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Salt Content in Ready-to-Eat Food and Bottled Spring and Mineral Water Retailed in Novi Sad

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SUMMARY

Introduction Salt intake above 5 g/person/day is a strong independent risk factor for hypertension, stroke and cardiovascular diseases. Published studies indicate that the main source of salt in human diet is processed ready-to-eat food, contributing with 65–85% to daily salt intake.

Objective The aim of this paper was to present data on salt content of ready-to-eat food retailed in Novi Sad, Serbia, and contribution of the salt contained in 100 g of food to the recommended daily intake of salt for healthy and persons with cardiovascular disease (CVD) risk.

Methods In 1,069 samples of ready-to-eat food, salt (sodium chloride) content was calculated based on chloride ion determined by titrimetric method, while in 54 samples of bottled water sodium content was determined using flame-photometry. Food items in each food group were categorized as low, medium or high salt. Average salt content of each food group was expressed as a percentage of recommended daily intake for healthy and for persons with CVD risk.

Results Average salt content (g/100 g) ranged from 0.36±0.48 (breakfast cereals) to 2.32±1.02 (grilled meat). The vast majority of the samples of sandwiches (91.7%), pizza (80.7%), salami (73.9%), sausages (72.9%), grilled meat (70.0%) and hard cheese (69.6%) had a high salt profile. Average amount of salt contained in 100 g of food participated with levels ranging from 7.2% (breakfast cereals) to 46.4% (grilled meat) and from 9.6% to 61.8% in the recommended daily intake for healthy adult and person with CVD risk, respectively. Average sodium content in 100 ml of bottled spring and mineral water was 0.33±0.30 mg and 33±44 mg, respectively.

Conclusion Ready-to-eat food retailed in Novi Sad has high hidden salt content, which could be considered as an important contributor to relatively high salt consumption of its inhabitants.

Keywords: sodium chloride; dietary; food; bottled water

INTRODUCTION

There is an overwhelming evidence that dietary salt (sodium chloride) intake above 5 g/person/day is in a positive correlation with average blood pressure and prevalence of hypertension within the population, incidence of cardiovascular disease (CVD) and all causes of death [1, 2, 3]. High salt intake was recognized as a risk factor for the end-stage of renal failure [4] and it is in a positive association with stomach cancer [5] and osteoporosis [6]. Worldwide investigations indicated that salt intake varies between 9 and 12 g/person/day, although in some population groups average salt intake exceeded 20 g/person/day. These amounts highly exceeded the amount that human ancestors consumed during several million years of evolution and the amount that is still consumed by some native population groups [1, 2, 3, 7]. In most countries the primary source of dietary sodium is salt, although in some foodstuffs, sodium is contained in flavor enhancers such is monosodium glutamate and food additives such are sodium benzoate, sodium bicarbonate, sodium citrate etc. The main source of salt is processed, mainly ready-to-eat food which contributes with 65–85% of total salt intake [8, 9, 10]. Modest reduction of salt intake was followed by the statistically significant reduction of blood pressure, prevalence of hypertension, morbidity and mortality rate of CVD and all causes of death [11, 12]. The recognized problem and beneficial outcome of salt intake reduction within population motivated national health authorities worldwide to implement programs on salt intake reduction by legislation on controlling and labeling salt content in food, educational programs and voluntary involvement of food industry and food manufacturers to reduce salt content in their products [8, 13, 14, 15].

A prevalence of hypertension in the Republic of Serbia (RS), systolic blood pressure ≥140 mm Hg and diastolic blood pressure ≥90 mm Hg, among adults aged 18 years and more, is 46.5%. In the RS cardiovascular diseases are the leading cause of death. They participate with 55.2% in all death cases [16]. In the RS there are no available data on salt content in processed ready-to-eat food and its salt profile, although the National Program for Prevention, Medical Treatment and Control of Cardiovascular Diseases in the RS until 2020 recognized the importance of salt control intake and food products salt labeling [17].

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OBJECTIVE

The objective of the paper was to present results on salt content in different ready-to-eat foods retailed in Novi Sad, which were brought to Institute of Public Health of Vojvodina (IPHV) for food safety control, classification of the controlled food items according to their salt profile and to consider their contribution to the recommended daily dietary intake of salt for healthy and for persons with CVD risk.

