Hungarian University of Agriculture and Life Sciences (MATE)

# ASSESSMENT OF CONSUMER HABITS OF ORGANIC FOOD AND NUTRITIONAL CONTENT OF SELECTED PRODUCTS

DOI: 10.54598/005370

Thesis of doctoral (PhD) dissertation

**Gyöngyi Györéné Kis**

**Gödöllő**

**2024**

**The Doctoral School**

| | |
|---|---|
| **Name:** | PhD School of Environmental Sciences |
| **Discipline**: | Environmental Sciences |
| **Head of School:** | Prof. Dr. Erika Csákiné Michéli<br>professor, DSc<br>Hungarian University of Agricultural and Life Sciences, Institute of Environmental Sciences, Department of Soil Science |
| **Scientific Supervisors:** | Dr. Apolka Ujj<br>associate professor, PhD<br>Hungarian University of Agriculture and Life Sciences, Institute of Rural Development and Sustainable Economy, Department of Agroecology and Organic Farming<br><br>Dr. habil. Andrea Lugasi<br>college professor, PhD<br>Budapest Business University,<br>Faculty of Commerce, Hospitality and Tourism, Department of Hospitality |

…….

Prof. Dr. Erika Csákiné Michéli

Approval of Head of School

| | |
|---|---|
| ..... | ..... |
| Dr. Apolka Ujj | Dr. habil. Andrea Lugasi |
| Approval of Scientific Supervisor | Approval of Scientific Supervisor |

## 1. Background and objectives

The volume of organic farming and the consumption of organic food (also known as ecological, bio, or organic products) is increasing worldwide, including in Hungary. This is due to several reasons. Firstly, consumers are becoming more and more aware of the consequences of climate change and the scarcity of natural resources (MOISANDER, 2007); secondly, people's concern about health and food safety is increasing year by year (RAMPL et al., 2012); and thirdly, a significant proportion of consumers perceive organic food as natural, healthy, safe and environmentally friendly, and therefore consider buying organic products as a reasonable option for sustainable consumption (ŻAKOWSKA-BIEMANS, 2011; VEGA-ZAMORA et al, 2014). Consumers choose organic products mainly for health reasons, environmental aspects, tastiness, and due to the risk factors that products from conventional agriculture that use chemicals may cause.

In recent years, there has been much interest and debate about whether organic foods are healthier than their conventional counterparts. Is there a measurable difference in the amount of nutritionally valuable ingredients or in the content of contaminants? I considered it important to summarize the scientific studies based on exact results and also get to know the consumers' perceptions. The latter is all the more important as consumers of organic food make their purchasing decisions based on trust, while "sceptics" who do not consume organic food do not trust that these products are better or healthier than their conventional counterparts (THORSØE, 2015; KOWALSKA et al., 2021; MURPHY et al., 2022).

Both at a national and international level, fruits and vegetables are considered the most popular organic products (SZENTE & TORMA, 2015; NOMISMA, 2018; MALISSIOVA et al, 2022; WU & TAKÁCS-GYÖRGY, 2022). It is therefore necessary to present a comprehensive picture of the results of comparative studies on the nutritional value of conventional and organic products, especially fruits and vegetables, published internationally and in Hungary. Several studies have been conducted to scientifically support the idea that organic foods have proven better nutritional characteristics than their conventional counterparts (VELIMIROV & MÜLLER, 2003; BARANSKI et al., 2014; MEADOWS et al, 2021). According to some publications, organically produced vegetables and fruits, in many cases, proved to be better than conventional products in terms of taste, flavour and some nutritional components (phytonutrients in organic fruits, vegetables and cereals, unsaturated fatty acids in organic dairy products and meat) (SMITH-SPANGLER et al., 2012; BARAŃSKI et al, 2014; BICKEL & ROSSIER, 2015; ŚREDNICKA-TOBER et al., 2016a; ŚREDNICKA-TOBER et al., 2016b; MDITSHWA et al., 2017). Other studies found no convincing evidence that organic food is healthier, more nutritious or better for food safety than conventional food (DANGOUR et al.,

2009; HSU et al, 2019; GLIBOWSKI, P., 2020), but it is proven that consumption of organic food can reduce human exposure to pesticide residues and antibiotic-resistant bacteria (MIE et al., 2017; EFSA, 2018; CABRERA et al., 2022).

Due to the importance of the topic, I consider it necessary to investigate the impact of conventional and organic production methods on the composition of the nutritional content of certain kinds of fruits and vegetables in the Hungarian context as well. Therefore, the objective of my PhD thesis is, on the one hand, to develop a comprehensive overview of the topic based on international publications comparing the components and quantities of the nutritional content of organic and conventional products, and on the other hand, to compare the nutritional content of domestic fruits and vegetables and certain processed products from different cultivation methods. Given the fact that no consumer survey has been conducted in Hungary yet, which, apart from exploring consumer habits and motivations related to organic food, would have focused on the consumers' perception of the nutritional value and health effects of organic food, I considered it important to explore these issues through a questionnaire survey.

In my thesis, I aimed to answer the following research questions:

1. Analysis of the nutritional characteristics of conventionally and organically grown fruits and vegetables

*1.1. Is there a significant difference in mineral and polyphenol content, in vitro antioxidant characteristics and potentially toxic heavy metal content between the organic and conventional fruit and vegetable juices available in the domestic market?*

*1.2. Is there a significant difference in bioactive compound content and in vitro antioxidant characteristics between the organic and conventional berry fruits used in the research, such as blackcurrant (Ribes nigrum, Titania), redcurrant (Ribes rubrum, Jonkheer van Tets), raspberry (Rubus idaeus, Fertődi Zamatos), and blackberry (Rubus rusticanus var. Inermis, Thornfree)?*

*1.3. Is there a significant difference in organoleptically relevant nutritional components and bioactive compounds between organic and conventional tomatoes (Solanum lycopersicum, Gardener's Delight, San Marzano, Saint Pierre, Brigade F1, Triple Red F1, UG Red F1, Red Code F1, Uno Rosso F1 and Strombolino F1) included in my study?*

2. Survey on organic food consumption habits:

*2.1. How aware are consumers of the organic certification labels?*

*2.2. What is the purchase frequency of organic products, which are the most popular products, distribution channels and what are the main consumer motivations?*

*2.3. How has the purchase frequency of organic food changed in the years 2020-2021 (during the COVID-19 pandemic)?*

*2.4. What do consumers think about the health benefits of organic food?*

*2.5. What are the main factors promoting the uptake and growth of organic food purchases?*

## 2. Materials and methods

The studies were carried out in two major research themes:

1) Comparative studies on the nutritional characteristics of conventional and organic products, in which the nutritional components of organic and conventional fruit and vegetable juices (73 samples in total, of which 37 organic and 36 conventional samples) available on the domestic market were analysed in 2006. In addition to that, organic and conventional berries from on-farm experiments, such as blackcurrant *(Ribes nigrum*, Titania), redcurrant (*Ribes rubrum*, Jonkheer van Tets), raspberry (*Rubus idaeus*, Fertődi Zamatos) and blackberry (*Rubus rusticanus* var. *Inermis*, Thornfree), were examined for their bioactive compound content and *in vitro* antioxidant characteristics in 2007 and 2008. I have also analysed the organoleptically significant nutritional components and bioactive compound content of a total of nine tomato varieties (*Solanum lycopersicum*, Gardener's Delight, San Marzano, Saint Pierre, Brigade F1, Triple Red F1, UG Red F1, Red Code F1, Uno Rosso F1 and Strombolino F1) in small plot open field organic and conventional trails in 2008, 2009, and 2011.

