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FRUIT AS A SOURCE OF ANTIOXIDANTS AND TRENDS IN ITS CONSUMPTION

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ABSTRACT

The positive effects of fruit on human health are mainly attributed to their antioxidant activity. The aim of this work was to observe public awareness about antioxidants consumed in fruit, to analyze their preferences and the frequency of fruit consumption in selected population groups. Preferences were assessed by questionnaire, which was attended by 220 respondents. Information about the presence of antioxidants in fruit showed 85% of respondents. Temperate zone fruit is prefered by 48% of respondents and 52% of respondents prefer fruit of southern zone. Fresh fruit is consumed by 54% of respondents, 18% of respondents prefer fruit juices, compotes are consumed by 12% of respondents, fruit spreads by 11% of respondents, and 5% favour the dried fruit. Fruit is consumed by 31% of respondents once to three times a week, 26% of respondents consumed fruit once a day, 23% occasionally and 20% of respondents more times a day. In terms of sex, higher fruit consumption was recorded at women who consume fruit mostly once a day, while men only once to three times a week. The relationship between place of residence and the possibility to grow their own fruit as well as preference between home and the consumption of fruit by country of origin was confirmed.

Keywords: consumer behavior; purchase; Chi-Square test of Independence; fruit consumption; research

INTRODUCTION

Consumer behavior regarding the food market is changing and is affected by several factors. Significant part of the consumer's decision to buy fruit takes visual marketing, mainly the shape of fruit and color as well as some other sensory characteristics such as aroma or flavor. Fruit purchase is also affected by dietary habits, which are created mainly during childhood. Consumer decision-making process is affected by own experience, the brand, as well as the reputation of the producer, the country of origin and others. Identifying of customer needs and examining their buying behavior is the basis for developing strategies and advertising campaigns. These activities can increase product sale.

Horská and Berčík (2014) examined the effect of light on the purchasing decisions of consumers and the perception of lighting on the food market. Consumer attitudes to food safety was investigated by **Nagyová et al. (2018), Serenčéš a Rajčániová (2007)**, perception of food safety in Slovakia by **Golian et al. (2018)**, differences in consumer behavior at organic product purchase by **Vietoris et al. (2016)**; **Kádeková et al. (2017)**.

Epidemiologic evidence of a protective role for fruit and vegetables in cancer prevention is substantial. The strength of this scientific base guides US national policymaking in diet and health issues and facilitates community and local programs that address national dietary goals to increase fruit and vegetable consumption **(Duyn, Duyn and Pivonka, 2000)**.

Positive effects of fruit have been attributed to their antioxidant activity, which depend mainly on the content of polyphenols and vitamins in fruit **(Lamien-Meda et al., 2008)**. The most important antioxidants include vitamin C, vitamin A and its precursor beta-carotene, vitamin E, trace elements – zinc, copper, selenium and iron, ascorbic acid, tocopherol, lycopene **(Lenucci et al., 2006)**. The most frequently occurring elements are potassium, sodium, magnesium, calcium, chlorine, sulfur and phosphorus. Fruit contain also a number of important minerals, organic acids, vitamins, tannins, enzymes, flavonoids, aromatic substances. Cohort studies demonstrates that increased consumption of fruit and vegetables from less than 3 to more than 5 servings per day is related to a 17% reduction in coronary heart disease (CHD) risk **(He et al., 2007)**.

A diet rich in fruit and vegetables significantly reduces the risk of lifestyle diseases such as cardiovascular disease, atherosclerosis, cancers, diabetes mellitus **(WHO, 2004)**. Based on several epidemiological studies it was shown that the intake of foods rich in antioxidants, especially fruit and vegetables, cereals and some natural oils increases the concentration of antioxidants in the blood, and is associated

with a decrease in mortality and some chronic diseases such as the obesity **(Bes-Rastrollo et al., 2006)**.

