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EATING HABITS OF MALE ADOLESCENTS IN RELATION TO BMI-FOR-AGE AND PLACE OF RESIDENCE

Irzada Taljić[*]

University of Sarajevo, Faculty of Educational Sciences, Skenderija 72, 71000 Sarajevo, Bosnia and Herzegovina

Summary

Introduction: It has been proven that girls have better eating habits, and therefore the aim was to assess dietary behavior of boys, taking into account BMI-for-age and place of residence observed as urban or rural, in the Canton of Sarajevo.
Material (participants) and methods: The study included 60 adolescent boys from rural and 264 from urban areas of the Canton of Sarajevo, aged 13-15. Methods that were used: anthropometric measurements (measurement of body weight and body height in order to calculate the BMI-for-age percentile) and a purpose-designed questionnaire about eating habits by which eating pattern was graded as proper or improper. Data were statistically analyzed by using SPSS 13.0 programme.
Results: The majority of participants were normal weighted (urban *vs.* rural 58.30%:70.00%), followed by overweight (urban *vs.* rural 24.20% 20.00%) and obese (urban *vs.* rural 14.40%:10.00%). Category of underweight was only present in adolescents from urban areas with 3.00%. Statistical significance of adolescents' nutritional status from urban areas was found for the number of daily meals ($p=0.039$), regular consumption of breakfast ($p=0.009$), diverse diet ($p=0.049$) and consumption of snacks ($p=0.037$). In adolescents from rural areas, the statistical significance was found between their nutritional status and consumption of carbohydrate foods ($p=0.024$).
Conclusion: Although no statistical significance of BMI-for-age in relation to the place of residence was found, higher percentage of adolescents from rural areas have normal weight, while both groups have high percentage of overweight. Eating habits need to be studied further, with additional factors to examine in the default settings.

Keywords: eating habits, adolescents, nutritional status, urban, rural

Introduction

Dietary habits and nutritional status as the characteristics of health depend on the period of life and life circumstances. Options vary upon the stage of life because each period has its advantages, disadvantages and challenges. Adolescence is a particularly challenging period of life with respect to the physical and cognitive growth and development, and the perception of events within and around them. Adolescence is also considered as a deadline for the correction of all the bad habits acquired, including food preference carried further into adulthood. Tracking the eating pattern among students is important to prevent the emergence of health problems in adulthood, and it is particularly important to track other factors, not just health (taste, cultural norms, socio-economic status, food availability, etc.), which affect eating behaviour (Brady et al., 2000; Harnack et al., 1997). Place of residence is also influencing factor. The differences between rural and urban cognition of food, dietary patterns and physical activity are due to different lifestyle (Woodward et al., 2000). Research results are mixed. In recent years, the trend of increased consumption of energy-dense foods, and reduced

physical activity are described in many rural areas in the world. This is most likely the reason why obesity and its complications ubiquitous in rural areas, in developed and developing countries (Popkin, 2001; Liebman et al., 2003). Changes in lifestyle including changes in eating habits are more pronounced among adolescents in urban areas. They quickly accept innovations and are exposed to commercial messages and market (Esposito et al., 2009). In a study conducted in Croatia consumption of fast food, soft drinks and alcohol is more widespread and more associated with eating behaviors in urban than in rural areas (Colić-Barić et al., 2004).

Subjects and methods

The study was conducted in the Canton of Sarajevo which was defined for the purpose of this study as urban and rural upon current Urbanistic plan (Zavod za planiranje razvoja Kantona Sarajevo, 2006). There were 324 participants, adolescent boys aged 14-15 years. 60 boys from rural and 264 boys from urban area who participated voluntarily and the number is proportional to the population distributions in the Canton of Sarajevo (Federalni zavod za statistiku, 2013). Eating habits were examined with specially designed Food Frequency

[*]Corresponding author: hirzada@hotmail.com, hirzada@pf.unsa.ba

Questionairre (FFQ) which included questinos regarding consumption frequency and portion (amount) of consumed food. Results were defined as proper (i.e. healthy/recommended) or improper (i.e. unhealthy) eating pattern for the purpose of writing this paper. Body weight and height were measured and used to calculate BMI-for-age percentiles. Height was measured with portable stadiometer and weight with medical digital balance (OT 150 FWEB Gorenje). Percentage distribution of children in relation to the standards of the World Health Organization by percentiles was defined and the nutritional status of children according to the WHO reference values (de Onis et al., 2007). Statistical analysis was performed

using the statistical software package SPSS 19.0. (SPSS Inc, Chicago, Illinois, USA). Significant difference was considered at the level of $p<0.05$.

Results and discussion

Results for nutritional status show the highest prevalence of normal weight in both areas (rural *vs.* urban 70.0%:58.3%) and is followed by overweight and obesity (Table 1). There are more overweight and obese boys in urban area of the Canton of Sarajevo, but also underweight category is only present in that area (3.0%).

Table 1. Nutritional Status

Place	Nutritional Status	N	%	Valid Percent
Rural	Normal weight (5th – 85th percentile)	42	70.0	70.0
	Overweight (85th - 95th percentile)	12	20.0	20.0
	Obesity (≥ 95th percentile)	6	10.0	10.0
	Total	60	100.0	100.0
Urban	Underweight (<5th percentile)	8	3.0	3.0
	Normal weight (5th – 85th percentile)	154	58.3	58.3
	Overweight (85th - 95th percentile)	64	24.2	24.2
	Obesity (≥ 95th percentile)	38	14.4	14.4
	Total	264	100.0	100.0

In the study by Suliga (2006) overweight and obesity were rare in children from rural areas aged 10.5 years, and they have higher risk of being

underweight, especially among boys. On the other hand, in urban areas, in both boys and girls aged 13.5 years overweight and obesity were more common.

Table 2. The number of daily meals in relation with adolescents' BMI-for-age from urban and rural area

Place	Pattern		BMI-for-age			
			Underweight	Normal weight	Overweight	Obesity
Rural		N	-	1	1	0
	Improper	%	-	50.0	50.0	0.0
Urban		N	1	21	6	5
		%	3.0	63.6	18.2	15.2
Rural		N	-	47	7	4
	Proper	%	-	81.0	12.1	6.9
Urban		N	7	184	26	14
		%	3.0	79.7	11.3	6.1

In rural area, BMI-for-age was not related with the eating pattern, reflected in the number of daily meals (should be at least three meals per day), $p=0.349$. Nevertheless, 81.0% of adolescents within normal weight follow the pattern of proper diet and consume more than three meals a day (Table 2). Also, 6.9% obese consume more than three meals a day. In urban area, BMI-for-age is correlated with the form of proper nutrition, reflected in the number of daily meals, $p=0.039$. Smaller percentage of obese (6.1%),

and a higher percentage of normal weight (79.7%) adolescents have more than three meals a day and follow the form of proper nutrition (Table 2). In the project conducted in Bjelovar-Bilogora County (Bertić, 2013) participants were 6th grade students and the majority of them (39%) during school day have three meals daily, one meal (9%), two meals (8%), four meals (28%), five meals (13%) and more than five (3%). According to a survey conducted in Sarajevo (Hodžić and Smajić, 2012), 49.6% of

adolescents (13-15 years old) consumed three meals a day, while four meals consumed 31.0% of respondents. It points out that 10.3% of adolescents consumed just two meals a day.

Table 3. Relation between breakfast consumption and adolescents' BMI-for-age from urban and rural area

Place	Pattern		BMI-for-age			
			Underweight	Normal weight	Overweight	Obesity
Rural		N	-	14	3	0
	Improper	%	-	82.4	17.6	0.0
Urban		N	1	51	13	8
		%	1.4	69.9	17.8%	11.0
Rural		N	-	34	5	4
	Proper	%	-	79.1	11.6	9.3
Urban		N	7	153	19	10
		%	3.7	81.0	10.1	5.3

In rural area, BMI-for-age was not correlated with the regular consumption of breakfast, $p=0.675$. Higher percentage of adolescents with normal weight (82.4%) and overweight (17.6%) do not follow the recommended eating pattern (do not eat breakfast regularly). In urban area, BMI-for-age was correlated with the regular consumption of breakfast, $p=0.009$. Smaller percentage of obese (5.3%) and overweight (10.1%) and a higher percentage of normal weight (81.0%) adolescents regularly consume breakfast (Table 3). Study examining eating habits of school children in Croatia (11, 13 and 15 years of age) found that only 56.0% of them always eat breakfast during weekdays, while 80.0% of them always eat breakfast on Saturdays and Sundays (Ministarstvo zdravlja R. Hrvatske, 2013).

Table 4. Relation between adolescents' BMI-for-age and the type of breakfast

Place	Pattern		BMI-for-age			
			Underweight	Normal weight	Overweight	Obesity
Rural		N	-	41	7	3
	Improper	%	-	80.4	13.7	5.9
Urban		N	5	148	20	13
		%	2.7	79.6	10.8	7.0
Rural		N	-	7	1	1
	Proper	%	-	77.8	11.1	11.1
Urban		N	3	54	12	6
		%	4.0	72.0	16.0	8.0

In rural area, BMI-for-age was not correlated with the type of breakfast (cereals, eggs, fruit as a proper pattern) $p=0.814$. Nevertheless, a higher percentage of normal weight (80.4%) and overweight adolescents (13.7%) make improper choice of food at breakfast and not the recommended, such as cereals, eggs and fruit (Table 4). While a higher percentage of obese (11.1%) make the correct choice. In urban area, BMI-for-age was not correlated with the type of breakfast, $p=0.412$. Almost the same percentage among all categories does (not) make proper selection of foods for breakfast.

Table 5. Relation between adolescents' BMI-for-age and fruit consumption

Place	Pattern		BMI-for-age			
			Underweight	Normal weight	Overweight	Obesity
Rural		N	-	27	2	2
	Improper	%	-	90.0	6.7	3.3
Urban		N	3	88	13	7
		%	2.7	79.3	11.7	6.3
Rural		N	-	20	6	3
	Proper	%	-	69.0	20.7	10.3
Urban		N	5	115	19	12
		%	3.3	76.2	12.6	7.9

In rural area, BMI-for-age was not correlated with the consumption of fruits, p=0.057. Nevertheless, a higher percentage of normal weight adolescents (90.0%) follow an improper eating pattern, while the highest percentage of overweight (20.7%) and obese (10.3%) follow proper eating pattern and consume at least two servings of fruit per day (Table 5). In urban area

nutritional status was not correlated with the consumption of fruits, p=0.694. Almost equal percentage across all categories follow/don't follow the pattern of proper nutrition. According to Hodị ić and Smajić (2012) the daily habit of eating fruit developed 29.4% of students (twice a day), and a similar percentage (28.7%) consumed fruit three times a day.

Table 6. Relation between adolescents' BMI-for-age and vegetables consumption

Place	Pattern		BMI-for-age			
			Underweight	Normal weight	Overweight	Obesity
Rural		N	-	35	4	2
	Improper	%	-	85.4	9.8	4.9
Urban		N	5	119	17	13
		%	3.2	77.3	11.0	8.4
Rural		N	-	13	4	2
	Proper	%	-	68.4	21.1	10.5
Urban		N	3	84	15	6
		%	2.8	77.8	13.9	5.6

In rural area, nutritional status was not correlated with the consumption of vegetables, p=0.133, nor in urban area, p=0.968 (Table 6). In Croatia, 66.0% of pupils do not eat fruit every day, and as much as 76.0% do not eat

vegetables every day (Ministarstvo zdravlja R. Hrvatske, 2013). In the Canton of Sarajevo, 37.8% of adolescents consumed fruits once a day and vegetables (37.2%) twice a day (Hodị ić and Smajić, 2012).

Table 7. Relation between adolescents' BMI-for-age and food diversity

			BMI-for-age			
			Underweight	Normal weight	Overweight	Obesity
Rural		N	-	16	1	3
	Improper	%	-	80.0	5.0	15.0
Urban		N	2	69	18	7
		%	2.1	71.9	18.8	7.3
Rural		N	-	32	7	1
	Proper	%	-	80.0	17.5	2.5
Urban		N	6	135	14	12
		%	3.6	80.8	8.4	7.2

In rural area nutritional status was not correlated with the diversity of food, p=0.824. In urban area nutritional status was correlated with food diversity, p=0.049. Among adolescents who have

diverse diet every day, the highest percentage is of those in the category of normal weight (80.8%), and a smaller percentage of those being overweight (8.4%) (Table 7).

Table 8. Relation between adolescents' BMI-for-age and the type of diet

Place	Pattern		BMI-for-age			
			Underweight	Normal weight	Overweight	Obesity
Rural		N	-	26	5	2
	Improper	%	-	78.8	15.2	6.1
Urban		N	3	116	17	10
		%	2.1	79.5	11.6	6.8
Rural		N	-	21	3	2
	Proper	%	-	80.8	11.5	7.7
Urban		N	4	84	14	8
		%	3.6	76.4	12.7	7.3

In rural area, nutritional status was not correlated with the type of diet in relation to the contribution of macronutrients, *p*=0.889 nor in urban area, *p*=0.976 (Table 8). Four options were given as macronutrient

describing: high protein, high fat, high carbohydrate and diverse diet. High protein and diverse diet were regarded as proper pattern.

Table 9. Relation between adolescents' BMI-for-age and the type of consumed fluid

Place	Pattern		BMI-for-age			
			Underweight	Normal weight	Overweight	Obesity
Rural		N	-	21	3	2
	Improper	%	-	80.8	11.5	7.7
Urban		N	5	114	13	13
		%	3.4	78.6	9.0	9.0
Rural		N	-	25	5	2
	Proper	%	-	78.1	15.6	6.3
Urban		N	3	86	18	6
		%	2.7	76.1	15.9	5.3

In rural area, nutritional status was not correlated with the type of fluid consumed, *p*=0.844, nor in urban area, *p*=0.586 (Table 9). Proper eating

pattern was demonstrated in the answers: spring water and fresh juices.

Table 10. Relation between adolescents' BMI-for-age and daily consumption of fluid

Place	Pattern		BMI-for-age			
			Underweight	Normal weight	Overweight	Obesity
Rural		N	-	10	1	0
	Improper	%	-	90.9	9.1	0.0
Urban		N	1	31	5	4
		%	2.4	75.6	12.2	9.8
Rural		N	-	38	7	4
	Proper	%	-	77.6	14.3	8.2
Urban		N	7	169	27	15
		%	3.2	77.5	12.4	6.9

In rural area, nutritional status did not correlate with the recommended daily consumption of

fluids (1-1.5 liters), *p*=0.301, nor in urban area, *p*=0.620 (Table 10).

Table 11. Relation between adolescents' BMI-for-age and daily consumption of milk/yoghurt

Place	Pattern		BMI-for-age			
			Underweight	Normal weight	Overweight	Obesity
Rural		N	-	5	2	0
	Improper	%	-	71.4	28.6	0.0
Urban		N	1	27	3	1
		%	3.1	84.4	9.4	3.1
Rural		N	-	34	4	2
	Proper	%	-	85.0	10.0	5.0
Urban		N	7	159	26	13
		%	3.4	77.6	12.7	6.3

In rural area, nutritional status was not correlated with the daily consumption of milk/yogurt (1-2-times per day and 3-4 times per day), *p*=0.443, neither in urban area, *p*=0.428 (Table 11). According to Hodţić and Smajić (2012) 32.2% of

respondents consumed milk twice, while 30.3% consumed milk three times a week. According to Tognarelli et al. (2004) milk is consumed regularly by only 42.0% of children (*p*=0.503 for urban compared to rural).

Table 12. Relation between adolescents' BMI-for-age and daily consumption of carbohydrates

Place	Pattern		BMI-for-age			
			Underweight	Normal weight	Overweight	Obesity
Rural		N	-	15	0	0
	Improper	%	-	100.0	0.0	0.0
Urban		N	1	37	7	5
		%	2.0	74.0	14.0	10.0
Rural		N	-	32	8	4
	Proper	%	-	72.7	18.2	9.1
Urban		N	6	150	19	13
		%	3.2	79.8	10.1	6.9

In rural area, nutritional status was correlated with the consumption of 250 grams of carbohydrate foods such as rice, pasta, potatoes, once or twice a week, *p*=0.024 (Table 12). In urban area, nutritional status was not correlated with the consumption of carbohydrate foods, *p*=0.238.

Table 13. Relation between adolescents' BMI-for-age and weekly consumption of sweets

Place	Pattern		BMI-for-age			
			Underweight	Normal weight	Overweight	Obesity
Rural		N	-	27	5	1
	Improper	%	-	81.8	15.2	3.0
Urban		N	3	116	15	7
		%	2.1	82.3	10.6	5.0
Rural		N	-	20	3	3
	Proper	%	-	76.9	11.5	11.5
Urban		N	5	86	17	12
		%	4.2	71.7	14.2	10.0

In rural area, nutritional status was not correlated with the consumption of sweets, *p*=0.561, neither in urban area, *p*=0.182 (Table 13). Proper eating pattern is reflected in the answers never or 1-2 times per week. Similar data were obtained in the survey by Hodžić and Smajić (2012) among adolescents in the city of Sarajevo, where 58.1% of respondents said they consumed sweets once a day. Dinarević et al. (2011) found that 65.5% eat sweets every day, and the rest of students from time to time. Bertić (2013) points out that 31.0% eat sweets every day, 28.0% several times a week, 27.0% up to two times a week and 14.0% rarely.

Table 14. Relation between adolescents' BMI-for-age and weekly consumption of snacks

Place	Pattern		BMI-for-age			
			Underweight	Normal weight	Overweight	Obesity
Rural		N	-	22	4	1
	Improper	%	-	81.5	14.8	3.7
Urban		N	4	99	12	5
		%	3.3	82.5	10.0	4.2
Rural		N	-	26	4	3
	Proper	%	-	78.8	12.1	9.1
Urban		N	4	99	20	14
		%	2.9	72.3	14.6	10.2

In rural area, nutritional status was not correlated with weekly consumption of snacks, *p*=0.736. In urban area, nutritional status was correlated with weekly consumption of snacks, *p*=0.037. Boys who follow proper eating pattern, either do not consume snacks or consume them minimally (once or twice a week) and 72.3% of them is of normal weight. On the other hand, the majority of boys with improper dietary pattern who consume snacks more often fall into normal weighted group (82.5%) (Table 14). This result is entirely unexpected due to the fact that snacks represent empty calories that increase the risk of obesity and diseases. Proper eating pattern is reflected in the answers never or 1-2 times per week. The frequency of consumption of snacks among adolescents in the city of Sarajevo was 47.5%, once a day (Hodžić and Smajić, 2012). Eating snacks (sticks, chips, etc.) is very popular. Most adolescents

(46.0%) consume snacks several times a week, and there are plenty of those (23.0%) who consume them every day, very rarely (30.0%), while only 1.0% of adolescents do not consume snacks (Bertić, 2013).

In rural area, nutritional status was not correlated with weekly consumption of meat products (salami, hot dogs, sausages), $p=0.736$, neither in urban area, $p=0.512$ (Table 15). Proper eating pattern is reflected in the answers never or 1-2 times per week.

According to Hodţić and Smajić (2012) 28.4% of adolescents consumed processed meats twice a week, while 8.8% do not consume these products. According to Bertić (2013) consumption of processed meats is highly abundant among adolescents in Bjelovar-Bilogora County (Croatia) and several times per week are consumed by 37.0%, 4.0% never eat them,, 23.0% eat them rarely, 23.0% up to two times per week, and 13.0% every day.

Table 15. Relation between adolescents' BMI-for-age and weekly consumption of meat products

Place	Pattern		BMI-for-age			
			Underweight	Normal weight	Overweight	Obesity
Rural		N	-	22	4	1
	Improper	%	-	81.5	14.8	3.7
Urban		N	3	122	18	8
		%	2.0	80.8	11.9	5.3
Rural		N	-	26	4	3
	Proper	%	-	78.8	12.1	9.1
Urban		N	5	82	14	11
		%	4.5	73.2	12.5	9.8

USDA recommendations (2010) for the studied population recommend five ounces per day of red meat, poultry and fish. One ounce is 28.34 grams, so daily intake of meat, poultry and fish should be 141.7 grams, a small steak of meat or a small fish. On a weekly basis, the recommended amount of protein food group would have been seven such steaks or smaller fish. It is known that restaurant' portion of meat is 250 grams, so this was taken into account in the design of FFQ, so the recommended amount would be 3-4 times a week of combined consumption of red meat, poultry and fish. The analysis for place of residence did not show statistical significance for poultry consumption (rural $p=0.470$, urban $p=0.595$), consumption of red meat (rural $p=0.687$, urban $p=0.307$), or fish consumption (rural $p=0.336$, urban $p=0.149$) (Table 16).

Table 16. Relation between adolescents' BMI-for-age and weekly consumption of poultry, red meat, and fish

	Place	Pattern		BMI-for-age			
				Underweight	Normal weight	Overweight	Obesity
POULTRY	Rural		N	-	34	4	3
		Improper	%	-	82.9	9.8	7.3
	Urban		N	8	137	23	13
			%	4.4	75.7	12.7	7.2
	Rural		N	-	14	4	1
		Proper	%	-	73.7	21.1	5.3
	Urban		N	0	63	9	6
				0.0	80.8	11.5	7.7
RED MEAT	Rural		N	-	37	6	3
		Improper	%	-	80.4	13.0	6.5
	Urban		N	6	151	22	13
			%	3.1	78.6	11.5	6.8
	Rural		N	-	9	2	1
		Proper	%	-	75.0	16.7	8.3
	Urban		N	2	47	10	6
				3.1	72.3	15.4	9.2
FISH	Rural		N	-	44	6	4
		Improper	%	-	81.5	11.1	7.4
	Urban		N	7	178	31	17
			%	3.0	76.4	13.3	7.3
	Rural		N	-	3	2	0
		Proper	%	-	60.0	40.0	0.0
	Urban		N	1	24	0	2
			%	3.7	88.9	0.0	7.4

Hodţić and Smajić (2012) point out that poultry is consumed by 66.5% of adolescents, while there's considerably lower consumption of red meat (17.3%) and fish (15.6%). Bertić (2013) showed that most students consume fish very rarely (45.0%), do not eat fish (17.0%), eat fish once a week (30.0%) or more times a week (8.0%). Although Croatia is a Mediterranean country, the presence of fish on the menu is very poor.

Conclusions

Although there is no statistical significance between BMI-for-age in relation to the place of residence, there is still higher percentage of adolescents from rural area with normal weight, and both groups have a high percentage of overweight. Statistical significance was found for more observed determinants of eating patterns for urban boys (the number of daily meals, regular consumption of breakfast, the diversity of diet and eating snacks) but looking at the percents, clear border between urban and rural eating patterns in this population can not be underlined. Eating patterns are complexed and needed to be studied in more details and with additional factors examined in the default settings.

References

Bertić, Ţ. (2013): „Prehrana školske djece" – projekt Zavoda za javno zdravstvo Bjelovarsko-bilogorske ţupanije u suradnji sa Ţupanijskim stručnim vijećem voditelja školskih preventivnih programa u osnovnim školama. *Hrvatski časopis za javno zdravstvo* 9 (33), pp. 92-108.

Brady, L.M., Lindquist, C.H., Herd, S.L., Goran, M.I. (2000): Comparison of children's dietary intake patterns with US dietary guidelines. *Br. J. Nutr.* 84, pp. 361-367.

Colić-Barić, I., Kajfez, R., Šatalić, Z., Cvjetić, S. (2004): Comparison of dietary habits in the urban and rural Croatian school children. *Eur J Nutr* 43 (3), pp.169-174.

Dinarević, S., Branković, S., Hasanbegović, S. (2011) Ishrana i fizička aktivnost učenika osnovnih škola u odnosu na gojaznost. *Journal of Health Sciences* 1 (1), pp. 46.

Esposito, L., Fisher, J.O., Mennella, J.A., Hoelscher, D.M., Huang, T.T. (2009): Developmental Perspectives on Nutrition and Obesity From Gestation to Adolescence. *Preventing Chronic Disease* 6 (3), pp. 94.

