REVIEW ARTICLE

Assessment of Bread Safety: A Review of Potassium Bromate Level in Breads Sold and Consumed in Nigeria

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Abstract

Bread is a staple food across the world, especially in Nigeria. Potassium bromate is widely used by bakers to enhance bread elasticity, functionality, and quality. Due to its toxicity, the use of potassium bromate in bread production in Nigeria was banned by the National Agency for Food and Drug Administration and Control (NAFDAC); the regulatory agency for food and pharmaceutical products in 2003. This review aims to assess the compliance levels of potassium bromate used in the production of low and high-cost bread consumed across Nigeria. 17 selected articles across the six geopolitical zones were evaluated. This review identified that most of the bread sold and consumed in Nigeria contained potassium bromate in quantities above the permissible limit. Surprisingly, even bread labeled as "bromate-free", "with NAFDAC registration number" and sold at high-costs also contained potassium bromate in excess concentration. This implies that many bread sold in Nigeria are unsafe for human consumption. Due to the deleterious effects of potassium bromate, its continual usage and consumption above the safe limit is a threat to the total well-being of the consumers. Its use in the bread-making industry also poses a serious health occupational hazard to bakers. Bread makers should opt for other alternative dough conditioners such as ascorbic acid, glucose oxidase, and potassium iodate for bread production. NAFDAC should put in more proactive measures to ensure constant monitoring of food products pre-and post-production to guarantee adherence to its regulatory standards and the safety of human life.

Keywords: Bread, bromate, compliance, Nigeria

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INTRODUCTION

Bread from time immemorial has been one of man's oldest staple foods. Bread is often leavened during processing, especially in the West to ease mastication and make it lighter. Leavening bread is achieved by introducing either *Saccharomyces cerevisiae* (yeast), naturally occurring microorganisms, aeration (carbon dioxide) or gas-producing chemicals (baking powder or baking soda). Bread is a good source of dietary fibres, carbohydrates, vitamin B, iron, selenium, and magnesium. It is usually baked from a dough of flour and water, which are often combined with additives to improve its strength, flavor, loaf volume, texture, ease of production, among others (1). Dough conditioners, otherwise known as bread improvers or improving agents, are food additives added to the dough to improve its texture, strength, enhance its rising, functionality, and quality (2). Examples of dough conditioners include potassium bromate, calcium salts, ascorbic acid, ammonium chloride, and enzymes (amylases, proteinases, and lipoxygenases).

Potassium bromate ($KBrO_3$), a white crystalline powder is a colorless, odorless, strong oxidizing agent, commonly used as a dough conditioner to strengthen and allow higher rising of the dough, making the bread alluring to the consumers (3) and more profitable to the producers (4). Potassium bromate oxidizes the sulphydryl groups of flours' gluten protein; this increases its elasticity and makes it less extensible to retain carbon dioxide gas produced by the yeast used for leavening (3,5). Potassium bromate was permitted as a bread conditioner since bromate is converted to bromide, with no traces of it when exposed to heat during bread production (as shown in the equation below) (6). However, this is dependent on the quantity of potassium bromate used and the duration of exposure to optimal temperature (4).

$$2KBrO_3 \rightarrow 2KBr + 3O_2$$

Non-adherence to these normal conditions (minimal quantity and sufficient heat) results in the detection of traces of bromate in bread and the exposure of unsuspecting consumers to bromate during bread consumption (4,7). The use of potassium bromate as a food additive in bread production and consumption has a deleterious effect on human health and the nutritional value of the bread. It degrades the essential vitamins (A2, thiamine, riboflavin and niacin) and reduces essential fatty acid content in bread containing bromate (8,9). Exposure to potassium bromate has been linked to ototoxicity, sore throat, nausea, abdominal pain, cough, nephrotoxicity, etc., in humans (6,9). Evidence from experimental studies using animals has identified