Several healthy foods such as olive oil, fruit, vegetables, nuts, legumes, have been inversely associated with depression risk and even have been postulated to improve depressive symptoms **(Lang et al., 2015)**. Polyphenol content and antioxidant activity in varieties of apple and pear were observed by **Mendelová et al. (2011)**, in bilberry **Habánová et al. (2013**), in cranberries and blackberries **Vollmannová et al. (2014)**. Changes in the composition of orange juice have been examined by **Sádecká et al. (2014**), in a strawberry juice by **Predná et al. (2016)**, in grapefruit juice by **Belajová et al. (2017)**. Degradation of ascorbic acid in orange juice observed **Aguirre et al. (2019)**; **Kopuncová et al. (2018)**; **Aguilar et al. (2017)**; **Lu et al. (2018)**.

The aim of this work was to analyze behavior of consumers at fruit consumption, to search for knowledge awareness/level about antioxidants in foods, to examine which kinds of fruit people prefer and the form(state) of fruit most commonly consumed by Slovak consumers, and if depending on their place of residence.

Scientific hypothesis

We investigated the validity of the following hypotheses as a part of our research:

Hypothesis H1: We suppose that the place of fruit purchase is affected by the economic activity of the consumer.

Hypothesis H2: We expect that consumers who originate from the village will prefer fruit of Slovak origin.

Hypothesis H3: We suppose that fruit of temperate zone will be more preferable by consumers who have the opportunity to grow this kind of fruit themselves.

Hypothesis H4: We suppose that gender, age, economic activity and the origin (village/city) of the consumer affect the frequency of fruit consumption.

MATERIAL AND METHODOLOGY

Preference of fruit and frequency of fruit consumption at Slovak consumers and their awareness of antioxidants importance in human nutrition were monitored by questionnaire technique. The survey was performed from March till May, 2018. The questionnaire consisted of 9 questions and 4 issues classificating age, sex, place of residence and economic activity of respondents.

Questions were as follows:

1. Have you heard about the presence and importance of antioxidants in fruit?
2. Where did you get information on antioxidants?
3. Which of the antioxidants do you know?
4. How often do you eat fruit?
5. What types of fruit do you most frequently eat?
6. In which form do you prefer to eat fruit?
7. Provide the most frequent place to buy fruit.
8. Can you grow your own fruit?
9. When buying a temperate zone fruit, you prefer fruit grown (in Slovakia, abroad)?

Sample group consisted of 220 respondents, women represented 50%, men 50%. Structure of respondents by age was as follows: young people aged 18 – 25 years accounted for 53%, age group 26 – 40 years was represented by 16%, age group 41 – 55 years up 21%, respondents aged over 56 years accounted for 9% of the group. Structure of respondents according to their economic activity: 45% of students, 37% employed, 11% unemployed and 7% retired. The place of residence was at 40% respondents living in the town and 60% in the village.

Statisic analysis

Basic approaches of descriptive statistics was used, as well as methods of association measurement. Results were analyzed by Chi-Square statistic. Statistical significance has been tested based on the *p*-values. Correlations were proved by the Cramer's V coefficient. Statistical analysis was performed in SAS Enterprise 5.1 software.

RESULTS AND DISCUSSION

Antioxidants present in fruit protect the human body against undesirable chemical reactions, increase the resistance of the body, support the immune system, contribute to healthy skin and act against aging of cells. Antioxidants affect nervous system function, particularly the functioning of the brain **(Kindersley, 2001)**. **Jennings et al. (2012)** state that the increased frequency of total flavonoid intake significantly reduces blood pressure and contributes to the overall reduction in the risk of cardiovascular diseases.

We monitored respondent awareness about the importance and presence of antioxidants in fruit. 85% of respondents had information about the presence of antioxidants. For the most used sources of information on antioxidants, respondents identified the internet (29% of respondents) and media (28% respondents) school 18%, magazines 17% (Figure 1). As antioxidants they recognise vitamins (47% of respondents), minerals (29%), 20% of coenzyme Q10, and only 4% of flavonoids and polyphenols. People should consume over 1 g of flavonoids and phenolic acids daily **(Rui, 2003)**. The fruit can be consumed fresh as well as frozen, canned or otherwise modified. We determined that consumers prefer to have fresh fruit (54% of respondents), 18% of respondents prefer fruit juices, compotes 12%, fruit spreads reported 11% of respondents and 5% of respondents prefer dried fruit (Figure 2).

