Original Research Article

ANALYSIS OF POTASSIUM BROMATE LEVELS IN BREAD BRANDS SOLD IN RUMUOLUMENI AND MILE 3 AREAS OF PORT HARCOURT METROPOLIS

ABSTRACT

The use of potassium bromates as flour improver for bread making has gained wide acceptability all over the world because of its slow oxidizing action which strengthens bread dough and helps to create a good texture in the finished product. The potassium bromate content of selected bread samples mostly consumed in areas around two tertiary institutions in Rivers State was studied. Sixteen different bread brands were randomly obtained from bakeries and food vendors around Rumuolumeni and Mile 3 area of Rivers State. Samples were qualitatively and quantitatively analyzed using the methods of AOAC, 2005. The qualitative analysis was determined by a color change from yellow to purple indicating the presence of Potassium bromate while quantitative analysis was done using a UV spectrophotometer. Results for Rumuolumeni ranged from 0.02µg/g to 1.98µg/g while results from Mile 3 area ranged from 0.02µg/g to 1.51µg/g. The results showed that bread samples from all studied areas were higher than the permissible standard set by NAFDAC for bromate bread. It is recommended that regulatory bodies in Nigeria be more proactive in the enforcement of laws regarding food safety.

Keywords: Bread, Flour, Potassium bromate, Port Harcourt Metropolis, Food safety

INTRODUCTION

Bread makes up the dominant part of the human diet. It is prepared from doughs of wheat flour and water, usually by baking [1]. All through history, it has been well-known around the world and is one of the oldest artificial foods, having been of importance since the dawn of agriculture. In Nigeria, bread is an important food item because it is readily available and at a very low price. This makes it possible for all income earners to afford it. It is extensively consumed in homes, restaurants, and hotels [2]. The ever-growing popularity of bread may be associated with its convenience, high acceptability, high energy content, and low level of blood cholesterol associated with its consumption [3]. Water and flour are the major components of a bread recipe. They affect the bread's texture and crumb properties. The major challenge in both flour milling industries and bakeries is the baking quality of flour, which is determined by the capacity of the dough prepared from it to retain gas. As a result of the wide variation in the composition of flour, various treatments, and supplement conditioning agents (flour/bread improver) are added for strength during mixing, extensibility for molding, and also to increase loaf volume and texture.

Over the years, several improvers have been used but studies have shown some to be deleterious to health, thereby necessitating their ban. Potassium bromate is a flour improver that acts as a

maturing agent. It acts principally in the late dough stage giving strength to the dough during the late proofing and early baking [4]. Potassium bromate takes the form of white crystals or powder. It has been used as a dough conditional for the past 60 years. According to USDA, it improves dough processing properties, internal crumb quality, and low volume in concentration from a few to 75ppm, the highest concentration permitted by law. The mechanism by which bromate acts in the dough is complex and not well understood [5]. The use of potassium bromate has been a common choice among flour millers and bakers throughout the world because it is cheap and probably the most efficient oxidizing agent. It acts as a slow oxidizing agent throughout the fermentation proofing and baking process affecting the structure and the rheological properties of the dough. As a result, many bakeries use potassium bromate as an additive to assist in the raising process and to produce a texture in the finished product that is appealing to the public. In the early 1990s, the World Health Organization (WHO) discovered that potassium bromate if consumed has the capacity to cause such diseases as cancer, kidney failure, and several other related diseases. The adverse effect of potassium bromate on health and its health effects are divided into two categories. The first category deals with effects related to non-cancer effects. This includes its effect on the nutritional quality of bread. It degrades vitamins A2, B1, B2, and niacin which are the main vitamins available in bread [6].

Studies have shown significant differences in the essential fatty acid content of flour treated with bromate or in bread made from flour containing bromate [6].

In humans, potassium bromate can cause cough and sore throat when inhaled [7]. Abdominal pain, diarrhea, nausea, vomiting, and kidney, are some of the other non-cancer health problems associated with the ingestion of potassium bromate [8]. In Nigeria, bromate use in bread making was banned in 1993. However, some bread makers have continued to include potassium bromate in their bread. Hence, the need for continuous monitoring of the presence of potassium bromate in different bread brands baked and sold around mile 3 and Rumuolumeni area of Port Harcourt metropolis.

