International Journal of Basic Science and Technology
October, Volume 10, Number 3, Pages 247 - 252 http://www.ijbst.fuotuoke.edu.ng/247
https://doi.org/10.5281/zenodo.13918445 **ISSN 2488-8648**

Assessment of Bread Safety of Some Bread sold in Asaba and Warri of Delta State

***Momah, M. and Adu, M.E.**
Department of Chemical Sciences, Faculty of Science, University of Delta, Agbor

Article Information

Article # 10037
Received: 9th April. 2024
Revision: 12th Sept. 2024
2nd Revision: 3rd Sept. 2024
Acceptance:29th Sept. 2024
Available online:
10th October, 2024.

Key Words
Bread, Cancer,
Potassium bromates,
Renal failure.
NAFDAC

Abstract

Bread is a staple food consumed daily by the majority of the population in Nigeria. Bakers often use additives such as potassium bromate to improve quality and enhance elasticity, despite its known harmful and toxic effects. This study assesses the presence and quantity of potassium bromate in bread samples sold in Asaba and Warri, Nigeria. A total of 22 bread brands were collected from retail shops in these cities and analyzed for potassium bromate concentration. Results revealed that all samples contained potassium bromate, with concentrations exceeding permissible limits, even in some samples labelled 'bromate free.' This indicates that the bread sold in these areas may pose significant health risks, including renal failure, cancer, and liver disease. Regulatory authorities (NAFDAC) must take immediate action. Additionally, alternative dough conditioners are highly recommended, and the ban on potassium bromate should be strictly enforced.

***Corresponding Author: Momah, M.**; momah.maxwell@unidel.edu.ng

Introduction

Production and consumption of bread has gained prominence in the lifestyle of many homes in Nigeria and over decades has played major roles in the feeding programmes of most Nigerians. The use of dough conditioners such as potassium bromate has gained unprecedented acceptance because of its great work as a dough improver as well as a maturing agent (Oloyede and Sunmonu 2009). Alli *et al.,* (2013) observed that potassium bromates carry out its action by oxidizing the sup-hydric group of gluten protein of the flour, which makes the dough less extensible and more elastic. Also, Emeje and colleagues (2015), opined that potassium bromate increases the loaf volume and by enhancing the texture of the bread thereby improving its elasticity, by holding the dough together, making it swell, thereby giving the bread an aesthetic beauty attractive to the consumers, who desire fluffy and soft loaf.

It has been observed that potassium bromate is a cheap and very good oxidizing agent used in bread production; hence bakers capitalized on this all-important characteristic to maximize profits. Also, in beer production, potassium bromide has equally been used to treat barley used to improve quality. Ati-Hellal *et al*.; (2018), in their study observed that during baking, potassium bromate can be converted to less toxic substance (potassium bromide by heat. However, Oyekunle *et al*., (2014) reported that when the quantity of potassium bromate is increased, it results in residual concentration in bread leading to toxic effects.

Potassium bromated is a colourless, odourless, tasteless white crystal that is soluble in water. It melts at 350ºC then decomposes at 370ºC. The baked bread bromate content is affected if the recommended limit is exceeded as well as using low temperatures for baking, these two factors result in elevated level of potassium bromate in bread and this is harmful to the consumer when such bread are consumed (Oyekunle *et al.,* 2014).

The possible carcinogenic effects of potassium bromate on humans prompted many organizations, and agencies on the need to ban the use of potassium bromate as flour additive (Chauhan and Jain 2016). Some countries such as the USA, Japan and China have recommended maximum acceptable doses for finished baked products as 0.02 mg/kg, 10mg/kg and 50mg/kg respectively (Kurokawa *et al*; 1990, Oyekunle *et al*; 2014,). The Food and Drug Administration (FDA) has recommended that concentrations below 75mg/kg or 50 mg/kg as acceptable level of potassium bromate in bread (Shanmugavel *et al.,* 2020). However, in 2003, National Agency for Food and Drugs Administration and Control (NAFDAC) in Nigeria outlawed the use of potassium bromate as a bread conditioner but despite this measure there are still high levels of potassium bromate in bread being produced and consumed in Nigeria, above permissible limits. Therefore, this study is to assess the level of compliance from Asaba and Warri areas of Delta State, Nigeria.

https://doi.org/10.5281/zenodo.13918445 ISSN 2488-8648

Materials and Methods

Study area

The study area was Asaba and Warri, both densely populated urban centres in Delta State. Asaba is the state capital while Warri is the commercial nerve centre of the state.