Consumption of fresh fruit and fruit products per capita and year (in terms of fresh fruit) in Slovakia observed **Meravá (2018)**. Consumption of fruit per capita and year reached 60.5 kg in 2017, consumption of fresh fruit reached 42.4 kg per person per year.

The qualitative properties of fresh garden fruit were analyzed by **Hegedüsová et al. (2016)**, **Mezey and Paulen (2003)**, the organoleptic characteristics of fruit and fruit juices during various storage conditions were evaluated by **Ozarda, Demirkoz and Özdemir (2015)**.

Modern trend knowledge in consumption and applying a healthy lifestyle also include consumer decision makers. By linking of current scientific knowledge and practice in the field of new fruit processing technologies, innovative multi-component products are developed, like smoothie.

Consumer preferences at fruit purchase

In terms of place of fruit purchase, respondents prefer supermarkets (48%). Directly from producers is fruit purchased by 19%, (Figure 3) in wholesale/retail stores by

17%. Similarly, 17% of respondents obtained the fruit directly from the small local markets.

We assumed that the purchase of fruit may be affected by economic activity of respondents (Hypothesis H1). Relationship between the place of fruit purchase and economic activity of the respondents is presented in Figure 3. Based on statistical evaluation there was not confirmed any existence of a statistically significant correlation. Place of fruit purchase is therefore influenced by other factors than the economic status of the respondents.

We also analyzed preferences of the respondents in relation to the selection and consumption of fruit according to its origin (Hypothesis H2). At 48% of respondents is prevalent fruit of temperate zone and 52% of respondents prefer fruit of southern zone. In our survey, the most commonly consumed fruit in the first order respondents indicated the pomes (51%), stone fruit (14%), tropical fruit (11%), small fruit (9%), grapes (9%) and nuts (6%).

In consumption of the temperate zone fruit in Slovakia per capita and year dominated apples (11.5 kg), grapes (4.8 kg) and peaches (2.5 kg). The consumption of small fruit per capita per year was 0.5 kg of currants, 1.0 kg of strawberries. Consumption of fresh fruit in fresh state on the Slovak market is increasing **(Meravá, 2018)**.

We also monitored the relationship between place of residence (village, city) and preference by country of origin (domestic versus imported fruit). Based on the *p*-value (*p*-value = 0.007), we can conclude that respondents who live in a village in its shopping behavior prefer fruit grown in Slovakia (Figure 5). Based on the Cramer coefficient (V = 0.18) this is only a weak correlation.

Fiľa and Tóthová (2013) state about the direct sale advantage in promoting the local economy, increasing employment in the region, reduction of transport costs as well as consolidation relations in the region. In relation farmer – consumer, there is a direct relationship between the seller and the buyer. Other benefits for producer are demand, development regarding consumers' needs, supporting social network. Food quality, transparent prices, contact with soil and animals belong to benefits for consumer **(Chreneková, Dirgasová and Fáziková, 2015)**.

Fruit originating from Slovakia is preferred by 86% of the respondents living in the villages and 72% of the respondents from the towns.

Ability to cultivate own fruit indicated 79% of respondents. In relation to the place of residence, it was found that 95% of respondents living in village can cultivate their own fruit. Among the respondents living in the city, the opportunity to cultivate own fruit have 55%. The results are shown in Figure 4.

We examined also the relationship (Hypothesis H3) between the ability to grow their own fruit and fruit preference according to zone, so we assumed that respondents who have the opportunity to grow their own fruit, will prefer more fruit of middle zone (Figure 4) but this relationship was not confirmed (*p*-value = 0.078).

