



Amount of Baking Soda and Salt in Bakeries of Zanjan City in 2011-2012

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ABSTRACT

Background: Today some bakeries for artificially production of bread in order to production process expedition and compensating defects that created by unnatural fermentation and as well as undesirable quality of flour. For cover superficial defects of bread use of harmful chemical material such as soda, that can cause health problems. The aim of this study is determination of soda and salt amount of bread bakeries in the Zanjan city.

Method: Total number of samples is 450 which include 330 bread samples, 77 Barbari bread and 43 other breads (Sangak, Tafton, and Shirmal). The collected data were analyzed by SPSS 11.5.

Results: The most amounts of soda and salt observed in Barbari breads with 55.8 and 11.7 percent, respectively. Use of soda in autumn and winter seasons, respectively with 31.9 and 41.4 percent had been maximum amount.

Conclusion: Total average of pH is higher than standard in bakeries. That from reasons can noted to undesirable quality of flour, unawareness of bakers and lack of adequate oversight.

1. Introduction

Bread is a valuable inexpensive food product playing an important role in supplying energy for Iranian people. It is used as the most significant source of energy, protein, some minerals, and vitamins, as 60-65% of protein, calorie, and 2-3 g of minerals are supplied by bread [1]. The baking soda or sodium bicarbonate (NaHCO_3) is produced out of combining a strong base (NaOH) with a weak acid (H_2CO_3). The compound is

produced in various purities used in pharmaceutical, laboratorial, and food industries; families' daily diet; and production of carbonated liquids, pastries, and sometimes bread. The compound may be also used as some other compounds, such as baking powder, when mixed with other materials. Women use baking powder or its derivatives in cooking cakes, pastries, and some kinds of food [2].

Most of nutrients in the natural composition of wheat and flour can enter the metabolic cycle and be digested and absorbed to be useful for the body only when the fermentation process is complete. The natural composition of wheat and flour contains a complex acid known as phytic acid that is combined with minerals, such as iron and calcium, and makes them water-insoluble, and consequently, non-absorbable for the body. The phytic acid can be removed by the phytase produced during fermentation, so that, the nutrients of bread would be absorbable and useful for the body. Phytase would be active optimally using only sourdough or yeast with appropriate retention time. Phytase is not produced in breads baked with baking soda, consequently, the minerals in these breads would be indigestible and unobservable [3]. Phytase exists in bacteria, yeasts, and fungi. The microorganisms in yeast and bread dough grow and proliferate optimally in rather weak acid media (pH=4.5-5.5). Under such circumstances, phytase is fermented through 70% degradation of phytic acid in flour, and consequently, nutrients, such as alcohols, ketones, carbon dioxide, and aromatic organic matters will be produced in bread in order to give the bread its true taste and smell. In this respect, necessary conditions for absorption of minerals, vitamins, antioxidants, and soluble micronutrients (iron, calcium, zinc, phosphorus, etc.) will be prepared, and people will be protected from suffering many diseases caused by shortage of the above substances [4]. Unfortunately, bakeries have begun using chemical additives for faster fermentation of the bread dough due to the growing population in recent decades and saving time in order to be able to satisfy the increased demands (for consumption of bread) following the grown population [5]. Based on known scientific evidences, those additives have many adverse mental and physical side effects for humans [5]. One common chemical additive is the baking soda

or sodium bicarbonate although it is forbidden [4].

