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The Study of Consumer Behaviour in the Honey Market with Emphasizing Quality and Nutritional Value

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RESEARCH ARTICLE

Abstract

The paper presents an interdisciplinary study involving consumer research complemented by analytical research. The research aim is to identify the mineral content of 5 different types of monofloral honey produced in Slovakia as well as the behaviour of Slovak honey consumers (n=600), but mainly their preferences and awareness of honey quality and its nutritional value. The results showed that honey produced by Slovak beekeepers contained trace and major minerals such as K, Ca, Mg, Na, Mn, Al, Fe, Ba, Sr, Li, Zn. The highest mineral content was identified in honeydew honey and linden honey while the lowest content was in acacia honey and rapeseed honey. Consumer research revealed that most consumers were not able to list nutritional values or specific minerals which are found in honey. The antibacterial activity was indicated by the majority of respondents as the most frequent positive effect of honey. The most preferred monofloral honey was honeydew honey followed by acacia honey and linden honey.

Keywords: biological value, honey consumer, mineral content, preferences, Slovakia.

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INTRODUCTION

One of the critical goals of public policy is to increase the consumption of nutritious and healthy food in the current environment (Blüher, 2019; Jiang et al. 2016). According to Afshin et al. (2017) and Murimi et al. (2017), economic incentives and nutrition education are examples of strategies to encourage healthy eating. Therefore, it can be stated that the promotion of healthy foods is rising (Chen et al. 2020). Considerable development in the food industry for nutrition, food processing and health has been made. Many consumers are now aware of the connection between specific food characteristics and health. Producers have introduced foods focusing on health (Grunert, 2017). Consumers are becoming more aware and proactively seeking food brands that promote health and well-being. Covid-19 contributed to the increased interest in health and healthy food consumption. The actions to stop the epidemic have altered daily living and brought significant changes in consumer behaviour (Sheth, 2020). Nonetheless, it might be challenging to determine which foods fall within the category of healthy (Chan and Zhang, 2022). As argued by Grunert (2017), consumers must have specific knowledge about what constitutes healthy products and healthy eating. Nutrition knowledge is an essential part of health

literacy. Low health literacy is linked with poor health results, so research is needed to inform society about nutrition education and public health policy (Spronk et al. 2014). Information is needed to understand food and diet composition and help to make the right product choices. Several studies show a link between understanding nutrition and proper eating habits (Handu et al. 2008; Lee et al. 2009). Consumers' perceptions of healthy foods can be influenced by intrinsic (such as nutrition) and extrinsic (such as packaging colour) aspects (Motoki et al. 2020). Regarding health, middle-aged and older consumers tend to be more health-conscious than the younger generation. Older people are affected by health problems and are exposed to a greater risk of disease (Olsen, 2003; Verbeke, 2005). Higher education and income levels correlate with increased consumption of healthy foods (Roux et al. 2000).

Healthy foods include products for consumers that control their dietary intake, including consumers who have developed specific preferences for or against certain food ingredients, such as gluten or lactose. This also includes products enriched or modified to have specific health benefits, so-called functional foods, where the health benefit is usually communicated as a health claim (Grunert, 2017).

It has been reported that a growing range of functional products involves various bee products (Kowalski and Makarewicz, 2017). Bee products are often used to enhance the nutritional value of other food products. Moreover, bee products are an excellent source of natural nutrients and provide a plentiful supply of biologically active compounds. (Bobis et al. 2010; Kolayli and Keskin, 2020; El Ghouizi et al. 2023). Human health is positively impacted by the high nutritional value and favourable benefits of honey, pollen, bee bread, royal jelly, and propolis. Proteins, simple carbohydrates, essential amino acids, and monounsaturated fatty acids are contained in bee products. These characteristics boost immunity, aid in the body's active bacterial defence, encourage high-quality tissue regeneration, and as a result, safeguard and improve general bodily health. The available evidence points to the increasing importance of bee products as a functional food to protect health with nutritious characteristics (Yucel et al. 2017). Moreover, they are the subject of rising research interest. They have been mostly known due to their nutritional benefits and medicinal features (Tafere, 2021). The benefits of bee products for health, medicine and nutrition have been proved in ancient Egypt, Greece and China (El-Seedi et al. 2020). It has been reported that several bee products, including honey, propolis, bee pollen, royal jelly, bee venom, bee bread, and beeswax, are potential sources of bioactive substances with therapeutic effects. They treat various infections brought on by viruses, bacteria, and parasites (Olas, 2022; Afrin et al. 2020; Oroian, 2012). According to several studies, popular bee products, including honey, propolis, royal jelly, bee pollen, and bee venom, have a high potential for treating various types of cancer (Afrin et al. 2020; Rehman and Majid, 2020).