Frequency of fruit consumption

To the question "How often do you eat fruit", 20% of respondents state consumption several times a day, 26% of respondents consume fruit once a day, 31% of respondents consume fruit once to three times per week, 23% of respondents consumed fruit only occasionally. By examining the frequency of fruit consumption (Hypothesis H4) by the age of respondents, we found that in the age category 18 – 24 years dominated consumption of fruit once to three times per week, aged 26 to 40 years consumption several times a day, in the age group 41 – 55 years dominated consumption of one fruit a day and in the age group over 56 years was prevalent once to three times per week. Following gender, we found that higher consumption of fruit is among women who consume fruit most common once a day, while men mostly consumed fruit only once to three times per week. At this point, we assumed the existence of a relationship among the frequency of consumption of fruit and gender, age of respondents, economic activity and provenances (place, residence) of respondents. It is not statistically significant difference in the frequency of fruitconsumption between men and women and it was not confirmed to be the difference in consumption of fruit among the age groups of respondents. Based on the relative frequencies it was shown that respondents who live in a village more often consume fruit, but the statistically significant difference between respondents from the village and the town was not confirmed (Table 1). Frequency of fruit composition was examined by several authors e.g. **Belej et al. (2016)**.

Fatrcová-Šramková, Schwarzová and Juríková (2017) examined the frequency of consumption of fresh as well as processed fruit and vegetables (canned products and vegetable and fruit juices) in adult females under the age of 26 and found that 1 – 2 portions of fresh fruit and 1 portion of vegetables predominated, that does not meet the recommendations. In the recommended doses of food it is stated that the consumption should be 96.7 kg for fresh fruit, of which fresh fruit of temperate zone is 57.7 kg. The World Health Organization **(WHO, 2004)** recommends consuming of five servings of fruit a day.

Eating habits of the population, food choice at purchase, choice of appropriate processing of fruit and its storage and even the popularity of certain foods are derived from the acquired habits from early childhood. Ongoing changes in the diet of consumers are affected by several factors such as globalization of markets, global trends in diet, developing tourism. Preferences of consumers can be affected by acquired eating habits and to a large extent, household income.

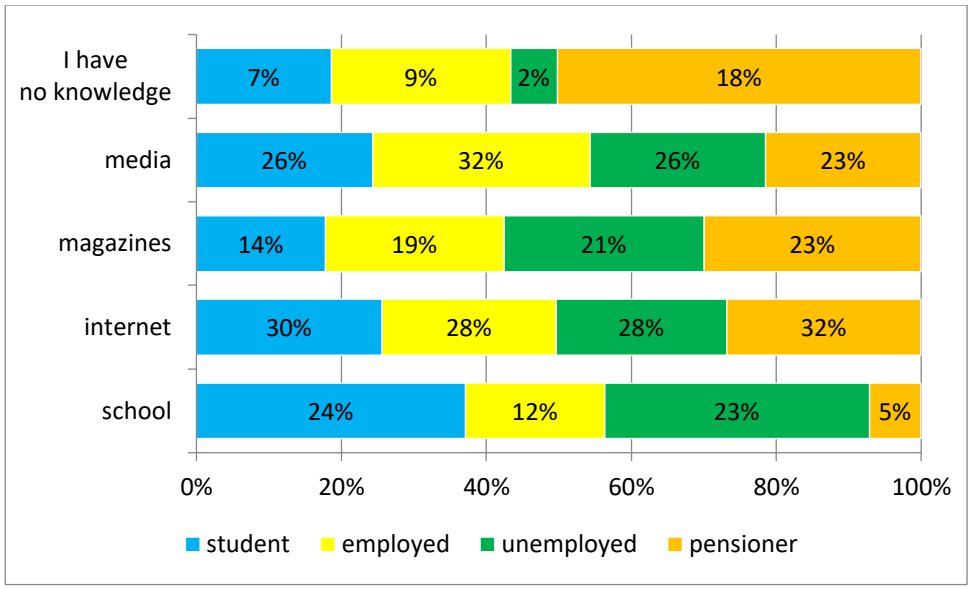

Figure 1 Respondents' answers to the question: "Where did you get information about antioxidants?" in relation to the economic activity of respondents.

