Article

A successful pilot experience of salt reduction in Tunisian bread: 35 % gradual decrease of salt content without detection by consumers

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Abstract: As bread is the most consumed food by Tunisian population and the major source of salt, a pilot experience of salt reduction in bread has already begun in Bizerte city. Salt analysis in bread collected from Bizerte city was realized with Volhard titration method. Application of the "salt reduction programme" allowed a gradual decrease of salt content in bread by 35 % during three years without detection by Tunisian consumers. A final salt concentration of 1.1 ± 0.1 g/100 g was then achieved. The establishment of an effective salt reduction strategy with lifestyle education is needed to reduce hypertension that is the first cause of death in Tunisia.

Keywords*:* Salt reduction; pilot experience; saltiness perception; Bizerte city; Tunisia

1. Introduction

Salt has been extensively proved to be one of the most important causal factors of hypertension (Frisoli, Schmieder, Grodzicki, & Messerli, 2012; He, Burnier, & Macgregor, 2011; Kazmi, Al-Maliki, Ali, & Al-Abbasi, 2020).Several countries have already reduced salt intake (Cashman, Kenny, Kerry, Leenhardt, & Arendt, 2019; He, Brinsden, & MacGregor, 2014; Loloei et al., 2019; Reynoso-Marreros, Pinarreta-Cornejo, Mayta-Tristan, & Bernabe-Ortiz, 2019). In Tunisian diet, bread is a staple food and was identified as the most important sources of sodium intake. The nationally food consumption data of 2015 suggested that the daily French bread consumption by person was about 197 g (222 g in urban area and 135 g in rural area). The consumption of all types of bread was 245 g (240 g and 253 g, respectively in urban and rural areas). French bread intakes contributing by 30% to 50% of the added salt intake (7.1 g/d at the national level) (NIS, 2018). The Tunisian government has embarked on a major programme to improve the nutritional quality of the Tunisian diet and to combat obesity as well as the Non Communicable Diseases by reducing the fat, sugar and salt content of the diet (INNTA/INSP/SURVEN, 2016). Several actions are being tested in Bizerte city (with about 165,000 inhabitants) as a pilot phase of this national plan and the reduction of the salt content in bread is one of these actions.

2. Methods and Materials

2.1. Bread collection and salt analysis

Twenty-two bakeries from Bizerte city (figure 1), a Northeast area with about 165,000 inhabitants, volunteered to achieve a 30% reduction of salt/sodium in bread-making process during 3 months (10% reduction each month) and maintain the reduction during two years and nine months. French bread was selected for the salt reduction programme as it is the most consumed food (194 g per day per person), contributing by 30% to 50% of the added salt intake (NIS, 2018). Bread collection was made weekly during the first 3 months and once every 3 months during the next period of the protocol. This experience was held from February 2015 to January 2018. Levels of sodium chloride in bread were determined by using the Volhard titration method (Serna-Saldivar, 2012). Briefly, 2.5 g of dried and milled bread were mixed with 29 mL of 0.5 mol L^{-1} silver nitrate and boiled in 15 mL of concentrated nitric acid and 2 mL of potassium permanganate solutions. Excess of silver ions was titrated with 0.5 mol L^{-1} ammonium thiocyanate in the presence of diethyl ether and ferric ammonium sulfate indicator.

Figure 1. Card of Bizerte city.

2.2. Saltiness perception by Tunisian consumer

During the first three months of the salt reduction programme, overall 184 consumers (99 women, 85 men) of mean age 37 y accepted to evaluate the saltiness of the salt reduced bread when they went to purchase from the selected bakeries. All the participants were not informed about the salt reduction in bread. From the 184 consumers, 51 persons tested the 10% salt reduction level in bread-making process during the first week of the pilot action, 39 tested the 20% reduction level in the fifth week, 57 tested the 30% reduction level in the ninth week and 37 tested the 40% reduction level in the thirteenth week. Bread samples were cut in 10 mm slices and served on plates. The first and the last cut of the loaves were not

considered in the saltiness test. Each consumer was asked to fill in a questionnaire rating the bread saltiness (Not at all salty- slightly salty-normal-salty and very salty) after rinsing their mouth with tap water.

2.3. Data management and statistical analysis

Data management was performed using Stata software version 13.0 (Stata Corporation, College Station, Texas, 2013) software. Results are shown as mean ± standard deviation for continuous variables and as percentages for categorical variables.