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potassium bromate as highly toxic and carcinogenic, having the capacity to cause serious health problems (7,10). The International Agency for Research on Cancer (IARC) thus classified it as a category 2B carcinogen (possibly carcinogenic to humans) (10). This resulted in a ban on its use as a food additive in several countries including Nigeria, Canada, Argentina, China, Korea, and Sri Lanka; meanwhile, it is still permitted at a relatively low level (0.02 µg/g) in many countries (9). Humans can be exposed to potassium bromate when consumed as a food additive in bread or when used as a dough conditioner during bread production and also in contaminated drinking water as a result of ozone disinfection (10). In Nigeria, the regulatory body for food and drug products, National Agency for Food and Drug Administration and Control (NAFDAC) banned the use of potassium bromate as a dough conditioner in 2003, despite this; elevated levels (above the normal permissible limit) of potassium bromate are consistently detected in bread produced and consumed in Nigeria (3–6). This review is therefore aimed at assessing the level of compliance to this regulatory policy by evaluating recent studies from all the six (6) geopolitical zones in Nigeria. The findings of this review would help to evaluate compliance and to create awareness to regulatory authorities (NAFDAC, Standard Organization of Nigeria and Association of Bakers), policymakers, bakers or bread factories, and most importantly unsuspecting consumers about this practice and alternative ways to get the best out of bread production and consumption.

METHODS

A literature search was done in November 2020 on Google Scholar, ResearchGate, and PubMed using the keywords "potassium bromate", "bread safety", "toxicity" and "Nigeria". Preprints, reviews, and full-text articles that did not meet the objectives of this review were excluded. 17 selected articles representing all six geopolitical zones in Nigeria were found suitable and evaluated. Bromate level in bread was presented as mean ± standard deviation as obtained from each study. Basic arithmetic operations (mean and percentages) were carried out for statistical analysis.

RESULTS

Qualitative Analysis of Potassium Bromate Level in Bread

This method is often utilized to determine the presence of bromate in bread samples because of ease and low-cost effectiveness. Often, a small crumb (1.0 g) of bread from each sample is measured in a weighing balance. 10 ml of distilled water is added to the crumb in a test tube, shaken and allowed to stand 28 ± 10 °C for 20 minutes. A 5.0 ml volume is then decanted from the test tube, while a 5.0 ml volume freshly prepared 0.5 % potassium iodide in 0.1 N hydrochloric acid is added. Color change from the initial light yellow to purple indicates the presence of potassium bromate in the tested samples (8,11,12) due to the complex of potassium bromate with potassium iodide (6,8). The color intensity is directly proportional to the level of potassium bromate in the bread samples (8,11). Hence, the degree of coloration increases with an elevated level of potassium bromate. However, this qualitative method also comes with its limitation. An earlier report (13) has shown that at a minute concentration (sometimes slightly higher than the permissible 0.02 µg/g), this procedure shows no color change, thereby giving false confidence.

Quantitative Analysis of Potassium Bromate Level in Bread

An often-used method to measure the absorbance of the reaction mixture is used for the qualitative analysis in an ultraviolet-visible spectrophotometer. The absorbance (read at 620 nm) is converted to concentration with reference to Beer's calibration curve (8,14). The wavelength-dispersive x-ray fluorescence (WDXRF) method can also be used to determine the quantity of bromate in bread samples (15). The WDXRF can be carried out on solid bread samples and requires minimal sample preparation. The application of this method in calibrating bromine in bread showed high sensitivity in bromine quantification. The WDXRF methodology usage in bakery control contributed to the reduction in the use of bromate in baking industries in Córdoba, Argentina (15). Another commonly used method is the redox titration method which involves the titration of potassium iodide with the bread sample solution, 2M hydrochloric acid, the addition of a few drops of starch solution and titrated with 0.1M sodium thiosulphate to a colourless endpoint (11,16). An earlier report (16) in South-South, Nigeria has shown that both redox titration and Mohr's method were consistent with quantifying potassium bromate concentration in bread but the Mohr's method was more precise. Other proven methods for potassium bromate determination in bread samples include photometric and fluorimetric kinetics-based techniques, congo red and crystal violet oxidation methods (4), chemiluminescence flow injection and ion chromatography.