2) Consumer attitudes towards organic food were examined through an online questionnaire survey. It was carried out between 28 January and 17 March 2022, while also looking at consumer attitudes in 2020-2021, with a particular focus on the impact of the COVID-19 pandemic on the market and consumers' perceptions of the healthiness of organic food. The questionnaire was distributed through social media and thematic channels.

The following methods were used in the research:

1) Method of comparative analysis of the nutritional characteristics of conventional and organic products

*Conditions of the horticultural experiments:* In the conventional and organic berry fruits and tomato experiments, there were significant differences between the conventional and organic cultivation in nutrient supplementation and plant protection treatments - due to the specificity of the cultivation methods - while soil and climatic conditions (temperature, precipitation, sunlight) were very similar. However, the conditions under which tomato seedlings were grown differed, as in conventional horticulture, they were grown in modern greenhouses, whereas in organic horticulture, they were grown in plastic tents. The samples from the berry fruit and tomato experiments were tested in four replicates in two parallel measurements, while the vegetable and fruit juice samples in four parallel measurements.

*Analytical assays:* most of the nutritional characteristics of vegetable and

fruit juices, berries and tomatoes, such as water soluble solids (Brix°), sugar/acid ratio, titratable acidity, carbohydrate, vitamin C, lycopene, total polyphenol and anthocyanin content, *in vitro* antioxidant characteristics: hydrogen-donating ability and reducing power were determined at the Department of Food Chemistry at National Institute of Food and Nutrition Science, other components (macro- and microelements, heavy metals) were measured at the Department of Applied Chemistry of Corvinus University, between 2006 and 2010 (MSZ EN 12143; MSZ ISO 750; BLOIS, 1958; SARUDI, 1961; OYAIZU, 1986; HATANO et al., 1988; MERCK et al., 1989; A.O.A.C., 1990; SADLER et al., 1990;).

*Applied statistical methods:* the values of the vegetable and fruit juices, berries and tomato experiments are expressed as mean and standard deviation. For statistical analyses, the data analysis module of the Microsoft Excel application was used. The results were evaluated by Student's t-test, and the effect of the harvest year and cultivation method was analysed by type III ANOVA analysis of variance in the statistical program R.

2) Methodology of the questionnaire survey on organic food consumers

*Topics covered:* the research examined consumer behaviour towards organic food, in particular focusing on the purchase frequency, awareness of choice (awareness of organic certification label), consumer motivation factors, main purchasing channels, preferred product groups, the impact of the COVID-19 pandemic on the market and consumers' perception of the benefits and health impacts of organic food.

*Survey design:* the assessment of consumer attitudes towards organic food was carried out through an online questionnaire survey via Google Forms, using snowball sampling. A total of 555 responses were received. Due to the limitations of the sampling method, the findings cannot be generalised to the entire Hungarian population. However, the size of the sample makes it possible to draw conclusions and reveal patterns.

*Applied statistical methods:* the data from the questionnaires were evaluated using the SPSS statistical program (SAJTOS & MITEV, 2007). The main methods used in data processing were descriptive statistical and relationship analysis methods. Relationship analysis was performed by cross-tabulation analysis, for which relationship coefficients were calculated.

## 3. Results

The results were evaluated based on the two major research themes as described in the Material and Methods section. The results are presented in chronological order of the experiments carried out.

1.) Results of comparative studies on the nutritional characteristics of conventional and organic products

When comparing organic and conventional fruit and vegetable juices available in the domestic market, differences in trends were observed. In terms of mineral content, in comparison to the calcium content of organic and conventional samples, organic peach juice contained more calcium, while organic apple, pineapple, blue grape, pear, orange peach and tomato juices contained more potassium, organic plum and blue grape juices more magnesium, and organic plum, blue grape, peach, orange, pineapple, apple and tomato juices contained more phosphorus than the conventional samples. In terms of sodium content, by contrast, conventional tomato juice showed a more favourable value. The antioxidant compounds and their *in vitro* antioxidant properties were also investigated. The organic plum, blue grape, pear and apple juice samples had higher polyphenol content than the conventional samples. Examining the antioxidant properties of organic and conventional juices, organic samples of pear and apple juices showed stronger hydrogen-donating ability than the conventional samples. The results of the reducing power assay showed that the organic plum, blue grape, pear and apple juice samples had higher values than their conventional counterparts. In contrast, in the case of tomato juices, the conventional samples were found to have higher reducing power. As for potentially toxic heavy metals, while mercury and cadmium were not detected in any of the fruit and vegetable juice samples, arsenic and lead were present in a few samples tested, regardless of the cultivation method.

In on-farm research of berries, in most cases, higher polyphenol content and *in vitro* antioxidant properties were measured in organically grown berry samples. Still, only a few species showed significantly more favourable values over two years than their conventional counterparts. Two-year results showed that organically grown blackberry and redcurrant samples had significantly higher polyphenol content than their conventional counterparts. Anthocyanins, the compounds that provide the intense red-purple colour of the fruit, were found to be significantly higher in organically grown blackberry, redcurrant, and blackcurrant samples than in their conventionally grown counterparts. In terms of *in vitro* antioxidant characteristics, organic blackberries showed significantly higher hydrogen-donating ability, exceeding the values of the conventional samples, and organic red currant and blackcurrant samples showed significantly higher reducing power than their conventional counterparts.

Based on three-year tomato research, organoleptically relevant nutritional characteristics such as water soluble solids (Brix°), carbohydrates and acidity and their ratios to each other were more favourable in conventionally grown tomatoes than in organically grown ones. In the case of lycopene, the bioactive compound that gives tomatoes their red colour, three of the nine varieties (Gadrener's Delight, San Marzano, Strombolino) gave significantly better values for the conventional samples than for the organic ones. By contrast, in terms of polyphenol content, which is also a bioactive component, all organically grown tomato varieties showed higher value than the conventional ones. In 2008, the organically grown Brigade F1 and Red Code F1, while in 2011, the hybrid Strombolino had significantly higher polyphenol content than their conventionally grown counterparts.

2.) Results of the organic food consumer questionnaire

Following an overview of the nutritional values of organic food products, a survey was conducted on how consumers in Hungary perceive the nutritional value of organic food, to what extent the importance of quality and organic production methods avoiding the use of chemicals is reflected in their choice decisions, and whether consumers consider organic food to have a more favourable nutritional value than conventional food. As the survey was conducted in 2022, at the end of the COVID-19 epidemic, it was possible to assess consumer attitudes towards organic food during this unusual period. Although the number of responses to the questionnaire does not allow the sample to be considered representative, the size of the sample (n=555) is large enough to allow conclusions to be drawn and patterns to be identified.

The survey of organic food consumption habits showed that only a small minority of respondents consumed organic food regularly. 2% of the respondents bought organic food daily, 28% weekly, 35% monthly, 23% every six months or less, while 12% never bought organic food. A significant connection was found between the purchase of organic food and age ($\chi 2=31.010$, df=5, $\alpha=0.000$). A higher proportion of those who purchase organic food belonged to the 35-54 age group, while younger people (18-24 years) tended to avoid organic food in higher proportion compared to other age groups. The frequency was similar. Daily buyers belonged predominantly to the 45-54 age group, while those who bought several times a week were most numerous in the 35-44 age group. The proportion of "non-buyers" was the highest in the 18-24 age group ($\chi 2=80.181$, df=35, $\alpha=0.000$). Regular buyers were predominantly middle-aged, highly educated women with higher incomes.

