Potassium Bromate Content of Bread Produced in Sokoto Metropolis

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ABSTRACT: Fifteen different bread samples were randomly collected from various local bakeries located in Sokoto metropolis. The samples were analysed for presence and quantity of potassium bromate. All the samples were analysed using the redox titrimetric method for the detection of potassium bromate. All the samples contained potassium bromate with sample L having the highest quantity (56.20mg/g) and sample D having the lowest quantity of potassium bromate (14.70mg/g). This study has shown that in spite of National Agency for Food and Drug Administration and Control (NAFDAC) campaign for bromate-free bread most of the bread marketed and consumed in Sokoto metropolis contains potassium bromate with the quantity varying from one bakery to another. This suggests that consumers of marketed bread in Sokoto stand the risk of potassium bromate toxicity.
Key words: Bread, Potassium, bromate

INTRODUCTION

Bread is a food made from dough of flour that is usually raised with yeast or baking powder and then baked. Bread is a staple food of man (Pagewise, 2002). It is one of the oldest known recipes. It is low in saturated fat, very low in cholesterol and it's also a good source of thiamine and folate (Cranton, 2004). Bread is also rich in protein, vitamins and minerals (Pagewise, 2002). The basic ingredients of baked products are usually flour, liquid (water, milk or juice) fats, sugar, salt, eggs, leavening agents' flavourings, yeasts, and bread improver.

Yeast feed on sugar to produce alcohol and carbon dioxide gas, this gas makes the bread to rise. Bread improvers are added to speed up bread making. There are approximately 60 approved chemicals used in making flour and bread. Although no single manufacturer uses all 60 additives, eight or more are commonly used. For instance, if carbon dioxide is not used, bleaching agents such as benzoyl peroxide and nitrogen peroxide may be added together with maturing agents such as potassium bromate or potassium iodate (McGee, 1997). Potassium bromate is an additive some barkers use to help bread rise rapidly and create a good texture in the finished product. Protassium bromate is a flour improver, it strengthens the dough, allowing higher rising. It is an oxidizing agent and under right conditions will be completely used up in bread making (Akunyili, 2005).

Potassium bromate appears as a white colourless trigonal crystalline powder, it decomposes at 370^{o}C releasing oxygen. It is soluble in water and almost insoluble in alcohol. It has a vapour density of 5.5 at 15^{o}C and boils at 59.48 ^{o}C with specific gravity of 3.27at 17^{o}C.

The uses 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 (Akunyili, 2005). It is known that if flour is left to age for a couple of months, it will have better baking properties. In this age of cost control, flour is not left to age naturally, but the effects of the ageing process are created using chemicals like iodate and potassium bromate. This treatment affects the chemical bonding properties of gluten in the same manner as ageing allowing the gluten to form stronger and more elastic dough. Bromate gives more bulkiness to the dough development resulting in more loaves of bread being cut out. It also gives smoother and a more beautiful look (aesthetic value) than bread baked with other improvers (Cavanaugh, 2002). Studies have shown that some of the additives used over the years are deleterious to health thereby necessitating their ban (including potassium bromate). Concern has been expressed on the harmful effect of potassium bromate. Toxicological studies have convincingly shown that potassium bromate affects the nutritional quality of bread as the main vitamins available in bread are degraded (Paul, 1996). There is a significant difference in essential fatty acid content of flour treated with bromate or in

bread made from such flour. Flour and bread treated with potassium bromate proved carcinogenic on oral administration in rats (Kurokawa *et al.,* 1982). In humans, potassium bromate causes cough and sore throat on inhalation, abdominal pain, diarrhoea, nausea, vomiting, kidney failure, hearing loss as well as redness and pain in both eye and skin (Akunyili, 2005). Potassium bromate has been banned worldwide except in Japan and the United States. It is rarely used in California because a cancer warning is required on the label (Starr, 2002). The World Health Organisation in 1994 stated that this ingredient was no longer acceptable for use as it was a possible human carcinogen (WHO, 1994). In Nigeria, use of potassium bromate in flour milling and baking has been banned by NAFDAC since 1993 (Akunyili, 2004). Ascorbic acid was recommended in its place. Vitamin C powder, egg, apple sauce when added to bread can enhance the texture and extend the shelf-life of the bread. The main aim of this research is to investigate the presence of bromate in breads baked and consumed within the Sokoto metropolis. This is to find out the level of compliance with the NAFDAC directives.

