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**Research Article**

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# Comparative Assessment of Bromate in Bread in Kogi State, Nigeria

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**Abstract** Despite the warning by regulatory agencies concerning the deleterious effects of using bromate in baking bread, Bakers are still indulging in the act for profit maximization at the expense of the good health of the general populace. Comparative Assessment of Bromate in Bread was carried out using spectrophotometric method based on the oxidation of congo red and crystal violet dyes in a hydrochloric acid media. Potassium bromate complexes with potassium iodide, to give a purple coloration [1]. The result revealed that congo red method revealed higher Potassium bromate concentration than the crystal violet method. The highest concentration for congo red method is 0.370±0.006 µg/g while that of crystal violet method is 0.112±0.003 µg/g. This may implies that the congo red method is a more effective method for determining the concentration of Potassium bromate in bread. However, there may be a need to verify this conclusion using HPLC method.

**Keywords** Potassium bromate, Congo red, Crystal violet, Spectrophotometry, Bread

## Introduction

Bread is an important source of food prepared by baking dough of flour, water and possibly more ingredients. Dough is usually baked but in some culinary art, breads are fried or steamed on skillet. It may be leavened or unleavened salt, fat and leavening agents such as yeast and baking soda may be added. Though bread usually contains several ingredients that would improve its quality, Some of the basic ingredients other than flour include: table salt, sugars, flavours, milk, egg, spice, raisins, onions, walnuts, poppy-seeds and at least a floor improver like potassium bromate [2-3]. The fast-growing popularity of bread may be as a result of its convenience, high energy profile content and low blood cholesterol level [3].

The use of potassium bromate has been a common choice among bakers and flour millers throughout the world because it is very cheap and probably an efficient oxidizing agent [4].

Bread is one of the oldest, stable and most reliable sources of food. Its consumption is very high in the eastern part of Nigeria where most of the bread makers has resorted to using potassium bromate as a maturing agent for flour and as a dough conditioner in order to improve the quality of the dough and allowing higher rising. Potassium bromate has been considered a category 2B (possibly carcinogenic to humans) carcinogenic by the International Agency for Research on cancer [5]. In addition, it has negative effect on the nutritional quality of bread. It degrades vitamins $A_2$, $B_1$, $B_2$, E and niacin in bread [5].

Research has shown that bread makers in other states of Nigeria are still using bromate as enhancers without minding the health risks associated with it. Hence the need to know the status of the most popular bread consumed in Kogi State with respect to bromate contents.

## Materials and Methods

### Sampling

Twenty (20) Bread samples were collected from different retail outlets and bakeries in the 3 senetorial districts of Kogi state. Representative samples were brought from anyigba, kabba, and Lokoja respectively. The samples analyzed were the most common on popular demands in the respective locations.

### Sample pre -Treatment

A sample of 2cm in diameter from the center of a 15mm thick slice of each bread was taken and dried in an oven for 72 hours at $57^{o}$ C, the crust was grinded to a fine powder with mortar and pestle. 5grams of each powdered sample was weighed into a clean 250$cm^3$ beaker, 50$cm^3$ of distilled water was then added. The mixture was centrifuge and the liquid fractions were then distilled to 100$cm^3$ in a calibrated flask. The appropriate volume of each of the aliquot was taken for treatment under the proposed procedure. The pre –treatment of sample was done in triplicate [6].

### Preparation of Reagent and Solution

43.10$cm^3$ of concentrated HCl, was diluted with water in a 250$cm^3$ volumetric flask and made up to the mark.

**$5x10^{-5}$ $mol/dm^3$ congo red dye solution**

0.348grams of congo red powder (mwt 696.67) was weighed into a 1000$cm^3$ volumetric flask, dissolve and dilute to mark with distilled water.

**$5x10^{-5}$ $mol/dm^3$ crystal violet dye solution**

0.21grams of crystal violet powder (mwt.431) was weighed into a 1000$cm^3$.

Volumetric flask, dissolved and diluted with water to the mark.

The working standard solution were prepared in the range, 12ppm, 24ppm, 36ppm 48ppm 60ppm and 72ppm respectively

### Procedure

4$cm^3$ of the aliquot of each of the twenty bread sample was measured into 40 separate 25$cm^3$ calibrated flask.

Congo red dye solution was added and or $5x10^{-4}$ $mol/dm^3$ solution of crystal violet dye solution was added, which is followed by 10$cm^3$ of 2M HCl solution. Each flask was diluted to 25$cm^3$ mark using distilled water; and shaken gently prior to colorimeter analysis. Absorbance was taking at $\lambda_{max}$ 485 nm for sample containing crystal violet organic reagent. And $\lambda_{max}$ 452nm for sample containing congo red organic reagent. All measurement was taking at room temperature against water as a reference point (blank) [6].

The absorbance of the samples were converted to concentration with reference to beers calibration curve. The result is mean of three replicates determination for each bread sample.

### Statistical analysis

Microsoft excel was used to calculate the mean and standard deviation.

