridge	1.5
		Bread crumbs	0.8
3. Deoxynivalenol (DON)	18.9	Maize and maize-based products	9.8
		Wheat and wheat-based products	5.3
		Oat and oat-based products	1.5
		Breakfast cereals	1.5
		Bread crumbs	0.8
4. Fumonisins	12.1	Maize and maize-based products	12.1
5. Zearalenone	3.8	Maize-based products	3.0
		Oat muesli	0.8
6. T-2 and HT-2 toxin	0.8	Oat flour	0.8

The majority of RASFF notifications on cereals and cereal-based products contaminated with mycotoxins in the period from 01/01/2015 to 31/12/2019 were classified as alert notifications (59.1 %) and 90.2 % of total number of notifications were of serious risk. Nearly half of the mycotoxin notifications were based on official controls on the market (46.2 %), 29.5 % were based on border control and 23.5 % were based on company's own check. Regarding the distribution status, 43.2 % of contaminated products were distributed to other member countries and in 47.0 % of the notifications contaminated products were withdrawn or recalled (Table 4.).

Table 4. RASFF notifications on cereals and cereal-based products contaminated with mycotoxins in the period from 01/01/2015 to 31/12/2019 by notification type, risk decision, notification basis, distribution status and action taken.

Notification type / Total	Risk decision/ Total	Notification basis/ Total	Distribution status and Action taken
Alert notification (78; 59.1 %)	Serious (75)	Official control on the market (41)	Distribution restricted to notifying country (7) No distribution from notifying country (4) Distribution to other member countries (30)
			Destruction (1) Detained by operator (2) Informing recipient(s) (2) Official detention (1) Public warning - press release (1) Re-dispatch (2) Return to consignor (2) Recall from consumers (19) Withdrawal from recipient(s) (1) Withdrawal from the market (10)
		Company's own check (27)	Distribution restricted to notifying country (8) Distribution to other member countries (15) No distribution from notifying country (3) No distribution to notifying country (1)
			Destruction (1) Detained by operator (3) Informing authorities (1) Informing recipient(s) (3) No action taken (1) Official detention (1) Recall from consumers (5) Re-dispatch (2) Return to consignor (1) Use in feed (1) Withdrawal from the market (7) ND (1)
		Border control (7)	Distribution to other member countries (6) Distribution restricted to notifying country (1)
			Informing consignor (1) Informing recipient(s) (1)
			No action taken (2) Official detention (1) Recall from consumers (1) Use for other purpose than food/feed (1)
	Not Serious (0)	-	-
	Undecided (3)	Official control on the market (2)	Distribution restricted to notifying country (1) No distribution from notifying country (1) Recall from customers (1) Return to consignor (1)
		Company's own check (1)	Distribution to other member countries (1) Informing recipients (1)
Border rejection (26; 19.7 %)	Serious (24)	Border control (24)	Product allowed to travel to destination under customs seals (6) Product not (yet) placed on the market (18) Destruction (4) Import not authorised (1)

Notification type / Total	Risk decision/ Total	Notification basis/ Total	Distribution status and Action taken
			Official detention (6) Physical/chemical treatment (1) Placed under customs seals (3) Re-dispatch (7) Return to consignor (2)
	Not serious (1)	Border control (1)	Product allowed to travel to destination under customs seals (1) Placed under customs seals (1)
	Undecided (1)	Border control (1)	Product allowed to travel to destination under customs seals (1) Use for other purpose than food/feed (1)
	Serious (20) (21; 15.9 %)	Official control on the market (13)	Distribution restricted to notifying country (10) Distribution to non-member countries (1) Product (presumably) no longer on the market (2) No stock left (1) Public warning - press release (1) Recall from consumers (5) Withdrawal from the market (4) ND (2)
			Distribution to non-member countries (1) Product (presumably) no longer on the market (1) Official detention (1) Public warning - press release (1)
			Distribution restricted to notifying country (5) Official detention (1) Recall from consumers (3) Withdrawal from the market (1)
		Company's own check (2)	Distribution to non-member countries (1) Product (presumably) no longer on the market (1) Official detention (1) Public warning - press release (1)
		Border control (5)	Distribution restricted to notifying country (5) Official detention (1) Recall from consumers (3) Withdrawal from the market (1)
	Not Serious (0)	-	-
	Undecided (1)	Border control (1)	Distribution restricted to notifying country (1) Official detention (1)
Information notification for follow-up (7; 5.3 %)	Serious (0)	-	-
	Not Serious (1)	Consumer complaint (1)	Distribution to other member countries (1) No action taken (1)
	Undecided (6)	Official control on the market (5)	Distribution to other member countries (4) No distribution from notifying country (1) Destruction (1) Withdrawal from the market (4)
			Distribution restricted to notifying country (1) Recall from consumers (1)
		Company's own check (1)	Distribution restricted to notifying country (1) Recall from consumers (1)
Total	Total	Total	Total
Alert notification (59.1 %)	Serious (90.2 %)	Official control on the market (46.2 %)	Distribution restricted to notifying country (25.8 %) Distribution to non-member countries (2.3 %) Distribution to other member countries (43.2 %) Informing recipients (0.8 %) No distribution from notifying country (6.8 %) No distribution to notifying country (0.8 %) Product (presumably) no longer on the market (2.3 %)
Border rejection (19.7 %)	Not Serious (1.5 %)	Company's own check (23.5 %)	
Information notification for attention (15.9 %)	Undecided (8.3 %)	Border control (29.5 %)	

Notification type / Total	Risk decision/ Total	Notification basis/ Total	Distribution status and Action taken
Information notification for follow-up (5.3 %)		Consumer complaint (0.8 %)	Product allowed to travel to destination under customs seals (4.5 %) Product not (yet) placed on the market (13.6 %)
			Total Destruction (5.3 %) Detained by operator (3.8 %) Import not authorised (0.8 %) Informing authorities (0.8 %) Informing consignor (0.8 %) Informing recipient(s) (5.3 %) No action taken (3.0 %) No stock left (0.8 %) Official detention (9.1 %) Physical/chemical treatment (0.8 %) Placed under customs seals (3.0 %) Public warning - press release (2.3 %) Recall from customers (26.5 %) Re-dispatch (8.3 %) Return to consignor (4.5 %) Use for other purpose than food/feed (1.5 %) Use in feed (0.8 %) Withdrawal from recipient(s) (0.8 %) Withdrawal from the market (19.7 %) ND (2.3 %)

Note: ND = no data available;

Conclusion

In the period from 01/01/2015 to 31/12/2019 a total of 132 RASFF notifications were published on cereals and cereal-based products contaminated with mycotoxins. Nearly half of the reported food products originated from Italy (15.2 %), Pakistan (9.1 %), India (8.3 %), Serbia (8.3 %) and Sri Lanka (7.6 %). More than half notifications were published by Germany (16.7 %), Switzerland (15.9 %), Italy (11.4 %) and Belgium (9.1 %). Only in less than one-fifth of the notifications the country of origin of the contaminated product was also the notifying country suggesting that public health threats were not recognized in the shortest timeframe possible. Contaminated products in more than two-thirds of cases were maize and maize-based products (31.1 %), rice and rice-based products (30.3 %), and rye and rye-based products (8.3 %). Aflatoxin B1 was the most frequent mycotoxin, present in 43.2 % of cases of contaminated cereals and cereal-based products. The majority of the notifications were classified as alert notifications (59.1 %) and 90.2 % of total number of notifications were of serious risk. Nearly half of the mycotoxin notifications were based on official controls on the market (46.2 %). Regarding the distribution status, 43.2 % of contaminated products were distributed to other member countries, which is worrying, as well is the fact that contaminated products were virtually available to consumers. In 47.0 % of the notifications, contaminated products were

withdrawn or recalled. We will refer to the conclusion of Friganović et al. (2019) that the aforementioned does not cast doubt upon RASFF system's efficacy in responding rapidly to health threats, but highlights the need to strengthen the preventive role of the competent authorities and food business operators themselves.