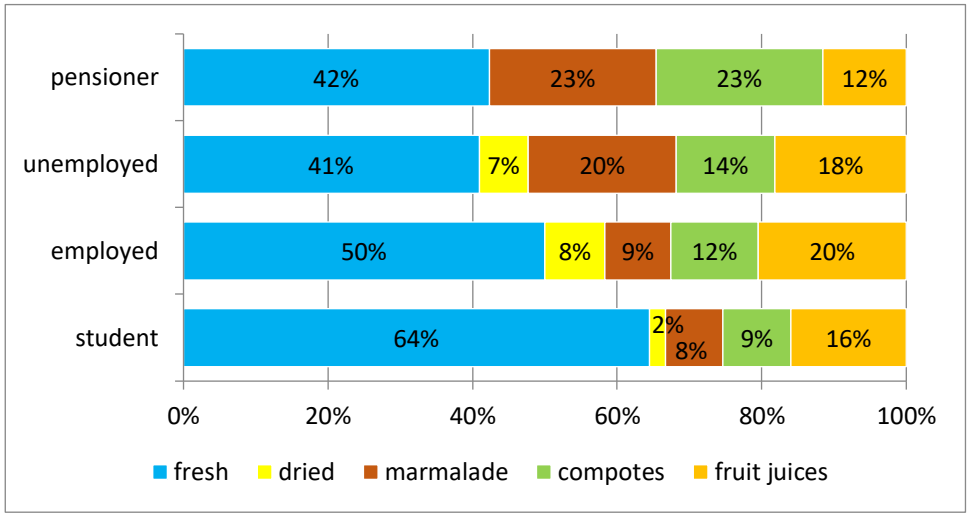

Figure 2 Respondents' answers to the question: "In which form do you prefer to consume fruit?" in relation to the economic activity of respondents.

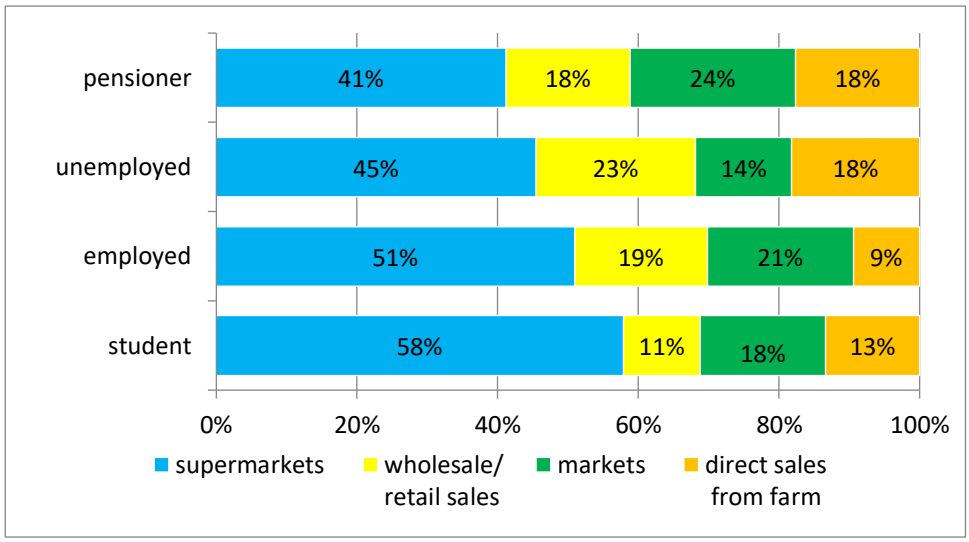

Figure 3 Most oftenplaceoffruitpurchase in relation to theeconomicactivityofrespondents.

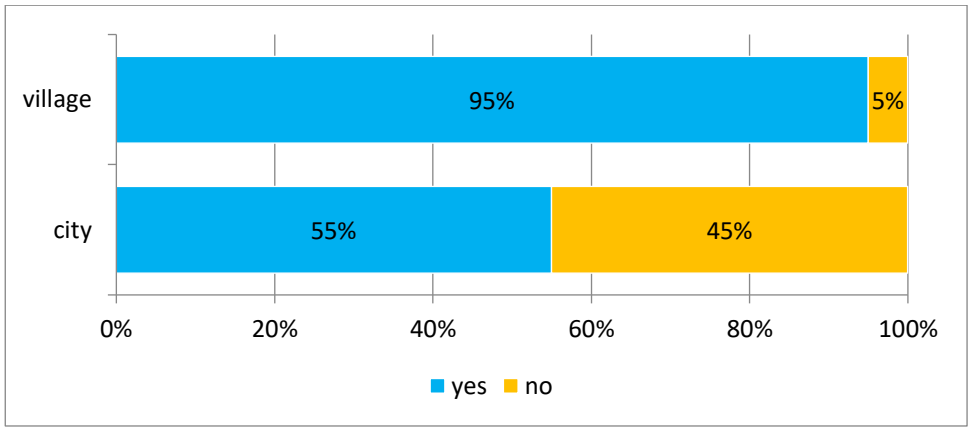

Figure 4 Possibilityofrespondents to cultivatetheirownfruit in relation to theplaceofresidence.

