



## Differences in the salt amount of the bread sold in different regions of Turkey: A descriptive study

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### ARTICLE INFO

#### Keywords:

Bread  
Salt  
Hypertension  
Cardiovascular diseases

### ABSTRACT

Excess salt intake is associated with the risk of cardiovascular diseases (CVD) and bread contributes to daily salt intake. The aim of this study was to determine the amount of salt in white bread (WB) and whole wheat bread (WWB). Breads were purchased from public selling points and bakeries in seven regions of Turkey. Mohr method was used to determine the salt ratio. Mean salt ratio of breads was  $1.28 \pm 0.39\%$  ( $1.31 \pm 0.37\%$  WB;  $1.25 \pm 0.41\%$  WWB) ( $p > 0.05$ ). The salt ratio of bread sold at public selling points and bakeries was  $1.31 \pm 0.39\%$ , and  $1.22 \pm 0.39\%$ , respectively ( $p = 0.009$ ). The majority of bread in Turkey was found appropriate to implemented legislation regulation and was not different according to the regions. However, it is noteworthy that there was a difference according to the place of sale.

### 1. Introduction

The definition of salt in the Turkish Food Codex Salt Communique is that “Salts are produced from raw salt, the main ingredient of which is sodium chloride (NaCl), suitable for human consumption.” There are different types of salt offered for human consumption in packaged form such as table salt, sea salt, rock salt, processed salt, and industrial salt. According to the communique, table salt refers to finely “ground”, “refined”, or “unprocessed salt” which is offered directly to the consumers [1].

When looking at the salt sources in the diet, bread and pastry products come first, followed by meat and meat products, and dairy products. Carbohydrates are the main energy and nutrient sources of many societies. The main sources of carbohydrates are cereals, legumes, fruits, and vegetables. Bread is the primary food obtained by processing cereals. As a result of a systematic review and meta-analysis published in 2020, 25–40% of the daily salt intake of individuals in the USA and Europe comes from bread and pastry products [2]. When bread consumption of countries was evaluated, Turkey was found to be the first in the consumption of bread annually per capita with 121 kg/year. This has

been followed by Germany with an annual consumption of 90 kg of bread per capita [3]. Additionally, one of the ingredients included in the standard bread in Turkey is table salt [4]. Sodium and potassium content of salt form the mineral content of the bread. It was showed in a study that white bread contains 858 mg of salt/100 g [5].

Food composition scales, books or databases, and online dataset services are scientific data sources in which detailed macro and micro-nutrient values of foods are given. These data are created by leading countries and used in the formation of nutrition, health, food, and agriculture policies. Moreover, they are offered to the users of data with continuous updates. “National Food Composition Database of Turkey (TurKomp)” provides to determine macro and micronutrient values of foods produced and consumed in Turkey. It is a national and sustainable system that includes producing, using and managing traceable data from start to finish [6]. The mean value of salt and sodium amount in whole wheat bread is 100 mg/100 g and 40 mg/100 g, respectively [7].

Salt serves several crucial roles in bread making such as flavour enhancement, dough development, enzyme regulation, shelf life extension, and crust formation. It strengthens the gluten in the dough and improves the dough's elasticity, allowing it to hold more gas produced by the yeast during fermentation. Another point is selecting the

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<https://doi.org/10.1016/j.hnm.2023.200211>

Received 1 March 2023; Received in revised form 14 July 2023; Accepted 18 July 2023

Available online 9 August 2023

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### Abbreviations

<b>CVD</b>	Cardiovascular diseases
<b>INTERSALT</b>	The International Sodium, Potassium and Blood Pressure Study
<b>Patent</b>	Turkish Hypertension Prevalence Study
<b>SALTurk</b>	The Relationship between Hypertension and Salt Intake in Turkish Population
<b>TEKHARF</b>	Turkish Adult Risk Factor Study
<b>TurKomp</b>	National Food Composition Database of Turkey
<b>WB</b>	White bread
<b>WHO</b>	World Health Organization
<b>WWB</b>	Whole wheat bread

appropriate amount of salt and yeast. Appropriate salt and yeast amount is essential for controlling fermentation. All of these factors provide a more desirable texture and flavour in the bread [8]. On the other hand, sodium is the main mineral of table salt and it is the main source of sodium in the diet. Excessive salt intake can lead to hypertension and an increased risk of cardiovascular diseases through fluid retention, increased blood vessel constriction, altered kidney function, endothelial dysfunction, oxidative stress and inflammation [9].