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**Analysis of RASFF notifications on allergens in cereals and cereal-based products in the
period from 01/01/2015 to 31/12/2019**

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Abstract

The aim of this study was to analyse RASFF notifications on allergens in cereals and cereal-based products in the period from 01/01/2015 to 31/12/2019. Allergies caused by food intake due to the presence of an allergen can pose a serious danger to the health of consumers. In order to promptly respond to any health risks related to food, food contact materials, or feed, The Rapid Alert System for Food and Feed (RASFF) enables quick information exchange between the bodies and institutions involved in the system. All data on allergens in cereals and cereal-based products were downloaded from the RASFF database (RASFF portal) and processed in MS Excel 2010. The collected data provided information on the: notifying country, country(ies) of origin and distribution of the food product in question, notification basis, notification type, risk decision, distribution status, action taken, allergen present and respective food product. More than half of the reported food products originated from Italy, Germany, United Kingdom and Netherlands. Almost half of notifications were published by United Kingdom, Germany, Italy and Spain. The most common allergens were milk, gluten and soya. Products in question in more than two-fifths of cases were pastry (sweet or savoury). The majority of the notifications were classified as alert notifications and a vast majority of total number of notifications were of serious risk. Allergen notifications were mainly based on official controls on the market and on company's own check but some were based on food poisoning. Just over two-thirds of products in question were distributed to other (member and non-member) countries and in over two-thirds of the notifications products in question were withdrawn or recalled.

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Key words: RASFF, notifications, cereals and cereal-based products, allergens.

Introduction

Some particular foods or food components may not be ingested, digested, absorbed, and/or metabolized by all people without causing adverse reactions (Brouns et al., 2019). There are two types of adverse reactions to food: toxic and non-toxic. Adverse non-toxic reactions can be allergic or non-allergic, i.e. those mediated and those not-mediated by immunoglobulin E (IgE) antibodies (Bošnjir et al., 2009). Food allergies are characterized as an adverse health effect resulting from a particular immune response that happens, reproducibly, upon exposure to a particular food (Waserman et al., 2018; Boyce et al., 2010 as cited in Licari et al., 2019).

Food allergies and anaphylaxis are becoming public health problem of increasing prevalence. There is still no cure for food allergies, despite the high disease burden and potential for fatal consequences. Allergen avoidance, symptomatic treatment, and having an auto-injector on hand in case of reaction are the standards of allergen management (Nowak-Węgrzyn et al., 2016, as cited in Tan-Lim and Esteban-Ipac, 2018; Feuille and Nowak-Węgrzyn, 2018; Waserman et al., 2018). Solely allergen-specific immunotherapy has been identified as the most forthcoming therapeutic approach in the treatment of food allergies (Tan-Lim and Esteban-Ipac, 2018; Licari et al., 2019).

For people who have food allergies, food allergen labelling is a crucial tool for lowering exposure risk and preventing anaphylaxis. Information on potential allergen presence (or substances with an intolerance effect) should be given to enable consumers to make informed choices which are safe for them. *Any ingredient or processing aid listed in Annex II of the Regulation (EU) No 1169/2011 or derived from a substance or product listed in Annex II causing allergies or intolerances used in the manufacture or preparation of a food and still present in the finished product, even if in an altered form* shall be mandatory food information (Regulation (EU) No 1169/2011). Cereals represent the main component of human nutrition in the world, whether consumed directly as a food product or indirectly as components of animal feed (Campbell et al., 1997). As a means to protect the health of consumers, it is highly desirable to know how to recognize potential allergens in production of the staples of our food, cereals and cereal-based products, and to properly inform consumers.

In order to promptly respond to any health risks related to food, food contact materials, or feed, The Rapid Alert System for Food and Feed (RASFF) enables quick information exchange between the bodies and institutions involved in the system which in the event of a health risk initiates an immediate notification procedure (EC, 2020a; EC 2020b). According to European Commission (EC, 2016; EC, 2017; EC, 2019a; EC, 2019b; EC, 2020b) in the period from 01/01/2015 to 31/12/2019 consumers suffered from allergic reactions as a result of the presence of an allergen that was not listed on the label and insufficient labelling not mentioning a potential allergen can be the cause of food poisoning.

Many times, traces of allergens were notified, which occur in foods by reason of cross-contamination. Some of RASFF alert notifications on allergens were linked to fraudulent activities. Milk, soya, nuts and gluten were the most commonly reported allergens. Cereals and bakery products were the most often notified regarding allergens except in 2018 when prepared dishes and snacks were the most often notified food containing allergens. Numerous notifications on allergens imply that considerable endeavour is required to provide better protection of consumers suffering from food allergies. As some of the food poisoning cases in 2015 demonstrated, it can be difficult to assess the risk of allergens because some consumers may react to very low quantities.

The aim of this study was to analyse RASFF notifications on allergens in cereals and cereal-based products in the period from 01/01/2015 to 31/12/2019.

Materials and methods

All data on notifications for the presence of allergens in cereals and cereal-based products were downloaded from the RASFF portal database (EC, 2020c) and processed in MS Excel 2010 (univariate descriptive statistics) (Microsoft Corporation). The search criteria were as follows: "Product type: food", "Hazard category: allergens", "Notified from: 01/01/2015", "Notified till: 31/12/2019" and "Product category: Cereals and bakery products". Notifications that did not relate to cereals (including pseudocereals) and their products were omitted during data processing. The search was repeated with the same criteria for two more hazard categories: "Hazard category: composition", "Hazard category: labelling absent/incomplete/incorrect" whereby the notifications that referred to allergens were singled out for further data processing. The collected data provided information on the: notifying country, country(ies) of origin and distribution of the food product in question, notification basis, notification type, risk decision, distribution status, action taken, allergen present and respective food product.

Results and discussion

A total of 160 RASFF notifications were published on allergens in cereals and cereal-based products in the period from 01/01/2015 to 31/12/2019. Four countries were notifying countries in 49.4 % of cases. United Kingdom was notifying country in 18.8 % of the published notifications, followed by Germany (10.6 %), Italy (10.6 %) and Spain (9.1 %). Other countries that participated as notifying countries in more than 5 % of published notifications each were Sweden (7.5 %), Netherland (6.8 %) and Denmark (5.6 %) (Table 1.). Products in question originated in 20 RASFF member countries and 15 RASFF non-member countries. The country of origin of products in question in 15.6 % of notifications was Italy, then Germany, United Kingdom and Netherlands in 14.4 %, 11.9 % and 9.4 % of notifications, respectively (Table 2.). Although in 43.1 % of total notifications the country of

product origin was also the notifying country, in 95.6 % of these cases product in question was distributed to other countries (to member countries – 88.4 %; to non-member countries – 7.2 %) and needed to be recalled (58.0 %) or withdrawn (23.2 %) (RASFF Portal, 2020). This points to the conclusion that the threats to public health were not promptly identified. In 89.5 % of its own cases, as a country of product origin, United Kingdom is also the notifying country. For Italy, Germany and the Netherlands, these numbers are lower, 52.0 %, 47.8 % and 46.7 %, respectively. Two countries were countries of origin of the product in question in 3.8 % of cases (Table 2.).

