Journal of Agricultural Science; Vol. 8, No. 4; 2016
ISSN 1916-9752 E-ISSN 1916-9760
Published by Canadian Center of Science and Education

A Study of Salt Content of Different Bread Types Marketed in Amman, Jordan

Fatema M. Abu Hussain[1] & Hamed R. Takruri[1]

[1] Department of Nutrition and Food Technology, Faculty of Agriculture, The University of Jordan, Amman, Jordan

Correspondence: Hamed R. Takruri, Department of Nutrition and Food Technology, Faculty of Agriculture, The University of Jordan, Amman, Jordan. E-mail: htakruri@ju.edu.jo

Received: January 17, 2016 Accepted: March 1, 2016 Online Published: March 15, 2016

doi:10.5539/jas.v8n4p169 URL: http://dx.doi.org/10.5539/jas.v8n4p169

Abstract

Noncommunicable diseases, including cardiovascular diseases are the leading cause of premature death in the 21st century. Dietary factors such as high salt intake constitute the main risk factors. Bread is considered as one of the most important sources of dietary salt. The objectives of this study were to determine the sodium content of the main types of bread that are marketed in Amman, and to evaluate the bakers' adherence to the Jordanian specifications. Sixty eight bread samples of seven types of bread were collected from 13 different bakeries distributed in Amman. Bread samples were dried, ashed and the sodium content was directly determined by using flame photometry method. The average salt content of the analyzed bread samples was 1.19±0.21 g salt/100 g of fresh bread, ranging between 0.42 g/100 g for white Arabic bread and 2.06±0.19 for *shrak* bread. Approximately half of bread samples have met the Jordanian specifications. It is concluded that salt content of bread varies widely in Jordan and that bread types such as *shrak* and *mashrouh* breads contain high amount of salt. The Jordanian specification of the salt content of bread should be applied to all breed types. Also, it should be reduced gradually to a lower limit.

Keywords: bread, Jordan, salt, sodium

1. Introduction

Non communicable diseases (NCD) are the leading cause of premature death in the 21st century (WHO, 2014a). Two thirds of worldwide deaths in 2010 were attributed to NCD, including: cardiovascular diseases (CVD), cancer, chronic lung diseases, and diabetes (Rahim et al., 2014). Hypertension is a main risk factor for having CVD. In Jordan, its prevalence was reported in 2009 to be 32.3% for adults aged 25 years or over (Jaddou et al., 2011).

Cardiovascular diseases, hypertension and diabetes are related to westernization that is associated with physical inactivity and high consumption of high salt, simple sugar and fat foods (Nwanguma & Okorie, 2013). In their report on the estimated daily intake of sodium based on Jordanian Household Expenditure and Income Survey (JHEIS, 2010), Takruri and Alkurd (2014), have reported that the daily sodium supply of Jordanians was 6478 mg/capita/day. Also, Alwa'al and Tukruri (2015), reported a sodium intake of 5176±2841 mg/d in a sample of Jordanian adults using 3 day food records method. Furthermore, in a study depending on 24-hour urine analysis, the estimated sodium intake in a sample of Jordanian adults employed at the Jordan University Hospital was 4.1 g/day, which is more than twice the current WHO recommendation (WHO, 2014b).

Bread, cheese, pickles and table salt added during cooking are considered as the major sources of salt in the Middle East region (WHO, 2012). The sodium level in plain cereals is very low and unsalted bread contains only 20 mg Na/kg bread. Therefore the sodium content of bread originates from salt added during processing (Daugirdas, 2013; Joossens et al., 1994). Although bread contains a relatively small amount of salt, its high consumption makes it one of the most important sources of dietary salt (Quilez & Salas-Salvado, 2012).

Various health organizations were established under the auspices of WHO to develop health strategies to reduce salt intake of processed foods and bread (Strazzullo et al., 2012). In response to WHO strategies, many European countries have reduced the salt content of bread (WHO, 2013).

Bertram et al. (2012), in their study in South Africa estimated that reducing sodium level in bread from 650

mg/100 g to 350 mg/100 g would prevent 6,400 deaths each year. Also, these authors estimated that there would be a reduction of an overall 8% of strokes, 6.5% of ischemic heart disease and 11% of hypertensive heart disease by such reduction in salt intake.

