

Survey of the Salt (NaCl) Contents of Traditional Breads in Tehran, 2016–2018: Implication for Public Health

Abstract

Background: Considering the importance of non-communicable diseases (NCDs) in Iran, the aim of this study is to identify the trend in the salt (NaCl) levels of various types of traditional bread (*sangak*, *barbari*, *taftoon*, and *lavash* breads) in Tehran in 2016 and 2018 and its implication for public health. **Methods:** A total of 777 samples of various traditional breads were randomly collected from various districts located in Tehran in 2018. The salt content (expressed as g/100 g dry weight) in these breads were determined according to Volhard method. Results from this study were compared with those reported in 2016. **Results:** The present study indicated that the mean salt content in traditional breads in 2018 was significantly higher than that reported in 2016. Salt content in traditional breads collected in 2018 ranged from 0.03 to 6.52/100 g dry weight, with mean value of 1.43 g/100 g dry weight. When comparing with the permitted limit set by Institute of Standards and Industrial Research of Iran (ISIRI), there was an increase in the percentage of samples complying with the permitted limit; 50.8% (2016) vs 54.1% (2018). **Conclusions:** The daily salt intake increased from 1.56 g per person in 2016 to 2.31 g per person in 2018. Considering the high bread per capita consumption in Iran, it seems that half of the daily recommended salt intake could be reached exclusively through breads. Hence, the main strategies for salt intake reduction from bread could be achieved through evaluation of salt reduction programs and development of technological factors in bread baking.

Keywords: Bread, Iran, non-communicable diseases, public health, salt, sodium chloride

Introduction

In recent years, chronic disease cases have increased worldwide. According to World Health Organization (WHO), the proportion of chronic non-communicable diseases (NCDs) is predicted to increase up to 57% by 2020.^[1-3] Chronic diseases cause significant consequences to economic and health conditions throughout the world.^[2-4] Monitoring the sugar, salt (sodium chloride), and fat intake (levels and types) are some of the important recommendations by WHO to suppress NCDs. As such, the two main policies to cope with NCDs growing trend are reduction in the level of nutritional risk factors in food products and guidance to consumer on healthier food products. According to a report released in 2014 by WHO, nearly 46.11% of deaths in Iran were associated with cardiovascular diseases (CVDs). In the following report in 2018 by WHO, NCDs are important health concern in the Islamic Republic

of Iran, whereby the annual death rate from NCDs represents about 82% of the total mortality in the country.^[5-10] Reports provided by various organizations in Iran indicate that the daily consumption of salt intake is almost twice the level recommended by WHO.^[11-13] Moreover, a research by the National Nutrition and Food Technology Research Institute (Iran) indicated that in 2016, the mean sodium intake level by adults in Tehran was more than 3,700 mg/day, which is considerably higher than the permitted level of sodium intake recommended by WHO, *i.e.*, 2,300 mg/day.^[14]

Australia and New Zealand have both recommended 1.1 g of salt (equivalent to 440 mg sodium) per 100 g of breads as the maximum level. In 2012, the UK Food Standards Agency

allowed a consumable salt level less than 1 g per 100 g of breads (equivalent to 400 mg of sodium).^[8] In our previous

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Access this article online

Website:
www.ijpvmjournal.net/www.ijpvm.net

DOI:
10.4103/ijpvm.IJPVM_338_20

Quick Response Code:



How to cite this article: Hadian Z, Reihani SFS, Mirmoghtadaie L, Tan TC. Survey of the salt (NaCl) contents of traditional breads in Tehran, 2016-2018: Implication for public health. *Int J Prev Med* 2022;13:91.

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study conducted in 2016, the salt levels in traditional breads; *sangak*, *barbari*, *taftoon*, and *lavash* breads, were reported to be approximately 0.41, 1.43, 1.07, and 1.14 g/100 g dry weight, respectively.^[15-16] Approximately 51% of these breads were in compliance with permitted limit set by Institute of Standards and Industrial Research of Iran (ISIRI), i.e., 1 g/100 g dry weight.^[17] The aim of this study is to identify the trend in the salt levels of various types of traditional bread (*sangak*, *barbari*, *taftoon*, and *lavash* breads) in Tehran in 2016 and 2018 and its implication for public health.

Methods

In this descriptive study, a total of 777 traditional bread samples were randomly collected from local bakeries in Tehran. Sample size determination for each type of bread was calculated using the following Cochran formula^[18]:

$$n = \left(\frac{Z \cdot s}{r \cdot \mu} \right)^2 / \left[1 + \frac{1}{N} \left(\frac{Z \cdot s}{r \cdot \mu} \right)^2 \right]$$

where, n = sample size, N = population size of bakeries, Z = 1.96 for 95% confidence, r or relative error as a measurement of precision was considered 0.01-0.1, S (standard deviation) = 0.98 and 0.1 and μ (mean) = 0.93 for traditional bread. The unknown parameters related to population and variables were estimated using data from traditional bakeries.