Table 1. RASFF notifications on allergens in cereals and cereal-based products in the period from 01/01/2015 to 31/12/2019 by year and notifying country.

Notifying country	Year and number of notifications					Total	
	2015	2016	2017	2018	2019	No.	%
1. Austria	0	1	0	0	1	2	1.3
2. Belgium	0	0	0	1	2	3	1.9
3. Cyprus	2	0	0	0	0	2	1.3
4. Czech Republic	2	2	1	1	2	8	5.0
5. Denmark	1	1	3	2	2	9	5.6
6. Estonia	0	1	0	0	0	1	0.6
7. Finland	2	0	0	1	1	4	2.5
8. France	2	1	1	2	0	6	3.8
9. Germany	0	9	2	3	3	17	10.6
10. Ireland	2	0	1	0	2	5	3.1
11. Italy	1	4	5	4	3	17	10.6
12. Malta	0	2	0	0	1	3	1.9
13. Netherlands	1	1	4	3	2	11	6.9
14. Poland	1	0	0	0	0	1	0.6
15. Slovakia	0	2	3	2	0	7	4.4
16. Slovenia	3	0	0	1	1	5	3.1
17. Spain	2	2	1	4	6	15	9.4
18. Sweden	1	3	2	2	4	12	7.5
19. Switzerland	0	0	1	0	1	2	1.3
20. United Kingdom	5	5	5	7	8	30	18.8
Total	No.	25	34	29	33	39	160
	%	15.6	21.3	18.1	20.6	24.4	100

Table 2. Countries of origin regarding RASFF notifications on allergens in cereals and cereal-based products in the period from 01/01/2015 to 31/12/2019 (% of cases) with an indication in how many of subject cases (for a particular country) the country of origin was also the notifying country.

Country of origin		Country of origin = Notifying country
Countries	% of total cases	% of subject cases
1. Australia	0.6	-
2. Austria	2.5	25.0
3. Belgium	2.5	-

Country of origin		Country of origin = Notifying country
Countries	% of total cases	% of subject cases
4. Bosnia and Herzegovina	0.6	-
5. Brazil	0.6	-
6. Bulgaria	1.3	-
7. Canada	0.6	-
8. China	1.9	-
9. Czech Republic	2.5	-
10. Denmark	2.5	50.0
11. Estonia	0.6	-
12. Finland	0.6	100
13. France	5.0	37.5
14. Germany	14.4	47.8
15. Greece	1.3	-
16. Hungary	1.3	-
17. India	0.6	-
18. Indonesia	0.6	-
19. Ireland	1.3	100
20. Italy	15.6	52.0
21. Lebanon	0.6	-
22. Netherlands	9.4	46.7
23. Poland	4.4	14.3
24. Republic of North Macedonia	0.6	-
25. Romania	1.9	-
26. Slovakia	0.6	100
27. Spain	4.4	85.7
28. Sweden	3.8	66.7
29. Taiwan	0.6	-
30. Thailand	3.1	-
31. Tunisia	1.3	-
32. Turkey	3.1	-
33. Ukraine	0.6	-
34. United Kingdom	11.9	89.5
35. Vietnam	0.6	-

The most common allergens in RASFF notifications on allergens in cereals and cereal-based products in the period from 01/01/2015 to 31/12/2019 were milk, gluten and soya in 24.4 %, 23.1 % and 15.0 % of published notifications, respectively. In some food products in question more than one allergen was an issue (Table 3.). Allergens were either undeclared as an ingredients, or possible traces of allergen were undeclared, or presence of allergens as contaminants was determined, or content of allergens was too high in allergen-free products, or wrong allergen was labelled instead of the correct one, or wrong product was labelled (the one containing allergen(s)), or information on allergens was not available in the language of the country where the product is sold (insufficient labelling, incorrect labelling, absence of allergen labelling) (RASFF Portal, 2020). Notifications on allergens were related to the following grouped products: "pastry (sweet or savoury)" in 43.1 % of cases, "breakfast cereals (muesli, cereal flakes), cereal bar, muesli bar" in 12.5 % of cases, "grains, flour, gluten" in 10.6 % of

cases, "pasta" in 9.4 % of cases, "cookies and wafers" in 9.4 % of cases, "bread, toast and bagels" in 8.1 % of cases and "crackers and snack food" in 6.3 % of cases (Table 3.).

Table 3. Allergens in RASFF notifications on allergens in cereals and cereal-based products in the period from 01/01/2015 to 31/12/2019

Allergens	% of cases		
	Total	In specific cereal or cereal-based products	
1. Milk	24.4	Pastry (sweet or savoury)	14.4
		Breakfast cereals (muesli, cereal flakes), cereal bar, muesli bar	1.9
		Bread, toast and bagels	2.5
		Cookies and wafers	2.5
		Crackers and snack food	1.3
		Grains, flour, gluten	1.3
		Pasta	0.6
2. Gluten	23.1	Pastry (sweet or savoury)	8.8
		Grains, flour, gluten	4.4
		Pasta	3.8
		Bread, toast and bagels	1.9
		Crackers and snack food	1.9
		Breakfast cereals (muesli, cereal flakes), cereal bar, muesli bar	1.3
		Cookies and wafers	0.6
		Cereal product*	0.6
3. Soya	15.0	Pastry (sweet or savoury)	3.8
		Grains, flour, gluten	3.1
		Breakfast cereals (muesli, cereal flakes), cereal bar, muesli bar	2.5
		Pasta	2.5
		Bread, toast and bagels	1.9
		Cookies and wafers	0.6
		Crackers and snack food	0.6
4. Eggs	7.5	Pastry (sweet or savoury)	3.1
		Cookies and wafers	2.5
		Pasta	1.9
5. Sesame	5.6	Bread, toast and bagels	1.9
		Breakfast cereals (muesli, cereal flakes), cereal bar, muesli bar	1.9
		Pastry (sweet or savoury)	1.9
6. Wheat	5.0	Grains, flour, gluten	1.9
		Pasta	1.3
		Pastry (sweet or savoury)	1.3
		Crackers and snack food	0.6
7. Mustard	3.1	Crackers and snack food	1.3
		Pastry (sweet or savoury)	1.3
		Grains, flour, gluten	0.6
8. Barley	1.9	Breakfast cereals (muesli, cereal flakes),	0.6

Allergens	% of cases		
	Total	In specific cereal or cereal-based products	
		cereal bar, muesli bar	
		Crackers and snack food	0.6
		Pastry (sweet or savoury)	0.6
9. Sulphite	1.3	Cookies and wafers	0.6
		Grains, flour, gluten	0.6
10. Celery	0.6	Crackers and snack food	0.6
11. Crustaceans	0.6	Pastry (sweet or savoury)	0.6
12. ND**	1.3	Pastry (sweet or savoury)	1.3

Note: ND = no data available

* Product was not specified in notification but allergen was (subject: too high content of gluten in gluten-free cereal product)

** Allergen not specified in notification (subject: insufficient labelling)

The majority of RASFF notifications on allergens in cereals and cereal-based products in the period from 01/01/2015 to 31/12/2019 were classified as alert notifications (84.4 %) and 97.5 % of total number of notifications were of serious risk. More than two-fifths of the allergen notifications were based on official controls on the market (44.4 %), 40.0 % were based on company's own check and 8.8 % were based on consumer complaint. It is worrying that in 3.8 % of cases allergen notifications were based on food poisoning. Regarding the distribution status, 68.2 % of products in question were distributed to other (member and non-member) countries and in 68.8 % of the notifications products in question were withdrawn or recalled (Table 4.).

