

INVESTIGATION OF SODIUM CONTENT IN THE WHOLE WHEAT BREAD ON THE MARKET OF MUNICIPALITIES BIJELJINA, ZVORNIK AND EAST SARAJEVO

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Summary

Medical studies demonstrated that controlling blood pressure could reduce the risks of cardiovascular disease. The relationship between daily diet, intake of salt and blood pressure has been well established and since bread is the main foodstuffs in population diet, especially in our country, the determination of sodium content of bread is of high priority and warrants further investigation. The sodium content was determined using Atomic Absorption Spectrophotometry (AAS) following wet digestion of the samples with concentrated hydrochloric and nitric acids. By applying a scoring system trained sensory evaluators assessed the expression of taste in samples.

The results of present study unfortunately showed that content of sodium in whole wheat bread in the market in two of three investigated municipalities (Bijeljina, Zvornik and East Sarajevo) is much greater compared with contents in other parts of the world. As we do not have assessment of daily sodium intake and on basis of result from this investigation we could conclude that sodium intake in Bosnia and Herzegovina is greater than that recommended by the World Health Organization (WHO). This means that population of investigated municipalities, which consumes whole wheat bread daily could be at a risk of cardiovascular diseases.

Keywords: bread, cardiovascular disease, diet, sodium, taste.

Introduction

There is an agreement of experts that improper diet and intake of excessive doses of salt is one of the risk factors for cardiovascular disease and other chronic diseases (WHO 2003, WHO 2007). Cardiovascular diseases, one of the main causes of increased mortality, are not monitored with adequate control of blood pressure (Thom et al., 2006; Chobanian et al., 2003). The results of medical studies conducted among the elderly population suggest that the inability to achieve normal blood pressure (systolic ≤ 140 mmHg) counts for 34% of strokes and 22% of myocardial infarction (Psaty et al., 2001). Many studies conducted over the past four decades have shown that effective control of blood pressure reduces the risk of cardiovascular disease (Ebrahim, 1998).

Link between salt intake, i.e., sodium and high

blood pressure is known (Tuomilehto et al., 2001). According to World Health Organization foods with a high content of sodium is a risk to the health of the population (WHO, 2003).

Sodium is one of the main cation of extracellular fluid in the human organism and is essential for maintaining the volume blood plasma pH, transmitting nerve impulses and normal functioning of cells. In a healthy body almost 100% of ingested sodium is absorbed during digestion. The primary mechanism for ejection of sodium from the body is excretion through urine (Holbrook et al., 1984). Even in tropical climates excretion through sweat is minimal. The main source of sodium is salt, but sodium may be present in composition of other compounds too, sometimes referred to as "hidden" sodium. In nature, sodium is found in most forms of food (e.g., milk, meat or seafood). In industri-

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ally processed foodstuffs, such as bread, crackers, processed meat, sodium is often present in large quantities (Leung et al., 1972, Webster et al., 2010; Mhurchu Ni et al., 2011, Centers for Disease Control and Prevention, 2011). Cereal products, especially bread, are one of major sources of dietary sodium (SACN report, 2003).

Due to the above mentioned, diet rich in industrially processed foodstuffs and lacking fruits and vegetables is consequently rich in sodium (Webster et al., 2010; Mhurchu Ni et al., 2011, Centers for Disease Control and Prevention, 2011). Despite the fact that the minimum levels of sodium for the normal functioning of the body are not specified, it is assumed that these are low concentrations, in the order 200-500 mg per day (Holbrook et al., 1984, Brown et al., 2009). As recommended by WHO daily dose of ingested salt should not be higher than 5 g or 2 g of sodium. This recommendation applies to the adult population, while for children and other groups of the population dietary intakes of sodium should be adjusted on the basic of energy needs of individuals (Brown et al., 2009).

Estimates of salt intake in EU population indicate that salt intake is several times higher than recommended. In most EU countries, it ranges between 8 to 12 g daily. Cyprus, Germany and Lithuania have the lowest intake (5 g, 6.6 g and 7.1 g daily) (WHO, 2012).

It is estimated that the daily intake of salt is highest in Hungary (17.5 g for men and 12.1 g of salt for women). In all EU countries, generally viewed, salt intake is higher in the diet of men (WHO, 2012).

The World Health Organization predicts a reduction of 2.5 million death cases in the world, if there is reduction of daily salt intake to less than 6g, that is reduction of sodium intake to less than 2300 mg daily (WHO, 2003, He and MacGregor, 2003, WHO 2007).

Because of all this it is of great importance to monitor the content of salt, e.g., sodium in bread in general. Reducing sodium intake should be beneficial to consumers, as it will act in the direction of normalisation of blood pressure and reduce the risk of cardiovascular disease and mortality in the whole population (WHO, 2007).

In most countries of Europe programs for monitoring of salt content in different foodstuffs, es-

pecially bread have been introduced. From these monitoring programs strategy to reduce daily salt intake through diet are created. Strategy based on identifying key foodstuffs for salt intake and joint actions of government agencies and the food industry in the search for technological solutions to reduce the need for use of salt. In this way, the practical implementation of the latest WHO recommendations relating to the daily intake of sodium should be implemented.

Since bread as staple food is one of the dominant constituent in our diet and in order to preserve the health of the population, it is of great importance to monitor the content of salt, that is, sodium in bread. Greater attention and more research on the content of sodium in bread and other foodstuffs will lead to the prevention of cardiovascular diseases and improve the situation for people with high blood pressure in Bosnia and Herzegovina.

Materials and Methods

The study was conducted at the Faculty of Technology in Zvornik and the Institute of Food Technology in Novi Sad. Material for testing consisted of 12 samples purchased in stores on the territory of three municipalities: Bijeljina, Zvornik and East Sarajevo. In each municipality 8 samples (with 2 parallel) were taken. Selection of individual samples was carried out by random choice method.