Bee products have long been utilized as nutritional supplements that promote health (Thakur and Nanda, 2020). Moreover, bee products offer a variety of biological qualities, including antioxidant, anti-inflammatory, and antibacterial characteristics (Ranneh et al. 2021; Nainu et al. 2021). Among the physiologically active elements are proteins, peptides, minerals, flavonoids, terpenes, fatty acids, and phenolic compounds (Thakur and Nanda, 2020; Huang et al. 2014; Carpena et al. 2020). According to Sforcin et al. (2017) Burlando and Cornara (2013) and Šedík et al. (2017), honey is the most popular bee product. It has been reported that increased nutritional and health awareness has led to the rising consumption of bee products (Wang et al. 2021; Johnston et al. 2005; Jin et al. 2017, Pocol and Ilea, 2011; Yeow et al. 2013; Zulkhairi et al. 2018; Anastasiou et al. 2021; Miguel et al. 2017). Consumption of honey has significantly increased during the past few years globally (Pocol and Bolboacă, 2013; Fakhlaei et al. 2020; Oravecz and Kovács, 2019). The production of honey is widespread globally. Honey contains carbohydrates in the form of fructose, glucose, monosaccharides, which are essential nutrients. As an antioxidant, anti-inflammatory, and antibacterial agent, honey significantly impacts wound healing (Al-Waili et al. 2014; Fiorani et al. 2006; Erejuwa et al. 2016). The floral resources that honeybees use, as well as the geographic and climatic conditions, have an impact on the characteristics and composition of honey (Singh and Bath, 1997). Moreover, the scent, colour (da Silva et al. 2016) and flavour of honey are directly influenced by the species of honeybees, the source of the flowers, the climate, the processing techniques used, the packaging used, and the storage conditions (Santos-Buelga and González-Paramás, 2017). Since the flavour and colour of honey are directly affected by the type of nectar that the bees collect from diverse floral sources, honey can be found in a wide range of colours and flavours, from nearly colourless to dark brown. According to Crane and Visscher (Crane and Krik Visscher, 2009), liquid honey's colour has a significant role in marketing, and several nations have developed standards for colour grading. As mentioned above, honey has been linked to several beneficial nutritional and health effects. These characteristics result from particular chemical compositions that vary according to the botanical source and give diverse varieties of monofloral honey unique sensory profiles. Due to these factors, consumers frequently accept paying higher prices for monofloral honey than polyfloral honey. This may result in false labelling and adulteration using lower-value honey (Schievano et al. 2016).

Many consumers believe that when honey is crystallised, it is unnatural or adulterated, connected with lower-quality honey. Crystallisation is a natural process mainly influenced by the type of honey and other external variables. Although it does not impact product quality, consumers prefer and choose liquid honey. Unfair practices of manufacturers led to recrystallising honey (first, the product is warmed up to be transformed into liquid