MATERIALS AND METHODS

Study area

Mile 3 and Rumuolumeni areas of Port Harcourt, Rivers State were selected for this study. Mile 3 is located at latitude 4° 47’ 24” N and longitude 6° 59’ 36” E. Rumuolumeni is located at latitude 4° 50’ 39” N and longitude 7° 0’ 14” E.

Sample collection

Sixteen different bread brands were randomly obtained from bakeries and food vendors around Rumuolumeni and Mile 3 area of Port Harcourt, Rivers State.

Analysis of Potassium Bromate Level in Bread

Bread samples were qualitatively and quantitatively analyzed for Potassium bromate using the method of Emeje et al. [2].

In the qualitative analysis, 1.0g of bread powder was weighed into different test tubes, and 10ml of distilled water was added to each. The mixtures were shaken and allowed to stand in a water bath at 28°c for 20 minutes, then samples were removed and cooled. 5.0ml of freshly prepared 5% potassium iodide solution in 0.1M hydrochloric acid was added, and the change in color of the solution from light yellow of the potassium iodide to purple color of the oxidized potassium iodide indicates the presence of potassium bromate.

Quantitative analysis was done by measuring the absorbance of the colored solution in a spectrophotometer at 620nm using the blank solution to set the machine at zero. The various concentrations of potassium bromate present in the samples were obtained by the plot of absorbance against concentration in the standard curve.

RESULTS

Table 1 shows Potassium bromate levels in bread sold around Rumuolumeni. Potassium bromate level ranged from 0.15µg to 1.98 µg.

Table 2 shows Potassium bromate levels in bread sold around mile 3 area. Potassium bromate level ranged from 0.024 µg to 1.51 µg.

Table 1: Potassium bromate level in selected bread samples in Rumuolumeni

Samples	Color reaction with potassium iodine (qualitative analysis)	Concentration of potassium Bromate (μg/g) (quantitative analysis)
A (CONTROL)		0.02 ± 0.0000^{a}
B	Dark Purple	0.77 ± 0.058^{b}
C	Light Purple	0.44 ± 0.045^{a}
D	Light Purple	0.54 ± 0.236^{a}
E	Dark Purple	0.78 ± 0.050^{b}
F	Yellow	0.15 ± 0.070^{a}
G	Dark Purple	0.75 ± 0.320^{a}
H	Dark Purple	1.23 ± 0.020^{b}
I	Dark Purple	1.98 ± 0.151^{a}

Values are expressed as Mean ± Standard error of mean (SEM) n = 3. Values with the same superscript within a column are not significantly different at ($p<0.05$).

Table 2: Potassium bromate level in selected bread samples in Mile 3

Samples	Color reaction with potassium iodine (qualitative analysis)	Concentration of potassium Bromate (µg/g) (quantitative analysis)
A (CONTROL)		0.02 ± 0.0000^{a}
B	Light Purple	0.024 ± 0.008^{b}
C	Light Purple	0.19 ± 0.054^{b}
D	Yellow	0.07 ± 0.007^{a}
E	Yellow	0.05 ± 0.001^{a}
F	Light Purple	0.16 ± 0.003^{b}
G	Light Purple	0.15 ± 0.001^{b}
H	Dark Purple	1.51 ± 0.049^{b}
I	Dark Purple	1.50 ± 0.0079^{b}

DISCUSSION

Potassium bromate in an acidic medium oxidizes potassium iodide to liberate iodine, to iodide and produce a purple coloration [9]. The color intensity is dependent on the concentration of potassium bromate in the reacting medium. In this study, a range of colour reactions was observed, ranging from light purple to dark purple. For Rumuolumeni, the concentration of Potassium bromate in the different bread brands reduced in the order of I > H > E > B > G > D > C > F. Results for Potassium bromate concentration in different bread brands around mile 3 decreased in the order of H > I > C > F > G > D > E > B. The concentration of potassium bromate in each of the sixteen (16) bread samples analyzed is higher than 0.02 µg/g, which is the permissible safe level of potassium bromate allowed in bread by NAFDAC. The result of this study corroborates the results of the studies carried out by Airaodion et al. [10]; Naze et al. [11] on the evaluation of Potassium bromate in bread in Ibadan metropolis and the determination of bromate content of selected bread brands consumed within Port Harcourt and its environs

