Quality Soil as a Pathway to Healthy Food in the EU- Challenges to 2030

F O O D I E

Proceedings of the online International Scientific Conference
„Quality Soil as a Pathway to Healthy Food in the EU- Challenges to 2030“
held at the Slovak University of Agriculture in Nitra
on October 19-21, 2021

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Slovak University of Agriculture in Nitra

SLOVAKIA

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CONTENT

1 INTRODUCTION

Soil quality is directly linked to food quality and quantity. However the globalisation and the pressure to increase the agricultural production results to deterioration of the environment, climate change and a serious threat to human and animal health. Soil contamination effected by the environmental pollution is one of the most pressing issues in the political and expertise debate on food safety within the related EU policies as Common agricultural policy, EU agri-environmental, EU food policy and EU health policy.

Numerous studies have shown that heavy metals can accumulate in tissues, subsequently affect organ functions, and disrupt the reproductive, nervous or endocrine system. Therefore, the health status in relation to xenobiotics should be monitored and explored.

The international scientific conference ***„Quality Soil as a Pathway to Healthy Food in the EU- Challenges to 2030“*** *aimed to highlight challenges of the food and feed management on the EU until 2030, including identification of risk factors for food and feed production, food chain, and sustainable agriculture.*

At the conference experts from 9 EU countires presented their latest research results related to soil and food quality and their visions and proposals how to decrease the negative effects of contamination of soil and food.

The conference „Quality Soil as a Pathway to Healthy Food in the EU- Challenges to 2030“ was divided into 2 parts: ***Sympsosium*** *and* ***Correspondence conference****. The symposium offered a unique platform for discussions and comparision of different approaches from following countries****: Italy, Poland, Hungary, Czech republic, the Netherlands, Germany, Croatia, Bulgaria and Slovakia****. The correspondence part of the conference offered to researchers from above mentioned countries possibility to prepare scientific papers on the topics of soil and food health.*

Scientific papers from both parts of the conference (symposium and correspondence part) were collected, reviewed and published in this Proceedings volume.

We hope that this Proceedings volume will provide interesting information about current research results and contribute to awarness about food and soil quality!

prof. JUDr. Anna Bandlerová, PhD.
Coordinator of the project Jean Monnet Project „Quality Soil as a Pathway to Healthy Food in the EU- FOODIE“

2 SYMPOSIUM

2.1 Programme of the International Scientific Conference

International Scientific Conference
"Quality Soil as a Pathway to Healthy Food in the EU– Challenges to 2030" – F O O D I E

OCTOBER 19, 2021

Moderators: Lucia Palšová, Peter Massányi, Marcela Capcarová

10:00-10:15 ***Opening and welcome speeches***
Ivan Takáč, vice-rector for communication and practice
Anna Bandlerová, coordinator of the JMO project "Quality Soil as a Pathway to Healthy Food in the EU"
(Slovak University of Agriculture in Nitra, Slovakia)

10:15-10:40 ***A soil quality challenge and its risks relating to healthy food***
Jaroslava Sobocká (Research Institute of Soil Science and Soil Protection, Slovakia)

10:40-11:05 ***Soil conservation challenging for healthy food in Hungary***
József Hefler (National Food Chain Safety Office, Hungary)

11:05-11:30 ***Some examples of soil data services focused on food quality protection in Slovakia***
Pavol Bielek (Slovak University of Agriculture in Nitra, Slovakia)

11:30-11:55 ***Soil quality in Central Europe – status and outlook in the global context***
Gergely Tóth (Institute for Soil Science, Hungary)

11:55- 12:20 ***Quality of soil and food –a case study from Germany***
Cosmas Lambini (The German Federal Association for Sustainability, Germany)

12:20- 12:45 ***Managing a transition towards a sustainable agro-food system, the case of the agroagenda in Northern Netherlands***
Rig Eweg (Van Hall Larenstein University of Applied Sciences, The Netherlands)

12:45-13:45 ***Lunch Break***

13:45- 14:10 ***Exposing on sanitary and phytosanitary measures in the Agreement between the EU and Mercosur***
Leonardo Pastorino (University of Verona, Italy)

14:10-14:35 ***Support of regional foods in the Czech Republic***
Radek Jurčík (Mendel University in Brno, Czech Republic)

14:35-15:00 ***Legal aspects of the health quality of food in terms of soil quality***
Katarzyna Leśkiewicz (Adam Mickiewicz University in Poznan, Poland)

15:00-15:25 ***Conclusion of the 1st day***
Peter Massányi- Marcela Capcarová (Slovak University of Agriculture in Nitra, Slovakia)

OCTOBER 20, 2021

Moderators: Lucia Palšová, Peter Massányi, Marcela Capcarová

10:00-10:25 ***Factors affecting food quality***
Francesco Vizzarri (University of Bari Aldo Moro, Italy)

10:25-10:50 ***Are there any farms free from the pesticides?***
Łukasz J. Binkowski (Institute of Biology, Pedagogical University of Krakow, Poland)

10:50-11:15 ***How to build resilience in food systems in times of crises: a case of Croatia.***
Marta Menardi- Eni Hoyka (University of Hohenheim, Germany)

11:15-11:40 ***Motivation, possibilities and risk sources in hazelnut production: Case of smallholder farm in Croatia***
Marko Reljić (representative of farmers, Croatia)

11:40-12:05 ***Risks in the context of food sovereignty***
Minko Georgiev (Agricultural University Plovdiv, Bulgaria)

12:05-13:00 ***Lunch break***

13:00-15:00 ***Presentation with Panel discussion "Risk Factors of Food Chain"***
Peter Massányi (Slovak University of Agriculture in Nitra, Slovakia)

15:00-15:25 ***Regional circular economy models and best available technologies for biological streams****- additional activities linked to the BIOREGIO project "Strengthening Technology Transfer Infrastructures for Thematic Universities and Innovation Infrastructures" (3TforUni)*
Presentation prepared within the project No 2020-1-TR01-KA203-094707
Eleonóra Marišová (Slovak University of Agriculture in Nitra, Slovakia)

15:25-15:40 ***Conclusion of the 2nd day***
Peter Massányi- Marcela Capcarová

OCTOBER 21, 2021

Moderators: Lucia Palšová, Peter Massányi, Marcela Capcarová

10:00-10:25 ***Presentation of the project: Quality Soil as a Pathway to Healthy Food in the EU- "From submission till outcomes" and presentation of results of other Erasmus+ projects:***
EDULAW, no. 2020-1-SK01-KA226-HE-094316;
STUD.IO, no. KA203-6A057B2A;
CAPE, no. 611792-EPP-1-2019-1-SK-EPPJMO-SUPPA
Lucia Palšová (Slovak University of Agriculture in Nitra, Slovakia)

10:25-10:45 ***Presentation of the project: Erasmus+, Jean Monnet Centre of Excellence: Centre of Excellence for European Agri-Food Chain – CEEAG, no. 611446-EPP-1-2019-1-SK-EPPJMOCoE***
Pavol Schwarcz (Slovak University of Agriculture in Nitra, Slovakia)

10:45-12:00 ***Presentation and discussion on the textbook "Risk Factors of Food Chain in the EU – Perspectives"***
Peter Massányi (Slovak University of Agriculture in Nitra, Slovakia)

12:00-12:30 ***Conclusions of the conference***
Peter Massányi- Marcela Capcarová

2.2 Papers from the Symposium

SOME EXAMPLES OF SOIL DATA SERVICES FOCUSED ON FOOD QUALITY PROTECTION IN SLOVAKIA (small review)

Pavol Bielek
Slovak University of Agriculture, Nitra, Slovakia

Abstract
Many data collections and data processings related to all over the soil cover of Slovakia have been carried out by many individual experts and teams during of past years. Some of those activities were focused also on relationships between soil-ecological properties including different implemented farming systems to quality of plant products as human food and feed for animals. Small review about that is available in this paper mainly on A:*Conveniences of soils for good yields and acceptable quality of plant production in Slovakia; B:Nitrate in food production;, C:Degradation of organic pollutants in soil as a tool of nature against threats for plants;* and *D:Soil heavy metal pollutions and plant contamination.*

Keywords: soil data collection, data processing, soil and food contaminantion, nitrate production in soil, organic pollutants, heavy metals

Introduction
Food production is mostly recognized as function of soil.. It is the foundation for agriculture in which nearly all food producing plants grow. In fact was estimated that 95 % of our food is directly or indirectly produced on soil (www.fao.org/3/i4405e/I4405E.pdf). Food production is a complex matter, affecting people life and quality of environment including profits of interested economy or individual bodies. It is result of soil parameters, climate conditions, farming systems used, supporting services, agricultural policies, etc. Besides, due to yield production increase, quality of produced food is more and more need to save and/or improved. Problem is pollution and contamination of harvested plants as results of soil pollutions from external sources or soil producing compounds (Bielek 2017). It is a strong motivation for adoption of measures or policies to protect all agricultural plant production against any form of contamination and simultaneously against any environmental pollution as well. Firstly, risk communication and consultations must be provided before the risk assessment and risk management applied, including food safety policy adoption on sufficient expert levels. One of the most progressive method of those communications and implementations is providing all relevant data collection and data processing including on-line using by all stakeholders and food producers mainly.

Material and methods
Detailed comprehensive soil data have been screened and collected by soil survey carried out on territory of all over the Slovakian agricultural soils (total area 2.4 mill. ha). The survey density was one soil profile described and sampled per every 14 ha of agricultural soils. Original data from 174 000 places of observation and relevant analytical data received from 400 000 soil samples taken off from soil profiles are available on www.vupop.sk. All is presented on digital soil maps in scale 1:10 000 and connected with orthophoto digital imageries, as well. After the specific data

processing several sophisticated information have been created about soils of Slovakia (comprehensively presented by Bielek in 2017).
Soil Geochemical Survey was carried out with soil sampling density from upper and subsoil depths per every 10 km², and 35 chemical elements were determined in every soil sample (Čurlík-Ševčík, 1999). All georeferenced data are located on orthophoto digital maps and presented on www.vupop.sk.
Soil monitoring observations is permanently performed on 318 places of observation from 1990 (Kobza, 2013). Received data are on-line available on www.vupop.sk.
Average net nitrate production in different agricultural soils of Slovakia was determined using of long time experiments. Received data have been generalized (Bielek, 1998a) for all more than 1000 different soil ecological places (named as Main Soil-Ecological Units) in Slovakia and information system of nitrate production in agricultural soils of Slovakia was created (Bielek, 1998b).
Also another generalized data have been used for support of conclussions presented in this work.

Fig. 1 Places of soil data collections in Slovakia, as example on window of 23 000 ha.

Comprehensive Soil Survey of more than 174 000 places of observation, more than 400000 soil samples were taken off.

Key places of Soil Survey every per 160 ha (as part of Comprehensive Soil Survey).

Soil Geochemical Survey, determination of 35 chemical elements for every 10 km in two upper genetically identified soil layers.

Soil monitoring observation, 318 places permanently observed from the year 1990.

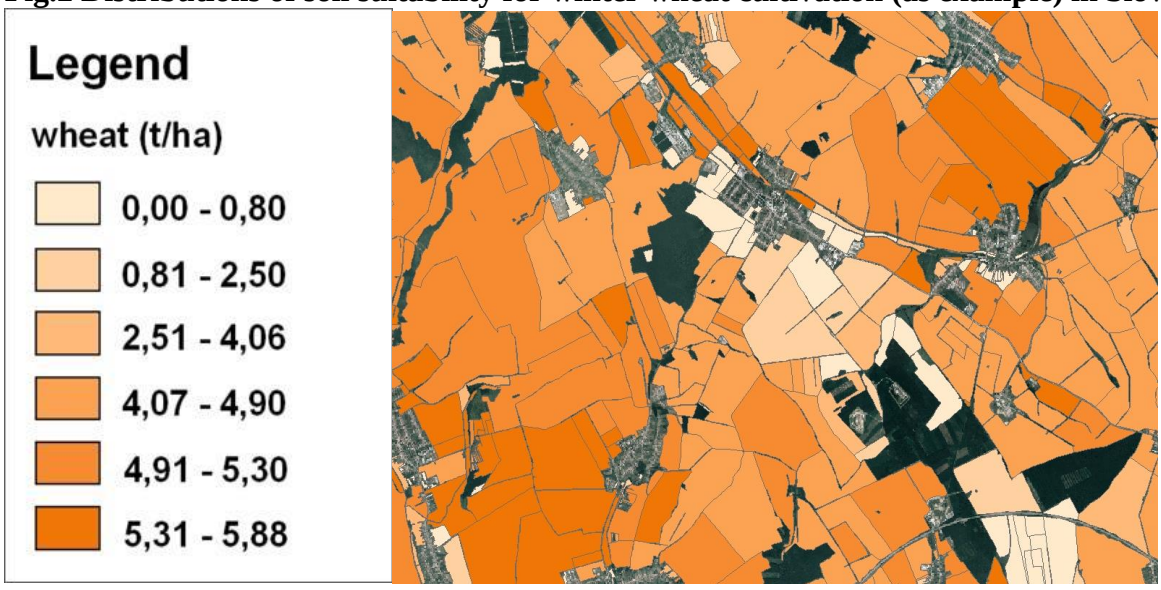
Results and discussion

Management of best agricultural practices including regulations related to food production must be carried out by data and by relevant expert systems. This is due to multifunctional dependances of food production on soil quality and another agri-ecological diversities. Only comprehensive approaches to those problems can bring practical results without threats for human health and quality of environment. This is strong imperative for activities of every government, scientific institutions, including relevant responsible persons. This article is a small contribution to solution of those problems.

A: *Conveniences of soil for good yields and acceptable quality of plant production in Slovakia.*

In combination of conprehensive dáta about soil/field with plant parameters needed for good quality and high yields of cultivated plants have been created information system focused on suitability of arbitrary soil/field for every mainly cultivated agricultural plants in Slovakia. There are possibilities to identify suitability of individual soil plots for cultivation of winter wheat, winter and spring barley, rape, maize, and sugar beet on all over soil agricultural cover of Slovakia. Good quality of production is incorporate as integral part of this information system as well. For example, potentials of nitrogen mobility and availability in different soils have been take into consideration in cases of barley and sugar beet yield with sutability for both quantity and quality of the productction. Using of webside www.vupop.sk farmer can find those informations on-line for every plots of his farm. Theoretical background for this system was determined by Fulajtar (1997) and creation of final electronic version have been coordinated and comprehensively published by Bielek (2017).

Fig.2 Distributions of soil suitability for winter wheat cultivation (as example) in Slovakia.

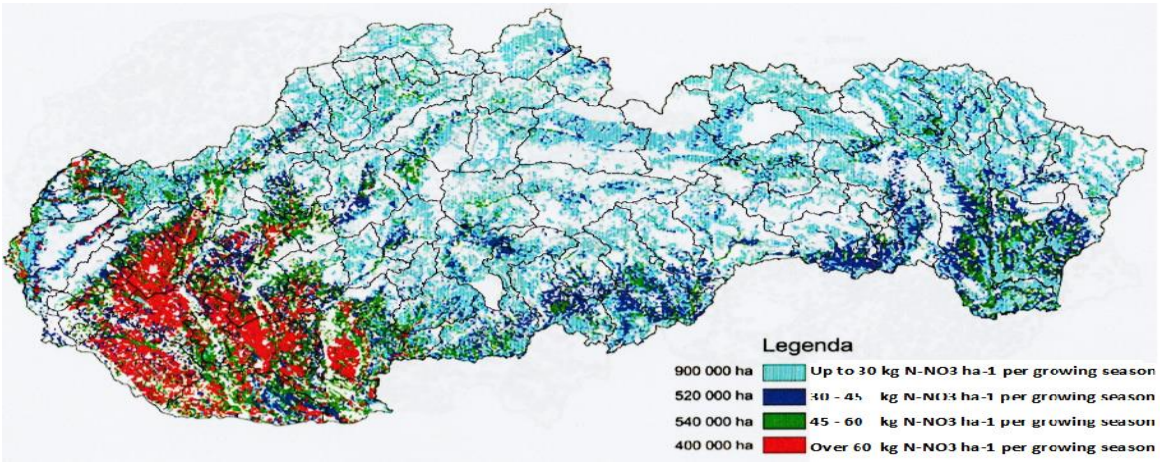


B: *Nitrate in food production*

Content of nitrates in plant production is really serious problem in present agriculture and food production mainly. It is because of higher level of nitrogen fertilizer use and also due to not correct practices of nitrogen fertilizers application in the present intensified agriculture. In case of high doses and/or not correct applications of nitrogen fertilizers, nitrates in soils are more producing and more uptaken by plants what is not acceptable from food quality and human health points of view

(Bielek, 1998). Different soils are able to produce a different quantities of nitrates and also different plants have not the same potentials for nitrates uptake and plant nitrate accumulations (Bielek, 2014).
Potentials of nitrate production in different soils and potentials of nitrate accumulations in different plants, have been determined during of long time field and laboratory experiments. Afterwards generalized electronic system for calculation of nitrate production in different soils and under different well known farming system have been created.. Developed information system can be used as a tool for calculation of plant contamination by nitrates in arbitrary soil-ecological conditions and also under farming systems used in Slovakia (Bielek, 1998b). Calculated potentials of nitrate nitrogen accumulation in non-fertilized agricultural soils of Slovakia are generaly presented in Fig. 3. Calculation is possible to be done for every arbitrary agricultural field in Slovakia.

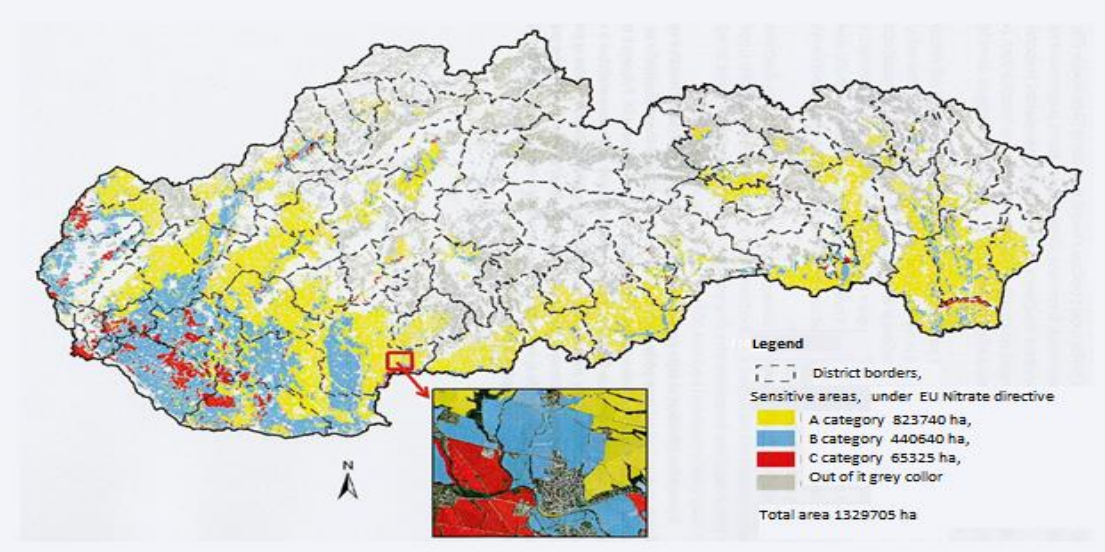
Fig.3 Distribution of different nitrate production in non-fertilized agricultural soils of Slovakia.



From the results is clear that the best non-fertilized soils (red coloured territory on the map) have highest potentials for nitrare production (more than 60 kg $N\text{-}NO_3$ per ha a year) and in opposite in case of poor soils (sky blue colour) lowest quantities of nitrates are offered for plants (less than 30 kg $N\text{-}NO_3$ per 1 ha a year). Medium accumulation of nitrates in soil is from 30 to 60 kg $N\text{-}NO_3$ per 1 ha and year (hard blue and green colours).
But another information are also very important. In case of best soils, nitrogen from fertilizers is more intensively transformed on nitrates than in poor soils. Simply, in good soils for example from applied 100 kg N per ha per year can be produced for about 90 kg $N\text{-}NO_3$ per ha more. In poor soils it is about 40-50 kg $N\text{-}NO_3$ per ha yearly. Of coarse, higher potentials of good soil to produce the nitrates can also bring a higher productions and higher reflux of nitrous oxides from soils to air (N_2O and another oxides of nitrogen) what is higher ecological presure related to climate change than in case of poor soils. Also nitrogen fertilizers applied on good soils can bring higher mentioned risks.
Created information system can be used for calculation of average nitrate production in arbitrary soil-ecological place of Slovakian agricultural soils. Farmers can use it as information for threats of nitrate in soil production and on potential contamination of cultivated plants for every field of his farm. In combination of those information with average uptake of nitrogen per unit of biomass (kg) of main cultivated plants in Slovakia and with respect to assumed quantity of yields can be

make a decission about qualified corrections of nitrogen fertilizers application in practice. Simply in case of soil/field with high nitrate accumulation and when low nitrogen uptake is expected by cultivated plant, farmer must significantly reduce the dose of nitrogen fertilizers application. Also another generalized recommendations are available for farmers as far as of application of nitrogen fertilizers (e.g. time of application, fertilizers forms recommended, limits of one separate dose during of year, atc.).

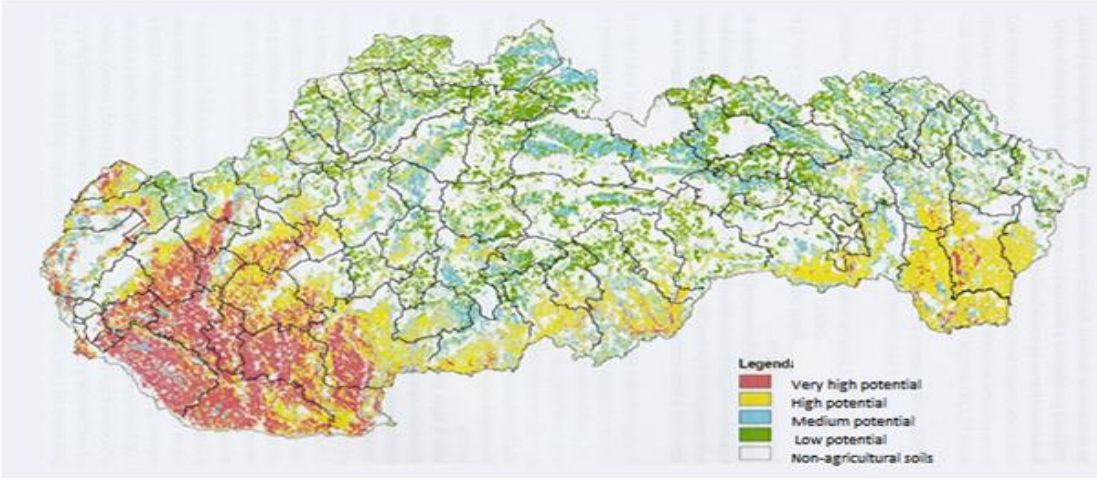
Fig.4 Sensitive areas of surface and ground water polution potentials by nitrates on territory of Slovakia.



Data about nitrate production in soil have been incorporated into the electronic expert systems which are available for every farming policy regulations against of plant contamination by nitrates and of course for high quality production as well. The system was also used in procedure of EU nitrate directive adoption in Slovakia (EU Nitrate Directive 91/676/EEC,1991). Data have been used for detailed locations of sensitive areas as far as of water contamination potentials on teritory of Slovakia. For the farmers is this information available on www.vupop.sk and generally it is presented on the fig. 4.

C: *Degradation of organic pollutants in soil as a tool of nature against threats for plants.*
Organic pollutants in soil are potentialy degraded by soil microorganisms and intensities of those processes are significantly depending on quality of soils. It was proved by laboratory experiments focused on oil fuel products degradations in different soils of Slovakia. Results of experiments have been generalized as information system enabling to calculate average intensities of those substances degradations in main soil quality categories. All is presented in fig.5 where is clear that good soils have higher potentials for oil fuel degradation (red and yelow colour) than medium quality soils (blue colour) and low quality soils (green colour) . After the mineral fertilizers application and soil ploughing applied could be degradation processes significantly intensified in comparison to non-treated soils. Generaly, in good soils poluted by 1 liter of oil fuel per 1 m^2 the significant degradation can be achieved after the 6 month or less. In opposite, poor soils could be cleaned after at least 1 year or more. Information system can inform of farmer about length of cleaning time need for arbitrary field of his farm.

Fig.5 Distribution of oil/fuel degradation intensities in plots of Slovakian agricultural soils.



D: *Soil heavy metals pollutions and plant contamination.*

During the years 1991-1999 the Geochemical Soil Survey have been carried out on all territory of Slovakian agricultural and forest soils as well. Space distribution of 35 chemical elements (Al,As,B,Ba,Be,Bi,Ca,Cd,Ce,Co,Cr,Cs,Cu,F,Fe,Ga,Hg,K,Li,Mg,Mn,Mo,Na,Ni,P,Pb,Rb,Sb,Se,Sn ,Sr,V,W,Y,Zn) have been identified in grid of 10 km^2 in depth of two top layers of genetically identified in soil profiles. Every individual place of survey have been georeferenced and the data were collected in form of comprehensive database and geographical information system have been created as well. Also 83 digitalized and printed maps (in the scale 1:1 mill.) which have been created and published by Čurlik and Šefčík in 1999 and now are available in electronic form for all who need those information (www.vupop.sk).
All what was done is good source for identification of critical areas for quality of food production and is used as tool of many levels of regulations and for behaviour of farmers in case when plant production is cultivated in any contaminated fields and/areas of Slovakia. Moreover, besides contents of pollutant also some another simultaneously screened soil parameters related to availabilities of possible transport of contaminants into the plants (soil pH, humus content, and content of carbonates) can be taken into consideration as well. Created system of information is a progressive approach to protect a quality of plant production as animal feed and food for human consuption, as well.

Conclusions

Soil data have been collected by

a) Comprehensive Soil Survey of agricultural soils of Slovakia;
b) Soil properties monitorig of agricultural soils of Slovakia;
c) Geochemical Survey of Slovakian agricultural and forest soils;
d) Long term field and laboratory experiments focused on nitrate production in soil.

Front the data have been created information systems as expert tools for

- determination of suitability for winter wheat, barley, rape, maize and sugar beet cultivations with respect to quality production for arbitrary agricultural plot of Slovakia;
- practical information for protection of plant/food against nitrate contamination;
- identification of sensitive areas in frame of EU Nitrate Directive adoption in Slovakia and for water protection advisory services for farmers;

- usable information about soil contamination with aim of plant/food protection against contamination from soil.

Summary
Several axamples are presented as real approaches for farm management by data and information. It is a critical need in present time of agriculture and mainly for the future of agricultural practices when high quantity and good quality of food production must be achieved with help of industrial technologies, e.g. chemicals and another measures of farming intensification. Seems to be that this situation is asking for use of more and more on-line regulation tools which must be developed on principles of qualified data and sophisticated data processing. Besides of good information, future of agriculture must be focused also on development of best level technologies of presentation practices and information must be available for everybody who need it. Advisory operation must be offered permanently, still actualized according of the season development, focused on last weather situation and with respect to the future weather forecast, using of remote sensing technologies with satelit imagery use and all must be clearly and demonstratively presented. Unfortunately, present forms of best advisory servises for farmers are only on the begining of the future way including those of this paper.

Acknowledgement
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SOIL QUALITY IN CENTRAL EUROPE
STATUS AND OUTLOOK IN THE GLOBAL CONTEXT

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b) Agricultural Research Centre, Institute for Soil Science

Abstract
Soil quality is key to secure adequate amount and quality food to the growing population globally. Central Europe is a region with relatively high per capita suitable area for agricultural production. Climate change is one of the challenges to food production and mitigation efforts shall consider water and nutrient efficiency as well as environmental and human health aspects of production.
The question in Central Europe is similar to those in other regions: how to use soil and land resources for the preservation and improvement of the quality of environmental and social systems, including human health? To answer this question solutions adapted for local conditions are needed. Main aspects to be considered are:

- stability (climate change adaptation, food security, food safety)
- efficiency (natural capital, competitiveness)
- sustainability (ecosystem services, environmental conservation)

Central European countries have the potential to tackle these aspects and maintain the land resource base and its sustainable utilisation to secure ecosystem and human health and social development.

Keywords: pedoclimatic zones, soil condition, land management, sustainability

Introduction
Global soil resources are under a number of degradation threats, while they have to secure healthy food and a series of ecosystem services for the coming generations. The uneven geographical distribution of soil resources globally increase the challenge of their sustainable utilisation. The diversity of spatial extent and quality of soil resources are characteristic for Central Europe as well. Characteristics of degradation threats and the possible management responses have great spatial variability too, largely depending on the local soil and climatic conditions.
The quality of soil resources determine the efficiency of agricultural use. The prevention against degradation threats guarantee the sustainability of land use and healthy food as well. Stability of agricultural production depends greatly on the applied management method. Efficient and stable, yet sustainable soil and land use is the common goal of farmers, policy makers, all other stakeholders and is the interest of all citizens.
In the current review, we make an attempt to provide a picture of the status of soil resources in Central Europe and highlight some of the challenges it faces. For this purpose the variability of soil resources both on a taxonomic level and regarding soil productivity is assessed. Furthermore three of the major degradation threats (erosion, contamination, land take) are highlighted.

Material and methods
In the assessment we use the soil maps in the region, including:

1. Distribution of Reference Soil Groups by the WRB (FAO2006) to reflect the diversity of soil conditions in Central Europe in a pan-European context.
2. Productivity of soils in Central Europe in the pan-European context.
3. Soil erosion in Europe (Panagos et al. 2015)

4. Concentration of heavy metal in European soils.
5. Land take form agricultural areas

1. Maps about the soils of the European Union (Tóth et al. 2008) includes spatial information on the distribution of Reference Soil Groups. The data is based on the Soil Geographical Database of Eurasia (SGDBE). The SGDBE at scale 1:1,000,000 is part of the European Soil Information System (van Liedekerke et al. 2004, Panagos 2006) which was created in a collaborative project of soil survey institutions and soil specialists across and beyond Europe. (Figure 1.)

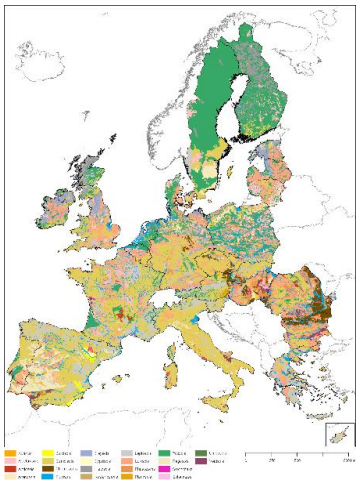
2. Productivity of soils of Europe was studied by Tóth et al. (2013). We use the output of this study to asses soil productivity in Central Europe in the pan-European context. (Figure 2. and Table 1.)

3. Soil erosion is assessed by Panagos et al (2015) who published a map as an output of this assessment. The map uses seven categories to characterise the status of soil erosion by water in Europe. (Figure 3)

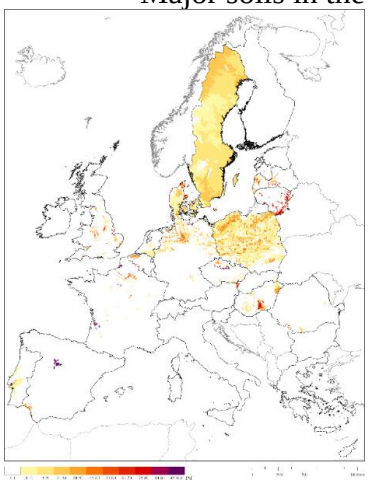
4. The map series on the concentration of heavy metals in European soils are based on the LUCAS soil survey and is published by Tóth et al. (2016). In our current paper we assess the Central European situation based on the map displaying the density of soil samples above the lower guideline value in NUTS3 regions in Europe. (Figure 4.)

5. Land take from agricultural areas are monitored by the European Environmental Agency, which also publishes statistics of land take in Europe (EEA 2021). In our assessment we extracted data on the situation in Central European countries for the period between 2000 and 2018. (Table 2.)

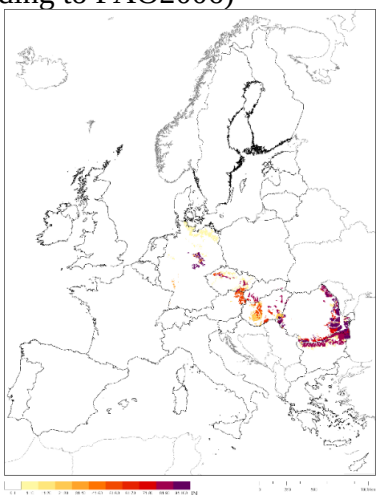
The above datasets were used to compare the situation in Central Europe regarding soil quality and the changes of soil resources. Maps and derived data provide an excellent basis for comparison and



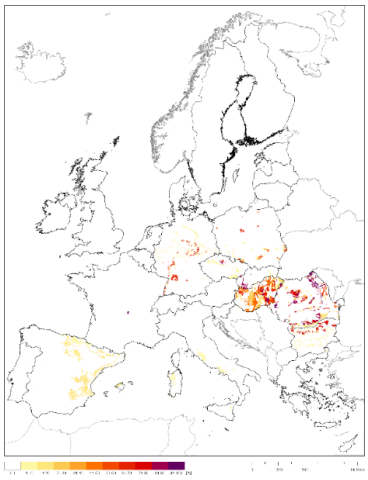
Major soils in the EU (legend according to FAO2006)



Arenosols



Chernozems



Phaeozems

Solonetzes

Figure 1. Soil map of the EU and spatial distribution of some characteristic Reference Soil Groups (10 classes of dominant, associated and inclusion soils are distinguished. The classes represent the share of the RSG within the polygon with 10 % increases between them.)