Prior to sampling, information about the bakeries were obtained from the State Trading Organization, Tehran, Iran. The list of bakeries and their production quantities were provided, covering 22 regions in north, center, south, east, and west of Tehran. Sampling was carried out during the summer of 2018, using ISO guideline.^[19] Upon collection, samples were immediately dried. Dried samples were ground using IKA M20 Universal Mill (IKA, USA) and stored at -20°C until further analysis.

Assessment of salt content

Basically, the method (AOAC Method 937.09) used to determine the salt content in the present study was similar to those used in our previous study in 2016.^[16,20] Samples (1 g) were added with 25 mL of 0.1 N silver nitrate (AgNO₃), 20 mL of nitric acid (HNO₃), and 50 mL of water in Erlenmeyer flask. The mixture was agitated and boiled for 5 min. The mixture was then cooled using running water. Ferric alum indicator (5 mL) was added and the mixture was titrated with 0.1N of ammonium thiocyanate (NH₄SCN) solution until the solution become permanently light brown. The percentage of salt was calculated using the following equation:

$$\text{Salt (g/100 g dry weight)} = 5.85 \times [(V_1 \times N_1) - (V_2 \times N_2)]/W$$

where, V₁ is the volume of AgNO₃ (in mL), N₁ is the concentration of AgNO₃ (0.1 N), V₂ is the volume of NH₄SCN (in mL), N₂ is the concentration of

NH₄SCN (0.1 N), and W is the weight of dried sample (in g).

Statistical analysis

Descriptive statistics, including the mean, standard deviation, median, range of variation, 25th and 75th percentile, and coefficient of variation, were carried out. Kruskal-Wallis test was used to compare salt contents in bread samples. Mann-Whitney test was used to compare salt contents in various bread samples, during 2016–2018. Wilcoxon rank-sum test was used to compare the salt contents with the maximum permitted limit set by ISIRI. SPSS Software SPSS Software v. 16 (IBM Analytics, USA) was used to analyze the data and P < 0.01 was considered as significant.

Results

In the present study, *traditional bread samples were categorized* based on their types, which were *lavash* (35.3%, n = 281), *sangak* (5.3%, n = 42), *barbari* (27.6%, n = 220), and *taftoon* (29.4%, n = 234) breads. As illustrated in Table 1, salt contents showed a high level of variability in the bread samples. Among these samples, *barbari* breads had the highest salt level (1.48 g/100 g dry weight), followed by *taftoon* breads (1.42 g/100 dry weight), whereby both exceeded the permitted level of ISIRI, i.e., 1 g/100 g dry weight. The maximum variability (0.01–1.29 g/100 g dry weight) with a coefficient of variation (CV) of 75.61% was reported for *sangak* and the minimum was recorded for *taftoon* breads (0.10–6.14 g/100 g dry weight, CV of 40.54%). In addition, the descriptive results of the results obtained from samples collected in 2018 were compared to those reported in 2016 [Table 1]. Comparison on the salt contents of the same type of bread between 2016 and 2018 indicated that there was a significant difference for *lavash* (P = 0.011) and *taftoon* (P < 0.001) breads. However, no significance difference was observed for *sangak* (P = 0.950) and *barbari* (P = 0.411) breads.

For *sangak* breads collected in 2018, all the samples collected were in accordance with the permitted level by ISIRI [Table 2]. However, for *lavash*, *barbari*, and *taftoon* breads collected in the same period, only 47.3, 60 and 48.3%, respectively, were compliant with the permitted level. Overall, 54.1% of these traditional breads collected in Tehran complied with the permitted level. This marked an increase compared to 2016, whereby only 50.8% complied. The salt content of the same bread type obtained from various regions of Tehran in this study was not significant (P > 0.01).

Assessment of bread and cereal dietary patterns has demonstrated that the mean consumption per capita of bread based on 24-h feeding reminder in Tehran households is approximately 214 g/day, accounting for 33% of the total household food basket.^[14] Based this mean consumption per capita of bread, the estimated salt intakes in Tehran from *lavash*,

Table 1: Comparison of salt contents in various traditional breads from Tehran in 2016 (n=130) and 2018 (n=777)