Federalni zavod za statistiku (2013): *Popis stanovništva, domaćinstva/kućanstavaistanova u Bosni i Hercegovini 2013. Preliminarni rezultati po općinama i naseljenim mjestima u Federaciji Bosne i Hercegovine*, Statistički bilten broj 195/2013. Available at www.fzs.ba,[Accessed: 28.02.2014.].

Harnack, L., Block, G., Lane, S. (1997): Influence of selected environmental and personal factors on dietary behavior for chronic prevention – a review of theliterature. *JNE* 29, pp. 306–312.

Hodţić, .I, Smajić, A. (2012): Prehrambene navike učenika završnih razreda osnovnih škola na području grada Sarajeva. *Zbornik radova Poljoprivredno-prehrambenog fakulteta Univerziteta u Sarajevu* 57(62/1), pp. 126-127.

Liebman, M., Pelican, S., Moore, S.A., Holmes, B.,Wardlaw, M.K., Melcher, L.M., Liddil, A.C., Paul, L.C., Dunnagan, T., Haynes, G.W. (2003): Dietary intake, eating behavior, and physical activity-related determinants of high body mass index in rural communities in Wyoming, Montana, and Idaho. *Inl J Obes Relat Metab Disord* 27, pp. 684-692.

Ministarstvo zdravlja R Hrvatske (2013): Nacionalne smjernice za prehranu učenika u osnovnim školama, Zagreb, pp. 12.

Popkin, B.M. (2001): Nutrition in transition: the changing global nutrition challenge. *Asia Pac J of Clin Nutr* 10 (Suppl.), S13-S18.

Suliga, E. (2006): Nutritional status and dietary habits of urban and rural Polish adolescents, *Anthropologischer Anzeiger* 64, pp. 399-409.

Tognarelli, M., Picciolli, P., Vezzosi, S., Isola, A., Moretti, F., Tommassetto, E., Fantuzzi, A.L., Bedogni, G. (2004): Nutritional status of 8-year-old rural and urban Italian children: a study in Pistoia, Tuscany. *Int J Food Sci Nutr* 55 (5), pp. 381- 387.

USDA (2010): Food Groups. Available at: http://www.choosemyplate.gov/food-groups/[accessed: 13.12.2013.]

Woodward, D.R., Cumming, F.J., Ball, J., Williams, H.M., Hornsby, H., Boon, J.A. (2000): Urban-rural differences in dietary habits and influences among Australian adolescents. *Ecol Food Nutr* 39, pp. 271-292.

Zavod za planiranje razvoja Kantona Sarajevo (2006): Prostorni plan Kantona Sarajevo za period od 2003. do 2023. pp. 11, 18, 227.

UTICAJ GEOGRAFSKOG PORIJEKLA NA ANTIOKSIDACIJSKU AKTIVNOST DOMAĆIH VINA

Aldina Kesić[*], Bianka Smajlović, Zorica Hodžić, Nadira Ibrišimović-Mehmedinovic

Univerzitet u Tuzli, Univerzitetska 4, 75000 Tuzla, Bosna i Hercegovina

Sažetak

Uvod i cilj: Crna vina sadrže različite spojeve koji se odlikuju visokom antioksidacijskom aktivnošću. Najznačajniji antioksidansi grožđa i vina su fenolna jedinjenja. Fenolne komponente iz vina su opće prihvaćeni antioksidansi koji imaju važnu ulogu u održavanju ljudskog zdravlja i prevenciji raznih bolesti zbog mogućnosti sprečavanja aktivnosti slobodnih radikala. Na sadržaj antioksidanasa u vinu utiče porijeklo sirovina (grožđa) kao značajan parametar pri određivanju kvaliteta vina kao i nacin proizvodnje samog vina.
Metode: Ovim istraživanjem određen je ukupni antioksidacijski kapacitet crnih vina indirektnom FRAP (Ferric Reducing Antioxidant Power) metodom uz $FeSO_4$ x $7H_2O$ kao standard. Istraživanjem je obuhvaćeno ispitivanje antioksidacijske aktivnosti uzoraka vina.
Rezultati: Najveću vrijednost antioksidacijske aktivnosti pokazao je uzorak vina Postup Vinogorje Pelješac (a=62,77 mmolFeII/L dok je najslabiju antioksidacijsku aktivnost pokazao uzorak vina individualnog proizvođača sa područja Kalesije (a = 10,54 mmolFeII/L).
Zaključak: Crna vina sa područja Bosne i Hercegovine predstavljaju značajan izvor antioksidanasa.

Ključne riječi: vino, polifenoli, antioksidacijska aktivnost, geografsko porijeklo

Uvod

Vino je poljoprivredno prehrambeni proizvod i njegova antioksidacijska aktivnost se bazira na djelovanju prirodnih antioksidanasa. Najznačajniji antioksidansi grožđa i vina su fenolna jedinjenja koja vino ne čine samo ljekovitim, već imaju važnu ulogu i u organoleptičkim karakteristikama. Fenolni spojevi djeluju kao antioksdansi na brojne načine, jedan od njih je zbog prisutnosti hidroksilnih skupina u molekuli fenola koje su dobri proton donori koji mogu reagirati s reaktivnim oksigenom i nitrogenom i na taj način spriječiti nastanak novih radikala. Utvrđeno je da fenolne komponente vina imaju veoma visok antioksidativni potencijal. Umjereno konzumiranje crnog vina (oko 120 mL dnevno) može da dovede do smanjenja rizika od kardiovaskularnih bolesti od 25 do 60 % (Bertelli, 2007; Gey, 1990; Doll, 1990; Mimić-Oka i sar., 1999). Važnost konzumacije namirnica bogatih polifenolima je u tome što fenolni spojevi pokazuju širok spektar fizioloških učinaka, kao što je antialergijsko, protuupalno, antimikrobno, antioksidativno, antitrombonsko, kardioprotektivno i vazodiletacijsko djelovanje (Benavente-Garcia i sar., 1997; Manach i sar., 2005; Middleton i sar., 2000; Puupponen-Pimiä i sar., 2001; Samman i sar., 1998). Ukupan unos polifenola u ljudski organizam značajno varira, a u prosjeku iznosi oko 1000 mg/dan (Scalbert i sar., 2000). Utvrđeno je da je antioksidativna aktivnost jedne čase crnog vina (150 ml) ekvivalentna aktivnosti 12 časa bijelog vina, 2 šolje čaja, 3,5 čaša soka od borovnice ili piva, 4 jabuke, 5 glavica luka, 5,5 patlidžana, 7 čaša soka od pomorandže i 20 časa soka od jabuke (Novak i sar., 2007).

Eksperimentalni dio

Istraživanjem je obuhvaćeno 8 uzoraka crnog vina (Tablica 1) različitog geografskog porijekla. Analizirano je sedam uzoraka vina sa područja Tuzlanskog kantona i jedan uzorak sa područja Hrvatske. Analizirani uzorci su uzeti od individualnih proizvođača i ne mogu se nabaviti u slobodnoj prodaji. Poređenja radi, izmjerena je i ukupna antioksidacijska aktivnost sedam komercijalno dostupnih uzoraka crnog vina (Tablica 2). Šest uzoraka sa područja Bosne i Hercegovine i jedan uzorak sa područja Hrvatske. Za sve uzorke navedeno je geografsko porijeklo vinove loze kao početne sirovine za proizvodnju vina, a ako je vino iz slobodne prodaje naveden je proizvođač.
Tijekom istraživanja sva vina su čuvana u frižideru u tamnim bocama, a analize su provedene u periodu od januara do marta 2014 godine. Ukupni antioksidacijski kapacitet određen je indirektnom FRAP (Ferric Reducing Antioxidant Power) metodom uz $FeSO_4$ x 7 H_2O kao standard.

[*]Corresponding author: aldina.kesic@untz.ba

Tablica 1. Opis uzoraka analiziranih crnih vina individualnih proizvošača

Table 1. The description of the analysed red wines from the individual producers

R. br. uzorka	Naziv	Proizvođač	Godina berbe	Obujam boce (L)	Porijeklo
1.	Domaće vino I	Obitelj A	2011	0,75	Brač
2.	Frankovaka	Obitelj B	2012	0,75	Tuzla
3.	Cabernett Sovignon	Obitelj B	2012	0,75	Tuzla
4.	Frankovka	Obitelj B	2011	0,75	Tuzla
5.	Domaće vino II (Slovenačko)	Obitelj C	2012	0,75	Požarnica
6.	Domaće vine III (Moldava)	Obitelj C	2012	0,75	Požarnica
7.	Domaće vino IV	Obitelj D	2012	0,75	Caparde
8.	Domaće vino V	Obitelj E	2012	0,75	Kalesija

Tablica 2. Opis uzoraka analiziranih komercijalno dostupnih crnih vina
Table 2. The description of the analysed comercially-available red wines

R. br. uzorka	Naziv	Proizvođač	Godina berbe	Obujam boce (L)	Porijeklo
1.	Postup	Istravino	2008	0,75	Vinogorje Pelješac
2.	Blatina	Vinarija Čitluk	2011	0,75	Čitluk
3.	Vranac Hepok	Vinarija Hepok	2011	0,75	Mostarsko vinogorje
4.	Romanca	Vinarija Čitluk	2009	0,75	Čitluk
5.	Hercegovački Vranac	Vinarija Čitluk	2011	0,75	Čitluk
6.	Blatina Stojić	Vina Stojić	2011	0,75	Mostarsko vinogorje
7.	Hercegovačka Blatina	Vinarija Čitluk	2010	0,75	Mostarsko vinogorje

Antioksidacijaksa aktivnost ispitana pomoću FRAP metode

Metoda se temelji na redukciji feruma iz feri Fe^{3+} u fero Fe^{2+} oblik u prisustvu antioksidanasa, gdje se pri niskoj vrijednosti pH razvija intenzivno plavo obojen kompleks fero tripiridiltriazina, koji ima apsorpcijski maksimum na 595 nm (Slika 1). Redukcija se prati mjerenjem promjene apsorbancija pri 595 nm. Rezultati su izraženi kao μmol Fe^{2+} ekvivalenta (FE)/mL uzorka (Kesić, 2011). Mjerenje je vršeno na UV/VIS spektrofotometru „UVmini-1240V SHIMADZU".
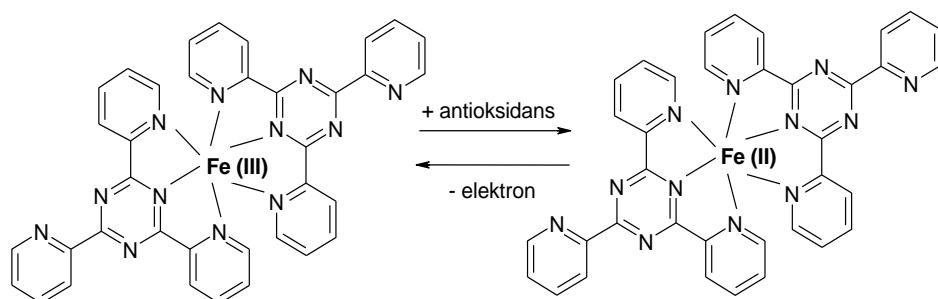
Slika 1. Reakcija redukcije željezo-2,4,6- tripiridil-s-triazina (TPTZ)
Fig. 1. The reduction of iron-2,4,6-TPTZ

Rezultati i diskusija

Najslabiju antioksidacijsku aktivnost pokazao je uzorak vina individualnog proizvođača sa područja Kalesije (a=10,54 mmolFeII/L) (Slika 2). Najveću vrijednost antioksidacijske aktivnosti pokazao je uzorak vina Postup Vinogorje Pelješac (a = 62,77 mmolFeII/L) (Slika 3). Poređenjem prosječne antioksidacijske aktivnosti uzoraka crnog vina sa područja Tuzlanskog kantona i ostalim ispitivanim uzorcima može se zaključiti da je antioksidacijska aktivnost znatno manja ali ne odstupa od literaturnih podataka (Slika 4).
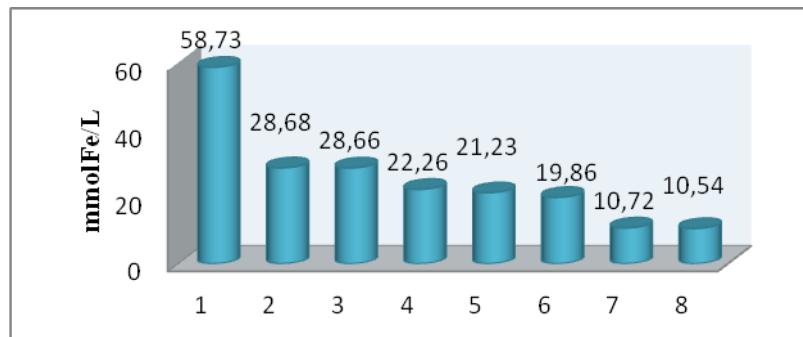
Slika 2. Antioksidacijska aktivnost analiziranih uzoraka crnog vina
Fig. 2. The antioxidant activity of the analyzed red wine samples
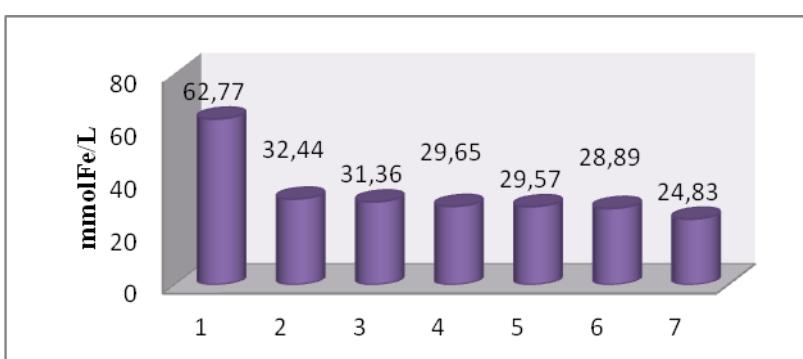
Slika 3. Antioksidacijska aktivnost komercijalno dostupnih analiziranih uzoraka crnog vina
Fig. 3. The antioxidant activity of the analyzed commercially available red wine samples
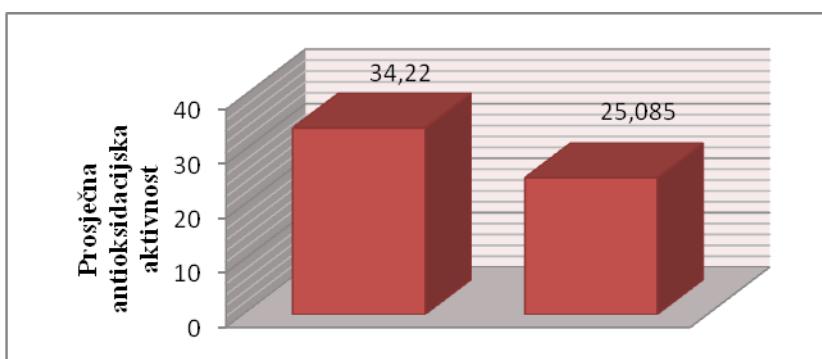
Slika 4. Prosječna antioksidacijska aktivnost analiziranih uzoraka crnog vina
Fig. 4. The average antioxidant activity of the analyzed red wine samples

Ukupna antioksidacijska aktivnost italijanskih crnih vina određena DPPH metodom kreće se u interval od 7,8 do 19 mmol TE/L (Simonetti i sar., 1997), dok je za crna vina južne Afrike određen interval od 9,51 do 12,39 mmol TE/L (De Beer i sar., 2003), što je u skladu sa rezultatima dobivenim u ovom istraživanju (10,55 - 62,77 mmolFe^{II}/L). Ukoliko se analizira korelaciju između prosječne antioksidacijske aktivnosti vina porijekla sa TK i uzoraka vina sa drugih područja (Hercegovina) može se zaključiti da antioksidacijska aktivnost u prosjeku manja za 73,3 % u uzorcima vina sa područja TK. Udio polifenolnih spojeva koji imaju veoma visok antioksidacijski potencijal u grožđu i vinu ovisi o velikom broju faktora kao što su kultivar, ekološki uslovi uzgoja, primjenjeni agrotehnički i ampelotehnički zahvati u vinogradu, te tehnike vinifikacije (Jackson i Lombard, 1993; Downey i sar., 2006). Istraživanje prezentirano u ovom radu pokazuje da

komercijalno dostupna vina koja su sa područja Hercegovine pokazuju u prosjeku veću antioksidacijsku aktivnost od vina sa područja TK uzetih od individualnih proizvoĎača. Ovo se može objasniti činjenicom da koncentracija polifenola u grožđu ovisi o svjetlosti i temperaturi te njihovom međudjelovanju (Crippen i sur. 1986; Guidon i sar. 2008). Naime, veća izloženost bobice svjetlu uslovljava i više polifenola, dok previsoke temperature mogu smanjiti ukupne polifenole (Crippen i Morrison, 1986), a samim time i antioksidacijsku aktivnost. Prema istraživanjima Ranković-Vasić (2003) na sadržaj fenola i monomernih antocijana u pokožici bobice, kao i na sadržaj monomernih antocijana u ogrozdini utiče temperatura vazduha u periodu od 7 do 35 dana prije berbe grožđa. Najveći uticaj na sadržaj fenolnih spojeva imala je suma maksimalnih temperatura vazduha od 17 do 26 °C u periodu 35 dana prije berbe grožđa. Koncentracija fenola kao i ukuna antioksidacijska aktivnost zavisi i od tehnološkog postupka proizvodnje vina. Koliki udio polifenolnih spojeva će se ekstrahirati u vino ovisi o sorti, temperaturi i trajanju kontakta s pokožicom, a najvećim dijelom o uslovima maceracije (Ribéreau-Gayon i sar., 2006). Porastom temperature znatno se ubrzava ekstrakcija fenolnih spojeva (Merinda i sar., 1991) što se može objasniti degradacijom ćelijskih zidova te se ubrzava isticanje ćelijskog sadržaja. Prema istraživanjima Ribereau-Gayon i sar. (1970) topivost ukupnih fenola i intenzitet obojenosti znatno se povećavao sa porastom temperature i trajanjem maceracije. Nakon 4 dana maceracije na temperaturi od 20 °C koncentracija fenolnih spojeva je iznosila 39 g/L dok je na temperaturi od 30 °C koncentracije fenola iznosila 55 g/L. Nakon 30 dana maceracije sadržaj feolnih spojeva na 30 °C je iznosio 72000 mg/L. Prema Sudraudu (1963) povećanjemtemperature fermentacije povećavao se i sadržaj fenola.Na osnovu prikupljenih podataka od proizvođača vina sa područja TK znamo da u uzorak 5, uzorak 6, uzorak 7 i uzorak 8 nije dodan sumpor-dioksid iako sumpor-dioksid intenzivira ekstrakciju fenolnih jedinjenja, prije svega antocijana iz pokožice jer razara ćelijske opne i olakšava isticanje rastvorljivih komponenti. Ovi uzorci su pokazali i najmanju ukupnu antioksidacijsku aktivnost. Na osnovu svega navedenog jasno je da su vina individualnih proizvođača koja u toku proizvodnje nisu izlagana visokim temperaturama pokazala i niži sadržaj slobodnih fenola, a samim tim i nižu antioksidacijsku aktivnost.

Zaključci

Vino, kao prirodni prehrambeni proizvod, predstavlja značajan izvor antioksidanasa za ljudski organizam. Istraživana vina individualnih proizvođača pokazala

su manju antioksidacijsku aktivnost u odnosu na komercijalno dostupna vina što je vjerovatno posljedica raznolikosti sorti grožđa, lokacije vinograda, klime, tipa tla, kao i različitih postupaka proizvodnje vina i njegovog starenja. Takođe možemo zaključiti da geografsko porijeklo utiče na prosječnu antioksidacijsku aktivnost vina. Uzorci vina iz Hercegovine bogatiji su izvor antioksidanasa, od uzoraka vina sa područja TK, što je vjerovatno posljedica veće izloženosti grožđa svjetlosti i većoj temperaturi te njihovom međudjelovanju. Tehnološki postupak proizvodnje vina utiče na prosječnu antioksidacijsku aktivnost vina. Uzorci komercijalno dostupnih vina bogatiji su izvor antioksidanasa od vina individualnih proizvođača, što najvjerovatnije ovisi o sorti, temperaturi i trajanju kontakta sa potkožicom, a najvećim dijelom o uslovima maceracije.

Literatura

Benavente-Garcia, O., Castillo, J., Marin, F.R., Ortuno, A., Del Rio, J.A. (1997): Uses and properties of citrus flavonoids. *J. Agric. Food Chem.* 45, 4505-4515.

Crippen, D.D., Morrison, J.C. (1986): The Effects of Sun Exposure on Phenolic Content of Cabernet Sauvignon Berries During Development. *Am.J.Enol.Vitic.* 37, 243-247.

De Beer Joubert, E., Gelderblom, W.C.A., Manley, M. (2003): Antioksidant Activity of South African Red and White Cultivar Wines: Free Radical Scavenging, *Journal od Agricultural and Food Chemistry* 51, 902-909.

Downey, M.O., Harvey, J.S., Robinson, S.P. (2003): Analysis of tannins in seeds and skins of Shiraz grapes throughout berry development. *Aust.J.Grape Wine Res.* 9, 15-27.

Guidoni, S., Ferrandino, A., Novello, V. (2008): Effects of Seasonal and Agronomical Practices on Skin Anthocyanin Profile of Nebbiolo Grapes. *Am. J. Enol. Vitic.* 59, 22-30.

Jackson, D.I., Lombard, P.B. (1993): Enviromental and Management Practices Affecting Grape Composition and Wine Quality – A Review. *Am. J. Enol. Vitic.* 44, 409-430.

Kesić, A. (2011): „Uticaj hemijskog sastava meda na njegovu antioksidacijsku aktivnost" Doktorska disertacija, Prirodno-matematički fakultet, Univerzitet u Tuzli. pp. 82-88.

Manach, C., Mazur, A., Scalbert, A. (2005): Polyphenols and prevention of cardiovascular diseases. *Curr. Opin. Lipidol.* 16, 77-84.

Merinda, J., Moyano, L., Millan, C., Medina. M. (1991): Extraction of phenolic compounds in controlled macerations of Pedro Ximenez grapes, *Vitis* 30, 117-127.

Middleton, E., Kandaswami, C., Theoharides, T.C. (2000): The effects of plant flavonoids on mammalian cells: implications for inflammation, heart disease and cancer. *Pharmacol. Rev.*52, 673-751.

Novak, I., Šeruga, M., Jakobek, L. (2007): Polifenolni antioksidansi i antioksidacijska aktivnost crnih vina, Prehrambeno tehnološki fakultet Osijek, 42. HRVATSKI I 2. MEĐUNARODNI SIMPOZIJ AGRONOMA.

Puupponen-Pimiä, R., Nohynek, L., Meier, C., Kähkönen, M., Heinonen, M., Hopia, A., i suradnici (2001): Antimicrobial properties of phenolic compounds from berries. *J. Appl. Microbiol.* 90, 494-507.

Ranković-Vasić, Z. (2013):„Uticaj ekološkog potencijala lokaliteta na biološka i antioksidativna svojstva sorte vinove loze Burgundac crni (Vitis vinifera L.)" Doktorska disertacija. Poljoprivredni fakultet,Univerzitet u Beogradu.

Ribereau-Gayon, P., Glores, Y. (2006): Handbook of enology, The Chemistry of wine stabilization and treatments. Second edition. John Wiley and Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, England. Pp. 53-58.

Ribereau-Gayon, P., Glores, Y. (2006): Handbook of enology, The Chemistry of wine stabilization and treatments. Second edition. John Wiley and Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, England. Pp. 53-58.

Samman, S., Lyons Wall, P.M., Cook, N.C. (1998): Flavonoids and coronary heart disease: Dietary perspectives. U: Flavonoids in health and disease (Rice-Evans, C. A. i Packer, L., ured.), Marcel Dekker, New York, str. 469-482.

Scalbert, A., Williamson, G. (2000): Dietary intake and bioavailability of polyphenols. *J. Nutr.* 130, 2073S-2085S.

Simonetti P., Pitta P., Testolin G. (1997): Polyphenol Content and total Antioxidant Potential of Selected Italian Wines. *Journal of Agricultural and Food Chemistry* 46, 1152-1155.