Organic food purchasing patterns in 2020-2021 (during the first five waves of the COVID-19 epidemic) were as follows: 6% of respondents increased their organic product purchases by more than 50%, 12% increased their organic product purchases by between 20% and 50%, and 34% increased their organic

product purchases by less than 20%. This means that more than half of the respondents (52%) increased their purchase of organic products in 2020 and 2021 compared to the previous period, while there is a narrow group of respondents who have never purchased this type of product (4.7%). More than a third of the respondents (36.4%) did not change the frequency of their organic food purchases during the period. Age also played a significant role in this change of habits. The young age group did not change their organic food purchasing habits, while consumption increased to a lesser extent among those over 35 ($\chi 2 = 62.915$, $df = 35$, $\alpha = 0.003$).

The awareness assessment of the organic certification trademarks showed that nearly half of the respondents were aware of the EU organic logo and nearly 70% recognised correctly the trademarks of the two Hungarian organic certification bodies.

The survey found that organic fruits and vegetables were the most popular and most frequently purchased products, followed by eggs, vegetable and fruit juice, cereals, flour, milk and dairy products. For all product groups, a significant correlation was found between the frequency of purchase and the willingness to pay a higher price for it, i.e. the more often someone buys a particular type of organic food, the more likely he or she is to be willing to pay a higher price for it.

The most common places of purchase were discounters, drugstores and hypermarkets, with an outstanding proportion of the daily/weekly shopping in discount stores. Organic food is also frequently purchased by respondents in eco-food shops, traditional markets and supermarkets. Frequency is lower at organic producers, independent retailers and via domestic retail chains. Organic markets and online shops were the least frequent options for purchasing these products.

Among the decision preferences, quality, composition, and price were the most important criteria for consumers, with place of origin being of medium importance, while presentation, packaging, and advertising were less important.

In my research, the responses to the questions on the motivation for buying organic food showed that for respondents the most important aspect of buying organic food was that the product was free of synthetic pesticide residues. Therefore, I considered it important to find out what proportion of the respondents agreed that pesticide residues were harmful to health. All respondents agreed that the use of pesticides has a negative impact on health. However, they were almost equally divided on whether all or only some of them were harmful, and in what quantities. Only 0.5% of the respondents said that none of the pesticide residues had a negative effect on health. Almost 38% of respondents considered pesticide residues above a certain threshold to be harmful to health, while 30% considered them harmful only in some cases and 32% considered them to be always harmful regardless of the amount. Importantly, however, there was a significant relationship between different opinions and age groups ($\chi 2=49.548$, $df=20$, $\alpha=0.000$). A higher proportion of the 35-54 age group,

who were more frequent buyer believed that all pesticide residues were harmful to health, while, for example, a younger age group believed that only some products or only above a certain level could cause problems.

In the consumer attitudes survey, respondents ranked the absence of contaminants as the most important attribute, followed by the health benefits of organic food compared to conventional food. The better nutritional composition of organic food and the scientific evidence that they are healthier also ranked in the top half of the list. This suggests that consumers perceive organic foods as having better nutritional values than their conventional counterparts and assume that they are scientifically proven to be healthier. According to the consumer attitudes survey, a moderately important characteristic was the positive environmental attribute of organic food production, which is related to sustainability and the protection of future generations.

Among the main factors that encourage people to start buying organic food and to increase existing consumption, the reduction of consumer prices was clearly the most important, followed by the widening of access, and then the availability of organic food in schools, e.g. in cafés and canteens. Scientific evidence of health benefits, personal health education and personal information on the benefits of organic products were also important aspects for the consumers (as the average here is also above 3 on the Likert scale).

## 4. Conclusions and recommendations

In addition to answering the questions set out in the objectives, I have drawn the following conclusions and suggestions in my research:

1.) Analysis of the nutritional characteristics of fruits and vegetables from conventional and organic production

*1.1. Is there a significant difference in mineral and polyphenol content, in vitro antioxidant characteristics and potentially toxic heavy metal content between the organic and conventional fruit and vegetable juices available in the domestic market?*

When comparing organic and conventional fruit and vegetable juices available in the domestic market, only trend differences were found with some organic juices having higher calcium, potassium and polyphenol content and higher *in vitro* antioxidant capacity than their conventional counterparts. The results of the heavy metal analysis clearly show that neither conventional nor organic farming can be fully protected from pollutants of environmental origin. Several factors other than cultivation methods are responsible for heavy metal contamination in food, such as industrial emissions, transport, processing, storage, packaging, etc.

*1.2. Is there a significant difference in bioactive compounds and in vitro antioxidant characteristics between the organic and conventional berry fruits used in the research, such as blackcurrant (Ribes nigrum, Titania), redcurrant (Ribes rubrum, Jonkheer van Tets), raspberry (Rubus idaeus, Fertődi Zamatos) and blackberry (Rubus rusticanus var. Inermis, Thornfree)?*

Two years of research on berries revealed significant differences, concluding that organically grown blackberries, redcurrants and blackcurrants have significantly higher polyphenol and anthocyanin content than their conventionally grown counterparts. In terms of *in vitro* antioxidant characteristics, organic blackberries showed significantly higher hydrogen-donating ability and organic redcurrant and blackcurrant had significantly stronger reducing power than conventional ones.

Research results suggest that consuming these organic berries may contribute to a higher dietary intake of antioxidants (polyphenols, anthocyanins) in the human body.

I recommend a systematic comparative study of organic and conventional fruit grown in the Carpathian Basin over several years with a larger sample size to analyse the variation of fruit characteristics depending on the year for a better understanding of the impact of cultivation methods.

*1.3. Is there a significant difference in organoleptically relevant nutritional components and bioactive compounds between organic and conventional tomatoes (Solanum lycopersicum,* Gardener's Delight, San Marzano, Saint Pierre, Brigade F1, Triple Red F1, UG Red F1, Red Code F1, Uno Rosso F1 and Strombolino F1*) included in my study?*

In the three-year study of tomatoes, the organoleptically relevant nutritional characteristics (water soluble solids, carbohydrates and acidity and their ratios to each other) were significantly more favourable in the conventional samples. Among the bioactive compounds, lycopene was present in higher amounts in the conventional samples of the research. In contrast, the polyphenol content, which is also a bioactive component, was higher in the organically grown samples of all tomato cultivars than in their conventionally grown counterparts.

In the case of tomatoes, all but two of the varieties used in the experiments were industrial tomato varieties bred for elevated lycopene content and conventional cultivation. Accordingly, the conventional samples provided excellent sensory and quality characteristics essential for processing industrial tomatoes. In organic farming, where the use of external inputs is limited or even nonexistent, conscious variety selection is the key to successful cultivation and the production of high-quality crops - and products. In organic variety selection, traits such as resistance to abiotic, and biotic stresses are given higher priority than, for instance, elevated lycopene content. Currently, the availability of organically bred varieties and organic seeds is still very limited in Hungary. Therefore, I recommend designing and carrying out experiments using organic varieties and seeds in the future.

Based on my experimental experience, observations and literature, I assume that organic farming techniques - without artificial inputs - can activate the natural defence mechanisms of tomato plants and berries by exposing the plants to higher stress conditions, thus increasing the total polyphenol content of the fruit.