Table 4. RASFF notifications on allergens in cereals and cereal-based products in the period from 01/01/2015 to 31/12/2019 by notification type, risk decision, notification basis, distribution status and action taken.

Notification type / Total	Risk decision/ Total	Notification basis/ Total	Distribution status and Action taken
Alert notification (135; 84.4 %)	Serious (135)	Official control on the market (58)	Distribution to other member countries (37)
			Distribution restricted to notifying country (9)
			No distribution from notifying country (8)
			No distribution to other member countries (3)
			Distribution to non-member countries (1)
		Official control in non-member country (1)	Withdrawal from the market (24)
			Recall from customers (16)
			Withdrawal from recipient(s) (6)
			Public warning - press release (3)
		Company's own check (58)	Relabelling (3)
			Informing recipient(s) (3)
			Detained by operator (1)
			Informing authorities (1)
			ND (1)
		Company's own check (58)	Distribution to other member countries (1)
			Recall from customers (1)
			Distribution to other member countries (49)
			Distribution restricted to notifying country (5)
			No distribution from notifying country (4)

Notification type / Total	Risk decision/ Total	Notification basis/ Total	Distribution status and Action taken
			Recall from customers (36) Withdrawal from the market (8) Public warning - press release (5) Informing recipient(s) (5) Relabelling (1) Return to consignor (1) ND (2)
		Consumer complaint (12)	Distribution to other member countries (9) Distribution restricted to notifying country (3) Recall from customers (8) Withdrawal from the market (1) Withdrawal from recipient(s) (1) Public warning - press release (1) Informing recipient(s) (1)
		Food poisoning (6)	Distribution to other member countries (6) Withdrawal from the market (3) Public warning - press release (1) Recall from customers (1) ND (1)
		Not Serious (0)	-
		Undecided (0)	-
Border rejection (4; 2.5 %)	Serious (3)	Border control (3)	Product not (yet) placed on the market (3) Relabelling (2) Re-dispatch (1)
	Not Serious (0)	-	-
	Undecided (1)	Border control (1)	Product not (yet) placed on the market (1) Relabelling (1)
Information notification for attention (18; 11.3 %)	Serious (18)	Official control on the market (10)	Distribution restricted to notifying country (7) Distribution to non-member countries (2) Product (presumably) no longer on the market (1) Recall from customers (3) Withdrawal from the market (3) Relabelling (3) Informing recipient(s) (1)
		Company's own check (6)	Distribution restricted to notifying country (4) Distribution to non-member countries (2) Recall from customers (3) Public warning - press release (2) Informing authorities (1)
		Consumer complaint (2)	Product (presumably) no longer on the market (1) Distribution to non-member countries (1) Recall from customers (2)
	Not Serious (0)	-	-
	Undecided (0)	-	-
Information notification for follow-up (3; 1.9 %)	Serious (0)	-	-
	Not Serious (3)	Official control on the market (3)	Distribution to other member countries (1) No distribution from notifying country (1) Information on distribution not (yet) available (1)
			Withdrawal from the market (1) Return to consignor (1) Informing recipient(s) (1)
	Undecided (0)	-	-

Notification type / Total	Risk decision/ Total	Notification basis/ Total	Distribution status and Action taken
Total	Total	Total	Total
Alert notification (84.4 %)	Serious (97.5 %)	Official control on the market (44.4 %)	Distribution to other member countries (64.4 %) Distribution restricted to notifying country (17.5 %) Distribution to non-member countries (3.8 %)
Information notification for attention (11.3 %)	Not Serious (1.9 %)	Company's own check (40.0 %)	No distribution from notifying country (8.1 %) No distribution to other member countries (1.9 %)
Border rejection (2.5 %)	Undecided (0.6 %)	Consumer complaint (8.8 %)	Product not (yet) placed on the market (2.5 %) Product (presumably) no longer on the market (1.3 %)
Information notification for follow-up (1.9 %)		Food poisoning (3.8 %)	Information on distribution not (yet) available (0.6 %)
		Border control (2.5 %)	Recall from customers (43.8 %) Withdrawal from the market (25.0 %) Public warning - press release (7.5 %) Informing recipient(s) (6.9 %)
		Official control in non-member country (0.6 %)	Relabelling (6.3 %) Withdrawal from recipient(s) (4.4 %) Informing authorities (1.3 %) Return to consignor (1.3 %) Detained by operator (0.6 %) Re-dispatch (0.6 %)
			ND (2.5 %)

Note: ND = no data available;

Conclusion

In the period from 01/01/2015 to 31/12/2019 a total of 160 RASFF notifications were published on allergens in cereals and cereal-based products. In 51,3 % of cases reported food products originated from Italy (15.6 %), Germany (14.4 %), United Kingdom (11.9 %) and Netherlands (9.4 %). Almost half of notifications were published by United Kingdom (18.8 %), Germany (10.6 %), Italy (10.6 %) and Spain (9.1 %). The most common allergens in RASFF notifications on allergens in cereals and cereal-based products in the period from 01/01/2015 to 31/12/2019 were milk, gluten and soya in 24.4 %, 23.1 % and 15.0 % of published notifications, respectively. Whatever was the reason for the publication of the notification related to food allergens, ultimately, consumers were not informed about the substance (potential allergens) in food that may pose a danger to their health. The majority of the notifications were classified as alert notifications (84.4 %) and 97.5 % of total number of notifications were of serious risk. More than two-fifths of the allergen notifications were based on official controls on the market (44.4 %), two-fifths were based on company's own check. It is worrying that in 3.8 % of cases allergen notifications were based on food poisoning. Products in

question were in 68.2 % of cases distributed to other (member and non-member) countries, which is troublesome because threats to public health were not timely identified, as well is the fact that these products were available to consumers. In 68.8 % of the notifications, products in question were withdrawn or recalled. We will advert to the conclusion of Friganović et al. (2019) that the previously stated underlines the need to build up the preventive role of the competent authorities and food business operators themselves.

