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Evaluating the Quality of Bread; Based on the Amount of Salt and Baking Soda Consumption

Samaneh Abolli *[1], Javad Kazemi [2], Zahra Hajian Motlagh [2]

1. Department of Environmental Health Engineering, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran
2. Department of Environmental Health Engineering, Center of Garmsar Public Health, Semnan University of Medical Sciences, Semnan, Iran

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Corresponding Author:
Samaneh Abolli
samanehabolli@gmail.com

ABSTRACT

Introduction: Bread is an unavoidable food ingredient in Iranian meals. Given the relationship between salt and baking soda and several diseases, this study aimed to investigate the role of bread and its effect on increasing additives (salt and baking soda) and comparing them to standards.

Methods: In this cross-sectional study, all bakeries (95 bakeries) of Garmsar county were selected and sampled from consumed bread (Taftoon; 125, Barbari; 168, Lavash; 48 and, Sangak; 22 samples) and were sent to the Food and Drug Laboratory. The samples were tested according to the National Standards of Iran (No. 2628) method. Descriptive statistics and dispersion, Skewness and Kurtosis, and Spearman correlation were used to evaluate the results. The outcomes of the measures were analyzed using Excel and SPSS software version 22).

Results: Comparison of the results of this study with Iranian standards showed that 16.3 and 66.7% of all bread samples, respectively, had the amount of salt and pH in the range of national standards. Barbari had the highest mean salt intake (1.47 ± 0.37), and Lavash had the highest mean pH (6.13 ± 0.36). Significant and reverse correlation was observed between salt intake and pH in Barbari ($p = 0.041$, $r = -0.158$) and lavash ($p = 0.022$, $r = -0.329$) samples. The results also showed that the type of additive to increase yeast activity was different according to the type of bread.

Conclusions: Bread can play a significant role in increasing the intake of salt and baking soda daily. As a result, bread is a potential source of these additives, and it is recommended that the amount of these substances be controlled to prevent a variety of diseases associated with salt and baking soda.

Keywords: Bread, Salt, Baking soda, Garmsar

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Introduction

The Islamic Republic of Iran is the second-most populous country in the Middle East, and like many countries in Iran, Cardiovascular Diseases (CVD) have the highest mortality rate (1).

According to the World Health Organization (WHO), CVD causes about 17 million deaths each year, with 45 percent of deaths from stroke and 51 percent of strokes leading to death due to high blood pressure (2, 3). According to a report by the Institute of Health Metrics and Evaluation in the field of information in Iran in 2010, high blood pressure was the second major risk factor among the ten risk factors that lead to death.

Numerous studies verified the relationship between salt intake and cardiovascular and kidney diseases (4-8). Therefore, it is important to examine the amount of salt consumed by Iranian households; Because the Iranian community uses 8-12 grams of salt per day on average, this is higher than the WHO (5 g NaCl / day) recommended levels and can increase the burden of disease in the society. On the one hand, high salt intake is associated with various diseases, such as hypertension, raised risk of stroke, and CVD (9), on the other hand, salt plays important roles in the cuisine of various foods, especially bread; for example, it performs a pleasant taste.

Routes of salt consumption vary widely in the Iranian food basket (e.g., bread, dairy, meat, etc.), but it is important to note that bread is one of the most important ingredients in the diet of many Iranians and many nations around the world, especially for low-income and populous households (10, 11).

Despite major changes and diversification of foods, still, bread is the first choice in Iranian household meals, especially for breakfast (12). Eating healthy bread can absorb most of the energy, protein, B vitamins, minerals such as calcium and iron necessitated on the body (2). Also, these nutrients in the natural composition of wheat and its flour can be absorbed into the metabolism cycle and can be beneficial to the human body for fermentation to occur effectively (13, 14).

As mentioned before, the WHO recommends the intake and consumption of sodium at 2 grams (5 grams of salt per day) in adults to reduce the incidence of diseases (15, 16). In addition to the use of salt in bread construction, the use of yeast is essential to produce characteristics such as porosity and the chewy texture of the dough.