Comparative Analysis of Bread Sourced from Corporate and Local Bakeries in Nigeria

In many countries including Nigeria, bread has become a major food product eaten daily. Bread is often taken with beverages, margarine, beans, groundnut, mayonnaise, and scrambled egg or with just water. It has become a part of many cultures as you see it being served toasted during celebrations or bought in stores or from retailers in motor parks as gifts to parents, family members, neighbors, and well-wishers. There is a very high demand for bread, but too few corporate bakeries can meet this need occasioned by Nigeria's high population density (3). Most corporate breads are not affordable (≥1.31 dollars) in a country where about 42 % of the 205 million population live in extreme poverty (on less than 1 dollar a day) (17). Hence, the majority have to opt for low-cost bread. These challenges have created an enabling environment for many substandard and local bakeries to thrive.

NAFDAC is saddled with the responsibility of ensuring maximal compliance of all food products to regulatory standards in Nigeria. Bakeries who meet the regulatory standards are assigned a unique NAFDAC number, which indicates safe consumption of the product. Most corporate bakeries are open to regulatory inspections and monitoring,

which is not so in local bakeries (3). A lot of concerns have been raised on the issue of unlabeled, unbranded, and fake or no NAFDAC number on bread on sale. This raises a concern of tracing unhygienic and unwholesome bread to the exact bakery. A disheartening finding from an earlier report (8) identified labeled bread samples with the inscription "bromate-free" contained a higher concentration of potassium bromate than those without such inscription. Also, 14 of the 30 bread samples representing 46.67% in the study (8) were not registered with NAFDAC. Since they are not registered with the regulatory agency, it becomes hard for them to adhere to the regulatory standards and for NAFDAC to monitor their activities. In 2019, NAFDAC released a press statement to enforce a nationwide clampdown on bakeries involved in this unhygienic practice (18).

Due to the relatively high cost and better packaging of bread from corporate bakeries, it is expected that bread from this source will be fit for human consumption. Intimidating results were derived when a study (3) from Lagos, Nigeria which compared the level of bromate in bread produced from corporate and local bakeries. Potassium bromate present in bread from both local and corporate bakeries was studied. The lowest bromate level in bread loaves obtained from corporate bakeries was 1.18 ± 0.01 mg/kg (59 times above permissible limit) and 3.85 ± 0.01 mg/kg (193 times above permissible limit) from local bakeries, while the highest was 2.26 ± 0.01 mg/kg (113 times above permissible limit) from corporate bakeries and 11.13 ± 0.00 mg/kg (557 times above permissible limit) from local bakeries (3). This corroborates another report (6) from Lagos where all bread samples tested had potassium bromate above the permissible limit irrespective if they were low or high priced bread. Graphical representation of the mean potassium bromate levels according to geopolitical zones are as shown in Figure 1.

In a comparative study (14) of potassium bromate content of low and high-cost bread in Kebbi, Northern Nigeria, the potassium bromate content of bread sold for consumption was so alarming. The lowest bromate levels in fifteen (15) high-cost bread sampled were 4.93 µg/g (247 times above permissible limit) and 4.83 µg/g (242 times above permissible limit) from twenty (20) low-cost bread sourced locally, while the highest was 8.07 µg/g (404 times above permissible limit) from high-cost bread and 11.77 µg/g (589 times above permissible limit) from local bakeries (14). Surprisingly enough, 12 (60 %) of the low-cost and 10 (66.7 %) of the high-cost unhygienic bread have NAFDAC registration number on their label. This implies that many bread-making industries do not adhere to regulatory standards. Therefore, NAFDAC should put in proactive measures to ensure constant monitoring of food products available in the market to guarantee the safety of human life. Potassium bromate can also be ingested via inhalation (14), hence, bakeries who still use this improver are not only harming consumers but also exposing their factory workers to a class 2B carcinogen via occupational exposure. Workplace safety can be improved by a constant evaluation of workers' exposure to biological or chemical toxicants (19).

