ORIGINAL RESEARCH ARTICLE UHD JOURNAL OF SCIENCE AND TECHNOLOGY

Determination of Potassium Bromate in Bread Brands in Sulaimani City, Kurdistan-Iraq

Sardar M. Weli[1], Sabiha M. Salih[2], Abdullah A. Hama[2,3]*, Ary B. Faiq[2], Fatimah M. Ali[4]

[1]Department of Nursing and Research Center, College of Health and Medical Technology, Sulaimani Polytechnic University, Kurdistan Region, Iraq, [2]Department of Medical Laboratory and Research Center, College of Health and Medical Technology, Sulaimani Polytechnic University, Kurdistan Region, Iraq, [3]Department of Medical Laboratory Science, College of Health Science, University of Human Development, Kurdistan Region, Iraq, [4]Department of Nursing and Research Center, Sulaimani Technical Institute, Sulaimani Polytechnic University, Kurdistan Region, Iraq

ABSTRACT

Bread is the most consumed and staple food in many countries worldwide. It is made from dough of flour such as wheat and barley, and water. It usually contains flour improver potassium bromate ($KBrO_3$) which is used by bakers. However, many studies have confirmed the deleterious effects of $KBrO_3$ on human health. Therefore, this study aimed to determine the rate of $KBrO_3$ in five main types of bread in Sulaimani city, Kurdistan-Iraq. The duration of the study was from August 2021 to November 2021. Thirty bread samples were collected from five main products that are extremely consumed by Kurdish citizens. The bread-type products were bakery bread (Nani frn), white hamburger bread (Samun), white bread known as Kurdish bread (Nani Hawrami), pizza, and brown barley bread. Single beam UV–visible spectrophotometer APEL-303 was used for the quantification of $KBrO_3$ in bread samples. The results found that all 30 samples were had $KBrO_3$ residues in their products with different concentrations. Samples of brown barley bread were having the least content of $KBrO_3$ while samples from pizza dough were having the highest concentration of $KBrO_3$. The present study concludes that all bread samples from five major bread types had potassium bromate above the permitted levels allowed by the United States Food and Drug Agency (FDA).

Index Terms: Potassium Bromate, White Bread, Barley Bread, Flour Improver, Spectrophotometer

1. INTRODUCTION

Bread is the most consumed and staple food in many countries around the world. It is made from dough of flour such as wheat and barley, and water. It usually contains several ingredients such as table salt, sugars, flavors, and flour improver [1]. Potassium bromate ($KBrO_3$) was commonly used due to its low cost and acts as a slow oxidizing agent and it makes the dough more strength, and more elastic [2]. Many studies have confirmed the deleterious effects of potassium bromate on human health. For example, according to a study done on mice, potassium bromate administration caused impairment in renal and hepatic tissues. It also increased plasma creatinine levels and decreased antioxidant capacity [3]. Another study found that $KBrO_3$ exposed mice had increased lipid peroxidation, protein oxidation, and numerous degenerative changes in the cerebellum tissues [4]. In addition, important vitamins in bread such as thiamine (B1) and Niacin (B3) were destroyed by the effects of $KBrO_3$. Carcinogenic and mutagenic effects of $KBrO_3$ were also confirmed in experimental animals [5]. The Center for Science and Environment (CSE) [6] indicated that some

Access this article online

DOI: 10.21928/uhdjst.v1n1y2017.pp76-79

E-ISSN: 2521-4217
P-ISSN: 2521-4209

Corresponding author's e-mail: Abdullah A. Hama, Department of Medical Laboratory and Research Center, College of Health and Medical Technology, Sulaimani Polytechnic University, Kurdistan Region, Iraq, and Department of Medical Laboratory Science, College of Health Science, University of Human Development, Kurdistan Region, Iraq. E-mail: abdullah.hama@spu.edu.iq

Received: 04-03-2022 Accepted: 07-04-2022 Published: 19-05-2022

studies found the link of bromate to cancer, so the global scientific expert committees and CSE suggested reducing the allowed limit of use; also, they recommended that $KBrO_3$ should not be used as a flour treatment agent.