Sodium content, after wet digestion of samples with concentrated hydrochloric and nitric acid, was determined by atomic absorption spectrophotometry (AAS) using an instrument VARIAN SpectrAA-10 (AACC, 2000). Sensory evaluation of taste crust and crumb was carried out by method of scoring by 6 trained evaluators. Evaluation is performed in the range of taste expression between 1 and 5 (1 - uncharacteristic, 2 - flavorless, 3 - acceptable, 4-good, 5-excellent). Data were statistically analyzed in Statistica version 9. using factorial analysis of variance (ANOVA), with the level of significance 0.05 ($P \leq 0.05$).

Results with discussion

The results obtained during the study are shown in Table 1.

Table 1. Average sodium content of whole wheat bread (mg/100 g) investigated in the three municipalities.

Tabela 1. Prosječni sadržaj natrija u integralnom kruhu (mg/100 g) istraživana u tri općine.

	Bijeljina	Zvornik	East Sarajevo
Samples number	8	8	8
Sodium content:			
Range	287,990-701,660	576,240-844,640	169,880-596,210
Mean	488,817 ^{ab}	672,607 ^b	405,066 ^a
Standard deviation	173,636	118,738	176,682

WHO Recommendations: Daily sodium intake 2000 mg, daily salt intake 5g ; Values with the same letter in superscript are not significantly different ($P \leq 0.05$).

Salt is one of the main raw materials in the production of bread. It improves the technological properties of dough and promotes formation of desirable sensory characteristics, primarily taste which makes it difficult to exclude from the recipe or adequately replace (Girgis et al., 2003).

Bread in all its forms is one of the most widely used foodstuffs, due to the use of salt in its prepa-

ration, it is one of the sources of sodium.

Given that the whole wheat flour has a poorer technological properties than white flour, for improvement of the development of whole wheat bread large amounts of salt are usually used. It is expected that a whole wheat bread contains more sodium, as studies prove (Hannah et al., 2013).

Table 2. Mean sensory values of taste tests in three municipalities.

Tabela 2. Srednja vrijednost senzorne ocjene ukusa ispitivana u tri općine.

	Bijeljina	Zvornik	East Sarajevo
Senzorna ocena ukusa	3,75 ^a	3,20 ^a	3,20 ^a

Values with the same letter in superscript are not significantly different ($P \leq 0.05$)

Sodium content in the samples varied depending on the municipality and producer.

Factorial analysis of variance shows that there were no statistically significant differences in the content of sodium in the samples from Bijeljina compared to samples from Zvornik and samples from East Sarajevo. On the other hand samples taken in Zvornik and East Sarajevo had a statistically significant difference in the content of sodium ($P \leq 0.05$).

When obtained concentrations of sodium are compared with the world and European research data it can be clearly seen that the sodium from the tested samples of bread can easily meet fourth of daily requirement for sodium intake by consumption of 100g of whole wheat bread daily. The World Health Organization recommends a daily intake of 5 g of salt, that is, 2 g of sodium. According to research conducted in the UK, the average content of

sodium in the whole wheat bread is 397mg/100g (Hannah et al., 2013). The average content of sodium on the market of Australia and New Zealand is 434 mg/100g, 436 mg/100g respectively (Dunford et al., 2011). According to this data, average sodium content in samples from East Sarajevo (405.066 mg/100 g) was considerably lower than data presented in these surveys in Australia and New Zealand. On the other hand the average sodium content in the samples of bread Bijeljina and Zvornik were considerably higher (488.817 mg/100g and 672.607 mg/100g, respectively).

Sensory evaluation of taste by scoring system (1-5), provides insight into the level of satisfaction with the sense of taste during the consumption of whole wheat bread. As shown in Table 2, the samples from East Sarajevo have a mean value of 3.2, samples from Bijeljina have a mean value of 3.75, and samples from Zvornik with average value 3.2. According to these results all samples have good

taste, but poorly expressed inherent taste characteristics of whole wheat bread. Conducted factorial analysis of variance shows that in the sensory evaluation there were no statistically significant differences in the expression of taste between municipalities. This result agrees with the results of other research that it is possible to reduce the salt content, to some extent, without any negative effects on the taste of whole wheat bread (Girgis et al., 2003).

Varying of sodium content in the samples is relatively large. This indicates a failure to follow recipes and a lack of adequate control of salt addition. Further it can be a signal that workers in bakeries do not have the appropriate knowledge and experience, and that urgent measures must be taken to educate them. Habits of the population in certain places, to consume more salty foods, should be changed through the system education and adequate information about risks

Conclusions

Since the population of municipality of Bijeljina, Zvornik and East Sarajevo daily consumes about 200 grams of bread, sodium intake can be assumed to be 810,133 mg 977,635 mg 1345,215 mg respectively. That is almost half the recommended daily intake.

Given the state, coordinated efforts to reduce the salt content, i.e., sodium in the production of whole wheat bread, as the target product, could achieve significant health benefit of population in Bosnia and Herzegovina.

Significant differences between the samples from East Sarajevo and Zvornik requires further study. The difference could be attributed to the specific diet of the population of these regions. As this study can not determine the cause, it is recommended to conduct systematic research of the salt content in whole wheat bread and to study the diet of the population of specific geographic areas.

Variation of sodium content in the samples of whole wheat bread as well as sensory evaluation of taste, indicate that production is not optimized regarding the amount of added salt and that it is possible to create products with significantly lower sodium content.

One general way of achieving recommended sodium intake is a diet rich in fruits and vegetables and low in processed foodstuffs.

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