condition once more) to meet consumer demands. However, this process may negatively impact honey's qualities (Źak, 2017). Consumers may prefer the quality aspects, freshness, and taste but are also more concerned about food safety because of the rise in food fraud (Wu et al. 2021). The trust of consumers has been disturbed globally by many significant food safety incidents, instances of food fraud, and changes in food manufacturing techniques (Esteki et al. 2019; Agnoli et al. 2016; Henderson et al. 2008; Thomson et al. 2012; Kendall et al. 2019). It is evident that modern consumers are increasingly likely to purchase typical and locally produced goods. According to Pitt et al. (2017) and Feldmann and Hamm (2015), local products refer to those that are made in or originate from a particular area, such as a region, city, or nation. They are frequently marketed as an alternative to imported or mass-produced products and buying them is perceived as protecting and supporting local businesses, producers, and the local economy. Food, beverages, handmade goods, and a wide variety of other products can all be considered local products (Feldman and Hamm, 2015; Brown, 2003; Memery et al. 2015). Many consumers have changed their habits. They prefer local products and travel short distances or buy products these products directly from the producer (Chambers et al. 2007). Regarding local honey, consumers benefit more from local honey compared to imported honey. Moreover, local bee colony pollination is crucial for preserving the regional ecological equilibrium (Allsopp et al. 2008). According to Rial-Otero et al. (2007), concerns about traces of several toxic substances increased the interest in certified organic honey. Production of organic honey represents an eco-logically based system. Organic production includes the sustainable use of natural resources, quality of the environment, animal welfare, and human health to support the agricultural ecosystem's balance and diversity (Gomes et al. 2011).

The main objective is to study consumer behaviour in the honey market with emphasis on the quality and nutritional value as well as to map the mineral content in selected types of monofloral honey produced in Slovakia.

RQ1: What are the preferences and consumption patterns of honey consumers in Slovakia based on gender?

RQ2: Are there any differences in mineral content among selected types of monofloral honeys in Slovakia?

MATERIALS AND METHODS

The paper is based on consumer and analytical research including primary data. The consumer research was conducted by implementing a questionnaire survey, where participated 600 Slovak honey consumers older than 18 years. The research sample is representative based on gender (50% males and 50% females). The average age of respondents is 40.80 years. Most of them live in urban areas (61.17%) with either secondary education (50.67%) or university education (48.17%). According to their economic status, 66% are employed, 13.33% are pensioners and 11.17% are students. The rest indicated either maternity leave or unemployment. The survey was conducted using an online questionnaire and disseminated via social media and emails in 2022. The questionnaire included both open-ended and close-ended questions, dichotomous questions as well as scaling questions. The majority of items in the questionnaire were oriented on quality and nutritional value.

Samples

The analytical research was oriented on different types of monofloral honey. The research sample consisted of 40 honey samples (8x rapeseed honey, 8x acacia honey, 8x sunflower honey, 8x linden honey and 8x honeydew honey) produced by Slovak beekeepers in 2022.

Chemicals

All the chemicals used during the sample preparation were highly pure. HNO_3 ≥69.0% (TraceSELECT®, Honeywell Fluka, Morris Plains, USA), H_2O_2 ≥30% (Sigma-Aldrich, Saint – Louis, Missouri, USA), ultrapure water (18.2 MΩ cm-1; 25 °C, Synergy UV, Merck Millipore, France), Multielement standard solution V for ICP (Sigma-Aldrich Production GmbH, Switzerland).

Instruments

High-performance microwave digestion system Ethos UP (Milestone Srl, Sorisole, BG, Italy), VWR Quantitative filter paper 454 (particle retention 12 – 15 μm) (VWR International, Leuven, France), inductively coupled plasma - optical emission spectrometer (ICP OES 720, Agilent Technologies Australia (M) Pty Ltd.) with axial plasma configuration and with auto-sampler SPS-3 (Agilent Technologies, Switzerland)

Laboratory Methods

Content of selected elements (Ag, Al, As, Ba, Ca, Cd, Cr, Fe, K, Li, Mg, Mn, Mo, Na, Pb, Sb, Sr and Zn) was determined in honey by inductively coupled plasma optical emission spectrometry (ICP-OES). The legitimacy of the whole method was verified using the certified reference material (CRM–ERM CE278 K, Sigma-Aldrich Production GmbH, Switzerland). All measurements of instrument readings were performed three times.