The National Standard of Iran recommends using yeast or sourdough to achieve these characteristics (17). However, some of the bakeries in Iran usually use baking soda ($NaHCO_3$) to reduce fermentation time (18). According to the most advanced National Standard of Iran, the use of baking soda in bread production is illegal because baking soda can impair the absorption of micronutrients and minerals (19). Due to their financial income, livelihoods, and affordable bread prices, Garmsar City citizens are more likely to use bread with their main meals.

Regarding the relation between salt and different diseases linked to extreme consumption, the correlation between salt and yeasts activity, the effect of increasing baking soda in reducing dough sleep time, and thus decreasing bread quality (notable changes in taste and sourness), and the importance and effective role of bread in the health of society and prohibition of the use of baking soda and extra salt; it is necessary to control the quality of bread and organize to improve it (1, 20). This study aimed to investigate the amount of salt consumed in traditional bread prepared in bakeries in Garmsar. Also, part of this study examined the use or non-consumption of baking soda in dough processing and bread baking. It is noteworthy that this study was written exactly after the latest version of the National Standard of Iran (No. 2628, No. 1, 2016) and distinguished from other studies.

Methods

Study area

The latest information provided by the Plan and Budget Organization of Iran in 2016 has shown that Garmsar has a population of 62190. Garmsar (35, 08, 56 North and 51, 19, 20 West), with a relatively warm and dry climate (15), is suitable

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for seeding wheat and is recognized as one of the sources of wheat production in Iran (21).

Sampling, chemical tests, and data analysis

This analytical cross-sectional study was conducted from 2016 to 2019 with a sampling of 363 samples from 95 bakeries and statistically, an average of 3.8 samples was taken from each bakery. A wide range of bread is baked and consumed in Iran, but sampling the most widely used and well-known bread in Garmsar (Barbari, Taftoon, Lavash, and Sangak). This research's statistical population was all bakeries of Garmsar, which were sampled from; 47 Taftoon, 31 Barbari, 12 Lavash, and 5 Sangak bakeries in Garmsar, respectively. It is essential to note that sometimes some bakeries are closed, and sampling is out of the proposal. After cooling, the samples were placed in plastic bags without reaction with the bread composition (food grade), and after labeling the sample specifications (bread type, production date, sampling date, cooking location, and storage conditions) sent to Semnan University of Medical Sciences Food and Drug Laboratory. The amount of baking soda and salt used in the bread samples was tested according to the Iranian Institute of Standards and Industrial Research No. 2628. According to this Standard (No. 2628, Amendment No. 1, 2016), the amount of salt used in the types of bread should be less than 1 gram per 100 grams of bread, and the pH should be less than 6.

In the data analysis section, Normality of Error in Quantitative Variables was evaluated by Kolmogorov–Smirnov test, and the Spearman Correlation Coefficient was investigated to examine the correspondence between salt consumption and baking soda with bread type was. In the next step, by descriptive statistics, frequency of salt consumption and pH were measured and compared with standards. The relationship between salt intake and pH in different types of bread samples was investigated. Then, the mean of salt used and the pH of the types of bread samples were compared using the Kruskal - Wallis test. All statistical analyses were performed by SPSS software version 22. **Significant Level Was 0.05.**

Results

Frequency analysis of samples taken during the years 2016 to 2019 (see Table 1) shows that only 16.3% of the samples were matched with the National Standard of Iran (Salt ≤ 1). The highest amount of salt was used in Taftoon (94.4% - 118 samples), Barbari (88.7% - 149 samples), Lavash (72.9% - 45 samples), and Sangak (9.1% - 2 samples).