Sudden reductions in salt content of bread affect bread flavor and make it less palatable (Quilez & Salas-Salvado, 2012); Saavedra-Garcia et al. (2015) demonstrated that reducing salt content by 20% could be detected by the consumer, however the consumer acceptance would not be changed by such reduction (Saavedra-Garcia et al., 2015). Whereas small to moderate reduction in salt content of bread may be less noticeable, especially if it occurs in a gradual manner (Girgis et al., 2003). Moreover, other salt minerals could be used as salt alternatives that do not affect the bread quality (Kaur et al., 2011).

The salt level in bread is controlled by many regulations around the world. In the absence of mandatory legislation, bakers add as much salt as they consider enough to achieve the desired quality and flavour (Nwanguma & Okorie, 2013). The Food Standards Agency of the UK set a salt limit of 1.0 g per 100 g as a target to be met in August 2012 by all bakeries (Brinsden et al., 2013). Whereas in Ireland, bakery industry established 0.45 g of salt per 100 g of bread as the average level in white and brown bread (Saavedra-Garcia et al., 2015). Australia and New Zealand set 1.1 g of salt per 100 g of bread as a reference in all bakeries (Nwanguma & Okorie, 2013). On the other hand, Portugal sets 1.4 g/100 g as an upper limit of salt concentration in bread (Plácido et al., 2012).

According to the Jordan Institute of Specification and Metrology (JISM), the content of salt in bread should not exceed 1.5% of bread on dry matter weight (JISM specification number 19, 2006). However, the bakers' adherence to this technical regulation is questionable.

The determination of sodium content in bread is important as a first step in the reduction of total sodium intake and decreasing the incidence of hypertension and cardiovascular disease. To the best of the researchers' knowledge, no study has been conducted to determine the sodium content in different types of bread marketed in Jordan. Therefore, the objectives of this study were to determine the sodium content of the main types of bread that are marketed in Amman, and to evaluate the bakers' adherence to the Jordanian specification.

2. Materials and Methods

2.1 Bread Samples Collection

Samples of bread types were collected from 13 bakeries distributed in Amman as available on the day of purchasing. Four loaves of each available bread type were purchased randomly from bakeries included in the study on random days with no bakers' knowledge of the research intention. In total, 68 bread samples of seven bread types were collected as follows: white Arabic bread (11 samples), brown Arabic bread (11 samples), bran bread (10 samples), hamam bread (10 samples), mashrouh bread (6 samples), shrak bread (10 samples) and burger buns (10 samples).

Bread samples were weighed and packaged in proper bags on which bakery name and date of purchasing were recorded. The samples were frozen at -18 °C until sodium content analysis (Silva et al., 2014).

2.2 Preparation of Bread Samples

Bread samples were removed from the freezer and kept at room temperature for defrosting and weight measuring. Then they were dried in a drying oven at 60 °C for 24 hours and weighed for moisture loss determination. The dried groups of bread from each bakery were ground into powder and homogenized in a kitchen grinder for sodium analysis (Nwanguma & Okorie, 2013).

Four grams of each bread sample were weighed into previously ignited, cooled and weighed crucible and ashed overnight in the muffle furnace (Carbolite; CWF 11/13, Hope Valley, England) at 550 °C until a white or light gray ash resulted. 10 ml of 4 M hydrochloric acid were added to the ash-containing crucible that was heated to boiling. After the mixture reached room temperature, it was quantitatively transferred to 100 ml volumetric flask (James, 1995).

Flame photometry (flame photometer model PFP7; JenWay®, Dunmow, UK) was used according to AOAC method 990.23 to determine the sodium content in bread samples. Seven reference sodium solutions with different concentrations were prepared using a sodium standard solution (1,000 mg/L) that was supplied by the American Society for Testing and Materials (ASTM), USA. The pre-treated samples were diluted to the appropriate volume. A standard curve with sodium concentrations between 0.5 and 12 mg/L was established daily, and the signal of 6 mg/L standard was checked occasionally during the analysis. The emission of the reference solutions and bread samples were measured at 589 nm wavelength (AOAC, 1995).

Each sample was analused twice. All reagents used were of analytical grade purity. To avoid contamination, used crucibles were immersed in a 6 M HCl solution for a 24 hour. All other equipments used in the analysis were rinsed twice with distilled water.

2.3 Calculation of Sodium Percent

Microsoft excel 2007 were used to determine the sodium content in the unknown sample against the standard curve. The sodium percent of the sample was determined by using this equation:

$$\% \text{ sodium in bread sample} = M/W \times V \quad (1)$$

Where,

M is the sodium concentration in mg/L;

W is the weight of dry bread used;

V the volume of ash solution diluted to 100 ml (in the dilution step) (James, 1995).