THE INFLUENCE OF GEOGRAPHIC ORIGIN ON THE ANTIOXIDANT ACTIVITY OF LOCAL WINES

Aldina Kesić, Bianka Smajlović, Zorica Hodžić, Nadira Ibrišimović-Mehmedinović

University in Tuzla, Univerzitetska 4, 75000 Tuzla, Bosnia and Herzegovina

Summary

Introduction and goal: red wines contain different compounds which are high in antioxidant activity. The most important antioxidants in grapes and wine are phenolic compounds. Phenolic components from wine are widely accepted antioxidants which have an important role in maintaining human health and preventing various illnesses because of its ability to stop the activity of the free radicals. The contents of the antioxidants in wine is affected by the origin of the grapes, as a significant parameter in establishing the quality in wine, as well as the way of winemaking itself.

Methods: In this research, the total antioxidant activity in red wines is established via indirect FRAP method (Ferric Reducing Antioxidant Power) with $FeSO_4$ x $7H_2O$ as the standard.

Results: The greatest value of antioxidant activity was in the sample of wine Postup, Pelješac Vineyard (a = 62.77 mmolFeII / L) while the lowest antioxidant activity was in the sample of wine from an individual producer from the area of Kalesija (a = 10.54 mmolFeII / L).

Conclusion: Red wines from Bosnia and Herzegovina are a very important source of antioxidants in nutrition.

Reference: Amerine, M.A., Ough, C.S. (1980): Methods for Analysys of Musts and Wines. John Wiley Sons, New , 45. Fern n dez-Pach n, M.S., Villano, D., Garc a-Parrilla, M.C., Troncoso, A.M. (2004): Antio, 48. German, J.B., Frankel, E.N., Waterhouse, A.L., Hansen, R.J., Walzem, R.L. (1997): Wine phenolics and t, 51. Graf, B.A., Milbury, P.E., Blumberg, J.B. (2005): Flavnols, flavones, flavanones, and human health, 88. Kesić, A., (2011): "Uticaj hemijskog sastava meda na njegovu antioksidacijsku aktivnost".

Keywords: wine, polyphenols, antioxidant activity, geographic origin

DOES KNOWLEDGE INFLUENCES OUR DIET?
DIETARY HABITS OF ADOLESCENTS ENROLLED IN GENERAL PROFILE AND CATERING SCHOOL PROGRAMME

Dragana Lošić[1], Daniela Čačić Kenjerić[2*]

[1]Kralja Petra II 57, 78000 Banja Luka, Bosnia and Herzegovina
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia

Summary

Introduction and objective: During adolescence lifestyle is formed, including dietary habits, which mainly remain unchanged throughout the life. Dietary habits and physical activity influence one's health status. The goal of this study was to examine and compare dietary habits in the population of high school teens enrolled in general secondary school and catering school.
Methods: Study was performed using a one-time questionnaire which, among other sections included basic data needed for characterization of the group and a group of questions on participants dietary habits.
Results: Data collected during this research are expressed on the whole research group and also on subgroups created considering gender, environment and educational programme. Collected data about dietary habits show drastically low breakfast consumption, low consumption of fish, fruit, vegetables, milk and dairy products, high consumption of meat and meat product, carbonized beverages and sweets. Significan difference in dietary habits was obtained for breakfast consumption, frequency of vegetables, soft drinks, milk and coffee consumption, dieting habits due to estetic motives and fluid intake.
Conclusion: This study about dietary habits shows significant deviation from health recommendations, and therefore it is necessary to develop and organize promotional programmes of healthy behavior that is customized to teens needs.

Introduction

Adolescence is a crucial period in a development of each person, during which intensive physical, psychological, emotional and personal changes occur. Currently, persons under 25 years of age make almost half of the human population, and number of adolescents is the highest in the human history (Kuzman, 2009).
Dietary habits are an important part of a healthy lifestyle and healthful nutritional practices need to be adopted during childhood and adolescence (Tupe and Chiplonkar, 2010).
Consolidation of nutritional behaviors and habits takes place in adolescence. They consolidate by the age of 15, and undergo a minor changes between 15 and 18 years of age. Acquired habits remain unchanged for the rest of our lifecycle (Djordjević-Nikić et al., 2013).
Dietary habits are influenced by the independence need, physical appearance and period spent outside of the hause. In general, they are also influenced by culture, financial status and education of parents, personal preferences and many other factors. Early establishment of healthyful dietary practices can have a positive impact on chronic diseases that occur later in life; particularly obesity, cardiovascular diseases and type 2 diabetes (Rossiter et al., 2012).
Studies indicate recurrence of few dietary patterns in adolescents around the Globe. These are skiping breakfast, intake of fast food, eating away from home, low fruit and vegetables intake, low intake of milk and dairy products, high intakes of soft drings, snacking and dieting with the purpose of weight regulation (Meandžija et al., 2006).
Current prevalence of obesity is ten times higher comparet to 1970´s indicating trend of epidemic proportions, and its prevalence in children and adolescents is a major concern (Sahingoz and Sanlier, 2011). Among main risk factors for obesity development are popularity and consumption of fast food and soft drinks on one side, and lack of physical activity on the other, and as mentioned above, both of these are highly represented in young adolescent population which seeks to build their own identitiy (Gómez-Martínez et al., 2012).
The aim of this study was to estimate and compare dietary habits in the population of high school teens enrolled in general secondary school and catering school (vocational school) in Banja Luka (Bosnia and Herzegovina).

*Corresponding author: daniela.kenjeric@ptfos.hr

Subjects and methods

Study was conducted following the principles of cross-sectional study in October of 2014 on the population of highschool pupils in Banja Luka.

Participants

Study was conducted on the group of 119 adolescents from the general high school and

vocational high school for the caterer profession in Banja Luka. Two grades of pupils were included from each high school, but due to the fact that general high school has larger study groups (grades) 55.5% of study participants were from the general high school and 44.5% of participants were from the vocational high school (Table 1). Due to the general interest in two selected study programes 54.6% of participants were males, and 45.4% females.

Table 1. Basic characteristics of studied adolescent population

	General high school		Vocational high school				
	n	%	n	%		n	%
Total	66	55.5	53	44.5		119	100
Gender							
Males	26	39.4	39	73.6		65	54.6
Females	40	60.6	14	26.4		54	45.4
Living area							
Urban	56	84.8	41	77.4		97	81.5
Rural	10	15.2	12	22.6		22	18.5

Questionairre

Study was conducted using the anonymous questionnaire which consisted of 36 questions. First part included basic categoring information (gender, age, height and weight, type of living residence). Second part consisted questions on dietary knowledge and third questions on the relationship between the diet and diseases. Part with questions relating their dietary habits was the last one, and consisted of ten questions including frequency of consumption for selected foods, number of meals and supplementation. Prior to questionnaire completing participant received the information about the study and instructions how to fill in the questionnaire. Participants were also informed that their participation is strictly voluntary and only interviewer will have an insight into their answers. In average 20 to 25 minutes were needed to fill in the questionnaire.

Data analysis

Collected data were analysed using the Excel and Statistica. Results are expressed on a whole study group as well as for subgroups based on enrolled school programme, gender and type of living residence. Data analysis was conducted using the t-test for parametric statistics at the $p<0.05$ level of significance.

Results and discussion

Dietary habits of the studied population are presented using tables and figures. Fig. 1 shows the number of daily meals in a studied population. As is can be seen number of those eating 2-3 meals and those eating 3-5 meals daily is similar and in average is 45%. Just half of the participants consumes recommended number of meals. Exsception are participants from the rural areas 72.7% of which has 3-5 meals daily in comparison with participants from the towns (37.1%).

Results of the cross-sectional AVENA study which included 1978 adolescents from five spanish cities show that 80.4% of boys and 75.9% of girls has four or more meals, which is much better that the results obtained in our study (Gómez-Martínez et al., 2012).

Breakfast consumption habit is presented on a Fig. 2. As visible, only 25% of participants are regular in breakfasting, and the difference is significant if the participants from the different schools are compared. 34% of the participants enrolled in a vocational highschool programme takes breakfast regularly, compared to only 18.2% of those enrolled in the general highschool programme. Reports from the Croatia indicate that 15% of children does not have breakfast on the working days, while 4% of them does not have breakfast even on weekends. Number of children eating breakfast decreases with the years

of age (77% of 11-year olds and 64% of 15-year olds) (HZJZ, 2012). Above mentioned AVENA study has shown that elevated body fat (skinfold ticknes measured at 6 positions and waist circumference as indicators) is associated with dietary habits such as skiping meals, especialy mid-morning snack and afternoon snack, les than four meals daily and quick eating. They also confirmed lack of physical activity and skiping breakfast as a risk factors in obesity development. In their adolescent population boys had higher physical activity and les skipped breakfast and dinner than girls (Gómez-Martínez et al., 2012).
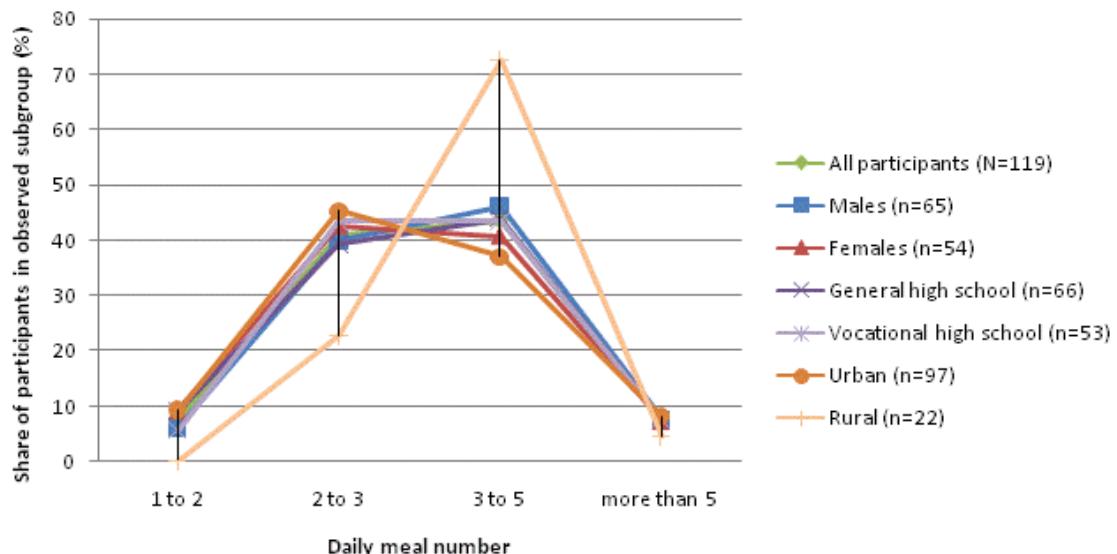
Fig. 1. Average daily meal number in studied population
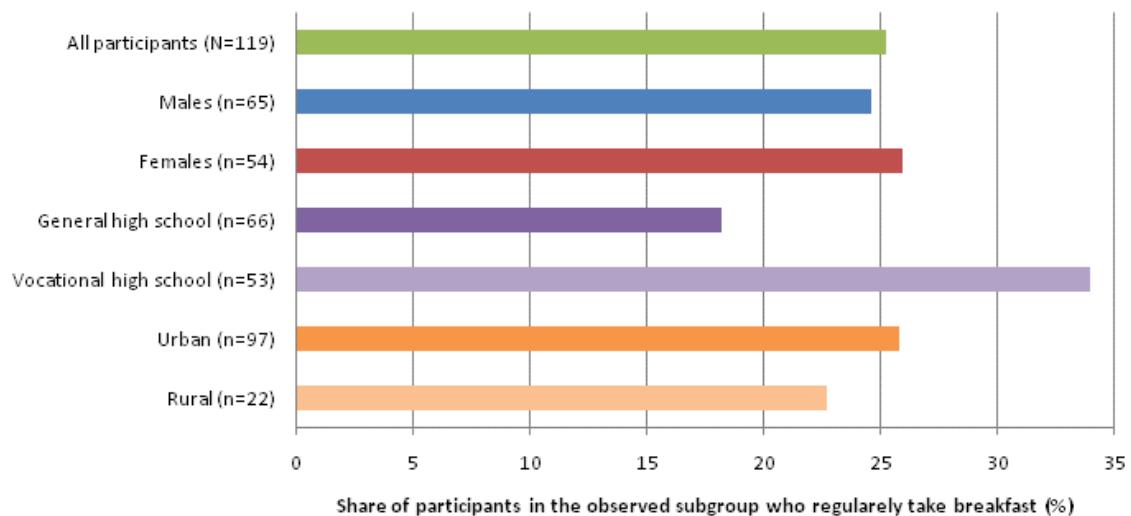
Fig. 2. Habit of regular breakfast consumation

Basic insight into dietary habits of the study group was achieved through the short food frequency questionairre which encompassed selected food groups (Table 2). High content of esential fatty acids makes fish one of the most valuable foods which, as such, should be consumed regularly. Most of the study participants (41.2%) consumes fish once a week which is in line with recommendations while

34.5% of them consumes fish only once a month. Fish consumption in the region where the study was conducted is in general low, and in Croatia it is just a litlle above 3 kg per person annually (Mandić,2007).

Most of the participants (35.3%) consumes meat 2-3x a week, while 30.3% of them eats meat once a day. High intake of meat and meat products is one of the risk factors for the development of obesity and cardiovascular diseases later in life.

22.7% of participants consumes fruit once a day, 31.3% of them 2x daily and 16,8% of them 3x daily. In comparison with fruit intake, vegetables are consumed once a day in 39.5%, twice a day in 23.5% and 3 times a day in 10.9% of the participants. Having in mind the recommendations for fruit and vegetables consumption (5 portions of 400 g a day) results are satisfiyng, especially havinh in mind the

fact that once a day consumption can equal 2 or more portions. Results of the EAT project on the fruit and vegetables intake in Minesota (USA) show that their fruit and vegetables intake is significantly below the recommendations. Only 45% of the adolescents reported consumption of two or more fruit portions daily and 17 % three or more portions of vegetables daily. Altogether, only one third (31%) reported to be in line with the recommended 5 a day intake (Neumark-Sztainer et al., 2003).

Considering the bread intake, 34.5% of participants consumes it 3x a day, while 25.2% of them bread consumes more than 3x a day. This was not a surprise since bread is traditionally a part of each meal in this region. Of all European countries, bread consumption is the highest in Estonia and Latvia (Vereecken et al., 2005).

Table 2. Consumption frequency of selected foods in studied adolescent population, all participants

	Frequency distributions of responses to selected foods (by percent)							
	once a day	2x per day	3x per day	>3x per day	once a week	2-3x per week	once a month	never
Fish	5.9	0.8	0.0	0.0	41.2	13.4	34.5	4.2
Meat	30.3	13.4	4.2	2.5	12.6	35.3	0.8	0.8
Fruit	22.7	31.1	14.3	16.8	5.0	9.2	0.8	0.0
Vegetables	39.5	23.5	6.7	10.9	6.7	10.1	0.8	1.7
Bread	13.4	21.8	34.5	25.2	1.7	0.8	0.8	1.7
Fizzy drinks	16.0	10.9	2.5	2.5	21.8	11.8	16.0	18.5
Sweets and cakes	32.8	17.6	7.6	14.3	11.8	10.1	1.7	4.2
Eggs	30.3	4.2	1.7	2.5	33.6	26.1	1.7	0.0
Milk/dairy products	35.3	24.4	6.7	13.4	9.2	7.6	1.7	1.7
Coffee	22.7	11.8	3.4	1.7	2.5	8.4	11.8	37.8
Alcohol	2.5	1.7	0.0	0.8	14.3	10.9	22.7	47.1

Soft drinks ar in studied adolescent population consumed in most cases once a week (21.8%), while 18.5% of them does not consume this type of drinks. Number of once a day and once a month consumers is same (16.0%). Obtained results are better than those obtained in adolescents from Serbia (Jovanović et al., 2011).

Sweets are, together with soft baverages, the main source of added sugar. Thea are consumed on a daily basis by 50.4% of the participants. Similar devastating results are obtained by studies on adolescents in Serbia (Ilić, 2010), and EU coutries (Vereecken et al., 2005). High intake of sweets and soft drinks, combined with sedentary activities (TV viewing) contributes to energy overload and obesity (De Bruijn and Van Den Putte, 2009).

Milk and dairy products are consumed on a daily basis in 59.7% of participants of opur study, and similar results are obtained in study conducted by Jovanović et al (2011). Low intake of milk and dairy

products is reported in Canada´s adolescent population. Milk consumption in adolescent population decreases while soft drink consumption remains unchanged or even increases indicating development of unhealthy dietary habits and increasing the risk of helath problems in the future. Decreased milk consumption negatively influences calcium and vitamin D intake which are important for bone development, while simultaneous increase of soft drinks provides nothing but „empty calories" and rises the risk of obesity (Rossiter et al., 2012).

Adolescence is a period of experimenting, and many young people during this period develop a habit of coffe and alcohol consumption, as well as a smoking habit. 37.8% of our study participants dos not consume coffe, while 22.7% of them drinks one cofee daily which is a good result. On the other hand, only 47.1% of the participants does not consume alcohol, 22.7% takes it once a month, and even 14.3% once a week.

Analysis of food frequency consumption in subgroups based on showed similar meat and bread consumption paterns in boys and girls, and pupils of both school while participants with residence in towns had slightly higher intake than those from rural areas. Higher fish consumption is noted in girls compared to boys, in general high school pupils compared to vocational school pupils and adolescents with residence in cities compared to those from rural areas. Higher fish consumption in towns than in rural areas was also reported in study conducted in Poland (Hoffmann et al., 2012) but intakes are in general higher in our study, which is positive. Girls have fruit and vegetables intake in line with recommendations in more cases than boys. Higher compliance with recomendations in girls than in boys was also found in adolescents from Virginia (USA) (Wilson et al., 2005). Fruit intake is similar in both school pupils and both residence types, while vegetables are more often consumed by general school programme pupils and children from town. 4.5% of participants from the rural areas does not consume vegetables at all. Fruit and vegetable intake is low in the adolescents from Canada as well (Rossiter et al., 2012). Boys more often drink soft beverages, and similar pattern is noted in adolescents in (HZJZ, 2012). They also eat more sweets than girls, and same patern is reported for Turkish adolescents (Sahingoz and Sanlier, 2011). Lower soft drinks consumption is noted in general school pupils and adolescents from towns. Milk intake is also higher in girls than in boys, in general school pupils than in vocational school pupils, as well as in children from town than those from rural areas. The results are in compliance with those reported by Rossiter et al. (2012). Considering the risk behaviour, cofee as well as the alcohol consumption is higher in boys than in girls. While, 64.8% of girls declared as non consumenrs of alcohol, this was the case in only 30.8% of boys. Coffee and alcohol consumption pattern was similar in children from town and rural areas, while vocational school pupils had higher intake of both cofee and alcohol.

Dieting practices for weight management (estetic reasons) are noticed in 65.5% of participants (Fig. 3). It is interesting that more boys (81.5%) than girls (46.3%) were practicing fad diets. Results of the study conducted on university students in Coratia show dieting practices in 10% of boys and 42% of girls (Banjari et al., 2011). Self perception of 50% of girls and 20% of boys in Australia is to be overweight while 13% of girls tryed to manage their weight by dieting, and 46% of Californian students wishes to loose weight (Gracey i sur., 1996). Compared to results from Croatia (Banjari et al., 2011) and Australia (Gracey i sur., 1996), participants of our study are more in favor of dieting, and even 5,9% of those dieting has used some weight reduction products (Fig. 3) with the prevalence among girls and vocational school pupils.
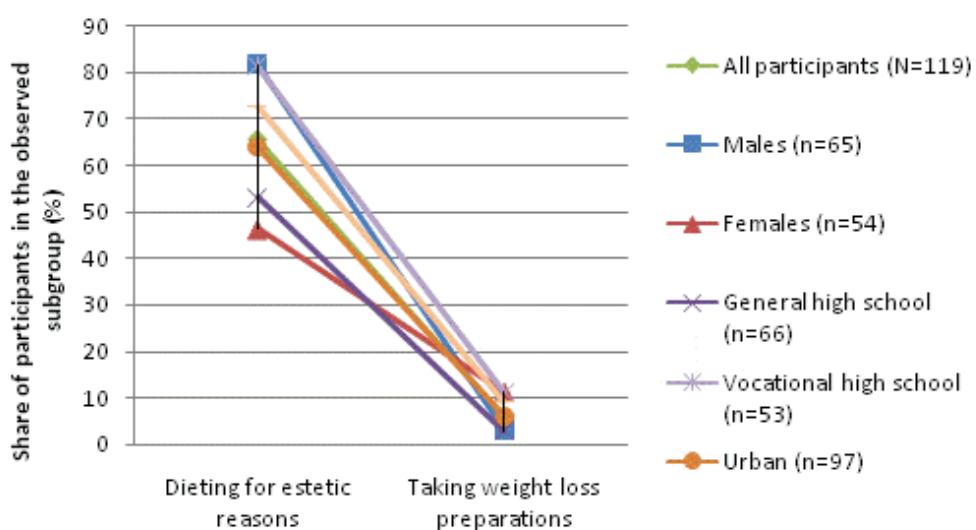

Fig. 3. Dieting and weight loss preparations consumption in studied adolescent population

Fluid intake (Fig. 4) recommendations (adequate intake, AI) of 1.8 L for girls and 2.6 L for boys (FNB and IOM, 2001.) is satisfied by 27.8% of girls and 36.9% of boys. Intake is higher in general school pupils.
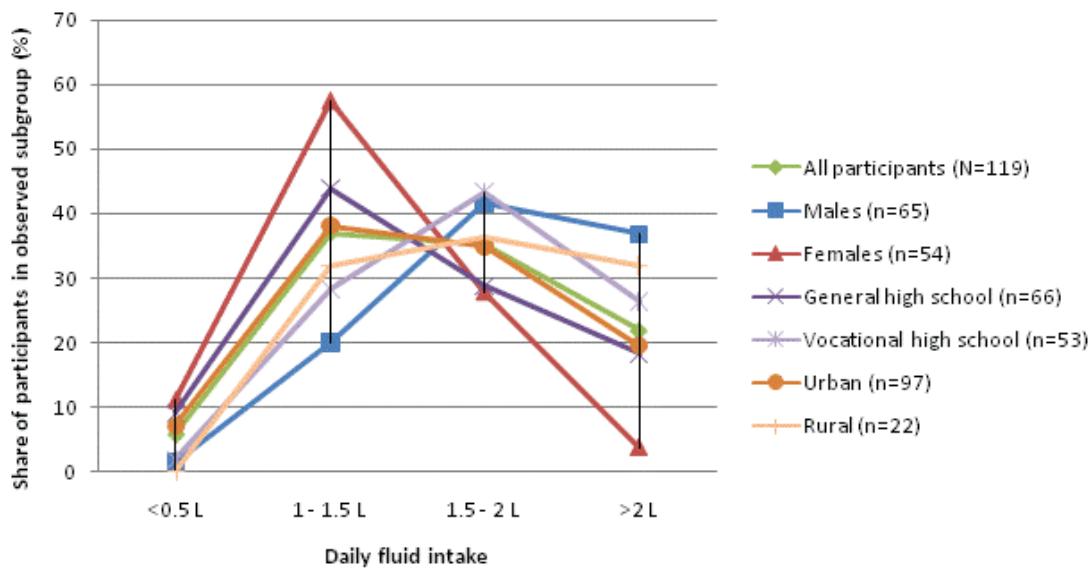
Fig. 4. Fluid intake in studied adolescent population

Although differences in nutritional patterns are noticed and discussed above, data analysis showed that only a few of them are significant (Table 3). Adolescents from the rural area consume significantly more daily meals than those from town (p=0.033) and those from town eat significantly more often fish than those from rural areas (p=0.011). Pupils of the general school programme more often take breakfast (p=0.049), consume more vegetables (p=0.003) and drink more milk (p=0.009) than those from the vocational school, while vocational school pupils have significantly higher soft drinks consumption (p=0.004) and coffee consumption (p=0.007). Cofee (p=0.015) and alcohol (p=0.002) consumption is significantly higher in boys than in girls. Vocational school pupils (p=0.001) and boys (p=0.000) are more often dieting, while girls more often (p=0.027) use weight management products.

