POTASSIUM BROMATE LEVELS IN BREAD SOLD WITHIN BENIN CITY

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CHINAZA CLARA OKPALA

PSC2008002

DEPARTMENT OF CHEMISTRY

FACULTY OF PHYSICAL SCIENCE

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF CHEMISTRY, FACULTY OF PHYSICAL SCIENCE, UNIVERSITY OF BENIN IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF SCIENCE DEGREE (B.Sc. Hons) IN CHEMISTRY.

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CERTIFICATION

This is to certify that this research project was carried out by CHINAZA CLARA OKPALA with the matriculation number PSC2008002 under the supervision of PROF MRS. J. UKPEBOR in the Department of Chemistry, Faculty of Physical Sciences, University of Benin, Benin City, Edo State.

CHINAZA CLARA OKPALA DATE

(Project Student)

PROF MRS. J. UKPEBOR DATE

(Project supervisor)

PROF EMMANUEL E.I IRABOR DATE

(Head of department)

DEDICATION

This project research is dedicated to the Almighty God who in His infinite mercy saw me through my journey in the University of Benin, to my dear mom Mrs. OKPALA JOSEPHINE and to my uncle and his wife, Mr and Mrs. IKECHUKWU IBEANU

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ABSTRACT

This study investigates the presence and concentration of potassium bromate in bread samples collected from various bakeries and retail outlets in Ovia North-East, Benin City, Edo State, using colorimetric detection and UV-Visible spectrophotometry. The qualitative analysis employed potassium iodide and hydrochloric acid to detect bromate presence through color changes, while quantitative analysis utilized spectrophotometry to measure bromate levels accurately. The results revealed that potassium bromate concentrations ranged from (26.95 ± 17.33 µg/g) to (167.72 ± 26.00 µg/g), with the highest levels found in Sample I (167.72 ± 26.00 µg/g) and Sample F (155.46 ± 25.96 µg/g), suggesting potential non-compliance with food safety regulations. Findings from this study provide valuable insights into the safety of locally available bread, highlight the need for stricter enforcement of food safety regulations, and raise consumer awareness about the dangers of potassium bromate, contributing to improved public health and regulatory oversight in the region.

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INTRODUCTION AND LITERATURE REVIEW

1.1 INTRODUCTION

1.1.1 BACKGROUND OF STUDY

Bread is a staple food widely consumed across the globe due to its affordability, convenience, and versatility. In Nigeria, it holds a prominent place in daily diets, with various brands and types available to meet diverse consumer preferences. To achieve the desirable qualities of bread—such as improved texture, enhanced dough elasticity, and increased loaf volume—flour improvers and bread additives are commonly employed. One such additive, potassium bromate, has been historically used in the baking industry. However, its safety has come under intense scrutiny due to its potential health risks(Olusola *et al.,* 2024). Research has shown that potassium bromate is a carcinogenic substance linked to kidney damage, respiratory problems, and cancer in humans. Consequently, its use in food production has been banned in many countries, including Nigeria (Olusola *et al.,* 2024).

Despite the regulatory prohibition, the detection of potassium bromate in bread samples across Nigeria suggests non-compliance by some bakeries. This non-adherence can be attributed to a lack of awareness among producers, weak enforcement mechanisms, or the perceived economic benefits of using the additive (Mode *et al.,* 2023). In Edo State, where bread is a major dietary component, the

situation is no different. Anecdotal evidence and previous studies hint at the persistent use of potassium bromate in bread production, raising concerns about consumer safety. Given that bread is consumed by individuals of all ages and socio-economic backgrounds, the implications of such contamination are far-reaching, with potential to compromise public health and strain the health-care system.

This study focuses on the determination of potassium bromate levels in bread samples from Ovia North-East, Benin City, Edo State. By employing both qualitative and quantitative analytical techniques, the research seeks to establish the presence and concentration of potassium bromate in bread sold in the region. The findings will provide valuable insights into the compliance levels of bread producers with existing food safety regulations and highlight the need for stricter enforcement. Furthermore, the study aims to raise awareness among consumers and stakeholders about the dangers associated with the use of potassium bromate, ultimately contributing to efforts geared toward safer food practices in Nigeria.

1.1.2 STATEMENT OF PROBLEM

Potassium bromate, a flour improver known for its ability to strengthen dough and enhance bread quality, poses significant health risks when consumed. Despite its ban in Nigeria due to its carcinogenic and nephrotoxic properties, reports of its continued use in bread production persist (Nkwatoh *et al.,* 2023). This alarming trend indicates a lack of compliance with regulatory guidelines by some bread producers, fueled by factors such as inadequate monitoring, weak enforcement mechanisms, and the

economic incentive to produce cheaper bread. The persistent use of potassium bromate not only endangers public health but also undermines consumer trust in the food industry (Omotoso, 2021).