The final sodium content per 100 g of fresh bread was adjusted for the moisture difference between fresh bread weight and dried bread weight, and the sodium chloride equivalent was obtained by multiplying the sodium concentration by 2.54.

2.4 Statistical Analysis

Statistical analysis was performed by using SPSS software, version 19.0 (Chicago, IL, USA). Descriptive statistics were used to estimate the mean and the standard error of the mean for different variables. Frequency and percentage were used to describe the categorical variables.

One way analysis of variance (ANOVA) was used to compare the sodium content of different types of bread from different bakeries, and the post hock Duncan test was used to compare the salt content of different types of bread. Differences between variables were considered significant at $P \leq 0.05$.

3. Results

Table 1 describes the characteristics of the seven analyzed bread types in terms of fresh weight, length or diameter and moisture.

Table 1. Description of the analyzed types of bread*

Bread type	Number of samples**	Fresh weight (g)	Diameter (cm)	Moisture (%)
White Arabic (small)	11	75.5 ± 1.8	17.9 ± 0.3	28.7 ± 0.5
Whole Arabic	11	72.5 ± 1.7	17.0 ± 0.2	28.6 ± 0.3
Hamam (large)	10	73.1 ± 1.3	17.1 ± 0.2	27.3 ± 0.4
Shrak	10	138.2 ± 4.9	50.2 ± 0.4	31.1 ± 0.5
Burger bun	10	85.4 ± 2.6	10.0 ± 0.2	28.5 ± 0.4
Bran	10	123.4 ± 4.9	16.9 ± 0.3	28.6 ± 0.9
Mashrouh (small)	6	251.9 ± 8.7	38.4 ± 1.7	31.9 ± 0.4

Note. *: Values in this table represent mean ± SEM; **: Each sample consists of four loaves of bread from the same bakery.

Salt content of fresh and dry weight of bread is shown in Table 2. Salt content of fresh white Arabic bread is about 0.42 g/100 g, and it is about 0.73 g/100 g of whole Arabic bread, 1.07 g/100 g of burger bun, 1.13 g/100 g of hamam bread, 1.29 g/100 g of bran bread, 1.61 g/100 g of mashrouh bread and 2.06 g/100 g of shrak bread. Table 2 shows that the salt content of White Arabic bread, whole Arabic bread, mashrouh bread and shrak bread differed significantly. On the other hand the differences in salt contents of hamam bread, burger bun and bran bread were insignificant.

Table 2. Salt content of the analyzed types of bread[*]

Bread type	Number of samples	Salt content in dry weight (g/100 g)[**]	Salt content in fresh weight (g/100 g)[***]
White Arabic	11	0.59 ± 0.08^{a}	0.42 ± 0.05^{a}
Whole Arabic	11	1.02 ± 0.09^{b}	0.73 ± 0.07^{b}
Hamam	10	1.55 ± 0.09^{c}	1.13 ± 0.06^{c}
Shrak	10	2.99 ± 0.28^{e}	2.06 ± 0.19^{e}
Burger ban	10	1.49 ± 0.08^{c}	1.07 ± 0.06^{c}
Bran	10	1.81 ± 0.07^{c}	1.29 ± 0.05^{c}
Mashrouh	6	2.36 ± 0.15^{d}	1.61 ± 0.10^{d}
Total	68	0.30	1.19 ± 0.21

Note. [*]: Values in this table represent mean ± SEM; [**]: Different letters indicate means that are statistically different between groups (Duncan test, $P < 0.05$); [***]: Salt content in fresh weight was calculated by correction the weight change between fresh and dry sample according to moisture loss.

Tables 3 and 4 show the bakers' adherence to the Jordanian Specification on salt addition to flour (JISM, 2006), 48.2% of total bread samples had salt content of ≤ 1.5 % of dry weight. All white Arabic bread samples and 90.9% of whole Arabic bread samples met the specification. On the other hand, 50% of hamam bread and burger bun bread samples had salt content of > 1.5 % of dry weight, whereas only 20% of bran bread samples met the specification and all shrak and mashrouh bread samples had salt content higher than recommended (Table 3).