With this purpose, limiting salt consumption by recommended values plays an important role to protect health and to prevent CVD, especially hypertension. World Health Organization [10] recommends that the table salt intake should not be over 5 g for a healthy individual. Although it is changing in different societies today, it has been seen that salt consumption is much higher than the recommendations for adults, especially in America and Europe [11,12]. The International Sodium, Potassium and Blood Pressure Study (INTERSALT) was conducted on fifty-two communities and salt intake below 3 g was considered low consumption [13]. Accordingly, it was seen that there were four communities consuming low levels of salt. In addition, it was revealed that the daily salt intake was generally between 6 and 12 g. Moreover, a statistically significant positive correlation was found between salt consumption and blood pressure in the study. The average daily salt consumption per capita was found to be 18 g in the SALTurk 1 study, and 15 g in the SALTurk 2 study [14,15].

According to the Turkish Hypertension Prevalence Study (Patent) [16], individuals with a diagnosis of hypertension were asked what the recommendations were for treatment, and most of the patients stated that they received regular medication (92.4%) and salt reduction (91.4%) recommendations. The ratio of people who shows compliance with these recommendations is 74.2% and 66.3%, respectively.

According to the WHO [17], the most frequent cause of adult death in the world is cardiovascular disease [18]. This situation is more prominent in developing countries like Turkey. High sodium intake leads to an increase in blood pressure and the prevalence of hypertension. This is especially important, as evidence has shown that high blood pressure is associated with increases in CVD mortality [19]. Therefore, various nutrition policies were developed and implemented to reduce salt consumption. One of them is the "Turkey Excessive Salt Consumption Reduction Program". The policy of reducing salt in bread, which is the most consumed carbohydrate source in Turkey was developed by the Ministry of Health. Within the scope of this program, the preparation of training materials and standard salt packs for the production of bread (using iodized salt in bread production based on 50 kg flour sacks, etc.) was planned and implemented [20]. Although the health benefits of decreasing salt consumption understand, there are some difficulties for reducing the salt amount in bread. One of them is the formulation of traditional bread because specific traditional bread can require a saltier taste. People can prefer to consume this traditional bread due to its desirable taste. All of them are considered, this study aimed to determine

the amount of salt in white and whole wheat breads sold in different regions of Turkey.

## 2. Materials and methods

### 2.1. Supply of bread samples

In this descriptive study, breads were taken from seven geographic regions of Turkey. In the cities, whether there are selling points depending on the municipalities was questioned. Between September 2018 and January 2019, one whole wheat and one white bread were purchased from public bread selling points and randomly selected bakeries from the cities. Local production was available in selling points and bakeries. The distributions of the breads according to the regions were shown in Table 1.

### 2.2. Sample preparation

All breads were covered with airtight plastic packaging and frozen at  $-20^{\circ}\text{C}$  until NaCl analysis. If there was no public bread-selling point in selected provinces, samples were obtained from only bakeries. A total of 249 bread samples, including 127 white breads and 122 whole wheat breads were analyzed.

### 2.3. Determination of salt amount

Determination of salt in bread by the Mohr method [21] (AOAC Method 937.09) has been conducted at Sabahattin Zaim University, Sabri Ülker Food and Nutrition Research Center, an accredited laboratory, similar to the study method of Hadian et al. [22] (Hadian et al., 2020). Besides, in salt determination, 1 g of salt was added to the bread and the recovery study was carried out. The recovery was found to be 98%. Silver Nitrate ( $\text{AgNO}_3$ ) and Potassium Chromate ( $\text{K}_2\text{CrO}_4$ ) solution are predicted to form  $\text{AgCl}$  as a result of the reaction. 1 g bread samples were weighed with precision scales from each bread. Each sample was cut into pieces with a hand mixer and transferred to 50 mL Falcon tubes. Then, 25 mL of distilled water was added, and it was kept in a water bath for 10 min at  $80^{\circ}\text{C}$ . The amount of distilled water in the Falcon tubes removed from the water bath was completed to 50 mL. After that, it was mixed with a Vortex and centrifuged with a laboratory-type centrifuge. Then, the titration device was prepared. The burette was filled with 0.1 N  $\text{AgNO}_3$  and set to "0". 20 mL of solution taken from Falcon tubes was poured into 100 mL Erlenmeyer and 1 mL of 5%  $\text{K}_2\text{CrO}_4$  was added. With the 0.1 N  $\text{AgNO}_3$  pre-filled in the burette prepared for the operations to be performed, the burette tap was opened and titrated. It was titrated to tile red with 0.1 N  $\text{AgNO}_3$ . As soon as each NaCl and  $\text{K}_2\text{CrO}_4$  solution turns tile red, the amount of  $\text{AgNO}_3$  spent is noted. The percentage of salt is calculated by the formulas below. Blind trials were made with the same processes as distilled water as much as the amount of filtrate taken.