In Ovia North-East, Benin City, bread is a widely consumed staple, forming a critical component of daily diets across all socio-economic classes. However, the extent to which bread produced and sold in this area is free from potassium bromate remains unclear. Previous studies by Olusola *et al.* (2024) in other regions of Nigeria have revealed significant levels of potassium bromate in bread samples, exceeding permissible limits and exposing consumers to severe health risks. This gap in knowledge regarding the safety of bread in Ovia North-East necessitates an investigation into the presence and concentration of potassium bromate in locally available bread products.

The lack of comprehensive data on the safety of bread in Ovia North-East further exacerbates the problem, limiting the ability of regulatory agencies to address potential violations effectively. Without concrete evidence, it is challenging to enforce compliance or educate the public about the associated risks. This study, therefore, seeks to bridge this gap by determining the levels of potassium bromate in bread samples from the region. By shedding light on the extent of the problem, the research aims to inform policy, strengthen enforcement, and safeguard public health.

1.1.3 SIGNIFICANCE OF THE STUDY

This study is crucial as it addresses a significant public health concern—the potential contamination of bread with potassium bromate in Ovia North-East, Benin City. Bread is a dietary staple consumed by people of all ages, making the risk of exposure to harmful substances like potassium bromate widespread. By determining the presence and concentration of this banned additive in bread, the study provides valuable insights into the level of compliance with food safety regulations among bread producers in the region. These findings can serve as evidence for regulatory agencies, such as the National Agency for Food and Drug Administration and Control (NAFDAC), to strengthen monitoring and enforcement mechanisms, thereby ensuring the safety of bread for consumers.

Beyond regulatory implications, the study has significant educational value. By highlighting the health risks associated with potassium bromate, it raises awareness among consumers, bread producers, and policymakers about the need for safer food production practices. The research findings can be used as a reference for advocacy campaigns aimed at promoting adherence to food safety standards. Furthermore, it encourages informed consumer choices by equipping the public with knowledge about the potential dangers in bread products. Ultimately, this work contributes to efforts to safeguard public health, foster trust in the food industry, and enhance the overall quality of life in the region.

1.1.4 SCOPE OF WORK

This study focuses on the determination of potassium bromate levels in bread samples collected from various bakeries and retail outlets in Ovia North-East, Benin City, Edo State. The scope encompasses the qualitative and quantitative analysis of potassium bromate using two primary methods: color determination and spectroscopic analysis. The color determination method involves the use of potassium iodide and hydrochloric acid to detect the presence of potassium bromate through observable color changes. The spectroscopic method employs UV-Visible spectrophotometry to measure the concentration of potassium bromate in the samples at a specific wavelength, providing accurate quantitative results. This research aims to assess compliance with regulatory standards, identify potential public health risks, and contribute to improved food safety practices in the region.

1.1.5 AIM AND OBJECTIVES

The aim of this study was to determine the concentrations of potassium bromate in bread samples from Ovia North-East, Benin City, Edo State.

To achieve the above stated aim, the following objectives were set:

- To collect bread samples from various bakeries and retail outlets in Ovia North East, Benin City.
- To extract the concentrations of potassium bromate in the bread samples using standard methods.

- To quantitatively measure the concentration of potassium bromate in the bread samples using a UV spectrophotometer.
- To evaluate the compliance of bread producers with regulatory limits on potassium bromate and raise awareness of its associated health risks.

1.2 LITERATURE REVIEW

1.2.1 BREAD

Bread is one of the most widely consumed food items globally, forming a vital part of diets in many cultures. In Nigeria, bread is a popular staple food consumed daily across all age groups and social classes. It serves as a quick, affordable source of energy and can be easily paired with various foods, making it an essential component of both breakfast and meals throughout the day. Given its widespread consumption and nutritional value, bread remains a fundamental food product in both urban and rural Nigerian communities, providing essential carbohydrates and energy to millions. Globally, bread holds similar significance, with different countries and regions embracing their own varieties, from baguettes to whole-grain loaves (Valavanidis, 2018).