Year	Types of Bread*	Salt Content (g/100 g dry weight)						P	Percentile (25 th)	Percentile (75 th)	CV [‡] (%)	P
		Mean	SD	Min	Max	Median	Range					
2016	Lavash (34)	1.14 ^{aa†}	0.45	0.58	2.81	1.15	2.23	0.011	0.77	1.38	39.88	≤0.001
2018	Lavash (281)	1.43 ^{aa}	0.64	0.64	6.40	1.40	6.32		1.02	1.75	45.16	
2016	Sangak (32)	0.40 ^{bb}	0.37	0.03	1.47	0.33	1.45	0.950	0.09	0.63	92.10	
2018	Sangak (42)	0.41 ^{bb}	0.31	0.01	1.29	0.48	1.87		0.20	0.70	71.48	
2016	Barbari (23)	1.43 ^{ab}	0.40	0.54	1.85	1.52	1.31	0.411	1.13	1.75	27.96	
2018	Barbari (220)	1.58 ^{aa}	0.87	0.87	6.52	1.43	6.35		1.06	1.76	55.05	
2016	Taftoon (41)	1.07 ^{aa}	0.31	0.64	1.74	1.03	1.10	<0.001	0.80	1.26	28.77	
2018	Taftoon (234)	1.48 ^{aa}	0.60	0.60	6.14	1.41	6.04		1.10	1.82	41.44	
2016	Total (130)	0.99	0.99	0.03	2.81	0.52	2.78	<0.001	0.67	1.38	52.55	
2018	Total (777)	1.43	0.74	0.01	6.52	1.34	6.50		0.96	1.74	52.58	

*Number in parentheses represents the number of breads for that type of bread. †Different letters within the column indicate significant differences ($P<0.01$). ‡Coefficient of variation

Table 2: Percentage of compliant for various traditional breads from Tehran in 2016 (n=130) and 2018 (n=777)

Types of Bread	Year	Compliant with the Permitted Limit [†]		Normality Test [‡]	Wilcoxon Signed Rank Test
		n	%		
Lavash	2016	13	38.2	<0.001	0.248
	2018	133	47.3	<0.001	<0.001
Sangak	2016	30	93.8	<0.001	<0.001
	2018	42	100	0.032	<0.001
Barbari	2016	5	21.7	0.006	<0.001
	2018	132	60.0	<0.001	<0.001
Taftoon	2016	18	43.9	0.009	0.315
	2018	113	48.3	0.001	<0.001
Total	2016	66	50.8	0.029	0.005
	2018	420	54.1	<0.001	0.809

[†]The permitted limit of salt content set by the Institute of Standards and Industrial Research of Iran (ISIRI) is 1 g/100 g dry weight.

[‡]Non-parametric tests (Signed rank test) were used for statistical analysis.

sangak, *barbari*, and *taftoon* breads were 1.93, 0.62, 2.22, and 1.73 g/day, respectively, in 2016 [Figure 1]. Nevertheless, the means of salt intake from these breads in 2018 were estimated to be 2.42, 0.62, 2.46, and 2.37 g/day, respectively. Comparing between these two sets of data, daily salt intake from bread consumption in Tehran increased in 2018.

Discussion

The present study suggests valuable perceptions. There were extensive variations in salt levels in different bread types. The lowest salt level was observed in *sangak* breads, possibly due to its different baking method. However, *sangak* breads showed higher levels of variability compared to other breads. The medians were similar within the samples, except for *sangak* breads. Pairwise comparisons of the results for 2016 and 2018 demonstrated that an overall increase in the salt levels of all bread types in addition to significant differences between the salt levels of different bread samples,

except for *sangak* breads. Overall, the results revealed a significant increase in salt levels compared to permitted level by ISIRI.

Researchers have reported various statistics on daily salt consumption. The level of salt intake in a population-based study conducted by Isfahan Healthy Heart Program was estimated to be about 9.1, 13.9, and 11.8 g/day in 1999, 2002, and 2006, respectively by a 24-hour urine collection method.^[12] In another study in 2010, a high salt intake by women referred to health centers in Yazd (10.09 g/day) was estimated.^[13] In another study in urban and rural households of Ilam (west of Iran), the mean daily salt intake using salt consumption frequency questionnaires biweekly, reported to be approximately 9.0 and 11.6 g/day, respectively.^[21] In another research in Rasht and Sari (north of Iran), the mean daily salt intake by measuring 24-h urine sodium from participants with 2–79 age range, estimated to be 7.2 and 7.7 g/day, respectively.^[22] Considering the WHO decision to reduce the salt intake by a relative 30% by 2025 and the rising trend of salt intake among Iranians, implementation of health intervention strategies seems to be critically important.^[23] Hypertension is a major NCD issue with a growing prevalence. In a recent study, the overall prevalence of hypertension in Iran was 17.3% (18.9 and 15.5% in men and women, respectively).^[24] In another study, the prevalence of high blood pressure among Tehranian adolescents were 12.3% in boys and 12.9% in girls.^[25] It has been reported that in 2015, CVDs are responsible for more than 17 million death annually and accounting for 30% of total deaths. High salt intake increases blood pressure in people with hypertension or normal blood pressure. According to WHO, daily salt intake should be limited to 5 g/day, equivalent to sodium intake of 2,000 mg/day.^[26] One of the global targets for NCDs is to reduce the prevalence of hypertension by 25% by 2025.^[4,27] In a study by Mozaffarian *et al.*, 1.65 million deaths caused by CVDs in 2010 were attributed to sodium intake more than 2,000 mg/day that recommended by WHO. Their report indicated that in 181 out of 187 countries, consisting