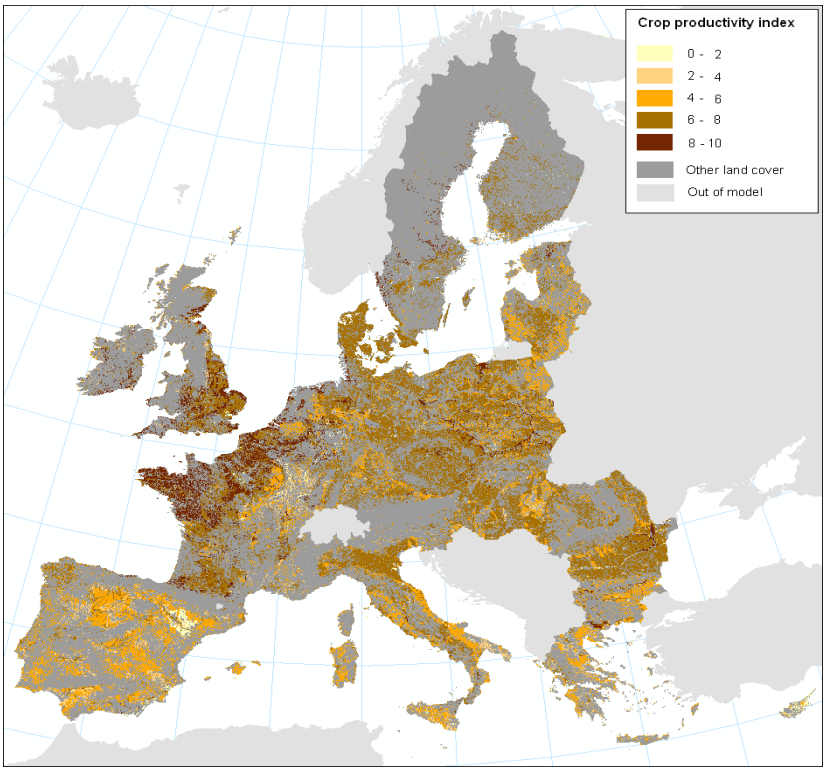


Figure 2. Soil biomass productivity of croplands in the European Union. (0-2 least productive soils; 9-10 most productive soils)

Table 1. Soil productivity indices of cropland soils in the European Union by main climatic zones

Climate zone*	Area		Mean productivity index (1= marginal land, 10 = best quality land)	STD of productivity indices	Zone productivity factor***
	km^2	% of total in the EU			
1	32458	2.4	6.1	1.0	1.0
2	308693	23.0	7.1	1.3	1.2
3	170655	12.7	5.7	1.6	1.0
4	337121	25.1	6.2	1.1	1.1
5	175914	13.1	5.8	1.0	1.0
6	174171	13.0	4.0	1.2	0.7
7	109687	8.2	5.0	1.2	0.8
8	35101	2.6	5.7	1.3	1.0

* 1- Boreal to Sub-Boreal; 2- Atlantic; 3 -Sub-Oceanic; 4 -Sub-Continental (Northern); 5 - Sub-Continental Southern); 6 - Mediterranean (Semi-Arid); 7- Mediterranean (Temperate and Sub-Oceanic); 8 - Temperate Mountainous **Expressed by productivity indices, *** Zone productivity factor = % of total productivity indices / % of total area in the EU (h=g/b)

Table 2. Land take in Central European countries - increase of artificial surfaces per land cover types (period: 2000 -2018; in km^2 – first raw, % of all land takes – second raw)

	Arable land & permanent crops	Pastures & mosaic farmland	Forests and transitional woodland shrub	Natural grassland, heathland, sclerophylous vegetation	Open space with little or no vegetation	Water bodies	Wetlands	Total
Total	2 464,84	908,86	580,36	79,36	15,97	11,20	7,52	4 068,11
	60,59%	22,34%	14,27%	1,95%	0,39%	0,28%	0,18%	100,00%
Austria	89,42	36,86	50,64	30,90	0,69	0,12		208,63
	42,86%	17,67%	24,27%	14,81%	0,33%	0,06%		100,00%
Croatia	10,29	58,31	83,42	27,60	2,60	0,03	0,10	182,35
	5,64%	31,98%	45,75%	15,14%	1,43%	0,02%	0,05%	100,00%
Czechia	210,89	71,25	25,50	2,33		0,09		310,06
	68,02%	22,98%	8,22%	0,75%		0,03%		100,00%
Germany	841,57	303,46	198,16	14,15	11,31	8,88	3,18	1 380,71
	60,95%	21,98%	14,35%	1,02%	0,82%	0,64%	0,23%	100,00%
Hungary	216,06	79,42	20,12	1,55		0,87	2,12	320,14
	67,49%	24,81%	6,28%	0,48%		0,27%	0,66%	100,00%
Poland	744,32	226,92	159,87	0,47		1,04	0,64	1 133,26
	65,68%	20,02%	14,11%	0,04%		0,09%	0,06%	100,00%
Romania	236,07	114,84	18,18	2,03	1,37	0,08	1,31	373,88
	63,14%	30,72%	4,86%	0,54%	0,37%	0,02%	0,35%	100,00%
Slovakia	111,74	11,92	12,62	0,33				136,61
	81,79%	8,73%	9,24%	0,24%				100,00%
Slovenia	4,48	5,88	11,85			0,09	0,17	22,47
	19,94%	26,17%	52,74%			0,40%	0,76%	100,00%

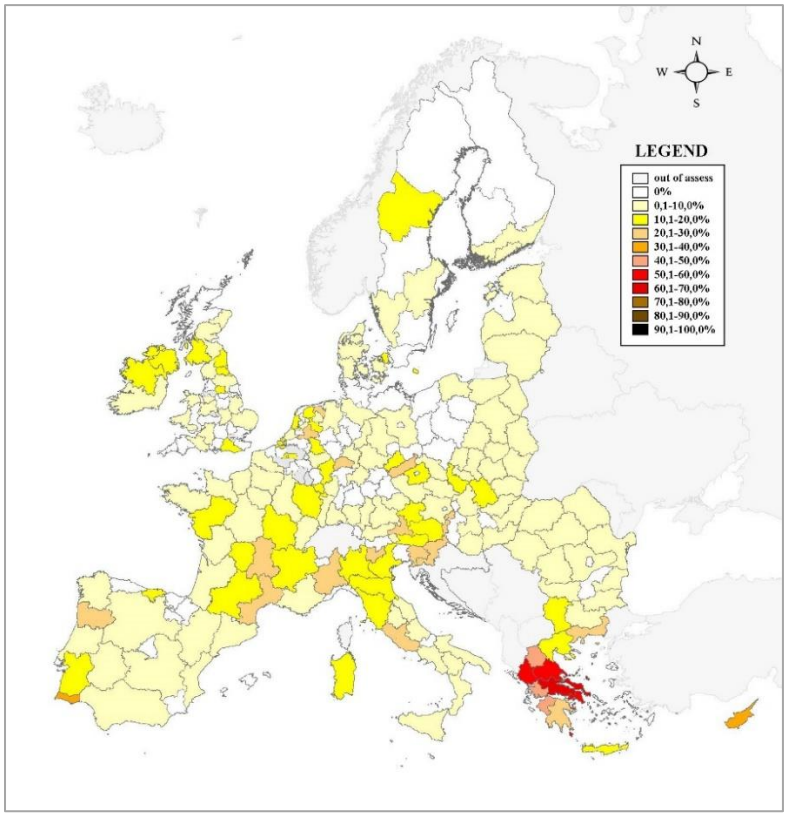


Figure 3. Percentage of LUCAS soil samples with concentrations above the lower guideline value in agricultural land

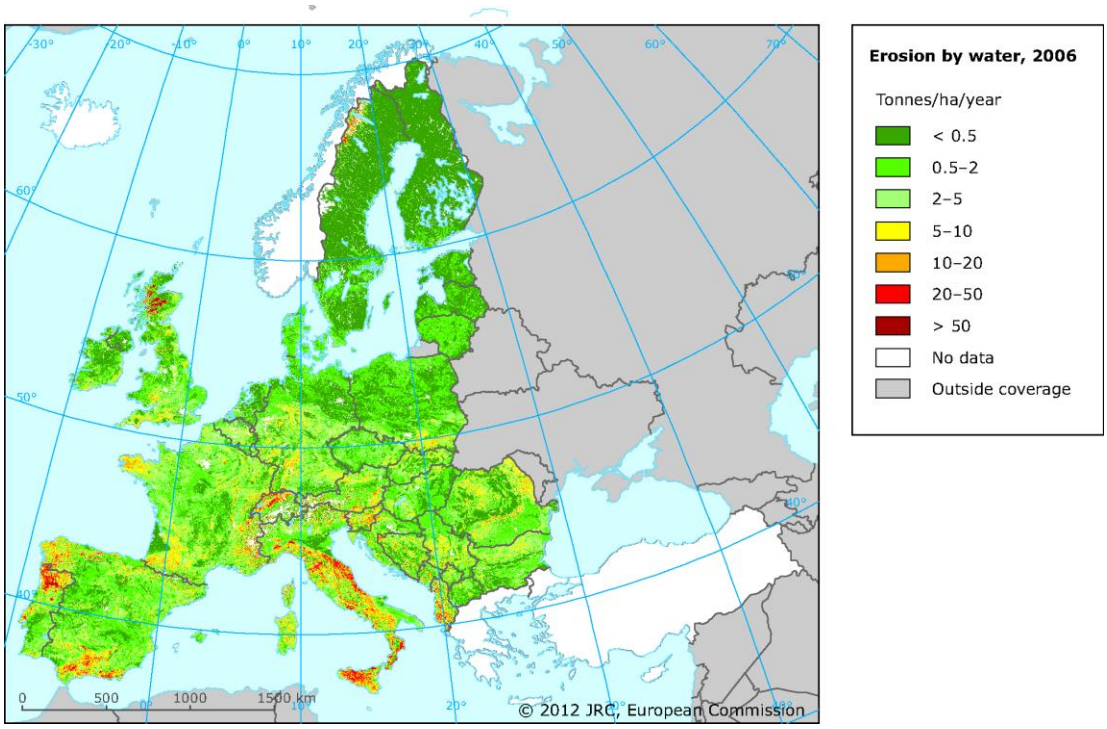


Figure 4. Estimated soil erosion by water in Europe

Results and Discussion

Climatic variability together with diverse geological and topographical conditions, as well as long-term anthropogenic influences are reflected in the diverse soil cover in Central Europe. Cambisols and Luvisols are the most widespread soil types, just like in the whole of Europe. However, soils with extreme properties, including light texture and high salt content are also found in the region. Furthermore the westernmost areas of the Chernozem belt reaches Central Europe too (Figure 1.). These diversity requires a series of site specific management techniques, including the selection of crops and soil management procedures. The opportunity in Central Europe is given to diversify the cropping pattern, thus provide a wider choice of healthy food against the global tendency of narrowing the number of crops utilised for human nutrition.

Cropland in Central Europe not only diverse in their soil types, but also variable in the productivity of soils. While the productivity of agricultural areas in Czech Republic and Austria are rather balanced, Poland, Slovenia and Slovakia has higher diversity in productivity conditions and Hungarian croplands are the most diverse in this regard, based on the very diverse soil and climatic conditions. Nevertheless Central European croplands can be regarded in general as rather productive compared to the Mediterranean regions. In addition, the per capita agricultural area in Central European countries also higher than the world's average, therefore we can state that the soil resource base for food security is available in this region, given that degradation processes and inadequate adaptation to climate change do not hinder its utilisation.

When assessing the situation of erosion, one of the World's most widespread soil degradation which threatens soil quality to the great degree, we can see that the situation in Central Europe is rather good, in comparison to other parts of Europe, especially that in the Mediterranean region. In fact, soil water erosion is reaches above the lowest category only in some of the hilly area of Central Europe. However, it would be misadvised to underestimate the damage may be caused by erosion. With the propagation of land management techniques controlling erosion, such as contour tillage

or no tillage, cover crops, parcel size and shelterbelts etc. soil quality resources can be kept in the current position in a global comparison.
Similarly to water erosion, the situation of heavy metal concentration in Central European cropland do not reach any alarming level. Results of the assessment applying lower guideline value on the LUCAS soil samples show a very low proportion of problematic samples with small areal coverage in Central Europe. Result suggests that food of Central European origin is in principle safe from heavy metal contamination and only precautionary measure shall be applied, including monitoring of soils for contaminants.
Soil sealing as a result of land take is a soil threat that is present in Central Europe to a degree comparable to that of the rest of the countries in the EU. According to the EEA (2021) between 2000 and 2018 in the European Union 11 times more land was taken from agricultural land to other, mainly urban and infrastructural uses than the area of recultivation. In fact, during the years from 2000 to 2018, 78 % of all land take of the EU affected agricultural areas. The highest share of cropland among the land uses affected by land take is seen in Slovakia (81,7%, total of 114,74 km^2) while the lowest in Croatia (5.64% and 10,29 km^2). Unfortunately the Croatian case seem to be exceptional, the rest of the countries consume their cropland with a many times higher speed. The countries in Central Europe need to consider land take very seriously, and act to control the negative trend if want to keep their soil resources for future generation.

Conclusion
Land resource base of agriculture in Central European has a good position in a global and also in a European comparison, although biophysical conditions within Central Europe has rather large diversity.

Main aspects of future utilisation of soil resources are:
- stability (climate change adaptation, food security, food safety)
- efficiency (natural capital, competitiveness)
- sustainability (ecosystem services, environmental conservation)

The quality of soil resources determine the efficiency of agricultural use. The prevention against degradation threats (erosion, contamination, soil sealing etc.) guarantee the sustainability of land use and healthy food as well. Stability of agricultural production depends greatly on the applied management method. Efficient and stable, yet sustainable soil and land use is the common goal of farmers, policy makers, all other stakeholders and is the interest of all citizens.

Central Europe in our current consideration can maintain the status of its soil resources in wider comparison if adequately addresses the main challenges of land use.
- Soil resource base for food security is available in this region, given that degradation processes and inadequate adaptation to climate change do not hinder its utilisation.
- With the propagation of land management techniques controlling erosion, such as contour tillage or no tillage, cover crops, parcel size and shelterbelts etc. soil quality resources can be kept in the current position in a global comparison.
- The opportunity in Central Europe is given to diversify the cropping pattern, thus provide a wider choice of healthy food against the global tendency of narrowing the number of crops utilised for human nutrition.

- Food of Central European origin is in principle safe from heavy metal contamination and only precautionary measure shall be applied, including monitoring of soils for contaminants.
- The countries in Central Europe need to consider land take very seriously, and act to control the negative trend if want to keep their soil resources for future generation.

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MANAGING A TRANSITION TOWARDS A SUSTAINABLE AGRO-FOOD SYSTEM- THE CASE OF THE AGROAGENDA IN NORTHERN NETHERLANDS

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Abstract
This paper analyses the initiative *AgroAgenda* in the northern Netherlands. The AgroAgenda is a platform in which multiple stakeholders together stimulate a circular, and nature-inclusive agro-food system in the Dutch provinces of Friesland, Groningen and Drenthe. Stakeholders come from, among others, provincial governments, farmers' and nature organizations, educational and research institutes and processing companies. They join forces to realize a system change, a transition, in the region, while promoting knowledge circulation, knowledge co-creation and joint learning. The platform, is a front runner of five national, comparable initiatives.
The AgroAgenda has the potential to lead to a more nature-inclusive and circular farming. Several of the 40 experiments have already led to good results. However, to bring about a real system change, more attention to innovations in governmental organizations (including law and regulations), policy, the value chains (division of margins, pricing and marketing) and the educational system are needed.

Keywords: transition management, circular agriculture, nature-inclusive agriculture, AgroAgenda

Introduction

Dutch and European policy

Loss of nature, water- and soil pollution, farmers struggling with low prices, carbon dioxide emissions, the Dutch agro-food system is confronted with major problems related to its impact on biodiversity, environment, climate and the future of family farms and rural areas. In the Netherlands, different missions for the agro-food sector are articulated by consumers, NGO's and ad-hoc civil initiatives and political parties (Ministry of Agriculture, Nature and Food, 2018, 2019, Socio-Economic Council, 2021). The missions address socio-cultural themes related to landscape, animal welfare and production systems and value chains. Furthermore, the missions comprise the task to reduce the environmental and climatic impact of agro-food systems and to close nutrient cycles. Soil-biodiversity is considered as one of the most important themes in these missions as it is the basis of agriculture (de Boer & van Ittersum, 2018). The biodiversity of the soil is an indicator for organic and an-organic contamination which has a direct impact on food and feed safety, it is an indicator for the soil-water system and influences natural and production eco-systems. The European Green Deal makes the missions even more important by adding concrete targets for use of pesticides, fertilizers nutrients cycles, fertilizer management and restoration of biodiversity in agricultural systems (European Commission, 2019).

Challenge for agricultural entrepreneurs

To meet all these demands, the challenge for agricultural entrepreneurs is now to transform their busines models. Most of Dutch farming systems are specialized on one product and focused on mainly one value: optimization of production, for example, of meat, milk or potatoes. If the agricultural entrepreneurs want to meet the requirements of the societal missions mentioned above,

they must create 'multiple values': values for society (such as nature or care), values for ecosystems (such as water storage) and values for their family (such as a sufficient income) (Porter & Kramer, 2011). However, this transition can't just depend on individual farms and enterprises. It needs a fundamental change in the agro-food system in the Netherlands, that is to say: not only new technologies are needed, but also alternative social arrangements, markets and policy structures (Geels & Schot, 2007, Klerkx & Rose, Loorbach et al., 2017). Multiple value creation thus requires coalitions and processes in which various stakeholders collaborate (Peterson, 2013).
Peterson (2013) describes these coalitions, alliances and processes as 'Multiple Stakeholder Coalitions'. He advocates 'vertical integration' by coalitions of stakeholders that collaborate in an open market. These coalitions might consist of actors from public governance, the private sector (processors, retailers etc.) and societal organizations.

Challenge for all stakeholders
Designing, developing and implementing the innovations that are needed to realize such a transition, requires so-called transformational knowledge, that integrates social/organizational and technological innovations (El Bilali, 2019).
What can this type of knowledge look like? Vogelezang et al. (Vogelezang et al., 2009) discern three types of knowledge processes that might lead to transformative knowledge: knowledge transfer, in which traditionally scientific (explicit) knowledge is shared with practitioners; knowledge-circulation, in which explicit and tacit knowledge are interactively exchanged and knowledge co-creation, in which new knowledge is developed in collaboration between researchers and practitioners. The latter approach is helpful in complex and uncertain environments, creates joint awareness of a problem and is often contextual. New knowledge is thus developed in a transdisciplinary approach, in which explicit knowledge of scholars is combined with the contextual (tacit) knowledge of practitioners (Peterson, 2009). Exchange of knowledge always means learning: El Bilali (2019) mentions learning as the most important process for innovation. He discerns learning-by-doing, learning-by-using, learning-by-interacting, single loop and double loop learning.

Research question of this paper
The AgroAgenda for the northern Netherlands aims at developing transformational knowledge and innovations that lead to a circular, nature-inclusive agro-food system. The platform, with multiple stakeholders, aims at promoting knowledge circulation, knowledge co-creation and joint learning among its participants. The AgroAgenda was originally initiated in 2013, In 2018 it was identified as an experimental area for circular agriculture by the Dutch Ministry of Agriculture, Nature and Food quality. The AgroAgenda doesn't follow the traditional linear approach of innovation, where scientists are the innovators who transfer their innovations to the practitioners that are supposed to adopt the innovations. Instead, the platform is explicitly built on a so called complex agricultural innovation system (AIS), as described by Douthwaite & Hoffecker (2017): central terms are co-creation, transdisciplinary, holistic perspective, responsive without a predefined agenda, multiple actor approach, aiming at institutional change and interventions based on relationships, trust and an open agenda.

The question in this paper is: does the platform meet the conditions to generate the transformative knowledge needed to lead to real changes in the region? To what extend has the initiative the potential to lead to real changes, and which gaps remain to be filled.

The analysis of course takes into account Covid 19. The implementation of the initiative was hampered by the pandemic, as creating relationships and trust are prerequisites for a successful process. These aspects require face-to-face meetings, visits and workshops which were impossible in 2020 and 2021, which also hampered the AgroAgenda initiative.

Analysis of the AgroAgenda Northern Netherlands initiative

The case of the AgroAgenda is described systematically by its *drivers*, enough *inputs* (organization, time and money), effective *activities, desired outcomes* and *emerging impact*.

Drivers

The drivers to change in the Netherlands are strong. In a SWOT analysis of the Dutch agricultural sector of Wageningen University & Research (Berkhout et al., 2021) points out that, although in general environmental pressure by Dutch agriculture has decreased, this decrease is insufficient to reach the environmental objectives set. Targets were not yet achieved on the nutrients load of water, nitrogen deposition is still too high to achieve biodiversity targets and the average ammonia deposition still amounts to 60 kgs per hectare of agricultural land, the highest in the EU, except Malta (Berkhout et al., 2021). In 2019, the Dutch government reported to the Convention of Biodiversity, a treaty of the United Nations Environment Programme (UNEP), that the country will not meet most of its targets on biodiversity formulated for 2020, while its main measures are considered as 'partly effective'. The establishment of the national ecological network is foreseen in 2027 and the report refers to the intensification of agricultural production, the reclamation of semi-natural areas, the drainage of wet areas and the use of artificial fertilizers as main causes (Sanders et al., 2019). In 2018, the Dutch minister of Agriculture, Nature and Food released a policy document urging for a nature-inclusive, circular agricultural sector (Ministry of Agriculture, Nature and Food, 2018). From a transition's perspective these various challenges can be considered as stimuli on a landscape level urging the stakeholders to act (Geels & Schot, 2007).

For the three northern provinces Friesland, Groningen and Drenthe, not only these international and national concerns were a driver for initiating the AgroAgenda, but also an internal motivation to ensure the viability of their agro-sector and societal pressure for more sustainability. (AgroAgenda, 2013). In fact, from the underlying documents of the AgroAgenda, a diversity of reasons to participate can be derived (Table 1). The underlying drivers of the initiators were to make a 'green' deal for the agro-sector, and to establish a collaboration between the vegetal (that needs manure) and animal husbandry sectors (that offers manure). Soil was mentioned for the first time as an important underlying theme (G. van Eck, personal communication, August 8, 2021

Document	Driver
AgroAgenda	Forthcoming reform of the CAP
	Societal demands on animal welfare, public health, biodiversity, landscape, climate, energy and relationship farmer-citizens
	Pressure experienced by farmers from society and regulations
	Environmental impact of minerals, plant protection products and ammonia

	Decline of biodiversity
Dairy agenda	Growing international demand for dairy products Abolition of EU quotas Major challenges on environment, water, biodiversity Need for production in societal harmony and acceptance
Innovation program for the 'Veenkoloniën' (cultivated former peat district)	European policy (CAP) – demand for more sustainability National policy (aim for biobased economy) Need for industrial development of agro-clusters and logistics Need for higher production and financial income per hectare for growers Need for more utilization of knowledge
Action plan Potato Valley	The demand to realize an economic, vital circular agriculture in harmony with its environment Decline in population and employment, vitality of rural areas is threatened
Regional Deal Nature Inclusive Agriculture	The existence of farmers, landscape and biodiversity is threatened by the present way food is being produced Agriculture has traditionally been important for wellbeing and landscape in northern Netherlands

Table 1 *The multiple drivers for the AgroAgenda and the related sectoral agendas (Sources: AgroAgenda 2013, 2015, Potato Valley Foundation, 2019, Stuurgroep voor de Agenda Veenkoloniën, 2012, Regio Deal Natuurinclusieve Landbouw, 2019).*

Inputs

The AgroAgenda is organized as a network initiative, in which the participating organizations and stakeholders finance their own hours. (Figure 1). This creates an optimal involvement. The steering committee comprises representatives from the agro-processing companies (milk processing cooperative, potato breeder & trader), farmers' organizations, nature organizations, education, provincial and national governments, waterboard and the three sector agenda's. The supporting team and catalyst team made up of 12 farmers, have the same set-up: members participate from their own interest or are delegated by their organizations. The budget of the AgroAgenda is composed by contributions of the three northern provinces, project subsidies from the EU-EFRD and in-kind contribution (hours) by participating organizations. The three sector agendas have their

own structure and funding. The same goes for the individual projects that are related to the AgroAgenda.

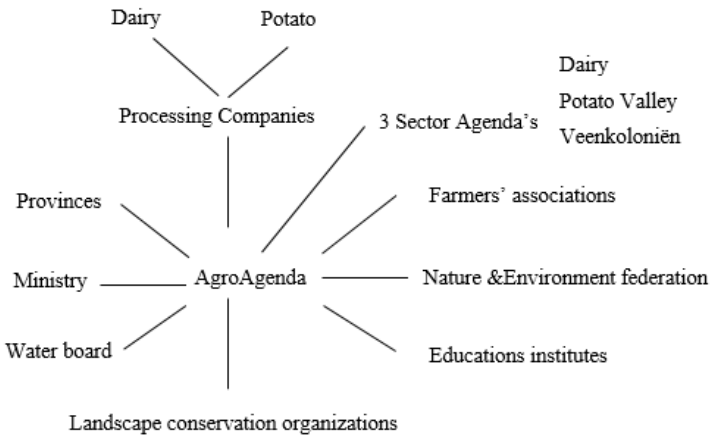

Figure 1 *Participating organizations in the AgroAgenda*

Activities

In 2019, the Dutch Ministry of Agriculture designated the northern Netherlands as one of the five experimental regions in which the ministry collaborates on a multiannual agenda for a transition towards a circular agro-food system.

The region organized a multi-stakeholder approach with tens of different stakeholders (see figure 1). They set up a light organizational structure: a secretariat was installed, and a program-leader appointed. Stakeholders from government, private sector, societal organizations and knowledge- and educational institutes now participate in three teams: a steering committee, with board members of the participating organizations, a supporting team that supports the program leader and a catalyst team with innovative farmers that exchange practical experiences and ensures the bottom-up approach.

The stakeholders jointly implement a common 'AgroAgenda' towards a sustainable agro-food system. In 2020, forty niche innovations were identified as relevant for the AgroAgenda, carried out by individual farmers, cooperatives and consortia of farmers, nature organizations and knowledge institutes. In order to induce a system change, in these pilots four types of innovations can be discerned: governance (innovations in regulation and organization), technologies and methods, competences (knowledge, skills and attitudes) and economic, towards sustainable business models and value chains (Table 2). These innovations affect all stakeholders and require involvement and collaboration.

Governance innovations (22%)	Innovations in National, Provincial and Local policy and legislation New organizational structures of stakeholders and regions
Technological & management innovations (50%)	Technical innovations in production and processing New methods of farm management and processing
Innovation in competences (10%)	Methods for co-creating new knowledge Training methods for new skills New awareness, new way of looking at the agro-food system New educational programs
Economic innovations (18%)	New business models New value chains

Table 2 *Classification of the 40 niche pilots in 2020: the % indicates the result of classification of the forty niche pilots in the types of innovations.*

The concrete activities of the AgroAgenda team are:

- Network meetings
- Communication and exchange of experiences and advice between the region and the Ministry
- Proposing strategies towards network partners how to realize the common goals
- Inspire and support stakeholders in generating new ideas and innovative projects
- Facilitate exchange of information and experiences between participants
- Intervene to eliminate barriers and support the creation of experimental space

The focus of the sector agendas is more on concrete projects that contribute to innovations in the sector related to technological innovations and business models. On the site, participants and interested parties can find news, agenda, desired outcomes and results from different areas (renewable raw materials, dairy cattle, potato valley, peat colonies).

Desired outcomes

The participants formulated the goals of the AgroAgenda as core qualities that should be achieved in the northern Netherlands. These core qualities are clustered in eight themes, as depicted in Table 3.

Themes and core qualities	
Diversity	In: Farms, Landscapes, Biodiversity, Markets and Value Chains.
Clean air, water and soil	No more emissions of pesticides veterinary medicines Climate neutral value chains As much as possible closed cycles Well-functioning soil-ecosystems
Connections with society	Commitment of all value chain actors Well informed and market-oriented entrepreneurs Accountability of all chain actors
Landscape	A valuable and diverse cultural landscape
Farms	Farms still exist in two generations Farms are flexible and adapt to market signals Farms are independent of CAP-
Value chains	At least 40% of production in top-market segments Leading in healthy food No reduced employment 5% of turnover labeled for R&D
Vital rural areas	Every entrepreneur and employees are active in local societies Agricultural production is clean, quit and safe Northern Netherlands offers an attractive living environment
Vital nature	Biodiversity contributes to higher agricultural production Agriculture contributes to biodiversity No farm-land species on list of endangered species

Table 3 *Desired outcomes (2030) of the AgroAgenda (source: https://www.agroagendann.nl/).*

The achievements of the AgroAgenda initiative in 2020-2021 were a.o. the following pilots (AgroAgenda, 2021):

- Early ploughing in wintertime: this project proved that is not necessary to use glyphosate on grassland before ploughing if ploughed during wintertime and that no Nitrogen leaching occurred, as this was absorbed by following arable crops (DLVAdvies, 2021).
- Incorporating straw-rich manure into the soil, to support biodiversity of meadow birds and soil biodiversity, together with a circular farmer cooperative Ecolana (https://ecolana.nl/).
- Collaboration between arable and dairy farms on exchanging feed and manure (de Wolf, 2018).

- Advisory meetings with the innovation department the Ministry of Agriculture, resulting in two approved innovative stable systems.

Discussion and reflection on impact

Successful niche-experiments are a step forwards, but how do we know that the results are viable on the long term and have actually an emerging impact? The process of the AgroAgenda can be considered as a transition pathway, as described by Geels & Schot (2007). Based on transition literature, they discern three levels in the process of system change: the *niche level*, where novelties emerge, the *regime level*, also called socio-technical regime, where engineers, scientists, policy makers, users and interest-groups together work on a system change, and the *landscape level*, the external environment that influences the regime and niches.

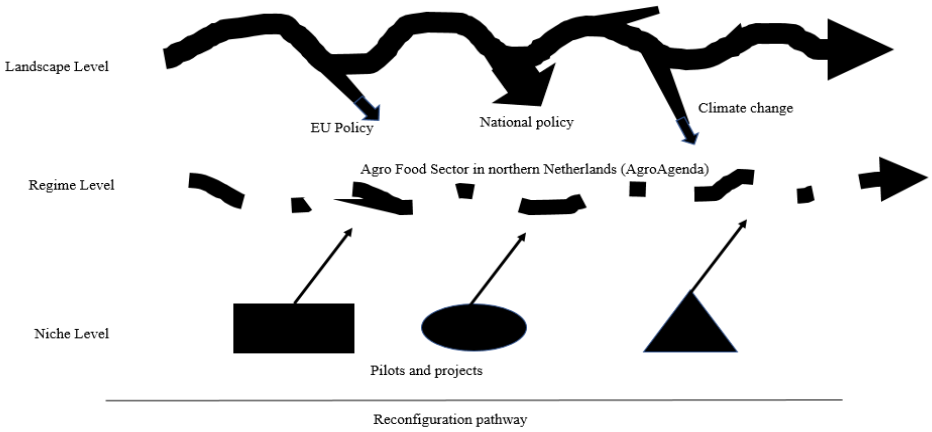

Figure 2 *Transition pathway towards a sustainable deed and food management in the northern Netherlands (Adapted from Geels & Schot, 2007).*

The AgroAgenda can be described in terms of transition theory: niche-innovations, socio-technological regimes and -landscapes. Whereas the innovation pilots and projects constitute niche-innovations, the diverse actors in the northern Netherlands constitutes the socio-technological regime. The landscape-level is established by three major forces: the European Commission issuing regulations on emissions and biodiversity, the national government advocating a transition towards circular agriculture and the environment affecting the regime through climatic changes.

Examining the forty niche-experiments identified by the AgroAgenda, it can be concluded that they meet the indicators as defined by Geels & Schot (2007) for viable niche-innovations that will have impact on the socio-technical regime because:

- The experiences in the pilots are embedded in a design, supported by the dominant stakeholders: the idea of a nature inclusive, circular agriculture that contributes to (soil)biodiversity, reduces climatic impact and closes nutrient cycles is formalized by policy documents of the ministry (Ministry of Agriculture, Nature and Food quality, 2018).
- The design of circular agriculture as-such has been accepted by major and powerful regime actors, who have joined the AgroAgenda.
- The pilots have led to a meaningful price-performance effectiveness in the innovative agricultural practices, because most innovations prove to be cost-effective and a niche market of processing companies and local customers as restaurants, consumers are willing to pay a higher price for regional, sustainable products.

- In 2019, market niches of sustainable agricultural products have raised up to 11% in the Netherlands as a whole (Logatcheva, 2019).

Combining the characteristics of the AgroAgenda with the theory of Multi Level Perspective-transition pathways of Geels & Schot (2007), we may conclude that the AgroAgenda is an example of a transition pathway. Major regime players (the boards of potato processor AVEBE, milk processor FrieslandCampina, farmers association LTO, the provinces, nature and landscape NGO's and educational institutes) are positive and ready to adopt the innovations from multiple experiments by existing and new suppliers and producers. A symbiotic relationship exists between the regime players and the niche-innovators, because of economic, political and environmental pressure.

This constellation leads to the hypothesis that the AgroAgenda in future will lead to technical changes and changes in perceptions of the regime. It can be expected that the external pressure by climatic change will increase and will lead to more and new transition pathways, which will lead to a more fundamental system change, also affecting the economic system (Geels & Schot, 2007).

More organizational learning needed

However, are these 40 experiments the right mix for a real change in the region? When looking at the forty niche-experiments half of the pilots have innovations in technology or farm management methods as the focus, while innovations focusing on economic and governance innovations each score around 20%. Table 2 shows that innovations focusing on competences development, education and learning constitute one-tenth of the pilots. Innovations in education and learning can be characterized by their focus groups: for example, students' education, practitioners training and organizational learning.

Of the forty pilots examined, only one project focuses on organizational or societal learning. Geels & Schot (2007) mention that an important condition for a reconfiguration pathway is that regime actors explore and learn from niche innovations, in order to bring about transformational changes in their institutions such as alternative types of R&D investments, educational systems, product marketing, coalitions and policy and regulations. Therefore, bottom-up, the niche experiments should be monitored and evaluated to learn from their experiences, scaled up within the agro-sector and connected with other sectors (Poppe, Termeer and Slingerland, 2009).

So, a systematic reflection on the AgroAgenda and its niche-experiments is needed. Because this will support the learning by regime-actors. This reflection can be both qualitative, using generative interviews and learning histories (van Mierlo 2010) and quantitative, using performance indicators related to the core qualities identified for the AgroAgenda. Performance indicators have been developed already by several scientific institutes (Koopmans, 2017, Eweg et al., 2021, Stobbelaar & van Mansfelt 1999). Figure 3 provides an example for key-performance indicators related to the AgroAgenda quality 'well-functioning soil-ecosystems'. Soil quality is an important aspect of the transition pathway toward more sustainable and healthier food but is part of a holistic approach considering all relevant variables and related indicators.

- Percentage of rest crops (grass, clover etc.) in crop-rotation
- Balance of organic matter
- % of plant cover
- Score of soil condition (soil life, structure, layers, soil water etc.)
- Use of pesticides and herbicides
- Farm nitrogen surplus

Figure 3 *Example: key-performance indicators for functional soil-biodiversity and good soil management mentioned by Louis Bolk Institute (Koopmans et al., 2017).*

Conclusions

We can conclude that the AgroAgenda creates an environment for impact on the regime and landscape level. The initiative turns out to fit in the multi-level transition theory as described by Geels & Schot. Many pilots for sustainable food production have been initiated and are supported by the initiative. The most relevant stakeholders from production, processing, governance, nature and landscape management, society and education are involved in the initiative.

However, to achieve impact on the regime level, besides developing and implementing niche pilots, not only the farmers but all stakeholders (figure 1) must keep on learning and innovating. They must ask themselves which transition pathways lead to sustainable environments and livelihood for farmers. Tackle long-term, often difficult issues such as: do we want more …. Or more or… And how can the niche-experiments be associated with the governmental and other companies and organizations in the northern Netherlands?

To reach its goals, the AgroAgenda initiative will have to broaden its scope on innovation. Most niche-experiments still focus on technological innovations and new farm management methods. A smaller share address innovation on governance, competences and economical themes we identified. Most of the innovations on governance, competences and economics focus on the farmers' level or take farmers as a starting point. Most of the goals of the AgroAgenda, formulated as 'themes and core qualities are related to primary production. However, to enable and support farmers to reach these qualities, also innovations in the complex and higher level agro-food system will be needed - in governmental organizations (including law and regulations), policy, innovations in value chains related to division of margins, pricing and marketing. Finally, real change also asks for innovations in the educational system: a more interdisciplinary systems-approach and students that are educated to become experts in facilitating transition processes.

A platform can design organizational learning, by starting with an exchange of experiences with the niche-pilots. As Peterson argued, actors must adopt new roles and form new coalitions. The AgroAgenda already started bringing together various actors in learning environments: in multi-disciplinary workshops, via regular markets and farm visits, a web site, and social media. Implementing regional monitoring programs, based on quantitative and qualitative performance indicators, will help to decide the successfulness of innovations. When this monitoring and the accompanying reflection is dynamic, a continuous learning process will be stimulated and facilitated.

The northern Netherlands embarked on a transition pathway towards more sustainable production and management of food and feed. The AgroAgenda is an open and flexible organization, so when it develops further, new actors might join, and new topics will pop up. It might have national impact, as the ministry of agriculture is closely involved in the initiative and initiated four other comparable initiatives all over the country. The coming years, the initiative will be monitored, and its impact will be further evaluated and assessed on its contribution to sustainable food and feed management and a new agro-food system.

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SUPPORT OF REGIONAL FOODS IN THE CZECH REPUBLIC

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Abstract
Food is essential for people's lives and to meet their basic life needs. The quality of food affects the health of the population and their ability to a full work and personal life. Food self-sufficiency also makes the state safer, and growing food at the point of consumption has a beneficial effect on the environment. For this reason, the author focuses on the support of regional foods in the Czech Republic in connection with the legislative development in this area.

Key words: regional foods, the Czech food regulation, Czech food, European Union

Introduction

One of the political themes that resonates mostly in connection with the elections is the issue of food self-sufficiency. In other words, support for local (regional) agricultural production. This is an issue that deserves discussion, given that it is an issue with an environmental impact, support for rural employment, social aspects and also with the issue of the security of the Czech Republic. On the other hand, we are part of the European Union, one pillar of which is based on the European single market, and therefore competition in the area of agricultural products. In other words, if our commitments to the European Union are not violated, the promotion of local food production can be seen as a positive aspect of sustainable land use. Protection of food is very important (RAYBURN, 2009).

Material and methods

Based on the method of analysis, the author presented changes in the basis of food and tobacco products in the Czech Republic in relation to the promotion of regional foods and the improvement of food quality.

Results and Discussion

Present situation in the support of quality foods

The quality of the Czech food industry has a rich tradition, which has been neglected and replaced in recent years by the effort to achieve the lowest possible price, often at the expense of product quality. This situation is unsustainable for our producers, because in the long run they cannot compete with countries with economies focused primarily on agricultural production and farming on incomparably larger areas of agricultural land. Against mass production, the Czech Republic can offer higher quality products, which can provide the Czech food industry and agricultural primary production with the necessary competitiveness. Top quality and added value are what create a competitive advantage in European food production (JORDANA, 2000). In the area of food safety and quality, the aim is in particular to improve the overall level of food sold and to support producers of quality local food, including established quality labels (WIDOWATY, 2019).

The Ministry of Agriculture and the State Agricultural Intervention Fund perceive the issue of food quality as one of their priorities and introduces the Klasa, Regional Food, Biolist, Biozebra, Protected Geographical Indication (PGI), Protected Designation of Origin (PGI) and Guaranteed Traditional Specialty (TSG) quality labels. the public with quality and local food production.

The main part of the support of quality food by the State Agricultural Intervention Fund is consumer education in food quality issues, organizing events to support the sale of award-winning products, including promotional campaigns and cooperation in presentations at domestic and foreign exhibitions and fairs (KOTOVICOVÁ, 2000). Projects to promote quality food and typical regional products are running in a number of European countries. Klasa brand www.eklasa.cz The KLASA national quality mark was introduced by the Ministry of Agriculture in 2003. During its existence, the KLASA brand has not only become a prestigious affair for its holders, but above all it has gained the trust of Czech residents who purchase products marked with the KLASA logo (MINISTERSTVO ZEMEDĚLSTVÍ, 2014).

Manufacturers and representatives of retail chains also evaluate the sales of these products very positively and welcome the promotion of quality food production (SKOŘEPA, 2009). The KLASA brand is awarded only to proven agricultural and food products that meet above-standard quality and safety criteria. The requirements for the award of the KLASA label are stricter than the usual hygienic and food standards. KLASA serves primarily to better orient consumers in the market, to identify quality food products and to present proven foods by control authorities. During its operation, the KLASA brand proved its marketing power and became an integral part of sales marketing support for domestic food producers. Marketing support for quality food will not only affect Czech agriculture and the food industry, but the entire economy and state budget revenues. Increasing the production and sale of food will ensure the need for agricultural production, higher employment - especially in rural regions with a difficult social situation and will create demands for increasing the production of the supply industry (LOOPSTRA, 2016). Regional Food Brand www.regionalnipotravina.cz The Regional Food project is aimed at supporting small and medium-sized farmers and food producers and at the same time meets the growing interest of consumers in fresh food with a clear domestic origin. The "Regional Food" brand is acquired by local food producers and growers in the form of regional competitions. The competitions are announced in all 13 regions of the Czech Republic (except Prague). An agricultural or food product that seeks to be awarded the Regional Food label must be produced in the region concerned from the raw materials of the area (MATUSIKOVA, 2006). Expert juries always select one winning product in 9 categories. The awarded products receive a certificate from the Minister of Agriculture and the right to use the "Regional Food" brand of the region for 4 years.

The brand's communication is supported by a nationwide information campaign, which aims to boost demand for these foods and convince consumers that food is important not only in price but also in quality, freshness and origin. The campaign also focuses, among other things, on activities that have a direct impact on supporting the sale of regional foods and promoting them directly at the point of sale. Projects to promote local foods and typical regional products are running in a number of European countries. This trend, together with a long-term focus on high quality and food safety, has significant economic effects, whether in terms of maintaining traditional production, maintaining and creating new jobs or, more generally, the inflow of funds into the regions. The Bio brand www.myjsmebio.cz BIO is a certified management system based on national and European legislation with its own control system guaranteed by the state. BIO can only be a food that meets the statutory and state-controlled requirements for organic farming. This is based on the sowing procedure and soil care. The fields are full of life, they do not use artificial fertilizers, pesticides, genetically modified organisms or chemical spraying. Animals are not only used, but they are cared for with love. They are always fed with feed from organic farming and are reared. The production of organic food in organic farming does not destroy nature (MICOVIC, 2011). On the contrary, it improves and preserves it for future generations.