Many studies have proofed that potassium may be cause detrimental health effects in humans [7,8], also in the same area (Metropolis Rivers Stat, Nigeria), the concentration of $KBrO_3$ in all samples was above the allowed concentration and the authors advised the consumer of read from the study area the bread conduction may be of harmful for our health [9]. Due to the harmful effects of this substance, many countries, including France, the United Kingdom, and Canada, have removed $KBrO_3$ from the list of acceptable additive substances to flour [10]. However, the maximal permitted dose of $KBrO_3$ in bread in other countries such as Japan, China, and the USA is 10 mg/kg, 50 mg/kg of flour mass, and 0.02 mg/kg, respectively [11], the most studies indicate that potassium bromate in bread concentration was exceeded the acceptable limit of 0.02 μg/g set by FDA, in Delta State, all 15 bread brand samples was contained a higher concentration of $KBrO_3$ than permitted range [12] and the authors sate that this can be very dangerous for the bread consumers in the study area, and in the study in Erbil, the level of $KBrO_3$ was found to be more (6.66 mg/L–67.45 mg/L) than the permissible limit set by FDA [13]. This study aimed to determine the level of $KBrO_3$ in different types of bread in Sulaimani city, Kurdistan-Iraq.

2. MATERIALS AND METHODS

2.1. Collection of Samples

Bread samples were collected during the day (morning and afternoon) from different bakeries and from different locations in Sulaimani city from August 2021 to November 2021. The locations were the city center, Ibrahim-pasha, Ibrahim-Ahmad, Kani-BA, Sarchnar, Tui-Malik, and Family-mall. Thirty bread samples were collected from five main products that are extremely consumed by Kurdish citizens. The bread-type products were bakery bread (Nani frn), white hamburger bread (Samun), white bread known as Kurdish bread (Nani Hawrami), pizza, and brown barley bread.

2.2. Preparation of Samples

Samples were prepared according to a procedure that has been described and used by Abdulla and Hassan [14]. A small part (about 2 cm) in the center of each bread sample was dried in the oven for 72 h at 55°C. After drying, the sample was ground with an electric grinder to a powder. A 2.5 g of the powder were dissolved in 25 ml of distilling water. After centrifuging, the liquid fraction was diluted to 50 ml.

2.3. Standard Preparations

A stock solution of 200 ppm potassium bromate ($KBrO_3$) was prepared by dissolving 0.200 grams of $KBrO_3$ into 1 L of distilling water. The standard series solutions of potassium bromate were prepared from the stock solution at 0, 4, 12, 20, and 40 ppm.

2.4. Method

A 5 ml of standard or sample solution was mixed with 5 ml of 1% KI, 10 ml of 0.1 N HCl, and then completed to 100 ml. The standards and samples were read after 10 min by a single beam UV–visible spectrophotometer APEL-303 at wavelength 420 nm with a calibration curve used for quantification of the samples.

2.5. Data Analysis

Data were entered into a Statistical Package for the Social Sciences "SPSS" version 26 for the storage and statistical analysis. The one-way ANOVA test was applied to test for association between different groups, with $P = 0.05$ or less considered significant.

3. RESULTS

The results of this study found that all 30 samples from five main types of bread contained different amounts of $KBrO_3$ residues in their products. Sample number 26 (brown barley bread) had the least content of $KBrO_3$ while sample number 21 (pizza dough) had the highest concentration of $KBrO_3$ (Table 1). The calibration curve of this study was shown (Fig. 1).

In addition, this study has found that the concentrations of $KBrO_3$ were highest in the pizza group and lowest in the brown barley bread group. The means and standard error of all groups with significant differences between each group of bread types are shown in Table 2 and Fig. 2. There were differences in the means of all groups. However, there were no significant differences between Kurdish bread, white bakery bread, and brown barley bread. On the other hand, there was a significant difference between pizza flour, brown barley bread, and Kurdish bread.