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**Proizvodnja, svojstva i upotreba magarećeg mlijeka (u prehrambene
i kozmetičke svrhe)**

Production, properties and use of donkey milk (for food and cosmetic purposes)

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Sažetak

Magarci se od davnina koriste kao radne životinje, dok se danas najčešće uzgajaju za proizvodnju magarećeg mlijeka, naročito na obiteljskim poljoprivrednim gospodarstvima kao važna sirovina u kozmetici i medicini te kao zamjena za humano mlijeko u prehrani novorođenčadi. Mlijeko magarica kao kvalitetna nutritivna namirnica koristi se za jačanje imunološkog sustava i liječenja nekih oboljenja, napose respiratornog sustava i kožnih oboljenja. Kozmetički proizvodi koji sadrže magareće mlijeko, kao što su kreme, sapuni, šamponi itd. njeguju i štite zdravu kožu te liječe problematičnu. Najčešća prodaja je na samom obiteljskom gospodarstvu zahvaljujući današnjoj internetskoj prodaji, sajmovima, dok su neki od tih proizvoda i u samim trgovačkim lancima. U budućnosti je svakako potrebna daljnja promidžba istoga, kao i sama edukacija budućih farmjera.

Ključne riječi: magarci, magareće mlijeko, kozmetika od magarećeg mlijeka.

Abstract

Donkeys have long been used as working animals, while today they are most often bred for the production of donkey milk, especially on family farms as an important raw material in cosmetics and medicine and as a substitute for human milk in the diet of newborns. Donkey's milk as a quality nutritional food is used to strengthen the immune system and treat some diseases, especially the respiratory system and skin diseases. Cosmetic products that contain donkey's milk, such as creams, soaps, shampoos, etc. nourish and protect healthy skin and treat problematic skin. The most common

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sales are on the family farm itself, thanks to today's online sales, fairs, while some of these products are in the retail chains themselves. In the future, further promotion of the same is definitely needed, as well as the education of future farmers.

Key words: donkeys, donkey milk, cosmetic products with donkey milk.

Uvod

Od davnina se magarac koristio kao radna životinja, međutim unapređenjem poljoprivredne mehanizacije, takvo iskorištavanje postupno iščezava. Tako kroz povijest nailazimo na brojne zapise o uporabi magarećeg mlijeka, kada se koristilo u medicinske te prehrambene i kozmetičke svrhe. Jedan od zapisa govori o tome, kako se Kleopatra kupala u magarećem mlijeku kako bi sačuvala svoju ljepotu. Kostić (2015) u svom radu navodi kako se u području Dalmacije mlijeko kobila i magarica tradicionalno koristilo kao pomoć pri liječenju bolesti dišnih putova posebice kod djece (hripavac i sl.). U današnje vrijeme sve više se koristi u kozmetičkoj industriji gdje se pokazalo veoma efikasno kod problema s kožom. Sa napredovanjem tehnologije u zemljama Europe, prvenstveno u Italiji, Francuskoj i Španjolskoj polako se razvijaju proizvodi koji sadrže određene količine magarećeg mlijeka.

Hrvatska održavanje populacije magaraca podupire različitim poticajnim mjerama koje država dodjeljuje, a od posebnog interesa je podupiranje programa gospodarske aktivacije. Također, jedan od gospodarskih programa koji zadnjih godina najviše pobuđuje pozornost jest proizvodnja mlijeka magarica (Ivanković i sur., 2009). Po svojem sastavu, magareće mlijeko je najbližije humanom te se zbog svojih dijetetskih i ljekovitih svojstava može rabiti umjesto majčinog kada ono nije dostupno. Posebno se to odnosi na količinu bjelančevina i laktoze što poboljšava apsorpciju kalcija u crijevima i pridonosi okoštavanju kostiju. Specifičnosti sastava magarećeg mlijeka čini udio bjelančevina sirutke, lizozima, α -laktalbumina i β -laktoglobulina. Magareće mlijeko, zahvaljujući svom sastavu i niskom udjelu kazeina i β -laktoglobulina, predstavlja odgovarajuću zamjenu za humano mlijeko u dojenčadi alergične na kravlje mlijeko, te isto tako najbolji izbor kod slučajeva višestruke prehrambene netolerancije, pa ga mnogi nazivaju i funkcionalnom hranom (Mansueto i sur., 2013). Najbolja proizvodnja mlijeka kod magarica je u periodu kad ona ima pule, a to je zapravo vrijeme laktacije koje dolazi nakon razdoblja pripreme (gestacije) koje traje se u prosjeku od 305 do 390 dana (Šlogar i sur., 2013).

Magarci

Već stoljećima magarci su prisutni u našim krajevima kao radna snaga. S vremenom se broj populacije magaraca u Hrvatskoj mijenjao tako je populacija magaraca 1937. u Hrvatskoj brojila 40.000 grla (Babić 1939. prema Caput i sur., 2010), no kako se kroz stoljeća poljoprivreda modernizirala i počela

koristiti mehanizaciju tako su i magarci prestali biti glavna radna snaga pa se njihov broj smanjivao i padao iz godine u godinu.

Magarac se često koristi za prijevoz robe i hrane u područjima gdje nema struje ili transporta. Čovjek je na magarcu u prošlosti često dopremao žito u mlin i na njivu i ljetinu doma, dok se u nekim nerazvijenim i neprohodnim sredinama i danas magarac koristi kao osnovni prijevoz robe, hrane i slično. Magarac je u Dalmaciji i Istri te u ostalim mediteranskim zemljama oduvijek bio prepoznatljiv turistima svojim izgledom, ali i po poznatim nadimcima - kao 'tovar', 'kenjac', 'živinče', 'sivac'. Ljudi magarca i dan danas od milja zovu 'magare', 'dugouško' i slično. Također, danas je magarac u Dalmaciji pojam turističke ponude pa ga tako turističke agencije tiskaju na razglednicama, turističkim prospektima, u monografijama i na raznim web-stranicama (Musulin, 2013).

Magarac je kroz povijest sudjelovao u svakodnevnom životu kao radna životinja (slika 1.), za prijenos hrane i vode, robe, ali i ljudi do određenog mjesta. Kao radna životinja koristio se više nego konj jer ima živahniji korak, veću brzinu hoda i veću upornost u radu što je zapravo sve suprotno od uvjerenja da su magarci tvrdoglavi i lijeni. S dolaskom automobila i strojeva uloga magarca kao radne snage je postajala sve manje bitna. Tako je iskoristivost magarca danas vrlo mala, ali se ta životinja i dalje drži iz ljubavi, hobija i entuzijazma (Ernoić i sur., 2001).



Slika 1. Primorsko-dinarski magarac (izvor: <https://www.agroportal.hr/zanimljivosti/28127.>)

Figure 1. Littoral-Dinaric donkey (Source: <https://www.agroportal.hr/zanimljivosti/28127.>)