## Results & Discussion

The spectrophotometric method for the determination of bromate based on the oxidation of congo red and crystal violet dyes in a hydrochloric acid media was used in this research. Potassium bromate complexes with potassium iodide, to produce purple coloration [1]. The mechanism of bromate detection for both methods are based on colour changes. The red colour of congo red changed to blue due to the HCl used. Crystal violet was purple in weak acid solution and green in strong acid solution due to the presence of bromate. Both dyes were water soluble because of the low sulphuric acid groups (-$SO_3H$) in congo red and dimethylamino groups in crystal violet. i.e the concentration

of potassium bromate in the reacting medium is the colour change from light yellow to purple at 452nm and 485nm for samples in crystal violet and congo red respectively. The degree of colour change correlates with the level of potassium bromate present [7].

**Table 1:** Concentration of potassium bromate in various bread samples using crystal violet organic reagent 485nm and congo red organic reagent at 452nm

| Samples Number | Crystal Violet Organic Reagent Concentration (µg/g) | Congo Red Organic Reagents Concentration (µg/g) |
|---|---|---|
| 1 | 0.026±0.002 | 0.218±0.003 |
| 2 | 0.104±0.001 | 0.360±0.006 |
| 3 | 0.054±0.001 | 0.320±0.004 |
| 4 | 0.013±0.002 | 0.300±0.020 |
| 5 | 0.011±0.001 | 0.280±0.00.3 |
| 6 | 0.112±0.003 | 0.370±0.006 |
| 7 | 0.066±0.03 | 0.340±0.010 |
| 8 | 0.050±0.003 | 0.320±0.003 |
| 9 | 0.056±0.001 | 0.330±0,002 |
| 10 | 0.051±0.002 | 0.350±0.010 |
| 11 | 0.057±0.004 | 0.340±0.004 |
| 12 | 0.051±0.002 | 0.360±0.006 |
| 13 | 0.062±0.002 | 0.360±0.003 |
| 14 | 0.065±0.003 | 0.360±0.005 |
| 15 | 0.051±0.002 | 0.340±0.010 |
| 16 | 0.062±0.001 | 0.370±0.006 |
| 17 | 0.014±0.002 | 0.320±0.020 |
| 18 | 0.013±0.001 | 0.270±0.003 |
| 19 | 0.058±0.002 | 0.350±0.006 |
| 20 | 0.052±0.003 | 0.360±0.010 |

Values represent mean±SEM of 3 replicate determinations

The table 1 above shows positive results for the presence of bromate compared to the minimum concentration (0.02 µg/g) allowed by the food and drug administration (FDA) in bread. Considering the method of congo red reagent, all the samples contained bromate concentration ranging from 0.218±0.003µg/g - 0.370±0.006µg/g While the results obtained using the method of crystal violet reagent, ranges from 0.011±0.001µg/g – 0.112±0.003µg/g. nine (9) out of the 20 samples had bromate concentration higher than the permissible limit of (FDA). The remaining eleven (11) samples contained bromate concentration lower than the permissible limit, implying that they may be safe for consumption with regards to their bromate concentration.

The result suggest that the congo red reagent method has higher sensitivity than the crystal violet reagent method, thus making congo red reagent method the likely preferred method for the determination of bromate contents in bread.

The concentration of potassium bromate in bread samples analysed in this study is slightly similar to the range of $KBrO_3$ (3.6 µg/g and 9.2 µg/g) reported in bread samples in 20 brands of bread in Gwagwalada area of Abuja. Alli et al, 2013. The range of (3.7µg/g and 12.6µg/g) of $KBrO_3$ found in bread samples consumed in Kaduna state, Nigeria as reported by Ojeka et al. [1]. Emeje et al. [7] also found $KBrO_3$ level above the permissible limit ranging from 1.2µg/g and 10.4 µg/g in Eastern part of Nigeria. The implication of high level of $KBrO_3$ is that it may result in possible long term toxicity and carcinogenic effect may emanate later. The presence of bromate in bread may cause renal failure, respiratory depression, hearing loss, breakdown of vitamins and cancer in humans [8-9].

More so, the result shows that the attitude of bakers and business men who seize every opportunity to defraud does not help. It is important for them to know that there are basically two ways by which humans get poisoned with potassium bromate; by ingestion when it is present in food such as bread and by inhalation. It is therefore not safe for the bread consumer and the factory worker who works in bakery where the substance is used as improver.

It should be noted that bromate is not totally dangerous for human consumption, it is however required at low amount. In bread production during the preparation of the dough, a network of proteins molecules linked together by disulphide bond bond is formed. The strength and elasticity of the network which gives the dough its characteristic properties is best when the network comprises of long chain proteins shell as gluten. Short chain peptides such as glutathione which are present as well; react in gluten molecules breaking down the dough structure. This structural breakdown can be prevented by the addition of oxidizing agents such as potassium bromate [10].

The evidence of regulatory approval in Nigeria is depicted by national agency for food, and drug Administration and Control (NAFDAC) registration number and to my greatest dismay, some of the bread samples in this study containing potassium above acceptable limit were duly registered by NAFDAC. The implication of this is that either NAFDAC does not actually test the products before granting approved or that once approval is given, there is no mechanism in place to monitor compliance by the industries. Since NAFDAC has a fully pledge department of pharmaco vigilance, one would except that other than drugs, foods should also be constantly monitored to ensure the safety of life of the consumers.

## Conclusion

The results obtained shows that potassium bromate is higher in all bread samples investigated with congo red reagent and 8 samples investigated with crystal violet reagents when compared with the minimum concentration (0.02 μg/g) allowed by the food and drug administration (FDA). The report also showed that congo red reagent is a more sensitive method for potassium bromate determination in bread.

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