The amount of salt was calculated via the formula used as  $1\text{ mL } 0.1\text{ N } \text{AgNO}_3 = 0.00585\text{ g NaCl}$ .

If the concentration of the prepared  $\text{AgNO}_3$  solution is not exactly

**Table 1**  
The distribution of the breads according to the regions.

Region	Bread type		Total	
	White	Whole wheat	n	%
Marmara	65	62	127	51.0
Black Sea	18	17	35	14.1
Mediterranean	13	14	27	10.8
Southeastern Anatolia	11	10	21	8.4
Central Anatolia	8	9	17	6.8
Eastern Anatolia	7	7	14	5.7
Aegean	5	3	8	3.2
Total	127	122	249	100.0

0.1 N, this value is used:

$$\begin{aligned} & (0.00585 \times \text{concentration of the prepared AgNO}_3 \text{ solution})/0.1 \text{ N.} \\ \% \text{Salt (g)} &= [(0.00585 \times V)/m] \times \text{DF} \times 100 \\ V &= \text{Volume of spent AgNO}_3 \text{ solution (mL)} \\ N &= \text{Concentration of adjusted AgNO}_3 \text{ solution} \\ m &= \text{amount of sample taken (g)} \\ \text{DF} &= \text{Dilution factor (if the sample is diluted into a 100 mL flask and} \\ & \text{10 mL is taken from this solution, then the dilution factor is } 100/10 \\ &= 10) \end{aligned}$$

#### 2.4. Statistical analysis

Statistical analyses were made with SPSS version 16.0 program. The suitability of the data for normal distribution was evaluated with the Kolmogorov-Smirnov Test. Salt ratios of breads were given as Mean  $\pm$  SD, minimum and maximum values. Differences in salt ratio of breads according to geographical regions were evaluated via Kruskal-Wallis test. All statistical tests were conducted under  $p < 0.05$  significance.

### 3. Results

In the study, the salt amounts of 127 white bread and 122 whole wheat bread taken from various regions of Turkey were determined. White bread consisted of 51.0% of all breads. It was detected that 64.3% of the analyzed breads were purchased from the bakery. Additionally, 51.0% of the breads were obtained from the Marmara Region.

In this study, we found that the mean salt ratio of breads is  $1.28 \pm 0.39\%$  and it varies between 0.41 and 3.36%. Besides, while white bread contains  $1.31 \pm 0.37\%$  salt on average, it was seen that whole wheat bread contains  $1.25 \pm 0.41\%$  salt. Therefore, there is no significant difference in terms of salt content ( $p > 0.05$ ). The results show that the salt ratio of breads sold at the bakery was  $1.31 \pm 0.39\%$  and was  $1.22 \pm 0.39\%$  sold at the municipal/public selling point ( $p = 0.009$ ) (Table 2).

When the salt ratios of the bread were examined according to the geographical regions, it was shown that the salt ratios were not statistically significantly different according to the regions ( $p > 0.05$ ) (Table 3). In addition, salt ratios of white and whole wheat bread were not different by geographical regions ( $p > 0.05$ ).

The percentage of the breads that have lower and higher limits was given in Table 4. Accordingly, 22.1% of the breads exceeded the legislated salt limit. However, there was no significant difference considering the geographic regions and bread types ( $p > 0.05$ ).