Sample Collection

A total of twenty – two different white breads were bought from bakeries and popular retail outlets in the capital city, Asaba, and the oil-rich town of Warri, Delta State Nigeria. Samples were randomly selected among the brands of bread produced and sold in the locality. Twelve samples were obtained from Asaba and ten samples from Warri City. The sample labels were removed and given a unique identifier to conceal the identity of the baker.

Preparation of Standard Calibration Curve for Potassium Bromate

A serial dilution method was used to prepare various concentrations (100, 200, 300, 400, 500, 600 mg/l) for the standard calibration curve of potassium bromate by dissolving 0.25g of potassium bromate ($KBrO_3$) in 250 ml of distilled water. This is achieved by adding 5ml of 1% potassium Iodide solution (freshly prepared) in 0.1N HCl to 5ml of the sample, the absorbance was read at 620nm. A standard calibration curve was prepared by plotting absorbance and concentration and used to determine the concentration of potassium bromate in all the samples.

Table 1: Standard calibration of Potassium Bromate

S/N	Conc. (mg/l)	Absorbance @ 620nm
1	100	0.044
2	200	0.064
3	300	0.075
4	400	0.101
5	500	0.124
6	1000	0.220

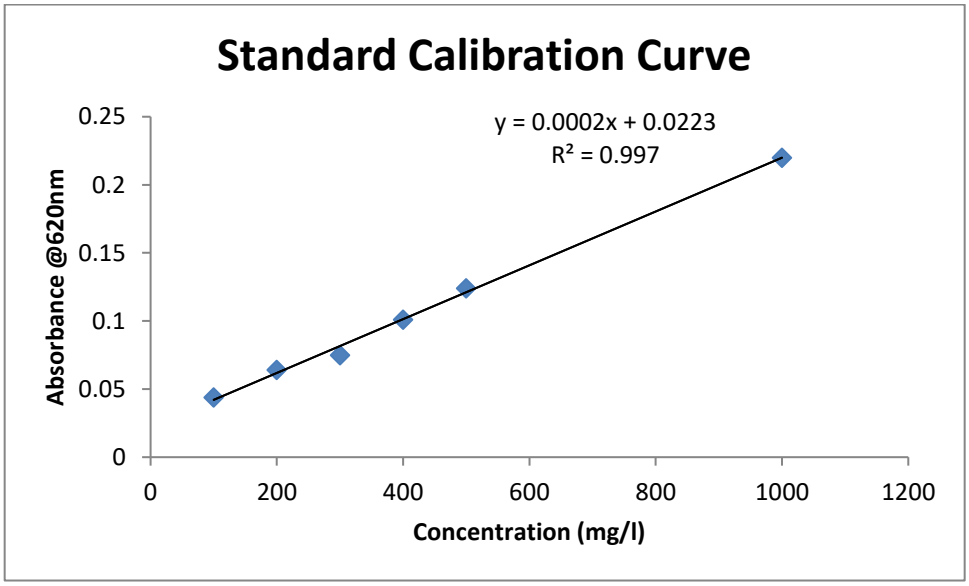

Fig.1: Standard calibration curve of potassium bromates

Quantitative Analysis of Potassium Bromate

Potassium bromate concentrations were measured using the spectrophotometric method, allowing for accurate quantification of its presence in bread samples. This was done by reading the absorbance from the qualitative analysis at 620nm using a UV-Vis spectrophotometer (752N PEC MEDICALS USA) and concentration was calculated from the standard calibration curve.

Statistical analysis

All data generated were analyzed statistically with Microsoft excel for the mean and variance of the concentration.

