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Qualitative And Spectrophotometric Determination Of Potassium Bromate In Bread Samples Sold In Asaba, Delta State, Nigeria

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ABSTRACT
Studies have shown that potassium bromate $KBrO_3$ an oxidizing agent used in bread-making process is a possible human carcinogen. For this reason, it has been banned by some countries including Nigeria, while other countries such as United State of America set permissible limit for its use in flour, bread and other bakery products. Bread is commonly eaten by all socioeconomic class in Nigeria. Due to the adverse health effect of consumption of potassium bromate by humans, it became necessary to investigate its usage in bread making process in the area of study; Asaba, Delta State, Nigeria. Twenty brands of bread sample were obtained from the area of study and analyzed for the presence and concentration of potassium bromate using David Pearson 1976 method. Five brands of bread sample amongst the twenty brands of bread sample tested positive to the presence of potassium bromate. The quantity of potassium bromate present in the five brands of bread sample was determined using spectrophotometer (spectrum Lab 21A) at 620nm. The result showed that the samples contained 3.8µg/g, 1.4µg/g, 5.1µg/g, 1.7µg/g and 3.7µg/g of potassium bromate. These results are above the permissible limit allowed for potassium bromate in flour, bread and other bakery products by US Food and Drug Agency (FDA)) and contravenes the non usage of potassium bromate in bread making in Nigeria, stipulated by the National Agency for Food and Drug Administration Control (NAFDAC) of Nigeria. The result of the study shows that the five brands of bread sample are unsafe for consumption.

1. INTRODUCTION
Bread is a staple food prepared from dough of flour and water, usually by baking. It is commonly eaten in Nigeria by all socioeconomic class of people. The process of bread making involves mixing low protein wheat flour with other ingredients such as salt, sugars, yeast, flavours and flour improver (oxidizer). Wheat flour used for bread production contains about 12% protein (1). The start of the bread making process, involves mixing flour with water. The proteins in flour hydrate to form gluten, a viscoelastic matrix holding the starch granules that constitute the bulk of flour (1). Gluten is not a single molecular protein species but a mixture of water-insoluble proteins falling into two broad classes, the gliadins and the glutenins (2, 3). Bubbles of carbon dioxide (CO_2) form as yeast ferment the sugars liberated from hydrated starch granules by the flour's natural complement of amylase enzymes. Mechanical work as a result of mixing stretches the gluten into sheets that trap the CO_2. This makes the gluten network to expand and leaves an open cellular structure with the gas trapped in pockets. This gives the bread loaf volume.

The major challenge in both flour milling industry and bakeries is the baking quality of flour, which is determined by the capacity of the dough prepared from it to retain gas (4). As a result, various conditioning agents (flour/bread improvers) such as Azodicarbonamide, potassium iodate, potassium bromate, ascorbic acid e.t.c. are added for strength during mixing, extensibility for molding and also to increase loaf volume. These oxidizing agents promote disulphide bond formation.

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 oxiding agent(4). It acts as a maturing agent and dough conditioner by oxidizing the sulfhydryl groups of the gluten protein in flour into disulphide bridges making it less extensible and more elastic, this will make the dough viscoelastic such that it can retain the carbon dioxide gas produced by the yeast (5). The overall effect is to make bread rise in the oven, increase loaf volume and texture (6).

The international agency for research on cancer (IARC) has classified potassium bromate $KBrO_3$ as a 2 B (possible human) carcinogen based on sufficient evidence that $KBrO_3$ induces cancer in experimental animals (7, 8). This has led to the ban of potassium bromate in flour, bread and other bakery products by some countries including the United Kingdom in 1990 and Canada in 1994 (1), while some other countries set permissible limit. The Joint Food and Agricultural Organization (FAO)/World Health Organization Expect Committee on Food Additives (JECFA) has temporarily recommened a maximum level of 75 ppm (75µg/g) of $KBrO_3$ for treating flour, provided that baking products prepared from such treated flour contain negligible residues of $KBrO_3$ (9). The maximum concentration of potassium bromate allowed in bread by the US Food and Drug Agency (FDA) is 0.02µg/g (0.02mg/kg) (10).

Nutritionally, potassium bromate degrades vitamins A_2, B_1, B_2, E and niacin which are main vitamins available in bread (11). In humans, potassium bromate can cause abdominal pain, diarrhea, nausea, vomiting, kidney failure, hearing loss, bronchial and ocular problems when ingested (12). Due to the adverse health effect associated

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with consumption of potassium bromate, the agency responsible for the regulation of food and drug substances in Nigeria, the National Agency for Food and Drug Administration Control (NAFDAC) in 2002 banned the use of potassium bromate in baking of bread and other bakery products (13).