METHODS

Within period 2005–2013 sodium chloride content was tested in processed ready-to-eat food items that were taken by the Sanitary Inspection Service of the city of Novi Sad and brought to Institute of Public Health of Vojvodina for safety control. Within the observed period, a total of 1,069 samples of retailed ready-to-eat food were tested on sodium chloride content, as well as 54 samples of bottled spring and mineral water.

Determination of salt content in food items was based on titrimetric determination of chloride ions with silver nitrate, and calculation of corresponding sodium chloride content. In the first part of the survey titration was performed using the visual method for determining the end point, enabled by the presence of potassium chromate as an indicator. The method was later changed to potentiometric titration (Radiometer analytical, SAS France TIM 850 Titration Manager) using a combined metal electrode for silver halides titration (MC6091 Ag HACH Lange) to determine the equivalence point.

In order to evaluate comparability of the results obtained by both methods of sodium chloride determination, as well as their accuracy, certified reference material was analyzed: processed meat (ERM BB01a, European reference materials) with certified value for chloride 1.45±0.05% (recalculated to sodium chloride 2.39±0.08%). The comparison showed that the difference between the results was negligible (in the range of method precision), and that both methods should be considered accurate. Based on the aforementioned facts, all the data on the salt content of analyzed food products were further treated equally regarding the quality of analytical results. Participation in Proficiency testing LCG QFCS Nutritional analysis (mixed matrix, sample 772, assigned value for salt content 0.71%) resulted with *z* score 0.75 (laboratory result 0.76%), confirming the quality of laboratory method performance.

Procedure for determining sodium chloride content in food products: test sample was finely comminuted and thoroughly mixed. Visual determination: 10.0 g of test sample was weighed into a 100 ml volumetric flask and diluted to volume with distilled water. After mixing and filtration, 20 ml aliquot was transferred to titration flask and potassium chromate indicator was added. The solution was titrated with silver nitrate standard volumetric solution (0.1 M) to the characteristic yellow-orange end point. Salt content was calculated according to the following equation: NaCl (%) = mL $AgNO_3$ × 0.05844 × 5 × 100 / g of test sample. Potentiometric determination: 2.0 g of test sample was weighed into a 200 ml volumetric flask and approximately 100 ml of warm distilled water was added (60°C). After 30 minutes on the shaker, the solution was cooled to room temperature, flask filled to the volume with distilled water and the solution was filtrated. An aliquot of 20 ml of filtrate was transferred to a titration beaker and 5 ml of 0.1 M nitric acid was added. Electrode and burette delivery tip were dipped in the solution and the titration was run with 0.1 M silver nitrate as titrant. Parameters of the method were set in the way to enable Titration Manager to directly calculate results in % of NaCl.

All the results were expressed as percentage of sodium chloride. Food items classification into food groups was performed following the World Health Organization's recommendations for salt reduction in processed food [18]. The salt content profile of food was made by following the classification of the United Kingdom Food Standard Agency: low (≤0.3 g/100 g), medium (>0.3–1.5 g/100 g) and high (>1.5 g/100 g) salt content [19]. Contribution of the average amount of salt contained in 100 g of each food group was compared with the recommendation for daily dietary intake of salt (5 g) of a healthy adult person [18] and for persons with CVD risk (3.75 g) [20].

Determination of sodium content in bottled water samples was done by flame-photometry. Sodium concentration in an unknown sample was determined by comparing its emission intensity to a corresponding emission intensity of the sodium standard solutions. The apparatus used was Evans Electroselenium LTD, England, with a burner using natural gas and air. A sample interference filter was used to isolate the sodium specific wavelength at λ=589 nm. Sodium standard stock solution of 1.00 mg/ml was made by dissolving sodium chloride in deionized water to make diluted solutions that cover the range of concentrations expected of the water samples (range 0.1–100 mg/L; if necessary, water samples were diluted). Series of standard solutions were aspirated in the flame, as well as the water samples, and readings were recorded. Concentration of sodium was calculated on the basis of readings for standard solutions that bracket emission intensity of unknown sample, and expressed as mg/100 ml.