2.) Survey on organic food consumption habits

*2.1. How aware are consumers of the organic certification labels?*

The results of my research differ from the assumption of other national research suggesting that the awareness of the EU organic logo in Hungary is relatively low (TÖRÖK et al., 2019). According to my study, almost half of the respondents were aware of the EU organic logo, while about 70% of them were aware of the Hungarian organic certification logo. In one-fifth of the cases, respondents confused the organic certification mark with labels carrying an eco-friendly, or vegan message, which may also lead them to mistakenly believe that they are buying organic food. The results confirmed that there is a continued need for information, credible and clear communication and education of consumers about the organic certification marks to increase the recognition of organic

certification marks and to avoid confusion with other marks.

I propose to develop and make available educational materials explaining the principles of organic farming, the precise definition of organic food, and the identification of organic food labelling (especially the EU organic logo), and to conduct promotional campaigns for the Hungarian population, from kindergarten to higher educational levels.

*2.2. What is the purchase frequency of organic products, which are the most popular products and distribution channels and what are the main consumer motivations?*

a) Purchase frequency

In my survey, I found a different shopping pattern from that in Western Europe: almost a third of the respondents bought organic products weekly, almost two-thirds at least once a month, almost a quarter bought less frequently, while 12% did not buy organic products at all. From a marketing perspective, it is a challenge to encourage consumers to buy organic food more often and to convince current non-consumers to find value in and consume this food category. It should also be noted that the frequency of purchases also depends, among other things, on the product categories available in the organic food retailers' offer.

b) Product groups

In my survey, organic fruit and vegetables were the most popular and most frequently purchased products. The preferred order of products following these two product groups in my survey differed from the order measured in previous national and international surveys. While in the SZENTE et al. (2011) survey in Hungary, the most frequently chosen products were vegetables and fruits (14.4%) milk and dairy products (6.9%) and bakery products (3.4%), in the research of NAGY-PÉRCSI and FOGARASSY (2019), vegetables and dairy products were the most frequently chosen products for consumers of organic food. This order had changed slightly. In my 2020-2022 survey of purchasing habits, vegetables and fruits were followed by eggs, then processed fruit and vegetable products, milk and dairy products, cereals and flour.

c) The distribution channels

In terms of distribution channels, my research showed that the most popular places of purchase were discount stores, drugstores and hypermarkets. The proportion, number and total value of purchases in discount stores is increasing year on year, which is important because these places have a high proportion of day-to-week shopping. Nowadays, as a result of the globalisation of food supply chains, consumers in Hungary have access to an ever-increasing range of organic products, as many discount stores, drugstores, hypermarkets and supermarkets include them in their offer. While international trends show that in countries with significant organic markets, the majority of sales are made through

the retail sector and online purchases (PEKALA, 2020), in my research, online sales were in last place. This may be due to the low share of organic food in online food sales in our country. Given that organic products are a kind of credence goods, most consumers tend to buy directly from producers - at least that is what some researchers have found in their surveys (SZENTE & TORMA, 2015). According to a survey conducted by SZENTE (2015), those who love organic food, pay attention to local origin. In my research, however, I found a different result, namely that for consumers, origin and the producer are less important. The sale of organic products through retail chains has increased in recent years in Hungary, allowing wider availability. It is important to highlight here that modern techniques (e.g. QR codes on product packaging) can play an important role in providing consumers with immediate and reliable information about the product at the point of purchase. For example, it is possible to check the origin, the cultivation technology, the product description and the traceability system, which can be a major key to building consumer trust.

d) Consumer motivations

The research shows that the most important decision preference for consumers was quality, followed by ingredients and price. My results differ from the national and international literature, according to which for the vast majority of consumers, the most important decision criterion and also the biggest barrier to buying organic products is the market price (SZENTE & TORMA, 2015; YADAV et al, 2019; WU & TAKÁCS-GYÖRGY, 2022). For organic food, advertising plays a much smaller role in the purchase decision than for conventional products, ranking last in the decision criteria based on my results. This may be due to the fact that awareness plays a more important role in the purchasing decision for organic food than for conventional products. Organic food is positioned for consumer groups who are more health-conscious and therefore less influenced by advertising on their decision preferences.

*2.3. How did the purchase frequency of organic food change in the years 2020-2021 (during the COVID-19 pandemic)?*

Half of the respondents increased their purchases of organic food in the survey period for several reasons. The increase is partly due to a significant rise in consumer interest in healthy foods as a result of the pandemic, and partly due to increased environmental awareness and availability of products. I also examined the impact of the COVID-19 pandemic on organic food consumption at the time of the survey. Interestingly, the responses generally show that the pandemic did not significantly increase organic food consumption, and even the demand for healthier food was lower than expected. It is important to note that the responses showed a wide standard deviation. Although the pandemic seems to have had an impact on organic food consumption, this impact was not significant among the respondents, but the underlying trend is that the change is

upwards, i.e. more purchases were being made, but not fundamentally because of the COVID-19 pandemic.

*2.4. How do consumers perceive the health benefits of organic food?*

In the consumer attitudes survey, respondents ranked the absence of contaminants as the most important attribute of organic food. In addition, for the question on the impact of pesticide residues in food on human health, consumers clearly agreed that the use of pesticides had a negative impact on health, which is a unique survey result in that it has not been tested in a Hungarian consumer survey before. In my survey, respondents were well informed about the adverse health effects of pesticide residues, but their opinions differed on the amount. There is also a need to provide science-based information to Hungarian consumers on this issue.

The improved nutritional composition of organic food and the scientific evidence of its healthier nature were also considered important by the respondents. This suggests that consumers perceive organic foods to have better nutritional values than their conventional counterparts and that there is scientific evidence that these products are perceived as healthier by the respondents.

Considering that scientific research (nutritional comparisons, human diet studies) shows a somewhat more nuanced picture, it is essential to inform consumers accurately and continue further research on this topic. While over-idealising organic food may lead to consumer disappointment, it is important to report realistic, already proven scientific results accurately to consumers, as recent systematic literature reviews and meta-analyses have shown significant and nutritionally relevant differences in the components of organic and conventional foods. These included higher levels of antioxidants, lower cadmium and pesticide residues in organic products (BARAŃSKI et al., 2014), higher omega-3 fatty acid concentrations in organic meat and dairy products (ŚREDNICKA-TOBER et al., 2016a; ŚREDNICKA-TOBER et al., 2016b), and lower dietary exposure to pesticide residues (BRADMAN et al., 2015; CURL et al., 2015; BAUDRY et al., 2019; VIGAR et al., 2020). My research showed that young people aged 18-24 are particularly interested in the positive health effects of organic food.

Therefore, I propose to develop a priority marketing programme for the young Generation Z (15-29 year-olds), given that in my survey the 18-24 year old age group showed a strong interest in the health benefits of organic food. Given that Generation Z knows more about sustainable living than previous generations and has a strong sense of social responsibility, they prioritise their health and their quality of life when making food choices, and are even willing to pay a premium price for food that they perceive as healthier. On this basis, I propose to carry out information and marketing campaigns for this target group. This is also important because in 20-30 years this age group could represent the main organic consumer group. Since quality and health are the dominant motives

for them, it would be worth involving opinion leaders such as doctors and nutritionists in promotional campaigns who can give clear and credible information on the benefits of organic food consumption. It is also important for them to ensure access to organic food through digital means, e.g. by providing information that meets the needs of this generation and ensuring easy online shopping.