Health Hazards of Potassium Bromate on Human Health

As earlier mentioned, the use of potassium bromate has been banned in Nigeria due to the accompanying health hazards. Health effects due to potassium bromate consumption outweigh the economic benefits gained by baking industries (13,18). Earlier reports (8,11) have identified that the inhalation of potassium bromate causes sore throat, diarrhoea, nausea, and cough in lower doses,

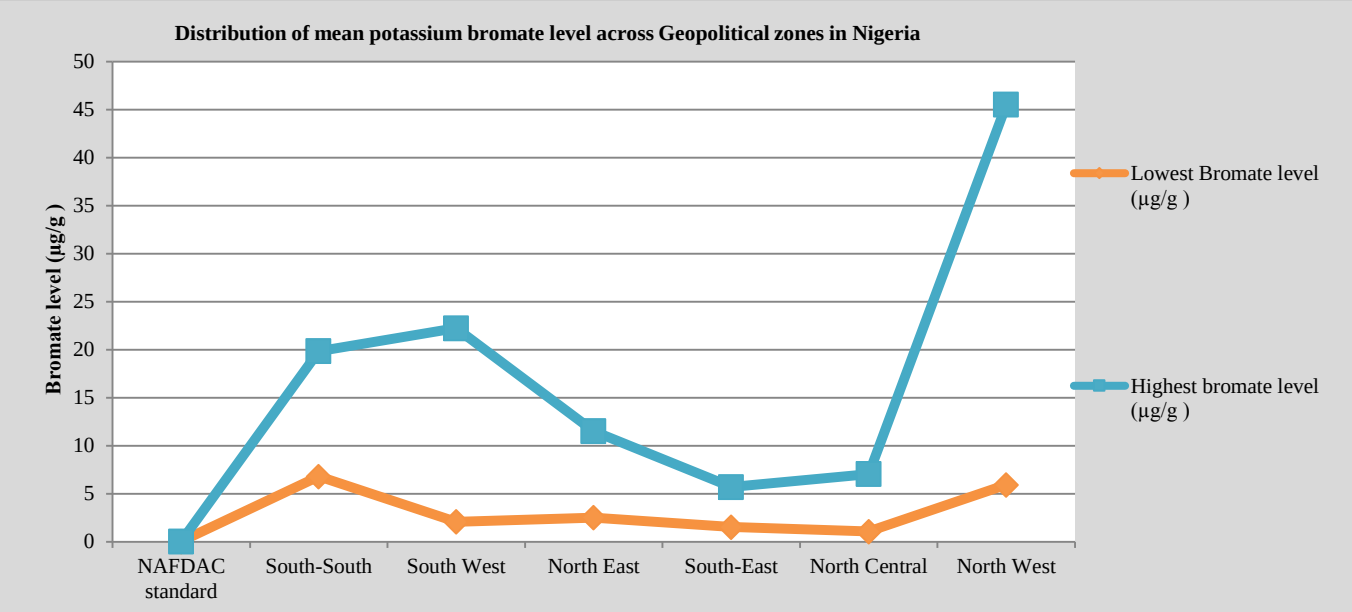

Figure 1. The mean distribution of potassium bromate level in bread samples across Nigeria

Table 1. Quantitative analysis of potassium bromate in bread across geopolitical zones in Nigeria