Organic products are always visibly marked with logos, which may be used only by those producers who comply with the precise legislative principles of organic production. The inspection system is set up so that at least once a year the entire chain goes from primary production to distribution through a complete special inspection, which is an extension of standard inspections in conventional agriculture.

Food Act and support of Czech food

As already indicated, the area has a political aspect, and probably in connection with the elections to the Chamber of Deputies in October 2021, an amendment to the Food and Tobacco Products Act was submitted by the government. Act No. 110/1997 Coll., On Food and Tobacco Products and on Amendments to Certain Related Acts (hereinafter referred to as the "Food Act"), contains, in accordance with EU law, the obligations of a food business operator, manufacturer, importer, retailer and distributor tobacco products and products related to tobacco products and regulates state supervision over compliance with the obligations arising from this Act and directly applicable regulations of the European Union, with the exception of drinking water with the exception of drinking water which the food business operator markets or uses at any stage of production, processing or food distribution in accordance with Article 3 (16) of Regulation (EC) No 178/2002 of the European Parliament and of the Council. The above-mentioned amendment to the Food Act was approved as Act No. 174/2021 Coll., Amending Act No. 110/1997 Coll., On food and tobacco products and amending certain related acts, as amended, and others. related laws. This law was published in the Collection of Laws on 27 April 2021 and brought a change not only to the Food Act itself, but also to the Act on the State Agricultural and Food Inspection Authority or the Public Procurement Act.

General changes brought by the amendment

The amendment brings a number of changes both in the regulation of the activities of food business operators and in the increase of consumer protection or responsible procurement. The most significant changes, which are discussed in detail below, include in particular:

- ban on dual quality food,
- clarification of the notification obligation of the food business operator,
- modification of the manufacturer's labeling rules,
- adjustment of the rules for handling unpacked food,
- adjustment of rules for food disposal,
- tightening of conditions for the use of the designation "Czech food",
- clarification of the mechanism for providing food to non-profit organizations by retail, adjustment of control rules,
- introduction of new conditions for participation in the tender for food supply,
- introduction of legal regulation of food control of a new type, the component of which is insects, or
- adjustment of control processes of administrative bodies.

In addition to transposing the new European Regulation (EU) 2017/625 of the European Parliament and of the Council on official controls and other official activities, and other related European legislation, the amendment also focuses, among other things, on regulating the much-discussed issue of dual food quality.

Prohibition of dual quality food

The introduction of a ban on dual food quality, as this institute can be simply described, is a fundamental change brought about by the amendment. As dual quality products, we refer to products interchangeable with products of inferior quality manufactured in the member states of the European Union intended for the European market. The point is that foodstuffs in the Czech Republic and abroad, which at first glance look the same, have the same composition. So it is also about a certain equality of Czech food. Thus, Czech food and foreign food may seem identical at first glance, but on closer inspection of the composition, we come across differences, both in the amount of added food ingredients and in their quality. According to the European Union, the dual quality of food is inherently misleading, so it falls into the category of unfair competition practices and as such is prohibited. However, it can be stated that the Directive on Unfair Commercial Practices of the European Union, which is followed by the amendment, does not contain a sharp ban on dual food quality. In this case, it is precisely the amendment to the Act on Food and Tobacco Products, which in this direction completes the goal set by the Directive by banning dual food quality within the scope of chiselling this directive. So that, for example, Coca cola that does not look the same should not sweeten natural sugar in one country, an artificial sweetener in another, etc. The amendment regulates the above-mentioned issues in the new provisions of § 10 par. (f) and (g), which provide that: 'The placing on the market of foods:

• containing substances in conflict with the requirements for the composition of food supplements or substances prohibited in the production of food according to the Decree on Food Supplements and Food Composition, and

• Seemingly identical to the food placed on the market in other Member States of the European Union, although the food placed on the market in the Czech Republic has significantly different composition or properties, unless justified by justified and objective facts and the food is provided with easily accessible and sufficient information different composition or properties.

In this case, we can talk about the so-called "hard ban" of dual quality food, which will, after its entry into force, exclude the sale of dual quality products in Czech stores. Compliance with the double quality ban will be supervised by the State Agricultural and Food Inspection Authority, which will also be the authorized body for imposing fines for violating the ban. These can reach up to CZK 50 million (MINISTERSTVO ZEMĚĎELSTVÍ, 2014).

The amendment came into force on 12 May 2021 and the ban on dual food quality indirectly expresses support for Czech food.

Conditions for the use of the designation "Czech food"

The use of the designation "Czech food" is tightened by the amendment. This designation may be used only not only if 100% of all components of the total weight of unprocessed food, wine products or milk come from the Czech Republic, and primary production, slaughter of animals and all stages of production took place in the Czech Republic, they must also be born and reared. in the Czech Republic. The designation "Czech food" may also be used in relation to food specified by implementing legislation, the production of which took place in the territory of the Czech Republic. This change is effective from May 12, 2021.

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Provision of food to non-profit organizations by retail

The amendment also clarifies the mechanism for providing food to non-profit organizations through retail. It is newly stipulated that the obligation to place these foods on the market free of charge does not apply to beverages with an alcohol content above 0.5% by volume. At the same time, it is introduced that the promotion of food is prohibited in the distribution of food other than non-profit organizations, food business operators providing food free of charge or public benefit legal entities. The change will be effective from 12 May 2021.

Conditions for participation in the procurement procedure for the supply of food

In Act No. 134/2016 Coll., On the award of public contracts, as amended by Act No. 147/2017 Coll., Act No. 183/2017 Coll., Act No. 368/2016 Coll., Act No. 287/2018 Coll., Act No. 309/2019 Coll., Act No. 277/2019 Coll., Act No. 527/2020 Coll. and Act No. 543/2020 Coll., a new Section 37a is inserted after Section 37, which, including the title and footnote No. 53, reads as follows: new “Section 37a Condition for participation in a tender for the supply of food. The contracting authority may, in a procurement procedure for the supply of foodstuffs, make delivery a condition for participation in the procurement procedure

a) local or regional foods from the short supply chain,

(b) foods complying with the certified quality schemes of Regulation (EU) No 1151/2012 of the European Parliament and of the Council on quality schemes for agricultural products and foodstuffs53), or

(c) food produced in the organic farming system.

This change will take effect on January 1, 2022.

Food quotas

The House version of the Act, supplemented by amendments, also sought to enforce mandatory quotas concerning the amount of Czech food in Czech shops. These should mainly concern stores over 400 square meters, which would be obliged to sell at least 55% of domestic products and food. The quota was to increase over the years until 2028, when it was to reach 73%. The quotas were to cover food that could be grown in the Czech Republic, especially potatoes, cucumbers, etc.

What quotas do MEPs want to order for shops

An amendment to the Food Act originally adopted by the Chamber of Deputies would order that from 2022, 55 percent of selected food from Czech production would have to be in stores over 400 square meters.

After 2022, according to the deputies' proposal, the ratio of compulsorily sold Czech food would increase by three percentage points per year until 2028, when the quota for Czech food should be at least 73 percent.

According to the idea of the parliamentary majority, the obligation of quotas was to apply to more than 120 products out of approx. offered, eg for eggs, honey, cauliflower, cabbage, garlic, fresh and chilled beef, pork and mutton. The quota would also apply to rapeseed or sunflower oil, milk, cheese or cottage cheese. The change was approved by the Chamber of Deputies, but rejected by the Senate.

However, the introduction of food quotas would be contrary to the principles of the single internal market, and for this reason the Senate did not accept the proposed amendments to food quotas in the amendment and these were not subsequently enforced in the Chamber of Deputies. Therefore, food quotas are not introduced by the amendment.

Conclusions

The amendment brings a number of changes both within the regulation of the activities of food business operators and within the framework of increasing consumer protection or responsible procurement.

The amendment will take effect mainly on 12 May 2021, cases where it will take effect later are listed above for the individual changes adopted.

In case of any questions concerning the issue of the amendment to the Act on Food and Tobacco Products and the current legal food regulations, we are at your disposal. So do not hesitate to contact us.

Summary

Summarizing the findings of the article, we conclude that the Czech Republic is taking active steps to support regional food development and improve food quality. As part of its efforts, it is obliged to comply with the obligations arising from membership in the European Union. In particular, the ban on dual quality food and the explicit possibility of promoting local food and organic food in public procurement are encouraging.

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LEGAL ASPECTS OF THE HEALTH QUALITY OF FOOD IN TERMS OF SOIL QUALITY

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Abstract

The health quality of food is an area of food safety. The expression food safety is not defined in European Union law, nor is the health quality of food. It can be concluded that, All the requirements health, sanitary, veterinary and phytosanitary requirements for agri-food products specified in regulations make up the so-called requirements for the "health quality" of food. According to the author's opinion, when talking about health quality of food, one should bear in mind not only the requirements health, sanitary, veterinary and phytosanitary requirements for agri-food products specified in food law regulations, but also clear air, water and soil. Against this background, there is a specific connection between the aspects of food safety and food security, as the requirements of food law focus precisely on food safety, and the need to protect resources, including soil qulaity, results directly from the need to ensure food security. Thus, the European Green Deal documents show, to some extent, the integration of activities relevant to both food safety and food security.

Keywords: health quality, food safety, soil quality, food security

Introduction

There is no definition of health quality in the EU regulation. However, it includes general criteria for assessing food safety[1], in addition, there are legal acts regulating, in particular, specific production requirements[2], hygiene[3], microbiological criteria[4], levels of acceptable production

1 Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety, Official Journal L 031 of 1 February 2002, p. 0001 – 0024, hereinafter as regulation no. 178/2002.

2 Council Regulation (EURATOM) 2016/52 of 15/01/2016 determining the maximum permitted levels of radioactive contamination of food and feed after a nuclear accident or other radiation emergency and repealing Regulation (EURATOM) No. 3954/87 and Commission Regulation (EURATOM) No. 944 / 89 I (EURATOM) No. 770/90, Official Journal of the European Union L No. 13, p. 2, hereinafter as Regulation no. 2016/52.

3 Regulation (EC) No 852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene of foodstuffs, OJ L 139, 30.4.2004, p. 1–54, Special edition in Polish: Chapter 13 Volume 034 P. 319 – 337, hereinafter as Regulation no. 852/2004.

4 Commission Regulation (EC) No 2073/2005 of November 15, 2005 on microbiological criteria for foodstuffs, OJ L 338, p. 1 as amended, hereinafter referred to as Regulation No 2073/2005; Commission Regulation (EC) No 1441/2007 of December 5, 2007 amending Regulation (EC) No 2073/2005 on microbiological criteria for foodstuffs, OJ L 322, p. 12, hereinafter as Regulation no. 2073/2005.

residues[5] and contaminants[6]. These requirements shape a certain level of food safety. The legislation also includes requirements for the control and supervision of the production and marketing of food[7]. On the other hand, the legal definition of food safety appears in the Polish Food and Nutrition Safety Act.8 The literature indicates that "the safety system is built through a set of definitions, rules, institutions, procedures aimed at achieving the optimal level of food safety in the European Union" [9].

On the other hand, "quality" can be seen from different points of view[10]. Economists point out that it is a "social category" because it defines a certain social relationship. They refer to the European philosophy, within which there was a dispute about the objective nature of quality, related to the problem of the objectivity of cognition and the cognitive value of sense impressions[11]. Quality is also a legal concept, it occurs both in EU law[12], and in domestic legislation[13]. However, the concept of health quality has not been defined in the food law, therefore getting to know its content requires interpretation. The paper focus on health quality of food connected with food safety in selected aspects – only from residues, contaminants and pesticidies point of view in relation to soil quality.

5 Regulation (EC) No 470/2009 of the European Parliament and of the Council of May 6, 2009 laying down Community procedures for the establishment of residue limits of pharmacologically active substances in foodstuffs of animal origin, repealing Council Regulation (EEC) No 2377/90 and amending Directive 2001/82/EC of the European Parliament and of the Council and Regulation (EC) No 726/2004 of the European Parliament and of the Council, OJ L 152, p. 11, hereinafter referred to as Regulation no. 470/2009.

5 Regulation No 2073/2005; Commission Regulation (EC) No 1441/2007 of December 5, 2007 amending Regulation (EC) No 2073/2005 on microbiological criteria for foodstuffs, OJ L 322, p. 12.; Regulation No 470/2009; Regulation no. 2016/52.

6 Regulation (EC) No 396/2005 of the European Parliament and of the Council of February 23, 2005 on maximum residue levels of pesticides in or on food and feed of plant and animal origin, and amending Council Directive 91/414/EEC (OJ L 70, p. 1 as amended), hereinafter referred to as Regulation No 396/2005; Regulation no. 2016/52.

7 Regulation (EU) 2017/625 of the European Parliament and of the Council of 15 March 2017 on official controls and other official activities performed to ensure the application of food and feed law, rules on animal health and welfare, plant health and plant protection products, amending Regulations (EC) No 999/2001, (EC) No 396/2005, (EC) No 1069/2009, (EC) No 1107/2009, (EU) No 1151/2012, (EU) No 652/2014, (EU) 2016/429 and (EU) 2016/2031 of the European Parliament and of the Council, Council Regulations (EC) No 1/2005 and (EC) No 1099/2009 and Council Directives 98/58/EC, 1999/74/EC, 2007/43/EC, 2008/119/EC and 2008/120/EC, and repealing Regulations (EC) No 854/2004 and (EC) No 882/2004 of the European Parliament and of the Council, Council Directives 89/608/EEC, 89/662/EEC, 90/425/EEC, 91/496/EEC, 96/23/EC, 96/93/EC and 97/78/EC and Council Decision 92/438/EEC (Official Controls Regulation), OJ L no. 95 of 7 April 2017, p. 1–142, hereinafter Regulation no. 2017/625.

8 The Act of August 25, 2006 on Food and Nutrition Safety, Journal of Laws of 2019, item 1252, as amended, hereinafter referred to as the Food and Nutrition Safety Act.

9 M. Korzycka, *Bezpieczeństwo żywności* in: M. Korzycka, P. Wojciechowski, *System prawa żywnościowego,* Warszawa 2017, p. 248.

10 See: Green Paper on agricultural product quality: product standards, farming requirements and quality schemes /* COM/2008/0641 final */ ; R. Budzinowski, *Il mercato agricolo polacco di qualità* in: La regolazione e la promozione del mercato alimentare nell'Unione Europea. Esperienze girudiche comunitarie e nazionali. Atti del Convegno Udine, 24-25 Novembre 2006, ed. M. D'Addezio i A. Germanò, Milano 2007, p. 123.

11 See K. Meredyk, *Ekonomiczna interpretacja kategorii „jakość"* in Rynkowe mechanizmy kształtowania jakości ed. S. Makarski, Rzeszów 2005, s. 13.

12 Regulation (EU) No 1151/2012 of The European Parliament and of The Council of 21 November 2012 on quality schemes for agricultural products and foodstuffs OJ L 343, 14.12.2012, p. 1–29.

13 Act of agri-food products'commercial quality of 21 December 2000, Journal of Laws od 2021, item. 630, as amended, hereinafter Act of agri-food products' commercial quality.

EU legislation focuses on the substantive regulation of the aforementioned microbiological criteria limits, contaminants and pesticides, residues of pharmacologically active substances, as well as hygiene requirements and official food control processes.
On the other hand, soil quality is related to EU policy[14]. As it is indicated, soil is an essential ecosystem that delivers valuable services such as the provision of food, energy and raw materials, carbon sequestration, water purification, nutrient regulation, pest control, and support for biodiversity and recreation. Soil is a non-renewable resourse that is subject to degradation, as well as other unfavorable processes such as land grabbing. In absence of a dedicated legislative framework, EU soil protection policy is shaped by the EU Soil Thematic Strategy and provisions in a number of other policy instruments, for instance, the Industrial Emissions Directive, the Environmental Liability Directive, the EU Biodiversity Strategy, the EU forest strategy and the Common Agricultural Policy[15]. However, regulations concerning the quantitative protection of soil (agricultural land) have been subject to national legislation in the field of spatial planning and development[16]. The quality of the soil should be related to the quality of the agricultural land used for food production.

Material and methods

The research area is determined by the regulation of EU and national law, e.g. Regulation no. 178/2002, as well as EU regulations on pesticide residues[17], pollutants[18] and other[19].
The issues specified in the title of the work have been the subject of studies in both Polish legal literature[20], and foreign[21], but only in terms of individual threads, and therefore it has not been exhausted.
When it comes to the considerations justifying undertaking the development of the issue specified in the title, it is necessary to indicate the considerations of human health protection, as well as environmental protection, including its element - soil. Human health is linked to nutrition and the latter is obviously linked to the health quality of food, which can be understood as the absence of health risks from food. The way of cultivating soil, especially plants for food purposes, affects the

14 Communication from the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Pathway to a Healthy Planet for All EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil', {SWD(2021) 140 final} - {SWD(2021) 141 final} , Brussels, 12.5.2021 COM(2021) 400 final.

15 See more on the website: https://ec.europa.eu/environment/soil/index_en.htm, access 28.9.2021.

16 The Act in force of 27.03.2013 on Spatial Planning and Land Development Journal of Laws 2021, item. 741.

17 Regulation no. 396/2005.

18 Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs (Text with EEA relevance), OJ L 364, 20.12.2006, p. 5–24, hereinafter as Regulation no. 1881/2006.

19 Regulation no. 2073/2005.

20 M. Korzycka, P. Wojciechowski, *System prawa żywnościowego*, Warszawa 2017; K. Leśkiewicz, *Prawo żywnościowe*, Warszawa 2020.

21 Z. Bohátová – L. Palšová – N. Floriš, *Quality soil and healthy food in the Jean Monnet project*, EU Agrarian Law vol. 10. no. 1/2021, 10.2478/eual-2021-0003 , https://www.sciendo.com/pdf/10.2478/eual-2021-0003, access 27.9.2021; A. Szajkowska, *Regulating food law. Risk Analysis and the Precautionary Principle as a General Principles of the EU Food Law*, Wageningen 2012; I. Härtel, D. Ren, *Agri-Food Law: Term, Development, Structures, System and Framework* in: ed. I. Härtel, *Handbook of Agri-Food Law on China, Germany, European Eunion. Food security, Food Safety, Sustainable Use of Resources in Agriculture*, Frankfurt (Oder) 2018.

properties of agricultural (food) products. In this respect, the EU regulation uses the method of the highest maximum levels of undesirable substances such as pollutants, pesticides, as well as the regulation of soil fertilization rules. From 2022, only safe and effective fertilizers are to be on the EU market[22].

In practice, in food there are various residues and post-production contaminants in food affecting its safety. Even practice shows that the safety of food containing contaminants or pesticide residues for human health is not ensured in one hundred percent. With regard to food products, the individual MRL exceedance indicator increased in 2015-2018 for table grapes (from 1.8% to 2.6%), sweet peppers (from 1.2% to 2.4%), bananas (from 0.5% to 1.7%) and eggplant (from 0.6% to 1.6%). In 2018, the exceedance rate decreased compared to 2015 for broccoli (from 3.7% to 2.0%), virgin olive oil (from 0.9% to 0.6%) and hen eggs (from 0.2% to 0.1%)[23]. Efsa indicates the assessments – one considering chronic effects on the thyroid system and the other acute effects on the nervous system[24].

Soil protection has gained a new dimension in the light of EU policy. Soil is an extremely complex, variable and living medium, but absolutely critical for life on Earth. It hosts 25% of the world biodiversity, it contains around twice the amount of carbon that is found in the atmosphere and three times the amount found in vegetation, and some 95% of our food is directly or indirectly produced from our soils[25]. Land and soil degradation is a global concern – this is one of the targets of the UN Sustainable Development Goals (Agenda 2030). A UN Convention is dedicated to combat desertification (UNCCD) while the UNEP and FAO have dedicated activities on soil protection. As indicated in the document of the European Green Deal „European food is famous for being safe, nutritious and of high quality. It should now also become the global standard for sustainability. Although the transition to more sustainable systems has started, feeding a fast-growing world population remains a challenge with current production patterns. Food production still results in air, water and soil pollution, contributes to the loss of biodiversity and climate change, and consumes excessive amounts of natural resources, while an important part of food is wasted"[26]. As indicated, in the European Green Deal, farmers and fishermen are key to managing the transition.

Detailed activities that are extremely important from the point of view of food safety and soil protection are indicated in the document the Farm to Fork Strategy[27].

The strategic plans will need to reflect an increased level of ambition to reduce significantly the use and risk of chemical pesticides, as well as the use of fertilisers and antibiotics. The area under

22 Regulation (EU) 2019/1009 of the European Parliament and of the Council of 5 June 2019 laying down rules on the making available on the market of EU fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 and repealing Regulation (EC) No 2003/2003, OJ L 170 of 25 June 2019, p. 1–114. *Regulation (EC) No 2003/2003 is repealed with effect from 16 July 2022.*

23 The 2018 European Union Report on pesticide residues - the EU-coordinated programme results, see more on: https://www.efsa.europa.eu/en/annual-pesticides-report-2018, access 27.9.2021.

24 https://www.efsa.europa.eu/en/news/pesticides-first-cumulative-risk-reports-published, access 27.9.2021.

25 See more on soil policy https://ec.europa.eu/environment/soil/index_en.htm, access 27.9.2021.

26 Communication From The Commission The European Green Deal, Brussels, 11.12.2019 COM (2019) 640 final, points 2.1.6., hereinafeter European Green Deal.

27 Communication From The Commission to the European Parliament, The Council, The European Economic And Social Committee and The Committee Of The Regions A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system, Brussels, 20.5.2020, COM/2020/381 final.

organic farming will also need to increase in Europe. The EU needs to develop innovative ways to protect harvests from pests and diseases and to consider the potential role of new innovative techniques to improve the sustainability of the food system, while ensuring that they are safe. The strategic activities will need to reduce significantly the use and risk of chemical pesticides, as well as the use of fertilisers and antibiotics. The future food system must become more sustainable[28]. All this has been linked to efforts to foster climate neutrality and decoupling economic growth from natural resources to achieve zero greenhouse gas emissions by 2050. For these reasons, the EU's activities focused mainly on the food sector and ecosystems.
With the above in mind, the aim of the considerations is an attempt to establish the relationship of the concept of health quality of food with soil quality in the light of the applicable regulations in the context of the new challenges of the European Green Deal. The volume of the article only allows you to signal some threads.

Results and Discussion

Soil quality in Poland

As it was mentioned, soil quality protection (agricultural land) in domestic law regards the soil quality under aspects of quality and quantity. The agricultural land state in 2020 in Poland, according to the geodetic status, amounted to 18741,5 of agricultural land. Agricultural land includes: arable land, orchards, pasture and meadow kept in good agricultural condition, in accordance with norms that meet the requirements regarding payments within direct support systems as well as other agricultural land according to geodetic status of agricultural land in Poland, classified according to criteria and requirements specified in the order of the Regulation of the Minister of Development, Labor and Technology on land and building records of 27 July 2021 (Journal of Laws of 2021, item 1390). According to the status presented in the land and property register and includes data on devastated and degraded land requiring reclamation and management which has completely lost its value in use (‘devastated lands’) and land whose value in use decreased as a result of deterioration of environmental conditions or environmental changes and industrial activity as well as faulty agricultural activity (‘degraded lands’)[29]. In 2019 in Poland devastated and degraded land was 62089 hectare, including reclaimed land (during the year) 1633 hectare, of which for: agricultural purposes only 1084 hectare[30].
M. Kozak, R. Pudełko underline, that the agricultural land abandonment is a process observed in most European countries. In Poland and other countries of Central and Eastern Europe, it was initiated with the political transformation of the 1990s. Currently, in Poland, it concerns over 2 million ha of arable land. Such a large acreage constitutes a resource of land that can be directly restored to agricultural production or perform environmental functions. A new concept for management of fallow/abandoned areas is to start producing biomass for the bioeconomy purposes. Production of perennial crops, especially on poorer soils, requires an appropriate assessment of soil conditions[31].

28 *Ibidem*.

29 *Statistical Yearbook of Agriculture*, Statistics Poland, Warszawa 2020, p. 63.

30 *Ibidem*, p. 80.

31 M. Kozak, R. Pudełko, *Impact Assessment of the Long-Term Fallowed Land on Agricultural Soils and the Possibility of Their Return to Agriculture*, griculture 2021, 11(2), 148; https://doi.org/10.3390/agriculture11020148, https://www.mdpi.com/2077-0472/11/2/148/htm, access 28.9.2021.

Legal national instruments to counteract the degradation and devastation of agricultural land (administrative orders and prohibitions, creation of protected areas surrounding industrial facilities and other) are:

1) **local spatial development plan –** designation of agricultural land of the highest production value (class I – III) for non-agricultural and non-forest purposes is included in the local spatial development plan which is made under the regulations regarding spatial planning and development; it requires permission of a governmental administration authority – the minister of rural development [32]. Designation of agricultural land of quality class I – III for non-agricultural and non-forest purposes does not require permission of the minister of rural development if this land fulfills the conditions specified in the regulation.
2) **decisions that permit exclusion of land from agricultural production –** an administrative-legal instrument. They are issued under the mentioned Act on the Protection of Agricultural and Forest Land of February 3, 1995 and they permit exclusion of agricultural land from agricultural production (exclusion meaning commencement of non-agricultural use of the land). Designation of agricultural land of quality class I – III as well as quality class IV – VI comprised of origin soils and designation of forest land requires a decision to allow such designation.
3) **fees collected under** the Act on the Protection of Agricultural and Forest Land of February 3, 1995 – administrative-legal instruments.

The Act of December 19, 2008 that amends the Act on the Protection of Agricultural and Forest Land (Journal of Laws, no 237, item 1657) excludes agricultural land situated within administrative city limits from the Act. It means that the procedure of designation of agricultural land to non-agricultural purposes and possible obligation to obtain administrative decisions that permit exclusion of agricultural land from production as well as possible fees and other obligations regarding farm land status change do not apply to these lands.

Reclamation of degraded or devastated agricultural land (methods, entities obliged to perform this task) are:

1) **spatial development plans on limited use areas situated in the vicinity of industrial plants.** Legal basis: the Act on the Protection of Agricultural and Forest Land of February 3, 1995. A commune council adopts a resolution regarding approval of the plan, having obtained an opinion of the agricultural chamber and academic centers or other individuals authorized by the minister of rural development in cooperation with the minister of environment. The cost of preparing of an opinion is covered by the industrial plant. A draft plan should include: types of pollution present as well as its concentration; influence of the pollution or other harmful factors on the current development plan with possible division of the protection zone into parts; current directions of plant production and size of this production; plants that can be cultivated; recommendations regarding their cultivation and proposed method of their use; methods to counteract decrease of land's value in use; anticipated level of global agricultural or forest production; a list of farms that run agricultural production; the level of anticipated compensations resulting from decrease of production or change of direction of production; possible obligations resulting from animal production, including fishery; possible expenses essential for a change of directions of production; anticipated area

32 Art. 7, sec. 1 of the Act on the Protection of Agricultural and Forest Land of February 3, 1995, Journal of Laws 2021, item 1326 with later amendments.

and cost of land purchase by an industrial plant.

2) **administrative decisions that specify reclamation obligations – these instruments are related to a general order** to counteract land degradation, in particular erosion and mass wasting as well as the order to cover the reclamation cost imposed on a person who causes loss or limitation of land's value in use. These are for instance the diffrent types of **decisions**, for example: decisions that order a land owner to forestate, plant trees or shrubs or to establish permanent grassland on this land or decisions that order a land owner to perform specific treatments in a specific period of time – in case the owner caused other forms of land degradation, including ones caused by noncompliance with regulations regarding the protection of crops from diseases, vermin and weed.

All decisions regarding reclamation and management specify: the level of limitation or loss of land's value in use specified on the basis of opinions of experts regarding the size of limitation of land's value in use; the person who is obliged to reclaim the land; the direction and deadline of land reclamation; the moment land reclamation is considered completed.

Competences of the local administration authorities in terms of ex officio reclamation in case of unknown perpetrators. At the areas of agricultural production space, lands devastated or degraded by unknown perpetrators or as a result of natural disasters or mass wasting, reclamation is performed by a competent authority (district head), with the use of resources from the province's budget. In the case of reclamation of forest land and land designed for forestation, resources from the state budget are used, under the rules specified in the forest law.

In Poland protection of the resources is based on the formal criterion related to revealing of agricultural land in the land and property register. The most efficient form of agricultural and farm land protection is the local spatial development plan or, paradoxically, lack thereof (it regards around 70 percent of land nationwide). Decisions that permit to exclude land from agricultural production are a pure formality when statutory preconditions are met, especially in terms of lower production classes. In fact, they are rather a state control instrument, not a tool to counteract designation of these lands to non-agricultural purposes. Evaluation of financial instruments adopted to protect agricultural land that is presented in the literature suggests that they are not an economic barrier that would discourage designation of agricultural land to other purposes. At the same time the statistics show that most of the lands are designated for residential housing purposes. Under the law, designation of these lands for such purposes excludes any charges[33]. It must be emphasized that an important barrier for the protection of agricultural and forest land in Poland may be provisions of the geodetic and cartographic law which do not grant authorities that run them appropriate land protection tools related to databases' update. Even if there is agricultural or forest land in practice that does not exist in the register, it is not subject to protection.

Health quality of food

Agricultural products may also constitute food products within the meaning of Art. 2 of Regulation no. 178/2002, however, not always food products can be considered agricultural products in the light of the Treaty on the Functioning of the EU. Regulation no. 178/2002 applies to all stages of production, processing and distribution of food and feed. On the other hand, it does not apply to primary production for own use or for home preparation, processing or storage for personal consumption. This means that the safety of food, which is also agricultural products, will often be

33 J. Bieluk, *Instrumenty finansowe ochrony gruntów rolnych i leśnych*, 'Acta Universitatis Wratislaviensis' 2015, issue 3656, pp. 13-24.

determined by meeting food safety criteria regulated in the food law. Therefore, in particular, compliance with hygiene requirements, not exceeding the levels of contaminants and residues of substances harmful to health in primary agricultural production is a condition of food safety for human health.

Residues and contaminants, pesticidies in food are not part of the concept of food within the meaning of Regulation no. 178/2002. So they are some undesirable substances in food. They come from agricultural practices or food processing. In the EU Member States, there is an obligation to apply the requirements of food law at all stages of production, processing and distribution of food and feed (Article 1 (3) and Article 4 (1) of Regulation No 178/2002), therefore in the field *from farm to fork*, throughout the food chain, including primary agricultural production.

The importance of regulating the entire food chain is now confirmed by *A Farm to Fork Strategy* it's components - particularly strategies for forests protection, biodiversity protection, environmental action plan and zero pollution action plan for water and soil. In agriculture, land is the most important means of production, from which departure is not always possible. For example, landless production has been banned by the EU's organic farming regulation. At the same time, alternative methods of food production are developing, but they cannot replace the land.

The principles of law and the processes based on them - the precautionary principle and risk management. The level of health protection depends on the result of their use. The starting point is always how they are understood and interpreted, and this largely depends on the adopted legal solutions and the role of scientific opinions. When it comes to scientific opinions, they are the source of much controversy at the intersection of differing legal systems. Sometimes the source of non-uniform risk assessment is different research methodologies or the determination of the subject of research and its scope. An example of this can be seen in the different results of the research on Glyphosate of the International Agency for the Research on Cancer (IARC) of the WTO, European Food Safety Authority (EFSA) and the Environmental Protection Agency (EPA)[34]. "IARC analysis focus either on plant protection products in their entirely with co-formulants and other components added to glyphosate, or on the glyphosate active substance per se". UE analysis in the risk assessment just studied the active substance glyphosate - in its pure formula, with no confounding factors, without assessing the final formula with adjuvants entering the market[35]. EU law also regulates the criteria for assessing food safety in many legal acts, including Regulation no. 178/2002, however, food safety does not have its definition there.

The Polish Food and Nutrition Safety Act defines the requirements and procedures necessary to ensure food and nutrition safety in accordance with the provisions of Regulation no. 178/2002. According to Polish law, food safety means, according to Polish regulation, "all the conditions that must be met, in particular regarding:

a) additives and flavorings used,
b) the levels of pollutants,
c) pesticide residues,
d) conditions of food irradiation,
e) organoleptic characteristics,

34 See: C. Finardi, *Reports Austria The Austrian Ban of Glyphosate Ban of Glyphosate and the Precautionary Principle Paradox: "The more you wreck it, the more you strengthen*, European Food and Feed Law Review, Volume 15, Issue 5 (2020), pp. 473 -474.

35 *Ibidem*.

and actions that must be taken at all stages of food production or marketing - in order to ensure human health and life ”(Article 3 (3) (5) of the Act).

When it comes to the health quality of food, in Polish legislation only a reference to this expression can be noted, which may result from the fact that these issues are subject to EU law, although as you can see, the themes related to health quality significantly fill the content of the concept of food safety in terms of substances. pollutants, pesticide residues[36] and other[37].

The Polish legislator uses the expression "health quality" in the Food and Nutrition Safety Act (precisely in the act there is the phrase: "food health requirements" - within the scope not regulated in EU regulations). In the light of the Polish law, the requirements for health quality include the requirements for introducing products to the market that do not meet the requirements of EU and national law, of course in the scope not regulated by EU law. It should be noted, however, that it is basically the EU regulation that covers health quality requirements.

By contrast, EU law often uses the expression "health quality" of food. This expression is referred to e.g. in Regulation 2017/625 in Polish version there is “health quality” in the article 1 seccion 2 lett. a. According to article 1 secc. 2 lett. a, the Regulation no. 2017/625 shall apply to the official controls performed for the verification of compliance with the rules, whether established at Union level or by the Member States, to apply Union legislation, in the areas of food and food safety, integrity and wholesomeness at any stage of production, processing and distribution of food, including rules aimed at ensuring fair practices in trade and protecting consumer interests and information, and the manufacture and use of materials and articles intended to come into contact with food.

Health quality of food is marked with the "health mark" in accordance with the requirements set out in the aforementioned regulations in relation to products of animal origin (e.g. Article 48 of Regulation no. 2019/627). What important, it covers all particular areas, like for example feed and feed safety at any stage of production, processing and distribution of feed and the use of feed, including rules aimed at ensuring fair practices in trade and protecting consumer health, interests and information, protective measures against pests of plants, prevention and minimisation of risks to human and animal health arising from animal by-products and derived products, requirements for the placing on the market and use of plant protection products and the sustainable use of pesticides, with the exception of pesticides application equipment; release into the environment of Genetically Modified Organisms (GMOs) for the purpose of food and feed production etc.

The health quality of food refers to the adjective "health", which comes from the term "health".

According to WHO Constitution, “health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity”[38]. There is no doubt that the aspects mentioned in the definition of health do not only refer to the pure physicality of man, but also broadly treat his social well-being, which cannot be achieved without a healthy environment and its resources. Therefore, when speaking about health quality of food, one should bear in mind not only the requirements health, sanitary, veterinary and phytosanitary requirements for agri-food

36 Regulation (EC) No 396/2005.

37 See: Regulation no. 2073/2005; Regulation no. 2073/2005; Commission Regulation (EC) No 1441/2007 of December 5, 2007 amending Regulation (EC) No 2073/2005 on microbiological criteria for foodstuffs, OJ L 322, p. 12.; Regulation no. 470/2009; Regulation no. 2016/52.

38 The Constitution was adopted by the International Health Conference held in New York from 19 June to 22 July 1946, signed on 22 July 1946 by the representatives of 61 States, and entered into force on 7 April 1948, see more: https://www.who.int/about/governance/constitution.

products specified in food law regulations, but also clear air, water and soil. Against this background, there is a specific connection between the aspects of food safety and food security, as the requirements of food law focus precisely on food safety, and the need to protect resources, including soil, results directly from the need to ensure food security.
In conclusion, all the requirements health, sanitary, veterinary and phytosanitary requirements for agri-food products specified in regulations make up the so-called requirements for the "health quality" of food, and the basis for the use of such an expression is, inter alia, for example in Regulation no. 2019/627[39].

Conclusions

In the mentioned European Green Deal documents, aspects of sustainable food production (food safety) and instruments of ensuring of the food security are linked. The combination of operating instruments in the European Green Deal, including A Farm to Fork Strategy, may in the future bring the strengthening of both food safety and support for food security.
In particular, in light of the Eruopean Green Deal documents and its components, soil quality will be a common denominator for agriculture, the environment and food. Without ensuring adequate soil properties, the issue of ensuring food security will be critical in the face of climate change in the future. Naturally, it is the final legal solutions and their application that will show the real effects. Soil quality is no longer just a category from the food security sphere, but has been given the status of a tool for building sustainable food systems. For these reasons, national law should also strengthen the protection of the quality and quantity of soil, especially agricultural land.
It can be said that when talking about health quality of food, one should bear in mind not only the requirements health, sanitary, veterinary and phytosanitary requirements for agri-food products specified in food law regulations, but also clear air, water and soil. The health aspect of this concept requires that quality soil should also be taken into account as a premise of safe and healthy food.
Against this background, there is a specific connection between the aspects of food safety and food security, as the requirements of food law focus precisely on food safety, and the need to protect resources, including soil quality, results directly from the need to ensure food security. Thus, the European Green Deal documents show, to some extent, the integration of activities relevant to both food safety and food security. The future Grean Deal legal instruments have a chance (after introducing them to specific legal acts) to become tools for building a "European model of food security solutions", in which food safety will also be an important element. In particular, the extent to which a change in the approach to fertilization of land, greater conservation of resources and the planned increase in organic farming will contribute to the improvement of the health quality of food will depend on the food producers themselves and their practices.

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FACTORS AFFECTING FOOD QUALITY – TECHNOLOGIES

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Abstract
The global food situation is well-defined by many influential forces such as population growth, availability of arable lands, water resources, climate change and food availability, accessibility and loss. The combined effect of these factors has indubitably impacted global food production and security. Two aspects are important when the quality of safe-food is discussed: scientific *status* and consumer preferences. Scientific activities involve manipulating (for instance feed additives in animal dietary strategies, natural additives in food-processing, smart packaging) several chemical components in food to increase the positive impact of food in human health. New knowledges reached by scientific community provide precious information to the whole spectrum of new legal or recommended requirements for both fresh and processed foods. This article provides in brief the most important factors affecting the food quality-technologies.