I also suggest that the most stable group of organic food consumers, the 35-54 age group, should be provided with adequate information to retain them.

*2.5. What are the main factors promoting the start and growth of organic food purchases?*

Of the main factors that encourage people to start buying organic food and to increase existing consumption, reducing consumer prices is clearly the most important. Direct sales or the use of other short supply chains could be a significant price reducing factor (GYÖRE & JUHÁSZ, 2012). In contrast, my survey found that respondents relatively rarely buy directly from organic producers. As a result of community-supported farming, producers can play a significant role in reducing barriers to organic food purchases by increasing the credibility and trust towards organic food through closer contact with consumers. As affordable prices would play a major role in increasing the organic food market, it is important to target producers and consumers with practical and theoretical information on the forms of marketing (direct sales: online marketing, farm-to-marketing, door-to-door marketing, box regular sales) where they can sell their products at the lowest possible price while ensuring a fair income for the producers. I recommend continuing information and promotion campaigns on alternative, direct sales methods for both producers and consumers in the future.

In summary, I suggest that a well-designed, targeted marketing strategy, tailored to the needs of different age groups, should be developed in the future. This could contribute significantly to the growth of the domestic organic food market. This strategy should include affordable prices, a range of products tailored to consumer needs, raising consumer awareness and communication based on scientific evidence, as well as ensuring continued availability.

## 5. Overview of new scientific results

I found the following new scientific results in my research:

1. The juices produced from certain organically grown vegetables and fruits available on the domestic market, as well as organically grown blackcurrants (*Ribes nigrum*, Titania), redcurrants (*Ribes rubrum*, Jonkheer van Tets), raspberries (*Rubus idaeus*, Fertődi Zamatos), blackberries (*Rubus rusticanus var. Inermis*, Thornfree), and tomatoes (*Solanum lycopersicum*, Brigade F1, Red Code and Strombolino), had significantly higher polyphenol content than their conventionally produced counterparts.

2. In terms of organoleptic characteristics (Brix°, carbohydrate and acidity content and their ratios), tomatoes for industrial use from conventional production (*Solanum lycopersicum*, Brigade F1, Triple Red, UG Red, Red Code, Uno Rosso and Strombolino) showed higher values than tomatoes from organic production.

3. In the case of tomatoes (*Solanum lycopersicum*, Gadrener's Delight, San Marzano, and Strombolino), conventionally grown tomatoes had significantly higher lycopene content than their organically grown counterparts.

4. Organically grown blackcurrant (*Ribes nigrum*, Titania), redcurrant (*Ribes rubrum*, Jonkheer van Tets) and blackberry (*Rubus rusticanus var. Inermis*, Thornfree) had significantly higher anthocyanin contents than their conventional counterparts.

5. In the *in vitro* antioxidant characteristics assay, organic blackcurrant (*Ribes nigrum*, Titania), and redcurrant (*Ribes rubrum*, Jonkheer van Tets) had significantly higher reducing power, while organic blackberry (*Rubus rusticanus var. Inermis*, Thornfree) had significantly higher hydrogen-donating ability than conventional ones.

6. Based on the questionnaire survey results, I found that respondents believe that organic food contains fewer contaminants, has a more favourable composition of ingredients and is healthier than conventional food, which most of the respondents consider to be scientifically justified.

7. The most important decision-making criterion for respondents when buying organic food is the absence of synthetic pesticide residues. In terms of consumer perceptions of pesticide residue content in food, the vast majority of respondents consider pesticide residues to have a negative impact on health.

8. The most important of the main factors that encourage people to start buying organic food regularly and to increase existing consumption is the reduction of consumer prices. My survey shows that respondents buy relatively rarely directly from organic producers. Direct sales and the use of other short supply chains could be a significant price reduction factor - and also an environmentally friendly solution - that could help to increase direct purchases.

9. Based on a survey of consumers' awareness of organic food choices, I have concluded that there is a need to raise awareness and thus knowledge of the precise definition of organic food. There is also a need to raise awareness of organic food labelling, particularly the EU organic logo, especially among consumers who do not or rarely consume this kind of product, in order to increase the proportion of consumers who recognise it correctly and do not confuse it with other labels.

# 6. Publications related to the topic of the dissertation

## 6.1. Publications in international peer-reviewed journals

### *In a foreign-language, impact factor journal:*

K., PÉRCSI, K. N. - UJJ, A. - ESSOUSSI, W. - **KIS, GY. GY.** - JANCSOVSZKA, P. (2024). Food consumption habits of Hungarian organic food consumers and their policy implications. Agriculture, 14(1), 91. DOI: https://doi.org/10.3390/agriculture14010091

**GY. GYÖRÉNÉ KIS** - D. DREXLER - G SOÓS - A. LUGASI - A. UJJ (2023): Organic food consumption in Hungary - factors supporting consumption growth. European Countryside Journal Vol.15, No.4, pp.579-597. DOI: https://doi.org/10.2478/euco-2023-0031

**GY. GYÖRE-KIS** - K. DEÁK - A. LUGASI - A. CSÚR-VARGA - L. HELYES (2012): Comparison of conventional and organic tomato yield from a three year-term experiment. Acta Alimentaria: an International Journal of Food Science 41 : 4 pp. 486-493. , 8 p. DOI: https://doi.org/10.1556/aalim.41.2012.4.10

### *In a Hungarian language, non-impact factor journal:*

**GYÖRÉNÉ KIS GY.** - SOÓS G. - LUGASI A. (2022): Bioélelmiszerek fogyasztói szemmel. In: Lugasi, Andrea (szerk.) Tanulmánykötet 2023 a Magyar Táplálkozástudományi Társaság XLV. Vándorgyűlésén (Szeged, 2022. október 20-22.) elhangzott előadások alapján. Budapest, Magyarország: Magyar Táplálkozástudományi Társaság (2023) 128 p. pp. 55-66.

**GYÖRÉNÉ KIS GY.** - VARGA A. - LUGASI A. (2006): Az ökológiai (bio) és konvencionális termesztésű növényi élelmiszerek beltartalmának, táplálkozási értékének összehasonlítása. Orvosi Hetilap, 2006. 147. évf. 43. szám, 2081-2090 p.

**GYÖRÉNÉ KIS GY.** - VARGA T. - LUGASI A. (2006): Élelmiszerbiztonság - bioélelmiszerek 1. rész. Zöldség- és gyümölcsfélék antioxidáns-tartalma. Egészségesebb-e a biotermék? Élelmezés Ipar, 2006, 8.-9. szám, 203-207 p.

**GYÖRÉNÉ KIS GY.** - VARGA A. - LUGASI A. (2006): Élelmiszerbiztonság - bioélelmiszerek 2. rész. Zöldség- és gyümölcsfélék szennyezőanyag-tartalma.Biztonságosabb-e a biotermék? Élelmezés Ipar, 2006, 10.-11. szám, 241-246 p.

LUGASI A. - HÓVÁRI J. - **GYÖRÉNÉ KIS GY.** - KONTRASZTI M. - VÍGH I. - DÉNES F. (2007): Málna, szeder és ribiszke fajták beltartalmi jellemzői és antioxidáns vegyületei. Fertődi Gyümölcstermesztési Kutató-Fejlesztő Intézet Kht., Fertőd, ISSN 1588 7014, 2007. VI. (1), 59-73. p.