Results

Presented below is the result of the study which shows that all bread samples evaluated contain potassium

https://doi.org/10.5281/zenodo.13918445 ISSN 2488-8648

bromate. Sample A23 was observed to have the highest amount of potassium bromate (105.0212mg/g), closely followed by A6 (103.2553mg/g), A22 (98.14189mg/g) and A7 (96.14026mg/g) respectively. The least amount of potassium bromate was observed in A10 (53.28206mg/g) followed by A17 (64.36666mg/g) and A2 (64.75352mg/g) respectively.

Table 2: Potassium bromate concentration in bread samples

Sample ID	Colour	Mean Reading Abs @ 620	Mean Conc. (mg/l)	Mean Conc. (mg/dl)
A1	Purple	1.789333±0.006	8917.664±27.79	89.17664±0.28
A2	Light purple	1.305333±0.004	6475.352±19.10	64.75352±0.19
A3	Purple	1.743667±0.011	8687.226±58.92	86.87226±0.59
A4	Yellowish purple	1.418667±0.002	7047.243±10.51	70.47243±0.11
A5	Purple	1.480667±0.005	7360.1±22.76	73.601±0.23
A6	Dark purple	1.985±0.010	9905.018±48.66	99.05018±0.49
A7	Dark purple	1.927333±0.004	9614.026±20.39	96.14026±0.20
A8	Dark purple	1.809667±0.002	9020.27±7.71	90.2027±0.08
A10	Purplish yellow	1.078±0.021	5328.206±104.28	53.28206±1.04
A11	Dark purple	1.749±0.008	8714.14±40.37	87.1414±0.40
A12	Dark purple	2.068333±0.003	10325.53±15.42	103.2553±0.15
A13	Purple	1.604333±0.001	7984.135±2.91	79.84135±0.03
A14	Yellowish purple	1.323333±0.004	6566.182±19.10	65.66182±0.19
A15	Light purple	1.576333±0.003	7842.847±16.22	78.42847±0.16
A16	Purple	1.873667±0.005	9343.219±25.10	93.43219±0.25
A17	Purplish yellow	1.297667±0.011	6436.666±58.49	64.36666±0.58
A18	Purplish	1.656667±0.002	8248.213±11.65	82.48213±0.12
A19	Purple	1.649333±0.024	8211.211±123.33	82.11211±1.23
A20	Dark purple	1.875±0.006	9349.948±30.28	93.49948±0.30
A21	Purple	1.615±0.002	8037.963±8.74	80.37963±0.09
A22	Dark purple	1.967±0.003	9847.522±45.26	98.14189±0.45
A23	Dark purple	2.103333±0.005	10502.12±23.85	105.0212±0.24
NAFDAC			0.002	0.00002