4. DISCUSSION

This study was carried out to determine the level of potassium bromate ($KBrO_3$) in the bread samples and to find the

TABLE 1: Concentrations of potassium bromate (ppm) in all bread samples

Samples	Type of breads	Quantity of $KBrO_3$ (ppm)
1	Kurdish bread (Nani Hawrami)	9.747
2	Kurdish bread (Nani Hawrami)	9.747
3	Kurdish bread (Nani Hawrami)	7.58
4	Kurdish bread (Nani Hawrami)	6.137
5	Kurdish bread (Nani Hawrami)	4.693
6	Kurdish bread (Nani Hawrami)	5.415
7	White hamburger bread (Samun)	14.801
8	White hamburger bread (Samun)	11.913
9	White hamburger bread (Samun)	21.227
10	White hamburger bread (Samun)	10.65
11	White hamburger bread (Samun)	16.968
12	White hamburger bread (Samun)	21.227
13	White bakery bread (Nani frn)	7.581
14	White bakery bread (Nani frn)	13.791
15	White bakery bread (Nani frn)	12.635
16	White bakery bread (Nani frn)	10.65
17	White bakery bread (Nani frn)	16.968
18	White bakery bread (Nani frn)	5.415
19	Pizza flour	11.913
20	Pizza flour	9.747
21	Pizza flour	29.783
22	Pizza flour	26.534
23	Pizza flour	27.076
24	Pizza flour	21.227
25	Brown barley bread	7.581
26	Brown barley bread	4.693
27	Brown barley bread	5.415
28	Brown barley bread	6.859
29	Brown barley bread	9.747
30	Brown barley bread	6.137

TABLE 2: Concentrations of $KBrO_3$ (ppm) in all five groups of bread samples

Group number	Type of bread	Concentrations of $KBrO_3$ Means±SE
1	Kurdish bread (Nani Hawrami)	7.22±2.18 A
2	White hamburger bread (Samun)	16.13±4.52 BE
3	White bakery bread (Nani fern)	11.17±4.22 AB
4	Pizza flour	21.05±8.41 CB
5	Brown barley bread (Nani Jo)	6.74±1.79 AD

Values are presented as means±SE (*n*=6 sample/group). Different capital letters denote significant differences between groups (*P*<0.05).

highest and lowest concentrations of $KBrO_3$ in different types of bread. Thirty samples from five major consumed types of bread were analyzed and $KBrO_3$ was found in all samples. According to the US Food and Drug Agency (FDA), the amount of $KBrO_3$ in bread higher than 0.02 μg/g (0.00002 parts per million) is considered not safe for human consumption [15]. All 30 samples of the present study were having concentrations of $KBrO_3$ higher than the national permitted levels so that none of the bread of all major types in

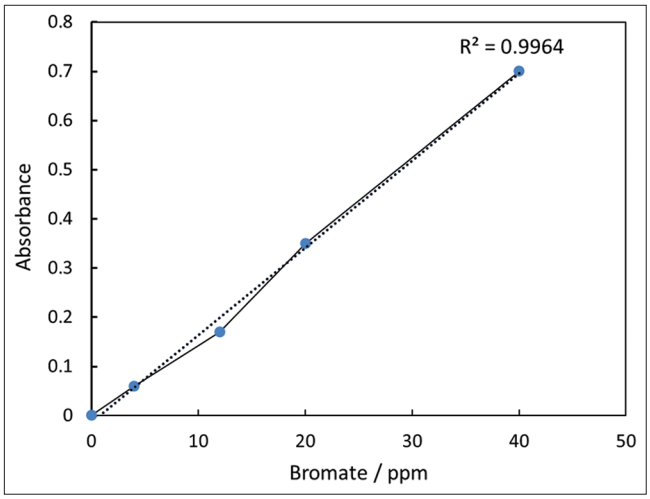

Fig. 1. Calibration curve.

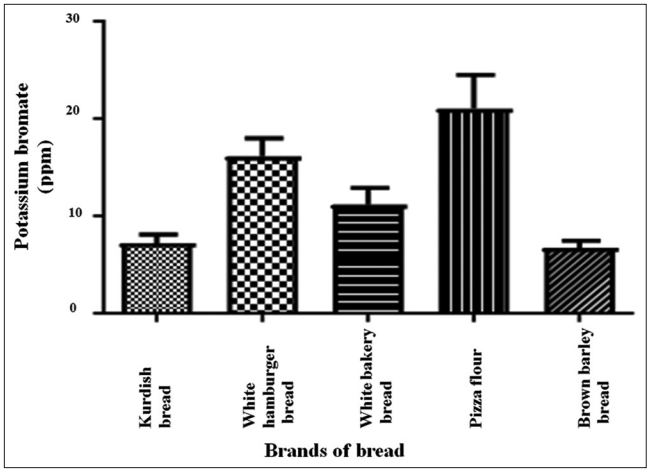

Fig. 2. Concentrations of $KBrO_3$ (ppm) in all five groups of bread samples. Values are presented as means ± SE (n=6 sample/group).