The results also showed that pH in 66.7% of samples was in accordance with the National Standard of Iran (pH ≤ 6) and 45.2% of Barbari samples, 18.4% of Taftoon samples, 37.5% of Lavash samples, and 18.2% of Sangak samples had pH higher than the National Standard of Iran (pH ≤ 6). Also, the results of comparison of the mean salt content and pH in the samples showed that the amount of salt used in the baking and processing of each type of bread had different amounts, with the lowest salt content being 0.1 g per 100 g and the highest was 2.6 g per 100 g. Also, the type of additive used to adjust the pH (such as yeast, sourdough, or baking soda) varied according to the type of bread. Of the 363 bread samples, 242 had a pH lower than or equal with the National Standard of Iran, the lowest being 4 and the highest being 7.8.

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Table 1. Frequency distribution of data and difference comparison between salt and pH in samples with standards, 2016-2019

Type of bread	Salt ≤ 1% in bread samples			pH ≤ 6 in bread samples			Number of total samples
	Number of samples	Mean ± SD	Percent	Number of samples	Mean ± SD	Percent	
Barbari	19	1.47 ± 0.37	11.3	92	6.12 ± 0.31	54.8	n = 168
Taftoon	7	1.43 ± 0.31	5.6	102	5.96 ± 0.28	81.6	n = 125
Lavash	13	1.30 ± 0.43	27.1	30	6.13 ± 0.36	62.5	n = 48
Sangak	20	0.51 ± 0.37	90.9	18	5.99 ± 0.13	81.8	n = 22

Variable	Number of Samples [a]	Mean ± SD	Standard	Min.	Max.	p
Salt	n = 59	1.37 ± 0.42	≤ 1%	0.1	2.6	**<0.001** [b]
pH	n = 242	6.06 ± 0.31	≤ 6	4	7.8	**<0.001**

Notes: [a.] Number of samples in accordance with the standard, [b.] the bold cases are significant

The results of Spearman correlation between salt intake and pH of bread samples (see Table 2) showed that there was a significant and reverse correlation between salt intake and pH in Barbari (p = 0.041, r = -0.158) and Lavash (p = 0.022, r = -0.329) bread samples. There was no significant relationship between salt intake and pH in Taftoon and Sangak bread samples.

Table 2. Spearman Correlation analysis between salt intake and pH of bread samples, 2016 – 2019

Type of bread	Number of Samples	p	r
Barbari	n = 168	**0.041**	**-0.158**
Taftoon	n = 125	0.130	-0.136
Lavash	n = 48	**0.022**	**-0.329**
Sangak	n = 22	0.091	-0.369

Note: The bold cases are significant

Discussion

After 2500 years of Iranian civilization (22), bread is still one of the main factors in Iranian household meals (13). In addition to using bread as a long-standing tradition in the Iranian diet, its main objective is to obtain the minerals and micronutrients demanded by the body at the most economical price because bread is one of Iran's inexpensive food. However, several studies in recent years (23, 24) have shown that the main bread component has changed.

As the results show in the samples taken during the years 2016 to 2019, the mean salt intake in Barbari, Taftoon, and Lavash bread was higher than the National Standard of Iran, and only in the type of Sangak the mean salt was lesser than standard. Such variations between salt intake and its standard level can cause a multifariousness of diseases, especially hypertension and ultimately CVD (25, 26), and will increase the ranking of this disease in Iran compared to the world's trend (27).

The present study showed that making and baking Barbari had the first rank in salt consumption compared to other types of bread, and Taftoon was the next. The more numerous Taftoon and Barbari bakeries in Garmsar County, the greater acceptance and use of these types of bread can make bakeries more feasible to use salt to form a better structure (taste and appearance) of bread and to counterbalance for bad quality flour (1).

When high salt (more than 1g per 100 g) was used to enhance the quality of flour in bread, yeast mortality increased and, their fermentation activity was reduced. On the other hand, adhesion, destruction of dough texture, and overgrowth of yeasts are results of complete salt removal (28). In Iran, baking soda is used to balance the salt and pH of the bread. There was a

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significant reverse correlation between means of salt and pH in Barbari (p = 0.041) and Lavash (p = 0.022) bread in the present study. However, Taftoon and Sangak's mean pH was lower than the National Standard of Iran, and there was no significant correlation between salt and pH in these types of bread.

