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Evaluation of potassium bromate level in local bread samples baked in JOS metropolis

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Abstract
The levels of potassium bromate in fifteen bread samples from Jos North Metropolis were determined using Spectrophotometric method. It was base on the redox reaction between bromate and promethazine in acidic medium. This reaction produces a red-pink product with maximum absorbance at 515nm. A qualitative test was carried out on a portion of each bread sample using 2cm^3 of promethazine and 0.6cm^3 of 12M hydrochloric acid. The change in color observed in each bread sample indicates the presence of bromate. The results obtained show bromate levels which ranged between 0.027mg/kg - 28.39mg/kg in bread samples. In all the samples examined, bromate level were found to exceed the recommended permissible level by US Food and Drug Agency and National Agency for Food and Drug Administration and Control of 0.02mg/kg. All bread Samples examined were considered unsafe for human consumption. Bread bakers should explore other alternative means of flour improvers like ascorbic acid instead of using bromate because of its deleterious Carcinogenic effects in humans.

Keywords: potassium bromate, bread, promethazine, carcinogenic, baking, bromate

Introduction

The common food most Nigerian homes consume is bread. Bread is classified as ready to eat food that does not require further processing before consumption (Afolabi, *et al*., 2015). All genders, all ages, all tribes, both the rich and the poor consume bread, and it comes in various sizes, shapes, compositions and price tags to meet the needs of different categories of consumers (Etim, 2017) [9].

Bread is a food made from dough of flour that is usually raised with yeast or baking powder and then baked. It is one of the oldest known recipes. It is low in saturated fats, very low in cholesterol and it is also a good source of thiamine and folate (Craton, 2014) [5].

The aims of bread making processes are to produce dough that will rise easily and have properties required in making good bread for consumer (BIRT, 2016). In a quest to harness the natural variability of wheat flour, baker's started using chemical oxidizing agents to strengthens gluten proteins. The addition of these agents to flour will create stronger dough. Potassium Bromate is such an oxidizing agents; other oxidizing agents include Ascorbic acid, potassium iodate. Flour millers and bakers all over the world uses potassium bromate as their common choice because it is economical and may be a good oxidizing agent (Akunyili, 2004) [2] and increases the shelf life of bread (Vanstaden, *et al*., 2004). Concerns have been expressed on the harmful effects of potassium bromate. Under normal condition, baking alters its chemical composition and renders it harmless, leaving no trace in the finished product (Abu - Obaid *et al*., 2016) [1]. However, if too much is added or the bread is not baked long enough, at a high temperature, then residual amount will remain, which may be harmful if consumed (Pilla, 2016) [12]. In humans, potassium Bromate causes cough and sore throat on inhalation, abdominal pain, diarrhea, nausea, vomiting, kidney failure, cancer, hearing loss as well as redness and pain in both eyes and skin (Akunyili, 2005) [3].

Armed with all this information on the harmful effects of Potassium bromate, the National Agency for Food, Drug Administration and Control (NAFDAC), the agency which is saddle with the responsibility of regulating drugs and foods and allied products in Nigeria in 2004 banned the use of Potassium bromate in which had been since 1993 (Akunyili, 2004) [2]. Potassium bromate has been banned worldwide except in United States. It is rarely used in California because a cancer warning is required on the label (Start, 2002). Ascorbic acid was recommended in its place.

Methodology

Sample collection

A total of 15 brands of breads were used in this study. They were purchased randomly from bakeries, bus stops, and markets in Jos North, Jos Plateau State, Nigeria.

Sample preparation

A sample of 10g of each bread was cut and triturated into 200ml of distilled water in a beaker with magnetic stirrer and then filtered through a what man no 41. A measured quantity of the filtrate (8.8ml) was transferred into a 20ml volumetric tube and mixed with 1cm^3 of PTZ 10-2M, 0.2cm^3 of 12M HCl was added; the mixture was well shaken for 1 minute and used for analysis.

Sample analysis

Prior to the quantitative determination of Bromate contents of the bread samples, qualitative tests were performed directly on a portion of each bread sample with 2cm^3 of PTZ 10-2M and 0.6cm^3 12M HCL. Quantitative determination of Bromate content in the bread samples was carried out following the spectrophotometric method described by El Harti *et al* (2011) [8]. Absorbance of the colored solution obtained was measured using a spectrophotometer at 515nm. The concentration of the Bromate was calculated from the linear regression curve obtained from the working standards.