Sulaimani city might be unsafe for human consumption. This is in agreement with a study done in Hawler city, Kurdistan Region of Iraq; they found that the residual bromate level in the analyzed bread samples by spectrophotometer was in the range from 6.66 mg/L to 67.45 mg/L [13]. In addition, a study in Iraq (Baghdad city) found that electrical Samun and loaf had 10 and 0.3 μg/g potassium bromate, respectively. These levels were higher than the permissible level by the US Food and Drug Agency (FDA). They also found the exposed bread industry workers were elevated in chromosomal aberrations (CA), represented by chromatic breaks (CB), micronuclei (MN), and ring chromosome (RC) [16]. Another study in Iraq (Basrah city) found the harmful effects of potassium bromate on both hematological and biochemical parameters in rats. Liver enzymes (A.L.T and A.S.T) were increased and blood

parameters (RBC, Hb, WBC, and PCV) were decreased [17]. A recent study which is done in Dhaka city in Bangladesh showed that 67% of collecting samples were had $KBrO_3$ above the permitted level [18]. The present study also found that there were different concentrations of residues of $KBrO_3$ in different types of bread. The concentrations of $KBrO_3$ were highest in the pizza group and lowest in the brown barley bread group. This agrees with a study done in Tunis country. They observed different concentrations of bromate residues in different types of bread. The muffin contained the highest mean concentration of bromate residue as opposed to bread without salt, which had the lowest mean bromate level [6]. Moreover, a study in Nigeria found that 25% of the bread samples were had potassium bromate above the permissible limit allowed by the US Food and Drug Agency (FDA) and explained that these samples are unsafe for human consumption [19].

5. CONCLUSION

The present study concludes that all bread samples from five major bread types had potassium bromate above the permitted levels allowed by the US Food and Drug Agency (FDA). In general, all samples are unsafe for human consumption; however, the riskiest samples that have a greater concentration of potassium bromate were pizza flour and white bakery bread. The Kurdish bread and brown barley bread have a lower concentration of potassium bromate compared to others.

REFERENCES

[1] M. O. Emeje, S. I. Ofoefule, A. C. Nnaji, A. U. Ofoefule and S. A. Brown. "Assessment of bread safety in Nigeria: Quantitative determination of potassium bromate and lead". *African Journal of Food Science*, vol. 4, no. 6, pp. 394-397, 2010.

[2] A. Abu-Obaid, S. Abu-Hasan and B. Shraydeh. "Determination and degradation of potassium bromate content in dough and bread samples due to the presence of metals". *American Journal of Analytical Chemistry*, vol. 7, pp. 487-493, 2016.

[3] N. G. Altoom, J. Ajarem, A. A. Allam, S. N. Maodaa and M. A. Abdel-Maksoud, "Deleterious effects of potassium bromate administration on renal and hepatic tissues of Swiss mice". *Saudi Journal of Biological Sciences*, vol. 25, no. 2, pp. 278-284, 2018.

[4] H. B. Saad, D. Driss, I. Jaballi, H. Ghozzi, O. Boudawara, M. Droguet, C. Magne, M. Nasri, K. M. Zeghal, A. Hakim and I. B.Amara. "Potassium bromate-induced changes in the adult mouse cerebellum are ameliorated by vanillin". *Biomed Environ Sci*ence, vol. 32, no. 2, pp. 115-125, 2018.

[5] L. A. Alli, M. M. Nwegbu, B. I. Inyang, K. C. Nwachukwu, J. O. Ogedengbe, O. Onaadepo, M. A. Jamda, G. A. Akintan, S. O. Ibrahim and E. A. Onifade. "Determination of potassium bromate content in selected bread samples in Gwagwalada, Abuja-Nigeria". *International Journal of Health and Nutrition*, vol. 4, no. 1, pp. 15-20, 2013.