MATERIALS AND METHOD

Bread samples

Fifteen bread samples were collected randomly from bakeries cited at different locations and sites of production within Sokoto metropolis.

Samples Preparation

Digested Samples

One gramme of each of the bread sample was weighed into a digestion flask; 10mls of nitric acid was added followed by 2mls of perchloric acid. The mixture was allowed to stay for 1 min and the flask was placed in the digestion block and heated to a temperature of 140-150^{o}C until a brown coloured fumes observed changes to a white fumes. The resulting solution was diluted to 30ml with water and used for analysis.

Undigested Samples

One gramme of each of the bread samples was weighed into a conical flask; 35mls of distilled water were added. The mixture was shaken to dissolve the bread in the water solution. The resulting solution was used for analysis.

METHOD

Potassium bromate was determined using Redox-titrimetric method (Vogel, 1961). This involved the titration of the bread sample solutions (digested and undigested) in mixture with potassium iodide (3g), 4 N Hydrochloric acid (5mls) and iodine solution (2mls) with 0.1 N Sodium thio-sulphate to a colourless end point. The concentrations were obtained by extra-polation from a Potassium bromate standard curve.

RESULTS

Table 1 showed the of potassium bromate contents of the tested samples (digested and undigested). The results indicated the presence of bromate in all the samples tested with sample L having the highest bromate content (56.20mg/g) while sample D has the lowest bromate content (14.70mg/g). Other samples had varying concentrations of bromate. The digested samples showed lower bromate levels than the undigested.

Table 1: Potassium Bromate Concentrations (mg/g) of Various Bread Samples Baked in Sokoto metropolis

Samples	Undigested	Digested
A	26.70 ± 1.33	22.27 ± 1.25
B	38.90 ± 6.01	30.62 ± 3.00
C	53.70 ± 14.44	12.81 ± 1.30
D*	16.70 ± 1.35	14.70 ± 1.27
E*	27.80 ± 1.33	26.50 ± 1.33
F	23.90 ± 2.63	21.10 ± 1.50
G	37.80 ± 1.32	32.60 ± 3.21
H	25.80 ± 1.32	25.60 ± 2.60
I	41.70 ± 5.03	17.54 ± 3.30
J*	26.70 ± 1.33	21.12 ± 2.10
K	18.30 ± 1.33	15.59 ± 1.33
L	56.20 ± 1.32	19.48 ± 1.60
M	35.00 ± 8.61	19.48 ± 1.50
N*	14.70 ± 1.32	25.06 ± 1.30
O*	21.10 ± 3.48	11.97 ±2.60

Values are mean± standard deviation

*Bromate free as labelled by the baker.

DISCUSSION

The result obtained from the bread analysis showed that a great number of bread makers in Sokoto metropolis still use potassium bromate as a bread improver. All the fifteen samples tested indicated the presence of high concentration of bromate. The results implied that consumers of marketed bread in Sokoto metropolis are still being exposed to this toxic

substance not withstanding several existing legislations outlawing its use. Bakeries and Confectionary industries employ the use of bromate in their formulation because of economic benefit. Potassium bromate function as a dough enhancer and it has a pronounced action in maintaining the size, colour and texture of a loaf. The more the quantity the more attractive is the bread to consumer. The presence of bromate in edible foodstuff call for concern because of its toxicological effect on human (WHO, 1989).