Design of the experiment

Sample preparation: All samples were collected in 50 ml plastic bottles, properly labelled with codes, and stored in a cool and dark place at 4 °C until their processing. The samples were mineralized in a solution of 5 mL HNO3 ≥69.0%, 1 ml H2O2 ≥30% for trace analysis and 2 ml of ultrapure water. Samples were digested according to method for honey developed and recommended by the manufacturer to achieve the most reliable results. The method consists of heating and cooling phases. During the heating stage, the samples were 15 min warmed to 200 °C and this temperature was maintained for another 15 min. Afterwards, during the cooling phase, the samples underwent 15 min of active cooling to reach the temperature of 50 °C. The digestates were into volumetric flasks and filled up with ultrapure water to a volume of 50 mL.

Statistical Analysis

The results were evaluated in statistical software XLSTAT 2022.4.1 (Addinsoft, NY, USA) at a significance level of p ≤0.05. Multiple correspondence analysis (MCA) was conducted to study associations among gender and selected questions focused on nutritional values and honey quality.

RESULTS AND DISCUSSIONS

The results of consumer research showed that the majority of both males and females consume honey on a daily basis (every day or a few times per week) as a healthier alternative to sugar. Different results were obtained in the research by Kowalczuk et al. (2017), where the majority of respondents tend to consume honey several times per month (43%) and less than once per month (30%) and the most important reason for consuming honey among the respondents was its positive impact on health. Honey was used mainly for culinary purposes, usually as a sandwich spread or sweetener. According to Batt and Liu (2012), the consumption among Australians indicates, that honey was mostly used as a sandwich spread and a sweetener for oatmeals and cereal.

According to respondents´ preferences for monofloral honey (Figure 1), most respondents indicated a preference for honeydew honey, acacia honey, linden honey or without any preference. Females tend to prefer more acacia honey while males indicated higher preferences for linden honey as well as no preferences for the specific monofloral honey. The rapeseed honey and sunflower honey are little preferred by both genders. The majority of both males and females know about honey with additions. In the study by Kowalczuk et al. (2017), the most preferred honey types were polyfloral (67%) and lime-tree (61%). Both types of honey were indicated by significantly more women (78%) and respondents aged over 60 years. Moreover, acacia honey was mostly preferred by women (62%) and respondents aged 30–44 years (62%). On the other hand, honeydew and buckwheat honey were more preferred by men (37%). Furthermore, Šedík et al. (2023) investigated the differences in honey preferences among various age segments. According to the data, the Silver Generation preferred more monofloral honey of a dark colour. On the contrary, Generation Z preferred polyfloral honey and Generations X and Y were associated with either not having any preferences for honey colour and honey type or were inclined to monofloral honey. Brščić et al. (2017) found out that in Croatia, the most preferred types of honey were mostly, acacia (56%), floral honey (44%) and meadow honey (35%).