VARGA, A. - **GYÖRÉNÉ KIS, GY.** (2008): Növekvő fogyasztás - az ökoélelmiszerek minősége. Agronapló, XII.évf. 10-11.sz. 80-83. p.

### *Other professional (non-peer-reviewed) journal articles:*

**GYÖRÉNÉ KIS GY.** (2006): Óvja gyermeke egészségét ökoétrenddel! Biokultúra, 2006. 4. szám, 27. p.

**GYÖRÉNÉ KIS GY.** (2006): Ökoélelmiszerek beltartalma I. Növényvédőszer-maradvány tartalom - öko- kontra konvencionális élelmiszerek. Biokultúra, 2006. 5. szám, 28. p.

**GYÖRÉNÉ KIS GY.** - VARGA A. - LUGASI A. (2006): Ökoélelmiszerek beltartalma II. Antioxidánsok - öko- kontra konvencionális élelmiszerek. Biokultúra, 2006. 6. sz., 28. p.

## 6.2. Conference proceedings with ISBN, ISSN or other certification

### *Full text, peer-reviewed, in English:*

**GY. GYÖRÉNÉ KIS** - É. STEFANOVITS-BÁNYAI - A. CSÚRNÉ VARGA - A. LUGASI (2006): Mineral, trace element content and toxic heavy metal contamination in organic and conventional fruit and vegetable juices. 7th International Symposium on „Metal elements in environment, medicine and biology", 2006. nov. 6-8. In: Metal elements in Environment, Medicine and Biology. Tome VII. Eds: Zeno, G., Petru, D., ISBN (10) 973-620-238-0, Publishing House Eurobit, Timisoara, România, pp.191-196.

**GY. GYÖRÉNÉ KIS** - A. CSÚRNÉ VARGA - Z. MENYHÉRT - A. LUGASI (2008): Antioxidant Characteristics and Total Polyphenol Content in Organic and Conventional Black Currant (*Ribes nigrum*), Red Currant (*Ribes rubrum*), Raspberry (*Rubus idaeus*), and Blackberry (*Rubus rusticanus var, Inermis*). 16th IFOAM Organic World Congress, Modena, Italy, June 16-20, 2008, IFOAM Head Office, Bonn, Proceedings in CD.

### *Full text, peer-reviewed, in Hungarian:*

**GYÖRÉNÉ KIS GY.** - VARGA A. - MENYHÉRT Z. - LUGASI A. (2007): Ökológiai és konvencionális termesztésből származó bogyós gyümölcsök bioaktív anyag-tartalmának összehasonlítása. ISBN 978 963 9639 22 5, CD, XLIX. Georgikon Napok, Keszthely, 2007. szeptember 20-21.

### *Abstract in English or in Hungarian, based on oral presentation or poster:*

**GY. GYÖRÉNÉ KIS** - G. SOÓS - A. LUGASI (2022): Consumer perceptions towards organic food in Hungary. In: Lilla, Szalóki-Dorkó; Ildikó, Batáné Vidács; Pradeep, Kumar; Andrea, Pomázi; Attila, Gere (szerk.) 4th FoodConf - International Conference on Food Science and Technology. Book of Abstracts. Bicske, Magyarország : Élelmiszertudományért OKF Alapítvány pp. 83-83.

**GY. GYÖRÉNÉ KIS** - A. VARGA - Z. MENYHÉRT - A. LUGASI (2007): Polyphenol content and antioxidant properties of organically and conventionally grown berry fruits. Poster, 4th International Conference on Polyphenols Application, Malta, ISBN 978 2 35609 007 2, Abstract book, november 14-16 2007, 105-106. p.

A. LUGASI - J. HÓVÁRI - **GY. GYÖRÉNÉ KIS** - F. DÉNES (2007): Antioxidant and technologically important compounds in berry fruits harvested in Hungary. Poster, 4th International Conference on Polyphenols Application, Malta, ISBN 978 2 35609 007 2, Abstract book, november 14-16 2007, 113-114. p.

**GY. GYÖRÉNÉ KIS** - A. VARGA - Z. MENYHÉRT - A. LUGASI (2008): Antioxidant Characteristics and Total Polyphenol Content in Organic and Conventional Black Currant (*Ribes nigrum*), Red Currant (*Ribes rubrum*), Raspberry (*Rubus idaeus*),

and Blackberry (*Rubus rusticanus var, Inermis*). 16th IFOAM Organic World Congress, Modena, Italy, June 16-20, 2008, Cultivate the future, Book of Abstracts, IFOAM Head Office, Bonn, ISBN 978-3-940946-03-4, p 85.

**GY. GYÖRÉNÉ KIS** - A. VARGA - Z. MENYHÉRT, - A. LUGASI (2007): Comparison of the bioactive material content of berry fruits originating from organic and conventional production. ISBN 978 963 9639 20 1, Poster, 49th Georgikon Scientific Conference, „Agri-buisness for Rural Development, Environment and Quality of Life", Keszthely, 2007. szeptember 20-21., 103. p.

**GY. GYÖRÉNÉ KIS** - A. VARGA, Z. MENYHÉRT, A. LUGASI (2007): A comparison of polyhpenol content and antioxidant properties of organically and conventionally grown berry fruits. ISBN 978 963 06 3270 6, Poster, Lippay János - Ormos Imre - Vas Károly Scientific Conference, 7-8 november, 2007, Budapest, 191. p.

A. LUGASI - **GY. GYÖRÉNÉ KIS** - J. HÓVÁRI - I. VÍGH - F. DÉNES (2007): Polyphenol and flavonoid content of berry fruits in correlation of species and varieties. ISBN 978 963 06 3270 6, Lippay János - Ormos Imre - Vas Károly Scientific Conference, 7-8 november, 2007, Budapest, 183. p.

**GYÖRÉNÉ KIS GY.** - SOÓS G. - LUGASI A. (2022): Bioélelmiszerek fogyasztói szemmel. In: Biró, Lajos; Gelencsér, Éva; Lugasi, Andrea; Rurik, Imre (szerk.) Magyar Táplálkozástudományi Társaság XLV. Vándorgyűlése : Program füzet és összefoglalók. Budapest, Magyarország : Magyar Táplálkozástudományi Társaság (2022) 77 p. p. 34.

**GYÖRÉNÉ KIS GY.** - MENYHÉRT Z. - CSÚRNÉ VARGA A. - LUGASI A. (2006): Hazai kereskedelmi forgalomban kapható öko- és konvencionális zöldség- és gyümölcsfélék antioxidáns tartalmának vizsgálata. Magyar Táplálkozástudományi Társaság XXXI. Vándorgyűlése, Keszthely, 2006. október 5.-7. Előadás, nyomtatott összefoglalóval. ISSN 1589 7311. Metabolizmus, IV. Évf. 4. szám, 2006. december. 310-311. p.

**GYÖRÉNÉ KIS GY.** - VARGA A. - MENYHÉRT Z. - LUGASI A. (2007): Ökológiai és konvencionális termesztésből származó bogyós gyümölcsök bioaktív anyag-tartalmának összehasonlítása. ISBN 978 963 9639 20 1, Poszter, XLIX. Georgikon Napok „Agrárgazdaság a vidékért, a környezetért, az életminőségért", Keszthely, absztrakt kötet, 2007. szeptember 20-21., 103. p.