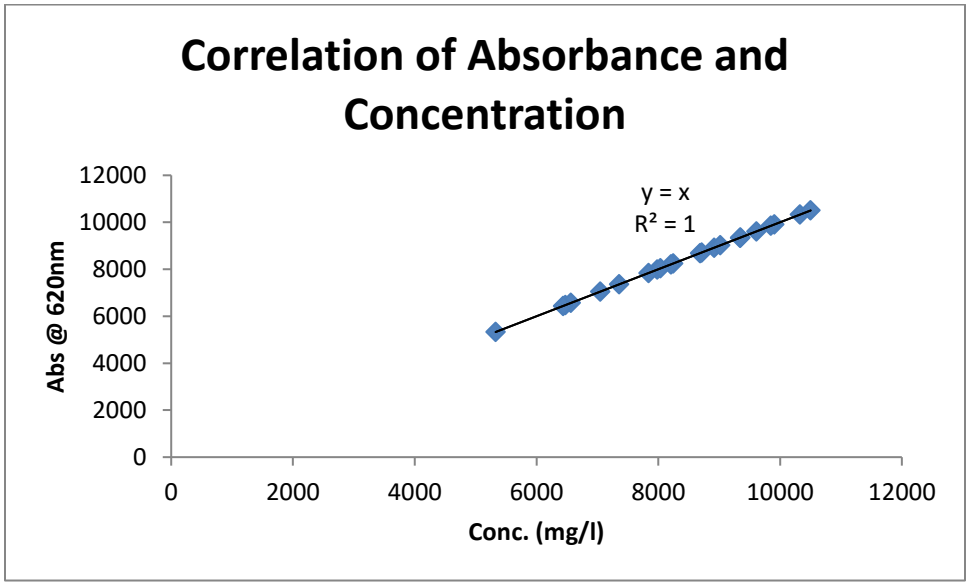

Fig.2: Correlation of Absorbance and Concentration of Samples

https://doi.org/10.5281/zenodo.13918445 ISSN 2488-8648

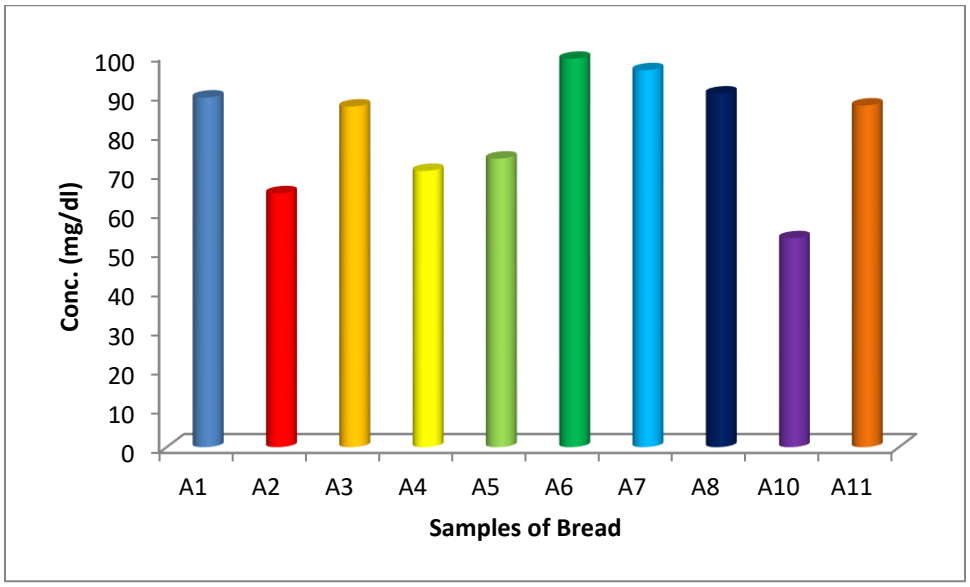

Fig.3: Potassium bromate concentration in samples of bread in Asaba

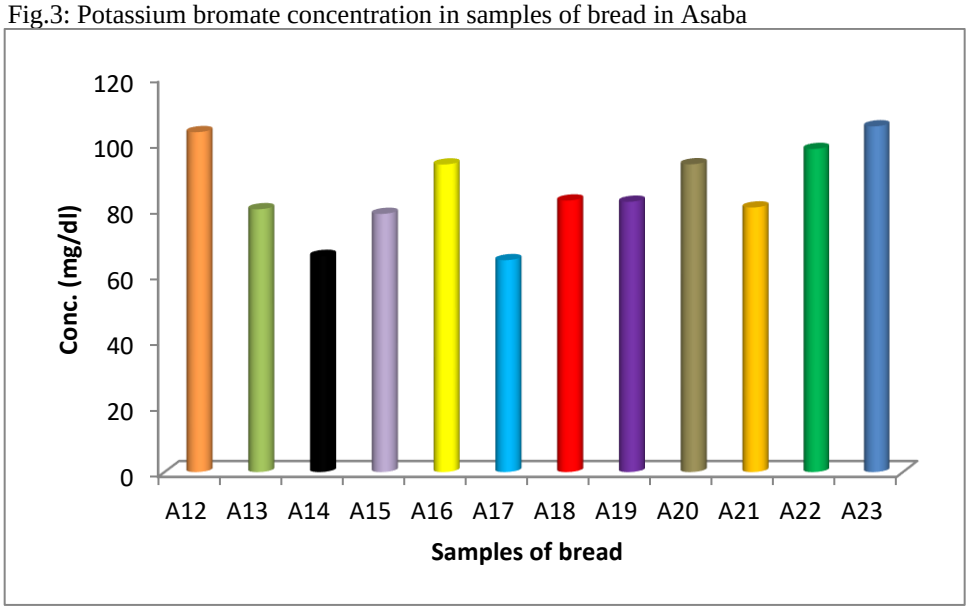

Fig.4: Potassium bromate concentration in samples of bread in Warri

Discussion

Consumption of bread as a staple food by every family especially in the urban areas has gained prominence where variety is the spice of life. In 2003, the National Agency for Food, and Drugs Administration Control (NAFDAC) outlawed potassium bromate as a bread enhancer due to its obnoxious effect on human health. Twenty years down the line, bakers still indulge in the use of potassium bromate for profit at the detriment of the well-being of the populace. Hence, this study is to assess the presence and concentration of potassium bromate of some bread sold in both Asaba and Warri City of Delta State.

The study observed the concentration of potassium bromate in the twenty- three bread samples exceeded the concentrations of 0.02mg/kg approved by NAFDAC as well as the permissible limits for USA (0.02 mg/kg), Japan (10 mg/kg) and China (50 mg/kg) for baked products. This is in tandem with an earlier report by Okwakpam *et al*., (2023) that did similar work in Port Harcourt and observed that all bread brands sold in Port Harcourt contain potassium bromate. These levels of potassium bromate pose a significant risk of chronic diseases, such as renal failure, cancer and liver diseases, according to WHO safety guidelines. In 1989, WHO (1989) warned against the addition of bromate to edible food due to its toxicological effects on the human system; however, Akunyili (2004), in her study opined that though potassium bromate may be harmful but

https://doi.org/10.5281/zenodo.13918445 **ISSN 2488-8648**