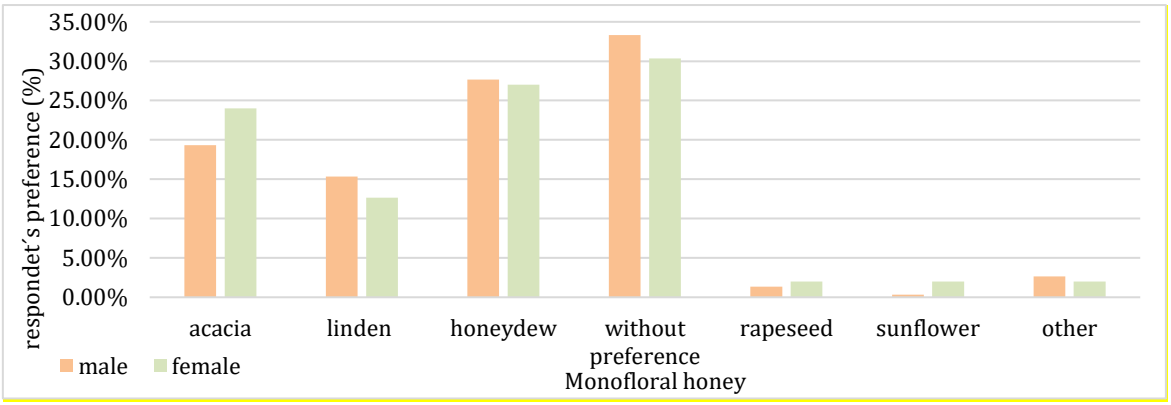

Figure 1. Preferences for monofloral honey

Furthermore, associations among gender and selected questions focused on nutritional values and honey quality were studied. The results of MCA (Figure 2) showed that female respondents are more associated with using honey in cosmetics, using honey as a treatment for various illnesses and are aware that heating honey decreases its biological value. The male respondents tend to not use honey in cosmetics, not being aware that heating honey decreases its biological value as well as tend to regularly consume honey in tea or coffee.

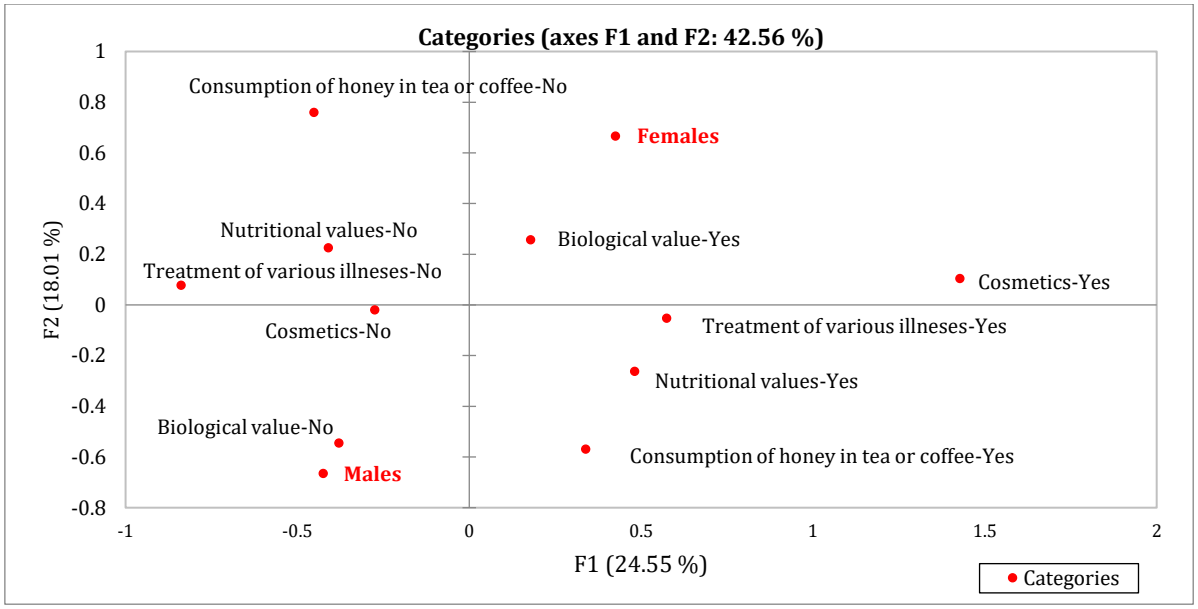

Figure 2. Results of multiple correspondence analysis (MCA)

Note: MCA is illustrating two dimensions created by using the following questions: gender and selected yes/no questions on the following statements: „Heating of honey decreases its biological value"; I use honey in cosmetics"; I use honey for the treatment of various illnesses"; „I usually use honey as a sweetener in tea or coffee" and „I consume honey due to its nutritional value".