Table 3. Significant diferences (p values˙) in dietary habits of gender, high school and living area based subgroups

	High school	Gender	Living area
Daily meal number	0.838	0.511	*0.033*
Regular breakfast consumption	*0.049*	0.871	0.769
Fish frequency of consumption	0.318	0.399	*0.011*
Meat frequency of consumption	0.093	0.850	0.934
Fruit frequency of consumption	0.213	0.420	0.297
Vegetables frequency of consumption	*0.003*	0.663	0.538
Bread frequency of consumption	0.663	0.870	0.681
Fizzy drinks frequency of consumption	*0.004*	*0.001*	0.071
Sweets and cakes frequency of consumption	0.278	0.550	0.248
Eggs frequency of consumption	0.071	0.179	0.892
Milk and dairy produscts frequency of consumption	*0.009*	0.652	0.568
Coffee frequency of consumption	*0.007*	*0.015*	0.124
Alcohol frequency of consumption	0.061	*0.002*	0.467
Dieting for estetic reasons	*0.001*	*<0.001*	0.437
Taking weight loss preparations	0.142	*0.027*	0.483
Fluid intake	*0.016*	*<0.001*	0.109
*t-test of differences, p < 0.05			

Conclusions

Altogether, results of this study indicate the need to improove dietary habits in adolescents. This can be achieved through the education of this sensitive group and various promotive activities which will promote healthy lifestyle, an as a part of it a healthy diet.

References

Banjari, I., Kenjerić, D., Mandić, M.L., Nedeljko, M. (2011): Is fad diet a quick fix? An observational study in Croatian student group. *Periodicum Biologorum* 113, 377-381.

De Bruijn, G.J., Van Den Putte, B. (2005): Adolescent soft drink consumption, television viewing and habit strenght. Investigeting clustering effects in the Theory of Planned Behavior. *Appetite* 53, 66-75.

Djordjević-Nikić, M., Dopsaj, M., Vesković, A. (2013): Ponašanje i navike u ishrani i fizičkoj aktivnosti kod beogradskih adolescenata. *Vojnosanit pregl* 70, 548-554.

Food and Nutrition Board (FNB), Institute of Medicine (IOM) (2001) *Dietary Reference Intakes for Water, Potassium, Sodium, Chloride and Sulfate*. National Academy Press, Washington DC.

Gómez-Martínez, S., Martínez-Gómez, D., Perez de Heredia, F., Romeo, J., Cuenca-Garcia, M., Martín-Matillas, M., Castillo, M., Rey-López, J.P., Vicente-Rodriguez, G., Moreno, L., Marcos, A. (2012): Eating Habits and Total and Abdominal Fat in Spanish Adolescents: Influence of Physical Activity. The AVENA Study. *Journal of Adolescent Health* 50, 403-409.

Hoffmann, K., Bryl, W., Marcinkowski, J.T., Rzesos, A., Wojtyla, E., Pupek-Musialik, D. (2012): Dietary behaviours of adolescents from urban and rural areas in the district of Szamotuly-a preliminary study. *Annals of Agricultural and Environmental Medicine* 19, 103-107.

Hrvatski zavod za javno zdravstvo (HZJZ) (2012) *Ponašanje u vezi sa zdravljem u djece školske dobi 2009/2010*, Zagreb. http://www.hzjz.hr/wp-content/uploads/2013/11/HBSC_10.pdf (08.08.2015.)

Ilić, M. (2010): Navike u ishrani adolescenata u Zaječaru. *Timočki medicinski glasnik* 35, 57-63.

Jovanović, V., Simić, V., Obradović, V., Vasiljević, S. (2011): Karakteristike ishrane mladih uslovljene socioekonomskim faktorima. *Zdravstvena zaštita* 40, 21-30, 2011.

Kuzman, M. (2009): Adolescencija, adolescenti i zaštita zdravlja. *MEDICUS* 18, 155-172.

Mandić, M.L. (2007): *Znanost o prehrani*. Sveučilište Josipa Jurja Strossmayera u Osijeku, Prehrambeno-tehnološki fakultet Osijek, Osijek.

Meandžija, N., Jurišić, I., Ivanko, M. (2011): Prehrambene navike i uhranjenost školske djece u Brodsko posavskoj županiji. *Hrvatski časopis za javno zdravstvo* 7 (82).

Neumark-Sztainer, D., Wall, M., Perry, C., Story, M. (2003): Correlates of fruit and vegetable intake among adolescents Findings from Project EAT. *Preventive Medicine* 37, 198-208.

Rossiter, M.D., Evers, S.E., Pender, AC. (2012): Adolescents' diet do not comply with 2007 Canada's food guide recommendations. *Appetite* 59, 668-672.

Sahingoz, S.A., Sanlier, N. (2011): Compliance with Mediterranean Diet Quality Index (KIDMED) and nutrition knowledge levels in adolescents. A case study from Turkey. *Appetite* 57, 272-277.

Tupe, R., Chiplonkar, S.A. (2010): Diet patterns of lactovegeterian adolescent girls: Need for devising recipes with high zinc bioavailability. *Nutrition* 26, 390-398.

Vereecken, C.A., De Henauw, S., Maes, L. (2005): Adolescents' food habits: results of the Health Behaviour in School-aged Children survey. *British Journal of Nutrition* 94, 423-431.

Wilson, D.B., Smith, B.N., Speizer, I.S., Bean, M.K., Mitchell, K.S., Uguy, L.S., Fries, E.A. (2005): Differences in food intake and exercise by smoking status in adolescents. *Preventive medicine* 40, 872-879.

PREHRAMBENE NAVIKE STUDENATA SVEUČILIŠTA U MOSTARU

Marija Banožić[1], Anamarija Ljubić[1*], Marija Pehar[1], Jozo Ištuk[1], Daniela Čačić Kenjerić[1,2]

[1]Sveučilište u Mostaru, Agronomski i prehrambeno-tehnološki fakultet,Biskupa Čule bb, 88000 Mostar, Bosna i Hercegovina

[2]Sveučilište Josipa Jurja Strossmayera u Osijeku, Prehrambeno tehnološki fakultet Osijek, Franje Kuhača 20, 31000 Osijek, Hrvatska

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Sažetak

Uvod i cilj: Prehrambene navike se stječu u ranom stadiju života. Upravo tijekom razdoblja studiranja mladi ljudi najčešće se po prvi put suočavaju sa samostalnošću i kreiraju vlastite životne, pa tako i prehrambene navike. Iz tog razloga cilj rada bio je ispitati prehrambene navike studenata Sveučilišta u Mostaru, te utvrditi u kojoj se mjeri one podudaraju s preporučenim smjernicama za pravilnu prehranu.

Metode: Ispitivanje je provedeno primjenom anonimnog, jednokratnog upitnika, sa pitanjima zatvorenog tipa, koji je obuhvatio podatke o spolu, učestalosti dnevnih obroka i doručka, zatim o količini i vrsti unesene tekućine, konzumaciji grickalica i različitih vrsta hrane na tjednoj bazi, te korištenju dodataka prehrani.

Rezultati: Prikupljeni podaci su izraženi na cjelokupnu ispitivanu populaciju, te na podskupine kreirane obzirom na spol. U usporedbi s preporučenim dnevnim porcijama različitih vrsta hrane konzumacija voća i povrća je poprilično mala, kao i konzumacija ribe. Dobiveni podaci o prehrambenim navikama ukazuju na male razlike među spolovima.

Zaključak: Istraživanje na temu prehrambenih navika studenata bilježi odstupanja od preporuka za zdrav životni stil, te je poželjno organizirati različite radionice i predavanja na temu pravilne prehrane, kako bi se studenti educirali o pravilnoj prehrani sukladnoj njihovim potrebama.

Ključne riječi: prehrambene navike, studenti, prehrana

Uvod

Tijekom adolescencije formiraju se sve životne navike, a među njima značajno mjesto zauzimaju i prehrambene navike (Lošić, 2014). Usvajanjem pravilnih prehrambenih navika moguće je efikasno prevenirati pojavu kroničnih nezaraznih bolesti, posebice pretilost, kardiovaskularne bolesti i dijabetes tipa 2 koje su u kontinuiranom porastu na globalnoj razini (Rossiter i sur., 2012). Odlazak na fakultet značajan je period u životu svake mlade osobe. Promjena životnog okruženja često rezultira promjenom životnih i zdravstvenih navika. Dolazi do smanjenja tjelesne aktivnosti kao i smanjenja unosa voća i povrća, dok se istovremeno povećava unos brze hrane i alkohola. Studentska populacija sklona je konzumiranju hrane visoke energetske vrijednosti siromašne nutrijentima, kao i preskakanju obroka osobito doručka (Koprivnjak, 2008; Yahia i sur., 2008; Banjari i sur., 2011). Loše prehrambene i zdravstvene navike, poput nedostatka tjelesne aktivnosti i pušenja za posljedicu imaju sve veći broj mladih koji imaju problema s tjelesnom masom (Kolodinski i sur., 2011).

Cilj ovog rada je ispitati prehrambene navike studenata Sveučilišta u Mostaru, te utvrditi u kojoj se mjeri one podudaraju sa preporučenim smjernicama za pravilnu prehranu.

Materijali i metode

Ispitivanje po principima presječnog provedeno je među studentima Sveučilišta u Mostaru u periodu od 20. travnja do 10. svibnja 2015. godine. Ispitivanjem je obuhvaćeno 146 ispitanika, 73 muškog i 73 ženskog spola sa različitih fakulteta.

Za potrebe ovog istraživanja korišten je jednokratni anonimni upitnik koji se sastojao od dva dijela. Prvi dio je sadržavao opće karakteristike ispitivane populacije (dob i spol), dok je drugi obuhvaćao pitanja o učestalosti konzumacije dnevnih obroka i doručka, zatim o količini i vrsti unesene tekućine, konzumaciji grickalica i različitih vrsta hrane na tjednoj bazi, te korištenju dodataka prehrani. Sudjelovanje u ispitivanju bilo je na dobrovoljnoj bazi, a prije ispunjavanja upitnika su svi ispitanici upoznati sa svrhom ispitivanja i dobili su upute za ispunjavanje upitnika.

Rezultati i rasprava

Obradom prikupljenih podataka dobiven je uvid u prehrambene navike ispitivane populacije. Preporuča se da adolescenti imaju 5-6 obroka dnevno (3 glavna obroka i 2-3 međuobroka) kako bi se osigurala potrebna količina glukoze nužna za funkcioniranje mozga i živčanog sustava (Vranešić i Alebić, 2006).

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*Corresponding author: ljubicanamarija@gmail.com

Obzirom na dnevni broj obroka (Slika 1A), od 146 ispitanika najmanje ih jede jednom dnevno (2,05%), od toga jedan student (1,37%), te dvije studentice (2,74%). Dva do tri puta dnevno najčešće jede 36 studenata (49,32%), dok je 28 studentica s tom učestalošću (38,36%) što daje ukupno 63 ispitanika, odnosno 43,84%. Najčešći odgovori su u kategoriji između tri i pet puta dnevno (48,63%), te od toga studentice jedu češće (53,42%) nego studenti (43,84%). Više od pet puta dnevno jede osam ispitanika (5,48%), s jednakom raspodjelom po spolovima. Rezultati studije Španjolskih adolescenata pokazuju da 80,4% mladića i 75,9% djevojaka konzumira četiri ili više dnevnih obroka, što je znatno bolji rezultat od rezultata ovog rada (Gomez-Martinez i sur., 2012)

Oba spola kuhane obroke (Slika 1B) najčešće konzumiraju jednom dnevno, no broj studenata koji takve obroke ne jedu svakodnevno je manji (16,44%) od broja studentica (30,14%). Razlog takvoj razlici može biti različita percepcija toga što znači kuhano jelo. Dok studentima kuhano jelo može biti i instant juha, kuhane hrenovke, i slična brza jela, studentice možda imaju drugačiju sliku kuhanog obroka. Također, razlika u konzumaciji kuhanih jela se može pojaviti ovisno o tome da li student, odnosno studentica živi s obitelji tijekom školovanja ili ne, te uslijed korištenja usluga studentskog restorana. Kada je u pitanju učestalost doručkovanja (Slika 1C), 10,96% ih je izjavilo da nemaju tu naviku, i to 16,44% studenata i 5,48% studentica. Ipak, najveći dio ispitanika svakodnevno doručkuje (50,69%), od čega je opet više studentica (54,79%) nego studenata (46,58%). U turskoj redovito doručkuje 67,9% mladih (Ayrancy i sur., 2010). Redovitost doručka je nužna potreba djece i mladih u razvoju radi kvalitetnog praćenja nastave (Koprivnjak, 2008).
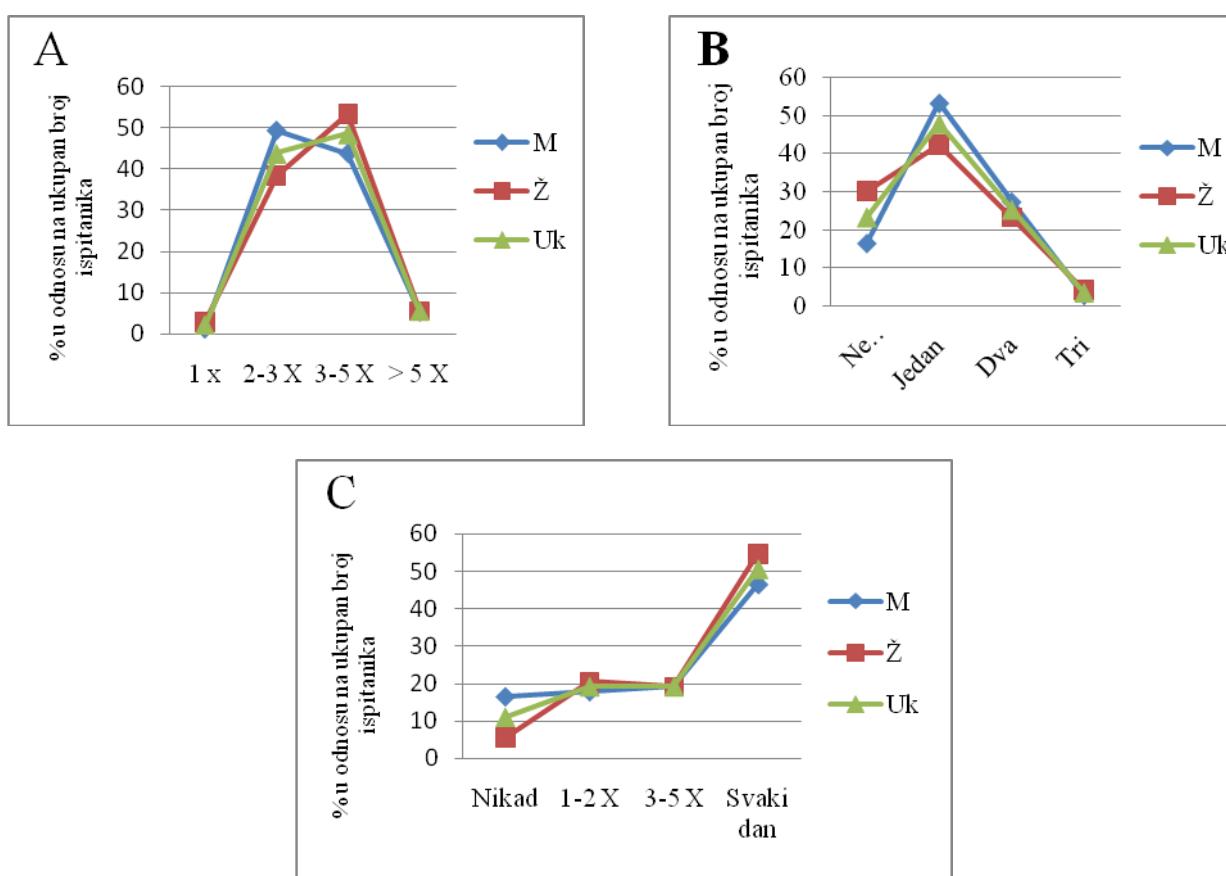
**Slika 1.** Distribucija ispitanika (M-muški, n=73; Ž-žnski, n=73; UK-ukupno, N=146) prema učestalosti:
A- objedovanja tijekom dana, B- konzumacije kuhanih obroka tijekom dana,
C- doručkovanja tijekom tjedna
Fig. 1. Distribution of study participants (M-males, n=73; Ž-females, n=73; Uk-total, N=146)
according to the frequency of: A- daily meals number, B- cooked meals daily,
C- breakfast consumption frequency

Kada je u pitanju konzumacija tekućine (Slika 2), studentice u prosjeku piju manje od studenata, te je tako kod studentica najčešći odgovor bio četiri do šest čaša (38,89%), a kod studenata šest do osam čaša (36,11%). Razlog tome može biti različita fizička potreba za vodom. Prema smjernicama Svjetske zdravstvene organizacije (SZO) muškarcima je optimalan unos oko 13 čaša tekućine dnevno, uz redukciju od oko 20% uslijed unosa tekućine putem hrane dolazimo do brojke od 10 čaša dnevno, a za žene je preporuka 9 čaša dnevno, te uz redukciju dolazimo do brojke od 7 čaša (Grandjean i Campbell, 2004). U početku su ovakve razlike bile očekivane, ipak možemo primijetiti kako svega 40,28% studentica unosi dovoljnu količinu tekućine, dok je broj studenata koji unose dovoljnu količinu tekućine još manji (29,17%). No uslijed smanjene tjelesne aktivnosti i sjedilačkog načina života koji je sve češći moguće je i to da su ispitanicima potrebne i manje količine tekućine nego je preporučeno od strane (SZO). Od tekućine najčešće se konzumira voda (82,39%), i to podjednako među spolovima, slijedi konzumacija sokova (8,17%) gdje prednjače studentice (9,88%) naspram studentima (6,41%), kao što je i slučaj kod čaja gdje 4,94% studentica konzumira čaj, a svega 2,56% studenata. Nadalje, pivo u ovom slučaju konzumiraju isključivo studenti (2,56%), konzumacija kave (1,26%) je podjednaka među spolovima, mineralnu vodu i mlijeko češće piju studenti (2,56%), dok vitaminske napitke, limunadu i gazirana pića češće piju studentice (3,7%). Iz ovih rezultata možemo primijetiti blagu sklonost studentica prema slađim napitcima, pošto je veća konzumacija sokova, gaziranih pića i vitaminskih napitaka.
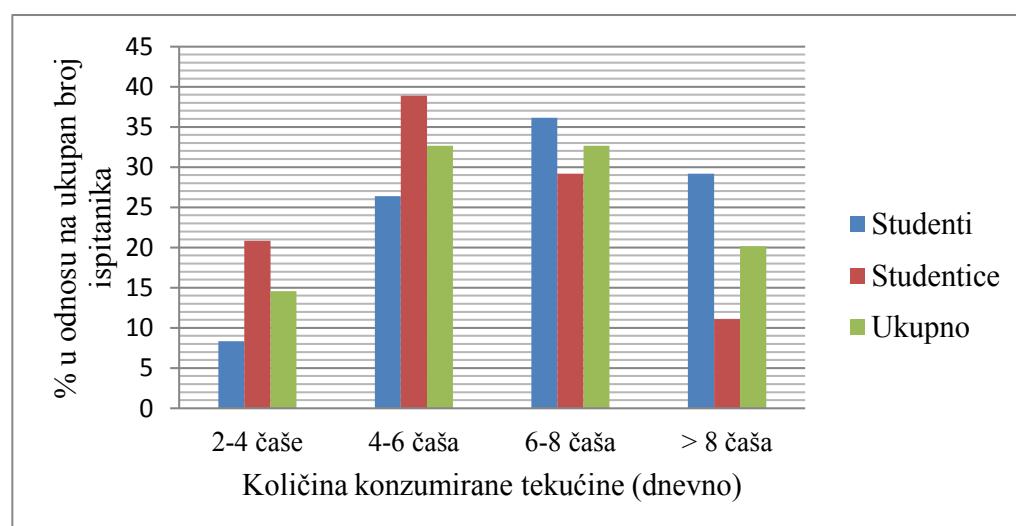
Slika 2. Distribucija ispitanika prema količini konzumirane tekućine dnevno
Fig. 2. Distribution of study participants according the daily fluid intake

Tablica 1. Najčešće konzumirana tekućina u odnosu na uzorak i spol
Table 1. Most frequently consumed drinks in studied student population

Vrsta tekućine		Studenti, n=73 n (%)	Studentice, n=73 n (%)	Ukupno, N=146 n (%)
Voda		66 (84,62)	65 (80,25)	**131 (82,39)**
Sok		5 (6,41)	8 (9,88)	**13 (8,17)**
Čaj		2 (2,56)	4 (4,94)	**6 (3,77)**
Pivo		2 (2,56)	0	**2 (1,26)**
Kava		1 (1,28)	1 (1,23)	**2 (1,26)**
Ostalo	*Mineralna voda*	1 (1,28)	0	**1 (0,63)**
	Mlijeko	1 (1,28)	0	**1 (0,63)**
	Vitaminski napitci	0	1 (1,23)	**1 (0,63)**
	Limunada	0	1 (1,23)	**1 (0,63)**
	Gazirana pića	0	1 (1,23)	**1 (0,63)**

Kroz brojna istraživanja provedena u svijetu na populaciji adolescenata uočeno je da se neka ponašanja u ovoj populaciji konzistentno ponavljaju. To su: preskakanje obroka posebice doručka, unos brze hrane i obroka van kuće, nizak unos voća, povrća, mlijeka i mliječnih proizvoda, visok unos gaziranih pića, grickalica i slastica kao i zaokupljenost tjelesnom masom uz primjenu popularnih dijeta, osobito u adolescentica (Meandžija i sur., 2006).

Konzumacija grickalica (Slika 3) se značajno razlikuje po spolovima, te je tako 38,36% studenata izjavilo da nikad ne konzumira grickalice, dok je takvih odgovora svega 21,92% kod studentica. Oba spola najčešće konzumiraju grickalice jednom do dva puta dnevno, i to 64,38% studentica i 57,53% studenata. Deset studentica poseže za grickalicama više od tri puta dnevno (13,7%), što je znatno veće u usporedbi sa svega tri studenta (4,11%) koji jednako često konzumiraju grickalice.