**GYÖRÉNÉ KIS GY.** - MENYHÉRT Z. - VARGA A. - LUGASI A. (2007): Ökológiai és konvencionális termesztésű bogyós gyümölcsök polifenol-tartalmának és antioxidáns tulajdonságainak összehasonlítása. Poszter, Lippay János - Ormos Imre - Vas Károly Tudományos Ülésszak, Budapest, ISBN 978 963 06 3270 6, Absztrakt kötet, 2007. november 7-8., 190. p.

**GYÖRÉNÉ KIS GY.** - VARGA A. - LUGASI A. (2007): Bio- és konvencionális termesztésű bogyós gyümölcsök polifenol-tartalmának és antioxidáns tulajdonságainak vizsgálata. Előadás, Magyar Szabadgyök Kutató Társaság IV. Kongresszusa, Pécs, 2007. október 11-13., Folia Hepatologica, Májkutatás Alapítvány, ISSN 1419 1156, 2007. Vol. 11. Suppl. 3., 18-19. p.

**GYÖRÉNÉ KIS GY.** - MENYHÉRT Z. - VARGA A. - LUGASI A. (2007): Bio- és

konvencionális fagyasztott bogyós gyümölcsök antioxidáns hatású összetevőinek vizsgálata. Előadás, Magyar Táplálkozástudományi Társaság XXXII. Vándorgyűlése, Kecskemét, ISBN 978 963 06 3242 3, Absztrakt kötet, 2007. október 18-20., 18. p.

LUGASI A. - **GYÖRÉNÉ KIS GY.** - HÓVÁRI J. - VÍGH I. - DÉNES F. (2007): Bogyós gyümölcsök polifenol-tartalma és flavonoid összetétele a faj és a fajta függvényében. Előadás, Lippay János - Ormos Imre - Vas Károly Tudományos Ülésszak, Budapest, ISBN 978 963 06 3270 6, Absztrakt kötet, 2007. november 7-8., 182. p.

**GYÖRÉNÉ KIS GY.** - MENYHÉRT Z. - CSÚRNÉ VARGA A. - LUGASI A. (2006): Bio- és konvencionális zöldség- és gyümölcslevek antioxidáns-tartalma. Magyar Szabadgyök-kutató Társaság, 2006. szeptember 11. Előadás, nyomtatott összefoglalóval. 11.p.

**GYÖRÉNÉ KIS GY.** - MEGYHÉRT Z. - VARGA A. - LUGASI A. (2007): Bio- és konvencionális termesztésből származó élelmiszerek beltartalmának összehasonlítása. Előadás. Wellness Konferencia, Pécs, Absztrakt kötet, 2007. március 30.-31., 20-21. p.

**GYÖRÉNÉ KIS, GY.** - LUGASI, A. (2008): A bio és iparszerű termelésből származó termékek összehasonlítása néhány példán keresztül. A Kárpátok-Eurorégió élelmiszerlánc felügyeleti körképe, Az Európai Élelmiszerlánc Parlament megalakítása, bemutatása, Visegrád, 2008. november 25-27., Konferencia kiadvány, Visegrad Fund, 187. p.

LUGASI A., PÉK Z., BRANDT S., **GYÖRÉNÉ KIS GY**., HÓVÁRI J., HELYES L. (2009): Mit tudunk ma a likopinról? Magyar Szabadgyök-Kutató Társaság 5. Kongresszusa, Szeged, 2009. augusztus 27-29. Absztrakt füzet 12 p.

### 6.3. Book, book chapter, educational materials

VARGA, A. - **GYÖRÉNÉ KIS, GY.** (2008): Növénytermesztés és élelmiszerminőség. Egyetemi jegyzet, SZIE MKK KTI, Szent István Egyetemi Kiadó, Gödöllő, ISBN 978-963-269-012-4, 119. p.

# 7. References


A.O.A.C. (1990): Official Methods of Analysis. 15th edition, Arlington USA 952.03/A-C.

BARAŃSKI, M., ŚREDNICKA-TOBER, D., VOLAKAKIS, N., SEAL, C., SANDERSON, R., STEWART, G. B., BENBROOK, C., …& LEIFERT, C. (2014): Higher antioxidant and lower cadmium concentrations and lower incidence of pesticide residues in organically grown crops: a systematic literature review and meta-analyses. British Journal of Nutrition, 112(5), 794-811. p.

BAUDRY J., DEBRAUWER L., DURAND G., LIMON G., DELCAMBRE A., VIDAL R., TAUPIER-LETAGE B., DRUESNE-PECOLLO N., …& KESSE-GUYOT E. (2019): Urinary pesticide concentrations in French adults with low and high organic food consumption: Results from the general population-based NutriNet-Santé J. Expo. Sci. Environ. Epidemiol. 29:366-378. p.

BICKEL, R., ROSSIER, R. (2015): Nachhaltigkeit und Qualität biologischer Lebensmittel. Forschungsinstitut Für Biologischen Landbau, 2(1405), 1-28. p.

BLOIS, M. S. (1958): Antioxidant Determinations by the Use of a Stable Free Radical. Nature, 181(4617), 1199-1200. p.

BRADMAN A., QUIRÓS-ALCALÁ L., CASTORINA R., SCHALL R.A., CAMACHO J., HOLLAND N.T., BARR D.B., ESKENAZI B. (2015): Effect of organic diet intervention on pesticide exposures in young children living in low-income urban and agricultural communities. Environ. Health Perspect. 123:1086-1093. p.

CABRERA, C., MEDINA, L., PASTOR, P. (2022): The 2020 European Union report on pesticide residues in food. EFSA Journal, 20(3).

CURL, C. L., FENSKE, R. A., ELGETHUN, K. (2003): Organophosphorus pesticide exposure of urban and suburban preschool children with organic and conventional diets. Environmental Health Perspectives, 111(3), 377-382. p.

DANGOUR, A. D., DODHIA, S. K., HAYTER, A., ALLEN, E., LOCK, K., UAUY, R. (2009): Nutritional quality of organic foods: a systematic review. The American Journal of Clinical Nutrition, 90(3), 680-685. p.

EFSA (2018): Monitoring data on pesticide residues in food: results on organic versus conventionally produced food. EFSA Journal, 15(4), e1397.

GLIBOWSKI, P. (2020): Organic food and health. Roczniki Państwowego Zakładu Higieny, 131-136. p.

GYÖRE D., JUHÁSZ A. (2012). A közvetlen termelői értékesítés gyakorlata és lehetőségei Magyarországon. Pannon Egyetem Georgikon. LIV. Georgikon Napok. A mezőgazdaságtól a vidékgazda(g)ságig (elektronikus dok.): 54rd Georgikon Scientific Conference. 184-191. p.

HATANO, T., KAGAWA, H., YASUHARA, T., OKUDA, T. (1988): Two new flavonoids and other constituents in licorice root. Their relative astringency and radical scavenging effects. Chemical and Pharmaceutical Bulletin, 36(6), 2090-2097. p.

HSU, S. Y., CHANG, C., LIN, T. T. (2019). Triple bottom line model and food safety in organic food and conventional food in affecting perceived value and purchase intentions. British Food Journal, 121(2), 333-346. p.

KOWALSKA, A., RATAJCZYK, M., MANNING, L., BIENIEK, M., ACIK, R. M., FANELLI, R. M. (2021): “Young and Green” a Study of Consumers’ Perceptions and

Reported Purchasing Behaviour towards Organic Food in Poland and the United Kingdom. Sustainability, 13(13022), 1-23. p.