Study	Study area	Geopolitical zone	Bread samples tested	Lowest bromate level (µg/g)	Highest bromate level (µg/g)	The method used for quantitative analysis	Add.
(20)	Port Harcourt	South-South	10	0.12 ± 0.08	7.28 ± 2.14	Spectrophotometry	R
(4)	Uyo	South-South	4	6.66 ± 0.00	52.19 ± 0.00	Congo red oxidation	R
(16)	Port Harcourt	South South	30	0.01 ± 0.001	0.095 ± 0.024	Redox Titration and Mohr's methods	R
(3)	Lagos	South-West	5	1.18 ± 0.01	2.26 ± 0.01	HPLC and AAS	C
	Lagos	South-West	5	3.85 ± 0.01	11.13 ± 0.00	HPLC and AAS	L
(8)	Ibadan	South-West	30	1.24 ± 0.31	9.31 ± 0.43	Spectrophotometry	R
(21)	Ile-Ife	South West	9	2.05 ± 0.011	66.22 ± 0.014	Spectrophotometry	B
(13)	Ogbomoso	South West	25	0.02 ± 0.05	10.12 ± 1.53	Spectrophotometry	R
(11)	Jalingo	North East	20	2.51 ± 0.25	11.52 ± 0.10	Spectrophotometry	R
(22)	Aba North	South-East	13	0.42 ± 0.08	2.97 ± 0.18	Spectrophotometry	R
	Aba South	South-East	10	0.40 ± 0.04	2.89 ± 0.25	Spectrophotometry	R
	Osisioma	South-East	9	0.27 ± 0.04	2.99 ± 0.14	Spectrophotometry	R
(12)	Enugu	South East	23	1.16 ± 0.006	10.44 ± 0.003	Colorimetry	R
(2)	Awka	South East	10	5.31 ± 0.023	9.14 ± 0.024	AOAC	R
(5)	Abuja	North Central	18	2.46 ± 0.001	12.66 ± 0.003	Spectrophotometry	R, N
	Abuja	North Central	8	1.01 ± 0.116	2.76 ± 0.031	Spectrophotometry	R
(23)	Jos	North Central	10	0.25 ± 0.008	4.38 ± 0.041	Spectrophotometry	C
(1)	Nasarawa	North Central	14	0.5 ± 0.05	8.4 ± 0.12	Spectrophotometry	R
(14)	Birnin Kebbi	North West	20	4.83 ± 0.075	11.77 ± 0.089	Spectrophotometry	L, N
	Birnin Kebbi	North West	15	4.93 ± 0.04	8.07 ± 0.02	Spectrophotometry	C, N
(24)	Kaduna	North West	5	11.5 ± 0.03	12.10 ± 0.01	Congo red and crystal violet method	R
(11)	Zaria	North West	15	2.46 ± 0.35	13.60 ± 1.00	Iodometric titration method	R

Bromate level in bread is presented as Mean ± standard deviation as obtained from each study.
Key: samples marked R – randomly purchased, B – labeled as bromate-free, N – labeled with NAFDAC registration number, C – Purchased from corporate bakeries (high-cost bread), L – Low price bread.

while elevated exposure results in renal toxicity (9). It has also been associated with nephrotoxicity, hepatotoxicity, ototoxicity, and neurotoxicity in experimental models (8,11). In experimental studies (2) with animals administered potassium bromate (8.52 – 9.14 µg/g), there was a significant increase ($p<0.05$) in the AST and ALT enzyme activities. This suggests a significant sign of kidney and liver toxicity. The major concern on the use of potassium bromate as a bread improver is its identification as a class 2B carcinogen and mutagen (8,10) rendering it unsafe for human consumption. NAFDAC, the regulatory agency for food and drug products in Nigeria has also classified it as unsafe for human consumption and hitherto banned it in bread production (18).

Alternatives to Potassium Bromate in Bread Production

This review has shown that a decade after the ban of potassium bromate in Nigeria, it is still being used in the bread-making process above the set standard by NAFDAC. As bread is a common staple food in Nigeria, it is pertinent to raise the alarm that bread consumers and bread factory workers in Nigeria may be at the risk of health hazards, especially cancer due to the unscrupulous practice of bakeries. It could be deduced that bakers use potassium bromate to gain more profit due to its low-cost and efficiency as a maturing agent (4). Most consumers are unaware of the health risks associated with the consumption of these pieces of bread laden with bromate over a long time. This calls for a need to introduce and promote the use of alternate bread conditioners. The non-toxic ascorbic acid (Vitamin C), alongside a suitable enzyme (glutathione oxidase, glucose oxidase or hemicellulases) should be considered as a suitable alternative to the toxic potassium bromate in bread production (14). Other alternatives that could be considered are potassium iodate (KIO_3) and azodicarbonamide.

