Chemistry Research Journal, 2019, 4(3):86-91

Available online www.chemrj.org

Review Article

ISSN: 2455-8990
CODEN(USA): CRJHA5

Determination of Bromate Content of Selected Bread Brands Consumed within Port Harcourt and Its Environs

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Abstract Potassium bromate content analysis was carried out on different samples of bread using Redox Titration and Mohr's methods for bread samples sold in Port Harcourt Metropolis. The sampling was done according the flour type; which included cake, wheat and whole wheat breads. The Potassium Bromate was found in all the samples for both methods except sample R30 that was not detected. Redox method indicated that the wheat and whole wheat bread samples were all above the National Agency for Food Drug Administration and Control limit while samples R6 (0.023±0.015 mg/Kg), R7(0.025±0.016 mg/Kg), R8 (0.026±0.010 mg/Kg) and R10 (0.031±0.003 mg/Kg) from the cake bread were also above the limit. Mohr's method revealed high bromate content for all the samples which were higher than 0.020 mg/Kg NAFDAC limit. The mean were 0.046±0.008 mg/Kg and 0.040±0.008 mg/Kg for redox and mohr's method respectively. The findings from this work showed that bakers within Port Harcourt and its environs are still in the habit of using bromate at high concentration for bread baking.

Keywords Potassium bromate, Bread, Analysis, flour

Introduction

The use of Potassium bromate as flour improver has gained wide acceptability all over the world. This is due to its slow oxidizing action which give strength to the bread dough in the process of preparation of the bread. Bromate enhances bread extensibility for molding. In addition, it also helps the bread to rise, contributing to loaf volume, grain as well create a good texture in the finished product [1]. It also improves elasticity, holds the dough together, promotes the ability to swell, gives the bread aesthetic beauty for consumers, fluffy and soft [2]. These qualities of potassium bromate flour improver has made it to be in use for the past 80 years [3]. Bread improvers are used due to variations of the flour types employed in bread baking as it helps to advance the quality of the product. Potassium bromate has found its application not only in bread making but also for the treatment of barley used in beer making as a quality improver and also a quality improver for fish paste product. The chemical bromate is also found in most water because of the action of ozone on the bromide ion in the water which is carried out normally in the purification process of water in most industries in Nigeria [4].

Potassium bromate is a colourless, odourless and tasteless white crystal that is highly soluble in water. It has a melting point of 350 ^{o}C and decomposes at 370 ^{o}C. Potassium bromate transforms into potassium bromide at relatively high temperature during the baking process. The bromate content of the baked bread is affected by the

following conditions; exceeding the recommended limit and baking at a very low temperature. These conditions result to high concentration of bromate in the bread which may be harmful to the consumer.

Potassium bromate has wide effect on human health. However, research findings about the residual value in baked food made Food and Drug Administration (FDA) and World Health Organization (WHO) experts committees on Food and Adaptive in 1993 recommend that potassium bromate should not be used as additives in food product above 0.02mg/kg (Joint FDA/WHO committees on food/additives [5]). Toxicological assessment has shown that potassium bromate has adverse effects on human health, this is as follows; the first kind deals with effects related to non-cancer cause. This includes its effect on the nutritional quality of bread as it leads to degradation of vitamins A1, A2, A3, B1, B2, E and niacin which are the main vitamins available in bread [6]. Cough, sore throat, abdominal pain, diarrhea, nausea, vomiting, kidney failure, hearing impairment are some of the non carcinogenic health hazards associated with potassium bromate [3]. It has been classified as a 2B carcinogen (a possible human carcinogen) by the International Agency for Research of Cancer (IARC) because it was observed to induce cancer on rat [3].

Thus, the objective of this study is to check the concentration of bromate in selected bread samples consumed in Port Harcourt metropolis. This is to ascertain the risk of exposure to bromate by the public. The study will help to checkmate if producers still involved in bromate usage at high dosage beyond the recommended limit.

Materials and Methods

Sample Collection

The samples were collected according to the flour type; including cake, wheat and whole wheat breads. Ten for each flour type, a total of sixty (60) samples were analyzed, thirty (30) for each method (Redox and Mohr's method).

Redox Titration Method

Potassium bromate in the bread samples were analyzed using previously reported methods by Magomya *et al.,* [7] with little modification. 2g of each bread sample were weighed into a digestion flask.15ml of nitric acid and 4ml of perchloric acid were added and allowed to stay for 3mins. The mixture was heated at a temperature of 140-150 ^{o}C till a brown colouration fume changed to white colour. The resulting solution was diluted to 50ml with distilled water and used for the analysis. This method involves the titration of the bread sample solution both the digested and undigested with potassium iodide, 2M hydrochloric acid, few drops of starch solution were added and titrated with 0.1M sodium thio-sulphate to a colourless end point.