Najpopularnija grickalica je čips (Slika 4 i Tablica 2), s 30,51% ispitanika koji su ga naveli kao omiljenu grickalicu. Pomalo iznenađujuće, i suprotno stereotipima koji nameću brojni mediji, je to da je čak 33,78% studentica navelo čips kao grickalicu koju najčešće konzumira, dok je svega 25% studenata navelo isto. Drugo mjesto je zauzela čokolada koju konzumira 21,19% ispitanika, i to 21,62% studentica i 20,45% studenata. Iz prethodnih rezultata možemo primijetiti da je konzumacija grickalica općenito veća kod ženskog spola, te čak 62,71% od ukupne količine navedenih grickalica otpada na studentice, a svega 37,29% na studente. Također je vidljivo da studentice češće konzumiraju grickalice sa većim udjelom šećera u usporedbi sa studentima, te i to da studentice imaju širu paletu proizvoda koje konzumiraju nego studenti.
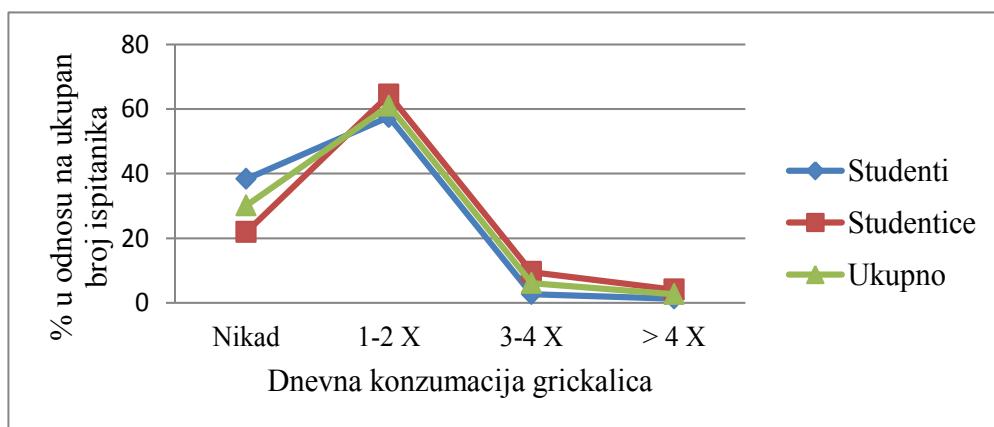
Slika 3. Distribucija ispitanika prema učestalosti konzumacije grickalica
Fig. 3. Distribution of study participants based on the snacking habit
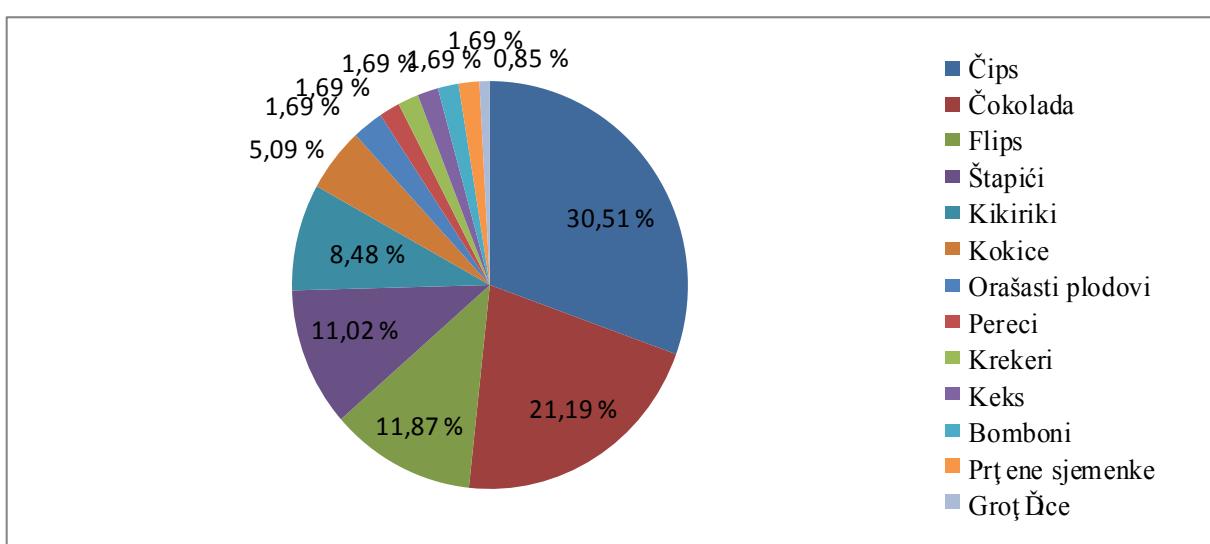
Slika 4. Najčešće konzumirane grickalice prema ispitanicima
Fig. 4. Choice of snacks in studied population

Tablica 2. Najčešće konzumirane grickalice po spolu
Table 2. Choice of snacks in male and female students

Vrsta grickalica	Studenti, n=73 n (%)	Studentice, n=73 n (%)
Čips	11 (25,0)	25 (33,78)
Čokolada	9 (20,45)	16 (21,62)
Flips	7 (15,91)	7 (9,46)
Štapići	3 (6,82)	10 (13,51)
Kikiriki	7 (15,91)	3 (4,05)
Kokice	2 (4,55)	4 (5,41)
Orašasti plodovi	0	3 (4,05)
Pereci	2 (4,55)	0
Krekeri	1 (2,27)	1 (1,35)
Keks	0	2 (2,70)
Bomboni	1 (2,27)	1 (1,35)
Pržene sjemenke	1 (2,27)	1 (1,35)
Grožđice	0	1 (1,35)

Od 146 ispitanika 145 ih je odgovorilo na pitanje o učestalosti konzumacije mesa, ribe, voća, povrća, mlijeka i pržene hrane (Tablica 3). Od svih navedenih namirnica u upitniku svakodnevno se konzumira samo mlijeko (27,59%), što se uklapa s dnevnim preporukama za unos. Meso se najčešće konzumira četiri do šest puta tjedno (40,0%), što je pozitivno ako se poštuju preporučene veličine porcija i koristi meso s manjim postotkom masti. Riba se najčešće konzumira jedan do dva puta tjedno (60,0%), što je također unutar smjernica za zdravu prehranu, no zabrinjavajuće je i to da čak 34,48% ispitanika nikako ne konzumiraju ribu. Voće se najčešće jede dva do četiri puta tjedno (35,86%), kao i povrće (33,79%), što je premalo usporedimo li to sa preporučenim smjernicama za zdravu prehranu. Prţena hrana se najčešće konzumira dva do četiri puta (37,24%) tjedno, te se u toj kategoriji javlja jedina razlika u učestalosti konzumacije među spolovima. Naime, studentice prţenu hranu najčešće jedu četiri do šest puta tjedno (30,56%), a studenti dva do četiri puta (46,58%) (Tablice 4 i 5).

Tablica 3. Prikaz učestalosti konzumacije određenih namirnica na tjednoj bazi za cijelu skupinu ispitanika (N=146)
Table 3. Frequency of consumption for selected food groups for the whole study population (N=146)

Kategorija	> 7 X	6.5-7 X	4.5-6 X	2.5-4 X	1-2 X	< 1 X	Nikad
Meso	1 (0,69%)	19 (13,10%)	58 (40,00%)	45 (31,03%)	20 (13,79%)	0	2 (1,39%)
Riba	0	3 (2,07%)	0	1 (0,69%)	87 (60,00%)	4 (2,76%)	50 (34,48%)
Voće	3 (2,07%)	28 (19,31%)	25 (17,24%)	52 (35,86%)	31 (21,38%)	0	6 (4,14%)
Povrće	4 (2,76%)	20 (13,79%)	44 (30,34%)	49 (33,79%)	26 (17,93%)	0	2 (1,39%)
Mlijeko	5 (3,45%)	40 (27,59%)	27 (18,62%)	22 (15,17%)	31 (21,38%)	1 (0,69%)	19 (13,10%)
Pržena hrana	2 (1,39%)	12 (8,27%)	35 (24,14%)	54 (37,24%)	34 (23,45%)	0	8 (5,51%)

Od ukupno 73 studentice, 72 su odgovorile na pitanje o učestalosti konzumacije mesa, ribe, voća, povrća, mlijeka i prţene hrane, te iz tabele 4 je vidljivo da meso najčešće konzumiraju četiri do šest puta tjedno (41,67%), ribu jedan do dva puta (54,17%), voće i povrće dva do četiri puta (33,33%), mlijeko šest do sedam puta (31,94%), te prţenu hranu četiri do šest puta (30,56%).

Tablica 4. Prikaz učestalosti konzumacije određenih namirnica prema spolu, studentice (n=73)
Table 4. Frequency of consumption for selected food groups for the female study participants (n=73)

Kategorija	> 7 X	6.5-7 X	4.5-6 X	2.5-4 X	1-2 X	< 1 X	Nikad
Meso	0	3 (4,17%)	30 (41,67%)	26 (36,11%)	13 (18,05%)	0	0
Riba	0	0	0	0	39 (54,17%)	1 (1,39%)	32 (44,44%)
Voće	0	20 (27,78%)	12 (16,67%)	24 (33,33%)	13 (18,05%)	0	3 (4,17%)
Povrće	1 (1,39%)	15 (20,83%)	22 (30,56%)	24 (33,33%)	10 (13,89%)	0	0
Mlijeko	1 (1,39%)	23 (31,94%)	12 (16,67%)	9 (12,50%)	15 (20,83%)	1 (1,39%)	11 (15,28%)
Pržena hrana	0	6 (8,33%)	22 (30,56%)	20 (27,78%)	18 (25,00%)	0	6 (8,33%)

Od ukupno 73 studenta iz tabele 5 je vidljivo da meso najčešće konzumiraju četiri do šest puta tjedno (38,36%), ribu jedan do dva puta (65,75%), voće (38,36%) i povrće (34,25%) dva do četiri puta, mlijeko šest do sedam puta (23,28%), te prženu hranu dva do četiri puta (46,58%).

Tablica 5. Prikaz učestalosti konzumacije određenih namirnica prema spolu, studenti (n=73)
Table 5. Frequency of consumption for selected food groups for the male study participants (n=73)

Kategorija	> 7 X	6.5-7 X	4.5-6 X	2.5-4 X	1-2 X	< 1 X	Nikad
Meso	1 (1,37%)	16 (21,92%)	28 (38,36%)	19 (26,03%)	7 (9,59%)	0	2 (2,73%)
Riba	0	3 (4,11%)	0	1 (1,37%)	48 (65,75%)	3 (4,11%)	18 (24,66%)
Voće	3 (4,11%)	8 (10,96%)	13 (17,81%)	28 (38,36%)	18 (24,65%)	0	3 (4,11%)
Povrće	3 (4,11%)	5 (6,85%)	22 (30,14%)	25 (34,25%)	16 (21,92%)	0	2 (2,73%)
Mlijeko	4 (5,48%)	17 (23,28%)	15 (20,55%)	13 (17,81%)	16 (21,92%)	0	8 (10,96%)
Pržena hrana	2 (2,74%)	6 (8,22%)	13 (17,81%)	34 (46,58%)	16 (21,92%)	0	2 (2,73%)

Na pitanje o konzumaciji dodataka prehrani (Slika 5) 18 ispitanika je odgovorilo potvrdno (12,33%), dok ih je 128 odgovorilo ne (87,67%). Od ispitanika koji su odgovorili potvrdno 7 je studentica (9,59%) i 11 studenata (15,07%).
Od dodataka prehrani najčešće se konzumiraju proteini (Tablica 6), koje koriste isključivo studenti (23,33%), dok vitamine i minerale češće konzumiraju studentice (16,67% i 26,27%) nego studenti (13,33% i 6,66%).

Kreatin, omega 3 masne kiseline i aminokiseline koriste isključivo studenti, njih četvero (6,67%, 3,33% i 3,33%), što je vidljivo u Tablici 6. Ono što je također vidljivo kroz upitnik je i činjenica da studenti općenito, neovisno o spolu i obrazovanju, nisu upoznati s time što zapravo znači termin dodatak prehrani, te su tako odgovori nerijetko uključivali vegetu, papar, majonezu, te tomu slične začine i namirnice.
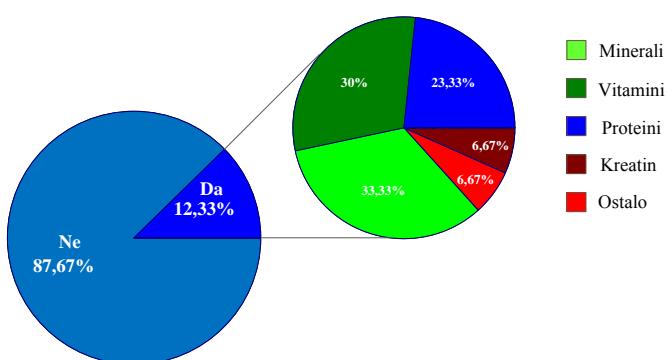
Slika5. Prikaz najčešće korištenih dodataka prehrani
Fig. 5. Supplementation habit and mostly used supplements

Tablica 6. Najčešće uzimane vrste dodataka prehrani prema spolu
Table 6. Most oftenly used dietary supplements in gender based subgroups

Vrsta dodatka prehrani		Studenti n (%)	Studentice n (%)
Proteini		7 (41,18)	0
Vitamini	*Multivitamini*	3 (17,65)	2 (15,38)
	B kompleks	0	3 (23,08)
	Vitamin D	1 (5,88)	0
Minerali	*Magnezij*	1 (5,88)	3 (23,08)
	Cink	1 (5,88)	1 (7,69)
	Željezo	0	2 (15,38)
	Kalcij	0	2 (15,38)
Kreatin		2 (11,76)	0
Ostalo	*Omega 3*	1 (5,88)	0
	Aminokiseline	1 (5,88)	0

Zaključci

U ovom istraţ ivanju prehrambenih navika studenata vidljiva su odstupanja od preporuka za zdrav životni stil. Studenti općenito unose malu količinu tekućine, odstupanja u konzumaciji mesa, ribe i mlijeka nisu prevelika, dok je konzumacija voća i povrća poraţ avajuće niska. Stoga bi bilo poželjno organizirati različite radionice i predavanja na temu pravilne prehrane, kako bi se studenti educirali o pravilnoj prehrani sukladnoj njihovim potrebama, kao i pokušati uspostaviti suradnju sa studentskim centrom gdje se hrani poprilično velik broj studenata Sveučilišta za uspostavu zdravijih dnevnih menija.

Literatura

Ayranci, U., Eronglu, N., Son, O. (2010): Eating habits, lifestyle factors, and body weight status among Turkish private educational institution students. *Nutrition* 26, 772-778.

Banjari, I., Kenjerić, D., Mandić, M.L., Nedeljko, M. (2011): Is fad diet a quick fix? An observational study in a Croatian student group. *Period biol* 13, 377-381.

Grandjean, A., Campbell, S. (2004): Hydration: fluids for life.A Monograph by the North American Branch of the International Life Sciences Institute, ILSI North America, Washington.

Gomez-Martinez, S., Martinez-Gomez, D., Perez de Heredia, F., Romeo, J., Cuenca-Garcia, M., Martin-Matillas, M., Castillo, M., Rey-Lopez, J.P., Vicente-Rodriguez, G., Moreno, L., Marcos, A. (2012): Eating Habits and Total and Abdominal Fat in Spanish Adolescents: Influence of Physical Activity. The AVENA Study. *Journal of Adolescent Health* 50, 403-409.

Kolodinsky, J., Harvey-Berino, R.J., Berlin, L., Johnson, R.K., Reynolds, T.W. (2007): Knowledge of Current Dietary Guidelines and Food Choice by College Students: Better Eaters Have Higher Knowledge of Dietary Guidance, *J Am Diet Assoc* 107, 1409-1413.

Koprivnjak, J. (2008): Prehrambene navike mladih i promocija zdravlja. Hrvatski časopis za javno zdravstvo 4.

Lošić, D. (2014): Procjena prehrambenih navika i znanja o prehrani u adolescenata, Specijalistički rad, Prehrambeno-tehnološki fakultet, Osijek.

Meandţij a, N., Jurišić, I., Ivanko, M. (2006): Prehrambene navike i uhranjenost školske djece u Brodsko posavskoj ţu paniji. *Hrvatski časopis za javno zdravstvo* 2.

Rossiter, M.D., Evers, S.E., Pender, A.C. (2012): Adolescents´diet do not comply with 2007 Canada´sfood guide recommendations. *Appetite* 59, 668-672.

Vranešić, D., Alebić, I. (2006): Hrana pod povećalom. Profil International, Zagreb.

Yahia, N., Achkar, A., Abdallah, A., Rizk, S. (2008): Eating habits and obesity among Lebanese university students, *Nutrition Journal* 7 (32), 1-6.

DIETARY HABITS OF STUDENTS OF THE UNIVERSITY OF MOSTAR

Marija Banožić[1], Anamarija Ljubić[1], Marija Pehar[1], Jozo Ištuk[1], Daniela Čačić Kenjerić[1,2]

[1]University of Mostar, Faculty of Agronomy and Food Technology, Biskupa Čule bb, 88000 Mostar, Bosnia and Herzegovina
[2]Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology Osijek, Franje Kuhača 20, 31000 Osijek, Croatia

Summary

Introduction and objective: Dietary habits are acquired in the early stages of life. During the University years young people are usually faced with independence for the first time and tend to create their own lifestyle and dietary habits. Therefore, the goal of this study was to examine dietary habits of students of the University of Mostar, and to determine the extent to which they match with guidelines for proper nutrition.

Methods: The study was performed using an anonymous, one-time questionnaire, with closed- ended questions, that included the data about gender, frequency of daily meals and breakfast, about the amount and type of liquids consumed, as well as the snacks, consumption of different kinds of foods on a weekly basis, and the usage of nutritional supplements.

Results: The collected data are expressed on the whole study group, as well as on the subgroups created considering gender. Compared to guidelines for different kinds of foods our data show that the consummation of fruits and vegetables is rather low, as for the fish. The obtained data about dietary habits show some small differences among the gender.

Conclusion: This study shows deviation from the guidelines for healthy lifestyle. It is advisable to organize different workshops and lectures on this topic, to educate students about proper nutrition that comply with their physical needs.

Keywords: dietary habits, students, nutrition

THE INFLUENCE AND THE ROLE OF POLYPHENOLS ON THE SENSORY AND ORGANOLEPTIC ASPECTS OF FOOD

Huska Jukić[1*], Damir Hrnjica[2], Asmir Aldžić[1]

[1]*University of Bihac, College of Medical Studies, Žegarska aleja bb, 77000 Bihać, Bosnia and Herzegovina*
[2]*University of Bihac, Biotehnical Faculty Bihać, Kulina bana 2, 77000 Bihać, Bosnia and Herzegovina*

Summary

A vast majority of food products found on the market contains specific, potentially toxic substances, whether those substances appeared as a result of food contamination by an exterior factor or during the production. As an examples of food contamination we can consider bacterial and fungal toxins, where the latter (mycotoxins) include some evidently mutagenic or genotoxic compounds, i.e. potentially cancerogenic compounds. Mycotoxins may enter the food chain via direct or indirect contamination. In direct contamination, the food products represent the basis for the development of toxigenic moulds (almost all food products may represent a basis for the mould development during their production, processing and storage). Bioactive plant polyphenols are relatively well-known for their antioxidant, anti-mutagenic, anticancerogenous, anti-inflamatory, antiangiogenic, antiulcer and antimicrobial characteristics. Many plant ingredients and extracts are reported to prevent the mould development, as well as the accumulation of mycotoxins in food. In addition to their multiple biological effects, extracts containing a large amount of phenols are important for the food industry, since they decelerate the oxidative degradation of lipids, thus enhancing the quality and nutritive value of food. On the other hand, plant polyphenols affect the sensory and organoleptic aspects of food, the functional and nutritive value of the proteins contained in food, as well as its texture.

Keywords: antioxidant activity, Echinacea purpurea, polyphenols, sensory analysis

Introduction

Mycotoxin contamination of food for human use, as well as of food for animal use, is a public health problem. Limits of contamination of specific foods are defined by the laws of the state governments (Tritscher, 2004; Kumar et al., 2008). Mycotoxins are low molecular metabolites which are formed by certain strains of different mold species from *Aspergillus, Penicillium, Fusarium* and other genera. They can enter the food chain directly or indirectly by food contamination as a substrate. In direct contamination, the food material alone is a basis of toxigenic mold growth. Almost all foods can be a substrate for the growth of mold during their production, processing, transportation and storage. In contrast, indirect contamination will occur if food supplements are contaminated with mycotoxins. The real danger of mycotoxins is reflected in their delayed activity because they can cause a variety of mutagenic and carcinogenic changes at the cellular level (Knasmüller et al., 2001; Clark et al., 2006). At the same time, it is impossible to avoid their presence in foods, and thus exposure. Species of *Echinacea L.* genus are scientifically established immunomodulators and phytochemical composition indicates the presence of substances with antioxidant and anti-inflammatory effects (Barnes et al., 2005; Kosalec, 2006).

Materials and methods

Plant material

This research used air dried aerial parts of purple Echinacea, taken from the Jan-Spider (Pitomača, HR). In order to analyse the potential use of plants extract in the treatment of food products (peanuts and raisins), including sensory analysis, samples of peanuts were used from EuroCompany 99 (Ljubuški, BiH), as well as raisins from Bernina (Široki Brijeg, BiH).

Chemicals

Acetic acid, aluminium chloride, ethanol, ethylenediaminetetraacetic acid (EDTA), hexamethylenetetramine, methanol, pyrogallol, sodium carbonate, sodium citrate, sodium hydroxide, sodium nitrite, tannic acid (95%), thiourea were purchased from Kemika (Zagreb, Croatia). Chlorogenic acid, 2,2-diphenyl-1-picryl-hydrazyl (DPPH[•]), hydrogen peroxide, potassium ferricyanide, rosmarinic acid (96%), 5,5-dimethyl-1-pyrroline-N-oxide (DMPO), dimethylsulfoxide (DMSO) and sodium molybdate were obtained from Sigma-Aldrich (St. Louis, MO, USA). Butylated hydroxytoluene (BHT, ≥99%) and quercetin-3-

[*]Corresponding author: huskaj037@gmail.com

rutinoside (rutin, ≥95%) were obtained from Fluka (Buchs, Switzerland). Folin–Ciocalteu's phenol reagent, 3-*tert*-butyl-4-hydroxyanisole (BHA) and were obtained from Merck (Darmstadt, Germany). Hydrochloric acid were obtained from Riedel-de Haën (Seelze, Germany) respectively. All chemicals and reagents used were of the highest analytical grade and obtained from "Kemika" Zagreb (Croatia).

Determination of total polyphenols, tannins, flavonoids and phenolic acids

Determination of total tannin as well as total polyphenol contents was performed following the method described in European Pharmacopoeia (EDQM, 2004). The percentage content of tannins, expressed as pyrogallol, was calculated from the following equation: *(%) = 3.125×(A₁-A₂)/(A₃×m),* where A_3 is the absorbance of the test solution containing 0.05 g of pyrogallol, and *m* the mass of the extract (g).

The total flavonoid contents of tested plant extract were determined using the spectrophotometric method of Christ et al., (1960). All determinations were performed in triplicate. The percentage content of flavonoids, expressed as quercetin, was calculated from the equation: *(%) = A × 0.772/b*, where *A* is the absorbance of the test solution at 425 nm and *b* is the mass of the sample, in grams.

Determination of hydroxycinnamic acid derivatives was performed according to procedure described in European Pharmacopoeia (EDQM, 2004). The percent of total hydroxycinnamic acid content was calculated and expressed as rosmarinic acid, according to the following expression: *(%) = A × 5.3/m,* where *A* is the absorbance of the test solution at 525 nm and *m* is the mass of the sample, in grams. Analysis of each sample was performed in triplicate.

2, 2-Diphenyl-1-picrylhydrazyl radical (DPPH·) radical scavenging assay

The free radical scavenging activities of the samples were measured using the stable DPPH· radical, according to the method of Blois (1958). Briefly, 0.1mM solution of DPPH· in ethanol was prepared and 1 mL of this solution was added to 3 mL of sample solution in ethanol at different concentrations (0.39-200 µg/mL). The mixture was shaken vigorously and left to stand for 30 min in the dark, and the absorbance was then measured at 517 nm. The capability to scavenge the DPPH· radical was calculated using the following equation: *(%) = [(A₀ − A₁)/A₀] × 100,* where A_0 is the absorbance of the

control reaction and A_1 is the absorbance in the presence of sample, corrected for the absorbance of sample itself. Butylated hydroxytoluene (BHT) was used for comparison. All determinations were done in triplicate.

Hydroxyl radical scavenging activity

As hydroxyl free radicals (·OH) are highly reactive, with relatively short half-lives, the concentrations found in natural systems are usually inadequate for direct detection by ESR spectroscopy. Spin-trapping is a chemical reaction that provides an approach to help overcome this problem. Hydroxyl radicals are identified because of their ability to form nitroxide adducts (stable free radicals form) from the commonly used DMPO as the spin trap (Buettner, 1985). The Fenton reaction was conducted by mixing 200 µl of DMPO (112mM), 200 µL of DMF, 200 µL of H_2O_2 (2mM) and 200 µL of $FeCl_2$ (0.3 mM) (control). The influence of *E. purpurea* extract on the formation and stabilization of hydroxyl radicals was investigated by adding investigated extracts in the Fenton reaction system at the range of concentrations 0.025-1.5 mg/mL. ESR spectra were recorded after 5 minutes, with the following spectrometer settings: field modulation 100 kHz, modulation amplitude 0.226 G, receiver gain 5 x10^5, time constant 80.72 ms, conversion time 327.68 ms, center field 3,440.00 G, sweep width 100.00 G, x-band frequency 9.64 GHz, power 20 mW, temperature 23°C. The SA$_{OH}$ value of the extract was defined as: SA·$_{OH}$ = 100 × $(h_0 − h_x)$ / h_0 [%]; where h_0 and h_x are the hight of the second peak in the ESR spectrum of DMPO-OH spin adduct of the control and the probe, respectively.