Table 3. Frequency distribution of salt content of different types of bread according to the Jordanian specification

Bread type	Salt content of ≤ 1.5% of dry weight		Salt content of > 1.5% of dry weight	
	Number of samples (n)	Percent (%)	Number of samples (n)	Percent (%)
White Arabic	11	100		
Brown Arabic	10	90.9	1	9.1
Hamam	5	50	5	50
Shrak			10	100
Burger ban	5	50	5	50
Bran	2	20	8	80
Mashrouh			6	100
Total	33	48.2	35	51.8

Table 4. Frequency distribution of salt content of bread in different bakeries as compared with the Jordanian specification

Bakery	Salt content of ≤ 1.5% of dry weight		Salt content of > 1.5% of dry weight	
	Number of samples (n)	Percent (%)	Number of samples (n)	Percent (%)
1	3	50	3	50
2	4	66.7	2	33.3
3	5	71.4	2	28.6
4	1	20	4	80
5	5	71.4	2	28.6
6	3	50	3	50
7	4	66.7	2	33.3
8	2	28.6	5	71.4
9	2	33.3	4	66.7
10	2	66.7	1	33.3
11	2	33.3	4	66.7
12	2	50	2	50
13			1	100
Total	33	48.2	35	51.8

White Arabic bread samples had a mean salt content less than the recommended limit of Ireland, whereas white Arabic bread and whole Arabic bread met the Food Standards Agency of the UK limit (1.0 g/100 g fresh bread) (Figure 1). Furthermore, all the 13 bakeries had mean salt content higher than the Irish limit, and only 3 bakeries (23.08%) had mean salt content equals to or less than the Food Standards Agency of the UK limit (Figure 2).

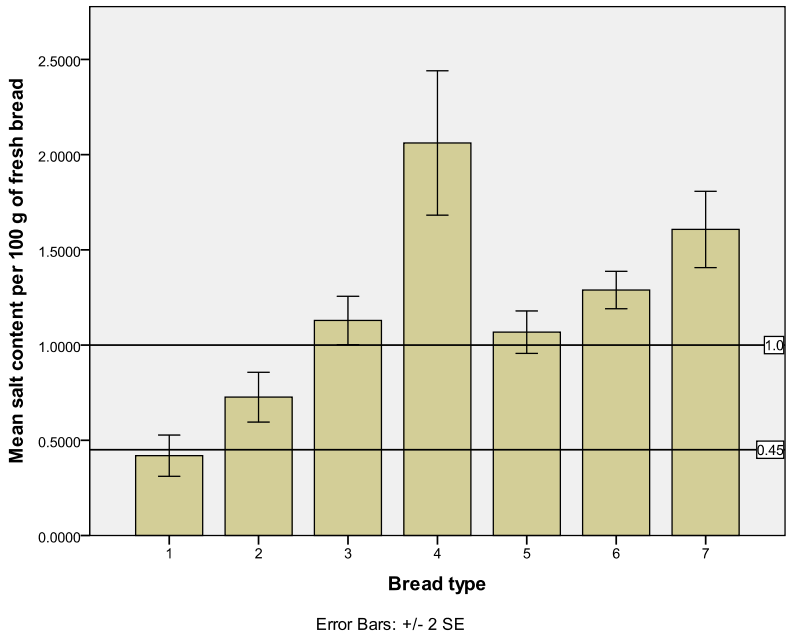

Figure 1. Salt content of different bread types, the 1.00 line indicates the Food Standards Agency of the UK limit, the 0.45 line indicates the Irish limit. Bread type 1 = White Arabic bread, 2 = Brown Arabic bread, 3 = Hamam bread, 4 = Shrak bread, 5 = Burger bun, 6 = Bran bread, 7 = Mashrouh bread