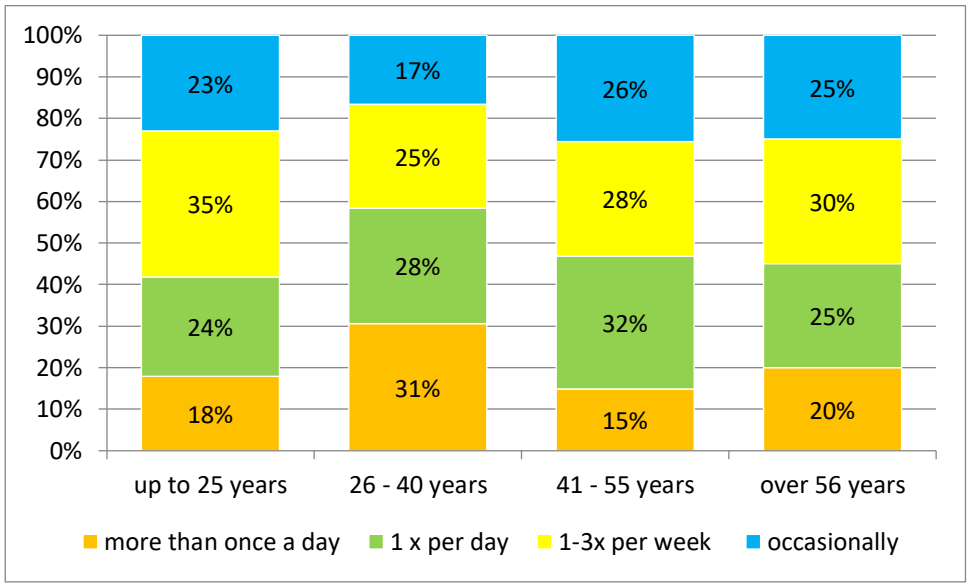

Figure 5 Frequencyoffruitconsumption in relation to theageofrespondents.

T**able 1** The results of the statistical testing to the hypotheses.

Hypothesis:	Statistics:	Chi-Square	Phi Coefficient	Contingency Coefficient	Cramer's V
H1	Value	7.706	0.176	0.173	0.101
	Prob.	0.564			
H2	Value	7.328	0.183	0.180	0.183
	Prob.	0.007			
H3	Value	3.107	0.119	0.118	0.119
	Prob.	0.078			
H4 (gender)	Value	1.938	0.094	0.094	0.094
	Prob.	0.585			
H4 (age)	Value	5.745	0.162	0.16	0.093
	Prob.	0.765			
H4 (economic activity)	Value	12.398	0.237	0.231	0.137
	Prob.	0.192			
H4 (placeofresidence)	Value	4.932	0.15	0.148	0.15
	Prob.	0.177			

CONCLUSION

We can conclude that 85 % of respondents have some information on the presence ofantioxidants in fruit. Almost one-third of respondents eat fruit once to three times per week, 26 % respondents consume fruit once a day, 23% occasionally and 20 %respondents several times a day. Consumers prefer to consume fresh fruit (54% of respondents), 18% of respondents prefer fruit juices, compotes are prefered by 12%, fruit spreads reported 11% of respondents and 5% of respondents prefer dried fruits. Most often is fruit purchased in supermarkets (48%). Directly from producers is fruit obtained by 19%, in wholesale/retail stores 17%. Similarly, 17% of respondents obtain the fruit directly at the small local markets. Respondents living in the village often consume fruit, but statistically significant difference between respondents from village and town was not confirmed. Information obtained suggest that the importance of fresh fruit and juices containing natural antioxidants is quite well known, but their annual consumption is in fluctuating character.

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