CONCLUSION

After a sufficient baking process (at high temperature and for about 25 minutes), potassium bromide is converted to a harmless bromide. Hence, at 50 mg/kg or less in flour, no residual potassium bromate would be detected in bread after production. However residual amounts of potassium bromide can be detected in bread if too much is added as a maturing agent, shorter baking time or at a low temperature. Against this backdrop, regulatory agencies in different countries have banned or have their permissible limit (often 0.02 µg/g) of

potassium bromate in bread. As revealed in this review, in a bid to gain more profit from unsuspecting consumers, or ignorance of bakers, potassium bromate is still detected in bread samples in very high quantities across Nigeria. Potassium bromate is regarded as a carcinogen. The findings from this present review call for a proactive measure from policymakers and regulatory agencies against the malpractices of bakers on the use of this food additive. Aside from enforcing the ban, it is also important to sensitize bakers on the health hazard of potassium bromate to consumers and their employees and to enlighten them about safer alternatives. We recommend a robust nationwide study on the compliance of the baking industry to the use of potassium bromate.

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REFERENCES

1. Johnson OR, Daniel KD, Iyabo AG, Oloruntoba AC. Analysis of Potassium Bromate and Hydrocyanic Acid Contents of Commonly Consumed Loaves of Bread and Wheat Flour Samples In Karu , Nasarawa State , Nigeria. IOSR J Environ Sci Toxicol Food Technol. 2013;6(1):42–6.
2. Okafor CS, Okeke D, Okoli CC. Determination of the Levels and Hepatic Effects of Potassium Bromate in Bread Samples sold in Awka Metropolis , Nigeria . Res J Sci IT Manag. 2013;2(3).
3. Dada EO, Akinola MO, Adewole OI, Ayobami PT, Braimoh BE. COMPARATIVE LEVELS OF BROMATE AND METALS IN BREAD LOAVES OBTAINED FROM CORPORATE AND LOCAL BAKERIES IN TWO COMMUNITIES OF LAGOS, NIGERIA. FUW Trends Sci Technol J. 2017;2(2):861–4.
4. Uwah EI, Ikwebe ED. Trace Metals , Potassium Bromate and Nutritional Potentials in Bread from Bakeries in Uyo , Akwa Ibom State , Nigeria. Am J Appl Chem. 2020;8(3):63–73.
5. Emeje O, Ifiora B, Ezenyi C, Ofoefule S. Assessment of Bread Safety in Nigeria : One Decade after the Ban on the Use of Potassium Bromate. J Food Process Technol. 2015;6(1):1–4.
6. Uduak A. Potassium Bromate Content of Bread Samples in Lagos City. Niger J Pharm Appl Sci Res. 2019;8(2):33–6.
7. Akinola BK, Olawuyi TS, Ogunmokunwa AE. The protective effects of Telfairia occidentalis on potassium bromate induced hepatotoxicity in adult Wistar rats. African J Biol Sci. 2020;2(3):51–61.
8. Airaodion AI, Ewa O, Ogbuagu EO, Ogbuagu U, Agunbiade A, Oloruntoba A. Evaluation of Potassium Bromate in Bread in Ibadan Metropolis : Fifteen Years after Ban in Nigeria. Asian Food Sci J. 2019;7(4):1–7.
9. Magomya A., Yebpella G., Okpaegbe U., Nwunuji P. Analysis of Potassium Bromate in Bread and Flour Samples Sold in Jalingo Metropolis , Northern Nigeria. IOSR J Environ Sci Toxicol Food Technol. 2020;14(2):1–5.