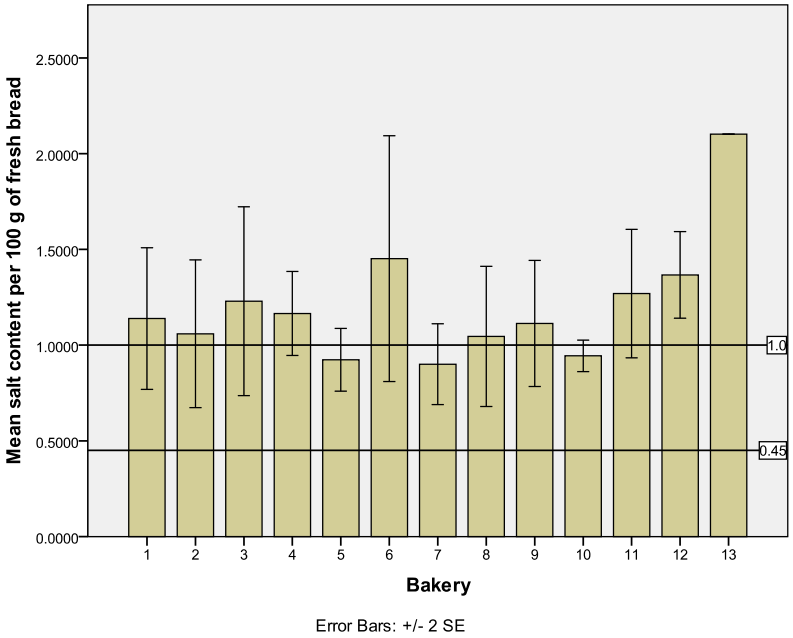

Figure 2. The average salt content of different bread types according to different bakeries, the 1.00 line indicates the Food Standards Agency of the UK limit, the 0.45 line indicates the Irish limit

Table 5 shows that only 14.6% of bread samples were within the Irish limit, which represents 72.3% of white Arabic bread samples and 18.2% of whole bread samples. All other bread types had a sodium content higher than the Irish limit. Whereas 45.26% of bread samples were within the Food Standards Agency of the UK limit and all white Arabic bread samples and 90.91% of whole Arabic bread samples were within the limit of the UK. However, all shrak and mashrouh bread samples and 90% of bran bread samples had sodium content higher than the UK limit (Table 5).

Table 5. Frequency distribution of salt content of bread according to the limits established by the Food Standards Agency of the UK and Ireland*

Bread type	The Food Standards Agency of the UK limit		Irish limit	
	< 1.0 g salt/100 g of bread	≥ 1.0 g salt/100 g of bread	< 0.45 g salt/100 g of bread	≥ 0.45 g salt/100 g of bread
White Arabic	100		72.73	27.27
Brown Arabic	90.91	9.09	18.19	81.81
Hamam	50	50		100
Shrak		100		100
Burger ban	40	60		100
Bran	10	90		100
Mashrouh		100		100
Total	45.26	54.74	14.60	85.40

Note. *: These two limits were chosen because the Irish limit is one of the lowest limits, and the UK limit is the predominant limit that the salt content of bread in many countries was compared with it.

4. Discussion

The present study showed that the average salt content of seven types of bread marketed in Amman was 1.19 ± 0.21 g/100 g of fresh bread (467.12 ± 80.81 mg Na/100 g) (Table 2). This is lower than the sodium content of the

bread marketed in many parts of the world; for example, in Iran it was reported to be 1.31 g salt/100 g (Zibaeenezhad et al., 2010), and in Nigeria it was reported to contain 1.36 g salt/100 g of bread (Nwanguma & Okorie, 2013). However, this average is still higher than the salt content of bread marketed in the countries that have salt reduction strategies such as the UK (0.98 ± 0.13 g salt/100 g) (Brinsden et al., 2013), New Zealand (1.12 g salt/100 g) and Australia (1.10 g salt/100 g) (Dunford et al., 2011).

The salt content of bread varied widely between bread types ranging between 0.42 ± 0.05 g/100 g for white Arabic bread and 2.06 ± 0.19 g/100 g for shrak bread (Table 2). Although white Arabic bread had the lowest salt content of the seven analyzed bread types, it contributes to 1.37 g of daily salt intake, which represents 27.4% of the 5 g daily salt intake recommended by WHO. Depending on the available JHEIS data, the per capita estimated consumption of bread was 337 g/day, and the most predominant bread (white bread) contributed to 326 g/day (DOS, 2012).

The salt content of whole Arabic bread and bran bread were significantly higher than the salt content of white Arabic bread (0.73 ± 0.07, 1.29 ± 0.05 and 0.42 ± 0.05 g/100 g respectively) (Table 2). Joossens et al. (1994), also reported a slightly higher salt content of brown bread (1.30 g/100 g) than the white bread (1.24 g/100 g) in 18 European centers. However, this difference was insignificant. These findings match those of Vieira et al. (2012) who reported a higher sodium concentration in the whole wheat bread compared to the white wheat bread.

Bran bread and brown bread are considered as healthy types of bread, because of their higher content of dietary fiber, essential fatty acids, B-vitamins, minerals, antioxidants and phytochemicals when they are compared with the refined bread (Quilez & Salas-Salvado, 2012). Such dietary components have many health benefits such as reducing the risks of metabolic syndrome, hypercholesterolaemia, diabetes mellitus, cardiovascular disease mortality and several types of cancer (Abu-Saad et al., 2009). However, the higher sodium content of these bread types reduces their nutritional value, and consuming them in large amount increases the risk of exceeding the WHO recommendation of daily salt intake. This causes worry if we know that 100 g of whole bread (approximately one and half small loaf) contributes to 14.6% of the 5 g daily salt intake recommended by WHO, and 100 g of bran bread (approximately three quarters of a loaf) contributes to 25.8% of the daily salt intake recommended by WHO.