Keywords: quality, food chain, hazard analysis

Introduction

Two aspects are important when the quality of food is discussed: scientific *status* and consumer preferences. Factors affecting the quality of food, from a scientific point of view, are composition, spoilage, additives, colorants, flavorants, nutrients, ingredients with functional functions and contamination. On the other hand, consumer preferences are directly associated with the human senses like sight, touch, smell, taste and mouthfeel. In particular, visual aspects involve color, moisture and overall appearance. Tactile factors include elasticity, sliminess, softness and hardness. Taste and smell factors depend on many specific chemicals contained in food. Mouthfeel refers to texture, tenderness, softness, chewy sensation and so on. In the last decade many professionals have defined the food quality including the terms “health” and “safety”. Anyway the nutritional and the safety characteristics of food have always been important since 1970s. Recently the term “health” involves manipulating (feed additives in animal dietary strategies, natural additives in food-processing, smart packaging, and so on) several chemical components in food to increase the positive impact of food in our health. New knowledges reached by scientific community provide precious information to the whole spectrum of new legal or recommended requirements for both fresh and processed foods.

Nutrition

Since the health impact of food is focused and discussed, the nutrition aspect of food has reached an all-time high level. It is a common opinion to consider a quality food as one with high nutritional value. For instance, meat is nutritious because of its high source of protein, vitamins and minerals; milk is considerate one of the most complex animal product, very important in the early-phase of children proper growth and development; fish and shellfish are important part of a healthy diet, because of their high-quality protein and other essential nutrients (omega-3 fatty acid) and law content of saturated fat.

Flavors and Aroma

Flavor and aroma represent one of the major reasons, among many, that we like to eat. Based on wide literature more than one thousand flavor compounds has been identified. Processing and subsequent storage contribute to the development of the characteristic flavors of animal products or in general food. Because the precise flavor precursors vary between and within livestock species, each food product has distinctive flavor characteristics. In generals, some foods (fresh saltwater fish, for example) are almost odorless because they contain a small quantity of volatile substances, while other foods (freshwater fish) contain more pyrrolidine and earthy-odor compounds.

From a quality point of view, the presence of some flavor and aroma compounds (trimethylamine or dimethylamine, among many) or the absence of others compounds (putrescine and cadaverine) serve as a quality index for food: best index and the worst index, respectively.

Color

The first impression that a consumer receives in relation to a food product is recognized visually, and the first characteristics considered are color, form and surface. Food's quality is mainly defined by color, and a product may be rejected simply because of its color, even before other proprieties. This is the reason why the industry is extremely concentrated on the appearance of the food product at the sale-store. Food technologists are always interested in the color of food for several reasons. First, to increase product's color and appearance. Second, to bring the product's color into line with what the consumer expects. Third, the need to maintain uniform color throughout processing. Fourth, to avoid any external or internal agent from acting on the product during processing, storage and display. From a practical point of view, color plays an important role in the animal production sector, especially in meat production (primarily in beef and poultry), since in many countries of the European Union paleness receives a wholesale premium.

Microbiology and Safety

Considering the potential hazards from the consumption of foods, state and federal agencies have developed and implemented rigorous safety requirements in the processing of meat, milk, eggs and seafoods production. As we well know, all foods contain microorganisms, some beneficial and some with potential harm for humans. Since in the last two decades, the government records show that pathogenic organisms in foods have been responsible of many deaths and injuries, it is not surprising that a quality food must also be a safe one.

Processing

The processing phase obviously affect the quality of any kind of food. There are many "modern" reasons why we process food, for instance adding value to a food, improving the visual appearance, simply convenience. Traditionally, the most important reason that push us to process food is to make them last longer without spoiling. Most probably the oldest methods to achieve this goal are the fermenting of milk, the salting of meat and fish, the pickling of vegetables. Natural materials contained in food undergo to deterioration in time like any living matter. The deterioration of food (putrefaction by spoilage) will modify the quality of foods resulting in discoloration, offensive smell and inferior taste. This can be caused by a large number of factors, mainly by biological factors, but also by chemical and physical factors. Consumption of spoiled foods can cause sickness and even death. Following selected methods are reported to elucidate how food processing can affect the quality of a food product. Cold preservation: freezing is a common example to preserve all kind of food from deference, giving the possibility to over-extended the shelf-life of foods. Heat application: all of us well know that over-heating tender meat usually means toughness.

Dehydration: the practice of food drying has been popular since the beginning of time, but one drawback is the lost of nutrients, especially vitamins. Fermentation: in general the most famous fermented product is the sausage (meat-derivate), whose quality is to a large extend determined by the methods applied, in terms of nutrients (presence and bioavailability), hardness, tenderness and flavor. New technology: recently numerous new technologies are investigated and applied such us irradiation, microwaving, dry-frying and ohmic heating. Obviously, each method affects the quality of a food in various ways.
The product resulting from a processing method needs packaging. The main reason for packaging a food product is to protect it from the exposition to elements until it is ready to be prepared and consumed. From this point of view, the way of packaging is extremely important to preserve the quality and the shelf-life of the food.

Consumer and Sensory Attributes
In general the sensory attributes of foods are related to the sense of taste, smell, sight, feel and sound. For all these markers there is a range of acceptable or unacceptable value in which the consumer goes through. Primarily, the consumer visually evaluates the color and surface of the food. The further technique of preparation that the consumer choices, usually alter the sensory attributes. Finally, the satiety value applied by the consumption of a food is great when comparing the general satisfying effect of the foods itself.

Hazard Analysis
In order to constantly monitor the quality of a food, every step-processor of the entire food chain should perform a hazard analysis to determine whether there are food safety hazards that are reasonably likely to occur for each kind of processed-food, and to identify the preventive measures to apply to control those hazards (1, 2). Experience, illness data, scientific report, or other information are the basis to determine an efficient Hazard Analysis Critical Control Point (HACCP) document (2) that includes the following information and description: location (where products are processed), description of raw materials and final product produced, establish monitoring procedures (what, how, frequency, who) (3), establish corrective action procedures, establish a record keeping system, establish verification procedures.

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HOW TO BUILD RESILIENCE IN FOOD SYSTEMS IN TIMES OF CRISES: A CASE OF CROATIA

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Abstract

Within the last couple of decades, the Croatian food system confronted diverse political, economic, social, and climatological challenges. One of the most influencing shocks on the Croatian food system was the early 2020 pandemic caused by COVID-19. By observing the situation on the market, implementation of the national measurements such as movement restrictions and lockdown measures affected the overall actors of the food system from producers, food processors, distribution sector, retailers and lastly consumers. The focus of this paper is to provide an analysis of the impact of the COVID - 19 on the food system actors in Croatia. The main objective of the paper is to provide guidelines for determining food system resilience and ideas on sorts of actions that may enhance the actors' ability to respond more effectively to future disturbances in the Croatian food system, using different scientific approaches and insights. In the study we made a intensive literature review of relevant opinion papers, official government reports and web based material. Our results showed that the most significant effect of pandemic was on the intensive agricultural producers (livestock) as they relayed on the distribution towards HoReCa channels and tourism purchases. The family farmers who depended on direct distribution channels (open-air markets, agricultural fairs) and tourist purchases were under the sustanial impact of pandemic, however they showed greater adaptive capabilities rather than intensive (livestock) producers. It was observed that they developed alternative value chains, door to door delivery service and contemporary use of digital tools and skills to communicate and preserve on the newly develop market. For the meat processing producers pandemic impact was most sever. For the food distributors the lock down measures directly affected the increase in transportation cost for 40%. Food retailing actors noticed rise in purchases by which they needed to employ more labor, moreover there was observed growth in online purchases. For the final actor – consumer, pandemic impact was divers. Consumers passed through 6 phases of the purchases. This article contributes to the existing literature by providing better understanding of the each food system actors of the Croatian food system and identify a set of recommendations towards better resilience in the context of future crises.

Keywords: Croatian food system, pandemic, food actors, resilience

Introduction

Pandemic crisis that appeared in the spring of the 2020 showed that it is not only harmful for the existence of the humanity but rather destructive for economies worldwide. In the sense of the agricultural and food production, crisis showed it's imposed impact and fragility of the sector. Delays in transportation of fast perishable products and shortage in agricultural labor, raw materials and other inputs due to lockdown measures, as well as changes in consumption habits due to reduce incomes have been just some characteristic of new global lifestyle. Considering that matter, worldwide food safety and availability were on the attention. The dependence of the production sector on international cooperation, delivery of raw materials, nutrients, pesticides, is not the basis

for ensuring safe and available food for future generations. In Croatia, food safety and availability was not a concern in the pandemic phase, but attention was rather paid to food accessibility as the country implemented lockdowns to cope with the pandemic. Considering that Croatia is a net importer of agricultural and food commodities, a topic about food accessibility raised further concerns: *What is Croatia's current level of self- sufficiency and what kind of changes needs to be made for resilient domestic agricultural and food production?* By now, the role of the Croatian agri-food sector has been expressed in enabling people access to food, providing feeds for the livestock, ensuring rural employment, generating value added, contributing to the favorable trade exchanges, and guaranteeing the public availability and safety of food (Franić, Gelo & Jurišić, 2014). Explained by Fan, Teng, Chew, Smith & Copeland (2021) the food system represent the totality of stakeholders and interactions along the food-value chain, from input supply and production of crops, animals, seafood and other agricultural products through transport, processing, retailing and wholesaling, as well as food creation and disposal. As it was shown at the start of 2020, food systems are becoming increasingly vulnerable to shocks as a result of numerous internal and external drivers of change, ranging from abrupt shocks to long-term stresses (Wisner, Blaikie, Cannon & Davis, 2003; Tendall, Joerin, Kopainsky, Edwards, Shreck, Le, Kruetli, Grant & Six, 2015). Regarding the most fragile actors of Croatian food system - producers, a consequence of the COVID-19 pandemic lead to the interruption of their direct sales channels (open-air market and agricultural product fairs), closure of contracts with HoReCa distribution channels, and a decrease in the purchasing power of consumers as well as the creation of the new consumption habits. Other stakeholders of the food system faced increased food safety requirements. Consumer consumption habits modified due to "home office" and closure of restaurants. Increase preparation of meals at home, while using more stored, staples and ready-to-eat products were the main characteristics of new global pandemic trends. Transportation delays effected increase costs and food waste, and on the other hand, food retailers are prospering from pandemic in terms of staff numbers, public orders, and consumption (Petetin, 2020). Thus, the objective of this paper is to point out which hidden and collateral effects on all actors in the food system caused by a stressor, which is currently the COVID-19 pandemic. Moreover, the authors are emphasizing the need for high collaboration, preparedness, and effectiveness of public policymakers, institutions and food actors in order to build high resilience to the continuance of the pandemic and future risks, in order to minimize collateral damage on individual lives and other sectors.

Material and methods

This is paper is conducted based on secondary and analytical research, adapted to the country in focus - Croatia. Research on this particular topic, resilience of the Croatian food chain in the realm of the COVID-19 pandemic, has not yet been conducted; however analyses of different markets and models that can be adapted to any market have served as basis of this analysis. In other words, facts that have been previously confirmed are applied in this research in form of critical evaluation of given public knowledge on the Croatian food system. Furthermore, as this study is focused on viewing the food system safety and resilience of Croatia in a given context (of the COVID-19 pandemic) and is suggesting possible relationships (causes and effects), thus being more descriptive - it can be considered a qualitative research. Therefore, we made an intensive literature review that was collected in the last months of the pandemic, such as official government reports (State Bureau of Statistics, Croatian Chamber of Commerce, Croatian Chamber of Agriculture and Agricultural Ministry), official reports from international institutions and statistical pages and other relevant webinars, blogs and media. We included appropriate review and opinion papers, to

link their findings to this study and to determine the additional value of our review. Lastly, the authors are aware of limitations of using the qualitative method, which include potential bias of data analysis that is not founded on statistics, but it also opens an opportunity for further studies on this topic. These may include interviews or the survey method with a representative of each food actor in this particular market, in order to confirm or reject the given findings.[1]

Results and Discussion

COVID-19 impact on the food system actors

The consequences of the pandemic have not only adversely impacted the public health system, but have also led to several economic, social and political problems. The situation in developing countries is desperate and worsened because it is difficult to fulfill the basic subsistence needs of a majority of the poor (Workie et al., 2020). Even though the direct effect of the pandemic on food and agricultural production should be minimal in developing countries, where agricultural production is labor-intensive, the population is less able to resist the macroeconomic shock and the risk to food security and livelihood (OECD, 2020).

To prevent the wide spread of COVID-19, most of the world's countries implemented a lock- down, stay at home, and mass quarantine measurements as well as traveling restrictions. The export and import flow in some areas have been sluggish or even halted. Additionally, transport operations have halted in several countries due to lockdowns, disrupting the supply chain for critical goods, particularly for foodstuffs and humanitarian aid (Reardon et al., 2020; Workie et al., 2020). It is clear that in the time of lockdowns, stay at home orders and mass quarantine measurements as well as traveling restrictions, the worldwide phenomena of decreased road congestion, clearer skies, healthier rivers and the appearance of wild fauna in human communities are some visible and imminent consequences of our changed modes of living (Diffenbaugh, Field, Appel, et al. 2020). Even though these effects may be seen to benefit the environment, the authors note that the effects on hunger, food security, mental health, disaster preparedness and biodiversity often occur negatively.

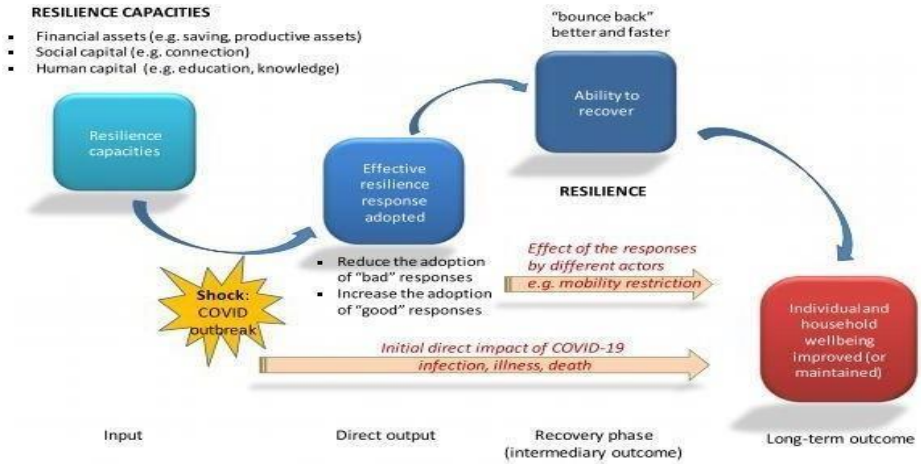
Since the availability and accessibility of markets in the agricultural system remains unclear, the introduction of the business closure and movement restrictions caused by COVID-19 increased farmers' price uncertainty. Farmers around the world struggled to achieve market competitiveness and profitability with the aim to adapt to the new market demand. Some producers face higher costs due to labor restrictions; others observe low revenue due to increasing trade and warehouse margins, or restricted in-vivo (fresh) market sales (Haqiqi and Bahalou Horeh, 2021).

Limits on cross-border migration and lock-outs in many countries of the European Union contributed to labor shortages in agriculture industries, especially during peak seasonal demand and labor-intense development cycles (OECD, 2020). Together with labor shortages, high-income countries were more exposed to disruption in the intermediate supply of the fertilizers, pesticides, seeds, feeds and power as they use large amounts of the inputs for their intensive agricultural practices (Schmidhuber, Pound and Qiao, 2020).

[1] The contribution to this paper will be mainly conceptual but it builds on the empirical experience that was gained while both of the authors were working for the Croatian Association for tourism and rural development "Village Membership Club". Moreover, it is important to mentioned that some information's for the article were took over from the master thesis *"Pandemic and agriculture: case of Croatia"* from University of Hohenheim, Stuttgart, Germany, for which Marta Menardi was the author.

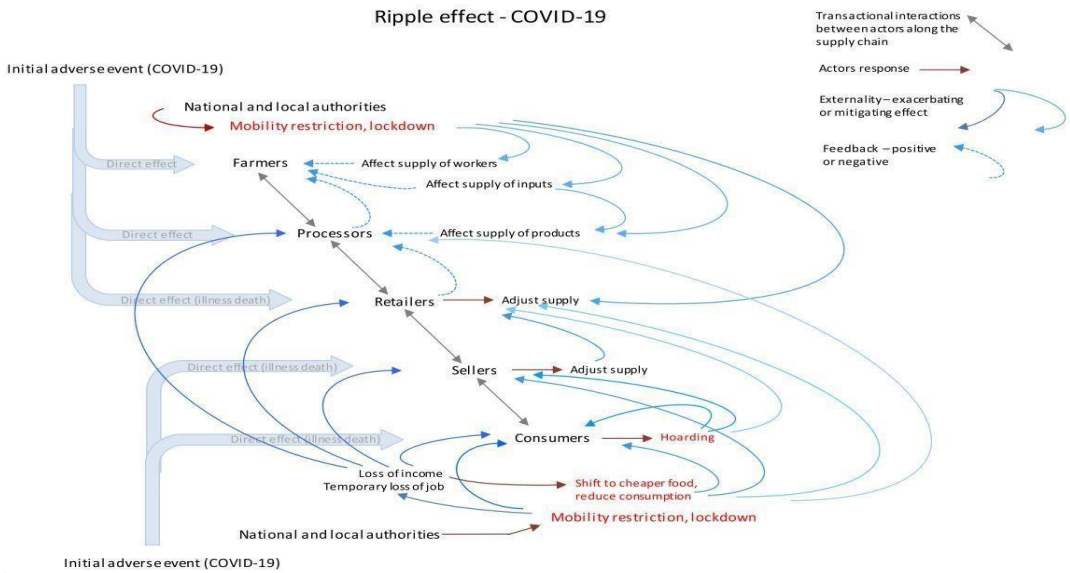
In some cases, labor shortage and transportation system disturbance resulted in the accumulation of surpluses, stressing shortages and rising food losses for extremely perishable products (OECD, 2020), which in the short turn will result in the decline of the farms' income.
The OECD (2020) report observed the significant shift in consumers' demand due to the pandemic. The reduced demand from closed restaurants, school food suppliers, hotels, and catering operations was offset by increasing household demand at local stores. As the report points out, demand also has moved from higher value fresh products towards stored, staples and ready-to-eat products.
Small-scale and family farms are (expected to be) among the most vulnerable groups in this pandemic. Some family farms have lost their customers in their local restaurants, which indirectly resulted in higher marketing and delivery costs (Haqiqi & Bahalou Horeh, 2021). To maintain their enterprises, small scale and family farms have faced difficulties, and there has been an emerging need to be open-minded towards new channels such as supply to supermarkets, rather than continuing to deliver through open markets and restaurants (OECD, 2020).

Response of the food system actors to the pandemic
As discussed in one of the sources used as the basis for our analysis, the endpoint at which the amount of resilience should be considered is the effect on individual and household wellbeing, as a result of shocks for the market (in this case COVID-19) (see Figure 1). The buffers that can mitigate negative impact are: financial assets, social and human capital (Béné, 2020). That is, a country's financial stability in terms of savings and assets for production, interconnection and communication between main actors of the system, and well-established education of the population (incl. institutional) can increase the resilience of a system. When applied to the food sector and food safety, faster responsiveness and resilience can lead to higher well-being of individuals and households, i.e. a faster recovery after a systematic shock.



[1]Figure 1: Resilience capacities and COVID-19 effects on a market

Another figure that can depict the cause and effect relationship is the so-called "Ripple effect", placing emphasis on how a governmental decision affects the supply chain and the end-user as a whole (see Figure 2). Precisely, ever since the first governmental mobility restriction was imposed across the EU, and hence also in Croatia, the immediate effect was visible on everyone -
from small farmers who could not sell their products due to the lack of demand because of insufficient funds and interest in local food, all the way to the end-user (EAFRD, 2020).

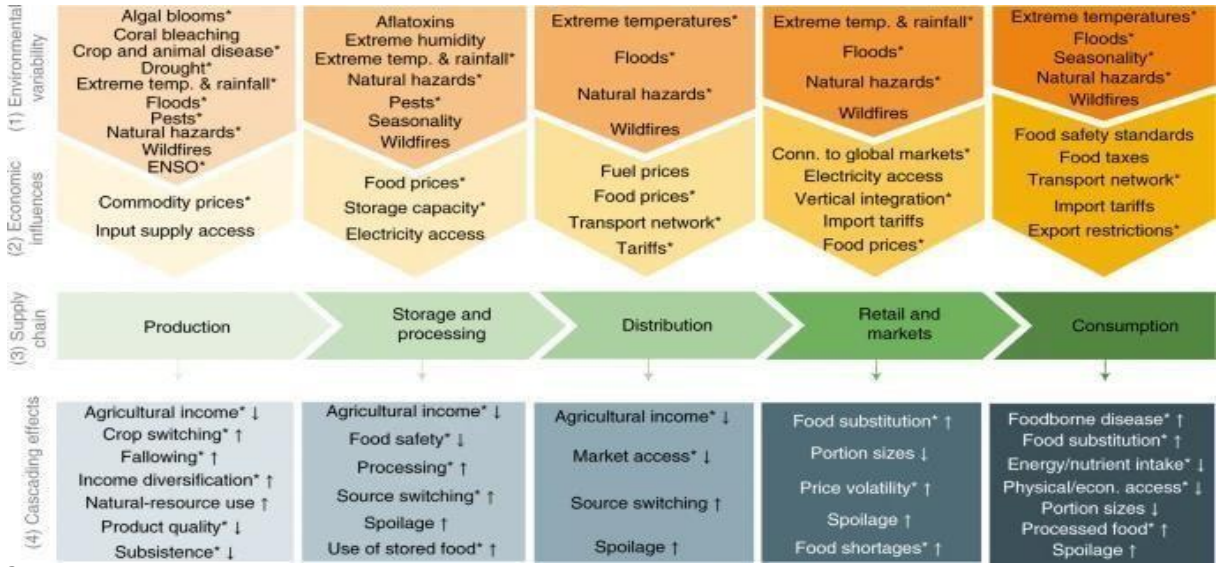


[2]Figure 2: Ripple effect of COVID-19 on markets.

Not only are all food actors interconnected and therefore affected just by a shock starting at any of its levels, but each and every level of the supply chain can also be directly influenced by a stressor. The perfect example of that is exactly the COVID-19 pandemic, where both an "upstream" and "downstream" shock led from suboptimal dietary choices and substitutes due to lower purchasing power of the nation, to lesser production and thus availability of a diverse range of (healthy) options on the market. Various examples of compromised food safety and recalled products from shelves are now frequently announced by EU and/or local governments. For instance, one of the most recent ones was the Ethylene Oxide Accident in July 2021, when a meeting was held between all EU member states, EFSA and Commission services, which resulted in complete withdrawal of "products that contain the additive E410 known to be contaminated with ethylene oxide" (RASFF, 2021, p.1). This also points out the importance and correlation between good communication among actors in the food system and having favorable outcomes for the end consumer's health and food safety.

On the contrary, low-income countries show a pattern of consumers purchasing less expensive food items, regardless of their lower quality and safety, which highly increases their contact-potential to foodborne illnesses or diseases (e.g. aflatoxin) (Mu, van Asselt and van der Fels-Klerx, 2021). Precisely, recent findings show that "highly globalized countries, net importers and low-GDP countries, and countries with low strategic reserves are most exposed to external shock events" (Descalzo et al., 2021).

Good practice has shown that it is of utmost importance that food systems are viewed as a whole, not only the aspect which was hit by a stressor (in this case the general populations' health and COVID-19), in order to build and/or maintain high resilience. Therefore, analyses have to view each and every actor and potential disruptions faced at each level of the system, including that of policymakers. What has specifically been lacking in the first response to the pandemic, by the majority of the world's markets, is consistency coming from decision-makers when balancing between the economy and the population's overall health and wellbeing. The (negative) consequences of these phenomena were mainly reflected on the general population, especially among the poor.



[3]Figure 3: Environmental variability effects on supply chain

As visible from Figure 3, environmental variability and outer risks affect supply chain levels in different segments, all of which have an influence on economic and behavioral patterns. In the case of COVID-19 outburst, the increase in commodity price, which is still present up to this day (last quarter of 2021), triggers more expensive production and, therefore, higher prices (and volatility of prices) on the market for both resellers and the end consumer. That brings consumers in the position of switching to cheaper nutrients and food substitutes, having less choice and purchasing/consuming smaller quantities. Most of the time, that leads to storing more food with longer expiration dates (canned and processed food), which correlates with unhealthy lifestyles and higher exposure to health risks (Béné, Headey, Haddad and von Grebmer, 2015).

Therefore, knowledge-building and awareness-raising campaigns by (inter)national institutions, and generally good communication with the population is one of the pillars to balance and soothe these behavioral and economic changes for an optimal outcome for all (FAO, 2020). In order for this to be successful, incentives for switching to the desired behavior (through nudges and other behavioral economic approaches) have to be clear and achievable for all actors involved, on a local level. Moreover, the cultural context has to be taken into consideration when localizing the communication, as something which has proven as good practice in a certain market may not work as successfully on another. One of the positive examples adopted in many countries in tackling the COVID-19 food safety and hygiene issue is exposing safety measures taken by vendors and HoReCa venues at the entrance to the objects. On the contrary, punitive (punishment) approaches using inspection have not shown any positive correlation with change in behavior, as the incentive was unclear to many actors involved (FAO, 2020).

[3] (Mu, van Asselt and van der Fels-Klerx, 2021)

Formation, changes and expectations of food prices directly influences behavior as a consequence of loss aversion, time inconsistency and various other behavioral economics patterns, which is why this is imperative knowledge and should be the starting point for governments implementing those changes. In other words, all policymakers have to function compatible with the food (market) prices, whereby incentives have to both follow capacities from the government and be a direct drive to those whose behavior is intended to change (Timmer, 2010). Many markets fail in this aspect, wherefore usually the end users of the supply chain are nudged towards unwanted behavior, oftentimes at the cost of the consumers themselves - either in terms of health, monetary value or both.

Pandemic impact on the Croatian food actors

Regarding that there is limitation in the research on the topic of impact of COVID-19 pandemic on food system actors in Croatia, most of the information is gathered from the web sources – news and social media, as well as newspaper articles. On the other hand, we provided an analysis of the all available official governmental reports and statistical dataset. In the upcoming paragraph, we present the imposed effect of the COVID-19 pandemic on different actors of the Croatian food system from producers, food processors, distribution sector, retailers and lastly consumers

1.1) Effect on the most fragile actors of the food system

The impact of the COVID-19 pandemic on the farmers in Croatia was relatively diverse. The most prominent impact of the pandemic was observed on the intensive production systems, which are a minor part of the agricultural production in Croatia. The biggest part of the agricultural producers, crop producers, was not significantly affected by the pandemic as they are distributing their commodities for the larger purchases that are exported abroad. For the vegetable and flower producers, pandemic impact was the most significant, as they distributed their product exclusively on the open air and agricultural fairs that were closed in the spring of 2020. Flower producers faced a high decrease in the sales due to cancelation of the wedding, confirmation, communion and baptism ceremonies. Viticulture and winemaking producers distribute their wines to hotels and restaurants on the Croatian coast. The reduction in the sales and consumption of wine in this area with the closures of public eateries has raised questions about the business and liquidity of Dalmatian and all Croatian wine producers in time of pandemic (Croatian Chamber of Economy, 2020a). Fruit and olive oil producers experienced a similar pandemic impact from the pandemic as vegetable and flower producers. Olive oil producers rely mostly on the tourism visits and purchases, which were minimized by restriction during the pandemic. Fruit producers use open air markets and agricultural fairs as their primary distribution channel. The reason for the significant impact of pandemic lie in the fact that Croatia's fruit production is defined mainly by the seasons, which mean that large quantities of goods are produced to be freshly consumed during a certain period of time (Ministry of Agriculture, 2020a). Moreover, lock down measures and transportation delay emphasizes the absence of storage capacity for fresh and low processed foods on the Croatian market. Consequently, this will lead to reduction in production exposure to market fluctuation (Ministry of Agriculture, 2020a) as well as reduction in competitiveness and increase in cost of production (Ondrašek, 2020). The producers of the most common fruits varieties, mandarins and apples, as reported by the Ministry of Agriculture (2020a) confront the problem of surplus goods, which generate volatility on the local market in the Republic of Croatia owing to occasional non-export possibilities or worsened export restrictions.

The Ministry of Agriculture (2020a) reported that apple harvest was estimated to be around 52,000 to 55,000 tonnes, which is 20 % lower than 2019. The season of key works in the orchards coincided with the sudden spread of the COVID-19 epidemic and the lockdown measures, as well as

restrictions on movement in the spring of 2020, delayed the spring work in the orchards which resulted in worse results in production and consequently of income. Due to the closure of the Country's borders and enforcement of the measures, the labor availability was limited as well. During the final work and harvesting, costs increased significantly due to the implementation of distancing measures, leading to increased logistical costs for the entire harvest. For the dairy producers the pandemic influence was not significant, since the dairy producers mostly sell milk to the large dairy producers, without their own processing. Problems occurred for producers who were selling their milk at the open air markets and agricultural fairs.

Beef producers experienced a medium influence of the pandemic on their agricultural operations. In the Republic of Croatia, a significant quantity of the beef is distributed via butcher shops. The introduction of the measures that closed butcher shops, and later changed the operating conditions of catering establishments, delayed and cancelled numerous events and associated catering services, significantly reduced the demand for beef and pork meat. As a consequence of the full closure of all activities, the number of carcasses processed and graded carcasses of all categories decreased by 30, 46% during April 2020 and by 20, 85% in May 2020 compared to the same months of 2019. The spread of the pandemic disease COVID-19, as the Ministry of Agriculture reported (2020a), has reduced movements, which also affected the operation of the tourism season in the Republic of Croatia, and consequently has adversely affected the market for fattened cattle and beef. The production of beef is partly targeted for domestic consumption while other parts are exported. According to *The market information system in agriculture (TIPUS)* data, the prices charged over the period March to October 2020 fell by 10.44 % compared to the same period in 2019. Due to lower demand for beef, the producers were forced to extend the expected lives of the head in fattening, which reduced the demand for accepting new calves for further fattening. This affected farms that raise meat and combined breeds of cattle, and whose product is calves for further fattening. As a result of the measures taken to combat the pandemic disease, COVID-19 in the Republic of Croatia and the distorted tourist season have also experienced a disturbance in the pigs market due to a slowdown in load capacity and less consumption of pork. Due to the above exceptional circumstances caused by the COVID-19 pandemic, producers in the raising beef sector and pork producers faced a serious decline in liquidity, which could seriously affect the economic situation of the producers in the short and medium term, and threaten their survival in the long term.

1.2.) Food Processing Sector on the hit of the pandemic

Meat processing sector is a significant component of Croatian food production according to numerous characteristics (Hadelan, Grgić, Zrakić, Salputra, 2015). The negative impact of the pandemic consequences on the slaughterhouse and meat processing industry is evident not only in Germany and the Netherlands, but also on the local market. Adaptation to the necessary measures for the protection of the workers' health, such as division of workers into teams and separate shifts, has caused reduced productivity of the Croatian meat processing sector. Moreover, due to imposed pressure of the EU products of lower prices on the market, reduction in consumption of meat and increased costs of transportation have further weakened the meat processing sector (Croatian Chamber of Commerce, 2020b).

1.3.) Trade and distribution of food in crisis

Distribution of the agricultural and food products in the first wave of pandemic was notable for the limited number of the producers on the Croatian market. Crop producers faced challenges in distribution in the first three months, however the situation recovered quickly without any significant effect on their business operations. On the other side, organic producers in Croatia benefited from

the distraction in import supply of food commodities. Regarding that majority of the organic shops (i.e. BIO&BIO) is importing organic products from Italian and Austrian, in the time of the transportation disturbances in between EU member states, they faced shortages of fresh organic products. Therefore, they were forced to turn towards local producers who showed preparedness on the unexpected quantities as well as motivation towards developing new cooperations. Logistic barriers and distribution issues affected the fishery sector (Pokrajac, 2020) which is mostly oriented toward the international market. Some producers have noted that logistical costs of the transportation increased by 40% due to pandemic circumstances. As fish being one of the fast perishable products, logistic disturbance of the food chain in pandemic frequently can result in unsold fishery products as well as large increases in food loss and waste (FAO, 2020; Rivera-Ferre, Lopez-i-Gelats, Ravera, Oteros-Rozas, di Masso, Binimelis, El Bilali, 2021)

1.4.) Food retailing – collapse of the HoReCa sector

The pandemic made significant changes in the way how consumer's purchase, prepare, think and feel about food. With HoReCa being one of the most significant channels of food consumption in Croatia, in the time of their closure, consumers were forced to shift towards local supermarkets and online purchases. Local supermarkets were facing shortages of the essential commodities, consumers spending was more than double the need as a consequence of the pandemic uncertainty and fear of the unknown. In overall situation, the COVID-19 has had a beneficial influence on the retailing business, with a noticeable rise in purchases and creation of new job opportunities (Nicola et al., 2020; Petetin, 2020; Rivera-Ferre, Lopez-i-Gelats, Ravera, Oteros-Rozas, di Masso, Binimelis, El Bilali, 2021). As supermarkets were in need to stay open and normally operate even in the peak moments of the pandemic, farmers have faced a major challenge of disrupting their product as only distribution chains: open air markets and agricultural fairs remain closed. The ban on the operation of the market left family farmers overnight without a single sales channel. Thanks to the timely organization of local self-government, it has been shown that with the cooperation and organization of participants, Croatia has the prosperity of developing a sustainable agri-food system. At the local level, it was noticed that the city of Vrgorac organized nearby 450 family farms on the online agricultural market. The launch of the digital platform was also initiated by the city of Čakovec, as well as transportation for delivery of agricultural and food products to most fragile consumers of the society. The City of Osijek ("Tržnice Osijek") has established a list of all certified family producers with a wide range of domestic products, and the cities of Sisak and Varaždin have not been late in advanced digitalization. Large retail chains such as Konzum, SPAR, Kaufland, Tommy, as well as smaller local specialized stores, begun to offer a collaboaration to local family farmers (Barać, 2020). For sure the most significant observation was notable as in the global market, as well as on Croatian market on which, customer purchasing habits switched to online shopping more than ever before.

1.5.) Change in consumption habits due to pandemic

In a recent analysis of consumer behavior in the crisis, the Nielsen agency (Smarter.hr, 2020) announced that increased sales were noticed in the second week of March 2020, and that consumers in the Croatian market went through 6 phases of shopping during the global pandemic. The first phase of shopping was called proactive shopping, which was determined by the need to purchases a product for the benefit of health. This phase resulted in an increase in sales of canned fish by 159%, pasta by 114%, flour by 108% and rice by 97%. The second phase, named as stock preparation phase, contributed to a 65% increase in the value of retails basket size. Sales of flour increased by 410%, rice by 301%, cake products by 221%, pasta by 210%, and ready-made sauces by 191%. The third phase of the purchase was named: preparation for life in quarantine. Online shopping has gained on

huge importance. According to the results of the analysis, consumers entered the fifth phase, which was characterized by increase demand in purchasing products via online platforms. The last phase, as Nielsen analysis states, is the one in which customers return to their old consumer habits, but with a far greater development of awareness of healthier food and product hygiene.

When it comes to the direct effect on the Croatian end consumer, more than usual products have been removed from shelves due to various health threats and impediments, as discussed in the previous section of the paper. Interestingly enough, many of those products are labeled as "bio" and "eco" productions, assuming a larger number of family-owned businesses and farmers who cannot sell their produce because of suboptimal quality and hence questionable safety of those products (HAPIH - Arhiva obavijesti, 2021). However, as an answer to this manifestation of the COVID-19 crisis, other than quick reactions by all institution-level Croatian and EU food actors, the European Food Safety Agency and the Croatian Agency for Agriculture and Food have just initiated a food safety campaign, with an aim of increasing awareness of citizens in the daily selection of food and point to high EU standards related to food safety (HAPIH - EFSA i HAPIH, 2021). This can be observed as a resilient trait of the Croatian food system, whereby the reaction was made in a timely manner and with a proactive goal in educating other actors (precisely, the end consumer). Further, the Rural Development Program (RDP) has also established the need for funds in Croatia in various fields, including "improved resource efficiency and climate resilience in agriculture, food processing and forestry" (EAFRD, 2020), implying that resilience to any unpredictable factors is not on a sufficient level.

Conclusion

The pandemic affected on multidimensional way Croatian food system actors. The fruits, meat and fishery producers showed that they are not able to coped with the pandemic uncertainty, as they were even of the most fragile actors in the pre-pandemic period. Dependency of those mentioned actors on the direct distribution channels (open air markets, agricultural fairies) and tourist purchases showed to be unsustainable to maintain business liquidity and providing secure access to food. On the other hand organic producers showed preparedness and motivation towards the new market demand and customer purchases. Farmers implemented delivery services, engaged into the online sales and shift from the *conventional* toward *contemporary* business operation. Meat processing sector showed to be under the serious effect. In the hit of the pandemic, the long supply chains and dependency on the import commodities showed to be determinants of even bigger risk for the Croatian food system safety. The article therefore contributes to the literature by providing an analysis of the impact of the pandemic on the food systems actors which can potentially affect food security of Croatia as well as the government introduced reforms and policy measures to cope with them. Following the analysis, we suggest measures like enhancing connectivity in between local producers (producers of the fast perishable products) with supermarket retails, vocalization of the farmers to engage into advanced operations (online marketing, social media usage, etc), and the development of proper legislative and market framework that promotes the long-term, stable functioning of all actors of food system. The ability to cope with hazards comes from stable operators that have been around for a long period of time.