Superoxide anion radical scavenging activity

Superoxide anion radicals ($O_2^{·-}$) were generated in the reaction system obtained by mixing 500 µL of dry dimethylsulfoxide (DMSO), 5 µL of KO₂ / crown ether (10 mM / 20 mM) prepared in dry DMSO and 5 µL of 2 M DMSO solution of DMPO as spin trap. The influence of extracts on the formation and transformation of superoxide anion radicals was obtained by adding the DMF solution of *E. purpurea* extract to the superoxide anion reaction system at the range of concentrations 0.005-0.1 mg/mL. After that the mixture was stirred for 2 min and transferred to a quartz flat cell ER-160FT. The ESR spectra were recorded on an EMX spectrometer from Bruker (Rheinstetten, Germany) under the following conditions: field modulation 100 kHz, modulation amplitude 4.00 G, receiver gain 1 × 10^4, time constant 327.68 ms, conversion time 40.96 ms, center

field 3440.00 G, sweep width 100.00 G, x-band frequency 9.64 GHz, power 20 mW, temperature 23 °C. The $SAo_2^{\bullet-}$ value of the extract was defined as: $SAo_2^{\bullet-} = 100 \times (h_0 - h_x) / h_0$ [%]; where h_0 and h_x are the height of the second peak in the ESR spectrum of DMPO-OOH spin adduct of the control and the probe, respectively.

The application of extracts and sensory properties of treated food products

Polyphenol content and antioxidant effects in in-vitro conditions were the basis for the interpretation of mechanisms ability of enriching food with extracts rich in antioxidants and other phytochemicals, which in addition to a role in increasing sustainability of food products, can modulate the toxicity of mycotoxins present in the organism.

Selected concentration range is based on two main factors: 1-efficient concentration which has an antioxidant effect, 2-level which does not alter substantially the sensory properties of the treated products. The application of Echinacea plant extracts included spraying of lyophilized water extracts and drying them. Sensory analysis was performed with the methodology described by Riveros et al. (2009) for peanuts and the methodology used for raisins was described by Al-Farsi et al. (2005) The treatment of food (peanuts and raisins) was performed with optimized spraying of lyophilized plant water extract of *E. purpurea* in three concentrations (0.1; 0.5 i 1.0

mg/mL). After the spraying was performed, drying was carried out at room temperature during 24 hours. Upon drying was completed, sensory analyst conveyed the intensity of individual properties on the line specified property.

Data analysis

One-way analysis of variance (ANOVA) and multiple comparisons (Duncan's *post-hoc* test) were used to evaluate the significant difference of the data at $p < 0.05$.

Results and discussion

The total amount of polyphenols in Echinacea purpurea

The results of spectrophotometrical identification of the total amount of polyphenols (prepared as shown in chapter 2.2) are presented in the Table 1. The Table 1 shows the values of the measured absorptions of the specimens of the ethanol extract in *E. purpurea* and the estimated content of the total polyphenols, tannin, phenolic acid, flavonoids. It was determined that the overhead parts of the examined species contain ranging between 12.98 and 13.80% of polyphenols, tannin between 0.85 and 0.92%, 3.23 to 3.72% hydroxycinnamic derivatives and portions of flavonoid between 0.123 to 0.131%.

Table 1. Contents of phenolic acids, flavonoids, tannins and total polyphenols in *E. purpurea* extract

Plant extracts	Total polyphenols	Contens (%) Flavonoids	Phenolics acids	Tanins
Echinacea purpurea	13.31±0.43	0.126±0.004	3.47±0.25	0.863±0.003
Each value is the mean ± SD of three independent measurements				

Antioxidant activities of E. purpurea ethanolic extracts

Polyphenolic compounds such as flavonoids, phenolic acids and tannins are considered to be the major contributors to the antioxidant activity of medicinal plants, fruits and vegetables (Pereira et al., 2009; Rice-Evans et al., 1996). Therefore, in the present study five different assays were employed in order to determine and compare the antioxidant properties of selected *Echinacea* species, as well as to elucidate their mode of action. The antiradical activity of the ethanol extract of the overhead part of the species *Echinacea purpurea*, chlorogenic acid, rutin, tannic acid, in comparison to the synthetic

antioxidant butyl-hydroxy anisole (BHA). After measuring absorptions at 517, the percentage of the inhibition capacity of DPPH$^{\bullet}$ radicals were calculated. The plant extract in lower amounts has quite a weaker effect than the synthetic andtioxidant. Although it lags continually after the effect of BHA, the difference is significantly lowered in the amounts above 50 µg/ml. It was also revealed that the chlorogenic acid, rutin and tannic acid are better catchers of DPPH$^{\bullet}$ than the referent antioxidant. The effect of BHA is equalised with the effect of rutin only at the amount of 12.5 µg/ml when it accomplished the inhibition above 85%.

The strongest antiradical activity was determined for the tannic acid which already in the amount of 0.78

μg/ml accomplishes a 50% exhibition of DPPH˙. The chlorogenic acid shows the same effect in the amount of 1.56 μg/ml and is equalised with the tannic acid in the concentration of 6.25 μg/ml. In the figure 1 it is visible that the necessary concentrations are above 15 μg/ml in order to achieve a 50% inhibition. In the concentration higher than 50 μg/ml the effect of the extract approaches the effect of clear substances and BHA. The results show that flavonoids, phenolic acid and tannins, present in the examined species, equally contribute to the antiradical effect of the extract.

The research of Yokozawa et al. (1998) has shown that tannins and some flavonoids show an activity in relation to DPPH˙ radicals and that the activity is closely related to their chemical structure. With the increase in galiol groups, the molecular mass and ortho-hydroxy groups in the structure, the activity of tanine increases, and the number and position of hydroxyl groups represent an important characteristic of flavonoids for "quenchers" free radicals. Fenglin et

al. (2004) released the results of the study of the 'scavangers' activity on DPPH radicals of water-methanol extracts of more then 300 medicinal herbs. For 56 of the examined specimens they got EC_{50} values under 0,500 mg of the specimen/ml of the extragent. The same authors attribute the activity of DPPH˙ radicals of plants to the present flavonoids and tannins in the extract. Chen et al. (2004) discovered that the chlorogenic acid most actively removes DPPH˙ radicals in plants, and that their activity in the same test is the same and larger than the activity of tocopherol. Orhan et al. (2009) got similar results when they studied antioxidant activities of the species *E. purpurea* and *E. pallida* by determining the catching capacity of DPPH˙ of free radicals and chelate ions of iron. A chrloroform extract in air of dry plant material *E. purpurea* showed the greatest capacity of chelate iron ions (Orhan et al., 2009).
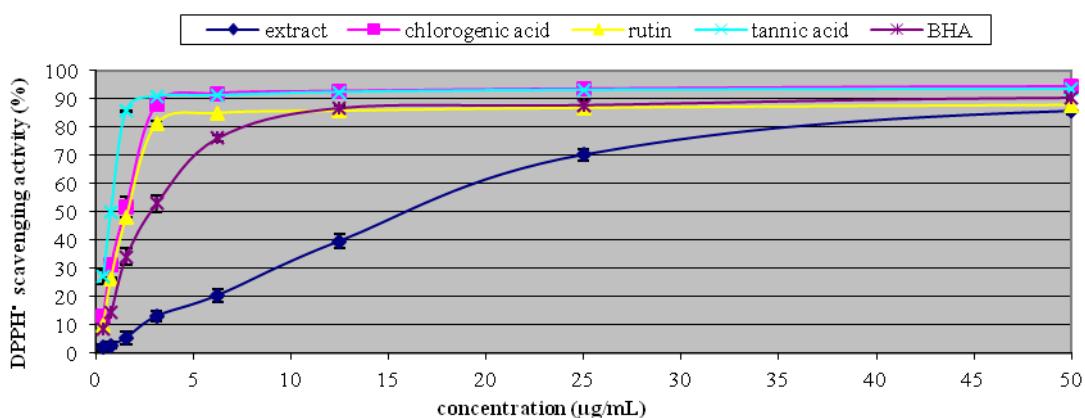

Fig. 1. DPPH free radical scavenging effects of *Echinacea* ethanolic extracts in comparison with polyphenolic compounds and a reference antioxidant

Results ESR

One part of our investigation on antioxidant activity of *E. purpurea* extract was the scavenging activities on hydroxyl and superoxide anion radicals measured by ESR method. Using a spin trap, such as DMPO, it is possible to convert reactive hydroxyl radicals to stable nitroxide radicals (DMPO-OH adducts) with spectral hyperfine splitting that reflects the nature and structure of these radicals. The reaction of Fe_2^+ with H_2O_2 in the presence of the spin trapping agent DMPO generated a 1:2:2:1 quartet of lines with hyperfine coupling parameters (aN=aH= 14.9 G) (Čanadanović-Brunet, et al., 2005). The intensity of the ESR signal, corresponding to the concentration of free radicals formed, was decreased in the presence

of different amounts of *E. purpurea* extract. The total elimination of hydroxyl radical (SA_{OH}=100%) was obtained in the presence of 1.5 mg/ml of extract, which indicates that this applied concentration inhibits the creation of hydroxyl radicals completely. The investigated extract showed dose-dependent radical scavenging activities. The EC_{50} value, defined as the concentration of extract required for 50% scavenging of superoxide anion radicals under experimental condition employed, is a parameter widely used to measure the free radical scavenging activity (Cuvelier et al., 1992); a smaller EC_{50} value corresponds to a higher antioxidant activity. The EC_{50} value of *E. purpurea* extract (0.077 mg/ml) shows that extract is rich in antioxidant compounds and efficiently scavenge superoxide anion radicals.

Sensory properties of treated products

On the basis of the treatment of food products, by adding purple Echinacea extracts rich in antioxidants and other phytochemicals, quantitative polyphenol content, antioxidant activity of the extracts and the potential modulation of toxicity of mycotoxins present was determined. Efficient treatments would certainly be able to hold the sensory properties of foods within acceptable limits. During the testing, the samples of selected treated foods were evaluated and mean scores of individual sensory properties were calculated, as shown on the network diagrams (Fig. 2-3). In this way, by application of quantitative descriptive analysis, sensory profiles of foods treated with the tested plant extract were described. Table 2 shows that values of some sensory parameters are significantly different from control. According to the sensory profiles (Figure 3), the biggest deviations are visible at the highest concentration that could be taken as an optimal compromise between efficiency and impact on sensory properties.

The treatment of raisins with Echinacea extracts caused a statistically significant difference compared to the control sample for parameters of taste, flavor and aroma (Table 3). Also, according to Figure 4, the strongest deviation from the original product is that for parameter of smell per material/fruit. It is evident that the specific smell of plant extracts had masked the original smell of raisins. According to the comments of participants of the panel, this deficiency in relation to the average mean score of the control sample is not considered undesirable. Moreover, it resulted with attractive sensory profile of the treated samples. Paired comparison test clearly distinguished treated from untreated samples of raisins and peanuts. However, judging by the sensory profile, it can be concluded that the newly created formulations of

treated food products, with added extracts showed satisfactory sensory profile, with some exceptions. Finally, in the treatment of peanuts, attention should be kept regarding salinity or the choice of drying process during the treatment of salting. Taking into consideration the sensory evaluation of treated peanuts and raisins with Echinacea extracts, the plant would certainly have the ability to completely justify use in food industry. In doing so, it should be stressed that, according to the sensory profiles (Fig. 4), the optimal addition was the lowest concentration of tested extracts.

During the recent decades, many researchers and food manufacturers showed great interest for the natural phenolic compound. The main reason for this interest is their antioxidant activity, their representation in human nutrition and its potential role in the prevention of various chronic diseases associated with oxidative stress. Consuming of foods rich in natural antioxidants, as well as processed foods enriched with them, provides the desired supply of antioxidants and helps in preventing diseases in which oxidative stress is a key pathogen (Hardy, 2000.). In accordance with the previous statement, plants like purple Echinacea would be particularly important and effective. Polyphenols are deliberately added to functional foods (Wyk and Wink, 2004; Buřiĉova et al., 2008; Sakaĉ et al., 2005; Huang et al., 2010), and can also often be found naturally in foods in quantities that have active effect on human health. Purple Echinacea herb extracts could serve as antioxidants that can be added for prevention of auto-oxidation spoilage of food, but also as functional ingredients that can act antimutagenic and anticancerogenic and thus reduce the potential damage of the organism from the mycotoxins that often contaminate food products.

Table 2. Median values of sensory parameters for peanut treated with pink echinacea extract

PARAMETERS	SAMPLES	KK	EK1	EK2	EK3
Appearance	color	9±1.5	8.3±1.6	8.2±1.6	8.5±1.6
Aroma	fried peanuts	7.8±2.2	6.0±2.3	5.9[a]±2.7	5.2[a]±2.7
	moist chalk	0±0	0.1±0.3	0.3±0.8	0.9[a]±1.5
	oxidised	0±0	0.3±0.7	0.3±0.8	0.2±0.6
	burnt	0±0	0.3±0.8	0.2±0.6	0.3±0.7
	atypical aroma	0±0	0.5±0.5	1.0[a]±1.1	1.7[a]±1.5
Taste	sweet	2.3±1.7	2.7±1.6	2.1±1.8	1.8[a]±1.4
	bitter	1.0±2.1	1.2±2.0	1.0±1.8	0.8±1.7
	salty	6.2±2.1	3.3[a]±2.5	2.9[a]±2.3	2.4[a]±2.1
	sour	0±0	0.1±0.3	0.0±0.2	0±0
Texture	hardness	5.5±1.0	5.6±1.2	5.7±1.7	5.0±1.9
Odor	typical odor	7.4±1.9	6.1±2.0	6±2.0	6±1.9
	atypical odor	0±0	0.1±0.5	0.1±0.5	0.1±0.5

KK: peanut control sample; **EK1**: pink echinacea extract treated peanut (0.1 mg/mL); **EK2**: pink echinacea extract treated peanut (0.5 mg/mL); **EK3**: pink echinacea extract treated peanut (1.0 mg/mL); [a] – the value is significantly different from control KK (p<0.05).
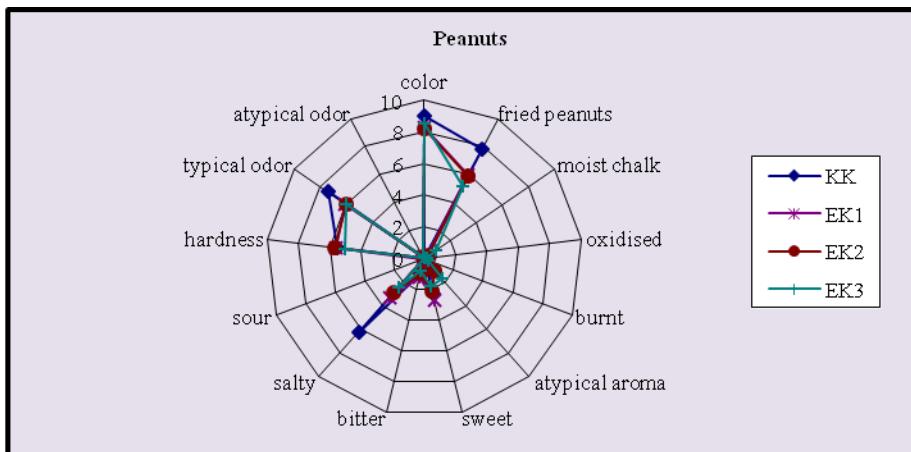
KK: peanut control sample; EK1: pink echinacea extract treated peanut (0.1 mg/mL); EK2: pink echinacea extract treated peanut (0.5 mg/mL); EK3: pink echinacea extract treated peanut (1.0 mg/mL). [a]– the value is significantly different from control KK (p<0.05).

Fig. 2. Sensory profile of peanut samples treated with purple Echinacea extract

Table 3. Median values of sensory parameters for raisins treated with pink echinacea extract

PARAMETERS	SAMPLES	KG	EG1	EG2	EG3
Appearance	color	7.8±1.5	8.1±1.6	8.1±1.8	8.1±18
Taste	sweet	8.2±1.4	7.5±1.3	7.3±1.4	7.2±1.8
	spicy	0.7±1.5	0.8±1.4	1.5 [a]±2.3	1.5 [a]±2.4
	sour	1.6±1.7	1.4±1.7	1.5±1.7	1.8±1.8
	bitter	0.5±1.4	0.5±1.4	0.5±1.4	0.6±1.4
Aroma	fruity	7.4±2.1	6.4±2.6	6.5±2.6	5.7±3.1
	atypical aroma	0.0±0.2	0.0±0.7	1[a]±1.8	1.3 [a]±2.1
Texture	hardness	4.9±0.9	5.0±1.1	5.1±1.1	4.91±1.3
	elasticity	4.0±1.4	4±1.5	4.1±1.5	4.2±1.8
Odor	fruity	6±2.2	2.6 [a]±2.8	3 [a]±3.0	2.4 [a]±2.9
	atypical odor	0.3±0.6	2.6 [a]±3.1	2.4[a]±3.2	2.7 [a]±3.3

KG- raisin control sample; **EG1**: raisins treated with pink echinacea extract (0.1 mg/mL);
EG2: raisins treated with pink echinacea extract (0.5 mg/mL); **EG3**: raisins treated with
pink echinacea extract (1.0 mg/mL); [a] – the value is significantly different from control KG (p<0.05).
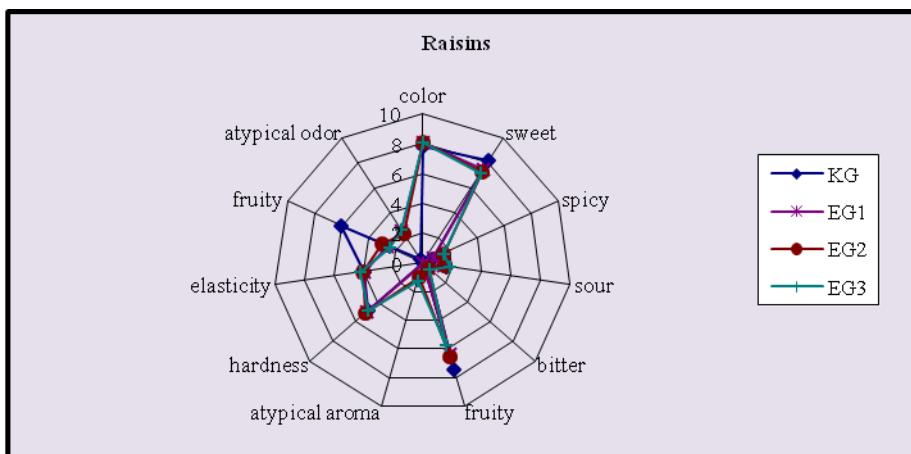
KG- raisin control sample; **EG1**: raisins treated with pink echinacea extract (0.1 mg/mL); **EG2**: raisins treated with pink echinacea extract (0.5 mg/mL); **EG3**: raisins treated with pink echinacea extract (1.0 mg/mL). [a] – the value is significantly different from control KK (p<0.05).

Fig. 3. Sensory profile of raisin samples treated with purple Echinacea extract

References

Al-Farsi, M., Alasalvar, C., Morris, A., Baron, M., Shahidi F. (2005): Compositional and sensory characteristics of three native Sun-dried date (*Phoenix dactylifera* L.) varieties grown in Oman. *Journal of Agricultural and Food Chemistry* 53, 7586-7591.

Barnes, J., Anderson, L.A., Gibbons, S., Phillipson, J.D. (2005): Echinacea species (*Echinacea angustifolia* (DC.) Hell., *Echinacea palida* (Nutt.) Nutt., *Echinacea purpurea* (L.) Moench): A review of their chemistry, pharmacology and clinical properties. *Journal of Pharmacology and Experimental Therapeutics* 57, 929-954.

Blois, M.S. (1958): Antioxidant determinations by the use of a stable free radical. *Nature* 181,1199-1200.

Buettner, G.R. (1985): Spin trapping of hydroxyl radical, in *CRC Handbook of Methods for Oxygen Radical Research*, Ed by Greenwald RA. CRC Press, Boca Raton, FL, 151-155.

Buřičova, L., Reblova, Z. (2008): Czech medicinal plants as possible sources of antioxidants. *Czech Journal of Food Sciences* 26, 132-138.

Chen, F.A., Wu, A.B., Chen, C.Y. (2004): The influence of different treatments on the free radical scavenging activity of burdock and variations of its active components. *Food Chemistry* 86, 479-484.

Christ, B., Müller, K.H. (1960): Zur serienmäßigen Bestimmung des Gehaltes an Flavonol-Derivaten in Drogen. *Archiv der Pharmazie* 293, 1033-1042.

Clark, H.A., Snedeker, M.S. (2006): Ochratoxin A: Its cancer risk and potential for exposure. *Journal of Toxicology and Environmental Health. Part B, Critical Reviews* 9, 265-296.

Cuvelier, M.E., Richard, H., Berset, C. (1992): Comparation of the antioxidative activity of some acid-phenols: Structure-activity relationships. *Bioscience Biotechnology and Biochemistry* 56, 324-325.

Ĉanadanović-Brunet, M.J., Djilas, S.M., Ćetković, G.S., Tumbas, V.T. (2005): Free-radical scavenging activity of wormwood (*Artemisia absinthium* L.) extracts. *Journal of the Science of Food and Agriculture* 85, 265-273.

European Directorate for the Quality of Medicines and Health Care (EDQM). (2004). *European Pharmacopoeia*, 4th ed.; Council of Europe: Strasbourg, France.

Kosalec, I. (2006): *Echinacea* vrste – biljni imunostimulansi (od iskustva Indijanaca do moderne fitofarmacije). Zagreb: DTP centar, 10-78.

Kumar, V., Basu, M.S., Rajendran, T.P. (2008): Mycotoxin research and mycoflora in some commercially important agricultural commodities. *Crop Protection* 27, 891-905.

Orhan, I., Senol, F.S., Gülpinar, A.R., Kartal, M., Sekeroglu, N., Deveci, M., Kan, Y., Sener, B. (2009): Acetylcholinesterase inhibitory and antioxidant properties of *Cyclotrichium niveum*, *Thymus praecox* subsp. *caucasicus* var. *caucasicus*, *Echinacea purpurea* and *E. pallida*. *Food and Chemical Toxicology* 47, 1304-1310.

Pereira, D.M., Valentão, P., Pereira, J.A., Andrade, P.B. (2009): Phenolics: From chemistry to biology. *Molecules* 14, 2202-2211.

Rice-Evans, C.A., Miller, N.J. (1996): Paganga G. Structure-antioxidant activity relationships of flavonoids and phenolic acids. *Free Radical Biology and Medicine* 20, 933-956.

Riveros, C.G., Mestrallet, M.G., Nepote, V., Grosso, N.R. (2009): Chemical composition and sensory analysis of peanut pastes elaborated with high-oleic and regular peanuts from Argentina. *Grasas Y Aceites* 60, 388-395.

Sakač, M., Kormanjoš, Š., Periĉin, D., Filipović, S., Ristić, M. (2005): Antioksidativni potencijal repinog rezanca i njegovo korištenje u proizvodnji funkcionalne hrane. *Veterinarski glasnik* 59, 267-273.

Singleton, V.L., Rossi, JrJA. (1965): Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagent. *American Journal of Enology and Viticulture* 16,144-158.

Tritscher, A.M. (2004): Human health risk assessment of processing-related compounds in food. *Toxicology Letters* 149, 177-186, 2004.

Van Wyk, B-E., Wink M: *Medicinal Plants of the World*. Briza Publications, Pretoria. (reprinted 2004, 2005) Also in German: Van Wyk B-E, Wink C, Wink M. 2004. *Handbuch der Arzneipflanzen.* Wissenschaftliche Verlagsgesellschaft, (reprinted 2004). Polish and Korean translations in 2007, Stuttgart.