10. Potassium Bromate (IARC Summary & Evaluation, Volume 73, 1999) [Internet]. [cited 2020 Oct 21]. Available from: http://www.inchem.org/documents/iarc/vol73/73-17.html
11. Magomya AM, Yebpella GG, Udiba U, Amos H, Latayo M. Potassium Bromate and Heavy Metal Content of Selected Bread Samples Produced in Zaria , Nigeria. Int J Sci Technol. 2013;2(2).
12. Emeje M, Ofoefule SI, Nnaji AC, Ofoefule AU, Brown SA. Assessment of bread safety in Nigeria : Quantitative determination of potassium bromate and lead. African J Food Sci. 2010;4(6):394–7.
13. Airaodion AI, Awosanya OO, Ogbuagu EO. Assessment of Bread in Ogbomoso Metropolis for the Presence of Potassium Assessment of Bread in Ogbomoso Metropolis for the Presence of Potassium Bromate. Asian J Res Biochem. 2019;4(2).
14. Shemishere UB, Turaki A, Anyebe D, Bashir Y, Ogundipe E, Tajudeen Y. ESTIMATION OF THE POTASSIUM BROMATE CONTENT IN LOW AND HIGH PRICE BREAD SOLD IN BIRNIN KEBBI. FUW Trends Sci Technol J. 2020;5(2):417–20.
15. Perez RD, Leon AE. Bromate Determination by X-Ray Fluorescence (XRF) to Identify Pre-Baking Potassium Bromate Addition in Bread. Int J Food Prop [Internet]. 2010;13(1):167–75. Available from: https://doi.org/10.1080/10942910802256636
16. Ugochukwu NA, Elechi O, Ozioma EA. Determination of Bromate Content of Selected Bread Brands Consumed within Port Harcourt and Its Environs. Chem Res J. 2019;4(3):86–91.
17. [Internet]. 2020 [cited 2020 Dec 23]. Available from: https://worldpoverty.io/headline
18. Nationwide shutdown of bakeries over illegal unhygienic practices [Internet]. [cited 2021 Jun 15]. Available from: https://www.vanguardngr.com/2019/10/nafdac-threatens-nationwide-shutdown-of-bakeries-over-illegal-unhygienic-practices/
19. Nsonwu-anyanwu AC, Nsonwu MC, Bebia DP, Fabian UA, Offor SJ, Egete PD, et al. Chronic Exposure to Toluene and Heavy Metals and Changes in Indices of Liver Function , Inflammation and Oxidative DNA Damage among Automobile Workers. Asia Pacific J Med Toxicol. 2021;10(2):53–60.
20. Obunwo C, Konne JL. MEASUREMENT OF LEVELS OF POTASSIUM BROMATE AND SOME HEAVY METALS IN BREAD SAMPLES PRODUCED IN PORT HARCOURT METROPOLIS , NIGERIA. Int J Appl Nat Sci. 2014;3(3):1–4.
21. Oyekunle JAO, Adekunle AS, Ogunfowokan AO, Olutona GO, Omolere OB. Bromate and trace metal levels in bread loaves from outlets within Ile-Ife Metropolis , Southwestern Nigeria. Toxicol Reports [Internet]. 2014;1:224–30. Available from: http://dx.doi.org/10.1016/j.toxrep.2014.05.007
22. Irogbeyi LA, Ifeoma NN, Christian AG, Prince CU, Ebere CA. Evaluation of Levels of Potassium Bromate and Some Heavy Metals in Bread and Wheat Flour Sold in Aba Metropolis , South Eastern Nigeria. Asia Pacific J Med Toxicol. 2019;8:71–7.
23. Ekere A, Odoh T, Mkurzurum C, Ekere G. DETERMINATION OF POTASSIUM BROMATE IN BREAD SAMPLES IN JOS METROPOLIS. Glob Sci Journals. 2020;8(4):768–74.
24. Ojeka EO, Obidiaku M, Enukorah C. Spectrophotometeric Determination of Bromate in Bread by the Oxidation of Dyes. J Appl Sci Environ Manag. 2006;10(3):43–6.