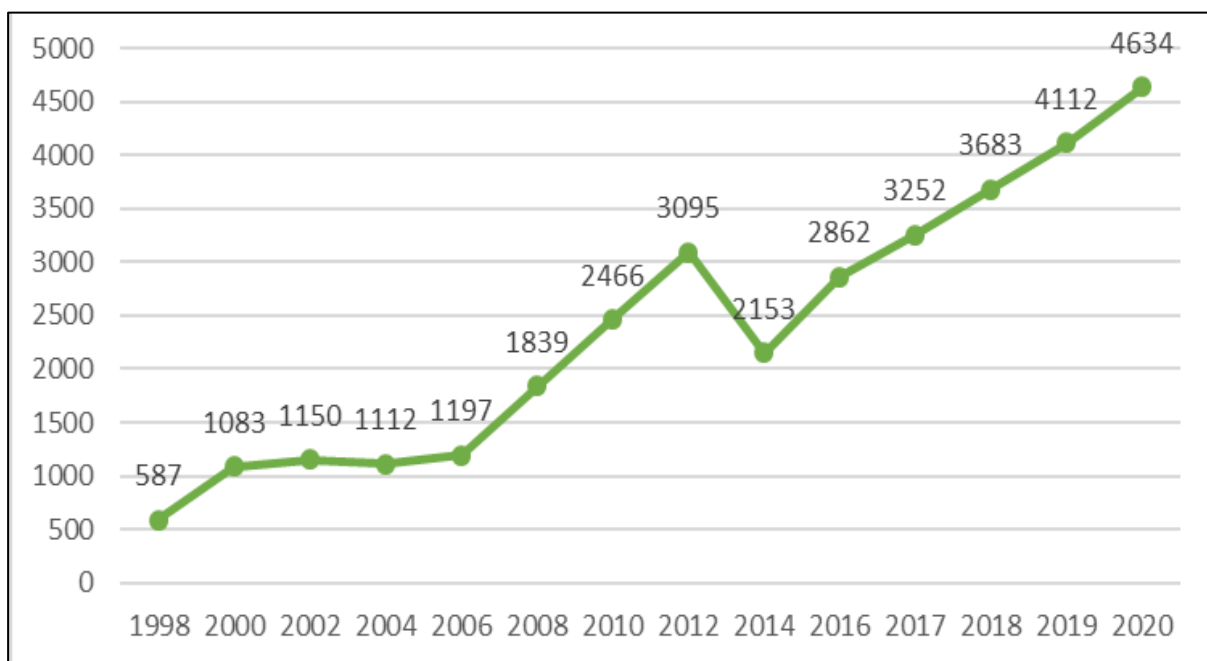
Prema programu zaštite autohtonih pasmina sama vrijednost magarca u današnje vrijeme očitovala bi se kroz:

- Turizam
- Medicinu, kozmetiku, hipoterapiju
- Hobi životinja
- Rad

Velika mogućnost iskorištenja magaraca u turizmu jest samo križanje magaraca i konja u cilju dobivanja bastarda (mula i mazgi) čija je uloga zapravo velika u turističkoj ponudi obilaska krševitih predjela jahanjem (Velebita, Dinare, Slapova Krke) što privlači turiste (Ernoić i sur., 2001).

Magarci su najviše bili rasprostranjeni na području Dalmacije i Istre i na tim dijelovima zemlje su ostali i dan danas turistička atrakcija. Magarac je dalmatincima zaštitni znak cijele regije, simbol ustrajnosti i izdržljivosti te je kao takav ostao najskromnija, najsimpatičnija i najpopularnija životinja koja predstavlja najpopularniji životinjski suvenir u hrvatskom turizmu. Također, svake godine se u Tribunju održavaju svjetski poznate utrke magaraca koje su proslavile svoju 54. godinu održavanja upravo na ljeto 2021. godine. Zahvaljujući tim utrkama i Društvu za zaštitu magaraca, Logorun, mali otok pored Tribunja, postao je, prvi u svijetu, rezervat za magarce (Musulin, 2013).

Prema godišnjem izvješću za 2020. godinu izdanom od strane Hrvatske agencije za poljoprivredu i hranu vidljiv je lagani porast (Slika 2) iz godine u godinu ukupnog broja magaraca u Republici Hrvatskoj.



Slika 2. Kretanje ukupnog broja magaraca po godinama (Izvor: HAPIH, 2021)

Figure 2. Total number of donkeys by year (Source: HAPIH, 2021)

Prema Ivanković i sur. (2000) u područjima srednjeg i južnog dijela hrvatskog priobalja uzgajani su magarci koji su bili nešto manjeg tjelesnog okvira dok su u području Istre i Kvarnera uzgajani magarci većih tjelesnih okvira koji su služili za proizvodnju bastarda s konjem (mula).

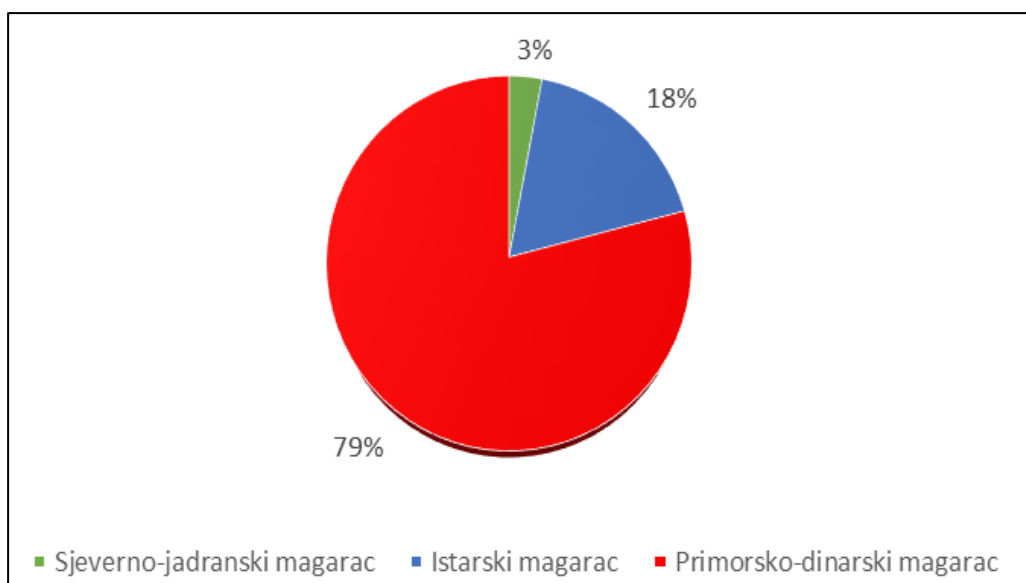
Hrvatske izvorne pasmine magaraca

U Republici Hrvatskoj su na Popisu izvornih i zaštićenih pasmina i sojeva domaćih životinja (NN 70/2009) od 2009. godine upisane tri pasmine magaraca:

1. Primorsko-dinarski magarac
2. Istarski magarac
3. Sjeverno-jadranski magarac

Naše izvorne i zaštićene pasmine magaraca se štite putem in situ programa, što bi značilo da se oni uzgajaju u izvornom okruženju i tradicijskim tehnologijama.

Promatrajući grafikon (slika 3) izdan od strane Hrvatske agencije za poljoprivredu i hranu (godišnje izvješće za 2020. godinu) prikazana je zastupljenost pojedine pasmine gdje je vidljivo da najveći udio zauzima pasmina Primorsko-dinarski magarac.



Slika 3. Udio izvornih pasmina magaraca u Hrvatskoj (Izvor: HAPIH, 2021)

Figure 3. Share of original breeds of donkeys in Croatia (Source: HAPIH, 2021)

Magareće mlijeko

Magareće mlijeko je po svom sastavu najbližije humanom mlijeku. Magareće mlijeko ne izaziva nikakve alergijske reakcije, te se koristi kao zamjena kravljem mlijeku kod ljudi koji ne podnose

kravlje mlijeko. Posebno je i po tome što dokazano liječi simptome astme i ostalih plućnih bolesti, a isto tako je izvrsno za održavanje imuniteta. Važno je napomenuti da se magareće mlijeko može zamrznuti te čuvati u zamrzivaču i nekoliko godina (naturala.hr).