Yokozawa, T., Chen, C.P., Dong, E., Tanaka, T., Nonaka, G.I., Nishioka, I. (1998): Study on the Inhibitory Effect of Tannins and Flavonoids against the 1,1-Diphenyl-2-picrylhydrazyl Radical - A newly found effect of hydrolysable-type tannin-containing crude drug and gallotannin. *Biochemical Pharmacology* 56, 213-222.

Fenglin, H., Ruili, L., Bao, H., Liang, M. (2004): Free radical scavenging activity of extracts prepared from fresh leaves of selected Chinese medicinal plants. *Fitoterapia* 75, 14-23.

Hardy, G. (2000): Nutraceuticals and funcctional foods: introducing and meaning. *Nutrition* 16, 688.

Huang, Y.C., Chang, Y.H., Shao, Y.Y. (2006): Effects of genotype and treatment on the antioxidant activity of sweet potato in Taiwan. *Food Chemistry* 98, 529-538.

Knasmüller, S., Schwab, C., Parzefall, W. (2001): Kanzerogene und genotoxische Supstanzen in Lebensmitteln und natürliche Protektionsmechanismen. *Aktuelel Ernahrüngsmedizin* 3, 5-16.

DOBRA HIGIJENSKA PRAKSA U RIBARNICAMA SARAJEVSKOG KANTONA

Karahmet Enver[*]**, Toroman Almir, Nuker Emina, Bektaš Adela, Musić Lejla**

Poljoprivredno-prehrambeni fakultet, Univerzitet u Sarajevu, Zmaja od Bosne 8, 71000 Sarajevo, Bosna i Hercegovina

Originalni znanstveni rad

Sažetak

Provođenje mjera dobre higijenske i sanitarne prakse nuţno je u cilju osiguranja zdravstveno ispravne hrane. Dobra higijenska praksa određuje šta je potrebno da se učini u vezi sa čišćenjem i higijenom, kao i kada i ko treba provesti te poslove u cilju dobijanja što kvalitetnijeg proizvoda. Cilj ovog rada je da se izvrši ispitivanje dobre higijenske prakse u 6 ribarnica Sarajevskog kantona, te da se ustanovi fizičko-hemijski kvalitet prodavane ribe na trţištu Sarajevskog kantona. Analiza stanja ribarnica izvršena je uzimanjem briseva sa 5 različitih površina, u 6 ribarnica, te je prema Normativima mikrobiološke čistoće, mikrobiološka čistoća ribarnica okarakterisana kao dobra i prihvatljiva. Za utvrđivanje hemijskog sastava ribljeg mesa, istraţivanjem je obuhvaćeno 30 uzoraka kalifornijske pastrmke. U okviru hemijskih pretraga, utvrđena je prosječna količina vode 72,85%, masti 5,55%, bjelančevina 19,62% i pepela 1,70%. Senzorna ocjena kvaliteta ribe ocijenjena je Quality Index Method testom (QIM) i svi su uzorci ocijenjeni kao svjeţa riba.

Ključne riječi: dobra higijenska praksa, mikrobiološka analiza, hemijski sastav, senzorna ocjena

Uvod

Zdravstvena ispravnost ribe u ribarnicama, a pri tom se misli prvenstveno na mikrobiološku ispravnost, ovisi o načinu i uvjetima čuvanja ribe, redovnoj i kontinuiranoj higijeni radnog prostora, opreme i pribora za rad s ribom, ličnoj higijeni osoba koje rade s ribama, te njihovom znanju i primjeni načela dobre higijenske i proizvođačke prakse. Poznato je da mikrobiološka čistoća radnih površina, pribora i opreme za rad s namirnicama, te čistoća ruku osoblja koje radi s namirnicama ima direktan uticaj na mikrobiološku sigurnost hrane. Svako zagađenje patogenim bakterijama uslijed unakrsnog zagađenja moţe dovesti do trovanja hranom.

S ciljem da se na vrijeme otkriju i saniraju izvori onečišćenja treba kontrolirati postupke tokom manipulacije ribom, odnosno nuţno je provoditi mjere dobre higijenske i sanitarne prakse.

Dobra higijenska praksa (DHP) predstavlja zahtjeve koji se odnose na ličnu higijenu zaposlenika, higijenu radnog okoliša, higijenu tehnološke opreme i proizvodnu higijenu. Dobra higijenska praksa nije zakonski obavezna, nju proizvođač provodi kako bi osigurao da krajnji proizvod bude boljeg kvaliteta.

Dobra higijenska praksa podrazumijeva u prvom redu drţanje pod kontrolom onih mikroorganizama koji uzrokuju bolesti koje se prenose hranom. Da bi dobra higijenska praksa bila uspješna, potrebno je voditi računa o sljedećem:

- unakrsnom zagađenju,
- čišćenju,
- hlađenju,
- termičkoj obradi.

Navedene mjere poznate su kao četri osnovna pravila (4 OP) koje pomaţu pri sprječavanju najčešćih problema u području sigurnosti hrane (Karahmet i Vileš, 2013).

Dobra proizvođačka praksa (DPP) predstavlja zahtjeve koji se odnose na stanje samih objekata, te poštivanje zadanih tehnoloških postupaka, dakle, prikladnu opremu, materijal opreme, lokaciju i dizajn objekata, kontrolu štetnika, dizajn okoliša i lokacije proizvodnje (zahvata, prerade).

Zbog svog hemijskog sastava, riblje meso je namirnica visoke hranidbene vrijednosti. Kao takvo, sklono je brzom i lakom kvarenju, a najznačajniji je produkt kvarenja histamin, koji nastaje dekarboksilacijom aminokiseline histidina. Da bi se preveniralo kvarenje, a riblje meso sačuvalo kroz duţe razdoblje, potrebno ga je preraditi (Kovačević, 2001).

Preradom se stvaraju nepovoljni uslovi za opstanak mikroorganizama, uzročnika kvarenja ribljeg mesa, bilo bakteriostatskim, baktericidnim, bilo kombinovanim djelovanjem. Osnovni tehnološki postupci prerade su fizičkog ili hemijskog karaktera.

Za proizvodnju ribe moţe se koristiti samo sirovina koja bi i svjeţa i zamrznuta bila pogodna za prodaju, odnosno bezbijedna sirovina, neškodljiva po zdravlje potrošača.

Pri izboru sirovine, treba voditi računa da riba koja se koristi u procesu proizvodnje bude bakteriološki ispravna. Kontaminacija mesa riba bakterijama moţe da bude direktna, kada mikroorganizmi potiču iz zagađene sredine ili indirektna kada je prisustvo bakterija u mesu riba posljedica kontaminacije ribe u toku manipulacije sa ribom od izlova, tokom čuvanja do momenta uključivanje sirovine u proces proizvodnje (Karabasil i sar., 2005).

Riba je poznata kao namirnica koja se kvari znatno brţe nego meso stoke za klanje. Kvar ribe je sloţen proces u koji su uključeni hemijski, mikrobiološki i fizički mehanizmi. Enzimske i hemijske rekcije su najodgovornije za početni gubitak svjeţine ribe, dok aktivnost mikroorganizama izaziva kvar i od njih

[*]Corresponding author: enverkarahmet@yahoo.com

zavisi održivost ribe. Faktor koji značajno utiče na svježinu ribe je pH vrijednost koja je kod ribe poslije smrti iznad 6,0 (Huss, 1995).

Riblje meso odlikuje laka probavljivost, prehrambeno-fiziološki povoljan omjer aminokiselina, te bogat sadržaj vitamina i minerala. Bjelančevine su najvrijedniji sastojci ribljeg mesa, koje uz masti i ugljikohidrate čine osnovu pravilne prehrane. Količina i sastav bjelančevina u ribi variraju od 12 do 24 %. Smanjuje se samo za vrijeme mrijesta, kada riba gubi oko 25 % tjelesne mase, kao ikra, koja je naročito bogata bjelančevinama. Riba se prema rasporedu masti u tijelu dijeli na plavu i bijelu. Količina masti u mesu ribe kreće se od 0,7 do 20 % (Šoša, 1989). Ugljikohidrata u mišićima riba ima svega 0,5 do 0,8 % i to u najvećem dijelu glikogena, te manjim dijelom nukleotida koji su izvor riboze pri autolitičkim postmortalnim promjenama. Radi manje količine glikogena konačni pH mesa riba iznosi od 6,4 do 6,8 i tako razmjerno visoki pH mesa razlogom je njegove pokvarljivosti (Hadžiosmanović i sar., 2002). Količine pojedinih hranjivih materija u mesu ribe značajno variraju ovisno o vrsti ribe, ishrani, starosti, spolu, uvjetima okoline te godišnjeg doba. Sastav ribljeg mesa je u suštini jednak sastavu mesa životinja za klanje. Ipak, zbog svojih osobina, riblje meso se različito ponaša pri uskladištenju i čuvanju. Na to prvenstveno utiče veći postotak vode u mesu ribe te je ono podložnije kvarenju.

Materijal i metode

Analiza higijenskog stanja ribarnica, odnosno, uzimanje briseva sa površina vršeno je u dva navrata. Brisevi su uzeti sa različitih površina, a mikrobiološka analiza uzetih briseva je evaluisana prema Normativima mikrobiološke čistoće za predmete, površine i ruke koje dolaze u dodir sa hranom (Sl. novine FBiH 101/12).

Ukupan broj uzetih briseva pri prvoj analizi je 30, sa 5 različitih površina u 6 ribarnica. Pri drugom ponavljanu je uzet isti broj briseva. Brisevi su u sterilnim uslovima doneseni u laboratoriju gdje je vršena mikrobiološka analiza.

Mikrobiološka čistoća objekta određivala se prema postotku nezadovoljavajućih briseva u ukupnom broju briseva uzorkovanih tokom jedne kontrole. Ako je postotak nezadovoljavajućih briseva manji od 20%, mikrobiološka čistoća objekta je dobra. Ukoliko je nezadovoljavajućih briseva između 20 i 30 %, mikrobiološka čistoća je prihvatljiva. Nezadovoljavajuća čistoća je kada 30% i više briseva ne odgovara propisanim normativima. Laboratorijska analiza utvrđivanja hemijskog sastava ribljeg mesa kod uzetih uzoraka obuhvatala je po 5 slučajno odabranih uzoraka iz svake ribarnice. U okviru hemijskih pretraga, ustanovljena je količina vlage postupkom sušenja do konstantne mase, zatim količina masti metodom ekstrakcije po Soxhletu, količina bjelančevina metodom po Kjeldahlu i količina pepela žarenjem u peći za žarenje na temperaturi od 550 °C.

Uzorkovanje je vršeno priborom za uzorkovanje na taj način da se spriječi svako njegovo naknadno onečišćenje, kvarenje i oštećenje, uz uvažavanje načela dobre higijenske prakse.

Senzorna ocjena kvaliteta ribe provodila se po Quality Index Method (QIM) testu. QIM uključuje senzorne pokazatelje svježine ribe i njihovu procjenu po bodovnom sistemu. Najmanji broj bodova (0) ima svježa riba, dok je najveći broj bodova ocjene svježine ribe 24 i odnosi se na ribu koja je pokvarena.

Rezultati i diskusija

Tablica 1. Rezultati prve analize na hranjivom agaru za prosječne vrijednosti aerobnih mezofilnih bakterija (cfu/cm^2)
Table 1. The average values of aerobic mesophilic bacteria (cfu/cm^2) analysed on nutrient-rich agar, the first analysis

PRVA ANALIZA	RUKE	MANTIL	PRODAJNI PULT	FRIŽIDER	ZID
R1	NEGATIVAN	NEGATIVAN	POZITIVAN	POZITIVAN	NEGATIVAN
R2	NEGATIVAN	NEGATIVAN	POZITIVAN	POZITIVAN	NEGATIVAN
R3	NEGATIVAN	POZITIVAN	POZITIVAN	POZITIVAN	NEGATIVAN
R4	NEGATIVAN	NEGATIVAN	POZITIVAN	POZITIVAN	NEGATIVAN
R5	POZITIVAN	NEGATIVAN	POZITIVAN	POZITIVAN	NEGATIVAN
R6	NEGATIVAN	NEGATIVAN	POZITIVAN	POZITIVAN	NEGATIVAN

Tablica 2. Rezultati druge analize na hranjivom agaru za prosječne vrijednosti aerobnih mezofilnih bakterija (cfu/cm^2)
Table 2. The average values of aerobic mesophilic bacteria (cfu/cm^2) analysed on nutrient-rich agar, the second analysis

DRUGA ANALIZA	RUKE	MANTIL	PRODAJNI PULT	FRIŽIDER	ZID
R1	NEGATIVAN	NEGATIVAN	POZITIVAN	NEGATIVAN	NEGATIVAN
R2	NEGATIVAN	NEGATIVAN	NEGATIVAN	NEGATIVAN	NEGATIVAN
R3	NEGATIVAN	NEGATIVAN	NEGATIVAN	NEGATIVAN	NEGATIVAN
R4	NEGATIVAN	NEGATIVAN	POZITIVAN	NEGATIVAN	NEGATIVAN
R5	NEGATIVAN	NEGATIVAN	NEGATIVAN	NEGATIVAN	NEGATIVAN
R6	NEGATIVAN	NEGATIVAN	POZITIVAN	NEGATIVAN	NEGATIVAN

Na osnovu broja izraslih kolonija urađena je statistička obrada podataka za svaku analiziranu površinu, kako bi se ustanovila statistički značajna razlika između prosječnog broja aerobnih mezofilnih bakterija između ribarnica (Tablica 1 i 2), a prilikom testiranja i utvrđivanja korištena je Anova: Two-Factor Without Replication test. Signifikantnost razlika ustanovljena je na nivou značajnosti od 0,05, a u sljedećem tekstu rezultati su predstavljeni za svaku površinu posebno.

Tablica 3. Analiza mikrobioloških briseva ruku radnika u ribarnicama
Table 3. The analysis of microbiological swabs of fishery workers' hands

		AEROBNE MEZOFILNE BAKTERIJE					
	BRIS	R1	R2	R3	R4	R5	R6
PRVA ANALIZA	POZITIVAN	0	0	0	0	1	0
	NEGATIVAN	1	1	1	1	0	1
DRUGA ANALIZA	POZITIVAN	0	0	0	0	0	0
	NEGATIVAN	1	1	1	1	1	1

Od ukupno 12 analiziranih briseva ruku radnika u šest ribarnica, samo je jedan uzorak bio pozitivan na aerobne mezofilne baterije, dok je ostalih 11 bilo negativno (Tablica 3). Pozitivan uzorak je zabilježen u R5, pri prvoj analizi, dok pri drugoj analizi broj pozitivnih uzoraka nije zabilježen ni u jednoj ribarnici što može biti posljedica dobre educiranosti o ličnoj higijeni zaposlenika, te njihovom znanju i primjeni načela dobre higijenske i proizvođačke prakse. Pranjem ruku veći dio tih mikroorganizama se ispere i time njihov broj reducira (Bojić-Turčić, 1994).

Na osnovu statističkih rezultata se može vidjeti da ne postoji statistički značajna razlika (p>0,05) u broju bakterija između prve i druge analize, niti po broju bakterija između ribarnica.

Tablica 4. Analiza mikrobioloških briseva mantila radnika u ribarnicama
Table 4. The analysis of microbiological swabs of fishery workers' work coats

		AEROBNE MEZOFILNE BAKTERIJE					
	BRIS	R1	R2	R3	R4	R5	R6
PRVA ANALIZA	POZITIVAN	0	0	1	0	0	0
	NEGATIVAN	1	1	0	1	1	1
DRUGA ANALIZA	POZITIVAN	0	0	0	0	0	0
	NEGATIVAN	1	1	1	1	1	1

Od ukupno 12 briseva mantila ranika (6 pri prvom analiziranja i 6 u drugom), 11 ih je odgovaralo Normativima mikrobiološke čistoće, odnosno, bili su negativni na prisustvo aerobnih mezofilnih bakterija, dok je jedan uzorak, u R3 bio pozitivan na aerobne mezofilne bakterije i okrakterisan kao neispravan (Tablica 4). Kako bi se broj bakterija na radnoj odjeći regulisao i sveo na minimum, prema Barošu (2010) radna odjeća mora biti

izrađena od materijala koji se moţe iskuhavati i peglati (pamuk). Iskuhavanjem i peglanjem uništavaju se mikroorganizmi koji mogu biti na odjeći.

Radna odjeća se ne smije koristiti van radnog mjesta i odlaţe se u individualne ormariće po završetku posla.

Na osnovu statističkih rezultata se moţe vidjeti da ne postoji statistički značajna razlika (p>0,05) u broju bakterija između prve i druge analize, niti po broju bakterija između ribarnica.

Tablica 5. Analiza mikrobioloških briseva prodajnog pulta u ribarnicama
Table 5. The analysis of microbiological swabs of selling counters in fisheries

		AEROBNE MEZOFILNE BAKTERIJE					
	BRIS	R1	R2	R3	R4	R5	R6
PRVA ANALIZA	POZITIVAN	1	1	1	1	1	1
	NEGATIVAN	0	0	0	0	0	0
DRUGA ANALIZA	POZITIVAN	1	0	0	1	0	1
	NEGATIVAN	0	1	1	0	1	0

Na osnovu dobivenih rezultata analiziranih briseva prodajnog pulta u ribarnicama, može se zaključiti da od analiziranih 12 briseva, 9 uzoraka je pozitivno na areobne mezofilne bakterije, dok su tri uzorka negativna (Tablica 5). Broj izraslih bakterija, pri prvom analiziranju uzetih briseva, nije bio u skladu sa Normativima mikrobiološke čistoće, odnosno bili su pozitivni na aerobne mezofilne bakterije, te su svi brisevi okarakterisani kao mikrobiološki neispravni. Pri drugoj analizi samo u R2, R3 i R5 brisevi su ocijenjeni dobre mikrobiološke čistoće jer su bili negativni na aerobne mezofilne bakterije. Da bi se stanje svelo na nulu, odnosno, kako bi se uklonile sve prisutne bakterije potrebno je pojačano voditi računa o ispravnom provođenju čišćenja, pranja i dezinfekciji, pogotovo u

toplijim danima, jer povišena temperatura pogoduje brţem rastu i razmnoţavanju mikroorganizama. Prema Memiš i sar. (2012) da bi sredstva za dezinfekciju mogla učinkovito djelovati, površine koje se tretiraju moraju biti potpuno čiste. Naime, nečistoće mogu zaštiti mikroorganizme od djelovanja sredstava za dezinfekciju ili umanjiti njihovu učinkovitost djelovanja. Osim toga, nečistoće su hrana mikroorganizmima te ukoliko zaostanu omogućiti će njihov rast i razvoj.

Na osnovu statističkih rezultata se moţe vidjeti da ne postoji statistički značajna razlika (p>0,05) u broju bakterija između ribarnica, ali postoji statistički značajna razlika (p<0,05) po broju bakterija između prve i druge analize.

Tablica 6. Analiza mikrobioloških briseva frižidera u ribarnicama
Table 6. The analysis of microbiological swabs of coolers in fisheries

		AEROBNE MEZOFILNE BAKTERIJE					
	BRIS	R1	R2	R3	R4	R5	R6
PRVA ANALIZA	POZITIVAN	1	1	1	1	1	1
	NEGATIVAN	0	0	0	0	0	0
DRUGA ANALIZA	POZITIVAN	0	0	0	0	0	0
	NEGATIVAN	1	1	1	1	1	1

Prilikom analiziranja uzetih briseva sa površine friţidera, ukupno 12 briseva, 6 uzoraka je pozitivno na aerobne mezofilne bakterije, dok je preostalih 6 negativno (Tablica 6). U toku prve analize, brisevi nisu bili u skladu sa Normativima mikrobiološke čistoće, dok su pri drugom analiziranju, u svim ribarnicama brisevi bili

ispravni, odnosno negativni na aerobne mezofilne baterije i ocijenjeni su dobre mikrobiološke čistoće, što se može pripisati pojačanom svakodnevnom čišćenju, pranju i dezinfekciji koju zaposlenici obavljaju. Prema Grujiću (2003) površine i oprema koje dolaze u dodir s hranom, moraju se održavati u dobrom stanju te biti takve

da se lako čiste i, prema potrebi, dezinficiraju. One moraju biti od glatkog, perivog i neotrovnog materijala otpornog na koroziju i materijala koji ne prenose neugodne mirise na hranu.

Na osnovu statističkih rezultata se može vidjeti da ne postoji statistički značajna razlika (p>0,05) u broju bakterija po mjesecima, niti po broju bakterija između ribarnica.

Tablica 7. Analiza mikrobioloških briseva zida u ribarnicama
Table 7. The analysis of microbiological swabs of walls in fisheries

		AEROBNE MEZOFILNE BAKTERIJE					
	BRIS	R1	R2	R3	R4	R5	R6
PRVA ANALIZA	POZITIVAN	0	0	0	0	0	0
	NEGATIVAN	1	1	1	1	1	1
DRUGA ANALIZA	POZITIVAN	0	0	0	0	0	0
	NEGATIVAN	1	1	1	1	1	1

Prilkom analize briseva sa površine zida, u svim ribarnicama, rezultati uzoraka su bili negativni na aerobne mezofilne bakterije, te su svih 12 briseva ocijenjeni dobre mikrobiološke čistoće (Tablica 7). Površine koje dolaze u dodir s hranom moraju se čistiti i dezinficirati više puta dnevno. Prema Barošu (2010) čišćenje ostalih površina i područja može se provoditi dnevno do godišnje, ovisno o nivou onečišćenja, ali dovoljno često da se izbjegne svaka opasnost od kontaminacije. Dubinsko čišćenje potrebno je u određenim vremenskim razmacima (jednom ili dva puta godišnje) skinuti i temeljito čistiti opremu i inventar koji su teško pristupačni kako bi se uklonila nakupljena nečistoća.

**Tablica 8.** Rezultati analize briseva za prosječne vrijednosti enterobakterija (cfu/cm^2)
Table 8. The average values of enterobacteria (cfu/cm^2)

	RUKE	MANTIL	PRODAJNI PULT	FRIŽIDER	ZID
R1	POZITIVAN	POZITIVAN	POZITIVAN	POZITIVAN	NEGATIVAN
R2	POZITIVAN	POZITIVAN	POZITIVAN	POZITIVAN	NEGATIVAN
R3	POZITIVAN	POZITIVAN	POZITIVAN	POZITIVAN	NEGATIVAN
R4	POZITIVAN	NEGATIVAN	POZITIVAN	POZITIVAN	NEGATIVAN
R5	POZITIVAN	POZITIVAN	POZITIVAN	POZITIVAN	NEGATIVAN
R6	POZITIVAN	POZITIVAN	POZITIVAN	POZITIVAN	NEGATIVAN

Pri analiziranju mikrobiološke ispravnosti briseva, odnosno određivanju prisustva ili odsustva *Enterobacteriaceae*, prema Normativima mikrobiološke čistoće, iz navedene tablice može se vidjeti da samo na površini zida nije evidentirano prisustvo bakterija, te su brisevi ocijenjeni mikrobiološki ispravni, za sve ribarnice (Tablica 8). Pored navedenog, također, uzorak na površini mantila u R4 bio je negativan na aerobne mezofilne bakterije te je bris okarakterisan kao ispravan. U svim ostalim ribarnicama, analizirani brisevi za preostale površine su bili neispravni, odnosno pozitivni na aerobne mezofilne bakterije gdje je u nekim ribarnicama broj bakterija bio daleko veći od dozvoljenog što može biti posljedica nedovoljne edukovanosti zaposlenika o njihovoj ličnoj higijeni, te se mora pojačano voditi računa o ispravnom provođenju pranja i dezinfekcije ruku, kao i o pravilnom provođenju dezinfekcije površina. I u slučaju kada su ispunjeni svi zahtjevi u pogledu higijene okoline i samog proizvodnog procesa, neželjene posljedice, tj. kontaminacija proizvoda ne može da se izbjegne, ako nije ispunjen zahtjev u pogledu lične higijene osoblja (Mandić i sar., 2007). Na osnovu statističkih rezultata se može vidjeti da ne postoji statistički značajna razlika (p>0,05) u broju bakterija između ribarnica, ali postoji statistički značajna razlika (p<0,05) između broja bakterija na analiziranim površinama u ribarnicama. Pored navedenih analiza, također, vršeno je i ispitivanje prisustva bakterija na hranjivoj podlozi SS, te na istoj nije bilo utvđeno prisustvo bakterija.
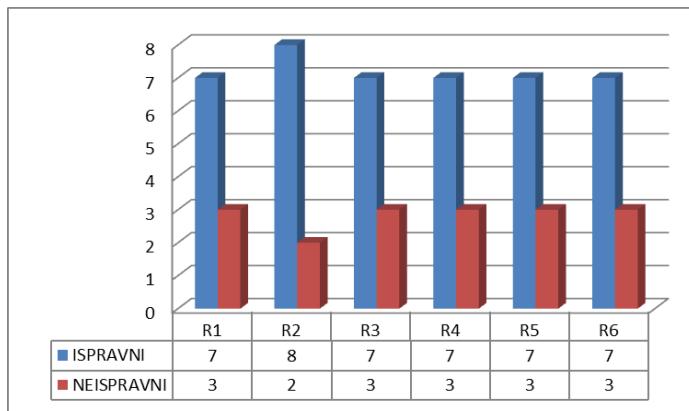
Slika 1. Cjelokupni prikaz mikrobiološke čistoće ribarnica u pogledu prisustva aerobnih mezofilnih bakterija
Fig. 1. The overall microbiological analysis of fisheries observed through determined aerobic mesophilic bacteria

Iz navedenog grafikona (Slika1), može se zaključiti da od ukupno 60 uzetih briseva, 17 briseva ne odgovara u pogledu mikrobiološke čistoće. U R2 od 10 analiziranih uzoraka dva su neispravan što čini 20%, dok u ostalim ribarnicama od 10 analiziranih, po tri uzorka su neispravna što čini 30%, za svaku. Prema Normativima mikrobiološke čistoće iz navedenog grafikona, može se zaključiti da je postotak nezadovoljavajućih briseva za ribarnicu R2 do 20%, te je mikrobiološka čistoća ribarnice ocijenjena kao dobra, dok je u ostalim ribarnicama broj nezadovoljavajućih briseva do 30% te je mikrobiološka čistoća ribarnica okarakterisana kao prihvatljiva. U pogledu prisustva enterobakterija, mikrobiološka čistoća ribarnica okarakterisana je kao nezadovoljavajuća, jer više od 30% briseva ne odgovara propisanim normativima.