### 4. Discussion

In this study, the salt content of bread sold in various regions of Turkey was analyzed. According to the Turkish Food Codex Communiqué on Bread and Bread Types [21,23], the salt percentage of the bread should be a maximum of 1.5%. In the results of the analysis, 22.9% (57 breads; 29 white, 28 whole wheat) of the breads had more salt than upper limit values. Additionally, 41.8% of these breads were bought from Marmara. However, the average salt content (basically 1.5

g/100 g) is similar to that reported from other European countries [22, 24]. Another study conducted in Tehran showed that the compliance of the salt amount in breads to the national limits ranged from 21.0% to 93.0% [23,25]. It is known that certain levels of sodium are required for healthy body functions, and the main sources of sodium come from diets. Currently, sodium intake exceeds the requirements and this situation results in various diseases [8]. High Na intake comes from excess salt intake is strongly associated with high blood pressure and stroke. Consequently, it is estimated that excess salt intake was responsible for worldwide 3 million deaths in 2017 [24,26]. WHO (2020) [10] does not recommend more than 2 g/day Na intake (equivalent to 5 g salt (NaCl) for adults to reduce the burden of non-communicable diseases. According to the latest data, dietary Na intake is higher than recommended values in almost all countries. Although dietary Na sources differ in high and low-income countries, bread seems to be one of the most important sources of Na intake worldwide. A review including data from 23 European countries reveals that Turkey has the highest sodium level in breads as 711 mg/100 g and the highest bread consumption as 411 g/day. Therefore, it can be said that reducing the salt amount in breads contributes to preventing excess sodium intake and related diseases [25, 27].

Reducing 1 g of salt intake can decrease more than 7% of deaths associated with stroke and myocardial infarction [26,28]. A significant decrease in systolic blood pressure was observed in individuals with high blood pressure when they began to consume salt-reduced breads in their diets [27,29]. Moreover, a randomized cross-over study conducted in Argentina showed that a 30% reduction in bread consumption in people with high blood pressure provided normalization of blood pressure. By reducing the consumption of bread, it was determined that the average salt intake was equivalent to 1.5 g salt per day (575 mg) and systolic/diastolic blood pressure decreased by 1.7/0.8 mmHg. However, due to the high salt concentrations of breads especially in Argentina (average 780 mg Na/100 g), participants consumed a significant amount of sodium (~950 mg Na/day) through bread. Therefore, the impact observed in this study could not be transferable to populations where bread contributes less sodium to the diet. However, an increase in the consumption of salt-reduced bread consumption can decrease cardiovascular risk factors [28,30].

In the SALTURK II study [15], it was determined that the daily salt intake of individuals was  $14.8 \pm 5.4$  g/day. Daily salt intake was higher in rural areas (16.0 g) than in urban areas (14.5 g/day). The results of our study show that the highest amount of salt was found in bread sold in the Mediterranean, Aegean and Southeastern Anatolia regions of Turkey, respectively. It was found in TEKHARF study [29,31] that the prevalence of all cardiovascular disease and hypertension was highest in the Black Sea region. A previous study reveals that the general consumer profile of Turkey does not prefer salt-reduced or salt-free bread due to the flavor factor [30,32]. Accordingly, in regions such as the Mediterranean, Aegean and Southeastern Anatolia, where the flavor factor comes to the fore, the amount of salt in breads may be higher, especially in bread taken from the bakeries. Similarly, in a study conducted by Pasqualone et al. (2019) [33] [31], breads that only have different NaCl amounts as 5, 10, 15 and 20 g/kg were submitted to consumer tests. The majority of consumers mostly preferred bread made with 20 g/kg salt. The amount of salt used to make bread has changed from region to region even if made from standard white or whole-wheat flour. The results of a study conducted in the eastern Mediterranean countries show that the upper limit of salt emphasized in legislation should be considered for also traditional breads [32,34].

When all of these factors are considered, Turkey assumes the role of the bridge between cultures due to its geographical location. This situation provides cultural diversity in different regions. There are specific types of bread in this cultural variety [33,35]. In the study, the results cannot be reflected in the whole country, since only white and whole wheat breads from the municipal/public selling points and bakeries were analyzed. This constitutes the limitation of the study. For future

**Table 2**  
Distribution of the average salt amount in bread types.

Type	Salt % (Mean $\pm$ SD)	Salt % (Min)	Salt % (Max)	P
White bread	$1.31 \pm 0.37$	0.41	3.36	0.182
Whole wheat bread	$1.25 \pm 0.41$	0.42	3.15	
<b>Selling point</b>				0.009*
Bakery	$1.31 \pm 0.39$	0.42	3.15	
Municipal/Public Bread	$1.22 \pm 0.39$	0.41	3.36	

\* Kruskal Wallis test and  $p < 0.05$  was considered statistically significant.