In addition, the results showed that 77.17% of respondents do not know which nutritional substances are in honey. The rest of them mostly answered the following: amino acids, saccharides, vitamins, minerals, or enzymes. Approximately 80% indicated that they are not able to list common minerals in honey. The rest of them listed mostly the following minerals: Potassium, Calcium, Magnesium, Iron, Zinc, Sodium, Copper, Manganese and Phosphorus. In addition, the respondents were asked which healing properties honey has. Approximately 49% did not know the answer while the other half mostly indicated that honey possesses antibacterial properties, anti-inflammatory properties, and wound healing properties or just stated that it is mostly used for the treatment of flu and sore throat. According to gender, we revealed that females are more aware of the antibacterial, antioxidant and enzymatic activity of honey. Research by Martinovski and Gulevska (2017) was focused on evaluating the consumer's knowledge about honey and its nutritional value. Based on the results, the relationship between respondents' knowledge of the health benefits of honey in their diet and familiarity with the nutritional qualities of honey is moderate (r=0,48). It is also moderate between respondents' knowledge of the health benefits of honey in people's diets and familiarity with the high energetic value of honey because it contains mostly simple sugars instead of complex sugars. The respondents' understanding of the advantages of including honey in people's diets and their familiarity with the fact that honey contains many vitamins and minerals are also found to have a moderate link.

The results of mineral content found in analysed honeys are shown in Table 1. Significant differences among honey types were identified in case of K, Ca, Mg, Na, Mn, Al, Fe and Ba. The predominant mineral in all honey samples, except for rapeseed honey, was K followed by Ca, Na and Mg. Similar mineral hierarchy order was identified by Conti et al. (2018) and de Oliveira et al. (2020). On the other hand, Fe, Ba, Sr and Li were present in an amount lesser than 5 $mg.kg^{-1}$. Zn was detected only in acacia honey and honeydew honey samples. Potassium is the most abundant element, representing approximately one-third or even more than 70 % of the total mineral content of honey (di Bella et al. 2020; Ortega-Bonilla et al., 2021). This finding was confirmed in our study, with the concentration of K being the highest in linden honey (69%) and honeydew honey (82%). The average total mineral content was obtained in the following descending order: honeydew honey 2446.72 $mg.kg^{-1}$ > linden honey 1208.82 $mg.kg^{-1}$ > sunflower honey 818.53 $mg.kg^{-1}$ > rapeseed honey 415.61 $mg.kg^{-1}$ > acacia honey 397.93 $mg.kg^{-1}$. Similar results were reported previously by Šedík et al. (2020). According to Seraglio et al. (2019), mineral content in honeydew honey can exceed 10000 $mg.kg^{-1}$. Normally, the mineral composition of honey is relatively low, with contents ranging between 0.1% and 0.2% regarding nectar honeys, and values above 1% for honeydew honeys (Silva et al., 2020). Heavy metals Ag, As, Cd, Cr, Pb, Sb, Mo and Co were not detected in any of the honey samples, which indicates their good quality and purity.

In comparison with other similar studies from Slovakia, Kacaniova et al. (2009) evaluated the mineral composition of honey randomly obtained from Eastern, Western and Central Slovakia and reported much lower values for Zn, Mg and Ca (1.79 mg/kg, 18. 62 mg/kg and 33.40 mg/kg, respectively). In a previous study, Šedík et al. (2020) found higher concentrations of all analysed elements, except for Na in linden honey, higher amounts of Ca, Mn, Fe, and Zn and lower concentrations of K and Na in sunflower honey, as well as more K, Ca, Mg, Fe and less Na,

Mn and Zn in honeydew honey from several apiaries owned by local beekeepers situated in the city of Nitra and surrounding areas. Kováčik et al. (2016) studied the mineral profile of rapeseed honey from Košice and reported higher concentrations of K, Mn and Zn, but lower amounts of Mg, Ca and Na. Regarding studies from other countries, the values found for K, Na, Ca, and Mg were higher than those reported in honey from Serbia (Velimirović et al. 2021), southern Italy (Perna et al. 2021), Jordan (Abdelghani et al. 2019), and Hungary (Kocsis et al. 2021). The chemical composition of honey varies depending on the type of plant, geographical origin, climate conditions, the state of environmental pollution, beekeeping practice etc. (Lyoussi et al. 2020). The mineral content is one of the parameters used for the evaluation of the nutritional values of honey (El-Haskoury et al. 2018). It can be considered as a potential indicator and an important biomarker for environmental pollution of honey with heavy metals (Lanjwani and Channa, 2019).