According to the Global Burden of Disease (GBD) report (16), even a single meal can be efficient in reducing salt intake, while people in Garmsar, by habit, use bread in all meals, especially at breakfast. Also, salt can be absorbed through the eating of bread precursors such as wheat (29). For example, the study by Varela-Moreira et al. (16) confirmed that cereal intake was the first source of sodium intake in all age groups, mainly in adults and the elderly.

Decreasing dietary salt intake, especially in bread baking and bread consumption, is one of the cheapest and most beneficial techniques to decrease daily salt intake (30, 31). Complete elimination is also not possible, as it may disrupt the baking process, reduce the taste and the sale of it (32).

Given the comparison between salt intake and a variety of diseases, notably hypertension and CVD, the strategy of reducing salt in meals and gaining positive feedback in many countries is of interest (33, 34). For example, the results of the study by Bernabe-Ortiz et al. (5) showed that salt reduction in bread could do with specified amounts, but conditions in the community for accepting these changes must be provided. So the strategy of decreasing salt consumption in Iran can begin by lessening the amount of salt in the baking process; because, similar to the UK and Argentina, in Iran, the community takes much salt within bread (35).

The opinion of reducing CVD is also achievable by recognizing its risk factors (e.g., hypertension) and a healthy diet (e.g., lessening salt in particular meals) (36, 37). However, the amount of salt and its reduction in meals should not be less than the amount needed by the body (38). This study's approach and suggestion are to diminish the bread salt level and its compliance with the National Standard of Iran.

As discussed, in Iran, in addition to salt, sometimes baking soda is used. Barbari bakeries in our country use baking soda, both inside the dough and to create a pleasant color on the bread's surface. To form this attractive color, baking soda, flour, and water are mixing and rubbed on the dough's surface (39).

Baking soda is also used in Lavash to offset the dough's sleep time and counteract the rollers' effect (using rollers to flatten the dough before baking). As a result, the uptake of this chemical increases, and the mean pH in Barbari and Lavash bread is higher than the mean of other bread and the National Standard of Iran (40).

The use of baking soda in preparing the dough will cause problems such as; impaired calcium absorption, anemia, increased absorption of heavy metals, and inactivation of vitamins and increased wastes (41). It is important to note that lack of knowledge of bakeries and the absence of technoscientific knowledge about the disadvantages of additives such as baking soda and high salt in bakeries increase the use of these ingredients (42). These problems appear to be resolved by using 1- inter-device coordination (43), 2- training the bakers, 3- informing them of National Standards, and 4- informing the public of the threats of additives such as baking soda and salt (beyond standard limits)(44). However, achieving these purposes in developing countries is more difficult, and using the reason for the success of developed countries will be helpful (45). One of this study's problems was the lack of accurate reflection of baking time (morning, noon, or evening) and consequently their impact on bread quality which remained unclear. There were also limitations such as not sending the sample to the laboratory on time, the inconsistency of sampling time (for example, evening sampling) with office hours, delay of several hours between sampling time and testing in this study.

Conclusion

The amount of salt consumed by the population

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of Garmsar showed that Barbari, Taftoon, and Lavash bread do not match the national standard of Iran. According to the National Standard of Iran (No. 103), the flour composition in Barbari, Taftoon, and Lavash bread is the same, but the construction of Sangak flour is different from other bread and has higher bran content. In the case of baking soda, Lavash and Barbari bread are served in the first and second stages. Given the established association between these additives, especially salt intake and human CVD, increasing knowledge of bakeries, and being aware of standards, it seems important to find a suitable clarification to reduce these additive use in Iranian society. This study, like other studies, has encountered limitations and barriers such as bakery intervention in sample selection, formal bakery holidays, bakery satisfaction for testing, and the ill-matched number of bakeries based on bread type.

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Author contribution

S. A. developed main conceptual idea. J.K. designed the study. Z.H.M analysis of the results and to the writing of the manuscript. S.A. performed the analytic calculations. All authors discussed the results and contributed to the final manuscript.

Conflict of interest

The authors of this article declare that they have no conflict of interest.

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