Also, it should be noted that shrak bread has the highest sodium content followed by mashrouh bread (Table 2). Consumption of such bread types by normotensive and hypertensive adults puts them at a great risk of exceeding their recommended daily allowance for sodium. For example, 100 g of Shrak bread contribute to 41.2% of the daily salt intake recommended by WHO, whereas one Shrak loaf (138.2 g, as shown in Table 1) contributes to 57% of the same salt recommendation. On the other hand, 100 g of Mashrouh bread contribute to 32.2% of the daily salt intake recommended by WHO, and one loaf of it (251.9 g, as shown in Table 1) contributes to 81.1% of the same salt recommendation.

In addition, mean salt content of bread varied between bakeries; this can be indicated by the frequency distribution of salt content of bread in different bakeries as compared with the Jordanian specification (Table 4) and the average salt content of different bread types according to different bakeries (Figure 2). This variation between bakeries indicates that further reduction of added salt in most bakeries is possible, and not technically difficult.

The present study shows that 48.2% of total bread samples met the Jordanian specification (salt content of ≤ 1.5% of dry weight). In a similar study conducted in Isfahan, Iran only 35.5% of analyzed bread samples met the standard limit of salt (2.0 g salt/100 g of bread) (Rezaiimofrad et al., 2013). Another study conducted in Iran also showed that approximately 82.1% of 204 bread samples were within the standard limit of 2.0 g of salt/100 g of bread (Zibaeenezhad et al., 2010). However, this limit is considered relatively high when it is compared with the specifications of other countries. For example, only 14.6% of bread samples in the present study were within the Irish limit which is considered as one of the lowest regulatory limits (Table 5). Moreover, only white Arabic bread had a salt content less than the recommended limit of Ireland (0.45 g of salt per 100 g of bread), (Figure 1).

On the other hand, the average salt content of only the white Arabic bread and whole Arabic bread met the Food Standards Agency of the UK limit (Figure 1), and of the total bread samples only 45.26% were below this limit (Table 5), this is relatively close to the percent of samples that met the Jordanian specification (48.2%) (Table 3). Also, as shown in Table 5 all white bread samples and 90.91% of brown bread samples were within the limit of the UK. Sliva et al. (2015) compared the sodium content of bread samples with the UK limit and they found that 84 % of bread samples were above the maximum limit (Silva et al., 2015). In Nigeria 57% of bread samples were within the UK limit (Nwanguma & Okorie, 2013), while in Australia only 20% of white bread samples and 8% of whole-meal bread samples met the UK limit (Grimes et al., 2008).

The nongovernmental organizations can have some impact in reducing the salt content of processed foods and bread. However, they lack the authority and resources of the government that has a critical role in this issue. For example, in the UK, there was a significant reduction of (20%) of salt content of bread when a target of ≤ 1.0 g/100 g was set for salt content of bread. The average salt level of bread decreased from 1.23 ± 0.19 g/100 g in 2001, to 0.98 ± 0.13 g in 2011. Also, the percent of bread samples that met the target increased from 28% in 2001 to 71% in 2011 (Brinsden et al., 2013).

Similarly, the percent of Australian bread that met the upper limit of sodium concentration (which is 400 mg/100 g) increased from 29% in 2007 to 50% in 2010. Also, in New Zealand, there was similar trend as the mean sodium content of bread decreased from 469 mg/100 g in 2007 to 439 mg/100 g in 2010, and the proportion of New Zealand breads meeting the national target (which is 450 mg/100 g) increased from 49% in 2007 to 90% in 2010 (Dunford et al., 2011).

In this study, white Arabic bread showed a lower sodium content and higher adherence to the Jordanian specification, and to the UK and Irish limits as compared with the other six bread types. One possible justification is that the bakers apply the Jordanian specification for white Arabic bread only, as it is the predominant bread in the Jordanian society (DOS, 2012). This indicates the importance of cooperation between the government and the private sector in controlling the salt content of bread and other processed foods.