Participation in Proficiency testing (LGC Aquacheck, water, sodium 238 mg/l) gave *z* score -0.06 (laboratory result 237 mg/l), and thus confirmed accuracy of the applied flame-photometry method.

Sodium content in the samples of spring and mineral water was expressed in mg/100 ml. The contribution to the daily dietary intake was calculated as percentage of the USDA and WHO recommendations for daily sodium intake (2.3 g/day and <2 g/day, respectively), as well as for USDA recommendation for daily sodium intake for persons with CVD risk (1.5 g/day) [18, 20].

The data were collected and statistically analyzed by Microsoft Excel 2003 and Microsoft Visual Studio 9.0 – Microsoft Visual Fox Pro. Descriptive statistical analyses were used (average, minimum and maximum value, standard deviation [SD], coefficient of variation [CV] and hypothesis testing for a proportion).

RESULTS

Average salt content in the controlled samples of retailed ready-to-eat food in Novi Sad ranged from 0.36±0.48 mg/100 g in breakfast cereals to 2.32±1.02 mg/100 g in grilled meat (Table 1). The average sodium content was statistically highly different ($p<0.01$) between bread and bakery pies, bread and rolls, pasty and sausages, pasty and salami, pizza and canned fish, pizza and canteen meals, cream and semi-hard cheese and canned fish and sandwiches. Classification of the controlled food samples based on their salt content profile showed that there was no sample of sandwiches, sausage, pasty, salami, hard or semi-hard cheese, canteen meal, pizza, canned fish, dressing and chips, crackers and salted nuts that belonged to the low salt profile group. Near 10% of bread samples belonged to the low, almost three quarters (73.6%) to the medium and 16% to the high salt group. The vast majority of the samples of sandwiches (91.7%), pizza (80.7 %), salami (73.9%), sausages (72.9%), grilled meat (70.0%) and hard cheese (69.9%) had a high salt profile. Majority (78.0%) of the samples of cream cheese belonged to the medium salt profile group, while 10% of samples of this type of cheese belonged to the high salt profile group. The salt profile was statistically highly different ($p<0.01$) for bread, sausages, grilled meat, cream and semi-hard cheese, pizza, breakfast cereals, canteen meals and sandwiches and statistically different ($p<0.05$) for rolls, pasty, salami and hard cheese (Table 2). Table 3 presents data on the contribution of average salt content in 100 g of food item to the recommended daily salt intake of an adult healthy person and a person with CVD risk. Average amount of salt contained in 100 g of a food group participated from 7.2% (breakfast cereals) to 46.4% (grilled meat) and from 9.6% to 61.8% in the amount recommended as daily intake for an adult healthy and a person with CVD risk, respectively. Average sodium content of bottled spring and mineral water was 0.33±0.30 mg/100 ml and 32.88±44.45 mg/100 ml, respectively (Table 4). Sodium content participated with 0.01–1.64% in recommended daily intake of sodium for a healthy person and with 0.02–2.19% in recommended daily intake of sodium for a person with CVD risk (Table 4).

DISCUSSION

It is well scientifically documented that high salt consumption is an independent and strong risk factor for rising blood pressure and that it has great impact on the development of CVDs [2, 3, 7]. These diseases are leading causes of premature death and disability in many countries including the RS [7, 12, 16]. Modest salt intake reduction within population had a significant beneficial influence on reducing CVDs and total health expenses burden [12, 13, 14]. Although there is no data on *per capita* salt intake in the RS, studies conducted in Novi Sad indicated that it is between 10 and 14 g/day [21, 22] and that salt content in meals in public kindergartens, elementary schools, boarding schools and student restaurants was high [23, 24]. The Ordinance on the National Program for Prevention, Medical Treatment and Control of Cardiovascular Diseases in the RS until 2020 recognized importance of salt intake reduction up to 6 g/person/day and obligation for salt content labeling of retailed food, but that has not been implemented yet [17]. Performed investigations in many countries indicated that salt content in processed food contributed with 65–85% of the total salt intake [8, 9, 10]. In countries where there are no obligations on salt content labeling, people are not aware of it in the food they buy and therefore they do not know how much salt they consume [25, 26]. This issue is