Proizvodnja magarećeg mlijeka

Nakon ždrebljenja počinje laktacija, a do sekrecije mlijeka dolazi kad nervni stimulans hipotalamus šalje signal hipofizi da počne lučiti hormon oksitocin u krvotok (Vrdoljak, 2019). Kod same proizvodnje magarećeg mlijeka neophodno je voditi računa o čistoći prostora u kojem se odvija mužnja. Potrebno je dezinficirati posuđe i pribor koji se koristi u procesu mužnje i proizvodnje. Kako bi se smanjio rizik od nečistoća i štetnih mikroorganizama potrebno je također održavati čistoću životinja koje se drže u čistim štalama. Nadalje, sama oprema za mužnju treba biti oprana i dezinficirana, ako je moguće odmah nakon mužnje. Mlijeko treba ohladiti u što kraćem vremenskom periodu da bi se spriječio rast mikroorganizama. Zbog manjeg volumena vimena magarice se muzu danju, svaka 2-3 sata. S ovim se načinom dnevno može izvršiti čak i do 8 mužnji. Noću se ne prakticira mužnja već se ostavlja mladunčadima da sisaju (Ivanković i sur., 2015).

Kemijski i nutritivni sastav magarećeg mlijeka

Magareće mlijeko je albuminsko, jer sadrži visok udio bjelančevina sirutke (oko 39 %). Slatkastog je okusa jer sadrži visok udio laktoze, a znatno manje mliječne masti i proteina (tablica 1.) u odnosu na kravlje i kozje mlijeko (Ivanković i sur., 2015). Samo mlijeko kopitara je siromašno mliječnom mašću, dok je mlijeko magarica najsiromašnije te sadrži 0,38-0,54 %. Mlijeko magarica je bogato vitaminima i to vitaminom A, C, K, E, B1, B2, B6 i mineralima kao što su željezo, kalcij, kalij, fosfor i drugi (Ivanković i sur., 2000).

Tablica 1. Kemijski sastav magarećeg mlijeka u odnosu na sastav mlijeka drugih životinja i humanog mlijeka (Izvor: Ivanković i sur., 2014)

Table 1. Chemical composition of donkey milk in relation to the composition of milk from other animals and human milk (Source: Ivanković i sur., 2014)

Mlijeko	Magareće	Kravlje	Humano	Kobilje	Ovčje	Kozje
Suha tvar (g/L)	88-117	118-130	107-129	97-122	181-200	119-163
Proteini (g/L)	14-20	30-39	9-19	18-34	45-70	30-52
Mliječna mast (g/L)	3-18	33-54	21-40	6-24	50-90	30-72
Laktoza (g/L)	58-74	44-56	63-70	61-72	41-59	32-50
Mineralne tvari (g/L)	3-5	7-8	2-3	3-6	8-10	7-9
Energija (kJ/L)	1582	2763	2763	1183	4309	2719

Objavljeni podaci o kemijskom sastavu magarećeg mlijeka potvrđuju veću sličnost s humanim mlijekom u odnosu na kravlje, ovčje i kozje mlijeko (Salimei i Fantuz, 2012).

Magareće mlijeko u prehrani

Magareće mlijeko ima vrlo visok udio vitamina C stoga je dobro za imunitet. Također, sadrži hipoalergena svojstva te ga mogu koristiti i ljudi koji su alergični na kravljje mlijeko. Pomaže kod ekcema, psorijaze i astme te sadrži omega-6 i omega-3 masne kiseline koje sudjeluju u razvoju mozga, zaštiti srca i pomažu aktivirati sve minerale i vitamine koju su važni za razvoj svih organa i njihovih funkcija. Među funkcionalnim proteinima koji su otkriveni u magarećem mlijeku postoje molekule aktivne u antimikrobnoj zaštiti poput lizozima i laktoferina. Sadržaj laktoferina u magarećem mlijeku nalazi se između nižih vrijednosti kravljeg mlijeka i viših vrijednosti ljudskog mlijeka (Fiocchi i sur., 2010).

Magareće mlijeko se koristi kao prirodno hipoalergeno mlijeko jer ga tolerira oko 90 % novorođenčadi s alergijama na hranu, npr. alergija na bjelančevine kravljeg mlijeka (CMPA), koja je česta alergija na hranu u djetinjstvu s prevalencijom od približno 3 % (Salimei i Fantuz, 2012). Međutim, tolerancija na magareće mlijeko kod novorođenčadi mora se procijeniti pod liječničkim nadzorom i nakon provođenja određenih alergijskih testova. S obzirom na smanjeni imunitet novorođenčeta ne preporučuje se davati magareće mlijeko djetetu mlađem od 6 mjeseci jer postoji povećana mogućnost infekcije (Pothapregada, 2014).

U energetske smislu, unatoč visokom udjelu laktoze u magarećem mlijeku, prosječni udio masti je niži te se onda u prehrani dojenčadi, magarećem mlijeku obično dodaje biljno ulje (4 mL na 100 mL mlijeka) kako bi oponašalo hiper energiju humanog mlijeka. Osim pozitivnih zdravstvenih učinaka, utvrđeno je da je okus magarećeg mlijeka privlačan djeci (Salimei i Fantuz, 2012).

Magareće mlijeko u kozmetologiji

Posljednjih godina kozmetička industrija usmjerava se prema proizvodima izrađenima od prirodnih sastojaka i orijentirana je na održivu potrošnju. Zbog svog prirodnog podrijetla i ljekovitih svojstava, mliječne komponente magarećeg mlijeka odgovaraju potrebama kozmetologije u mnogim poljima. Nedavno znanstveno istraživanje na kremi koja sadrži liofilizirano magareće mlijeko pokazalo je razne dobrobiti za kožu kao što su učinkovitosti komponenata magarećeg mlijeka poput proteina, minerala, vitamina, esencijalnih masnih kiselina, bioaktivnog enzima i koenzima koji koži omogućuju uravnoteženu prehranu i pravilnu hidrataciju (Cosentino i sur., 2015).

Konkretno, sami sadržaj vitamina C u magarećem mlijeku gotovo je 4 puta veći od kravljeg mlijeka. Također, već je spomenuto kako magareće mlijeko sadrži više laktoferina i lizozima nego kravljje mlijeko pa i iz tog razloga magareće mlijeko ima potencijala, ako je pravilno formulirano, umanjiti probleme kože s ekcemima, aknama, psorijazom i herpesom (Cosentino i sur., 2015).