The purpose of baking bread is the production of a food that is highly digestible with a suitable volume and appearance. The main ingredients of bread include wheat flour, water, salt, yeast or sourdough that must meet properties complying with Iranian Standards [6]. Yeasts are unicellular organisms converting starches and sugars of the flour into carbon dioxide and alcohol through a complicated process and facilitate digestion of the bread for the gastrointestinal tract through breaking long chains of starches [7]. Carbon dioxide causes the porous texture of dough, and the alcohol makes the bread spongy. Moreover, the acid and alcohol produced during fermentation eliminate the pathogenic microorganisms and improve safety of the dough and bread. The low pH following formation of acid and gluten colloidal state, make the bread more durable [8]. The most obvious use of yeasts for consumers is the smell and taste they give to bread through producing aromatic acids, in addition to containing a large amount of proteins, minerals, and vitamins [3]. Today, most bakeries unfortunately use harmful chemicals, such as baking soda, blankit (sodium hydrosulphite), and extra salt for reducing fluidity of gluten and increasing resistance of the dough produced out of contaminated wheat (sun > 1%) in artificially processing of bread in order to accelerate the production process and compensate deficiencies resulting from lack of natural fermentation, undesirable quality of the bread, and its apparent disadvantages. Those chemicals cause chronic severe health-related complications, including dyspepsia, gastrointestinal disorders, malnutrition, hypertension, and allergies [6]. Baking soda is used as a leavening agent for the dough in bakeries because it is decomposed by heat and produces CO₂. A substantial amount of baking soda in dough creates an alkaline taste and a yellow color due to its sodium carbonate, and consequently, the bread does

not look and taste pleasant. Having increased pH of the environment, baking soda decreases the development and activity of the yeast and, subsequently, decreases the activity of phytase and produces the unpleasant alkaline taste that has adverse effects on the stomach after a long time of consuming such bread [9]. Baking soda affects the gastrointestinal tract adversely and makes its environment alkaline [10]. Alkaline matters produce metabolic alkalosis that may reduce the concentration of hydrogen. Minimum changes in the concentration of hydrogen result in changes in velocity of biochemical reactions, including their inhibition or intensification [11]. Moreover, the metabolic alkalosis may lead to nervous system irritability that involves peripheral and central nerves and may be severe to the extent that the nerves are irritated spontaneously and frequently even without normal irritants, and consequently, muscles suffer a type of tonic spasm (tetanus). Generally, any agent disturbing the absorption of minerals, such as calcium, may cause bone mineral deficiency and symptoms like osteomalasia that develops rickets during children's growth [2].

Baking soda can neutralize the gastric hydrochloric acid and, consequently, disturb digestion and absorption of minerals, especially bivalent elements, and gastroenteritis [12]. Following the reduced gastric acidity, gastrointestinal disorders, epigastric pain, maldigestion, and delayed emptying of the stomach occur [13].

Furthermore, baking soda may cause gastric cramps, flatulence, and other gastrointestinal complications. If it is used for a long time, adverse effects on the stomach will arise. Another gastrointestinal complication caused by the bread containing baking soda is that the dough is not baked and toasted perfectly, and thus, the bread sticks to teeth and stays more in the stomach, and consequently, causes stomach and duodenum inflammation and ulcer. Having combined

with the gastric acid, baking soda produces sodium chloride that is harmful for people with renal and heart diseases and hypertension. Moreover, baking soda can develop and exacerbate seizures in children [14]. Swallowing large amounts of baking soda can lead to metabolic disorders of which one very common disorder is hypochromic metabolic alkalosis that happens after renal excretion of a large amount of baking soda and can change the protein-calcium bond, reduce ionized calcium, and consequently, tetanus. The metabolic alkalosis develops neuromuscular symptoms, such as paresthesia and myoclonus, which can be attributed to the decreased level of serum calcium [15]. Other side effects of baking soda are the increase in sodium and decrease in calcium in blood and the subsequent increase in blood pressure, sudden attack of cramps, reduced intracavitary blood flow, and alkaline urine. Moreover, baking soda used in bread may increase the uptake of heavy metals, such as lead and mercury, and cause serious disorders when used for a long time. A study on animals reported that baking soda overdose in chicken could lead to abnormal accumulation of urates (monosodium and calcium urates) and increase the incidence of visceral and articular gout [16].