harmless as a bread additive since there is broken down of the substance to insignificant levels by heat during baking as earlier observed by Ati-Hellal *et al*., (2018).The result of Sample A10 aligned with the report of Abubakar and colleagues (2008) on a similar study in Sokoto and its environs. Oyekunle *et al*., (2014) in their report observed bromate concentration ranged from 6.33 – 41.336 mg/gin bread samples from Ile- Ife but Ojo *et al*; (2013), Obunwo and Konne (2014), reported bromate concentrations range of 0.5 – 8.4 mg/g and 0.12 – 7.28 mg/gin breads in Karu and Port-Harcourt, Nigeria respectively.

The study observed that all the samples contained potassium bromate concentration that exceeded the permissible limit of 0.02mg/g approved by NAFDAC (Ekop *et al.*, 2008). The import of this is that none of the test samples is safe for human consumption. This is in tandem with earlier observation of Abubakar et al., (2008). Also, factory workers in these bakeries are exposed to potassium bromate daily thereby making them vulnerable to diseases. Potassium bromate is poisonous to humans, when ingested as present in food, like bread or when inhaled (Emeje *et al.*, 2010). It is however unsafe for bread consumers and bread production workers, as this will expose them to the toxic effect of potassium bromate which may lead to terminal diseases at the long term.

Conclusion

It is therefore pertinent to conclude that the 22 bread samples investigated have elevated levels of potassium bromate far above the permissible limit of 0.002mg approved by NAFDAC. The cheap and effective oxidizing agent that produces high-quality bread has encouraged the use of potassium bromate by Nigerian bakers. This study calls for serious concern from regulators and underscores the imperative of regular monitoring by the government and its agencies to ensure strict compliance with regulatory standards for the safety of Nigerians that rely on the daily consumption of bread. Also, regulatory authorities (NAFDAC) must implement stricter enforcement of the ban on potassium bromate. Introducing safer alternatives, such as ascorbic acid or enzymes, could be viable solutions for improving bread quality without compromising public health.

References

Abubakar, M.G., Abbas, A.Y. and Faseesin, B.A (2008). Potassium content of bread Produce in Sokoto Metropolis, *Nigerian Journal Basic and Applied Science*, 16(2), 183-186.