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MOTIVATION, POSSIBILITIES AND RISK SOURCES IN HAZELNUT PRODUCTION: CASE OF SMALLHOLDER FARM IN CROATIA

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Family farm (OPG) Reljić

Abstract
Agriculture in Croatia is a very important sector contributing 3.3% to Croatian GDP in 2020, which is almost double the contribution of agriculture in the EU. Although the number of farms in both the EU and Croatia has declined sharply over the last decade, the number of farms in Croatia has been increasing slightly since 2017 reaching 170 837 in 2020. This slight increase could be due to the opportunities provided by Croatia's EU membership and access to different types of financial instruments, such as larger subsidies, various measures and funds, especially under the EU CAP. As in the EU, over 2/3 of farms in Croatia are small farms with less than 5 ha of land. In the period 2014-2018, the area under cultivation for all types of production in Croatia decreased, except fruit production which increased (at a rate of 11.8%), and one of the crops whose area under cultivation almost doubled is hazelnut. According to FAO (2019), hazelnuts were grown on 5 530 ha in Croatia, which makes them one of the most important fruit crops in terms of cultivated area, along with walnuts, apples and plums. There are many reasons and motivations for entering hazelnut production. Some of them are the favorable agro-ecological conditions, rather low planting costs, lower maintenance costs and plant protection requirements compared to other fruits, easier and longer storage without investing in expensive refrigeration equipment, etc. On the other hand, subsidies, which have multiplied in fruit production since EU accession, and access to various investment measures (e.g. funds for Rural Development) can also serve as motivation. EU accession has also improved and facilitated the possibilities of marketing hazelnuts to a wider market, which increasingly demands healthy, high quality and safe products produced according to the principles of good agricultural practice. In the marketing of hazelnuts, in addition to reducing production risks for producers and increasing safety for consumers, the numerous production certificates such as GlobalGAP, HACCP, organic farming certainly help. All this makes hazelnut production a promising branch of agriculture in Croatia.

Keywords: fruit production, hazelnuts, food safety, certificates

Introduction

Agriculture as a primary sector is very important for any country as it produces and provides key ingredients for the food we consume. The general consensus is that global agricultural production needs to increase by 60-70 % from current levels to cope with population growth and changing food habits by 2050 (Silva, 2018). In addition to population growth, agriculture faces the impacts of climate change on biodiversity, soil and water quality, leading to more frequent extreme weather conditions that ultimately affect the quantity and quality of food produced. According to EUROSTAT (2020), there were more than 10 million agricultural holdings in the European Union (EU) in 2016, with the vast majority (over 96 %) classified as family farms. Although an estimated 9.2 million people worked in agriculture, hunting and related service activities in 2018, this number increases to over 44 million people when the entire EU food supply chain is taken into account (European Commission, 2017). This is about 10 % of the total EU population. The share of agriculture, forestry and fisheries in the EU GDP has been stable at around 1.7 % over the last

decade. In contrast, in Croatia, the share of agriculture in total GDP has been declining for several decades, reaching 3.3 % in 2020. Although the contribution of agriculture to the total GDP of the country has decreased by more than 40 % in the last 25 years, it is still one of the highest in the EU (World Bank, 2020). While the number of farms in both the EU and Croatia has declined sharply over the last decade, the number of farms in Croatia has been increasing slightly since 2017, reaching 170 837 in 2020 (PAAFRD, 2020). This slight increase could be due to the opportunities provided by Croatia's EU membership and access to various types of financial instruments, such as larger subsidies, various measures and funds, especially under the EU CAP (Common Agricultural Policy). As in the EU, over 2/3 of farms in Croatia are small farms with less than 5 ha of land (Ministry of Agriculture, 2020). In 2014-2018, the area under cultivation decreased for all types of agricultural production in Croatia, except for fruit production, which increased (at a rate of 11.8 %), and one of the crops whose area under cultivation almost doubled is hazelnut (Ministry of Agriculture, 2020). The aim of this paper is to present and analyze hazelnut production, focusing on smallholder (family) farms, which make up the majority of agricultural holdings in Croatia. The paper presents statistical data on hazelnut production, as well as opportunities and potential risks of entering this emerging and fast growing type of fruit production in Croatia.

Materials and Methods

Case of smallholder hazelnut farm

The Reljić hazelnut farm is located in the central part of Croatia, 15 km northeast of the town of Daruvar in Bjelovar-Bilogora County (Figure 1). The orchard is located on a hilly terrain between Mount Papuk in the south and Mount Bilogora in the north, at an altitude of about 180 m above sea level. The average annual temperature for Daruvar, as the nearest weather station, is 11.3 ºC with a maximum value of 21.6 ºC in July and a minimum value of 1.0 ºC in January. Average annual precipitation (1988-2017) was 910.2 mm, with a minimum of 532.7 mm (2011) and a maximum of 1312.1 mm (2010). Hazelnuts are grown on 2 individual orchards located very close to each other, the larger being 4.5 ha and the smaller just over 1 ha, with a total of 2 400 hazelnut trees. Of the total 5.5 ha, 2.3 ha (about 1 000 trees) are on average 10 years old and 3.2 ha (about 1 400 trees) were planted in winter 2017. Considering only 1 000 fully producing trees, the average yield in 2020 was ~ 4.0 kg per tree, or about 1 700 kg ha-1. As the quantities produced are still small, the hazelnuts are dried, stored and processed on the farm and packaged and sold directly to end users.

Figure 1. Location of smallholder (family) farm Reljić

Results and discussion

Hazelnut is a fruit of the hazel tree (Corylus avellana L.) used mainly in the chocolate, bakery and confectionery industries and is referred to as a functional food because the consumption of hazelnuts is associated with multiple health benefits for humans due to the high concentration of various bioactive compounds such as sterols, tocopherols, phenolic acids and flavonols (Bolling et al., 2011; Amaral et al., 2006; Oliveira et al., 2008; Tas et al., 2017). Hazelnuts are widely distributed across the globe, but most are grown in continental and Mediterranean climate. Globally, the area under hazelnut cultivation has grown steadily over the last 20 years and has exceeded 1 000 000 ha in 2019, according to FAOSTAT. Over 70 % of the hazelnut harvested area is in Turkey, most of it along the Black Sea coast, making them the largest hazelnut producer in the world. Due to inter-annual yield variability, Turkey's average annual hazelnut production varies widely (Frary et al., 2019), ranging from 350 000 to over 800 000 tons (FAOSTAT). Besides Turkey, Italy, Azerbaijan, Chile and the USA are the leading hazelnut producers and they account for about 90 % of both harvested area and total world production, which was 1.12 million kg in 2019 (FAOSTAT). The global harvested area (ha) and production (tonnes) is shown in Figure 2.

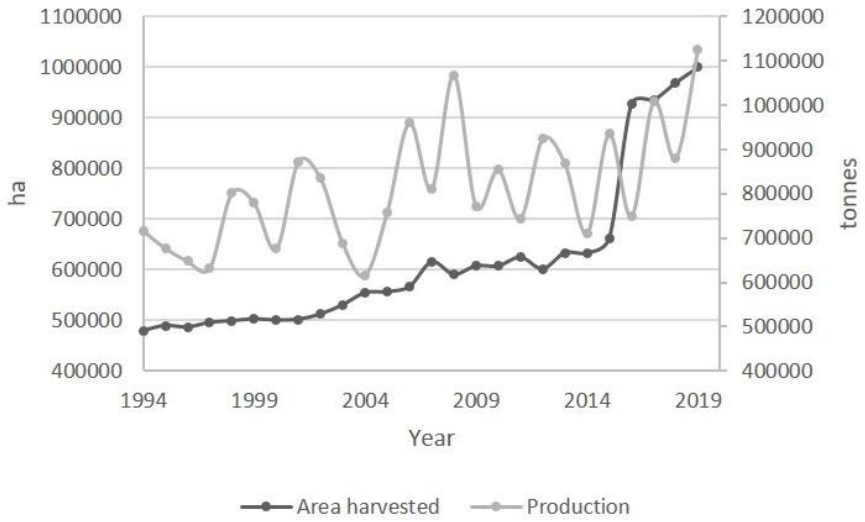

Figure 2. World area harvested/production of hazelnuts with shell 1994-2019 (FAO)

The area under hazelnuts in Croatia follows the global trend and has been increasing for the past decade, reaching a total cultivated area of 5 530 ha and a production of 1 959 tonnes in 2019 (Croatian Bureau of Statistics, 2020) with an average yield of only about 400 kg ha-1. Available data for 2018 (PAAFRD, 2018) show that most hazelnut plantations are located in the three counties, Virovitica-Podravina (657.92 ha), Osijek-Baranja (766.81 ha) and Bjelovar-Bilogora (807.62 ha) County, where the Reljić smallholder (family) farm is located.

As said, there is a trend of increasing acreage of hazelnuts in Croatia. In addition to hazelnuts, in the fruit sector, the areas under walnuts grew the most, and they are currently the leading fruit species grown in Croatia (if we consider the area under cultivation) with over 7 000 ha. There are several reasons why people tend to grow both hazelnuts and walnuts. Hazelnuts, as mentioned above, are considered a very healthy and valuable functional food, and the demand for them is constantly increasing, especially by the chocolate and confectionery industry. Croatia has favorable agro-ecological conditions for growing hazelnuts and they are considered a crop with rather low

planting and maintenance costs. There is also a financial aspect with stable market prices, easier access to a wider EU market, subsidies (e.g. direct payments) that have multiplied in fruit sector since EU accession, and access to various investment measures (e.g. funds for Rural Development). These could be some of the reasons why walnuts and hazelnuts account for more than 35 % of the total area under fruit cultivation in Croatia in 2019.

In view of the above, two main motivators for entry into hazelnut production can be identified. On the one hand, these are favorable conditions for the cultivation of healthy, nutritious and high quality fruits, which have a growing demand on the world market. On the other hand, the motivation may be purely financial. Of potential concern is that hazelnuts are increasingly being planted for the possibility of benefiting from direct payments, with no intention of investing in future production. What makes this possible is very low level of field controls by the authorities. This is supported by the fact that the area under hazelnut cultivation has almost tripled in the last 10 years, while the quantity of hazelnuts produced has remained about the same. However, if a family or individual decides to enter hazelnut production with the intention of producing a high quality, marketable product, there are many ways to make this possible. Croatia's accession to the EU in 2013 opened up the possibility of receiving funds from the EU for various investments, including investments in agriculture. For agriculture, the most important fund is certainly the European Agricultural Fund for Rural Development (EAFRD), in particular Measure 6: Farm and business development, through which farmers can receive EUR 15 000 (6.3 Start–up aid for the development of small farms) and up to EUR 50 000 (6.1. Business start-up aid for young farmers) with a co-financing rate of 100 %. There are also the already mentioned direct payments, which are under the EU CAP and often represent an important share of total farm income.

In terms of production, two main types of production can be distinguished, conventional and organic. Hazelnuts are generally more resistant to plant diseases and pests than other fruits. However, in recent years producers across Europe, including ourselves, are seeing some changes in orchards in terms of pest control, where problems are more frequent and intense. In addition to some standard diseases and pests that we need to monitor and control, such as bacterial blight (Xanthomonas arboricola pv. Corylina), monilinia (Monilinia fructigena), botrytis (Botrytis cinerea) and pests such as the hazelnut weevil (Curculio nucum), some other diseases such as eastern blight and powdery mildew and pests such as mites and stink bugs (Halyomorpha halys) have caused significant economic losses in recent years. In addition to plant protection management, fertilization plays an important role in achieving high quality and stable yields. In Croatia, organic agriculture is very often equated with extensive agriculture, where these orchards are usually not fertilized at all and there is no plant protection management, resulting in very low, if any, yields. For high quality organic hazelnut production, many conditions should be met, starting with suitable soil type, good agro-ecological conditions, higher altitude and good exposure to avoid spring frosts, and certified quality seedlings. In addition, farmers should have a high level of knowledge and skills in organic farming to overcome all the challenges that this type of production can bring. With this in mind, we opt for a more conventional cultivation of hazelnuts, but with some restrictions regarding fertilization and plant protection. Fertilization is done according to soil analysis and plant protection according to the condition of the orchard. We monitor for pests and diseases and use pesticides only when necessary, using no herbicides. When the nuts become ripe and hard, we tend not to use pesticides and fertilizers, except organic foliar fertilizers, and we usually have about 2 months from the last application of chemicals to harvest. In this way, we are able to achieve high quality yields while reducing the risk of pesticide residues in our products. From personal experience and from the experience of other growers in our area,

the balance between conventional and organic farming gives the best results, but with a bias towards more environmentally friendly, sustainable practices. Also, we are seeing a large number of active substances in plant protection products being banned in the EU which makes it more difficult to protect our crops, but as growers this is one of the many things we will have to adapt to in the coming years.

As with many other products, consumers tend to be loyal to certain brands when it comes to food. Even though most agricultural products in Croatia are not branded, consumers are very often loyal to certain producers and their products. Although price is still the most important purchasing driver, consumers pay more and more attention to the quality of products, especially if the quality is guaranteed by some kind of certificate. In Croatia, many different certificates are used to guarantee a certain level of quality for agricultural products. Some of them have a more local meaning, while others are internationally recognized and accepted. Among the most important certificates for agricultural products are milk, meat, eggs and honey produced on Croatian farms and they are given and controlled by Croatian Agricultural Agency (HPA). Croatian Quality and Croatian Creation are also well-known and regulated quality marks awarded by Croatian Chamber (HGK). For Croatian Quality, which is one of the most important and recognized quality marks, there are a number of well-defined rules and quality standards prescribed by the ordinance, which include the implementation of some international standards such as ISO 9001, ISO 14001, OHSAS 18001, etc. In addition, there are many other quality certificates and seals that producers can obtain, and many of them are associated with producer organizations and cooperatives. Among the more international certificates is the aforementioned Organic farming at EU level, which is well established among producers and recognized by consumers. If agricultural products are processed in any way, processing facilities should have HACCP certification. HACCP (Hazard Analysis and Critical Control Point) is a management system that addresses food safety by analyzing and controlling biological, chemical and physical hazards from raw material production and processing through manufacturing and distribution to final product consumption (FDA). In simple terms, HACCP is a system of self-regulation that ensures food safety. To ensure a quick and rapid response when food safety problems occur in the EU food chain, the RASFF system (Rapid Alert System for Food and Feed) was developed in 1979 and has been a valuable and powerful tool ever since. Another certificate, perhaps the most important for primary agricultural producers (such as hazelnut production) besides Organic farming, is GlobalGAP (Good Agricultural Practice). Although it was created in the 1990s, it is used by only a hand full of producers in Croatia. It is the world's leading agricultural quality assurance program that promotes good agricultural practices and safe production of primary agricultural products under strict procedures that focus on farm produce, livestock and aquaculture. The standards for fruit are based on good agricultural practices in farming, such as soil management, pre- and post-harvest pest control, packaging and storage practices. GlobalGAP certification offers many benefits to both growers and consumers. Growers benefit from the use of cost-effective practices that improve product quality. They are encouraged to use modern farming practices that minimize environmental damage, reduce health risks, and promote safe food production. One of the key benefits is access to larger markets (as more retailers require their growers and suppliers to adopt GlobalGAP) and traceability of produced goods along the value chain. To ensure food safety and public health, GlobalGAP also promotes pest control to a minimum level by promoting Integrated Pest Management (IPM), Integrated Crop Management, Quality Management System and of course HACCP. On the other hand, consumers are offered certified, high quality and safe products that are free from chemical, biological and physical hazards. Nevertheless, data from 2016 show only 130 GlobalGAP certified producers in Croatia.

As far as the production of hazelnuts is concerned, most of them are sold in bulk as raw hazelnuts, without any processing except drying, which is done immediately after harvesting to ensure longer and safer storage. Smaller quantities are further processed. This includes roasting, the production of flour, oil and "butter" and the production of various spreads. As with many other agricultural products, there is the possibility of various residues in raw and processed hazelnuts. In most cases two types of residues can be distinguished: pesticide residues and contaminants, of which aflatoxins are the most important. Pesticide residues are not as common in hazelnuts as in other fruits for several reasons. The first reason is the lower number of pesticide applications in the season due to the lower number of pests in hazelnut orchards. Another reason is that once the shell is formed, there is usually no need for spraying. Nevertheless, a recent study showed that pesticides such as acetochlor, boscalid, carbendazm, chlorantraniliprole, chloridazon, diflubenzuron, fenarimol and fluopyram were found in hazelnut samples, but at much lower levels than the MRLs published by the EU (Cebi et al., 2021). In Croatia, of all these pesticides, only boscalid is used in hazelnut production, but we have not had a need for it on our family farm. Even though this study showed lower levels than the EU MRLs, hazelnut producers still need to be careful as some of these pesticides remain in the final products and may pose a risk. One way to avoid this and be sure as a grower that your product is safe for consumption is to be certified, either with Organic farming or GlobalGAP for conventional farming. This way we can ensure that our products are safe, even if we use agrochemicals. A potentially bigger problem than pesticide residues in hazelnut production can be aflatoxins. Of all the known mycotoxins, aflatoxins are the most toxic, dangerous, and widespread (Kabak, 2016). The problem with hazelnuts is that they can be infected with aflatoxin producing fungi in orchards before harvest, during harvest and/or especially during storage after cracking the shell (Ozay et al., 2008). In the literature, we find different data regarding aflatoxin occurrence in hazelnuts, ranging from well over 90 % infected samples (Baltaci et al., 2012) to 6.5 %, with only two raw and one roasted samples (out of a total of 170 samples) exceeding EU ML levels and hazelnuts in shell showing no infection at all (Kabak, 2016). As with pesticide residues, the RASFF system plays an important role in warning the public about aflatoxins in food. In the period 2004-2014, 8 % of all notifications (warnings) of aflatoxins worldwide concerned hazelnuts. This is much less than for pistachios (35 %) and groundnuts (29 %). However, if only Turkey is considered as the largest producer of hazelnuts, this number increases to 33 % (Kabak, 2016). While there are many factors that can contribute to fungal growth and mycotoxin formation, environmental conditions play the most important role, and hazelnuts are generally produced in areas with very favorable conditions for the growth of aflatoxin-producing fungi (Rodrigues et al., 2012). All this can be an incentive for producers to adopt some kind of certification, both to protect their own production by reducing the risk of adverse events (such as residues of pesticides or other contaminants), and to preserve the safety and loyalty of consumers.

Although there are potential risks involved in hazelnut plant protection and some form of quality certification should be considered, we still produce and sell products on our family farm without a certificate. We manage our farm in a very sustainable way with pest and nutrient monitoring and all the work is done by family members. When it comes to harvest and post-harvest processes, we take this very seriously and consider this a crucial moment in the quality production of hazelnuts. We only start harvesting when the hazelnuts are fully ripe (when they fall to the ground). Many farmers start the harvest by picking them from the tree, but when hazelnuts are fully ripe, they fall to the ground. This is the first important step for achieving high quality in raw hazelnuts. Then we rake them into rows and harvest them with a machine that separates all the waste from the hazelnuts. Immediately after harvesting, they are transported to a warehouse where they are stored

in perforated boxes and air-dried for several weeks. This ensures that the time from harvest to storage is as short as possible, and hazelnuts are dried to around 5 % of water content. Many growers harvest the hazelnuts in plastic bags and store them this way for several days, some even to the end of harvest. They are also dried on the floor in various barns or attics without any air circulation. Another problem is the location of many orchards, which are planted in low-lying fields, where there can be problems with stagnant surface water if there are heavy rains during the harvesting season (early/mid-September), as is common in the continental part of Croatia. All this can lead to aflatoxin infestation of hazelnuts potential health problems of our consumers.

Conclusions

According to everything that has been shown in this paper, hazelnut production is an emerging, popular type of agricultural production in Croatia with increasing acreage, especially as organic production. Many small family farms have decided to enter hazelnut production, taking advantage of Croatia's EU membership, especially under the EU CAP. Although hazelnut is considered an "easy" fruit species to grow, the cultivation and production of hazelnut brings some challenges, such as "new" pests and diseases, and also post-harvest problems, such as contaminant residues, especially aflatoxin. To manage the hazelnut production in a sustainable way with product safety and traceability with low risk of contaminants, hazelnut family farms should consider some form of certificate, preferably Organic farming and/or GlobalGAP. Although certification can be costly initially and involves a lot of administration, it is a way for smallholder farms to reduce risk and produce high quality food in the future.

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RISKS IN THE CONTEXT OF FOOD SOVEREIGNTY

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Abstract
The study analyzes risks in the context of food sovereignty concept. The paper observes the public relations in the agricultural sector. In this regard three main risks are defined: (1) risk of "over efficiency" associated with the degree of consolidation and concentration of resources which creates issues with access to factors of production for some groups of farmers; (2) communication risk – generated by the dynamics of technological change on the basis of information and may create barriers to the adaptation of small local producers; (3) risk of energy poverty - transformation of production through the use of clean energy, which can cause an increase in energy prices and a decline in competitiveness and income affecting local agricultural producers. The aim of the study is to present and outline rules related to the food sovereignty and some of the effects that disrupt agricultural sector in Bulgaria. The paper presents a vision for a new type of risk, which could cause limited access to technology for some farmers. Based on the analysis, some practical solutions are highlighted.

Key words: food sovereignty, access to land, adaptation, energy poverty

Introduction

The European Union has started the Green Deal Strategies implementation (Claeys et.al, 2019). In parallel with these processes, the concept of bioeconomy is evolving, integrating knowledge and resources directed to technological transformation based on use of green energy (Voicilas, 2020).
The risk to food sovereignty is linked to the possibility of a country to not be able to produce sufficient and diversified agricultural production (FAO, 2017). The seven principles of food sovereignty focus mainly on food and land rights and environment and domestic food production over international trade (Clapp, 2015a). The deficit of local production can be covered by imports from other countries. However, due to the limited supply locally the investment activity and income of farmers and their households could be reduced. Small-scale farmers are the first that lose position in the value chain and could seek employment outside of agriculture (FAO, 2015). On the other hand, the existence of barriers, including legal ones, can also restrict the supply of agricultural products by local producers. In this context, small local farmers may be non-competitive to local and international markets.
The aim of the study is to present and outline the main risks associated with food sovereignty and some of the potential negative effects that the latter may have on the agricultural sector in Bulgaria.
In the paper the risk to food sovereignty in Bulgaria is divided into three main categories:
(1) Risk of “over efficiency,, associated with the degree of consolidation and concentration of resources which creates issues with access to factors of production for some groups of farmers;
(2) Communication risk – which is generated by the dynamics of technological change on the basis of information and may create barriers to the adaptation of small local producers;
(3) Risk of energy poverty - transformation of production through the use of clean energy, which can cause an increase in energy prices and a decline in competitiveness and income affecting local agricultural producers.

Theoretical background

According to Food sovereignty as political, economic and legal concept, farmers should be able to produce enough food on their own to meet their personal needs and those of their households (Patel, 2009). Number of authors has analyses food sovereignty from different perspectives – some of the studies focus on food sovereignty issues related to the agricultural reform, trade agreements, and land rights (Brezner Kerr et.al, 2013). Other consider the term associated with access to local markets, application of sustainable farming methods and control of natural resources (Pimbert, 2006, Rosset, Martínez-Torres, 2012, McMichael, 2012).

In 2007 the "pillars" of food sovereignty are defined (Jones, Fink Shapiro, Wilson, 2015). In addition to those principles, the supply of agricultural products must be sufficient to provide protection from food crises at national level; to create market pressure on unrestricted and sometimes uncontrolled imports through large traders; the link between local farmers and their independence in determining the institutional mechanisms that meet their interests (Clapp, 2015b). In order to assess the effects related to the production and distribution of food, the following should be analyzed: the distribution of resources, the barriers to the normal functioning of coordination mechanisms, the interests of the actors – in this context the main question is who benefits from the produced goods (Aerni, 2011, Wittman, 2009, McMichael, 2009).

The WGGT Act (FAO, 2012) aims to solve the issues with the distribution of factors of production. The concentration of agricultural land at EU level is a major concern (European Parliament, EC, 2015a). Despite the measures taken by the European Commission (EC, 2017), land grabbing continues to have an impact on access to basic resources, which makes it particularly difficult for small farmers (Kay, 2016, Medarov, 2013).On the other hand, there is a process of consolidation of large companies, which is the reason for the gradual reduction of the number of the small, local farm managers (Beluhova-Uzunova et.al., 2020).

The management of the legal process is often accompanied by dualism in legal doctrine, leading to rules acting as barriers, allowing to individual or group to have an informational advantage. According to Evans et.al (2015) and Szilágyi et.al. (2017) this coordination problem predetermines the existence of national legal systems which put food sovereignty at the center through their constitutional framework. The communication risk leads to adaptation problems, which are significant for the smaller local agricultural producers.

At first glance, energy poverty is not linked to the food sovereignty (EC, 2020a). However, this is a central issue of the Green Deal due to the need for effective management of value chains in relation to the applied factors of production in agriculture (EC, 2019a). The Bulgarian legal position also imposes food security, as a synergy of the use of green energy and the vitality of local agricultural production (EC, 2020b, WUR, 2018). On the other hand, there is no clear incorporation in national legislation of this link, which poses a risk to the country's food sovereignty. Both in the Energy Act and in the by-laws related to the support of individuals that cannot pay the price for heat and electricity - there are no specific legal norms affecting farmers and their households.

Materials and methods

The agricultural economics theory analyses the relationship between production factors and economic results (Guth and Smędzik-Ambroży, 2020). Based on that technical, economic and allocative efficiency are defined (Farrell, 1957). The technical efficiency affects the market supply and possible deficits, which may cause increased imports of agricultural products (FAO, 2017). This process has a negative impact on local production and rural communities and can be identified as a risk to the country's food sovereignty.

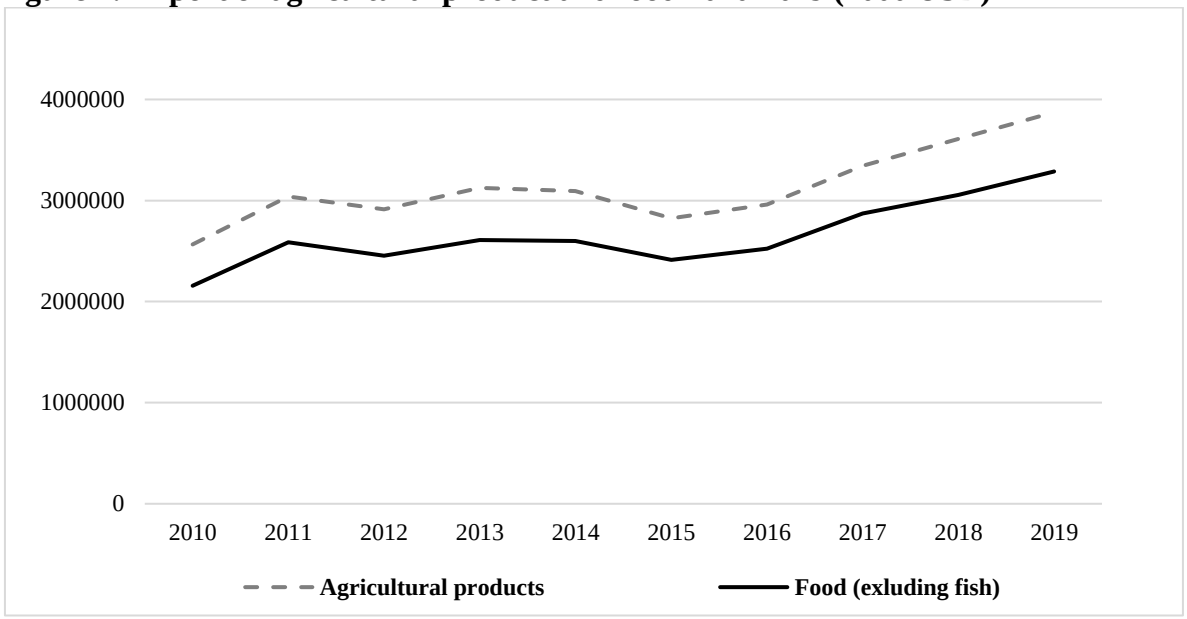
The study is based on the framework presented by Leiter (2002) and Green, (2005). It is used to explain the "legal errors". The latter helps to identify the issues related to the access to resources, as well as to measure legal and economic effects which are complex and sometimes contradictory in terms of long-term adaptation (Lazíková et.al, 2015). The communication risk is analyzed as a barrier to the course of legal proceedings (EPEC, 2011). On the other hand, it is a consequence of the information asymmetries related to trade and efficient use of resources, as well as the uncertainty associated with the protection of human health (Akerlof, 1970, Bennett, Calman, 1999). Legal acts can create uncertainty in the legal field, especially in the case of extraordinary rulemaking, which is currently observed due to COVID - 19.

Results and Discussion

- *Food Sovereignty indicators*

The trends in the import of food and agricultural products in the last 10 years in Bulgaria are presented in Figure 1. The data show an increase of 66.24% for food and 65.61% - for agricultural products.

Figure 1: Import of agricultural product and food 2010-2019 (1000 USD)



Source: Based on FAO Statistic division

Based on National Statistical Institute latest data, in 2020, the agricultural sector remains important in the Bulgarian foreign trade. It forms 15% of the total trade, 17.1% of total exports and 13% of total imports. In 2020, the supply of oilseeds and fruits increased by 66.5%. Among the important groups of agricultural products, a serious increase in import is observed in oils of animal or vegetable origin: by 43%, and – of vegetables; fruits; wheat plants; coffee, tea, spices; soft and alcoholic beverages; fruit and vegetable foods - within 3% -9%.

On the other hand, household food consumption, despite some minor variations, has remained stable for the past 10 years. According to the National statistical institute data, food imports in the last two years continue to grow, while maintaining approximately the same levels of consumption. In this regards there is a downward trend in the production of important food products from

agriculture and the food industry (Ruscheva, 2020). Therefore, there is a possibility the decline in local agricultural production to become a long-term trend. This could lead to a substitution effect - increased imports of food and agricultural products in the next years.

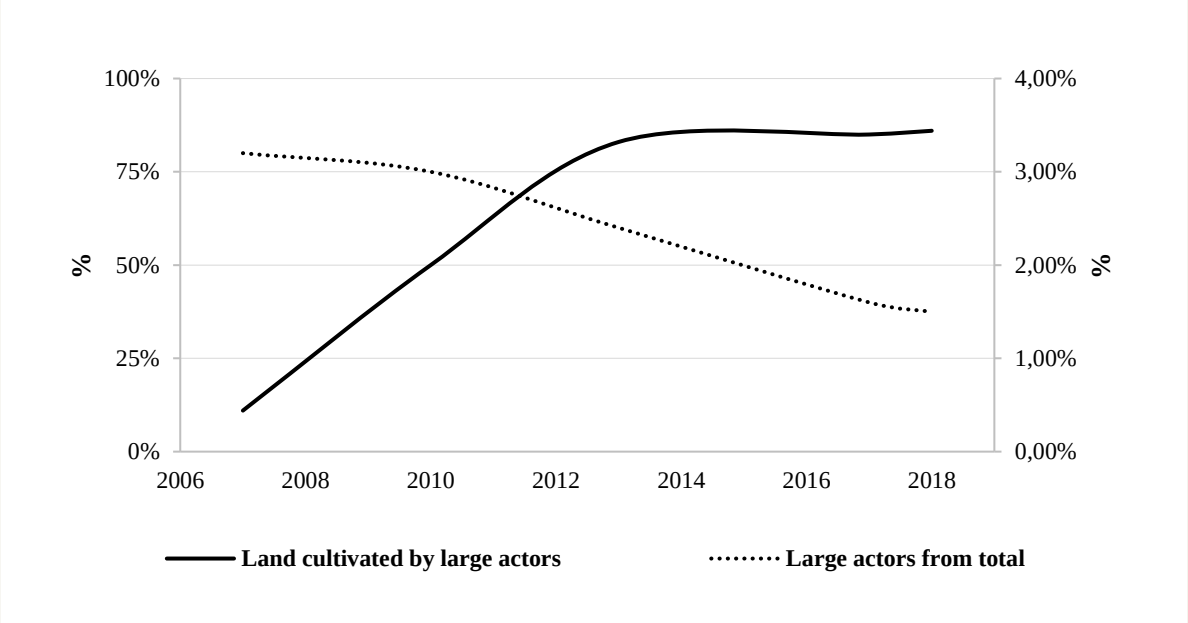
- *Over - efficiency and access to production factors*

The consolidation of resources supports the efficiency of farmers (Zeng et.al, 2018). In this regard the legislative framework should impose incentives both for the integration of organizational systems and for a profit by maximizing activities. In agriculture, however, support for the Pillar I CAP leads to forms of "rent seeking" (Stiglitz, 1974).

Based on the Agricultural Census primary data published in 2021, trends of consolidation and commercialization are observed. In Bulgaria there are 132 400 farm compared to 340 200 in 2010 (64% decline). The average size of the farms increased three times over the last ten years to 33 ha per farm. Significantly decreases the number of farms with UAA below 10 ha compared to 2010. However, the largest decline by 80% is registered in farms with UAA to 1 ha. Another important trend is associated with overconcentration - around 9% of the farms accumulate more than 85% of UAA.

Therefore, due the vertical and horizontal agreements, indirect barriers to the access to land are created for whole groups of market and non-market actors (Norrerm, 2019). In this regard, some agricultural associations may be associations that protect the interests only of certain members.

Figure 2: Distribution of Utilized Agricultural Area and number of farm (% of total)



Source: Georgiev M., Roycheva A. (p. 255, 2018)

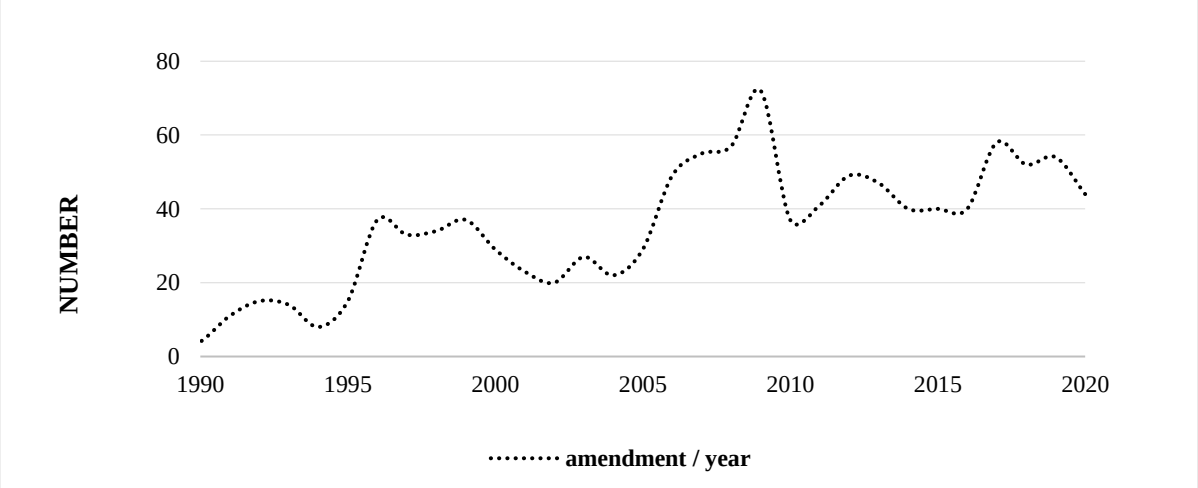
Agricultural land trusts can be a form of total control over the production factor. Specially introduced rules to support this type of investors represent a form of commercialization of agriculture, in which companies with internationally represented capital have increasing market power. Agricultural land management companies were established with the Law on Special Investment Purpose Companies (LSIPC). The latter have privileges over small producers who want

to acquire agricultural land, which makes them suitable for large international foreign investors, but often at local level prevents producers from acquiring land.
Transactions between large landowners and producers, as well as between producers and traders, may be part of vertical agreements which indirectly distort the forms of legal competition and indirectly discriminate other participants in the turnover. Therefore small farmers and their families have limited access to land as a resource. On the other hand, large companies have an advantage in consolidating agricultural land. They are preferred by both local administrations and large landowners because of the benefits of production and organizational economies of scale.

- *Information asymmetry and adaptation of small farmers*

The communication risk can be divided into two. Technological change cannot and should not be stopped. However, it goes hand in hand with a change in the systems like information registers and a change in the rules.

Figure 3 Number of the amendments

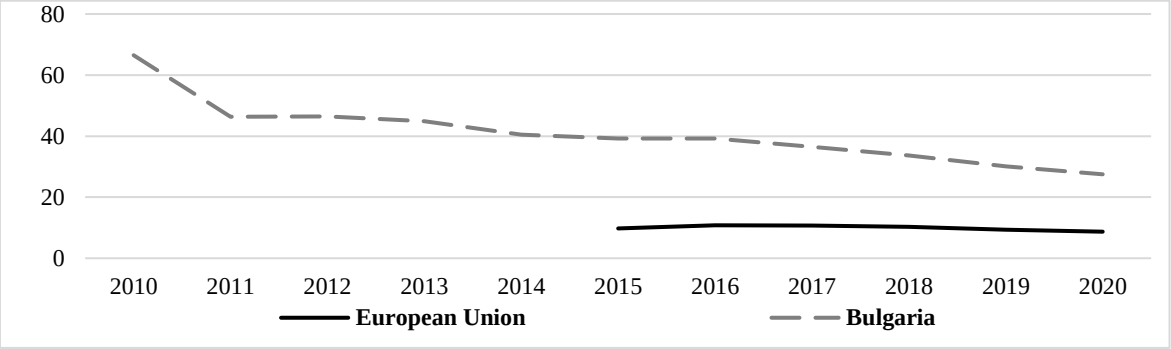


Source: Own survey

The information registers and systems in Bulgaria are numerous and functioning with limited integration (European Commission, 2015b). On the other hand, legal change is extremely dynamic. Some of the legal acts change with great speed 5-10 times a year. The processes create uncertainty in the use of information (Semov, 2020, Valchev, 2020)
Figure 3 shows the formal institutional change in the legislation related to one of the sectors affecting food sovereignty - laws and by-laws affecting agricultural land. The change in legislation is more than significant and causes issues in the agricultural sector.
Large producers and entrepreneurs can adapt due to organizational economies of scale, unlike small producers, whose transformation is more difficult. This would jeopardize their participation in the market and production process and can lead to issues with food sovereignty in Bulgaria.

- *Green energy, production and income in agriculture*
This risk can be linked to two policy actions: (1) The closure of electricity enterprises due to the agreement for production of only green energy. (2) The introduction of restrictions in the trade and use of certain products related to heat at the level of an individual household.

Figure 4: Population unable to keep home adequately warm by poverty status (% of the population)



Source: Based on EUROSTAT

According to Bonjour (2013), in Bulgaria there is still heating with the help of burning charcoal. In Bulgaria the percentage of people that are unable to keep home adequately warm declines from 66.5% in 2010 to 27.4% in 2020. However, it is 3.5 times higher compare to EU-27 level (Figure 4). In the country rural areas have the highest percentage of households who cannot keep the house adequately warm (38.8%). The latter can be explained by the building type as most dwellings are detached and located in areas with higher heat dissipation (European Commission, 2019b).