2. Materials and methods

In this descriptive cross-sectional study, the study population was all the samples collected from Zanjan's bakeries in 2012. The samples were tested in the laboratory of Zanjan's Deputy of Food and Drug using national standard methods, and the results were reported to the relevant centers. To determine pH of a sample, it was first air-dried and milled in the laboratory, then, 10 g of the powdered sample was carefully scaled into a 250 cc Erlenmeyer flask, 90 cc of distilled water was added to the flask, and the flask was capped with a stopper. The flask was shaken intermittently for 10-15 min, and finally, pH of the sample was measured using a calibrated pH meter. To measure salt of a

sample, one gram of the dried and milled sample was precisely weighed and poured in a 250 cc Erlenmeyer flask, and 10 cc of 0.1 N silver nitrate solutions and 10 cc of concentrated nitric acid were respectively added to the flask. Then, the flask was boiled, and 5 cc of saturated permanganate was added to it while boiling. Finally, the composition was titrated with 0.1 N potassium thiocyanate solution until the red-brown color appeared and remained for 15 s. According to Iranian Standards, the standard pH for the bread is 6, as pH greater than 6 shows the use of baking soda, and the standard amount of salt in the bread is 2.3%. The results reported from the laboratory were analyzed. The samples were totally 450 samples collected from Zanjan's bakeries and delivered to the laboratory by health care professionals. All the samples were selected randomly and included 330 Lavash bread, 77 Barbari bread, and 42 samples of other kinds of bread (Sangak, Taftoon, and Shirmal). The samples collected in spring, summer, fall, and winter comprised 97, 62, 69, and 222 samples, respectively. The collected data were analyzed using SPSS11.5 software.

3. Results

The results of the analysis using SPSS11.5 software are summarized in tables 1 and 2. The most frequent use of baking soda was observed in 55.8% of Barbari bread samples. In this regard, the Barbari bread samples with baking soda collected in spring, summer, and winter comprised 60%, 33.3%, and 52.3%, respectively. Baking soda was also used in 28.5% of Lavash bread samples. The most frequent use of baking soda in Lavash bread samples was observed in samples collected in winter with frequency of 39%. The Lavash bread samples with baking soda collected in spring, summer, and fall comprised 11.8%, 11.1%, and 31.5%, respectively. Furthermore, the most frequent use of baking soda in samples of other kinds of bread was observed in samples collected in winter with frequency of 35.7%. In this regard, the samples with

baking soda collected in spring and fall comprised 33.3%, and there was not any sample with baking soda collected in summer. The most frequent use of salt was observed in Barbari bread samples collected in spring, as 33.3% of them contained nonstandard amount of salt. The amount of salt in 13.2% of Lavash bread samples and 11.7% of samples of other kinds of bread was out of standard range.

4. Discussions and Conclusions

The results showed that the mean total pH and salt in the studied bread samples were greater than the standard level in 32.4% and 6.4% of samples, respectively. In 146 samples of the 450 samples with baking soda, the mean, standard deviation, maximum, and minimum of the data (pH) were respectively 6.61, 0.4, 8.65, and 6.17. In 29 samples with nonstandard amount of salt, the mean, standard deviation, maximum, and minimum of the data (percentage of salt) were respectively 62.67%, 0.18%, 3.2%, and 2.26%. Similar studies have been performed in other cities of Iran in recent years and showed that pH of 8% of samples in Isfahan [17], 12% of samples in Yazd [18], 8% of samples in Chaharmahal and Bakhtiari [19], 11.8% of samples in Savadkooh [20], 9.8% of samples in Kashan [21], and 2% of samples in Shahroud [22] was greater than the standard level. The mean total pH in Iran was 9.1% [3]. Moreover, the amount of baking soda used in bread in Tehran, Rafsanjan, and Kerman has been reported as 17%, 22%, and 47.7%, respectively [23]. The comparison of results of the present study with those of previous studies and the total national mean revealed that a high percentage of bakeries in Zanjan used baking soda in processing the bread. The results showed that the frequency percentage of breads' baking soda in Zanjan was higher than the total national mean by 23.3%. The most frequent use of baking soda was respectively reported in Lavash and Barbari breads, as 60%, 88.9%, and 60% of Lavash bread in Zahedan, Gorgan, and Eslamshahr, respectively contained baking

Table 1: Frequency Distribution of Different Kinds of Bread in Terms of the Standard pH in Different Seasons in Zanjan.