This study aims at assessing the safety of bread sold in the area of study; Asaba, Delta State, Nigeria, and compliance of the non usage of potassium bromate in bread making by bakers in the area of study.

2. EXPERIMENTAL

2.1 *Sampling Area and Sample Collections*

Twenty brands of bread samples were purchased from retail outlets in Asaba, Delta State, Nigeria located 6^0 11^1 0" North, 6^0 45^1 0" East.

2.2 *Sample Preparation and Analysis*

10g of each bread sample was taken from its centre and dried in an oven for an hour at 60^0C. The crust was ground to a fine powder with a pre-cleaned ceramic mortar and pestle. 5g of each powdered sample was weighed into a pre-cleaned petri dish and properly labeled. Equal volume; 1 ml of 2M HCl (sigma chemical Co.St Loius USA) and 1% KI (BDH, England) were accurately measured and evenly distributed over the samples inside the petri dish until all particles were wet. Presence of black specks or purple spots indicated the presence of potassium bromate (Cunniff, 1995) and (Pearson, 1976) (13, 14).

The concentration of potassium bromate in the samples was determined using spectrophotometric method of Pearson, 1976. 5g of each powdered bread sample was weighed into well labeled 100ml conical flask. 50 ml of distilled water was measured and transferred into each conical flask and left to stand for 45 minutes. At the end of 45 minutes, the content of each flask was decanted into well labeled beakers and 5ml of each extract was measured into a test tube and labeled. 5ml of freshly prepared 1% KI in 2M HCl was measured and added in each test tube. The presence of potassium bromate was indicated by change in colour from light yellow to purple (Pearson, 1976). Each test tube was diluted to 50 ml with distilled water, properly mixed and poured into cuvette and analyzed at 620nm using spectrophotometer (Spectrum Lab 21A). Concentration of potassium bromate in the samples was obtained from the calibration curve previously constructed for potassium bromate using the pure sample (Sigma Chemical Co. St Louis, USA). The accuracy of the instrumental method and analytical procedure and the precision of the results of the samples were checked by performing the measurements in triplicate, therefore the values presented are mean of three replicate determinations.

3. RESULTS AND DISCUSSION

Result of the analyzes carried out is shown on table 1 and 2. Five brands of bread samples out of the twenty brands of bread samples used in this study showed positive result to the presence of potassium bromate. The five bread samples showed visible colour change while the remaining fifteen did not. It is possible that the remaining fifteen bread samples do not contain potassium bromated or might be present below the detection limit.

Table-1: Qualitative determination of potassium bromate in some brands of bread sold in Asaba.

Bread samples	Colour change
A	No visible colour change
B	No visible colour change
C	Light purple
D	No visible colour change
E	No visible colour change
F	No visible colour change
G	Light purple
H	No visible colour change
I	No visible colour change
J	No visible colour change
K	No visible colour change
L	Light purple
M	No visible colour change
N	Light purple
O	No visible colour change
P	No visible colour change
Q	Light purple
R	No visible colour change
S	No visible colour change
T	No visible colour change

Letter A to T represents the code for different brands of bread sample analyzed.

The amount of potassium bromate found in the five brands of bread samples are above the permissible limit allowed in bread samples by US Food and Drug Administration (FDA). Moreover, the regulatory agency responsible for food and drug administration control in Nigeria; National Agency for Food and Drug Administration Control (NAFDAC), in 2002 banned the use of potassium bromate in flour, bread making and other bakery products. Therefore, these make the brands of bread samples identified with potassium bromate in this study unsafe for consumption.

Table 2: Quantitative determination of potassium bromate in some brands of bread sold in Asaba.

Bread sample	$KbrO_3$ Content (µg/g)	Colour change
C	3.8 ± 0.78	Light purple
G	1.4 ± 0.64	Light purple
L	5.1 ± 0.22	Light purple
N	1.7 ± 0.42	Light purple
Q	3.7 ± 0.25	Light purple

Values represent mean ± SD of 3 replicate determinations

4. CONCLUSION

The result of this study shows that the five brands of bread sample identified with potassium bromate are unsafe for consumption. It shows also that some bakers do not comply with the non usage of potassium bromate in bread making and probably other bakery products in Nigeria. The regulatory agency NAFDAC needs to intensify efforts to ensure that bakers comply with non usage of potassium bromate in bread making and other bakery products in Nigeria.

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