Mohr's Method Determination of Bromate in Bread

The Mohr's method as described by Otalekor [8], was used with slight modification. 5g of the representative bread sample was weighed into 100cm^3 digestion flask, 20cm^3 of concentrated Hydrochloric acid was added and heated until the brownish fume stopped evolving and the bread dissolved completely. The solution was allowed to cool and suction filtration was carried out. The filtrate was made up to 50cm^3 with distilled water; with the addition of 3cm^3 of ethanoic acid and 10 drops of eosin indicator. The filtrate was titrated with standard solution of silver nitrate with constant agitation until a distinct magenta colour appeared.

Results and Discussions

The result of potassium bromate substance carried out using Redox titration method and Mohr's method is shown in tables 1 and 2.

Table 1: Bromate in Bread using redox titration method (mg/kg).

Bread Samples	Concentration of Bromate (mg/Kg)
R1	0.011±0.001
R2	0.010±0.001
R3	0.010±0.002
R4	0.013±0.002
R5	0.019±0.001

R6	0.023±0.015
R7	0.025±0.016
R8	0.026±0.010
R9	0.019±0.003
R10	0.031±0.003
R11	0.030±0.014
R12	0.031±0.002
R13	0.034±0.011
R14	0.033±0.002
R15	0.031±0.002
R16	0.038±0.012
R17	0.051±0.023
R18	0.038±0.022
R19	0.094±0.024
R20	0.036±0.012
R21	0.035±0.003
R22	0.031±0.010
R23	0.025±0.012
R24	0.095±0.024
R25	0.093±0.013
R26	0.040±0.001
R27	0.040±0.002
R28	0.064±0.025
R29	0.038±0.010
R30	ND
Range	0.010-0.095
Mean	0.046±0.008
NAFDAC standard	0.02

ND= Non Detected, Mean ± Standard Deviation, R1-R10 represents cake bread, R11-R20 represents wheat bread, R21-R30 represents whole wheat bread. Analysis was done in triplicate.

Table 2: Concentration of Bromate in mg/kg using Mohr's method

Bread samples	Concentration of bromate (mg/Kg)
M1	0.035±0.002
M2	0.039±0.010
M3	0.032±0.010
M4	0.035±0.003
M5	0.034±0.001
M6	0.032±0.001
M7	0.033±0.012
M8	0.032±0.021
M9	0.034±0.002
M10	0.033±0.001
M11	0.038±0.002
M12	0.049±0.003

M13	0.049±0.001
M14	0.056±0.002
M15	0.038±0.010
M16	0.047±0.001
M17	0.053±0.023
M18	0.040±0.003
M19	0.047±0.012
M20	0.048±0.002
M21	0.051±0.021
M22	0.051±0.021
M23	0.039±0.003
M24	0.044±0.002
M25	0.060±0.023
M26	0.049±0.012
M27	0.036±0.010
M28	0.048±0.021
M29	0.040±0.002
M30	0.039±0.001
Range	0.032-0.060
Mean	0.040±0.008
NAFDAC standard	0.020

ND= Non Detected, Mean ± Standard Deviation , M1-M10 represents cake bread, M11-M20 represents wheat bread, M21-M30 represents whole wheat bread. Analysis was done in triplicate.

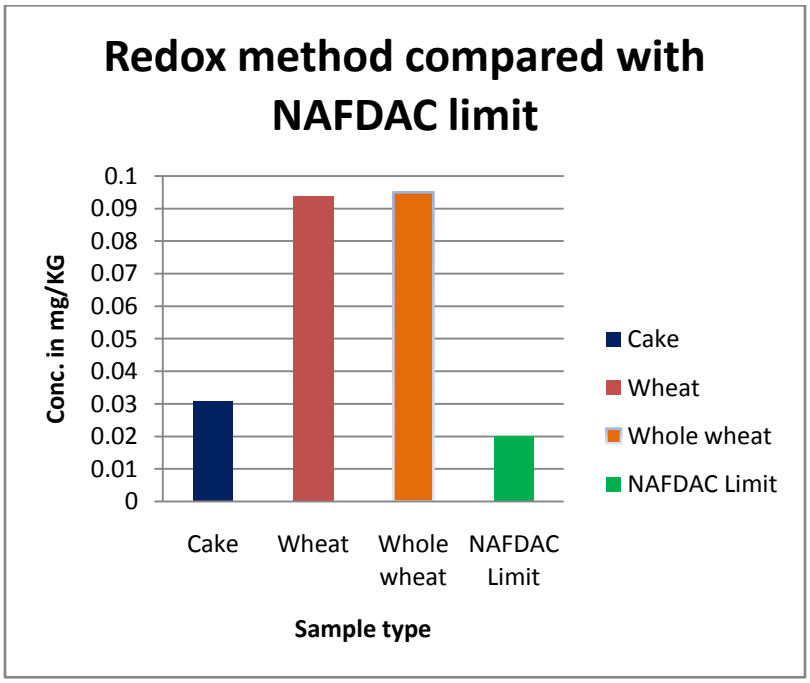

Figure 1: Bromate concentration in the different sample type compared with the NAFDAC limit