Based on the data it can be concluded that energy poverty in Bulgaria continues to be a major problem. However, the term energy poverty is not defined in Bulgarian legislation, as a result the issue is often part of broader social policies (Buzar 2007, Bouzarovski et al. 2011).

Bulgarian power futures contracts started trading on the European Energy Exchange in June 2019. On the other hand, in the summer of 2019 there were some allegations of manipulations on the centralized market and establishment of bilateral contracts (EC, 2020c).

Bulgaria is planning to introduce market-based elements in retail prices for electricity (Energy and Water Regulatory Commission, 2019). On other hand, the there is a limited access of the consumers to competitive offers. In addition, the quality of the service is poor and among the lowest recorded in the EU for those markets (Black Sea Energy Research Centre, 2018).

The challenges in the energy sector and the increasing prices could lead to negative scenarios. It should be noted that the reversal of the trend will lead not only to the return of bad practices (such as burning wood and coal from households) and also to redirecting costs to meet the necessary requirements, rather than to introduction of innovation. There is a possibility of demotivation for whole groups of participants for implementation of new technologies based on green energy.

Conclusions

Possible negative scenario. The increase in the prices of some of the production resources, in parallel with the reduced supply of local food products, could lead to a sharp decline in incomes of local farmers. The number of holdings and types of organizational forms in Bulgarian agriculture could also decrease and lead to negative processes as “land grabbing” and overconcentration of UAA. In this regard, the dependence on imports will continue to grow.

In the long run, these trends can be transformed into the emergence of risks related to the access to technology for smaller, local farmers.

There is a possibility of a number of social problems arising from the loss of livelihood and from consequences as migration from the village to urban areas; development of low-tech productions; pressure on labor markets; lack of qualified staff for a number of agricultural activities.

In this regards some recommendations that can reduce the three types of risk can be outlined:

(1) Zones of agricultural land, in which only local producers living in the same area have an advantage for using the land. The latter does not contradict the European rules for free trade and investment in the consolidation of agricultural land.
(2) Alternative institutions (rules) in the implementation of information resources and registers. A new type of integration can be proposed. The rights related to the property for small local agricultural producers to be collected by the administrative services on the principle of ex officio. The criteria for granting "price discounts" in the case of decentralized electronic services should be changed through the use of digital technical devices. Lower prices should be provided - not only when the farmers seek protection of their individual property rights, by obtaining more documents, but also when they live and own farm in the same settlement.
(3) Providing new technologies adapted to the needs of small farmers living and operating in the same agricultural region. Such an approach should displace the financial support provided against the obligation not to use fossil fuels, helping small local producers to follow the new concepts of bioeconomy in order to reduce the risk to food sovereignty.
In order to overcome the issues related to food sovereignty it is necessarily to introduce national strategies and local enactments and improve coordination between different authorities. It should be noted that food sovereignty should be related to synergy between institutions at national level and in international context in order to achieve its long run goals.

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3 CORRESPONDENCE CONFERENCE

3.1 Papers from the correspondence conference

FOOD LABELLING TO PROTECT CONSUMERS

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Abstract

Food labelling is an important tool for the consumer. Finding a reasonable level of consumer information requires considering the consumer's interest and the original idea that accompanied the emergence of food labelling. The paper provides a short historical review of food labelling emergence, an overview of the current legal instruments of food labelling in the EU to consider if food labels are overloaded in connection to consumer needs and the ability to perceive new information and innovation in the food labelling. The question of food labelling in the EU arose because of free movement of goods. The new regulation 1169/2011 provides the basis for the assurance of a high level of consumer protection and establishes the general principles, requirements and responsibilities governing food information, particularly food labelling. Currently, twelve mandatory information pieces must be present on all European Union food labels. On the other hand, increasing consumer information is overloaded, and there is a risk that the consumer will give up accepting further information. The current food labelling law needs to be checked which information is needed on consumers and whether it will protect the interests of consumers. As we can expect an increase in the pieces of information on food products in the future, the use of information and communication technologies, like smart labels and RFID technologies, could secure consumer protection in relation to food information.

Keywords: food, food labelling, consumer, consumer protection, smart labels

Introduction

Food labelling is the primary means of communication between the producer and seller of food on one hand, and the purchaser and consumer of the other (FAO, 2001; Hutt, Gonzalez, 2014). A food label is a medium to reduce the information gap between producers and consumers (Dudeja, Gupta, 2017). Food labels provide important information to consumers and assist them in making informed purchase decision (Harris, 2014). Moreover, food labelling has been recognized as an effective tool to protect consumer health in terms of food safety and to promote nutritional well-being (FAO, 2016). From public health point of view, a label is a tool to promote health by providing accurate nutritional information so that consumers can make informed dietary choices (Dudeja, Gupta, 2017). The study of Jevdjevic et al. (2021) suggests that implementing Front-of-Package Food Labelling has the potential to improve oral health and yield substantial economic benefits. On the other hand, Golan et al. (2001) find that mandatory food-labeling requirements are best suited to alleviating problems of asymmetric information and are rarely effective in redressing

environmental or other spillovers associated with food production and consumption. The food label is where food policy meets the road and becomes personal to a consumer (Hutt, Conzalez, 2014). Labelling laws follow the main objective to prevent fraud and misleading information which should protect consumers (FAO, 2016). Barahona et al. (2021) find that food labels increase consumer welfare by 3.8% of total expenditure. They added that under optimal policy thresholds, food labels and sugar taxes generate similar gains in consumer welfare but food labels benefit the poor relatively more (Barahona et al., 2021). Further, food label information should support consumers in building a well-balanced diet and in avoiding risks that may be connected with consumption of foods containing allergens. Therefore, ensuring clear labelling that will help consumers make proper food choice is crucial (Halagarda, Poperk, 2018). According to the current EU legislation there are twelve mandatory pieces of information that must be present on all European Union (EU) food labels. There are product name, list of ingredients, allergens, quantitative ingredient declaration, net quantity, durability dates, storage, and instructions for use, business name and address, country of origin, nutritional declaration, and alcoholic strength (article 9 of the regulation (EU) no. 1169/2011). In addition, the mandatory information must be presented in a minimum font size (Roche, 2016). Studies show that easy legibility is an important element in maximizing the possibility for labelled information to influence its audience and that illegible product information is one of the main causes of consumer dissatisfaction with food labels (point 26 of preamble of the regulation (EU) no. 1169/2011). Legibility means the physical appearance of information, where the information is visually accessible to the general population and which is determined by various elements, inter alia font size, letter spacing, spacing between lines, stroke width, type colour, typeface, width: height ratio of the letters, the surface of the material and significant contrast between the print and the background (art. 2(1) m of the regulation (EU) no 1169/2011). Consumers want this label information presented in an easy to understand and transparent way (Wingfield, 2016). However, many food labels already appear overloaded (Grunert, 2016) but we can expect the increasing of the pieces of information on the food products in the future. We mentioned above there are twelve mandatory pieces of information that must be present on all European Union (EU) food labels. In US Law, food labels must contain five primary elements (unless subject to limited exemptions). There are statement of identity (name of the food); net quantity of contents; nutrition facts; ingredient statement (including allergen declaration); and name and address of responsible firm. Additional labelling requirements are applicable to certain products, e.g., juice content, warnings (Steele et al., 2016). Because of overloading of food labels, they are supplemented by other information channels such as Internet, and it is common for food labels to refer consumers to websites, for example, by QR codes (Grunert, 2016). However, to date, none of these has revolutionized the way in which consumers shop (Grunert, 2016). A classical store is a highly information-rich environment, and additional information being supplied by handheld devices only makes the shopping task more difficult for consumers, unless they include a way of reducing the information overload by tailoring the information stream to the individual consumer (Grunert, 2016). Moreover, the average consumer makes one major shopping trip per week, spending about an hour in the store (Meloy, et al., 1988) and the consumer evaluates the over 15,000 products offered by the typical store on complex nutrition, taste, convenience, and price criteria in a limited period of time (Caswell, Padberg, 1992). Moreover, research on grocery shopping behaviour indicates that decision-making quality deteriorates when the shopper is under time pressure (Park et al., 1989). These facts limit many consumers' use of labels as shopping aids (Caswell, Padberg, 1992). The above mentioned papers from various part of the world confirm that the food labelling is an important tool for consumer until food labels are overloaded. Finding a reasonable level of

consumer information requires taking into account the consumer's interest and the original idea that accompanied the emergence of food labelling. The paper provides a short historical review of food labelling emergence, an overview of the current legal instruments of food labelling in the EU to consider if food labels are overloaded in connection to consumer needs and ability to perceive new information and innovation in the food labelling including the new legal amendments prepared by Slovak law maker.

Material and methods

The paper used the normative national and EU legal acts, the explanatory reports, relevant judgements of the Courts of Justice of the EU and opinions from the scientific publications of lawyers and relevant public bodies.

There are used the methods of jurisprudence such as logical methods and formal legal methods, which are necessary for the interpretation of normative legal acts of the EU and sociological methods, especially methods of examining various documents that preceded or accompanied the emergence of normative legal acts as well as documents resulting from application practice in this area.

Results and Discussion

1 Development of the food labelling in the EU

In the middle age most food was produced and consumed on the local markets and the food labels were mostly not required. The first labels applied to alcoholic beverage containers in the 18th century, bearing the manufacturer's name, the quantity and the quality of the content (Marcotrigiano et al., 2018). In 1266, England has adopted the Statute of the Pillory and Tumbrel which regulated the price, weight and quality of the bread and beer produced and sold in towns and villages and provide a punishment for violation of the Assize Bread and Ale (Beer). The Statute asked the Name of the Owner to be written upon every product (Moore, 2001; Cartwright, 2001). In the Statute, we can find one of the oldest laws related to the food labelling regulation.

In the 19th century, the industrialisation was related also the food industry when the consumers asked for information before the making purchases. The used trademarks were not able to provide all necessary information to consumer and the need for food label regulation was appeared. Moreover, the food label regulation should prevent the misleading of consumers, fraudulent labelling or food adulteration known since ancient times (e.g. Gaius Plinius, Naturalis historia, AD 23 -70, cited from Marcotrigiano et al., 2018). At first labelling requirements were basics such as weight, the name of the food, and the address of the manufacturer. With advances in nutrition science and the discovering the connection between food consumption and diseases, labelling requirements included also nutrition information (Moore, 2001). , e. g. according to the U.S. Department of Health and Human Services, the update of food labelling in 1989 was based on the consensus on dietary recommendations aimed at controlling diet-related disease or WHO (2003) proposed the work in the area of nutrition and labelling could be further strengthened to cover diet-related aspects of health.

The European Union, mainly its predecessor, European (Economic) Community was not primary focused on the food labelling and consumer health. The main idea was to receive the internal market where free movement of goods and service would be ensured. However, the question of food labelling arose because of free movement of goods. According to the article 34 Treaty on the Functioning of the European Union (hereinafter as TFEU) quantitative restrictions on imports and all measures having equivalent effect shall be prohibited between Member States. This article is included under the title II named free movement of goods. The Court of the Justice of the EU (hereinafter as ECJ) interpreted the goods as products which can be valued in money and which are capable, as such, of forming the subject of commercial transactions (C-7/68). It means that food fulfil both condition to be considered as good in the meaning of free movement of goods. However, article 38 (2) TFEU laid down a rule: Save as otherwise provided in Articles 39 to 44, the rules laid down for the establishment and functioning of the internal market shall apply to agricultural products. Moreover, article 38(3) TFEU laid down that the agricultural products which are fallen with the article 39 – 44 TFEU are named in the Annex I of TFEU. It means if the rules of Common market organisation and common agricultural policy are not applicable on food; the article 34 of TFEU is applicable also on the import of food. The ECJ applied article 34 of TFEU to alcoholic beverages in the famous case Cassis de Dijon (C- 120/78). According to the ECJ the concept of measures having an effect equivalent to quantitative restrictions on imports is to be understood to mean that the fixing of a minimum alcohol content for alcoholic beverages intended for human consumption by the legislation of a member state also falls within the prohibition laid down in that provision where the importation of alcoholic beverages lawfully produced and marketed in another member state is concerned. The German government also claimed that the fixing of a lower limit for the alcohol content of certain liqueurs is designed to protect the consumer against unfair practices on the part of producers and distributors of alcoholic beverages. However, the ECJ stated this line of argument cannot be taken so far as to regard the mandatory fixing of minimum alcohol contents as being an essential guarantee of the fairness of commercial transactions, since it is a simple matter to ensure that suitable information is conveyed to the purchaser by requiring the display of an indication of origin and of the alcohol content on the packaging of products. The ECJ has developed the information paradigm of internal market food law when determined that the preference should be given to an information- related rule. Instead of prohibiting certain practices, information of consumers is understood, as a standard, to be a sufficient consumer protection measure (Purnhagen, Schebesta, 2019). The ECJ maintained the information paradigm also in the case of Italian vinegar (C-193/80) where the Italian government wanted to limit the label vinegar only to vinegar made from the wine because the Italian consumers were accustomed to the term “Aceto” being used in commerce for wine-vinegar alone. According to the ECJ such protection may however be provided by other means enabling national and imported products to be treated alike, in particular by the compulsory affixing of suitable labels giving the nature of the product sold and containing a description of additional information specifying the type of vinegar offered for sale, provided that such a requirement applies to all vinegars including wine-vinegar. Such a course would enable the consumer to make his choice in full knowledge of the facts and would guarantee transparency in trading and in offers to the public by providing an indication of the raw material used to make the vinegar (C-193/80). The ECJ preferred the food labelling as a sufficient consumer protection to prevent Butter and Margarine from being confused in the mind of consumer (C-261/81) or to mislead consumers who attribute specific qualities to beers manufactured from particular raw materials (C-178/84) or to pasta manufactured only with durum wheat (C-407/85).

From the above mentioned cases it follows that the ECJ shifted partially to consumers. Food producers and traders had an obligation to ensure putting labels on the food and consumer had an obligation to be active in finding information on food quantities and qualities including its raw materials. The ECJ judgements were an impulse to the European law maker to prepare the secondary legislation for food labelling on the base of article 114 of the TFEU. However, a new question was appeared. The German Court referred to the ECJ the following questions: First, in order to assess whether, for the purposes of Article 10(2)(e) ofRegulation (EEC) No 1907/90, statements designed to promote sales are likely to mislead the purchaser, must the actual expectations of the consumers to whom they are addressed be determined, or is the aforesaid provision based on a criterion of an objectified concept of a purchaser, open only to legal interpretation? Second, if it is consumers' actual expectations which matter, the following questions arise: (a) Which is the proper test: the view of the informed average consumer or that of the casual consumer? (b) Can the proportion of consumers needed to prove a crucial consumer expectation be determined in percentage terms? Third, if an objectified concept of a purchaser open only to legal interpretation is the right test, how is that concept to be defined? The ECJ formulated these three questions into one related to the concept of consumer to be used as a standard for determining whether a statement designed to promote sales of eggs is likely to mislead the purchaser, in breach of Article 10(2)(e) of Regulation No 1907/90. The ECJ defined a concept of average consumer. According to the ECJ the national court must take into account the presumed expectations which it evokes in an average consumer who is reasonably well-informed and reasonably observant and circumspect. However, Community law does not preclude the possibility that, where the national court has particular difficulty in assessing the misleading nature of the statement or description in question, it may have recourse, under the conditions laid down by its own national law, to a consumer research poll or an expert's report as guidance for its judgment (C-210/96). The ECJ used its concept of average consumer also in it further cases. An average consumer who is reasonably well informed and reasonably observant and circumspect could not be misled by the term “naturally pure” used on the label simply because the jam contains pectin gelling agent whose presence is duly indicated on the list of its ingredients (C-465/98, point, 22). However, the fact that the list of ingredients is displayed on the packaging of the goods at issue in the main proceedings does not in itself exclude the possibility that the labelling of those goods and methods used for it may be such as to mislead the purchaser within the meaning of Article 2(1)(a)(i) of Directive 2000/13 (C-195/14, point 38). Of itself such a list is, however, not sufficient, to preclude that consumers are misled through other labelling elements (Schebesta, Purnhagen, 2016). The labelling, as defined in Article 1(3)(a) of that directive, is composed of any words, particulars, trademarks, brand name, pictorial matter or symbol relating to a foodstuff and placed on its packaging. Some of those items may in practice be misleading, erroneous, ambiguous, contradictory or incomprehensible (C-195/14, point 39). In that case, the list of ingredients, even though correct and comprehensive, may in some situations not be capable of correcting sufficiently the consumer’s erroneous or misleading impression concerning the characteristics of a foodstuff that stems from the other items comprising its labelling (C-195/14, point 40). Therefore, where the labelling of a foodstuff and methods used for the labelling, taken as a whole, give the impression that a particular ingredient is present in that foodstuff, even though that ingredient is not in fact present, such labelling is such as could mislead the purchaser as to the characteristics of the foodstuff (C-195/14, point 41). In the context of that examination, the referring court must in particular take into account the words and depictions used as well as the location, size, colour, font, language, syntax and punctuation of the various elements on the fruit tea’s packaging (C-195/14, point 43). Articles 2(1)(a)(i) and 3(1)(2) of Directive

2000/13 must be interpreted as precluding the labelling of a foodstuff and methods used for the labelling from giving the impression, by means of the appearance, description or pictorial representation of a particular ingredient, that that ingredient is present, even though it is not in fact present and this is apparent solely from the list of ingredients on the foodstuff's packaging (C-195/14, point 44). This case showed that the burden of processing of information is not solely shifted towards consumers (Purnhagen, Schebesta, 2019). The distribution of obligations in relation to the food labelling was expected however the ECJ by its judgements did not provide clear border between them. The last cited judgements bring more legal uncertainty into the legal relations between producers and sellers on the one side and consumers on the other side.

2 EU secondary law of food labelling

In previous chapter the EJC judgment mentioned directive 2000/13 as a secondary legal instrument of the European Union in relation to the food labelling. However, there were adopted a number of secondary legislation, mainly directives and regulations. The first secondary legislation was adopted in 1979 as Council Directive 79/112/EEC of 18 December 1978 on the approximation of the laws of the Member States relating to the labelling, presentation and advertising of foodstuffs for sale to the ultimate consumer. The preamble of this directive explains the reason for its adoption by differences which existed between the laws; moreover, regulations and administrative provisions of member states on the labelling of foodstuffs impeded the free circulation of these products and were able to lead to unequal conditions of competition. On the other hand, approximation of these laws was considered to contribute to the smooth functioning of the common market.

In 1990, Council Directive 90/496/EEC of 24 September 1990 on nutrition labelling for foodstuffs was adopted which concerns nutrition labelling of foodstuffs to be delivered as such to the ultimate consumer. This directive was more detailed in nutrition labelling while Council Directive 79/112/EEC was more general and the nutrition labelling were not compulsory on the food labelling.

In 80s and 90s of the 20th century, there were adopted more specific directives related to the food including drinks labelling. There were adopted the Commission Directive 87/250/EEC of 15 April 1987 on the indication of alcoholic strength by volume in the labelling of alcoholic beverages for sale to the ultimate consumer; Commission Directive 94/54/EC of 18 November 1994 concerning the compulsory indication on the labelling of certain foodstuffs of particulars other than those provided for in Council Directive 79/112/EEC; Commission Directive 1999/10/EC of 8 March 1999 providing for derogations from the provisions of Article 7 of Council Directive 79/112/EEC as regards the labelling of foodstuffs.

In 2000, the Council Directive 79/112/EEC was abolished and replaced by the new one because the original directive was frequently and substantially amended. In 2000, the directive 2000/13/EC of the European Parliament and of the Council of 20 March 2000 on the approximation of the laws of the Member States relating to the labelling, presentation and advertising of foodstuffs was adopted. However, the nutrition labelling directive 90/496/EEC was still valid and new specific directives or regulations were adopted, such as Commission Directive 2002/67/EC of 18 July 2002 on the labelling of foodstuffs containing quinine, and of foodstuffs containing caffeine; Commission Directive 2008/5/EC of 30 January 2008 concerning the compulsory indication on the

labelling of certain foodstuffs of particulars other than those provided for in Directive 2000/13/EC of the European Parliament and of the Council; or Commission Regulation (EC) No 608/2004 of 31 March 2004 concerning the labelling of foods and food ingredients with added phytosterols, phytosterol esters, phytostanols and/or phytostanol esters.

The enlargement of the European Union has led to the great disparities in food law among the member states. In 2002, the Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety was adopted. The disparities were not eliminated by the directive but the regulation as stricter legislative measure was used. The preamble of this regulation stated that it is necessary and appropriate for the achievement of the basic objectives of this Regulation to provide for the approximation of the concepts, principles and procedures forming a common basis for food law in the Community and to establish a European Food Safety Authority (point 66 of preamble of the regulation 178/2002). The regulation laid down the basic of the food law or general food law. According to the article 1 of this regulation provides the basis for the assurance of a high level of protection of human health and consumers' interest in relation to food, taking into account in particular the diversity in the supply of food including traditional products, whilst ensuring the effective functioning of the internal market. It establishes common principles and responsibilities, the means to provide a strong science base, efficient organisational arrangements and procedures to underpin decision-making in matters of food and feed safety. Moreover, this Regulation lays down the general principles governing food and feed in general, and food and feed safety in particular, at Community and national level. However, the issues of food labelling were further regulated by the directive 2000/13. The general food law mentioned the label only three times: First, in determining whether any food is unsafe, when regard shall be had also to the information provided to the consumer, including information on the label, or other information generally available to the consumer concerning the avoidance of specific adverse health effects from a particular food or category of foods (article 14(3) of the regulation 178/2002). Second, without prejudice to more specific provisions of food law, the labelling, advertising and presentation of food or feed, including their shape, appearance or packaging, the packaging materials used, the manner in which they are arranged and the setting in which they are displayed, and the information which is made available about them through whatever medium, shall not mislead consumers (article 16 of the regulation 178/2002). Third, food or feed which is placed on the market or is likely to be placed on the market in the Community shall be adequately labelled or identified to facilitate its traceability, through relevant documentation or information in accordance with the relevant requirements of more specific provisions (article 18(4) of the regulation 178/2002). Therefore the legal regulation of food labelling by the directive was still necessary. However, the majority of the provisions laid down in that Directive date back to 1978 and should therefore be updated. Moreover, Council Directive 90/496/EEC includes the majority of the provisions date back to 1990 and should be also updated. In addition, the general labelling requirements are complemented by a number of provisions applicable to all foods in particular circumstances or to certain categories of foods. In addition, there are a number of specific rules which are applicable to specific foods. It is necessary to streamline it in order to ensure easier compliance and greater clarity for stakeholders and to modernise it in order to take account of new developments in the field of food information (point 8 and 9 of preamble of the regulation 1169/2011). Therefore both directives (directive 90/496/EEC and directive 2000/13/EC) were repealed and replaced by a single regulation. In 2011, the regulation (EU) no 1169/2011 of the European parliament and of the

Council of 25 October 2011 on the provision of food information to consumers, amending Regulations (EC) No 1924/2006 and (EC) No 1925/2006 of the European Parliament and of the Council, and repealing Commission Directive 87/250/EEC, Council Directive 90/496/EEC, Commission Directive 1999/10/EC, Directive 2000/13/EC of the European Parliament and of the Council, Commission Directives 2002/67/EC and 2008/5/EC and Commission Regulation (EC) No 608/2004.

The new regulation provides the basis for the assurance of a high level of consumer protection in relation to food information, and establishes the general principles, requirements and responsibilities governing food information, and in particular food labelling. It shall apply to food business operators at all stages of the food chain, where their activities concern the provision of food information to consumers. It shall apply to all foods intended for the final consumer, including foods delivered by mass caterers, and foods intended for supply to mass caterers (article 1 of the regulation 1169/2011).

This regulation is structured in seven chapters. The first chapter contains general provisions related to the scope of the regulations and basic definitions. The second chapter includes general principles on food information. The third chapter contains general food information requirements. It deals also with the fair information practices and responsibilities of food business operators. The fourth chapter includes mandatory food information with detailed provisions on mandatory particulars and nutrition declaration. The fifth chapter establishes voluntary food information in two articles. The sixth chapter deals with the national measures and the seventh chapter includes the implementing, amending and final provisions. Moreover, the regulation includes also 15 annexes.

The definition of food is included in the regulation no. 178/2002 called also general food law and is used also for food labelling law. According to the article 2 of this regulation food means any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans. Definition of food information law is included in article 2(2) of the regulation no. 1169/2011. Food information law means the Union provisions governing the food information, and in particular labelling, including rules of a general nature applicable to all foods in particular circumstances or to certain categories of foods and rules which apply only to specific foods (article 2(2)b of the regulation 1169/2011). Food information means information concerning a food and made available to the final consumer by means of a label, other accompanying material, or any other means including modern technology tools or verbal communication (article 2(2)a of the regulation 1169/2011). The regulation includes mandatory food information that are required to be provided to the final consumer by Union provisions and voluntary food information provided on a voluntary basis. Food label means any tag, brand, mark, pictorial or other descriptive matter, written, printed, stencilled, marked, embossed or impressed on, or attached to the packaging or container of food (article 2(2)i of the regulation 1169/2011). Food labelling means any words, particulars, trademarks, brand name, pictorial matter or symbol relating to a food and placed on any packaging, document, notice, label, ring or collar accompanying or referring to such food (article 2(2)j of the regulation 1169/2011).

The core rule of this regulation is mandatory food information in fourth chapter. According to the article 9 of the regulation 1169/2011 the following particulars shall be mandatory: the name of the food; the list of ingredients; any ingredient or processing aid listed in Annex II 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; the

quantity of certain ingredients or categories of ingredients; the net quantity of the food; the date of minimum durability or the 'use by' date; any special storage conditions and/or conditions of use; the name or business name and address of the food business operator referred to in Article 8(1); the country of origin or place of provenance where provided for in Article 26; instructions for use where it would be difficult to make appropriate use of the food in the absence of such instructions; with respect to beverages containing more than 1,2 % by volume of alcohol, the actual alcoholic strength by volume; a nutrition declaration. In addition to the particulars listed in Article 9(1), additional mandatory particulars for specific types or categories of foods are laid down in Annex III. The list must be read together with their detailed counterpart as fleshed out in section 2 (Articles 10 to 35) and the respective technical Annexes (I-XV) (Purnhagen, Schebesta, 2019). Regulation (EU) 1169/2011 allows for exemptions under three main categories: the list of ingredients, the nutritional declaration and the obligation to indicate the origin of raw materials for specific food categories (Marcotrigiano et al., 2018). Moreover, mandatory food information shall be available and shall be easily accessible for all foods (article 12 of the regulation 1169/2011). The mandatory particulars listed in Article 9(1) shall be printed on the package or on the label in such a way as to ensure clear legibility, in characters using a font size where the x-height, as defined in Annex IV, is equal to or greater than 1.2 mm. In case of packaging or containers the largest surface of which has an area of less than 80 cm^2, the x-height of the font size shall be equal to or greater than 0.9 mm (article 13 of the regulation no. 1169/2011). In addition, mandatory food information shall appear in a language easily understood by the consumers of the Member States where a food is marketed (article 15 of the regulation no. 1169/2011).

Voluntary food information are regulated by article 36 and 37 of the regulation no 1169/2011. Where food information referred to in Articles 9 and 10 is provided on a voluntary basis, such information shall comply with the requirements laid down for mandatory information (i.e. article 17 – 35 of the regulation no. 1169/2011). Food information provided on a voluntary basis shall meet cumulative the following requirements: (1) it shall not mislead the consumer, as referred to in Article 7; (2) it shall not be ambiguous or confusing for the consumer; and (3) it shall, where appropriate, be based on the relevant scientific data (article 36 of the regulation no. 1169/2011).

In order to clarify the rules including in the regulation no. 1169/2011, the European Commission adopted some notices, such as a Commission Notice on questions and answers on the application of the Regulation (EU) No 1169/2011 (2018/C 196/01); a Commission Notice on the application of the principle of quantitative ingredients declaration (QUID) (2017/C 393/05); a Commission Notice on the provision of information on substances or products causing allergies or intolerances (2017/C 428/01); and a Commission Notice on the application of the provisions of Article 26(3) of Regulation (EU) No 1169/2011 (2020/C 32/01).

Further food information are regulated by the special legislative acts. The regulation no. 1169/2011 shall apply without prejudice to labelling requirements provided for in specific Union provisions applicable to particular foods (article 1(4) of the regulation 1169/2011). According to this rule, we can consider the regulation no 1169/2011 as a general food labelling law and there are a number of special secondary legislative which regulate the food information in a special cases, such GM labelling, nutrition claims etc. The special law of food labelling includes:

- health claims regulated by the regulation (EC) No 1924/2006 on nutrition and health claims made on foods (NHCR);

- labelling of GM foods regulated by the regulation (EC) No. 1829/2003 concerns labelling of foods which contain or consist of GMOs or are produced from or contain ingredients produced from GMOs and regulation (EC) No 1829/2003 of the European Parliament and of the Council of 22 September 2003 on genetically modified food and feed;
- labelling of organic products regulated by regulation (EU) 2018/848 of the European parliament and of the Council of 30 May 2018 on organic production and labelling of organic products and repealing Council Regulation (EC) No 834/2007; Commission regulation (EC) No 889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control; and Commission regulation (EC) No 1235/2008 of 8 December 2008 laying down detailed rules for implementation of Council Regulation (EC) No 834/2007 as regards the arrangements for imports of organic products from third countries;
- food supplements regulated by directive 2002/46/EC on the approximation of the laws of the Member States relating to food supplements concerns information to consumer requirements about food supplements;
- food for specific groups regulated by regulation (EU) No 609/2013 on food intended for infants and young children, food for special medical purposes, and total diet replacement for weight control;
- gluten information regulated by the Commission implementing regulation (EU) No 828/2014 of 30 July 2014 on the requirements for the provision of information to consumers on the absence or reduced presence of gluten in food;
- country of origin regulated by Commission implementing regulation (EU) 2018/775 of 28 May 2018 laying down rules for the application of Article 26(3) of Regulation (EU) No 1169/2011 of the European Parliament and of the Council on the provision of food information to consumers, as regards the rules for indicating the country of origin or place of provenance of the primary ingredient of a food; regulation (EC) no 1760/2000 of the European parliament and of the Council of 17 July 2000 establishing a system for the identification and registration of bovine animals and regarding the labelling of beef and beef products and repealing Council Regulation (EC) No 820/97; commission implementing regulation (EU) No 1337/2013 of 13 December 2013 laying down rules for the application of Regulation (EU) No 1169/2011 of the European Parliament and of the Council as regards the indication of the country of origin or place of provenance for fresh, chilled and frozen meat of swine, sheep, goats and poultry; and Commission implementing regulation (EU) No 543/2011 of 7 June 2011 laying down detailed rules for the application of Council Regulation (EC) No 1234/2007 in respect of the fruit and vegetables and processed fruit and vegetables sectors;
- food additives, food enzymes and food flavourings regulated by regulation (EC) no 1331/2008 of the European parliament and of the Council of 16 December 2008 establishing a common authorisation procedure for food additives, food enzymes and food flavourings; regulation (EC) no 1332/2008 of the European parliament and of the Council of 16 December 2008 on food enzymes and amending Council Directive 83/417/EEC, Council Regulation (EC) No 1493/1999, Directive 2000/13/EC, Council Directive 2001/112/EC and Regulation (EC) No 258/97; regulation (EC) no 1333/2008 of the European parliament and of the Council of 16 December 2008 on food additives; and regulation (EC) no 1334/2008 of the European parliament and of the council of 16 December 2008 on flavourings and certain food ingredients with flavouring properties for use in and on foods and amending Council

Regulation (EEC) No 1601/91, Regulations (EC) No 2232/96 and (EC) No 110/2008 and Directive 2000/13/EC;

- novel food regulated by regulation (EU) 2015/2283 of the European parliament and of the Council of 25 November 2015 on novel foods, amending Regulation (EU) No 1169/2011 of the European Parliament and of the Council and repealing Regulation (EC) No 258/97 of the European Parliament and of the Council and Commission Regulation (EC) No 1852/2001; Commission implementing regulation (EU) 2017/2470 of 20 December 2017 establishing the Union list of novel foods in accordance with Regulation (EU) 2015/2283 of the European Parliament and of the Council on novel foods;
- other food information such as Directive 2009/54/EC on the exploitation and marketing of natural mineral waters; regulation (EC) No 1925/2006 on the addition of vitamins and minerals and of certain other substances to foods; regulation (EU) No 1308/2013 establishing a common organisation of the markets in agricultural products; regulation (EU) No 1379/2013 on the common organisation of the markets in fishery and aquaculture products; Regulation (EU) no 1151/2012 of the European parliament and of the Council of 21 November 2012 on quality schemes for agricultural products and foodstuffs; and Directive 2011/91/EU of the European Parliament and of the Council of 13 December 2011 on indications or marks identifying the lot to which a foodstuff belongs.

According to the list of EU secondary legislation related to the food labelling there is a question if the regulation no. 1169/2011 is able to receive its objective to ensure easier compliance and greater clarity for stakeholders and to modernise it in order to take account of new developments in the field of food information (point 9 of the preamble of the regulation no 1169/2011). On the one hand, it is very difficult for food producer or seller to be oriented in number of secondary legislation in relation to the food labelling. On the other hand, increasing consumer information is overloaded and there is a risk that the consumer will give up accepting further information. The current food labelling law need to be checked which information is really needed on consumers. Purnhagen and Schebesta (2019) proposed careful realignment of information provisions with insights of behavioural science.

3 Innovation of food labelling

Labelling is often preferred as a policy tool in such situations because it does not restrict a product from being marketed but it allows consumers to express their views through their purchases (Albert, 2010). Product information should be easily understood and be relevant to consumers in different markets. On the one hand new knowledge on the human nutrition increases the requirements on the lists of nutrients have increased and greater attention has been paid to listing nutrients in addition to the basic fats, protein and carbohydrates. Many countries require sodium, saturated fats, trans-fats, dietary fibre, sugar, cholesterol and a range of vitamins with the aim to provide consumers with as much information as possible (Hawkes, 2010). On the other hand, it means additional costs for food producers and increasing demand of knowledge on human nutrition for consumers. Moreover, consumers can feel overwhelmed by excessive information. In addition, information displayed in food labels is useful; however the way it is presented may decrease consumer interest and understanding (Moreira et al., 2021). Therefore, food companies, research institutes or non-profit organizations are trying to develop alternatives, e.g. labels depicting

nutritional information in a graphical form, smart labels and others modern communication technologies to communicate the food information to consumers.

Graphical format of nutrition labelling is a relatively new phenomenon in the western countries (Hawkes, 2010). Use of graphical nutrition labelling has been increasing in light of evidence that nutritional facts tables are insufficiently effective (Cowburn, Stockley, 2003). There are more types of graphical nutrition labels (Hawkes, 2010):

- traffic light labelling providing separate information on the key nutrients; however, it could create the impression that a food is good or bad;
- guideline daily amount labels developed by the the European food industry involves presenting the amount of energy and key nutrients in one portion of the food as a percentage of the 'guideline daily amount' in a graphical form;
- nutrition scoring systems, where the foods score is estimated using a system based on the presence of vitamins, minerals, fibre and/or whole grains and trans and/or saturated fats, cholesterol, added sugars and added sodium; e.g. Slovak University of Agriculture is one of the founding members of the Pro Nutri-Score Alliance which supports the introduction of nutrition labelling. The scheme classifies products according to their nutritional profile into five colour-coded categories and excels in clarity (SUA, 2021).
- calorie labelling as the labelling of calories on the front of food packages.

Smart labels is a term for any labelling that uses technology to add functionality and contents of packaging beyond traditional print methods, such as barcodes, QR codes, RFID (Radio-Frequency Identification) tags, sensing labels and a wide range of innovative new applications.

QR codes or quick response codes are mobile marketing tools which are able to overcome the labels limitations on the food products (Bacarella et al., 2015). Traditional linear barcode can hold only 20 characters; however, the two-dimensional QR barcodes can hold 7000 characters. Nowadays, QR codes are only a simple example of smart labelling. It allows consumers to scan the code with their phone to receive more information about a product than what the packaging included. However, current smart labels are more advanced and variable.

Another smart label for expanding information is RFID as radio frequency identification devices, which is able to carry much more data. Its principle is data transmission via radio waves. As these applications continue to prove their value, labels with additional functionality such as time-temperature, pressure, tilt monitoring and chemical sensing are emerging (Smits et al., 2012). RFIDs technology provides the information of food in order to avoid health implications, food allergies, or other dietary issues. The food products are provided with "smart" chips or "tags" that can be embedded or attached with it will provide the details about the food product by scanning microchip or smart tags (Moyeenudin et al., 2018). Implementation of such technologies in the food chains includes challenges and requirements that range from technical issues, such as Internet connection, storage requirements, device security, and government requirements and regulations, to those concerning consumer acceptance (Astill et al., 2019). RFID solutions in the retail sector handle sensitive information about consumers, whose behaviour will essentially depend on their perceptions of the level of security guaranteed by sellers and the government to communication systems (Novotny, et al. 2015). Mainly the acceptance of new technologies by consumers will be very important. According to the results of Hobbs et al. (2012) initial consumer acceptance of the technology is low, however, information matters and highlighting the problems of adulteration reduces resistance more effectively than providing positive technology information. Most

importantly, consumers will be more likely to accept RFID solutions that offer clear, tangible benefits for them (e.g. faster checkout, original and safe items) than ones that seem to be important for retailers only (Novotny, et al. 2015). The trend towards information and communication technologies in food labelling will continue in spite of the consumer distrust because the development of food sciences brings ever new information for human nutrition and human health.