3. Results

Data on the salt content analysis in bread after application of the salt reduction programme are presented in figure 2. Before the application of the programme, the mean salt content in bread was 1.7 ± 0.2 g/100 g. Results show a decrease in the amount of added salt reaching 35 % after 3 months of weekly control. A stabilization of salt concentration in bread was then noticed with a final salt concentration of 1.1 ± 0.1 g/100 g after three years of subscription to the salt reduction programme.

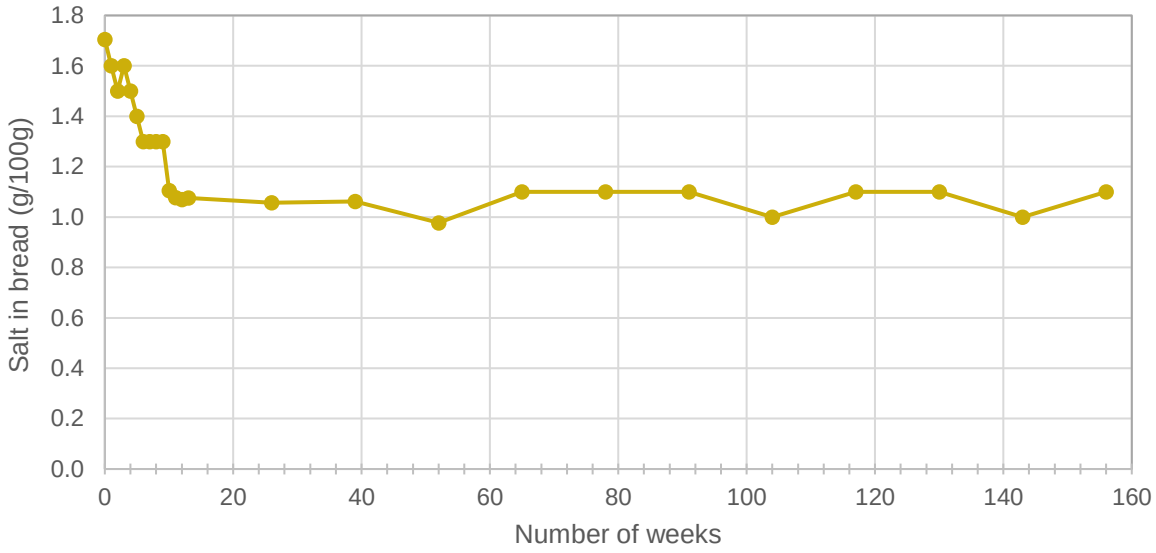

Figure 2. Mean levels of salt in bread collected from Bizerte city after application of the salt reduction programme.

Results on bread saltiness perception by Tunisian consumers revealed that salt reduction in bread-making process is not detected up to 30 % level as 79 % of the selected participants found that this salt reduced bread is with normal saltiness (figure 3). However, only 3 % of Tunisian consumers who tested the 40 % salt reduction level in bread-making process estimated its salinity as normal.

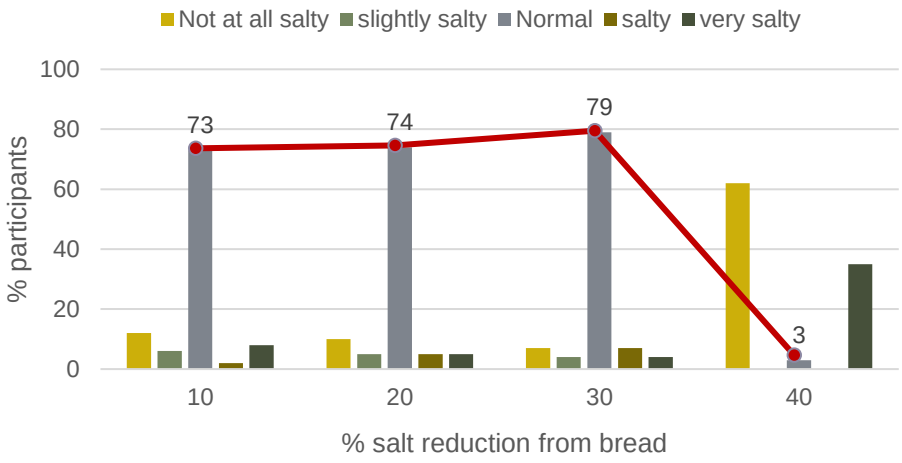

Figure 3. Saltiness perception of salt reduced bread by Tunisian consumers.