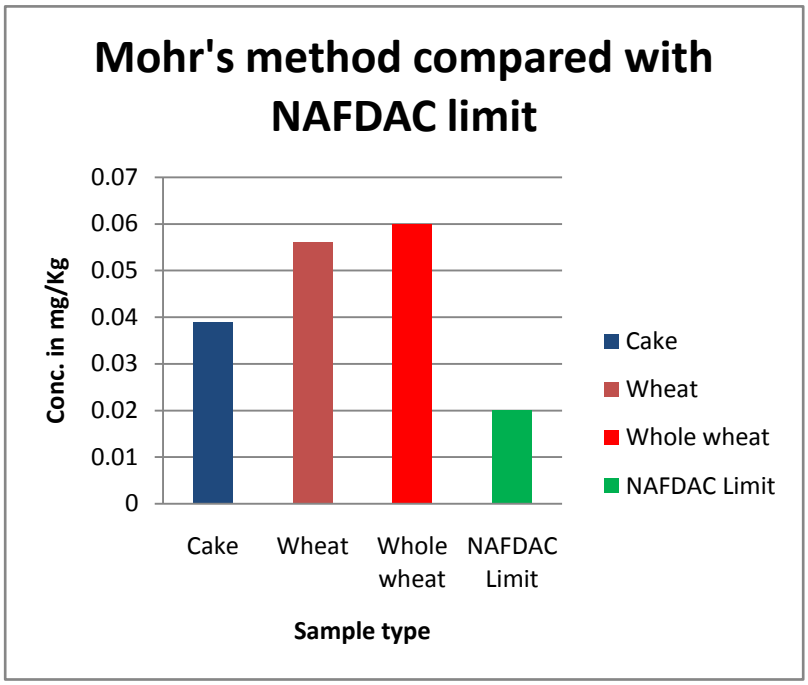

Figure 2: Bromate concentration of the different flour type compared with the NAFDAC limit.

Discussions

Table 1 above showed the result of potassium bromate in bread using the redox titration method. The samples were made of cake, wheat and whole wheat bread. The result indicated that the least concentration were R2 (0.010±0.001 mg/Kg) for cake bread, R11 (0.031±0.004 mg/Kg) for wheat bread and R23 (0.025±0.012) for the whole wheat samples respectively. The highest concentration was R10 (0.031±0.003 mg/Kg), R19 (0.094±0.024 mg/Kg) and R24 (0.095±0.024 mg/Kg) for cake, wheat and whole wheat bread samples. The table also showed that R30 was not detected by the test method, samples R6 (0.023±0.015 mg/Kg), R7 (0.025±0.016 mg/Kg), R8 (0.026±0.010 mg/Kg) and R10 (0.031±0.003 mg/Kg) for the cake bread samples were above the National standard limits for bromates in bread in Nigeria. The samples from the wheat and whole wheat bread were all above the standard limits of National Agency for Food Drug Administration and Control for potassium bromates in bread. Table 2 also showed that all the samples were above the standard of 0.020 mg/Kg of potassium bromate in bread. The samples with the highest concentrations were M2 (0.039±0.010 mg/Kg), M14 (0.056±0.002 mg/Kg) and M25 (0.060±0.023 mg/Kg) for the cake, wheat and whole wheat bread samples. M3 (0.032±0.010 mg/Kg), M11 (0.038±0.002 mg/Kg) and M30 (0.039±0.008mg/Kg) were least in concentration for the cake, wheat and whole wheat breads respectively. Figure 1 and 2 also shows the highest concentration for each flour type compared with the NAFDAC limit (0.020 mg/Kg).

The mean value for the redox method was 0.046±0.008 mg/Kg and the range was 0.010 to 0.095 mg/Kg. The result from this method was lower than works by Abubakar *et al* [9] on breads around Sokoto metropolis with a concentration of 56.20mg/g. Also, the mohr's method had a range of 0.032 to 0.060 mg/Kg and the mean of 0.040±0.008 mg/Kg. This report on mohr's method is lower than works by Otalekor [8] on Potassium bromate (0.208 mgg^{-1}) in bread around Ughelli, Delta State, Nigeria. The result revealed that both methods were consistent but the mohr's method was more precise for the three flour types analyzed.

The two methods showed that bakers in Port Harcourt metropolis still use potassium bromate at concentrations above the standard by National Agency for Food Drug and Administration Control.

Conclusion

The work showed that both the redox titration and Mohr's method were of consistent detection. The study revealed that bakeries within Port Harcourt are using potassium bromate chemical in the baking of bread at above the set standard by the National Agency of Food and Drug Administration Control (NAFDAC) for bread baking in Nigeria. It is pertinent to state that consumers of bread within Port Harcourt and its environment may be at the risk of cancer if they consume it consistently.

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