U današnjoj kozmetologiji magareće se mlijeko koristi u proizvodnji mnogih kozmetičkih preparata pa se tako na tržištu mogu naći sapuni od magarećeg mlijeka koje koriste osobe sa problematičnom kožom. Zbog visokog sadržaja mlijeka omogućavaju koži dobru opskrbljenost vitaminima A, F i E i masnim kiselinama te su zbog toga izvrsni zatezači kože. Osim sapuna proizvodi se i magareći melem koji štiti kožu od štetnih utjecaja i obnavlja tonus tkiva te ublažava bol i iritaciju. Koži vraća sjaj i eliminira znakove umora te dodatno hidratizira uz istovremeno sprječavanje gubitka vode, osigurava koži mekoću. Na tržištu danas postoje i mnoge kreme sa dodatkom magarećeg mlijeka koje su sastavni dio preparativne kozmetike jer te kreme sadrže vitamin A koji služi za obnavljanje stanične membrane, vitamin B2 i vitamin C koji imaju antioksidativnu ulogu i vitamin E koji usporava starenje kože. Također sadrže esencijalne masne kiseline koje pomažu da koža upije vitamine i omogućava prevenciju bolesti kože kao što su psorijaza i ekcemi. Osim za njegu lica postoje i proizvodi za njegu kose i tijela s magarećim mlijekom koji regeneriraju i hidratiziraju kožu. Magareće mlijeko se koristi u kozmetologiji najvjerojatnije zbog sadržaja lizozima, učinkovitog u zaglađivanju upala kože i vlasišta (Kocic i sur., 2020a; Derdak i sur, 2020). Magareće mlijeko pokazuje potencijal u zacjeljivanju rana, regenerativnoj i estetskoj dermatologiji. Nekazeinski bioaktivni peptidi magarećeg mlijeka mogu biti odgovorni za protuupalna svojstva magarećeg mlijeka i kolostruma, što može ukazivati na korisnost u liječenju upalnih kožnih bolesti (Kocic i sur., 2020b).

Zaključak

Od davnina se magareće mlijeko koristilo za prehranu, liječenje (kašlja, bronhitisa, astme, alergija), kao nadomjestak za majčino mlijeko te ljepotu. Magareće mlijeko je bogato vitaminima A, B1, B2, B6, C, D i E te nezasićenim masnim kiselinama omega-3 i omega-6. Nadalje magareće mlijeko jača imunološki sustav, a koži daje elastičnost i sjaj. Posljednjih godina povećao se interes za uzgoj magaraca, posebno magarica upravo radi proizvodnje magarećeg mlijeka, kao visokovrijedne hranjive namirnice, a napose zbog uporabe u kozmetičke svrhe. Kozmetička upotreba magarećeg mlijeka poznata je od davnina. Kozmetika od magarećeg mlijeka djeluje hidratizirajuće na kožu, djeluje na akne, psorijazu, opekotine i druge rane te se primjenjuje u regenerativnoj i estetskoj dermatologiji.

Napomena

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Nagrade Udruge Future u 2022. godini

Awards of the Association Futura in the year 2022

Boris Dorbić¹

društvene vijesti i obavijesti (social news and announcements)

I ove godine Udruga Futura dodjeljuje nagrade osobama koje su unaprijedile rad Udruge. U nastavku dajemo popis nagrađenih osoba prema različitim vrstama nagrada. Svim dobitnicima čestitamo na zasluženim priznanjima!

1. Zlatna plaketa

Za višegodišnju opće priznatu djelatnost, kojom je navedena osoba znatno pridonijela razvoju Udruge Future:

Vesna Štibrić, dipl. ing. preh. tehn. – Sisak.

2. Srebrna nagrada

Za opće priznatu djelatnost, kojom je dolje navedena osoba znatno pridonijela razvoju Future i to za rezultate postignute tijekom posljednje 2 godine:

Izv. prof. dr. sc. Ivana Vitasović Kosić – Sveučilište u Zagrebu, Agronomski fakultet.

U Šibeniku, 17 lipnja 2022.

Doc. dr. sc. Boris Dorbić, prof. v. š.

Predsjednik Udruge Futura

¹ Udruga Futura Šibenik, Bana Josipa Jelačića 13 a, 22000 Šibenik, Hrvatska.

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Upute autorima

Stručno znanstveni časopis Futura objavljuje znanstvene i stručne radove iz biotehničkih znanosti (poljoprivrede, šumarstva, drvne tehnologije, prehrambene tehnologije, nutricionizma, biotehnologije i interdisciplinarne biotehničke znanosti) kao i društvene vijesti, bibliografije, zatim prikaze knjiga i radova, popularne znanstvene radove, polemike i dr. Objavljaju se samo radovi koji nisu drugdje predani za objavljivanje, niti objavljeni. Znanstveni radovi se kategoriziraju: – izvorni znanstveni rad (*original scientific paper*) – pregledni znanstveni rad (*scientific review*) – prethodno priopćenje (*preliminary communication*) – konferencijsko priopćenje (*conference paper*) – rad prethodno prezentiran na konferenciji. Radove recenziraju dva ili više znanstvenika iz odgovarajućeg područja. Rad ne smije imati više od 17 tipkanih stranica, veličina slova 11, font Times New Roman, prored 1,5, margine 2,5. Izuzetno, uz odobrenje uredništva, neki interdisciplinarni ili uredništvu interesantni radovi mogu sadržavati do 25 ili više tipkanih stranica. Rukopisi se predaju u elektroničkom obliku na hrvatskom ili engleskom jeziku (e-mail: urednistvo@gazette-future.eu).

Izvorni znanstveni rad treba sadržavati: puna imena i prezimena autora s nazivima institucija, adresom i e-poštom u bilješkama – font 10, naslov, sažetak, abstract, uvod, materijale i metode, rezultate istraživanja, diskusiju, zaključak i literaturu – font 12 podebljano za naslove. Radovi napisani na engleskom jeziku se predaju bez naslova na hrvatskom jeziku i hrvatskog sažetka.

Naslov rada treba biti što kraći, na hrvatskom i engleskom jeziku. Kategoriju rada predlažu autori, a potvrđuju recenzenti i glavni urednik.

Sažetak treba sadržati opći prikaz, metodologiju, rezultate istraživanja i zaključak. Rad je potrebno pisati u trećem licu s min. 3 do 5 ključnih riječi. Obim sažetka ne bi smio biti veći od 250 riječi. Abstract je prijevod sažetka s ključnim riječima.

Uvod treba sadržavati što je do sada istraživano i što se željelo postići danim istraživanjem. Materijale i metode istraživanja treba ukratko izložiti. U rezultatima i diskusiji (raspravi) potrebno je voditi računa da se ne ponavlja iznijeto. U zaključcima je potrebno izložiti samo ono što pruža kratku i jasnu predstavu istraživanja. Literaturu treba poredati prema abecednom redu autora i to: prezime i početno slovo imena autora ili Anonymous (nepoznat autor), godina izdanja u zagradama, naslov knjige ili članka, naziv časopisa te broj ili godište, kao i mjesto izdavanja i oznaku stranica od–do. Više od tri autora se u literaturi navodi kao npr. (Prezime et al., 2018). Fusnote u radu treba izbjegavati ili eventualno koristiti za neka pojašnjenja. Autori se u tekstu citiraju sukladno APA standardu npr. (Prezime, 2018); (Prezime1 i Prezime2, 2016); (Prezime et al., 2018) (više od dva autora). Citate prate navodnici ("n") i stranica preuzimanja citiranog teksta (Prezime, 2018, str. 44).

Tablice se numeriraju i navode iznad na hrvatskom i u kurzivu na engleskom jeziku.

Slike se numeriraju i navode ispod na hrvatskom i u kurzivu na engleskom jeziku.

Rezolucija slika (grafikon, fotografija, crtež, ilustracija, karta) treba iznositi najmanje 300 dpi.



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Autor: Emilija Friganović.