Table 1. Salt (sodium chloride) content in controlled food items (g/100 g)

Food	Food group	N	$\bar{X}$±SD (CV%)	Mode	Median
Bread and rolls	Bread	155	1.21±0.46 (38.0)	1.3	2.8
	Rolls	59	1.35±0.71 (52.5)	1.9	1.4
	Bakery pies	104	1.82±0.63 (34.5)	1.4	1.6
Delicatessen (cured meat)	Sausages	70	1.78±0.47 (26.7)	1.6	1.8
	Pasty	58	1.48±0.45 (30.0)	1.4	1.4
	Salami	23	2.06±0.73 (36.1)	2.5	2.2
Ready-to-eat meat	Grilled meat	80	2.32±1.02 (43.9)	2.6	2.1
Dairy products	Hard cheese	23	2.08±0.89 (43.0)	1.2	1.9
	Cottage cheese	45	2.01±1.32 (66.0)	2.9	1.8
	Cream cheese	50	1.12±0.88 (78.0)	1.0	1.0
	Semi-hard cheese	68	1.37±0.35 (26.0)	1.3	1.3
Dehydrated soup (per portion)		33	2.19±0.99 (45.0)	3.1	2.2
Chips, crackers and salted nuts		14	2.13±1.02 (48.0)	2.2	2.1
Dressing		26	1.62±0.82 (50.8)	1.0	1.3
Canned vegetable salad		27	1.58±0.62 (39.0)	1.2	1.5
Pizza		57	1.81±0.46 (25.3)	1.6	1.8
Breakfast cereals		71	0.36±0.48 (134.0)	-	0.1
Canteen meals		43	1.41±0.62 (44.0)	1.3	1.3
Caned fish		27	1.52±0.54 (35.5)	1.2	1.4
Sandwiches		36	2.10±0.42 (19.9)	2.7	2.1

N – number of controlled samples; $\bar{X}$±SD – mean value and standard deviation

Table 2. Salt (sodium chloride) profile of the controlled food

Food	Food group	N	Salt content g/100 g					
			Low (≤0.3)		Medium (0.31–1.50)		High (≥1.51)	
			n	%	n	%	n	%
Bread and rolls	Bread	155	16	10.3#	114	73.6#	25	16.1
	Rolls	59	6	10.1&	27	45.8	26	44.1
	Bakery pie	104	1	0.9	49	47.1	54	51.9
Delicatessen (cured meat)	Sausages	70	0	0.0	19	27.1#	51	72.9
	Pasty	58	0	0.0	38	65.5&	20	34.5
	Salami	23	0	0.0	6	26.1&	17	73.9
Ready to eat meat	Grilled meat	80	1	1.2	23	28.7#	56	70.0
Dairy products	Hard cheese	23	0	0.0	7	30.4&	16	69.6
	Cottage cheese	45	6	13.3	16	35.6	23	51.1
	Cream cheese	50	6	12.0#	39	78.0#	5	10.0
	Semi-hard cheese	68	0	0.0	54	79.4#	14	20.6
Dehydrated soup (per portion)		33	0	0.0	0	0.0	33	100.0
Chips, crackers and salted nuts		14	0	0.0	5	35.7	9	64.3
Dressing		26	0	0.0	14	53.8	12	46.2
Canned salad		27	1	3.7	13	48.1	13	48.1
Pizza		57	0	0.0	11	19.3#	46	80.7
Breakfast cereals		71	48	67.6#	20	28.2	3	4.2
Canteen meals		43	0	0.0	31	72.1#	12	27.9
Caned fish		27	0	0.0	14	51.8	13	48.2
Sandwiches		36	0	0.0	3	8.3#	33	91.7

N – number of controlled samples
– low and medium / medium and high salt content is statistically highly different (p<0.01)
& – low and medium / medium and high salt content is statistically different (p<0.05)

Table 3. Average salt content in controlled food samples (g/100g) expressed as a percentage of the recommended daily dietary intake for healthy person (5 g/day) and for person with cardiovascular risk (3.75 g/day)