respectively. Potassium bromate has been classified as a carcinogen. Furthermore, studies have shown that the consumption of potassium bromate comes with health complications in adults and children. Children exposed to 20mg-1g/kg body weight of potassium bromate, present with lethargy, depression of the central nervous system, and irreversible deafness, while adults exposed to potassium bromate present with abdominal pain, diarrhea, vertigo, oligouria few hours after exposure [12, 13]. Potassium bromate poses an additional risk to the health of bakery workers as a result of the inhalation of potassium bromide, a heat decomposition product of potassium bromate, which is toxic. The kidney is thought to be the main target organ affected by potassium bromate ingestion [14]. It is therefore imperative that regulatory bodies constantly monitor the use of potassium bromate by bakers as bread bakers in the areas studied continue to use potassium bromate at concentrations higher than what is stipulated by NAFDAC. Consequently, there may be future occurrences of carcinogenicity and other symptoms associated with chronic exposure to high levels of potassium bromate in the studied areas.

CONCLUSION

Bread is a basic meal commonly consumed by humans because it is readily available and affordable. Potassium bromate is a colorless and odorless crystal that is water soluble. It is useful for the preparation of lab reagents, as food additives, in the production of cosmetics, and as a flour improver. However, its use as flour improver in bread making, results in serious toxic effects such as chronic kidney and liver disease, and cardiovascular disease to humans who consume the bread. It is also known to affect the nutritional composition of bread because of its ability to destroy vitamins such as vitamins B1, and B2. It is recommended that regulatory bodies in Nigeria be more proactive in the enforcement of laws regarding food safety.

REFERENCES

1. Grotts L.M. (2017). Bread and butter etiquette. *Huffington Post*, 2-4.
2. Emeje, M.O., Ofoefule, S.I., Nnaji, A.C., Ofoefule a.u., & Brown, S.A. (2009). Assessment of bread safety in Nigeria; Quantitative determination of potassium bromate and lead. *African Journal of Food Science.* 4(6), 394-397.
3. Gaman, W. & Sherington, J. M. (2020). An Analytical and Kinetic Investigation of the Vanadium (V)-catalyzed Bromate oxidation of Bordeaux. *Analyst*, 95, 28 -31.

4. Kurokawa, Y., Akihiko, M., Takahashi, M. & Hayashi, Y. (2019). Toxicity and carcinogenicity of potassium bromate - *A New Renal Carcinogen. Enviromental Health Perspective*, 87, 309-335.
5. Destefanis, L.K. (2012). Spectrophotometric determination of bromated using promethazine. *International Journal of Current Research*, 5(8), 2236-2238.
6. IARC (2020). Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Toxicity and carcinogenicity of potassium bromate. *World Health Organization/International Agency for Research and Cancer, Lyon, France*, 35, 207-220.
7. Atkins, D. P. (1993). Potassium Bromate in Bread Index to MAFF-UK Food Surveillance Information Sheets. No. 2.
8. Atkins, D.P. (2015) Chemical food poisoning by potassium bromate. *New Zealand Medical Journal*, 65, 33-40.
9. Ekere, A.S., Odoh, T.T., Mkurzurum, C., & Ekere, G.O. (2020). Determination of potassiun bromate in bread samples in Jos metropolis. *Global Scientific Journals,* 8(4), 2320-9186.
10. Airaodion, A.I., Ewa, O., Ogbuagu, E. O. Ogbuagu, U., Agunbiade A. & Oloruntoba, A. (2019). Evaluation of potassium bromate in bread in Ibadan metropolis: Fifteen years after ban in Nigeria. *Asian food science journal,* 7(4), 1-7.
11. Naze, A.U., Owhoeke, E., & Ekpete, A.O. (2019). Determination of Bromate content of selected bread brands consumed within Port Harcourt and its environs. *Chemistry Research Journal*, 4(3), 86-91.
12. Shanmugavel, V., Komala, S.T., Kurup, A.H., Kumar, K.S., Anandharaj, A., & Rawson, A. (2019). Potassium bromate: effects on bread components, health, environment and method of analysis: a review, *Food Chemistry*, 311, 1-49.
13. Kumar, S., & Pankaj, P. (2012). Accidental potassium bromate poisoning in nine adults; case report. *Journal of Indian Academy of Forensic Medicine,* 34(4), 364-266.
14. Mode, M.A., Dandare, S.U., & Umar. R.A. (2023). Ban on the use of potassium bromate in Nigeria: A review on bread bakers compliance with regulations. *Journal of Applied Science and Environmental management,* 27(3), 401-419.