Results and discussion

The results of the analysis are shown in the table and figure below. Bread sample A recorded the least amount of residual bromate, 0.027mg/kg. Highest level of bromate, 28.39mg/kg was recorded by bread sample M. The color change ranged from No coloration to dark pink with increase in concentration. The quantity of bromate in bread samples correlates with the degree of pink color obtained in the qualitative analysis (table 1)

Table 1: Qualitative and quantitative potassium bromated level in selected local bread samples

Bread sample	Color change	Quantity of KBrO3 formed	Quantity of KBrO3 (mg/kg)
A	No color	0.093	0.027
B	Pink	0.825	18.97
C	Pink	0.611	11.31
D	Light pink	0.305	4.6
E	Pink	0.549	9.96
F	Dark pink	1.281	25.90
G	Pink	0.527	9.48
H	Pink	0.651	12.18
I	Dark pink	0.941	18.5
J	Pink	0.585	10.7
K	Light pink	0.425	7.1
L	Pink	0.713	13.5
M	Dark pink	1.395	28.39
N	Pink	0.680	12.85
O	Light pink	0.326	5.1

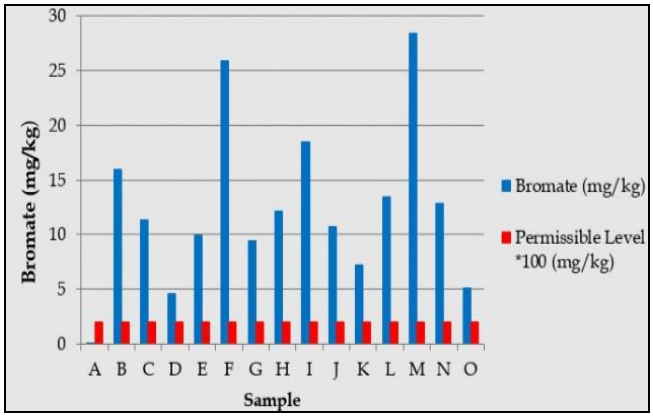

Fig 1: Histogram of bromate in bread Samples

The amount of residual bromate in each bread samples examined was higher than the NAFDAC'S permissible level of 0.02mg/kg. These values contravened the NAFDAC's permissible level, implying that none of the bread samples in Jos North examined in these study is safe for human and are hazardous on consumption as far as potassium bromate is concerned.

The sample with the minimum concentration of potassium bromate contains 0.027mg/kg and the maximum concentration contains 28.39mg/kg. These are 1-fold and 1419-fold in excess over the allowable permissible safe level. The values are lower in the minimum and higher in maximum than 2.4 mg/kg- 13.69mg/kg, 1.24mg/kg - 9.31mg/kg, 1.01mg/kg - 12.66mg/kg, 0.28mg/kg - 2.99mg/kg bromate levels in bread obtained by A.M Magomya *et al*., A.I Airaodion *et al*., O.M Emeje *et al*., L.A Irogbeyi *et al*., respectively. The bromate of this study is lower than those reported by Saeed *et al* (2014), to be in the range 19.41mg/kg - 41.7mg/kg.

One interesting but contracting finding of this study is that bread samples with "bromate free" on their labels actually contains higher potassium bromate than those without such inscription on their labels. This shows the degree of falsity in the bakery industry in Jos North and Nigeria in general.

Eight of the bread samples used in this study were not registered with the National Agency for Food, Drug and Administration Control (NAFDAC) as they had no NAFDAC number on their labels while one of the bread sample has no label at all. So, there is no way they could abide since they are not registered with the regulatory body.

Considering the elevated level of potassium bromate present in the analyzed bread samples in conection with the fact that bread is a common food consumed on a daily basis by residents of Jos North Metropolis irrespective of their status, we can conclude by reasoning that there is high dietary exposure to bromate through consumption of bread. Potassium bromate is harmful to consumers, it may cause poisonous in two ways either by ingestion when present in food such as bakery products or by inhaling. Serious poisoning in adults are caused when 0.2g - 0.5g per kilogram are infested (Kurma *et al*., 2012). Potassium bromate is therefore not safe for bread consumers and workers in bakeries or factories.

Potassium bromate present in bread is harmful because it has been associated with Neurotoxicity and Nephrotoxicity (kurokawa *et al*., 2005) [11] as well as Ototoxicity (Diachenko *et al*., 2002) [7] and it possess additional threat to the health of bakery workers as potassium bromide, a heat decomposition product of potassium bromate, is also toxic (Giesecke *et al*., 2000) [10]

Conclusion

The study assessed the potassium bromate levels of bread sold and consumed within Jos North Metropolis. The results revealed that the bakeries do not conform to the ban on potassium bromate as stipulated by FDA, NAFDAC and WHO even when they mark the loaves as "bromate free" on their labels and thus, bread consumers and bakers are at health risk of exposure to bromate with serious health complications. This is an important result as human health is directly affected by consumption of breads containing bromate.

Recommendations

The results calls for a conscious effort by relevant agencies especially NAFDAC to reassert the ban on the use of bromate by bakeries. Since NAFDAC has a fully pledge department of pharmaco vigilance, one expect that other than drugs, foods should also be constantly monitored to ensure the safety of life of the consumers.

The agencies should educate people through public enlightenment on the danger of the use of bromate as food additives. They should encourage the use of natural dough enhancers, like Vitamin C powder, eggs, apple sauce etc. (Craton, 2004) [5].

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