Food	Food group	N	Average salt content of food group (g/100 g)	% of the recommended daily intake for healthy adult person (5 g/day)[a]	% of the recommended daily intake for person with cardiovascular risk (3.75 g/day)[b]
Bread and rolls	Bread	155	1.21	24.2	32.2
	Rolls	59	1.35	27.0	36.0
	Bakery pies	104	1.82	26.9	48.6
Delicatessen (cured meat)	Sausages	70	1.78	35.6	47.5
	Pasty	58	1.48	29.7	39.6
	Salami	23	2.06	41.2	54.9
Ready to eat meat	Grilled meat	80	2.32	46.4	61.8
Dairy products	Hard cheese	23	2.08	41.7	55.5
	Cottage cheese	45	2.01	40.3	53.7
	Cream cheese	50	1.12	22.5	29.9
	Semi-hard cheese	68	1.37	27.5	36.6
Dehydrated soup (per portion)		33	2.19	43.8	56.8
Chips, crackers and salted nuts		14	2.13	42.6	56.7
Dressings		26	1.62	32.3	43.1
Canned vegetable salad		27	1.58	31.7	42.2
Pizza		57	1.81	36.3	48.4
Breakfast cereals		71	0.36	7.2	9.6
Canteen meals		43	1.41	23.4	37.5
Canned fish		27	1.52	30.5	40.6
Sandwiches		36	2.10	41.9	55.9

N – number of controlled samples
[a] Reference [18]; [b] Reference [20]

of special concern for persons with increased CVD risk because they are usually suggested by their doctors to reduce salt intake [20]. In the RS there are no available data on salt content in retailed ready-to-eat food. Following data on the high prevalence of hypertension and cardiovascular burden in the RS, the objective of this paper was to present results on salt content in different ready-to-eat foods retailed in Novi Sad which were brought to the IPHV for

Table 4. Average sodium content (mg) in 100 ml of controlled samples of bottled spring and mineral water expressed as a percentage of the USDA and WHO recommended daily dietary intake of sodium for healthy person (2.3 g/day and <2.0 g/day) and USDA recommended daily dietary intake of sodium for person with cardiovascular risk (1.5 g/day)

Product group	N	$\bar{X}$ (mg/100 ml) ±SD (CV%)	Mode	Median	% of population nutritive goal for sodium for healthy person (2.3 g/day)[a]	% of population nutritive goal for sodium for healthy person (<2.0 g/day)[b]	% of population recommended daily intake of sodium for person with cardiovascular risk (1.5 g/day)[a]
Spring water	24	0.33±0.30 (89%)	0.1	0.28	0.01	0.02	0.02
Mineral water	30	32.88±44.45 (135%)	-	13.21	1.43	1.64	2.19

N – number of controlled samples
[a] Reference [20]; [b] Reference [18]