Akuyili, N.D (2004). Potassium bromates in bread – wheat is the implication. *NAFDAC*., 1:13-21

Alli, L.A. Nwegbu, M.M. Inyang, B.I. Nwachukwu, K.C. Ogedengbe, J.O. Onaadepo, O. Jamda, M.A. Akintan, G.A. Ibrahim, S.O. and Onifade, E.A (2013). Determination of potassium bromated content in selected bread samples in Gwagwalada, Abuja-Nigeria. *International Journal Health & Nutrition*, 15-20

Ati-Hellal, M.E. Doggui, R. Krifa, Y. and Ati, J.E (2018). Potassium bromates as a food additive: a case study of Tunisian breads. *Environmental Science & Pollution*, doi: 10.1007/s11356-017-0712-9

Chauhans, D. and Jain, P.A (2016). Scientific study of genotoxic-carcinogenic impacts of Potassium Bromate as food additive on human health. *International Research Journal Engineering & Technology*, 3:1136-1139. (Google Scholar).

David, P. (1976). The Chemical Analysis of Foods. Seventh ed. Longman Group Ltd; London. (Google Scholar).

Ekop, A.S. Obot, I.B. and Nikpatt, E (2008). Anti-Nutritional Factors and Potassium Bromate Content in Bread and Flour Samples in Uyo Metropolis, *Nigeria Environmental Journal Chemistry*, 5(4):736-741.

Emeje, M.O. Ofoefule, S.I. Nnaji, .A C. Ofoefule, A.U. and Brown, S.A (2010). Assessment of bread safety in Nigeria: Quantitative determinations of potassium bromated and lead. *African Journal Food Science*,4(6) : 394 – 397

Emeje, M.O. Ifiora, B.I. Ezenyi, C.I. and Ofoefule, S.I (2015). Assessment of bread safety in Nigeria: one decade after the ban on the use of potassium bromate. *Journal of Food Process and Technology*, 6:394-397.

Kurokawa, Y. Maekawa, A. Takahashi, M. and Hayashi, Y (1990). Toxicity and carcinogenicity of potassium bromate-A new renal carcinogen.*Environmental Health Perspectives*, 87:309-335. (PMC free article) (PubMed) (Google Scholar).

Obunwo, C. C. and Konne, J. L. (2014). Measurement of levels of potassium bromate and some heavy metals in bread samples produced in Port Harcourt metropolis, Nigeria. *International Journal Applied Natural Science*, 3 (3) : 1-4

Ojo, R. J. Kajang, D. D. Adebayo-Gege, G. I. and Akintayo, C. O (2013). Analysis of Potassium Bromate and Hydrocyanic Acid Contents of Commonly Consumed Loaves of Bread and Wheat Flour Samples in Karu, Nasarawa State, Nigeria. *IOSR Journal Environmental Science, Toxicology & Food Technology*,6(1):42-46

https://doi.org/10.5281/zenodo.13918445 **ISSN 2488-8648**

Okwakpam, F.N. Felagha, I. and Ibiama, B.G (2023). Analysis of potassium bromate levels in bread brands sold in Rumuolumeni and Mile 3 areas of Port Harcourt metropolis, Nigeria. *Asian Journal Advance Research Reports*, 17(10): 208-212.

Oloyede, O.B. and Sunmonu, T.O. (2009). Potassium bromate content of selected bread samples in Ilorin, Central Nigeria and its effect on some enzymes of rat liver and kidney. *Food Chemistry & Toxicology*, 47:2067-2070. (PubMed) (Google Scholar)

Oyekunle, J.A.O. Adekunle, A.S. Ogunfowokan, A.O. Olutona, G.O. and Omolere, O.B (2014). Bromate and trace metal levels in bread loaves from outlets within Ile-Ife Metropolis, South-western Nigeria. *Toxicology Reports*,1:224-230. (PMC free article) (PubMed) (Google Scholar).

Shanmugavel, V. Santhi, K.K. Kurup, A.H. Kalakandan, S. Anandharaj, A. and Rawson, A (2020). Potassium bromate: effects on bread components, health, environment and method of analysis: a review. *Food Chemistry*, 311 (PubMed) (Google Scholar).

WHO(1989). Toxicology evaluation of certain food additives and contaminants; the 33rd meeting of the Joint FAO/WHO Expert committee.