Season	pH								
	Lavash			Barbari			Others		
	Standard	Nonstandard	Total	Standard	Nonstandard	Total	Standard	Nonstandard	Total
Spring	67(88.2%)	9(11.8%)	76(100%)	6(40%)	9(60%)	15(100%)	4(66.7%)	2(33.3%)	6 (100%)
Summer	32(88.9%)	4(11.1%)	36(100%)	6(66.7%)	3(33.3%)	9(100%)	17(100%)	0(0%)	17(100%)
Fall	37(68.5%)	17(31.5%)	54(100%)	1(11.1%)	8(88.9%)	9(100%)	4(66.7%)	2(33.3%)	6(100%)
Winter	100(61%)	64(39%)	164(100%)	21(47.7%)	23(52.3%)	44(100%)	9(64.3%)	5(35.7%)	14(100%)

Table 2: Frequency Distribution of Different Kinds of Bread in Terms of the Standard amount of Salt in Different Seasons in Zanjan.

Season	Salt								
	Lavash			Barbari			Other breads		
	Standard	Nonstandard	Total	Standard	Nonstandard	Total	Standard	Nonstandard	Total
Spring	66(86.8%)	10(13.2%)	76(100%)	10(66.7%)	5(33.3%)	15(100%)	4(88.3%)	2(11.7%)	6(100%)
Summer	33(91.7%)	3(8.3%)	36(100%)	8(88.9%)	1(11.1%)	9(100%)	17(100%)	0(0%)	17(100%)
Fall	50(92.6%)	4(7.4%)	54(100%)	42(95.5%)	2(4.5%)	44(100%)	6(100%)	0(0%)	6(100%)
Winter	163(99.4%)	1(0.6%)	164(100%)	68(88.3%)	9(11.7%)	77(100%)	14(100%)	0(0%)	14(100%)

soda, and 39.1% of Barbari bread in Kashan contained the highest amount of baking soda.

The national mean total use of baking soda showed the maximum and minimum use of baking soda respectively in Barbari bread with frequency of 21.2% and Taftoon bread [3]. In Zanjan, the most frequent use of baking soda was respectively observed in Barbari (55.8%) and Lavash (28.5%) bread. This result revealed that the frequency percentage of baking soda used in Barbari bread in Zanjan was also higher than the total national mean by 34.5%. Baking soda is mostly used in bread when the flour has a poor quality, or managers, workers, and those involved in bakeries have not acquired necessary knowledge and instructions. Most of the time, bakers use baking soda instead of yeasts to prepare the dough faster due to their shortage of time and faster preparation of the dough. The results of this study indicated that Barbari bread contained higher amount of baking soda than other kinds of bread. Given that the bread supplies over one third of calorie of Iranians, special attention should be

paid to the quality of bread. The knowledge necessary for those involved in baking bread can be provided through training programs.

Furthermore, the increased supervision of health care professionals and continuous collection of bread samples can reduce the use of baking soda and improve the quality of bread. Regarding results of this study, required instructions about disadvantages of baking soda are suggested to be taught to people working in bakeries in order to improve their knowledge and attitude in this regard. As the frequency percentage of baking soda used in Barbari and Lavash bread in Zanjan is much higher than the total national mean, health center professionals can be very effective in reaching the goal of not using baking soda in breads through increasing their routine inspections, teaching the instructions to bakery workers in bakeries, and seriously dealing with violators if they repeat using baking soda.

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