MALISSIOVA, E., TSOKANA, K., SOULTANI, G., ALEXANDRAKI, M., KATSIOULIS, A., MANOURAS, A. (2022): Organic food: A Study of consumer perception and preferences in Greece. Applied Food Research, 2(100129), 1-7. p.

MDITSHWA, A., MAGWAZA, L. S., TESFAY, S. Z., MBILI, N. (2017): Postharvest quality and composition of organically and conventionally produced fruits: A review. Scientia Horticulturae, 216, 148-159. p.

MEADOWS, A. D., SWANSON, S. A., GALLIGAN, T. M., NAIDENKO, O. V., O'CONNELL, N. S., PERRONE-GRAY, S., … & LEIBA, N. (2021). Packaged foods labeled as organic have a more healthful profile than their conventional counterparts, according to analysis of products sold in the u.s. in 2019-2020. Nutrients, 13(9), 3020.

MERCK & CO (1989): Merck index, 11th edition, Rahway, NJ, USA, 884 p.

MIE, A., ANDERSEN, H. R., GUNNARSSON, S., KAHL, J., KESSE-GUYOT, E., REMBIAŁKOWSKA, E., QUAGLIO, G., GRANDJEAN, P. (2017): Human health implications of organic food and organic agriculture: A comprehensive review. In Environmental Health: A Global Access Science Source, 16(1).

MOISANDER, J. (2007): Motivational complexity of green consumerism. International Journal of Consumer Studies, 31(4), 404-409. p.

MSZ EN 12143: Gyümölcs- és zöldséglevek. Az oldható szárazanyag-tartalom becslése. Refraktometriás módszer.

MSZ EN 12143: Gyümölcs- és zöldséglevek. Az oldható szárazanyag-tartalom becslése. Refraktometriás módszer.

MSZ ISO 750: Gyümölcs- és zöldségtermékek titrálható savtartalmának meghatározása

MURPHY, B., MARTINI, M., FEDI, A., LOERA, B. L., ELLIOTT, C. T., DEAN, M. (2022): Consumer trust in organic food and organic certifications in four European countries. Food Control, 133, 108484.

NOMISMA (2018): Tutti i Numeri del bio. I Driver del Consumatore e le Novità del Canale Specializzato, ed Zucconi S. (Osservatorio Sana 2018). http://www.sana.it/media//sana/press_release/2018/Nomisma-per-Osservatorio-Sana-2018.pdf Keresőprogram: Google. Kulcsszavak: bio, driver, consumatore. Lekérdezés időpontja: 2023.11.03.

OYAIZU, M. (1986): Studies on products of browning reaction. Antioxidative activities of products of browning reaction prepared from glucosamine. The Japanese Journal of Nutrition and Dietetics, 44(6), 307-315. p.

PEKALA, A. (2020): Market analysis of organic foods in the Nordic and Baltic countries. Nordic Council of Ministers. https://norden.diva-portal.org/smash/get/diva2:1386343/FULLTEXT01.pdf . Keresőprogram: Google. Kulcsszavak: organic foods, Nordic, Baltic. Lekérdezés időpontja: 2023.09.23.

RAMPL, V., L., EBERHARDT, T., SCHÜTTE, R., KENNING, P. (2012): Consumer trust in food retailers: conceptual framework and empirical evidence. International Journal of Retail & Distribution Management, 40(4), 254-272. p.

SADLER, G., DAVIES, J., DEZMAN, D. (1990): Rapid extraction of lycopene and β-carotene from reconstituted tomato paste and pink grapefruit homogenates. Journal of Food Science, 55, 1460-1461. p.

SAJTOS L., MITEV A. (2007): SPSS Kutatási és adatelemzési kézikönyv. Alinea Kiadó, 404. p.

SARUDI I. (1961): Szénhidrátanalitikai módszerek. Mérnöki továbbképző jegyzet, Budapest.

SMITH-SPANGLER, C., BRANDEAU, M. L., HUNTER, G. E., BAVINGER, J. C., PEARSON, M., ESCHBACH, P. J., SUNDARAM, V & BRAVATA, D. M. (2012): Are Organic Foods Safer or Healthier Than Conventional Alternatives? Annals of Internal Medicine, 157(5), 348. p.

ŚREDNICKA-TOBER, D., BARAŃSKI, M., SEAL, C., SANDERSON, R., BENBROOK, C., STEINSHAMN, H., … & LEIFERT, C. (2016a): Composition differences between organic and conventional meat: a systematic literature review and meta-analysis. British Journal of Nutrition, 115(6), 994-1011. p.

ŚREDNICKA-TOBER D., BARAŃSKI M., SEAL C.J., SANDERSON R., BENBROOK C., STEINSHAMN H., GROMADZKA-OSTROWSKA J…& LEIFERT C.(2016b): Higher PUFA and n-3 PUFA, conjugated linoleic acid, α-tocopherol and iron, but lower iodine and selenium concentrations in organic milk: a systematic literature review and meta- and redundancy analyses. Br J Nutr 115(6):1043-1060. p.

SZENTE V. (2015): Consumer motivations in the purchase of organic foods in Hungary. Acta Fytotechnica et Zootechnica, 18(Special Issue).

SZENTE V., SZAKÁLY Z., SZÉLES G. (2011): Ökoélelmiszerek megítélése Magyarországon - alakuló fogyasztói tudatosság. Gazdálkodás, 55(5), 512-520. p.

SZENTE V., TORMA D. (2015): Organic food purchase habits in Hungary. Journal of Economic Development, Environment and People, 4(1), 32. p.

THORSØE, M. H. (2015): Maintaining Trust and Credibility in a Continuously Evolving Organic Food System. Journal of Agricultural and Environmental Ethics, 28(4), 767-787. p.

TÖRÖK Á., JANTYIK L., MARÓ Z. M. (2019): Minőségjelzős élelmiszerek helyzete és kilátásai Magyarországon - Az EU biocímke esete. Vezetéstudomány / Budapest Management Review, 50(10), 13-25. p.

VEGA-ZAMORA, M., TORRES-RUIZ, F. J., MURGADO-ARMENTEROS, E. M., & PARRAS-ROSA, M. (2014). Organic as a heuristic cue: What Spanish consumers mean by organic foods. Psychology & Marketing, 31(5), 349-359. p.

VELIMIROV, A., MÜLLER, W. (2003). Die Qualität biologisch erzeugter Lebensmittel - Ergebnisse einer umfassenden Literaturrecherche (p. 59). Bio Ernte Austria.

VIGAR, V., MYERS, S. P., OLIVER, C., ARELLANO, J. M., ROBINSON, S., LEIFERT, C. (2019). A systematic review of organic versus conventional food consumption: is there a measurable benefit on human health? Nutrients, 12(1), 7. p.

WU, Y., TAKÁCS-GYÖRGY K. (2022): Comparison of Consuming Habits on Organic Food—Is It the Same? Hungary Versus China. Sustainability, 14(7800), 1-19. p.

YADAV, R., SINGH, P. K., SRIVASTAVA, A., AHMAD, A. (2019): Motivators and barriers to sustainable food consumption: Qualitative inquiry about organic food consumers in a developing nation. International Journal of Nonprofit and Voluntary Sector Marketing, 24(4), e1650.

ŻAKOWSKA-BIEMANS, S. (2011): Polish consumer food choices and beliefs about organic food. British Food Journal, 113(1), 122-137. p.