**Table 3**  
Salt ratios of breads according to geographical regions.

Regions	White Bread (100 g)			Whole Wheat Bread (100 g)			Total		
	(Mean ± SD)	(Min)	(Max)	(Mean ± SD)	(Min)	(Max)	(Mean ± SD)	(Min)	(Max)
Eastern Anatolia (n = 14)	1.25 ± 0.44	0.70	1.93	1.23 ± 0.26	0.67	1.45	1.24 ± 0.35	0.67	1.93
Central Anatolia (n = 17)	1.19 ± 0.21	0.86	1.54	1.29 ± 0.31	0.94	2.0	1.24 ± 0.27	0.86	2.01
Southeastern Anatolia (n = 21)	1.42 ± 0.70	0.41	3.14	1.29 ± 0.49	0.41	1.82	1.35 ± 0.60	0.41	3.15
Black Sea (n = 35)	1.35 ± 0.28	0.85	2.07	1.19 ± 0.39	0.56	2.12	1.27 ± 0.34	0.56	2.12
Mediterranean (n = 27)	1.38 ± 0.26	0.94	1.89	1.54 ± 0.62	0.87	3.35	1.46 ± 0.48	0.87	3.36
Aegean (n = 8)	1.35 ± 0.36	1.01	1.86	1.19 ± 0.31	1.01	1.54	1.29 ± 0.33	1.01	1.87
Marmara (n = 127)	1.29 ± 0.37	0.71	3.06	1.20 ± 0.37	0.41	2.74	1.25 ± 0.37	0.41	3.06

**Table 4**  
The percentage of the breads that normal and exceeded salt limit.

Region	Salt Content												p value
	White Bread				Whole Wheat Bread				Total				
	Normal		Exceed		Normal		Exceed		Normal		Exceed		
	n	%	n	%	n	%	n	%	n	%	n	%	
Marmara	53	81.5	12	18.5	51	82.3	11	17.7	104	81.9	23	18.1	0.09
Black Sea	14	77.8	1	22.2	15	88.2	2	11.8	29	82.9	3	17.1	
Mediterranean	10	76.9	3	23.1	6	42.9	8	57.1	16	59.3	11	40.7	
Southeastern Anatolia	8	72.7	3	27.3	6	60.0	4	40.0	14	66.7	7	33.3	
Central Anatolia	7	87.5	1	12.5	8	88.9	1	11.1	15	88.2	2	11.8	
Eastern Anatolia	4	57.1	3	42.9	7	100.0	0	0.0	11	78.6	3	21.4	
Aegean	3	60.0	2	40.0	2	66.7	1	33.3	5	62.5	3	37.5	
Total	99	78.0	28	22.0	95	77.9	27	22.1	194	77.9	52	22.1	

\* Kruskal Wallis test and  $p < 0.05$  was considered statistically significant.

studies, increasing the type and number of bread, such as including traditional bread, can be a solution for limitations. The strength of the study is that it fulfills to lack of information about the amount of salt in breads. This research reveals new findings in terms of salt content in bread obtained from different regions of Turkey and the differences in salt content of breads. In addition, the study is important as it is thought that it will guide the attempts to reduce the amount of salt in these breads by detecting the breads containing more salt than stated in "Bread Notification".

## 5. Conclusions

According to the results of this study, it was found that more than 1/5 of the breads analyzed in this study exceed salt limits. Considering that bread is the primary carbohydrate source in daily consumption, reducing the salt content of bread contributes to decreasing daily salt intake. With this purpose, the Program for Reducing Excessive Salt Consumption in Turkey was initiated by the Ministry of Health. The amount of salt in breads was reduced from 2% to 1.5%. In order to better understand the relationship between salt consumption and diseases, the education of producers on regulations can be increased. On the other hand, using different types of salts such as potassium, calcium, and magnesium salts may help to reduce the amount of daily sodium intake. More bread types can be analyzed to obtain more comprehensive results in future studies.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgments

The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

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