Conclusions

To facilitate the development and use of food labelling, more understanding of good labelling practices is needed among governments, industry, civil society organizations and consumers (Albert, 2010). Food labelling is usually the first contact between food producers or sellers and consumers. There is a number of legislative rules in the EU law what requirements the producers need to fulfil. Moreover, there are many exemptions for particular food – stuffs. In addition, there is stipulated also the minimal font size. In many cases, it is not possible to provide all requirements of food labelling on the food packing. They must be larger and more waste is generated. On the other hand, there are different types of consumers in relation to the quantity and quality of food information. However, consumers usually do not have so much time to read all pieces of information stipulated by the law on the food packing in the shops when purchasing food. The food labelling innovations try to help to consumers and food producers as well. Graphical format of nutrition labelling could be able to provide nutrition information to consumer more effective. First, there are more comprehensible for majority of consumers. Secondly, it saves time to consumers to read much more information in small font size on the back-packing of food. The information and communication technologies are also able to help to both parties. Smart labels add contents of packaging beyond traditional print methods and reduce the amount of waste, which is one of the EU's objectives in the circular economy. There are barcodes and QR codes, where the quantity of information is very limited. RFID technologies and other new applications provide more space to provide all necessary information; however their use is only on the beginning and still accompanied by many legal problems such as personal data protection. However, new technologies could be helpful to food producer on the one hand and to consumers who are more data-intensive when purchasing food.

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SMALL DISTILLERIES FOR DISTILLATES AS A SPECIFIC BUSINESS IN THE SLOVAK REPUBLIC

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Abstract
The spirits industry represents a traditional branch of the food and beverage industry. It has a dominant position among all alcoholic beverages within the Slovak Republic if we compare consumption of pure alcohol per capita. We decided to investigate the position of distilleries for distillates as a specific form of distilleries defined within the Slovak legislation. We have found that these distilleries have only limited access to the market with spirits due to their limitation in raw materials allowed for the processing. This fact may considerably brake their further development. We also investigated other limitations that have a negative impact on these distilleries. We identified a minimum financial guarantee as one specific factor that influences access to the market from the side of new companies.

Introduction

The spirits industry represents a traditional branch of the food and beverage industry. The start mass production of spirits can be dated to 12th century (Hartmann and Schwarz, 2018) but the number of distilleries grew significantly during the industrial revolution. There were about 700 hundred commercial distilleries in 1848 (Nydrle, 1920).

The growing number of distilleries was stopped by the era of collective ownership introduced by the Communist party in 1945. Hundreds of distilleries were transformed into a few dozen large companies. This transformation brought also modernisation of production processes. Fruit as a basic raw material was substituted by starch-based raw materials.

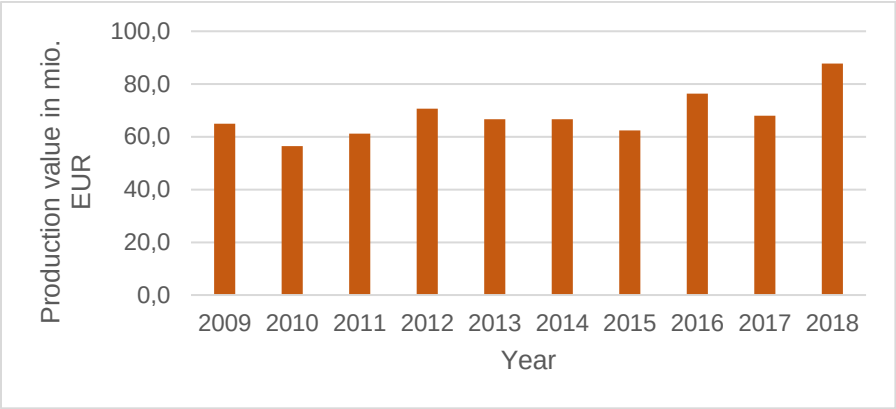
The global alcoholic beverages production is projected to 1 665,7 bln. USD in 2021 (Statista, 2021). The global spirits industry represents almost one-third of these abovementioned revenues (Statista, 2021). The EU is one of the key producents of alcoholic beverages. There are many traditional products protected by European[1] and International Law that support the competitiveness of the EU spirits industry on the global markets. The EU spirits industry generated revenues 29.6 mblnld. EUR in revenues in the year 2018 (Eurostat, 2021). These revenues were generated by 7 411 enterprises employing 61 14 employees (Eurostat, 2021).

Material and methods

Economics of the Slovak Spirits industry

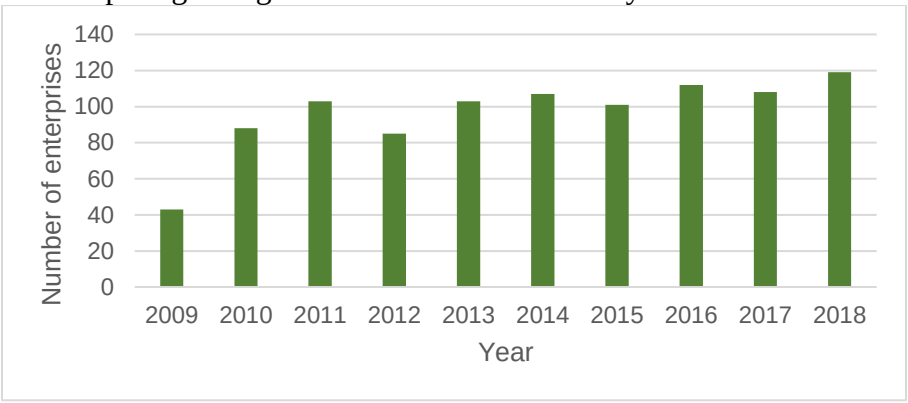
We investigated the economics of the spirits industry within the Slovak Republic, first. The main aim was to identify the position of the sprits production structure, exports, imports and the number of companies working within the Slovak spirits industry.

[1] Regulation (EU) 2019/787 of the European Parliament and of the Council of 17 April 2019 on the definition, description, presentation and labelling of spirit drinks, the use of the names of spirit drinks in the presentation and labelling of other foodstuffs, the protection of geographical indications for spirit drinks, the use of ethyl alcohol and distillates of agricultural origin in alcoholic beverages, and repealing Regulation (EC) No 110/2008



Graph 1: Total value of spirits production within the Slovak Republic between years 2009-2018 (in million EUR)
Source: EUROSTAT, processed by the author

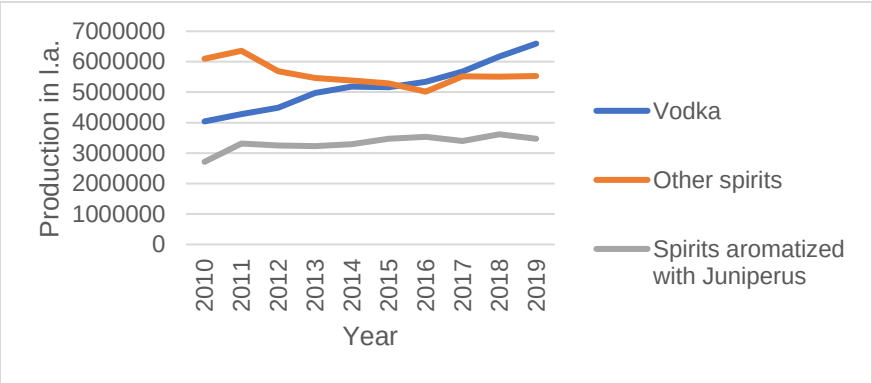
Our research was oriented on the production of the spirits of the Slovak Republic, first. As shown in graph 1, we have identified positive change when comparing the years 2009 and 2018. The production of spirits rose by 35% between these years and suggest that there is a positive trend in spirits production within the Slovak Republic. Unfortunately, there is relatively high volatility in production when comparing changes between each individual year.



Graph 2: Number of enterprises within the Slovak spirits industry
Source: EUROSTAT, processed by the author

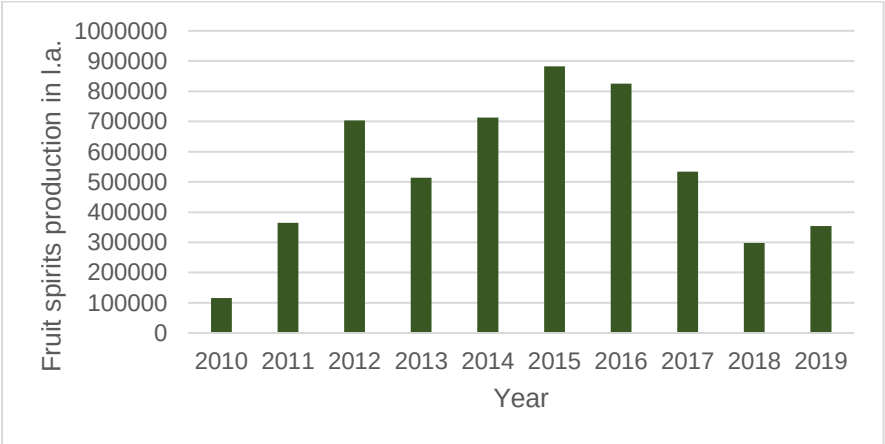
The number of companies doing business within the Slovak spirits industry has a positive trend if years 2009 and 2018 are compared. There were 119 companies within the Slovak spirits industry in 2018 compared to 43 in the year 2009. This may be contributed to the legislation change with the amendment of the Act No 467/2002 Coll. in the year 2008 when the financial guarantee was changed for distilleries for distillates from 20 000 000 SKK[2] to 2 000 000 SKK[2].

[2] 1 EUR equals to 30,126 SKK accoring to the Act No 659/2007 Coll. on the Introduction of the Euro in the Slovak Republic and on amendments and supplements to certain laws



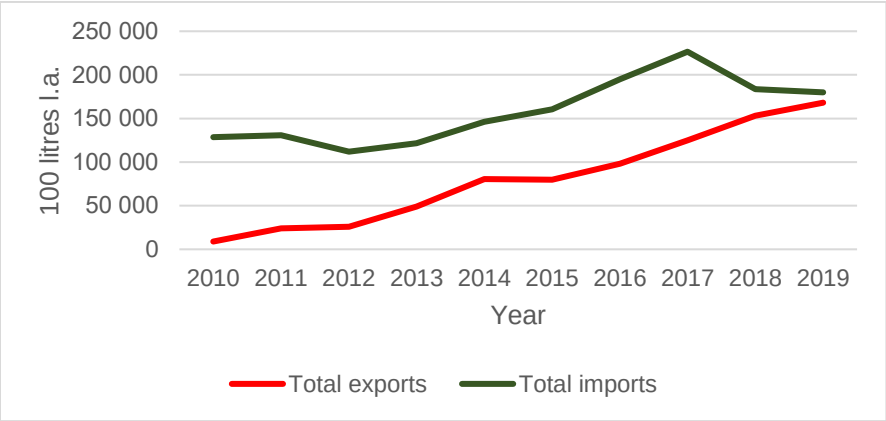
Graph 3: Production of the three most important spirits types within the Slovak Republic between the years 2010-2019 (in l.a.)
Source: Radela s.r.o., processed by the author

We conducted also research on the most important types of spirits produced (and also consumed) within the Slovak Republic. The main production is oriented on vodka, spirits aromatized with Juniperus and other spirits. The last category represents a wide variety of alcoholic beverages including some fruit spirits, spirits aromatized with artificial or natural flavours and others. From the abovementioned graph, we can clearly identify that the trend in production goes towards the production of vodka. There were produced 6 593 638 l.a. of vodka in the Slovak republic in the years 2018, compared to 4 039 892 l.a. in the year 2010. If we compare these two years, we see a growth in the amount of 63%.



Graph 4: Production of fruit spirits in the Slovak Republic between the years 2010-2019 (in l.a.)
Source: Radela s.r.o., processed by the author

Distilleries for distillates represent a specific form of distilleries with a relative restricted base of raw materials used for further processing. Until the year 2008, the production relied almost exclusively on fruit and grape. With the amendment of the Act No 467/2008 Coll. in the year 2008, the production extended also toward starch-based raw materials. This production is not been fully utilized until now and many distilleries produce spirits mainly using fruit and grape. We decided to analyse the potential of spirits made by the use of fruit. In the last observed year, fruit spirits production represented only 2% of the total spirits production in the country. This 2% represent accessible markets for distilleries for distillates.



Graph 5: Total imports and exports between the Slovak Republic and the EU (100 litres l.a.)
Source: EUROSTAT, processed by the author

In order to identify the competitiveness of the Slovak spirits industry, we decided to compare export and import of the observed commodity. As we can clearly see from the above-mentioned graph, there is considerable growth in export during the observed years 2010 and 2019. If we compare individual types of spirits, we can identify only one category of spirits with exports higher than imports. This situation was observed with vodka when exports were higher than imports for the first time in the year 2019.

Legislative limitations for small distilleries

Legislation regulating production and selling of spirits is stipulated by the Act No. 467/2002 Coll. on the production and distribution of spirit into the market, as amended which repealed the act No. 289/1996 Coll. on the production and circulation of alcohol and on the amendment of Act no. 455/1991 Coll. on Trade Licensing (Trade Licensing Act), as amended. Small distillery as a special type of distillery was recognized already by the act No. 289/1996 Coll. published on October 15th 1996. The small distillery was identified as „Distillery for fruit spirits" and was defined as a distillery which processes fruit, fruit and grape wines, junipers and waste from wine production and fruit processing as basic raw material; the production plant is arranged so that the distillation is connected directly to the rectification.

Distilleries for fruit spirits were regulated by the same provisions as all other types of distilleries defined by the Act No. 289/1996 Coll. The act 467/2002 was published on August 9th 2002. The basic definition of the distillery for fruit spirits remained unchanged. This type of distillery was regulated by the same provisions as all other types of distilleries in this act, too. This caused a significant limitation for businesses to enter the production of fruit spirits. The policymaker brought a new requirement in the form of a financial guarantee. Distilleries were obliged to prove that they possess a financial guarantee in the amount of 20 000 000 SKK[3]. Thus, distilleries for fruit spirits were regulated by the same provisions as large distilleries producing spirits from starch-based raw materials, which led to higher financial requirements during the establishment and operating distilleries for fruit spirits. On one hand, these manufacturing facilities were regulated by

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the types of spirits that were allowed to produce within their premises but on the other hand, there was little or no advantage in requirements for the establishment and running of the distillery.
A significant change was brought by the Act No 279/2008 Coll. amending Act no. 467/2002 Coll. on the production and marketing of alcohol, as amended, and on the amendment of Act no. 105/2004 Coll. on excise duty on alcohol and on the amendment of Act no. 467/2002 Coll. on the production and marketing of alcohol, as amended by Act no. 211/2003 Coll. as amended. This amendment to the Act No 467/2002 Coll. brought changes both in the definition of the distillery for fruit spirits and minimal financial guarantee required for the establishment and running of this type of distillery.
The distillery for fruit spirits was renamed into the distillery for distillates. This change in the name also brought a wider range of spirits that were allowed for production within this type of distillery. According to the new definition distillery for distillates represents distillery which processes as its raw material fruit, fruit wines, grapes, waste from wine production and fruit processing, as well as junipers, beets, cereals, honey, chicory or beer for distillates and puts them in consumer packaging; the production plant is not used for the production of raw alcohol or refined alcohol.
Requirements for the financial guarantee were eased, too. According to the new stipulation in the § 3 section 12 of the Act No 467/2002 Coll., distilleries for distillates are obligated to prove financial guarantee in the amount of 2 000 000 SKK[1] compared to 20 000 000 SKK[1] in the previous regulation. This allowance in the financial guarantee also brought a new element in limitations set for distilleries for distillates. Financial guarantee in the amount of 2 000 000 SKK[1] is valid only for those distilleries for distillates that produce 35 000 l.a. of spirits or less during one calendar year.

<u>Current limitations influencing further development of small distilleries for distillates</u>
Based on the overview of the current economics and legislative environment of sprits production we would like to highlight the most important elements which shape the current competitiveness of distilleries for distillates. The business environment in the spirits industry is highly regulated and influenced by the legislation adopted by policymakers at both, the EU level and national level. We will focus on adopted legislation and its sections that directly influence the competitiveness of distilleries for distillates on the national and international market.

1. Limitation in types of spirits produced.

According to the § 2 section 3 c) of the Act No. 467/2002 Coll., distilleries for distillates are allowed to process as a raw material:

- material fruit,
- fruit wines,
- grapes,
- waste from wine production and fruit processing,
- junipers,
- beets,
- cereals,
- honey,
- chicory,
- beer.

This abovementioned regulation relatively strictly creates an accessible market for small distilleries for distillates. Thus, the most important product for these distilleries is fruit and grapes brandy

(including junipers). However, this does not represent even 2% of the total spirits market within the Slovak Republic. Distilleries for distillates are not allowed to process neutral ethyl alcohol and produce vodka, spirits aromatized with junipers or liqueurs (sweet or bitter). The first two abovementioned types of spirits represented almost 60% of the total spirits production within the Slovak Republic in the year 2019.
The second part of the § 2 sections 3. c) of the Act No 467/2002 Coll. also stipulates that distilleries for distillates are producing distillates from the abovementioned raw materials and put them directly to consumer packaging. This regulation does not allow to mature spirits. This regulation does not allow to add value to previously processed raw materials like fruit, grapes and cereals when the presentation of these products is regulated within the EU territory by the on the definition, description, presentation and labelling of spirit drinks, the use of the names of spirit drinks in the presentation and labelling of other foodstuffs, the protection of geographical indications for spirit drinks, the use of ethyl alcohol and distillates of agricultural origin in alcoholic beverages, and repealing Regulation (EC) No 110/2008.

2. Financial guarantee for establishment and running of the distillery

Adoption of the Act No 467/2002 Coll. brought significant limitations in conducting business in the field of spirits production in the year 2002. All distilleries producing spirits for final consumption were regulated in the same manner when entering the market of spirits production. The policymaker set a financial guarantee in the amount of 20 000 000 SKK[4] significantly overpricing the cost of spirits production, especially for small distilleries with limited financial resources. Later, by amendment of the Act No 467/2002 Coll., the policymaker made the correction and set the obligatory minimum financial guarantee in the amount of 2 000 000 SKK[3] in the year 2008. This new regulation also brought limitation in production in the amount of 35 000 l.a. If the distillery for distillates surpasses this production, it is obligated to prove available financial guarantee in the amount of 20 000 000 SKK[3].
The current legislation regulating the minimal amount of financial guarantee is one considerable element when entering the business with spirits production.

Conclusion

The research objective of the manuscript targeted the current situation of distilleries for distillates. This specific type of distillery is regulated by the act no 467/2002 Coll. which sets specific rules for doing business by these abovementioned distilleries on the Slovak market. First and relativity strict restrictions were set by the structure of allowed raw materials for processing and minimum financial guarantee. These restrictions were eased by the policymaker in the year 2008 when further raw materials were allowed for processing and the minimum financial guarantee was changed to 2 000 000 SKK[3] for distilleries for distillates producing 35 000 l.a. or less.
Our calculations show that despite easement in the rules set for distilleries for distillates there are still limitations significantly reducing the capability of entrepreneurs to enter and success on the Slovak spirits market.
The first disadvantage is the structure of allowed raw materials for further processing within investigated distilleries. First, the production of spirits was restricted mainly to fruit and grape spirits but later the policymaker added to allowed raw materials cereals. This action opened new possibilities to distilleries for distillates. But still, our calculations show that despite this change,

4 1 EUR equals to 30,126 SKK accoring to the Act No 659/2007 Coll. on the Introduction of the Euro in the Slovak Republic and on amendments and supplements to certain laws

investigated distilleries have access only to less than 2% of the total spirits market within the Slovak Republic. The policymaker should adopt a change in the current legislation allowing distilleries for distillates to process also neutral ethyl alcohol and mature their products in order to add further value to their end products.

The second limitation set for distilleries for distillates is the minimum financial guarantee. This requirement is not a standard part of legislation in the area of spirits production when comparing other legislative act regulating this area of business in nearby European countries. The policymaker has also other possible options when securing a potential financial debt of distilleries. One solution could be a more exact overview of annual financial statements of distilleries or a minimum financial guarantee set as average monthly production based on the previous production.

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A REVIEW: CONTENT OF LEAD AND CADMIUM IN MILK AND DAIRY PRODUCTS FROM EUROPEAN COUNTRIES

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Abstract

The purpose of this article is a brief overview of the current situation about contamination of milk and dairy products with toxic heavy metals – cadmium and lead in selected European countries. Concentrations of cadmium and lead in products from five countries: Slovakia, Croatia, Poland, Turkey, and Italy were compared in this article. Milk and dairy products are an integral part of human nutrition with numerous favorable health effects. The nutritional value of milk has been recognized since ancient times. On the other side, due to the higher level of non-ecological industrialization from the recent past, milk can be associated not only with benefits but also with risks. One of the most common sources of exposure to heavy metals for humans is food. Fortunately, recent studies show that consumption of milk and dairy products from Europe can be considered safe and the levels of toxic metals have a declining character. Regular monitoring of the current situation is however recommended.

Keywords: milk, dairy products, heavy metals, lead, cadmium, environmental contamination, food safety, Europe

Introduction

Milk and dairy products are quite important dietary sources of nutrients, such as proteins, essential fatty acids, and minerals. In addition, they are easily accessible and affordable, which makes them significantly important food ingredients (Totan and Filazi, 2010). Consumption of dairy products is recommended on daily basis by world institutions like FAO, UNESCO, WHO, and the exact number of portions are set by national recommendations according to its availability in the region, quality of products, environmental pollutions and adapted to customs and eating habits of natives (Castro Gonzales et al., 2017). The average milk consumption around the globe is 100 kg/ year/ person. The content of nutrients in milk varied from animal species and breeds to the stage of lactation, environment, provided diet (Bansal, 2020). The role of milk is even more important in children's nutrition, pregnant and breastfeeding women nutrition and nutrition of older. Consumption of milk and dairy products, mainly fermented dairy products has a preventive effect on cardiovascular diseases, osteoporosis, diabetes, decreases the risk of obesity (Clark et al., 2020, Lu et al., 2016). On the other side children, pregnant and breastfeeding women, seniors belong to risk groups in terms of susceptibility to contamination with heavy metals and milk potentially could be a source of them (Pšenková and Toman, 2021). The biological accumulation of heavy metals in lactating animals can unfavorably affect the quality of milk and dairy products. The content and the amount of heavy metals in milk which potentially can have toxic effects depends on many factors - similar or the same as mentioned above about content of nutrients, such as the lactation period of animal species, composition of the animal diet, and its seasonal variations, climatic conditions, and contamination of the environment (Bansal, 2020).

Negative health effects of exposure with cadmium and lead

Cadmium is a highly toxic element and the main route of exposure is contaminated water or food. It accumulates in the liver, kidneys, muscles and even a low exposure has for children very toxic effect and can cause serious disorders (Bocquet et al., 2021).

Lead can cause poisoning, but the prevalence of lead poison is falling. Nowadays 65 % of lead exposure in children comes from food – with the highest concentrations in water, cereals, milk, vegetables, meat, fish, and chocolate (Bocquet et al., 2021).

Table 1 shows unfavorable health effects possibly caused by high exposure to lead and cadmium.

Table 1 Negative health effects or diseases caused by an excess of cadmium and lead (Bansal, 2020).

Metal	**Effects/ Diseases**
Cadmium	DNA repair disruption, tumor suppressor proteins → carcinogen effect disruption of the mineral balance in the body, decreased absorption of calcium→ osteoporosis, kidney stones, endocrine disruption, neurodevelopmental toxicity, anemia
Lead	Reactive oxygen and DNA repair disruption → carcinogen, fatigue, anemia, low appetite, weight loss, infertility, miscarriages, delayed mental development in the children, disrupts the metabolism of minerals (Fe, Zn, Cu) and vitamin D; disrupts the biosynthesis of hemoglobin, hepatotoxicity, nephrotoxicity

Content of cadmium and lead in milk and dairy products from selected European countries

Slovakia

Since concentrations of toxic metals in Western Slovakia, in the region with the slightly disturbing environment was recorded in the soil and infeed of sheep, the content of cadmium and lead in sheep's milk were below LOQ in this work as we can see also in table 2 (Pšenková and Toman, 2021). By Antunovič et al. (2005) milk of ewes contains very low concentrations of toxic elements in general. Their excretion from sheep organisms to milk is very low (Houpert et al., 1997). Despite the fact milk comes from a monitored area with environmental contamination, the low concentrations of heavy metals indicate it is safe to use this milk for direct consumption or further food processing (Pšenková and Toman, 2021). Similar results showed also previous studies in different regions in Slovakia, for example in Čečejovce (which is categorized as the area with a highly disturbed environment) with the need for regular monitoring of current concentrations of heavy metals in cow´s milk. (Pšenková et al., 2020).

Italy

In the study by Barone et al. (2018) cadmium was detected in 66.7 % samples of fresh cheese with mean concentrations of 0.002 μg/g. The mean content of cadmium in hard cheeses was 0.004 μg/g. By Miedico et al. (2016) concentrations of lead and cadmium in milk samples are significantly lower than in previous studies or compared to studies from other countries as Iran or Turkey.

Croatia

In milk samples from Central and Eastern Croatia, cadmium concentrations were not detected (below the LOD of 3 micrograms per kilogram). In the Southern region, Cd was detected in only 3% of milk samples and Croatian Littoral and Mountain Croatian regions (CL-MC regions) in 6,1 % of milk samples. Mean Cd levels were 12 and 16 μg/kg. In regions with the content of cadmium in milk, samples are higher cadmium concentrations in soil. A similar trend we can observe with a concentration of lead while in milk samples from Eastern or Southern Croatia lead concentrations were not detected. In Central and CL-MC regions lead was measured in only 4.7 % and 12 % of milk samples with almost identical means 7.1 and 7.2 μg/kg. In relative to previous studies in Croatia, these results show a significant improvement and reduction of concentrations of cadmium and lead in consumable milk (Bilandžić et al., 2021).

Turkey

Bigecu (2016) in his study in Turkey found out that the highest lead concentration in milk samples was in the Sakirbey region which is close to highways. Lead emission from leaded fuel of vehicles caused accumulation of lead on pasture lands of this region. Lead concentrations in cow´s milk samples were higher than the maximum permitted level in the Codex standard. Heavy traffic contributes to higher contamination of cadmium, which is also in Turkey present in milk in excess (Bigecu, 2016).

Poland

In a Polish study (Sujka et al., 2017) the highest content of lead was in cheese spreads and cottage cheeses from the industrial region. The permissible level of lead was exceeded 10- fold in consumable milk from Silesia. This study showed the correlation between the level of industrialization of a region and the content of lead in dairy products. The highest content of cadmium was found in yogurt from the same region, Silesia, and in cheese spread from the less industrial Lublin region.

Table 2 Content of cadmium and lead in milk and dairy products from various countries in Europe.

Sample	**Place of collection**	**Cd**	**Pb**	**Reference**
Sheeps milk	Slovakia	*<0.004 *μg/g*	*<0.10 *μg/g*	Pšenkova and Toman, 2021
Hard cheese	Italy	0.004±0.001 *μg/g*	0.13±0.001 *μg/g*	Barone et al., 2018
Fresh cheese		0.002±0.002 *μg/g*	0.07±0.04 *μg/g*	
Milk		0.820 *μg/g*	4.70 *μg/g*	Miedico et al., 2016
Raw milk	Central Croatia	x	7.1±3.7 *μg/kg*	Bilandžić et al., 2021
Milk	Turkey	0.124±0.11 mg/L	1.011±0.36 mg/L	Bigucu et al., 2016
Milk	Poland (Industri	0.000±0.00 mg/kg	0.234±0.079 mg/kg	Sujka et al., 2017

Kefir	al region)	0.0007±0.0002 mg/kg	0.004±0.000 mg/kg	
Cottage cheese		0.000±0.000 g/kg	0.380±0.060 mg/kg	

*Concentrations are below the limit quantification (LOQ).

Conclusion

Milk is an important food source, rich in nutrients, its consumption positively impacts health status and helps prevent various health issues. However, the content of heavy metals can counterbalance these benefits and even negatively affect human health.

Studies clearly show the correlation between the level of concentration of lead and cadmium in raw material – milk and the level of industrial activity in areas where milk comes from. Comparison of results indicates consumption of milk and dairy products from Europe is relatively safe from the view of exposition of cadmium and lead and content of this elements has a declining trend. Review shows the difficulty to obtain the multifactorial aspect of food safety-related in consumption of milk and dairy product. Moreover, continuous monitoring (not just) of environmentally disturbed areas and data collections is recommended for current and updated evaluating the potential risk of consumption of milk and dairy products.

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AN ASSOCIATION OF ENVIRONMENTAL FACTORS WITH *DIABETES MELLITUS*: VIRUS INFECTION

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Abstract
In this brief review we are discussing recent literature focused on an association of virus infection with metabolic disorder – Diabetes mellitus. Diabetes is a multi-factorial autoimmune disease determined by the interaction of genetic, environmental, and immunologic factors. One of the environmental factors is virus infection, which has the potential to be involved in the development of diabetes, through specific mechanisms.

Keywords: Diabetes mellitus, virus, infection, Coxsackievirus B

Introduction

Regulation of insulin expression by pancreatic β-cells ensures glucose homeostasis. In the event of dysfunction or metabolic changes, blood sugar levels increase, and Diabetes mellitus (DM) develops (Ilonen et al., 2019; Talchai et al., 2012). The type 1 (DMT1) and 2 (DMT2) are among the most common and increasing types of diabetes. The nature of diabetes is thought to be influenced primarily by genetic, environmental and lifestyle factors (Billings and Florez, 2010). Viral infections that fall under environmental factors can cause diabetes. However, the induction of hyperglycaemia has only been observed in some animal models and there is still no direct association between viruses and human diabetes (Mason and Alexander, 2001). The aim of this review is summarizing available literature on viral infections in relation to Diabetes mellitus.

Viral infection as a risk factor for diabetes

In DMT1, autoimmune damage to pancreatic islet β-cells occurs, ultimately leading to hypoinsulinemia and hyperglycaemia. In patients with DMT2, abnormal glucose metabolism occurs primarily because of increasing age associated with obesity. Compared to the DMT1, there is a little evidence to suggest that immune destruction of β-cells would lead to the development of DMT2 (Steppan et al., 2001). It is difficult to assess whether a viral infection is a cause or a consequence of the prevalence of DM, as DM adversely affects the immune response. However, there is a lot of evidence that the infection affects insulin sensitivity. One of the most common viruses that reduce insulin sensitivity is influenza A, cytomegalovirus, and herpes simplex (Sestan et al., 2018; Fernandez-Real et al., 2006). DMT1 is associated with a large number of viruses, especially enteroviruses, including Coxsackievirus B (CVB), but also rotavirus, mumps virus and cytomegalovirus (Hyöty and Taylor, 2002; Honeyman et al., 2000; Hyöty et al., 1988). If an individual is exposed to a viral infection, stops eating, feels weak because of the immune system changes normal endocrine regulation of key metabolic processes in organism. In response to the viral infection, the physiological changes in metabolism can trigger permanent deregulation of blood glucose levels (American, 2018). Viral infection induces production of IFN-γ and causes insulin resistance of myocytes by downregulating insulin receptor transcription (insulin resistance of muscle). To compensate for increased insulin resistance of muscles, the pancreas increases insulin secretion, leading to hyperinsulinemia and the patient developing sustained glucose intolerance (Figure 1) (Kiernan and Maclver, 2018). There is currently insufficient evidence as to

whether acute viral infection is a risk factor for DMT2, but recently data suggest that most of these are chronic viruses that are behind the development of DMT2. Moreover, regarding acute viruses and the association with DMT2, a global initiative has recently been launched to address SARS-CoV-2 and DM (Rubino et al., 2020; Yoo et al., 2019).

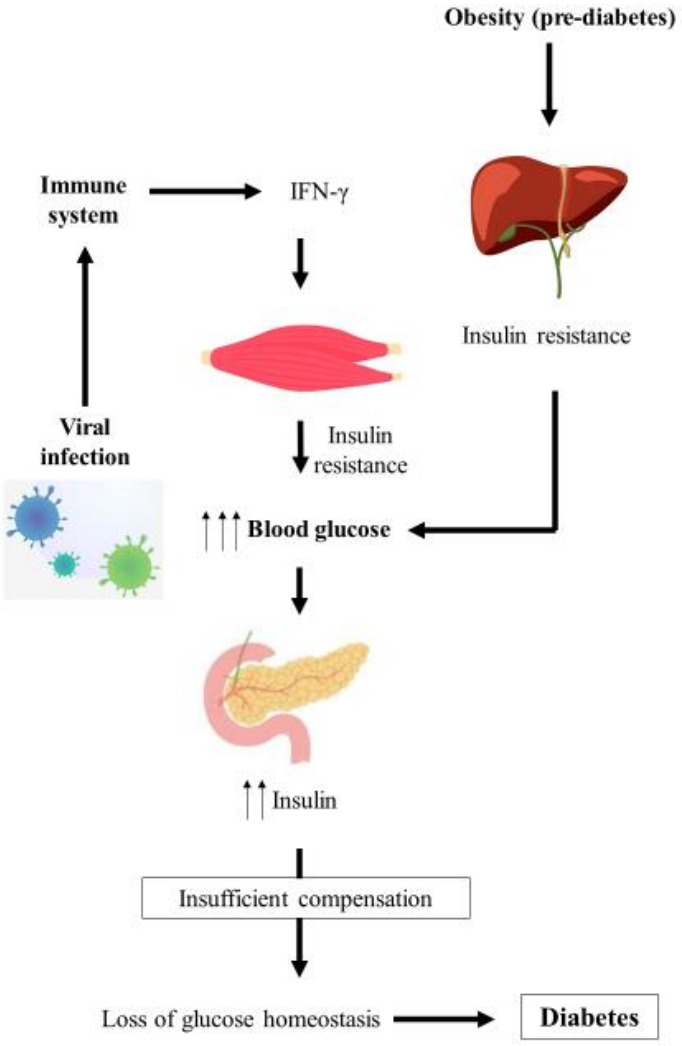

Figure 1. The mechanism by which viral infection promotes diabetes (Modified according to Kiernan and Maclver, 2018)

Coxsackievirus B as a trigger for diabetes

CVB belongs to the genus Enterovirus of the Picornaviridae family. CVB is a small, non-enveloped RNA virus and its role is developing the chronic disease such as chronic myocarditis and DMT1 (Hober and Sauter, 2010). Enteroviruses act as environmental factors involved in the development of DMT1. CVB might initiate the autoimmune process and contribute to progression from islet autoimmunity to clinical DMT1 (Krogvold et al., 2015). The role of CVB in the onset of DMT1 has been addressed both in vivo and in vitro using animal models. Virus targets β-cells to promote

inflammation and innate immunity, resulting in β-cell damage (Beeck and Eizirik, 2016). The persistent enterovirus infection, instead of acute lytic infection, is the key factor that induces the production of type 1 interferons and other pro-inflammatory cytokines, which contribute to the initiation of autoimmune destruction of β-cells in humans (Hober and Sauter, 2010). The presence of anti-CVB-4 activity in the saliva of patients with DMT1 may be a useful marker for studying the role of CVB in the pathogenesis of DM, as confirmed by a study of Badia-Boungou et al. (2017). Furthermore, CVB in pancreatic tissue has been demonstrated using the application of the short fluorescent labelled oligonucleotide probes proving the direct role of CVB in genesis of the diabetes (Busse et al., 2017). The solution and prevention of DMT1 may involve the use of CVB serotypes in the form of vaccines. However, there are no available commercial vaccines, and everything is still the subject of current research (Stone et al., 2018). To conclude data further studies are needed to establish the role of CVB in pathogenesis of DMT1, because of its potential as enteroviral vaccine for preventing DMT1 (Manderwand, 2017).

Conclusions

Diabetes mellitus is a metabolic disease in which several factors are involved. One of the factors is environment, including viral infections. There are several viruses that are associated with the onset of diabetes. The best known are enteroviruses, of which the Coxsackievirus B is involved in the development of diabetes, through an inflammatory mechanism. Proper understanding of the mechanism can lead not only to clarifying the onset of diabetes but also to finding a suitable treatment for diabetes.

Acknowledgements

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THE MYCOTOXIN CONTAMINATION: PROBLEM FOR ANIMAL AND HUMAN HEALTH

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Abstract
Mycotoxins are defined as secondary metabolites produced by fungi causing acute and chronic adverse effects in humans and animals. Evidence suggests that some mycotoxins or mycotoxin derivatives can be used as antibiotics or growth promotion agents. But, the most mycotoxin exposures are chronic generating irreversible effects as immune suppression or cancer. It is known, that acute poisoning can be lethal. Various mycotoxins can cause different complications; they can be genotoxic, immunotoxic, allergenic, carcinogenic, mutagenic or teratogenic. This review focuses on the most known mycotoxins linked with human and veterinary diseases.

Keywords: mycotoxins, global problem, human and animal health, contamination, prevention

Introduction

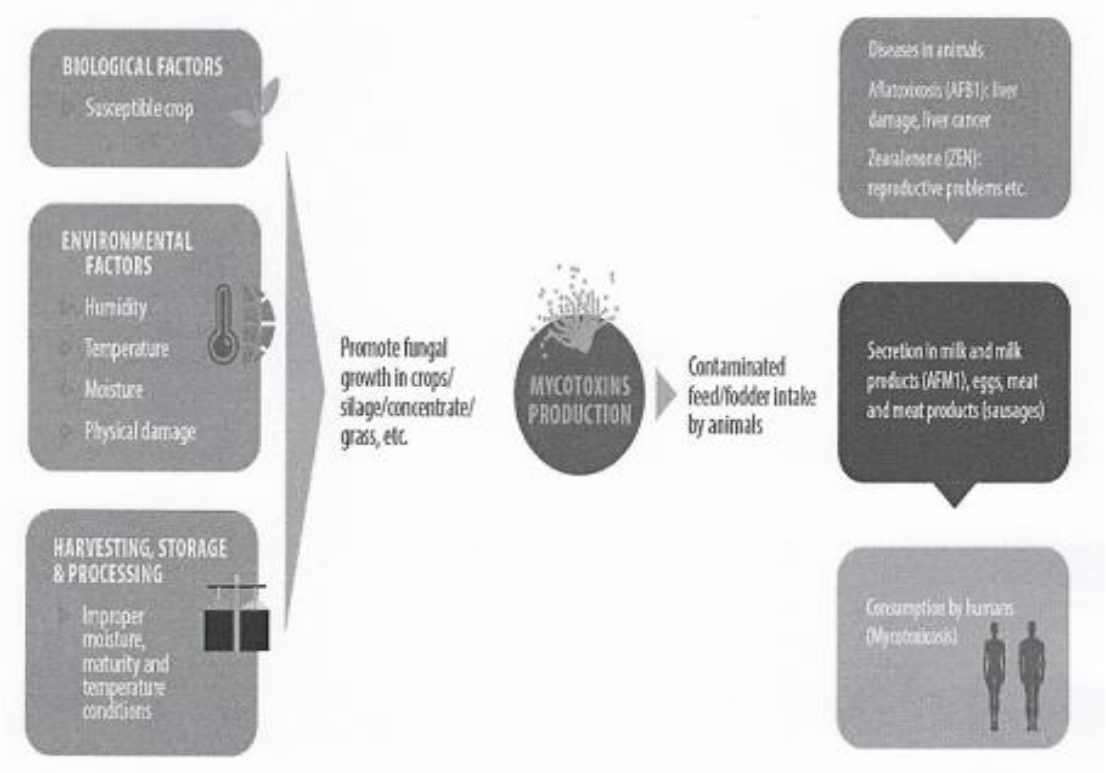
The term mycotoxin comes from "mykes" meaning fungi and "toxicon" meaning poison. Mycotoxins are defined as secondary metabolites with low molecular weight generated by a wide range of fungi, mainly molds. Among the mycotoxins listed to this main group belong the aflatoxins, fumonisins, deoxynivalenol, zearalenone, ochratoxin, T-2 toxin and certain ergot alkaloids. Animals and human are exposed to mycotoxin via inhalation, food or skin contact which can lead to number of illnesses (e.g. kidney and neurological diseases, cancer). Diseases related to mycotoxins are named as mycotoxicoses (Huong et al., 2016; Deepa et al., 2019; Sun et al., 2020). Classification of these toxins may be done on the basis of toxicity and clinical symptoms linked to the damaged organs (Tab. 1). Inputs facilitating the production of mycotoxins in contaminated products involve environmental temperature (22-30ºC), moisture content (20-25%), composition of food, relative air humidity (70-90%), pH, quality of cereals, and presence of mold spores (Fig. 1). Soil and air create natural environments for specific mould species. Mycotoxins are mainly present in cereal (wheat, corn, feed), seeds and spices. When animals are fed with mycotoxin-contaminated feed it can subsequently accumulate in their tissues and products as eggs, milk, or meat (Xu et al., 2019; Hou et al., 2020). Mycotoxin contamination is an inevitable and unpredictable problem because of its resistance to high temperatures and chemical or physical treatments. Hence, standard cooking is not enough for mycotoxin removal (Alshannaq and Yu, 2017).