Table 1. Mineral content in selected types of monofloral honey

	Monofloral honey				
	Rapeseed honey (mg.kg^{-1} ±SD)	**Acacia honey (mg.kg^{-1} ±SD)**	**Sunflower honey (mg.kg^{-1} ±SD)**	**Linden honey (mg.kg^{-1} ±SD)**	**Honeydew honey (mg.kg^{-1}± SD)**
K**	121.67^{a} ±17.89	152.12^{ab} ±23.66	466.79^{ac} ±283.66	844. 14^{cb} ±328.32	2026.65^{c} ±504.18
Ca**	158.6^{ab} ±21.8	120.8^{b} ±17.33	193.5^{a} ±32.84	196.3^{a} ±36.27	179.1^{a} ±36.99
Mg**	42.18^{ab} ±7.34	32.75^{a} ±5.93	57.28^{bc} ±10.07	59.77^{bc} ±9.02	89.54^{c} ±18.02
Na**	86.50^{a} ±9.78	82.14^{a} ±15.76	93.42^{ab} ±15.75	101.59^{ab} ±12.59	118.50^{b} ±17.74
Mn**	0.07^{a} ±0.05	0.11^{a} ±0.04	0.18^{a} ±0.29	0.84^{ab} ±1.32	4.11^{b} ±2.40
Al**	4.68^{ab} ±1.98	2.79^{a} ±1.47	5.04^{ab} ±0.47	3.7^{ab} ±2.07	22.61^{b} ±16.12
Fe**	0.76^{a} ±0.23	0.89^{a} ±0.42	1.14^{ab} ±0.47	1.14^{ab} ±0.57	2.31^{b} ±1.05
Ba**	0.35^{ab} ±0.06	0.31^{a} ±0.05	0.35^{ab} ±0.08	0.41^{b} ±0.07	0.41^{ab} ±0.11
Sr	0.79 ±0.09	0.71 ±0.09	0.82 ±0.15	0.91 ±0.13	0.82 ±0.12
Li	0.01 ±0.00	0.01 ±0.00	0.01 ±0.00	0.02 ±0.01	0.02 ±0.01
Zn	ND	5.30 ±0.15	ND	ND	2.65 ±1.22

Note: Ag, As, Cd, Cr, Pb, Sb, Mo – not detected in all samples (ND)
**Significant differences between types of honey samples according to the Kruskal-Wallis test ($p < 0.05$). Means in the same row with different superscripts are statistically different according to the Dunn-Bonferroni post hoc method ($p<0.05$).

CONCLUSIONS

The consumer research showed that the most preferred types of monofloral honey are honeydew honey, linden honey and acacia honey. Female honey consumers prefer acacia honey and tend to use honey in cosmetics as well as a remedy for various illnesses. Male respondents prefer linden honey and tend not to use honey in cosmetics, but they consume honey in beverages such as tea or coffee on a regular basis. Moreover, most respondents were not able to list nutritional properties and common minerals in honey, however, the antibacterial properties were more known among the respondents. In addition, analytical research revealed that Slovak monofloral honey contained the following trace and major minerals: K, Ca, Mg, Na, Mn, Al, Fe, Ba, Sr, Li, Zn. In general, honeydew honey and linden honey had the highest mineral content while rapeseed honey and acacia honey had the lowest mineral content. Potassium was the most abundant mineral. Future studies should aim to replicate results in different countries using larger samples.

Author Contributions: P.Š., C.B.P. conceived and designed the analysis; P.Š. collected the data; C.B.P., P.Š. and R.V. performed the analysis; M.H., R.V., C.B.P. and P.Š. wrote the paper. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare that they do not have any conflict of interest.

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