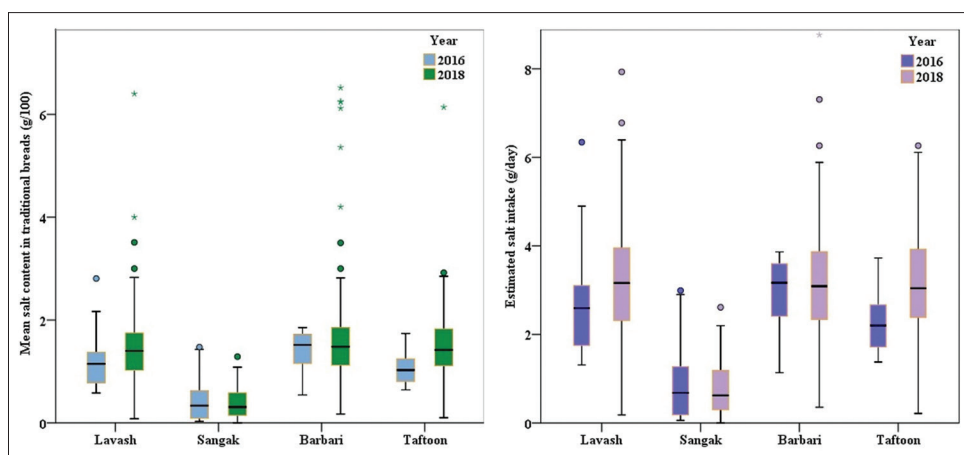


Figure 1: Comparison of mean salt content (g/100 g dry weight) with estimated salt intake (g/day) of traditional breads in five cities in Tehran in 2016 (n = 130) and 2018 (n = 777)

a total of 99.2% adult population, the mean sodium intake exceeded the recommended level by WHO; and in 119 countries with 88.3% of adult population, it exceeded more than 1 g/day.^[28]

Comparing the salt intake estimations in various other countries, it is obvious that the average salt intake in the Middle East countries is higher, nearly 10 g/day. In 2005, a global expert group called World Action on Salt and Health (WASH) was established to decrease the global salt consumption. Two major activities, decreasing salt in food formulations and enhancing consumers' knowledge about the disadvantages and risks of salt over-consumption, were defined in order to achieve this goal.^[29-31] Nowadays, many countries follow these strategies to control major health risk factors such as salt consumption according to the recommended level.^[32,33] In Malaysia and in Chennai (Tamil Nadu, India), the mean salt intakes were reported as 7.15 and ≥ 6.5 g/day, respectively.^[34,35] Furthermore, nutritional labelling can potentially be effective, based on the studies in Finland^[36] and Spain.^[37] Although nutritional interventions can be provided to communities, workplaces and schools or to individuals, effectiveness of these interventions have been demonstrated to be highly variable.^[38-40]

The current study included a comprehensive investigation on the salt content in various traditional breads collected in 2 different years (2016 and 2018). Documented researches reveal a high prevalence of chronic non communicable diseases in Iran. Monitoring salt levels in bread as a NCDs risk factor is the most commonly implemented plan among the cost effective diet policies. This survey provides better projection to the salt intake by Tehranians as well as accurate information about salt levels in traditional breads, and offers rising public health awareness on NCDs. One of the main limitations of this study was lack of multi component interventions.

Conclusions

The salt level of breads is a critical issue in decreasing nutritional risk factors of NCDs. Considering per capita consumption of breads in Iran, at least half of the recommended salt level could be reached exclusively through breads (especially *barbari* bread). Our results implies that in addition to modification the permitted salt level regulations, bread making needs a deep knowledge on the broad variety of raw materials and process interactions in order to reduce the salt level in breads. Further studies are needed to evaluate salt intake estimations from other main dietary salt (sodium chloride) sources.

Acknowledgments

This study was supported by the Ministry of Health and Medical Education, Food and Medicine Organisation and National Nutrition and Food Technology Research Institute, Iran.

Financial support and sponsorship

The current study was supported by two grants from the National Nutrition & Food Technology Research Institute, Shahid Beheshti University of Medical Sciences, No. 1448 and No. 1288.

Conflicts of interest

There are no conflicts of interest.

Received: 17 Jun 20 **Accepted:** 08 Sep 20

Published: 24 Jun 22

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