5. Conclusions

There was a wide range of salt content among different bread types marketed in Amman/ Jordan, as well as in the content of salt in the same bread produced in different bakeries. Only half of bread samples met the Jordanian specification. Since bread is consumed in large amounts in Jordan, it increases the risk of exceeding the recommended daily allowance of sodium. It is recommended to reduce the added salt to flour and to apply the Jordanian specification of the salt content of bread to all bread types marketed in Jordan.

Acknowledgements

The authors would like to acknowledge The Deanship of Academic Research for the financial support and Professor Khaled Al-Samail for technical the advice.

References

Abu-Saad, K., Shai, I., Kaufman-Shriqui, V., German, L., Vardi, H., & Fraser, D. (2009). Bread type intake is associated with lifestyle and diet quality transition among Bedouin Arab adults. *British Journal of Nutrition, 102*(10), 1513-1522. http://dx.doi.org/10.1017/S0007114509990675

Alwa'al, T. J., & Tukruri, H. R. (2015). Sodium and potassium intakes in a sample of students and employees in the university of Jordan aged (20-40 years) using 3-day food diaries. *Nutrition and Food Science, 46*(1), 43-50. http://dx.doi.org/10.1108/NFS-06-2015-0067

AOAC. (1995). *Official methods of analysis of the association of official analytical chemists* (16th ed.). Association of Official Analytical Chemists, Virginia, USA.

Bertram, M. Y., Steyn, K., Wentzel-Viljoen, E., Tollman, S., & Hofman, K. J. (2012). Reducing the sodium content of high-salt foods: effect on cardiovascular disease in South Africa. *South African Medical Journal, 102*(9), 743-745. http://dx.doi.org/10.7196/samj.5832

Brinsden, H. C., He, F. J., Jenner, K. H., & MacGregor, G. A. (2013). Surveys of the salt content in UK bread: Progress made and further reductions possible. *BMJ Open, 3*(6), e002936. http://dx.doi.org/10.1136/bmjopen-2013-002936

Castanheira, I., Figueiredo, C., André, C., Coelho, I., Silva, A. T., Santiago, S., & Calhau, M. A. (2009). Sampling of bread for added sodium as determined by flame photometry. *Food Chemistry, 113*(2), 621-628. http://dx.doi.org/10.1016/j.foodchem.2008.07.047

Daugirdas, J. T. (2013). Potential importance of low-sodium bread and breakfast cereal to a reduced sodium diet. *Journal of Renal Nutrition, 23*(1). http://dx.doi.org/10.1053/j.jrn.2012.03.002

DOS (Department of Statistics). (2012). *Household Expenditures and Income Survey 2010*. DOS, Amman-Jordan.

Dunford, E. K., Eyles, H., Mhurchu, C. N., Webster, J. L., & Neal, B. C. (2011). Changes in the sodium content of bread in Australia and New Zealand between 2007 and 2010: Implications for policy. *The Medical Journal of Australia, 195*(6), 346-349. http://dx.doi.org/10.5694/mja11.10673

Girgis, S., Neal, B., Prescott, J., Prendergast, J., Dumbrell, S., Turner, C., & Woodward, M. (2003). A one-quarter reduction in the salt content of bread can be made without detection. *European Journal of Clinical Nutrition, 57*(4), 616-620. http://dx.doi.org/10.1038/sj.ejcn.1601583

Grimes, C. A., Nowson, C. A., & Lawrence, M. (2008). An evaluation of the reported sodium content of Australian food products. *International Journal of Food Science and Technology, 43*(12), 2219-2229. http://dx.doi.org/10.1111/j.1365-2621.2008.01856.x

Jaddou, H. Y., Batieha, A. M., Khader, Y. S., Kanaan, A. H., El-Khateeb, M. S., & Ajlouni, K. M. (2011). Hypertension prevalence, awareness, treatment and control, and associated factors: Results from a national survey, Jordan. *International Journal of Hypertension, 2011*, Article ID 828797. http://dx.doi.org/10.4061/2011/828797

James, C. S. (1995). *Analytical chemistry of foods* (1st ed.). London, Chapman and Hall. http://dx.doi.org/10.1007/978-1-4615-2165-5

JISM (Jordan Institue of Specification and Metreology). (2006). *Specification for Cereals, Pulses and Derived Products-Bread* (Specification 19). JISM, Amman, Jordan.