[6] A. Tewari and A. Khurana. "*Potassium Bromate/Iodate in Bread and Bakery Products*". Centre for Science and Environment, pp. 1-12, 2016. Available from: https://www.cseindia.org. [Last accessed on 2022 May 06].

[7] A. M. Magomya, G. G. Yebpella, U. C. Okpaegbe and P. C. Nwunujui. "Analysis of potassium bromate in bread and flour samples sold in Jalingo Metropolis, Northern Nigeria. *Journal of Environmental Science*, vol. 14, no. 2, pp. 1-5, 2020.

[8] N. A. Ugochukwu, O. Elechi and E. A. Ozioma. "Determination of bromate content of selected bread brands consumed within port harcourt and its environs". *Chemistry Research Journal*, vol. 4, no. 3, pp. 86-91, 2019.

[9] A. U. Naze, O. A. Epete and E.Owhoeke. "Bromate content in thirty different brands of bread baked in Port Harcourt Metropolis Rivers State, Nigeria". *Journal of Applied Sciences and Environmental Management*, vol. 22, no. 8, p. 1321, 2018.

[10] M. El Ati-Hellal, R. Doggui, Y. Krifa and J. El Ati. "Potassium bromate as a food additive: A case study of Tunisian breads". *Environmental Science and Pollution Research*, vol. 25, pp. 2702-2706, 2018.

[11] J. El harti, Y. Rahali, M. Ansar, H. Benziane, J. Lamsaouri, M. O. B. Idrissi, M. Draoui, A. Zahidi and J. Taoufik. "A simple and rapid method for spectrophotometric determination of bromate in bread". *Journal of Materials and Environmental Science*, vol. 2, no. 1, pp. 71-76, 2011.

[12] A. Uwague and O. C. Oghenekohwoyan. "Investigation into the health danger of potassium bromate in bread consumed in Sapele Town, Delta State". *International Journal of Modern Engineering Research*, vol. 7, no. 9, pp. 1-3, 2017.

[13] S. A. Narmin and A. H Media. "Spectrophotometric determination of bromate in bread by the oxidation of dyes". *Kirkuk University Journal-Scientific Studies*,vol. 4, no. 1, pp 31-39, 2009.

[14] N. S. Abdulla and M. A. Hassan. "Spectrophotometric determination of bromate in bread by the oxidation of dyes". *Journal of Kirkuk University-Scientific Studies*, vol. 4, no. 1, pp. 31-39, 2009.

[15] A. S. Ekop, I. B. Obot and E. N. Ikpatt. "Anti-nutritional factors and potassium bromate content in bread and flour samples in Uyo Metropolis, Nigeria". *E-Journal of Chemistry*, vol. 5, no. 4, pp. 736-741, 2008.

[16] A. Haleem. "Cytogenetic effects of potassium bromate $KBrO_3$ associated with Iraqi baking industry cytogenetic effects of potassium bromate $KBrO_3$ associated with Iraqi baking industry". *Indian Journal of Applied Research*, vol. 4, no. 6, pp. 10-12, 2015.

[17] S. A. Zainab and R. F. Ghadhban. "Effect of potassium bromate on some hematological and biochemical parameters and protective role of Vitamin C on laboratory rats (*Rattus rattus*). *Annals of the Romanian Society for Cell Biology*, vol. 25, no. 2, pp. 669-674.

[18] S. S. Mahmud, M. Moni, A. B. Imran and T. Foyez. "Analysis of the suspected cancer causing potassium bromate additive in bread samples available on the market in and around Dhaka City in Bangladesh". *Food Science and Nutrition*, vol. 9, pp. 3752-3757, 2021.

[19] H. I. Kelle, V. U. Oguezi and I. P. Udeozo. "Qualitative and spectrophotometric determination of potassium bromate in bread samples sold in Asaba, Delta State, Nigeria". *Pakistan Journal of Chemistry*, vol. 5, no. 2, pp. 93-95, 2015.