4. Discussion

Application of the salt reduction programme in Bizerte city lead to an average reduction of added salt in bread of 35 %, after three years of subscription to this national programme. A final salt concentration of 1.1 ± 0.1% was then achieved. These results are very encouraging when compared to other salt reduction experiments carried out in the world. In Argentina, the average salt content in bread was 2 % and French bread accounts for 25% of the total salt intake (Ferrante et al., 2011). A reduction in salt concentration of French bread from 2% to 1.4% was tested and well accepted in the studied population. In Europe, salt reduction strategy started in Finland in the late 1970s. It involved mass media campaigns, cooperation with the food industry and implementation of salt-labeling legislation (Pietinen, Valsta, Hirvonen, & Sinkko, 2008). The launch of this legislation has resulted to a 20% reduction in the average salt content in bread, from 1.5 % to 1.2 %. The United Kingdom strategy for salt reduction is considered as a model for other countries. It started in 2003 and was based on a set of voluntary targets promoting the gradual reduction in the salt content of processed foods (Brinsden, He, Jenner, & Macgregor, 2013). In the case of white bread, average concentrations of salt decreased from 1.22 ± 0.18 % to 1.00 ± 0.10 % between 2001 and 2011, which corresponds to a total reduction of 18% in salt level. Following the successful experiments carried out in Finland and United Kingdom, several other European countries have developed their own guidelines by a gradual and sustained reduction of the salt added in processed food. Moreover, the World Health Organization (WHO) has implemented national salt reduction strategies in countries at all income levels to achieve the target of 30 % reduction in salt intake by 2025 (WHO, 2013). Despite the large and increasing number of countries with salt programme in place (75 until 2015), additional support is required in Eastern Mediterranean and African regions where only 3 countries (Kuwait, Morocco and South-Africa) have assessed salt reduction strategies (Trieu et al., 2015).

In this study, the salt concentration in bread from Bizerte city was gradually reduced by 35 % in a period of three months and maintained at this level of reduction during two years and nine months. This rate could be considered as satisfactory as the saltiness of bread was considered as

normal by Tunisian consumers until a 30 % salt reduction level (when prepared by bakers). However, a 40 % reduction in salt content of bread was detected by almost all participants. Accordingly, the selected bakeries opted for a final level of salt reduction of 30 % in bread-making process during the pilot study. Salt has several important functions in bread. It controls the rate of fermentation, improves the texture of the product and creates a specific flavor and taste profile (Israr, Rakha, Sohail, Rashid, & Shehzad, 2016). According to Bolhuis and al. (2011) a gradual reduction of salt in bread by up to 52% did not lead to lower consumption of bread in a period of 2 weeks (Bolhuis et al., 2011). Another meta-analysis study conducted on salt-reduced products suggested that reducing the salt level in breads by approximately 40% did not impact significantly consumer acceptability (Jaenke, Barzi, McMahon, Webster, & Brimblecombe, 2017). Pasqualone and al. (2019) tested the effect of salt reduction on quality and acceptability of durum wheat bread. They found that it would be possible to decrease the salt amount of durum wheat bread formulation from 2 % to 1.5 % without significantly affecting consumers appreciation (Pasqualone, Caponio, Pagani, Summo, & Paradiso, 2019). Reduction of salt in bread could be realized stepwise within few months or years to be undetected by the consumers or in a short time by using suitable salt replacers and taste enhancers such as potassium chloride (Israr et al., 2016). The use of encapsulated salt is another technological approach to reduce the sodium concentration in bread by creating taste contrast while maintaining saltiness intensity(Noort, Bult, & Stieger, 2012). Despite the limited amounts of reduced salt in a long period of time, the stepwise reduction of added salt in bread remains the simplest strategy which has brought tangible results around the world (Israr et al., 2016; Trieu et al., 2015).

5. Conclusion

A gradual salt content reduction of 35 % was achieved in bread collected from 22 voluntary bakeries (out of the 42 bakeries of Bizerte city), without detection by Tunisian consumers. After this encouraging outcome, the challenge is to ensure that this applies to the bakeries across all regions of the country. This measure is now under study to be rolled out to all the 24 governorates with the support of Tunisian Union of Industry, Trade and Handicrafts and the national federation of bakers.

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Conflict of Interest: The authors declare that they do not have any conflict of interest.

Ethical review: The Ethical Committee of the Tunisian National Institute of Nutrition and Food Technology approved the survey protocol (visa n°3/2015).

Informed Consent: All study participants provided informed consent.

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