Joossens, J. V., Sasaki, S., & Kesteloot, H. (1994). Bread as a source of salt: an international comparison. *Journal of the American College of Nutrition, 13*(2), 179-183. http://dx.doi.org/10.1080/07315724.1994.10718392

Kaur, A., Bala, R., Singh, B., & Rehal, J. (2011). Effect of replacement of sodium chloride with mineral salts on rheological characteristics of wheat flour. *American Journal of Food Technology, 6*(8), 674-684. http://dx.doi.org/10.3923/ajft.2011.674.684

Nwanguma, B. C., & Okorie, C. H. (2013). Salt (sodium chloride) content of retail samples of Nigerian white bread: implications for the daily salt intake of normotensive and hypertensive adults. *Journal of Human Nutrition and Dietetics, 26*(5), 488-493. http://dx.doi.org/10.1111/jhn.12038

Plácido, A., Kupers, R., Paíga, P., Magalhães, J., Nouws, H. P. A., Delerue-Matos, C., & Oliveira, M. B. P. P. (2012). Salt content in bread and dough from northern Portugal: Method development and comparison. *Journal of Food Composition and Analysis, 27*(1), 14-20. http://dx.doi.org/10.1016/j.jfca.2012.04.004

Quilez, J., & Salas-Salvado, J. (2012). Salt in bread in Europe: potential benefits of reduction. *Nutrition Reviews, 70*(11), 666-678. http://dx.doi.org/10.1111/j.1753-4887.2012.00540.x

Rahim, H. F. A., Sibai, A., Khader, Y., Hwalla, N., Fadhil, I., Alsiyabi, ... Husseini, A. (2014). Noncommunicable diseases in the Arab world. *The Lancet, 383*(9914), 356-367. http://dx.doi.org/10.1016/S0140-6736(13)62383-1

Rezaiimofrad, M., Jeddi, F. R., & Azarbad, Z. (2013). Baking soda and salt in bakeries of Mehrdasht (Najafabad), Isfahan, Iran: a survey on a typical rural population in a developing country. *Journal of Preventive Medicine and Hygiene, 54*(1), 53-56.

Saavedra-Garcia, L., Sosa-Zevallos, V., Diez-Canseco, F., Miranda, J. J., & Bernabe-Ortiz, A. (2015). Reducing salt in bread: a quasi-experimental feasibility study in a bakery in Lima, Peru. *Public Health Nutrition*. http://dx.doi.org/10.1017/S1368980015001597

Silva, V., Padrão, P., Novela, C., Damasceno, A., Pinho, O., Moreira, P., & Lunet, N. (2015). Sodium content of bread from bakeries and traditional markets in Maputo, Mozambique. *Public Health Nutrition, 18*(4), 610-614. http://dx.doi.org/10.1017/S1368980014000779

Strazzullo, P., Cairella, G., Campanozzi, A., Carcea, M., Galeone, D., Galletti, F., ... Scalfi, L. (2012). Population based strategy for dietary salt intake reduction: Italian initiatives in the European framework. *Nutrition, Metabolism and Cardiovascular Diseases, 22*(3), 161-166. http://dx.doi.org/10.1016/j.numecd.2011.10.004

Takruri, H. R., & Alkurd, R. A. (2014). Intakes of fats, cholesterol, fiber and micronutrients as risk factors for cardiovascular disease in Jordan. *Jordan Journal of Biological Sciences, 7*(2), 119-126. http://dx.doi.org/10.12816/0008225

Vieira, E., Soares, M. E., Ferreira, I. M., & Pinho, O. (2012). Validation of a fast sample preparation procedure for quantification of sodium in bread by flame photometry. *Food Analytical Methods, 5*(3), 430-434. http://dx.doi.org/10.1007/s12161-011-9247-8

WHO (World Health Organization). (2012). *Consultation on Developing Strategic Directions for Salt and Fat Reduction in The Eastern Mediterranean Region*. WHO regional office, Cairo, Egypt.

WHO (World Health Organization). (2013). *Mapping Salt Reduction Initiatives in the WHO European Region*. UN City. Retrieved from http://www.euro.who.int

WHO (World Health Organization). (2014a). *World Heart Day 2014: Salt Reduction Saves Lives*. September 25, 2014, Geneva.

WHO (World Health Organization). (2014b). *Estimating Habitual Salt Consumption in Jordanian Citizens by Measuring Sodium Excretion in 24-hour Urine Collection*. August, 2014, Amman, Jordan.

Zibaeenezhad, M., Hooshangi, M., Abtahi, A., & Heydari, S. (2010). A study of salt (sodium chloride) content in different bread consumed in Shiraz city in Spring/Summer 2009. *Iranian Cardiovascular Research Journal, 4*(1), 17-21.