Table 1.Classification of mycotoxins on the basis of toxicity

MYCOTOXINS		
HIGLY TOXIC	**SEVERELY TOXIC**	**ALL OTHER MYCOTOXINS**
(lethal at 1-10 $mg.kg^{-1}$ body weight) Trichothecenes Aflatoxin B_1 Citreoviridin	fatal even<1 $mg.kg^{-1}$ body weight) Rubratoxin B Cyclochilorotine	(toxic>10 $mg.kg^{-1}$ body weight)

(Janik et al., 2020)

Figure 1. Mycotoxins production and their occurence in the food chain



(Janik et al., 2020)

Mycotoxins as a global problem

A global problem is mycotoxin indoor environment contamination mainly in less technologically developed countries. Mycotoxins have been the cause of epidemics in humans and animals for the last 30 years (John and Miller, 2017). Cereals present a main source of mycotoxins in human and domestic animals' nutrition. **Ergot alkaloid** intoxication, known as ergotism, was very common in the Middle Ages in Central Europe. From the 9th to 14th century, the outbreak of ergotism was prevalent in the eastern regions of Germany, France and Russia. In the early 1960s the revelation

of aflatoxins started when a total of 100,000 turkeys died by unknown turkey "X" disease in England. The disease was allied to Brazilian groundnut meal contaminated by *Aspergillus flavus*. The toxin was named *Aspergillus flavus* toxin-**aflatoxin**. Aflatoxins show the highest importance in agricultural industry. Until now, a total of 20 aflatoxins have been described. Aflatoxins B_1, B_2, G_1, and G_2 are the most significant. Contamination by aflatoxins became a global health problem. Zearalenon (**ZEA)** possesses an estrogen-like effect on the reproductive function of animals. It also harms the liver and kidneys and decreases immune function which results in cytotoxicity and immunotoxicity (Hueza et al., 2014). **T-2** mycotoxin can cause Kashin–Beck disease which etiology is still unclear. In 1962, poisonous fungi were found in Egyptian ancient tombs and mummies. It is concluded that fungi were responsible for the deaths of people involved in the discovery of the Tutankhamen tomb (Łukaszuk et al., 2015). **Deoxynivalenol** (DON, vomitoxin) is mostly produced by *Fusarium graminearum* and *F*. *culmorum* (Kushiro 2008, Tian et al., 2016). These fungi grow on field crops and cause a disease called *Fusarium head blight* (FHB). **Patulin** is defined as a natural contaminant of vegetables and fruits, including apples, apple-derived products, grapes, plums, pears, pineapples, peaches, and tomatoes. Principally, patulin contamination is linked to blue and soft rot, predominantly caused by *P*. *expansum*. Humans are exposed to this toxin through intake of contaminated food and beverages (Adeyey, 2016). Surprisingly, in Belgium organic apple juice reveals higher levels of toxin in comparison to conventional juices. In Portugal, 23% of apple-derived products and 69% of rotten apples are contaminated with patulin (Zhu et al., 2015; Tang et al., 2019). Mycotoxins have a definitely negative effect on human or animal health and they can even cause death. **Ochratoxins**, produced by *Penicillium*, *Fusarium*, and *Aspergillus* species, are present naturally in many plant products such as cereals, beans, coffee, pulses, and dried fruits (Gizachew et al., 2019). It has been found in maize and rice samples from west Africa, mainly Nigeria (Zhang etal., 2016). Ochratoxin is responsible for nephropathy in humans (Bragulat et al., 2019); it is also suspected to cause the cause of Tunisian nephropathy and human Balkan endemic nephropathy (BEN) (Chen, and Wu 2017); Nogaim et al., 2020).

Prevention and control of mycotoxins in foods include:

•inspection of whole grains (mainly corn, sorghum, rice, wheat), dried figs, nuts (peanuts, pistachio, almond, walnut, coconut, Brazil nuts and hazelnuts) which are frequently contaminated with aflatoxins;

•improvement of grain quality before and during drying, in storage, as damaged grain is more prone to invasion of moulds and subsequently to mycotoxin contamination;

•freshness of grains and nuts;

•proper storage of foods - free of insects, dry, and not too warm;

•a diverse diet (EFSA, 2017).

Conclusion

Human exposure to mycotoxins is common because of food and feed contamination. Fungal contamination means a serious hazard to human and animal health. Depending on dose and time of exposure it can result in many illnesses. A main effects of mycotoxin exposure on the human organism is presented in table 2 . In addition, contamination of crops with mycotoxins contributes to notable economic losses (Mitchell et al., 2016).

Table 2. Healt effects of mycotoxin

MYCOTOXIN PRODUCTION T-2, AFB1, ZEA, OTA, DON, PATULIN	
HEALT EFFECT	
NEUROTOXICYTY	inhibition of astrocyte proliferation and differentiation, reducing glutamate absorption by astrocytes, ROS generation, cell apoptosis, changing in the concentration of neurotransmitters
HEPATOTOXICYTY	disruptions in bile acid metabolism, lipid accumulation in the liver, increasing the concentration of malondialdehyde, upregulation of the Caspase-3 and Bax apoptotic genes
IMMUNOTOXICYTY	decreasing the production of IL-2 and the expression of plasma IFN-γ, upregulation the mRNA expression of IL-1β, IL-6 and TNF-α, increasing a number of monocytes, NK cells and cytotoxic T cells, decreasing a number of lymphocytes and peripheral blood leukocytes
NEFROTOXICYTY	ROS generation, mitochondrial anion superoxide generation induction, p38 and JUN kinase activation
DERMAL TOXICYTY	necrosis, erythema
GENOTOXICYTY	DNA mutations, RNA, DNA and proteins synthesis inhibition, cellural function s disorders, modification in DNA methylation

(Janik et al., 2020)

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THE INFLUENCE OF ENVIRONMENTAL FACTORS ON THE DEVELOPMENT OF CATARACTS

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Abstract
Cataract is known as one of the leading causes of preventable blindness worldwide, results from lens degradation that leads to blurry vision. Because the majority of the population has limited access to cataract surgery, it is very important to identify the risk factors for its prevention and treatment. Environmental factors like toxic gases, pollutants, chemicals, smoking, drugs, ultraviolet radiations and others can lead to a plenty of eye disorders. Chronic exposures to toxic pollutants present in air, water as well as in soil can damage the eye in various ways. In addition to providing an overview of the pathophysiology of cataracts in this review, we would focus on the role of environmental factors on the development of cataracts.

Key words: cataracts, lens, environmental factors

Introduction

WHO's epidemiological data show that more than one billion people worldwide suffer from a visual impairment, of which about 94 million have cataracts (WHO, 2019). Cataracts thus remain the main cause of blindness in the world in the third millennium, despite all efforts to reduce its spread (Kuchynka, 2016; Heruye, 2020). As the average life expectancy increases worldwide, so does the number of people suffering from cataracts. Only the population of the most developed countries in the world has unrestricted access to surgical treatment, and remains inaccessible to majority people on earth (Kuchynka, 2016). Big attention is paid to the influence of the external environment on the development of many eye diseases, including cataracts. The main causes of cataracts are age and genetic influences, which cannot be influenced. The aim is to find the possibilities of preventing the occurrence, or slowing down the progression of cataracts, by eliminating external risk factors unrelated to age or genetics.

Lens – *lens crystallina*

The basic feature of the lens is its transparency, which ensures focusing of light rays on the retina and thus the creation of a sharp image. The lens has a complex antioxidant system, consisting of enzymatic and non-enzymatic mechanisms, whose main task is to protect against free radicals and thus maintain transparency. The non-enzymatic antioxidant system of the lens consists of glutathione, vitamin C, vitamin E and the carotenoids lutein and zeaxanthin. The enzymatic antioxidant system of the lens includes glutathione peroxidase (GSH-Px), glutathione reductase (GSH-Rx), catalase (CAT) and superoxide dismutase (SOD) (Dukuran, 2006; Kuchynka, 2016; Heruye, 2020).

Etiopathogenesis of cataract, influence of environmental and other risk factors

The main causes of cataractogenesis are generally considered to be age, genetic predisposition, congenital mutations in lens proteins, physical environmental influences (ionizing radiation, thermal effects, intoxication, smoking, etc.) and overproduction of sugar alcohols due to metabolic diseases (Kuchynka, 2016; Heruye, 2020). *Age and heredity* are the most important risk factors

leading to different subtypes of cataracts, while the aging process is associated with increasing oxidative stress, which is the causal cause of cataract development. The identification of risk factors that are causally related to the development of cataracts is essential for successful prevention. Environmental factors are among those that have a causal relation to the development of cataracts and where preventive actions can be taken. Such external influences include *smoking*, which leads to nuclear cataracts. The studies showed the reversibility of the process and the improvement of the finding in former smokers (Robman, 2005; Yadov, 2019). According to WHO up to 20% of cases of cortical cataracts are caused by *UV-B radiation* (Robman, 2005; Yadov, 2019). *Ionizing radiation* leads to a rapid progression of subcapsular opacification. Long-term treatment with *corticosteroids* may have the same side effect, with systemic as well as topical administration in drops, creams or sprays for inhalation being risky. The increased risk of cataracts development has also been documented as a result of chronic medication by various other groups of drugs (antihypertensives, diuretics, phenothiazines and many others). The pathological effect of toxins generated during domestic heating, especially when using biofuels, is also assumed, as well as the thermal effect in bakers, a clear mechanism of action, however has not yet been clearly described (Yadov, 2019). The Barbados Eye Study has proven an increased occurrence of cataracts in obese individuals (Robman, 2005). Similarly, the Blue Mountains Eye Study confirmed the positive impact of a healthy diet and a normal body mass index on reducing the risk of cataracts in comparison with obese individuals in the Australian population (Tan, 2019). A special subtype is *diabetic cataract*, due to the fact that it occurs much faster and at a younger age compared to the non-diabetic population. Glucose, which enters the lens by diffusion, is metabolized to sorbitol, which accumulates in the lens, has a decisive influence on the pathomechanism of diabetic cataract development. The result is an osmotic imbalance, an increase in water content, which leads to oxidative stress. *Diabetes mellitus* is a group of diseases with multifactorial etiopathogenesis, where environmental factors play a very important role. These include mostly air quality, food quality, the effect of viruses, psychogenic stress and much more. The causal relationships of these effects to the development of diabetes are the subject of studies and they have not yet been described in detail. The final result of all these processes is excessive oxidative stress, which leads to exhaustion or failure of the antioxidant system of the lens with the subsequent development of cataracts, vision deteriorates and without treatment decreases to the level of blindness (Yamakoshi, 2002; Dukuran, 2006; Kanski, 2008; Kuchynka, 2016; Heruye, 2020). Although the influence of many of these external factors can be eliminated to the maximum level possible under certain circumstances, they cannot be eliminated completely.

There is currently no pharmacological treatment for cataracts, and the only causal therapy remains the surgical approach of phacoemulsification of lens masses and subsequent implantation of an artificial intraocular lens. However, this modern method of treatment is available only to the inhabitants of the most developed countries in the world. For majority people, surgical treatment either remains completely unavailable or only older procedures are performed, such as so-called intracapsular lens extraction, which is associated with a high risk of serious postoperative complications (Kuchynka, 2016; Heruye, 2020). Therefore, the aim of many research projects is to understand the mechanisms of cataract development and to find a way to prevent the occurrence or slow down its progression.

The results of many experimental works and clinical studies aimed at researching the anticataractogenic effect of various substances show that substances with antioxidant potential are especially important (Yamakoshi, 2002; Dukuran, 2006; Kimakova, 2017; Heruye, 2020, Hrnkova, 2021). The most frequently studied substances include the antioxidants vitamin C, vitamin E,

glutathione, carotenoids, the flavonoid quercetin and the polyphenol resveratrol. An example is the REACT (Roche European American Cataract Trial) study, whose findings support the statement that increased intake of vitamin E, C and beta-carotene in early stages of cataracts may have a positive effect on slowing disease progression (Schalch, 2003; Chiu, 2007; Lim, 2020; Mathew, 2012; Braakhuis, 2019; Heruye, 2020; Francisco, 2020). The anti-cataractogenic effect is very likely to be inhibition of lipid, protein, nucleic acid oxidation and peroxide formation (Doganay, 2006; Shetty, 2010; Dubey, 2016; Singh, 2019, Lim, 2020).

Conclusion

An increased industrialization and global warming lead to increasing environmental pollution. It is being shown that harmful substances accumulating in the air, in water, in the soil have a significant effect on the eye, which is constantly exposed to their influence. These external factors can thus lead to the development of various serious eye diseases leading to severe visual impairment, even to blindness. Cataracts are the most common cause of blindness in the world, which is treatable and preventable. However, modern surgical treatment remains unavailable to majority people on earth. The development of cataracts has a multifactorial etiopathogenesis, in which the influence of environmental factors plays an important role. The goal of many research projects is to understand the mechanisms of cataract development and to find a way to prevent the occurrence or slow down its progression.

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DETECTION OF TOXIC ELEMENTS IN DAIRY PRODUCTS FROM THE SLOVAK MARKET

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Abstract
The monitoring of various elements in the food has high priority due to the health of consumers and in respect of food quality and safety. The aim of this study was to analyse the concentration of Cd and Pb in milk products (yogurt and cottage cheese) available on Slovak market. The samples were analysed using atomic absorption spectrometry. According to our results, milk products were not contaminated by toxic elements. All results were within the tolerable limit and the differences between the groups were insignificant. Both elements are known for their cumulative effect and the monitoring of Cd and Pb in milk products is strongly required.

Keywords: toxic elements, cadmium, lead, milk products

Introduction

The consumption of dairy products in Slovak republic is very low in comparison to other European countries (FAO, 2011). The recommended minimum intake of milk and milk products given by WHO (World Health Organization) per person should be at least 220 kg per year (Petrilák et al., 2017). In Slovak republic the intake of milk is evaluated on the level ranges from 160 to 165 kg per capita (Kurajdova et al., 2015; Petrilák et al., 2017). The milk and milk products are considered as the most important source of proteins, vitamins, minerals (mainly calcium) and more than 20 different minor and trace elements (Kurajdova et al., 2015; Bilandzic et al., 2016). They are essential for development and growth of children. Nevertheless, they might contain risk elements and contaminants as the consequence of growing environmental pollution (Kazi et al., 2009). Presence of risk elements in dairy products is an indicator of qualitative parameters of the food and can image hazardous conditions as environmental pollution, hygiene condition in factory processing milk, sanitation, processing conditions and packaging methods (Ayar et al., 2009; Bilandzic et al., 2016). Generally, the contamination of milk and milk products by heavy metals as cadmium (Cd) and lead (Pb) is low, but these elements might have a cumulative effect (Morais et al., 2012; Capcarova et al., 2017), so their occurrence, even at low concentration, might lead to metabolic disorders and health complications (Morais et al., 2012).
The aim of the present study was to measure the concentration of toxic metals (Cd and Pb) in milk products (yogurt and cottage cheese) commercially available in Slovakia using atomic absorption spectrophotometry (AAS) techniques.

Material and methods

The samples of commercially available white yogurt (n=15) and cottage cheese (42) were collected from markets located in Nitra (Slovak Republic). Analyses of concentration of Cd and Pb were proceeded with the mineralization of the whole subsample in the open mineralization system (Velp Scientifica DK20, Usmate, Italy) with nitric acid. Mineralized solutions were fulfilled with ultrapure water (Merck Millipore, Direct 3) to 10 mL. Consequently the samples were placed in the atomic absorption spectrometer (AA240 Z, Varian, Australia).

The one-way analysis of variance (ANOVA) was used to determine significant differences in concentrations between the groups. The differences were compared and had statistical significance at the $P<0.05$ level.

Results and Discussion

Monitoring of the various elements is very useful in evaluating the quality of milk and milk products during the manufacturing treatments and production (Khan et al., 2014). Children are most affected by Cd and Pb toxicity as they are not completely developed (Er et al., 2013). The concentration of Cd and Pb are shown in Figure. Higher concentration of Cd was measured in cottage cheese in comparison to yogurt. Opposite trend was observed in the case of Pb, where cottage cheese possessed lower content of Pb when compared to the yogurt. However, in both cases the differences among the groups remained insignificant ($P>0.05$).

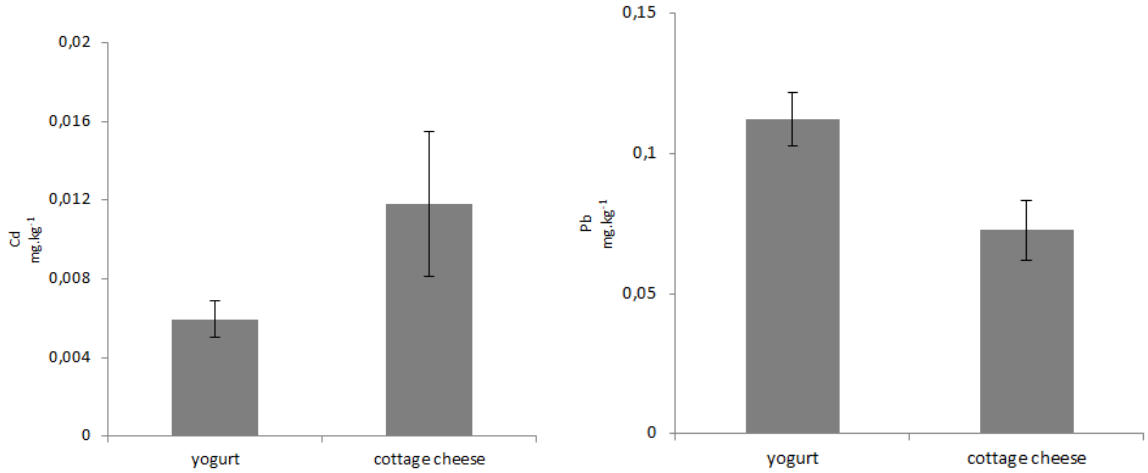

Figure. The concentration of heavy metals (Cd and Pb) in milk products ($mg.kg^{-1}$)
Cd – cadmium, Pb – lead,

The main sources of heavy metals and trace elements are food and beverage, except for occupational exposure (Kaya et al., 2008). The monitoring of concentration of toxic elements such as Cd and Pb is important for the safety and quality of milk and dairy products (Kazi et al., 2009). In our study the content of both toxic elements were under the tolerable limits. Contaminated dairy products by toxic elements, even in low dose, may be a source of long-term exposure. Thus, controlling and monitoring of these elements in milk and dairy products is required (Suturovic et al., 2014; Siddiki et al., 2012). Some evidences indicate that specific diseases (e.g. osteoporosis

caused by Cd exposure) are the result of chronic intake of toxic elements in food (Galbavy, 2008; Omelka et al., 2010).

Conclusions

In this study the concentration of toxic trace elements (Cd and Pb) in milk products (yogurt, cottage cheese) were analysed in order to mirror a situation in one consumer place in the Slovak Republic. We found higher concentration of Cd in samples of cottage cheese in comparison to yogurt, but the concentration of Pb was lower in cottage cheese when compared to yogurt. However, the differences between the groups were insignificant. For assurance of the food safety, ceaseless monitoring is needed.

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RISK ELEMENTS IN SELECTED ORGANS AND TISSUES OF FALLOW-DEER (*DAMA DAMA*)

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Abstract
Monitoring the concentration of risk elements in the organs and tissues used for consumption is crucial for possible contamination of the food chain. This study is focused on the detection of selected risk elements in organs and tissues of fallow deer (*Dama dama*). The concentration of cadmium was highest in the kidneys, the second highest content was in the liver. The highest average nickel content was in the diaphragm and similar values were in muscle. The highest lead concentration was in the heart with an average of 0.8202 mg/kg. The lowest average lead content was in the liver and diaphragm. The highest arsenic content was measured in the diaphragm, then in the kidney and liver. We found the lowest average content of arsenic in the heart, lungs, and spleen. The highest zinc content was measured in the diaphragm and liver. The lowest mean concentration was in the lungs. Large differences in copper concentrations were found in the liver and kidneys compared to other samples. The results obtained indicate that the limits of the average concentration of cadmium in the kidneys and liver have been exceeded. Similarly exceeded permissible concentrations were found in cardiac muscle.

Key words: fallow-deer, tissues, organs, biogenic elements, risk elements

Introduction
The meat is defined by the International Organization for Standardization (ISO) as an edible part of the body of animals for slaughter (**Chudý et al., 2000**). In a broader sense, the term meat means everything that can be used as food from the animal's body, including offal (heart, liver, lungs, kidneys, etc.). In a narrower sense, meat refers to the skeletal muscle of slaughter animals with the relevant adipose tissue and tissues that are not normally found in meat (nervous, vascular, and lymphatic system) (**Čuboň et al., 2012**).
Hudec et al. (1971) state that the nutritional value of game meat lies mainly in the high amount of easily digestible proteins, low content of lipids, cholesterol and a favorable ratio of unsaturated essential and saturated fatty acids, which allows easy digestion (for easy digestion must be suitably heat treated, treated, because poor processing or improper culinary preparation can disrupt it), but also minerals such as iron, calcium, phosphorus, potassium, zinc, selenium and various vitamins.
Korénková (2016) states that iron is the most important component of meat and from a dietary point of view, the content of vitamins is also important, especially from group B, such as B1 and B2, or the high content of purines and creatine. It contains unsaturated omega 3 fatty acids, which have a beneficial effect on human health, especially by protecting against cardiovascular disease, lowering blood cholesterol, and preventing atherosclerosis. The meat is softer, has a higher energy value and is more economically demanding. Each species of animal has its own specific aroma, the

color of the game is significantly darker than in farm animals. The game is used to prepare delicacies. Game meat is often compared to beef and veal.
A biogenic element is a chemical element found in living organisms. They are found in the biosphere and are essential for the structure and vital activity of organisms. The most important biogenic elements include chlorine, iron, calcium, sodium, hydrogen, carbon, sulfur, magnesium, potassium, phosphorus, nitrogen, and oxygen (**Capcarová et al., 2019, 2020**). According to **Kováčik et al. (2006)** risk elements are part of our daily lives, the main source of these substances, which are especially dangerous for humans, is the food chain. The growth of chemical industries, a greater amount of use of chemical fertilizers causes an increase in the so-called. heavy metals in the biosphere. Improper handling can adversely affect our health and the environment. The WHO lists 10 chemical elements that are essential for public health (https://www.who.int/ipcs/assessment/public_health/chemicals_phc/en/).
The aim of this study was the determination of selected risk elements in selected organs and tissues of spotted fallow deer, and to evaluate the concentrations of monitored elements in relation to legislative standards.

Material and Methods

In this study we focused on monitoring the concentrations of selected risk elements in samples of organs and tissues (liver, kidney, spleen, lungs, diaphragm, muscle) of the fallow deer (n=7). Sampling was collected during the shooting in Malacky, and samples were taken from individuals of the same sex (females) at the age of one year.
Samples were weighted and approximately 1 g of the sample was added into PTFE mineralization tubes. The mineralization was carried out by wet means using a pressure microwave decomposition on an Ethos One (Milestone, Italy). Further process was preparing the mineralizate through a quantitative filter paper to reach 50 ml filtrate with deionized water to prepare the sample for further analysis.
The mineralizates of the biological material and the substrate were analyzed quantitatively and qualitatively on an Agilent ICP-OES 725 instrument (Agilent Technologies, Germany) using optical emission spectrometry with induced bound argon plasma. A Agilent SPS-3 peristaltic pump and a robotic autosampler (Agilent Technologies, Germany) to dispense the samples were used.
The statistical program GraphPad Prism (version 8.0.0. For Windows, GraphPad Software, San Diego, California USA, www.graphpad.com) was used for statistical processing of the results of all performed analyzes.

Results and Discussion

The data of selected risk elements in the monitored organs and tissues are given in Tables.

Table 1: Concentration of selected risk elements in liver (mg/kg)

Element	LIVER			
	Mean	SD	Minimum	Maximum
Cd	**1.601**	2.821	0.024	6.955
Ni	**0.04066**	0.0871	0.0003	0.2416
Pb	**0.0008**	0	0.0008	0.0008
As	**0.1547**	0.2171	0.0015	0.5293
Cu	**34.54**	19.94	7.53	59.94
Zn	**25.53**	8.01	17.19	38.24

Table 2: Concentration of selected risk elements in kidney (mg/kg)

Element	KIDNEY			
	Mean	SD	Minimum	Maximum
Cd	**2.558**	2.179	0.2104	5.254
Ni	**0.02383**	0.04981	0.0003	0.1274
Pb	**0.04603**	0.07503	0.0008	0.213
As	**0.2565**	0.2388	0.0015	0.5958
Cu	**14.73**	13.63	7.88	40.67
Zn	**19.75**	1.345	17.92	21.58

Table 3: Concentration of selected risk elements in spleen (mg/kg)

Element	SPLEEN			
	Mean	SD	Minimum	Maximum
Cd	**0.06801**	0.03776	0.0059	0.1289
Ni	**0.0003**	60.49	0.0003	0.0003
Pb	**0.04181**	0.08895	0.0008	0.2502
As	**0.0015**	0	0.0015	0.0015
Cu	**1.091**	0.0996	0.95	1.22
Zn	**20.02**	1.626	17.94	22.71

Table 4: Concentration of selected risk elements in lungs (mg/kg)

Element	LUNGS			
	Mean	SD	Minimum	Maximum
Cd	**0.0935**	0.06633	0.00005	0.1818
Ni	**0.06236**	0.1318	0.0003	0.3436
Pb	**0.07828**	0.1145	0.0008	0.3288
As	**0.0015**	0	0.0015	0.0015
Cu	**2.034**	0.1643	1.81	2.29
Zn	**12.5**	0.7676	11.3	13.65

Table 5: Concentration of selected risk elements in heart (mg/kg)

Element	HEART			
	Mean	SD	Minimum	Maximum
Cd	**0.1151**	0.141	0.00005	0.3384
Ni	**0.06549**	0.03853	0.0003	0.2396
Pb	**0.8202**	1.728	0.0008	4.109
As	**0.0015**	0	0.0015	0.0015
Cu	**3.275**	1.457	1.54	4.67
Zn	**15.4**	1.417	13.95	17.36

Table 6: Concentration of selected risk elements in diaphragm (mg/kg)

Element	DIAPHRAGM			
	Mean	SD	Minimum	Maximum
Cd	**0.1151**	0.141	0.00005	0.3384
Ni	**0.06549**	0.03853	0.0003	0.2396
Pb	**0.8202**	1.728	0.0008	4.109
As	**0.0015**	0	0.0015	0.0015
Cu	**3.275**	1.457	1.54	4.67
Zn	**15.4**	1.417	13.95	17.36

Table 7: Concentration of selected risk elements in skeletal muscle (mg/kg)

Element	MUSCLE			
	Mean	SD	Minimum	Maximum
Cd	**0.06031**	0.04367	0.00005	0.1277
Ni	**0.2881**	0.2728	0.0003	0.6505
Pb	**0.1907**	0.1896	0.0008	0.4495
As	**0.09871**	0.2269	0.0015	0.6941
Cu	**1.939**	0.2963	1.5	2.24
Zn	**18.39**	4.414	11.43	22.91

Cadmium concentration was highest in the kidneys (0.2104 – 5.254 mg/kg) with a mean of 2.558 mg/kg. The second highest content was in the liver (0.024 – 6.955 mg/kg) with an average of 1.601 mg/kg. Other samples ranged from 0.1151 to 0.06031 mg/kg. The highest average nickel content was in the diaphragm (0.0003 – 1.164 mg/kg) with an average of 0.2927 mg/kg. Similar values were in muscle (0.0003 – 0.6505 mg/kg) with a mean of 0.2881 mg/kg. The nickel content in the other monitored samples was measured in the range of 0.0003 – 0.06549 mg/kg.

There were differences in lead concentrations between all organs and tissues. The highest lead content was in the heart (0.0008 – 4.109 mg/kg) with an average of 0.8202 mg/kg. The lowest average lead content was in the liver and diaphragm (0.0008 mg/kg). The highest content of arsenic was measured in the diaphragm (0.0015 – 0.8141 mg/kg) with an average of 0.348 mg/kg, then in the kidney (0.0015 – 0.5958 mg/kg) with an average of 0.2565 mg/kg and liver (0.0015 – 0.5293 mg/kg) with an average of 0.1547 mg/kg. We found the lowest average arsenic content in the heart, lungs, and spleen (0.0015 mg/kg).

The highest zinc content was measured in the diaphragm (24.21 – 31.6 mg/kg) with an average of 28.57 mg/kg and in the liver (17.19 – 38.24 mg/kg) with an average of 25.53 mg/kg. The lowest mean concentrations were in the lungs (12.5 mg/kg) and in the heart (15.4 mg/kg). Large differences in copper concentration were in the liver and kidneys compared to other samples. An average content of 34.54 mg/kg was measured in the liver and 14.73 mg/kg in the kidney. The other samples proved a copper concentration from 1.091 to 3.275 mg/kg.

In this study we analyzed selected risk elements qualitatively and quantitatively using optical emission spectrometry with induced bound argon plasma. Cadmium, lead, and arsenic were identified as risk elements based on the International Public Health Program (WHO).
At relatively low concentrations, they adversely affect cell function, organs, and the whole organism. We can consider them toxic to humans, animals but also plants. Therefore, we decided to determine some of the risk elements in concentrations in wild animals – fallow deer. The bioavailability of contaminants depends on the physicochemical properties and composition of the food itself. It is a strong link between plants, animals and populations (**McLaughlin. 1999**).
Kováčik et al. (2006) stat that the average content of cadmium in hares in the liver is 0.16 mg/kg and in the kidneys 1.570 mg/kg; in European roe deer 0.258 mg/kg and in the kidneys 2.387 mg/kg. According to our data, the average content of cadmium in fallow deer in the liver is 1.601 mg/kg and in the kidneys 2.558 mg/kg. There are big differences compared to the hare, but for deer the values are similar for kidneys.

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IMPACT OF THE ENVIRONMENT ON BEEKEEPING AND BEE PRODUCTS

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Abstract
Honey bees are our essential pollinators, they pollinate around 70 % of the crops used for human nutrition. The bees are bio-indicators of environmental pollution, but also contamination from beekeeping practice. If the quality of the environment is decreasing, the overall quality and quantity of bees and bee products are decreasing. Nowadays, we are facing the global environmental pollution crisis and we can clearly see the results on the contamination level from different sources such as pesticides, heavy metals on the bees itself, but also on bee products. We need to focus on locating beehives far from urbanized areas, we need to observe and study the beehives and try to find new, modern tools and approaches how to manage them, in order to achieve their best health and ability to reproduce, be productive and adapt to the new conditions. At the same time, we need to stop extensive urbanization, deforestation, destruction of their natural habitat and focus on sustainable agriculture.

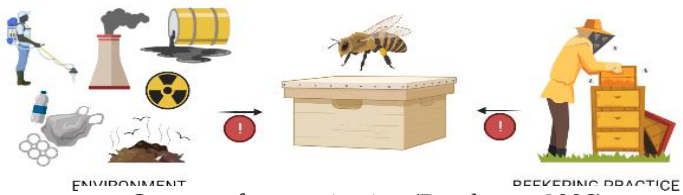
Key words: honey bee, pollinator, bee product, pollution, contamination, heavy metals, pesticides

Introduction

The bees are the most important pollinators (Klein et al., 2007; Kremen at al., 2007) and are also used as a biological indicator of contamination, because they can indicate environmental pollution through signals such as high mortality and the residues present in their bodies or in beehive products (Yakobson, 1997; Porrini et al., 2003). The current extensive urbanization, degradation, destruction and fragmentation of habitats, intensification of agriculture associated with the use of many insecticides, herbicides, antibiotics, shrinking natural areas have an extremely negative impact not only on number of bee colonies, but also on bee colony productivity and overall vitality (Winfree et al., 2009). As a result of these influences, we are facing an exponentially declining amount of our main pollinator, which is a cause for considerable concern.

Sources of contamination

Bee products can be contaminated from different sources, from beekeeping practices or from the environment (Bogdanov, 2006). Honey bees may forage over 6 kilometers from the hives and they sample nectar, water, pollen and honeydew, which are all brought back into the hive, incorporated into the bee tissue, the wax, the honey, or the hive itself (Przybylowski – Wilczyńska, 2001). A number of contaminants can enter into bee products during storage, handling and processing. A contamination might happen also due to bad condition of drums, pipes, tanks, wood protectants (Yakobson, 1997).



Sources of contamination (Bogdanov, 2006)

Environmental sources of contamination

Contaminants from the environment are heavy metals, bacteria, genetically modified organisms, radioactivity, organic pollutants, pesticides (insecticides, fungicides, herbicides and bactericides). These substances get into the bee hive through pollen, nectar, honeydew, transmission by bees. Air and soil contain heavy metals from industry, transport, and combustion. Bees are bio-indicators for contamination from heavy metals, trace elements, most often lead and cadmium, fluoride, zinc, nickel, which are monitored and studied (Bogdanov, 2006; Schindler et al., 2013; Sherif et al., 2019; Kuppler et al., 2021). Large concentrations of heavy metals were found in honey from hives located in industrial areas (Omar, 1994; Formicki et al., 2013; Omran et al., 2019).

A polluted environment contains such radionuclides as Sr 132 and/or such heavy metals as As, Pb, Cd, Hg. Organic contaminants include polychlorinated biphenyls (PCBs) derived from motor oil, coolants manufactured before 1980. The most common insecticides are organochlorides, which are still present in the environment, organophosphates, carbamates. Sources of contamination by these insecticides can be traced from honey. Antibiotics such as streptomycin, which are used against bacterial pests such as *Erwinia amylovora*, are also contaminants. The major microbial contaminant of honey is *Clostridium botulinum*. Genetically modified organisms such as rape, maize can be a danger to bee colonies, due to the pollen contamination of these plants (Yakobson, 1997; Haarmann, 2002).

Sources of contamination from beekeeping

Contaminants are also substances used to destroy bee pests such as bee brood plague, small hive beetle, bee tick. To control these pests, substances such as acaricides, various organic acids, antibiotics (such as tetracycline, oxytetracycline, chloramphenicol, sulfathiazole, fumagillin) are used, which cause considerable contamination and might be found in bee products. Chemical repellents can also be a source of contamination. The storage of bee products must also be controlled, as contamination can occur if unsuitable containers are used (Wang et al., 2021). Since honey bees are extremely sensitive to pesticides, it remains as the major contaminant for honey originating from cultivated plants (oranges, cotton, etc.) (Yakobson, 1997 ; Porrini et al. 2003; Al-Waili et al., 2012).

How to provide suitable living conditions for bees at present?

Even in urban areas are many ways to provide the bees with suitable living conditions, such as the creation of city parks, where standardized vegetation units are created, which provide bees with sufficient opportunities for pollination. We conclude that pollinators are declining globally due to these environmental disruptors (Winfree et al., 2009; Daniels et al., 2020).

In particular, the number of wild bees, which occur naturally in the wild, is decreasing. We are reducing their natural home through urbanization, but also through many environmental contaminants. Honey bees, which are managed in beehives, are not as drastically negatively affected as wild bees, but their viability and colony quality, depending on the degree of contamination, are fundamentally affected. It is important to preserve the natural flora of the place where the bees are located (Bates, 2011). It is extremely important to continue working to optimizing breeding, both in the fight against pests and in the fight against environmental contaminants (Bodganov, 2006; Schindler et al., 2013; Gorretti et al., 2020; Noi et al., 2021).

Beekeeping practice advices

I. Education of beekeepers regarding proper bee hive location, the hives should be located in pollution free areas, far from big cities, factories and mining areas.

2. Judicious use of pesticides, acaricides, and antibiotics (amount and timing).

3. Systematic monitoring at all level - producer, packer and national organizations (Beetlestone, 1994).

Conclusion

We need to establish appropriate living conditions, minimalized sources of contamination by monitoring the area, where the beehives are located. We need to educate beekeepers with optimized beekeeping practice, prevent further urbanization, deforestation. We need to provide honey bees optimal conditions for them to reach their optimal function, reproduction, growth, development, productivity and by this way also quality of bee products. Therefore, a system of analysis of critical control points should also be developed for the field of beekeeping. It is necessary to acquire new knowledge about the optimization of the bee colony, how to provide them with suitable conditions as well as nutrition and care so they can adapt and prosper.

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