Laboratorijske analize utvrđivanja hemijskog sastava ribljeg mesa obuhvatala je 30 slučajno odabranih uzoraka svježe kalifornijske pastrmke, po 5 uzoraka iz 6 ribarnica. Rezultati analiza prikazani su u narednim grafikonima.
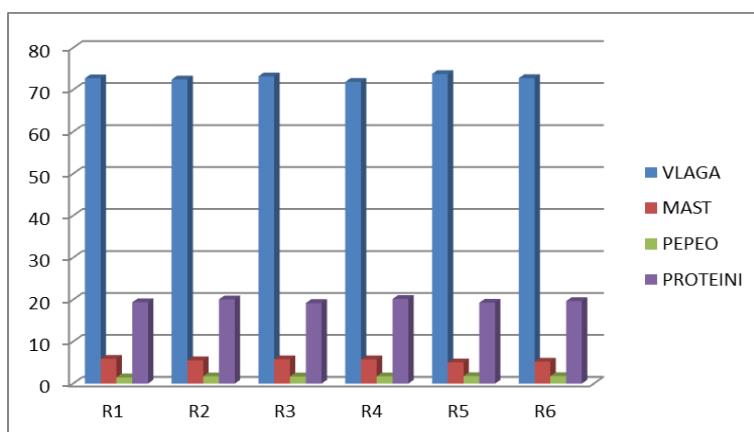
Slika 2. Hemijska analize sastava ribljeg mesa
Fig. 2. Chemical analysis of fish samples

Na osnovu statističkih rezultata se može vidjeti da ne postoji statistički značajna razlika (p>0,05) između ribarnica u pogledu hemijskog sastava ribe. Hemijski sastav ribe značajno varira ne ovisi samo o vrsti ribe, već i prehrani, starosti, spolu, migraciji, uvjetima okoliša te godišnjem dobu (Plavša i sar., 2000). U nastavku su prikazani pojedinačni rezultati za svaku ribarnicu u pogledu istog (Slika 2).

Najmanji sadržaj vlage utvrđen je kod uzorka u R4 (71,88%), dok je najviši sadržaj vlage bio u uzorku u R5 (73,77%). Utvrđeni sadržaj vode u pastrmci bio je niži u poređenju sa podacima koje navode Grujić (2000)

(75% vode), i Bud i sar. (2008) (77,03%). U ispitivanjima Plavše i sar. (2000) meso jedinki kalifornijske pastrmke sadrži 72,85 – 74,20 % vode, dok prema ispitivanju koje je vršio Celik i sar. (2008.) sadržaj vode iznosio je 71,65%. U ispitivanim uzorcima fileta pastrmke koje je istraživao Savić i sar. (2004) sadržaj vode varirao je od 66,8 – 75,5 %. Prosječan sadržaj vode u ispitivanju koje je vršio Karahmet i sar. (2013) iznosio je 72,4%, što je skoro jednako prosječnom sadržaju vode u ispitivanim uzorcima riba iz ribarnica koji je iznosio 72,85%. Ako dobijene rezultate analiza prikazane na Slici 2, uporedimo sa prosječnim hemijskim sastavom koji su prikazani u pregledu literature, može se zaključiti da dobijeni rezultati ne odstupaju od prosječnog hemijskog sastava, odnosno da je hemijski sastav uzorka mesa ribe u okvirima rezultata prosječnog hemijskog sastava prikazanih u dostupnim literaturnim izvorima. Hemijske analize za utvrđivanje sadržaja masti na ispitivnim uzorcima urađene su po Soxhlet metodi gdje se analiza bazirala na ekstrakciji masti u uzorku uz pomoć organskih rastvarača. Najmanji sadržaji masti je bio u uzorku u R5 (5,04%), a najveći sadržaj je bio u uzorku u R1 (5,91%). Znatno manji sadržaj masti u odnosu na ispitivani u svom istraživanju su dobili Bud i sar. (2008) (2,94%), a takođe i prema Grujić (2000), sadržaj masti je niži i iznosi 3,8%. Prema istraživanju koje je vršio Savić i sar. (2004) sadržaj masti u mesu kalifornijske pastrmke iznosio je 4,1 – 5,3 %, dok je približan sadržaj masti bio i pri istraživanju koje su izvršili Celik i sar. (2008), a iznosio je 4,43%. Ako dobijene rezultate prosječnog sadržaja masti u analizama prikazane na Slici 2, uporedimo sa prosječnim sadržajem masti kalifornijske pastrmke koje je dobila Plavša i sar. (2000), (7,02 – 8,27 %) može se zaključiti da je znatno niži, dok s druge strane istraživanje koje je vršio Karahmet i sar. (2013), gdje je dobijeni sadžaj masti iznosio 5,11%, približan prosječnom sadržaju ispitivanih uzoraka. Količina masti u mesu ribe nije konstantna i mijenja se tokom godine, a najčešče je obrnuto proporcionalna sadržaju vode (Šoša, 1989). Na osnovu poređenja sa literaturnim podacima, može se zaključiti da dobijeni rezultati variraju u odnosu na druge, ali su prosječne vrijednosti dosta slične. Najniži sadržaj poteina utvđen je u uzorku u R3 (19,19%), dok je najveći sadržaj bio u uzorku u R4 (20,17%). Dobivene razlike su bile male i nisu bile statistički značajne. Utvrđeni sadržaj proteina u pastrmci je bio veći u odnosu na rezultate koje su u svojim istraživanjima dobili Plavša i sar. (2000) (18,16 - 18,51 %), i Savić i sar. (2004) (14,00 - 18,90 %). Prema Grujić (2000), sadṛaj proteina je iznosio 20 %, što je slično dobijenim rezultatima analizirane pastrmke. Također, slični podaci su dobijeni i pri

istraživanju Karahmet i sar. (2013) gdje je sadržaj proteina iznosio 20,4%, te pri istraživanju Celik i sar. (2008), sa sadṛajem od 19,6% proteina. U svom istraživanju Bud i sar. (2008) dobili su prosječan sadržaj proteina 18,88%, što je malo niže u odnosu na ispitivane uzorke. Ako dobijene rezultate prosječnog sadržaja proteina uporedimo sa prosječnim sadržajem proteina prema literaturnim podacima, može se konstatovati da dobijeni rezultati ne odstupaju u velikoj mjeri od prosječnog sadržaja proteina u navedenim literaturnim izvorima. Metodom suhog spaljivanja uzoraka izvršena je analiza za utvrđivanje pepela u uzorcima riba. Prosječan sadržaj pepela je bio u skoro svim uzorcima isti, osim u uzorku u R1 gdje je iznosio 1,48% i kao takav imao najnižu vrijednost, dok je najveći sadržaj pepela zabilježen u R5 (1,78%). U poređenju sa drugim istraživanjima, sadržaj mineralnih materija kod ispitivanih uzoraka pastrmke je znatno veći. Prema Grujić (2000) sadržaj pepela je iznosio 1,2%. Sličan iznos je i kod drugih autora, gdje je najveći sadržaj zabilježen u ispitivanju Karahmet i sar. (2013) (1,44%), a sadržaj mineralnih materija u količini od 1,24 - 1,28 % dobila je Plavša i sar. (2000). U svom istraživanju Savić i sar. (2004) dobili su da je sadržaj pepela varirao od 1,35 - 1,6 %, dok je Bud i sar. (2008) dobio sadržaj pepela 1,15 %. Sadržaj mineralnih tvari u mesu riba varira od 0,9 do 1,7 što je znatno više nego u mesu toplokrvnih životinja (Bogut i sar., 1996). Prema navedenim literaturnim podacima, može se zaključiti da dobijeni rezultati ne odstupaju od literature.

Senzorna ocjena

Rezultati senzorne ocjene, koja je urađena na ukupno 30 uzoraka ribe, predstavljeni su u Tablici 9. Bodovanje je izvršeno na osnovu organoleptičkih svojstava kod svih 30 uzoraka i predstavljeno je kroz ocjenjivački list. Organoleptičkom pretragom riba svi su uzorci ocijenjeni kao svježa riba. Oči su bile bistre, napete i sjajne do ravne i ponešto zamućene. Površina uzoraka bila je sjajna, do manje biserno sjajna, škrge su bile crvene boje, a miris skoro svih uzoraka bio je specifičan miris svježe ribe. Prvi znaci kvarenja uočeni su na škrgama, koži i muskulaturi. Slično istraživanje izvršio je Karahmet i sar. (2013), gdje je senzorna ocjena uzoraka kalifornijske pastmke također pokazala da je svježina ribe bila najbolja poslije prve ocjene (nakon 12 sati) i s najmanjim brojem bodova u ocjenjivačkom listiću (četiri), a prvi znaci kvarenja uočeni su također na škrgama, koži i muskulaturi.

Tablica 9. Ocjenjivački listić za senzorsku analizu uzoraka kalifornijske pastrmke
Table 9. Evaluation form for sesory testing samples of California trout

Parametri kvaliteta		Bodovanje					
		R1	R2	R3	R4	R5	R6
Oči	Zjenica	0	0	0	0	0	0
	Oblik	0	0	0	1	0	1
	Boja	0	0	0	0	0	0
Škrge	Sluz	1	1	0	0	0	0
	Miris	0	1	1	1	1	0
Koţa	Boja	1	1	0	1	1	0
	Sluz	0	0	1	0	0	1
	Miris	0	0	1	1	0	0
Muskulatura	Tekstura	0	1	1	0	1	0
Abdomen	Krv u abdomenu	0	0	0	0	0	0
	Miris	0	0	0	1	0	0
Suma		2	4	4	5	3	2

Zaključci

- Broj aerobnih mezofilnih bakterija na rukama radnika u najvećem broju prisutan je u R5 što nije u skladu sa Normativima mikrobiološke čistoće, dok je u ostalim ribarnicama zabilježen znatno manji broj, te su brisevi dobre mikrobiološke čistoće.
- Od ukupno 12 briseva koji su uzeti sa mantila radnika, samo jedna bris u R3 bio je pozitivan na aerobne mezofilne bakterije, a svi ostali brisevi su ocijenjeni dobre mikrobiološke čistoće.
- Broj aerobnih mezofilnih bakterija na površini prodajnog pulta pri prvom analiziranja uzetih briseva, nije bio u skladu sa pravilnikom, te su svi brisevi okarakterisani kao mikrobiološki neispravni. Pri drugoj analizi, samo u R2, R3 i R5 broj bakterija je odgovarao Normativima te su brisevi ocijenjeni dobre mikrobiološke čistoće.
- Kako bi se uklonile sve prisutne bakterije potrebno je pojačano voditi računa o ispravnom provođenju čišćenja, pranja i dezinfekciji, pogotovo u toplijim danima, jer povišena temperatura pogoduje brţ i rast i razmnožavanje mikroorganizama.
- Prilikom analiziranja uzetih briseva sa površine frižidera, u toku prve analize, uzeti brisevi su okarkterisani kao neispravni, dok su pri ponovljenoj, drugoj analizi, u svim ribarnicama brisevi bili ispravni i ocijenjeni su dobre mikrobiološke čistoće, što se može pripisati svakodnevnom čišćenju, pranju i dezinfekciji koju zaposlenici obavljaju.
- Na površini zida broj aerobnih mezofilnih bakterija u oba mjeseca analiziranja je iznosio nula za sve ribarnice, te su brisevi ocijenjeni dobre mikrobiološke čistoće.

- Pri analiziranju mikrobiološke ispravnosti briseva, odnosno određivanju prisustva ili odsustva *Enterobacteriaceae*, samo na površini zidova, za sve ribarnice, i na mantilu radnika u R3 nije evidentirano prisustvo bakterija, te su brisevi ocijenjeni mikrobiološki ispravni. U svim ostalim ribarnicama, analizirani brisevi za preostale površine su bili neispravni.
- Pri određivanju prisustva ili odsustva *Enterobacteriaceae*, najlošiji brisevi su na rukama zaposlenika koji rade sa ribom, te su brisevi označeni kao mikrobiološki neispravni, što je pokazatelj da se mora pojačano voditi računa o ispravnom provođenju pranja i dezinfekcije ruku.
- Prema Normativima mikrobiološke čistoće postotak nezadovoljavajućih briseva za ribarnicu R2 je do 20%, te je mikrobiološka čistoća ribarnice ocijenjena kao dobra, dok je u ostalim ribarnicama broj nezadovoljavajućih briseva do 30% te je mikrobiološka čistoća ribarnica okarakterisana kao prihvatljiva.
- U pogledu prisustva enterobakterija, mikrobiološka čistoća ribarnica okarakterisana je kao nezadovoljavajuća, jer više od 30% briseva ne odgovara propisanim normativima.
- Na osnovu statističkih rezultata, ne postoji statistički značajna razlika (p>0,05) između ribarnica u pogledu hemijskog sastava ribe.
- Prosječan hemijski sastav ribljeg mesa kod uzoraka kalifornijske pastrmke pokazuje da je utvrđeni sadržaj vode iznosio 72,85%, proteina 19,62%, masti 5,55% i pepela 1,70%, što je u skladu sa rezultatima iz dostupnih literarnih izvora.
- Organoleptičkom pretragom riba svi su uzorci ocijenjeni svježom ribom.

Literatura

Baroš, K., Hegedušić, P., Karačić, T., Premzl, D. (2010): Vodič za dobru higijensku praksu i primjenu načela HACCP-a u industriji mesa, I dio Higijenska praksa. HGK, Sektor za poljoprivredu, prehrambenu industriju i šumarstvo, Zagreb, Hrvatska.

Bogut, .I, Opačak, A., Stević, I., Bogut, S., (1996): Nutritivna i protektivna vrijednost riba s osvrtom na omega-3 masne kiseline. *Ribarstvo* 54 (1), 21-38.

Bojić-Turčić, V. (1994): Sterilizacija i dezinfekcija u medicini. Medicinska naklada, Zagreb, Hrvatska.

Bud, I., Ladesi, D., Reka, S.T., Negrea, O. (2008): Study concerning chemical composition of fish meat depending on the considered species. *Zoorehnie si Biotehnologii* 42 (2), 201-206.

Celik, M., Gocke, M., Basusta, N., Kucukgulmez, A., Tasbozan, O., Tabakogly, S. (2008): Nutritional quality of rainbow trout (Oncorhynchus mykiss) caught from the Ataturk Dam lake in Turkey. *Journal of Muscle Foods* 19 (1), 50-61.

Grujić, R. (2000): Nauka o ishrani čoveka. Tehnološki fakultet, Banja Luka, BiH.

Grujić, R. (2003): Dobra proizvođačka praksa. Tempus JEP, Banja Luka, BiH.

Hadžiosmanović, M., Kozačinski, L., Cvertila, Ţ. (2002): Kakvoća morske ribe. *Meso* IV (16), 31-33.

Huss, H.H. (1995): Quality and quality changes in fresh fish. *FAO Fisheries Technical Paper* 348, Roma.

Karabasil, N., Dimitrijević, M., Teodorović, V., Kilibarda, N., Baltić, Ţ.M. (2005): Najčešće bakterijske kontaminacije mesa riba. Beograd, Srbija.

Karahmet, E., Vileš, A. (2013): Higijena i sanitacija u prehrambenoj industriji. Sarajevo, BiH.

Karahmet, E., Vileš, A., Muhamedagić, S., Omanović, H., Toroman, A., Omanović, N. (2013): Uporedno ispitivanje senzornih svojstava tri vrste pastrmke čuvanih u istim uslovima. *Veterinaria* 62 (1-2), 93-103.

Kovačević, D. (2001): Kemija i tehnologija mesa i ribe. Osijek, Hrvatska.

Mandić, S., Grujić, R., Topalić-Trivunović, Lj., Stojković, S. (2007): Značaj mikološke kontrole u pogonima za proizvodnju mesa i proizvoda od mesa. Naučni rad, Institut za higijenu i tehnologiju mesa, Beograd, Srbija.

Memiš, N., Škrinjar, M., Vesković-Moračanin, S. (2012): Uticaj higijensko-sanitarnih mera u pogonu za proizvodnju maslaca na mikrobiološku ispravnost finalnog proizvoda. *Vet. Glasnik* 66 (1-2), 123-141.

Plavša, N., Baltić, M., Sinovec, Z., Jovanović, B., Kulišić, B., Petrović, J. (2000): Uticaj ishrane obrocima različitog sastava na kvalitet mesa kalifornijske pastrmke (Oncor-hynchus mykiss Walbaum). Savremeno ribarstvo Jugoslavije monografija, radovi saopšteni na IV Jugoslovenskom simpozijumu „Ribarstvo Jugoslavije", Vrašac, Beograd.

Pravilnik o normativima mikrobiološke čistoće za predmete, površine i ruke koje dolaze u dodir sa hranom (Sl. novine FBiH 101/12).

Savić, N., Mikavica, D., Grujić, R., Bojanić, V., Vučić, G., Mandić, S., Đurica, R. (2004): Hemijski sastav mesa duţ ičaste pastrmke (Oncorhynchus mykiss Wal.) iz ribnjaka Gornji Ribnik. *Tehnologija mesa* 45 (1-2), 45-49.

Šoša, B. (1989): Higijena i tehnologija prerade morske ribe. Zagreb, Hrvatska.

GOOD HYGIENE PRACTICE IN FISHERIES AT THE SARAJEVO CANTON

Karahmet Enver, Toroman Almir, Nuker Emina, Bektaš Adela, Musić Lejla

Faculty of Agriculture and Food Sciences, University of Sarajevo, Zmaja od Bosne 8, 71000 Sarajevo, Bosnia and Herzegovina

Original scientific paper

Summary

Implementation of good hygiene measures and sanitation practices is necessary in order to ensure safe food. Good hygiene practice determines what is needed to be done regarding to cleaning and hygiene, as well as when and who should carry out these measures in order to ensure the best quality products. The aim of this study was to perform testing of good hygiene practices in six fisheries at the Sarajevo Canton, and to determine the physical and chemical quality of fish sold on the market of Sarajevo Canton. The analysis in fisheries included microbiological swab collection from five different surfaces, in six fisheries, and according to the Standards of microbiological cleanness, microbiological cleannessall fisheries were characterized as good and acceptable. Also, chemical analysis of nutritional composition of fish meat was performed, including 30 samples of California trout. The average contents were: water 72.85%, fat 5.55%, protein 19.62% and ash 1.70%. Sensory evaluation of fish samples was evaluated by Quality Index Method test (QIM), and all samples were evaluated as fresh fish.

Keywords: good hygiene practice, microbiological analysis, chemical composition, sensory evaluation

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e-mail address: ivana.pavlekovic@ptfos.hr

Faculty of Technology
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Be sure to use lettering, data lines, and symbols sufficiently large and thick to be clearly legible when the figure is reduced to the normal published size. In graphs and charts, curves should be identified by using different symbols for points (•, ◊, ○, □, ■, ▲, etc.) and not by line width or colour. Several figures should be grouped in a plate on one page. Do not place figures into bordered frames. Figure caption and legend should be placed at the bottom of each figure, while table headings should appear above the tables. The text into the figures and tables should be written in the same language as the body text.

Whenever possible formulae and equations are to be written in one line, centred on the page, and consecutively numbered in Arabic numbers between round brackets at the right margin of the paper. Refer to equations by the abbreviation "Eq.".

SI (System International) units should be used. Only symbols (not their subscripts, superscripts or description in brackets) of physical quantities should be written in italic. All physical quantities given in table columns or rows and corresponding table headings with units, or graphical plots and corresponding table headings with units, or graphic plots and corresponding axis labels should conform to the algebraic rules, i.e.

$$\text{physical quantity} / \text{unit} = \text{numerical value}.$$

It is preferred to write the measurement units as "kg/m3".

Conclusions

Conclusions have to briefly explain significance of the research results.

References

References should be selective rather than extensive (with the exception of review articles). Literature citations inthe text should be referred by author's last name and year, in brackets, such as (Knowles, 2007), or with the lastname of the author as part of the sentence, immediately followed by the year of publication in brackets, such as("Smith (1963) reported growth on media."). If there are more than two authors, mention the first author and add etal., followed by the year.

In the reference list which has to be written at the end of the paper, all authors have to be listed (surname and nameinitials – capitalizing only the initial letters) in alphabetical order, and paper of the same author by chrono-logicalorder. If there are more papers from the same author published in the same year, references have to be differentiated by letters in the text (a, b, c, d) behind the year of publishing. In case of multi author papers, in reference list all the authors have to be written (not the first author and mark "et al.").

Italicize only those words that were underlined or italicized in the original, such as names of microorganisms. Alsotitles of journals have to be written in italics.

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Abbreviations for periodicals should be in accordance with the latest edition of the Thomson ISI List of Journal Abbreviations (Thomson Scientific, USA). Full stop should be used after each abbreviation.

Reference list should be written as shown:
Journals:
Kopjar, M., Piližota, V., Hribar, J., Nedić Tiban, N., Šubarić, D., Babić, J., Požrl, T. (2008): Influence of trehalose

addition on instrumental textural properties of strawberry pastes, Int. J. Food Prop. 11 (3), 646-655.

Books:

Doyle, M.P., Beuchat, L.R., Montville, T.J. (2001): Food Microbiology: Fundamentals and Frontiers, Washington, USA: ASM Press, pp. 572-573.

Chapter in book:

Varoquaux, P., Wiley, R.C. (1994): Biological and Biochemical Changes in Minimally Processed Refrigerated Fruits and Vegetables. In: Minimally Processed Refrigerated Fruits and Vegetables, Wiley, R.C. (ed.), New York, USA: Chapman, pp. 226-268.

Conference proceedings:

Babić, J., Šubarić, D., Ačkar, Đ., Kopjar, M. (2008): Utjecaj hidrokoloida na reološka svojstva voštanog kukuruznog škroba. In: 43rd Croatian and 3rd International Symposium on Agriculture, Pospišil, M. (ed.), Zagreb,HR, pp. 558-562.