safety control by the Sanitary Inspection Service. National household food consumption surveys are usually used for creating sampling plans [27, 28], but available data from the household budget survey of the RS do not include ready-to-eat foods except for bread and baked goods [29]. Other countries were also faced with the same problem due to very fast changes of dietary patterns of their respective populations. These changes were considered to be a consequence of rapid consumption growth of marketed morning goods, fast food and canteen meals [10, 30]. Although the number of samples in each food group that passed through salt control could not be considered correspondent to the consumption pattern of the inhabitants of Novi Sad, the obtained results showed that 45% of controlled food items, regarding United Kingdom Food Standard Agency proposals [19], belonged to the high salt profile group and 47% belonged to the medium salt profile group. There was no sample of cured meat, pizza, sandwich, canteen meal, hard or semi-hard cheese, canned fish, dressing and chips, crackers and salted nuts that could be considered food with low salt profile. These results are in line with the results obtained throughout national surveys of other countries which indicated that majority of controlled ready-to-eat food items have high hidden salt content [8, 9, 10, 31]. Our data indicated that salt contained in 100 g of bread and rolls, delicatessen, grilled meat, dairy products, pizza and sandwiches contribute within range of 22.5–46.4% in the amount recommended as daily salt intake for adult healthy persons and 29.9–61.8% of the amount recommended as daily intake for person with CVD risk [20]. There were very few samples of the ready-to-et food that had low salt content: 10.3% of bread, 10.1% of bakery rolls, 13.3% of white cottage and 12% of cream cheese and 3.7% of canned vegetable salad samples. The exception was the group composed of breakfast cereals, with 67.6% of samples with low salt profile. Salt content in bread (1.2 g/100 g) is of special concern due to its high contribution in the recommended daily salt intake for healthy and persons with risk for CVD, with 24.2% and 32.3%, respectively. Salt content in bread and other baked goods was identified as the main source of salt intake of the population in many countries and thus the national programs for salt reduction often focus on lowering salt content in this staple food and salt labeling of all processed ready-to-eat food [8, 18, 32]. It is recognized that the reduction of salt intake to the recommended level is difficult to achieve without industry involvement. Voluntary and modest reduction of salt content in staple food was strongly recommended by health authorities in many countries [8, 12, 18, 20] because its statistically significant favorable effect on the population average blood pressure and saved costs has been well documented [14, 15]. Average sodium content in spring bottled water is similar to sodium content in spring waters from North America (4±4 mg/L) and lower then sodium content in low mineralization waters from Europe (13±13 mg/L), while the average sodium content in mineral water is lower then sodium content in mineral waters from North America (371±335 mg/L) and high mineralization waters from Europe (1151±153 mg/L), but higher than in moderate mineralization waters from Europe (157±197 mg/L) [33]. According to the USDA and WHO recommendation [18, 20], bottled spring and mineral water on the Serbian market does not represent an important source of sodium for the population.

CONCLUSION

The obtained results indicate that ready-to-eat food retailed in Novi Sad has high hidden salt content and could be considered an important contributor to relatively high salt consumption of its residents. Further, more accurate investigations are needed in order to measure contribution of the ready-to-eat retailed food to the total salt intake of the population. It is reasonable to expect that more accurate data could be derived by the implementation of the national program on salt reduction as it has been formulated by the Ordinance on the National Program for Prevention, Medical Treatment and Control of Cardiovascular Diseases in the RS until 2020.

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Садржај соли у готовој храни и флашираној природној изворској и минералној води на тржишту Новог Сада

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КРАТАК САДРЖАЈ

Увод Унос соли већи од пет грама дневно је снажан и независан фактор ризика за развој хипертензије и кардиоваскуларних болести (КВБ). Подаци бројних истраживања у свету показали су да индустријски произведена храна у дневном уносу соли учествује са 65–85%.

Циљ рада Циљ истраживања је био да се утврди садржај натријум-хлорида у храни спремној за конзумирање из малопродајних објеката Новог Сада, као и учешће утврђене количине соли у 100 грама намирнице у препорученом дневном уносу соли здравих и особа с ризиком од развоја КВБ.

Методе рада У 1.069 узорака хране садржај соли (натријум-хлорид) је израчунат на основу титриметријског одређивања хлорида, док је у 54 узорка флаширане воде пламеном фотометријом одређен садржај натријума. Намирнице су класификоване у групу са ниским, средњим или високим садржајем соли. Просечан садржај соли у 100 грама намирнице упоређен је с препорукама за унос соли здраве одрасле и особе с кардиоваскуларним ризиком.

Резултати Просечан садржај соли (*g/100 g*) био је од 0,36±0,48 (житарице за доручак) до 2,28±1,02 (гриловано месо). Већина узорака сендвича (91,7%), пице (80,7%), салама (73,9%), кобасица (72,9%), грилованог меса (70,0%) и тврдог сира (69,6%) имала је висок садржај соли. Утврђена количина соли у 100 грама намирнице чинила је од 7,2% (житарице за доручак) до 46,4% (гриловано месо) препорученог дневног уноса за здраву одраслу особу, односно 9,6–61,8% за особу с ризиком од развоја КВБ. Садржај натријума у 100 *ml* флаширане изворске воде био је 0,33±0,30 *mg*, односно 33±44 *mg* у флашираној минералној води.

Закључак Готова храна из малопродајних објеката у Новом Саду одликује се високим садржајем соли у свом саставу и може се сматрати значајним фактором који доприноси уносу соли код становника Новог Сада.

Кључне речи: со; индустријски произведена храна; флаширана вода

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