There has been a raging controversy over the use of bromate. Many scientists claimed in the early 90s that potassium bromate was likely to be harmless as bread additive, as the substance is broken to insignificant levels during baking (Akunyili, 2004). However in 1993 the Food and Drug Administration in America tested several loaves of bread in circulation and discovered many of the loaves had detectable levels of bromate (CSPI., 2004). Three quarter of the loaves tested by the science laboratory UK in 1989 had significant residual bromate (WHO, 1994). This was followed by its ban in Britain and many other countries. In Nigeria, NAFDAC have de-listed potassium bromate as food additives since 1993. A decade and a half after we are still finding bromate in Nigerian bread.

The action of bromate as a food enhancer is attributable to its inhibitory action on certain proteolytic enzymes thereby affecting the nutritional quality of bread. This leads to degradation of vitamin A, B_1, B_2 , E and niacin.

Results obtained from in-vivo and *in-vitro* mutagenic studies show that potassium bromate is a potential cancer initiator. In humans, acute intoxication of this substance leads to renal failure and loss of hearing (Sai *et al.,* 1991). The high bromate content detected in tested samples have their major vitamins degraded and consumption may lead to vitamin deficiency diseases. The net carcinogenic effect of potassium bromate is cumulative, therefore continues consumption of breads with potassium bromate could leads to cancer over a period of time.

The main problem in Nigeria is implementation of the ban. Urgent and drastic effects are required to curtail the use of this food poison.

CONCLUSION & RECOMMENDATION

The result of this work had confirmed that potassium bromate is still been used in bread making by bakers in Sokoto metropolis. The result calls for a conscious effort by relevant agencies especially NAFDAC to reaffirm and reassert the ban on the use of bromate by bakeries. The agencies should educate people through public enlightenment on the danger use of bromate as food additive. Relevant agencies should encourage the use of natural dough enhancers, like Vitamin C powder, egg, apple sauce, etc. (Craton, 2004).

REFERENCES

Akunyili N.D. (2004). Potassium bromate in bread-wheat are the implication. NAFDAC., **1:** 13-21

Akunyili N.D. (2005). Eradication of potassium bromate from Nigerian bakery Industry. NAFDAC., **5:** 1-6

Cavanaugh, R. (2002). Potassium bromate: baker's ingredient. *Keymax*; **8:** 1-2

Chipman, J.K., Davies, J.E., Parsons, J.L., Neill, J.O. (1998). DNA oxidation by potassium bromate; a direct mechanism or linked to lipid peroxidation. **126:** 93 – 102.

C.S.P.I. (2004). Guidelines for carcinogen risk assessment Federal register 51 (185): 33992-34003.

Cranton, M. (2004). Modern bread. The broken staff of life. 1-2.

Kurokawa, Y., Hayashi, A., and Meakawa, T. (1982). Carcinogenicity of potassium bromate administered orally to F344rats; *J. **Nat.** Cancer Inst* **71:** 965-972

McGee, H. (1997). On food and cooking scriber; 3-4.

Pagewise, I. (2002). The history of bread: A recipe for wonderful bread making. *Truester Health Ency*, **3:** 1 – 5.

Paul; A.H. (1996). Chemical food poisoning by potassium bromate N.2. *Med J.* **65:** 33-36.

Sai, K.C.A., Tyson, A. and Thomas, R. (1991). Oxidative DNA damage induced by potassium bromate in isolated rats renals proximal tubules and nuclei. *Cancer Letter* **87:** 1-7.

Starr, J.H. (2002). Sweet poison. 5th ed; Aspan Publishers, USA, 1-9.

Vogel, I. (1961). A textbook of quantitative inorganic analysis including elementary

instrumental analysis. Eng. Lang. Stc. 4th ed. pp. 370 – 372.

W.H.O. (1989). Toxicology evaluation of certain food additives and contaminant ; the 33rd meeting of the join (FAO) WHO expert committee.

W.H.O. (1994). Specifications for the density and purify of food additives and their toxicological evaluation. Word Health organisation technical report series. No. 28.