1.2.1.1 BREAD PRODUCTION PROCESS

The production of bread involves a series of stages that transform basic ingredients into the final product. The process begins with mixing flour, water, yeast, and other ingredients to form a dough. This dough is then kneaded to ensure proper gluten development, which is essential for bread's structure and texture. The dough

undergoes fermentation, allowing the yeast to work, producing carbon dioxide that causes the dough to rise (Rosell, 2016). Afterward, the dough is shaped into loaves and baked at high temperatures to achieve the desired texture and flavor. During the production process, flour improvers and additives are often incorporated to enhance the bread's quality. These additives may include enzymes, dough conditioners, emulsifiers, and bleaching agents, which improve the dough's workability, the bread's shelf life, and its visual appeal (Das *et al.,* 2023).

1.2.1.2 THE ROLE OF ADDITIVES IN BREAD

Additives are essential in modern bread production to ensure consistency, quality, and desirable characteristics in the final product. These ingredients help improve dough strength, texture, volume, and freshness. One commonly used additive is potassium bromate, which strengthens the dough by improving its elasticity and helping it rise better during baking (Ravi *et al.,* 2000). This results in a lighter, airier loaf with improved texture and better volume, making the bread more appealing to consumers. Potassium bromate also plays a role in enhancing the whiteness of the bread, which is often considered a sign of quality. However, its use has raised concerns due to its potential health risks, leading to increasing scrutiny and regulatory restrictions in many countries, including Nigeria (Olusola *et al.,* 2024). While potassium bromate improves bread quality, its presence in baked goods poses significant health hazards if consumed in large quantities, prompting calls for safer, regulatory-approved alternatives in bread production.

1.2.2 POTASSIUM BROMATE

Potassium bromate is an oxidizing agent that improves dough. It has the chemical formula $KBrO_3$. It is an ingredient used in bread dough and many other baked goods as a flour enhancer. It acts as a maturing agent and dough conditioner by oxidizing the sulfhydryl groups of gluten protein in flour into disulphide bridges making it less extensible and more elastic; this will make the dough Visco-elastic such that it can retain the carbon dioxide gas produced by the yeast. The overall effect is to make it rise in the oven, increase loaf volume and texture *(*Nakamura *et al. 2006)*. It acts mainly in the late dough stage by giving strength to the dough during late proofing stage of baking (Fisher *et al.,* 1979) During the preparation of the bread, the formation of protein molecules joined together by disulphide linkage arises. The strength and elasticity of this network which gives the bread its characteristic properties is best when it comprises of long chain proteins such as gluten. Short chain peptides such as glutathione (a tripeptide) which are present as well react with gluten molecules breaking down the dough structure. This structural breakdown can be prevented by the addition of oxidizing agents *(*Emeje *et al. 2010).* Potassium bromate is the most commonly used oxidizing agent. Where potassium bromate is no longer used, bread of good value can be made using vitamin C (ascorbic acid) as the oxidizing agent together with amylases. In the presence of any of these oxidizing agents, the glutathione is oxidized to glutathione disulphide and therefore cannot interfere with disulphide bonds of gluten molecules (El harti *et al.* 2011) But in the absence of these oxidizing agents, the reverse is the case. In addition, potassium bromate reduces the

nutritional quality of bread by degrading essential vitamins such as vitamin A, B and E *(*Joint FAO/WHO *et al. 1992;* Oloyede *et al. 2009)*

1.2.2.1 ROLE AND BENEFITS OF POTASSIUM BROMATE

Potassium bromate is a synthetic chemical compound that has long been used in the baking industry as a flour improver to enhance the quality of bread. Its primary function is to strengthen dough by acting as an oxidizing agent, improving the development of gluten. This allows the dough to hold more air during fermentation, resulting in a lighter, more voluminous loaf of bread. The use of potassium bromate also improves the bread's texture by making it more elastic, which helps in producing bread with a finer crumb structure (Shanmugavel *et al.*, 2020). Additionally, potassium bromate contributes to a whiter appearance of the bread, which is often associated with higher quality in the consumer market. These benefits make it a popular additive in both large-scale commercial bakeries and smaller artisanal bakeries (Nkwatoh *et al.,* 2023).

Potassium bromate enhances the overall performance of bread dough, particularly in large-volume production, where consistency and efficiency are critical. It allows bakers to produce uniform loaves with desirable qualities such as increased volume, smoother texture, and better shelf life (Shanmugavel *et al.,* 2020). In addition, it reduces the need for long fermentation times, thus speeding up the baking process. These properties make it an invaluable tool for improving productivity and maintaining consistent product quality in the baking industry. Despite its benefits in bread production, the use of potassium bromate is controversial due to its potential

health risks, leading to a growing shift toward alternatives.

1.2.2.2 HISTORICAL AND CURRENT USE OF POTASSIUM BROMATE

Historically, potassium bromate has been used in the baking industry since the early 20th century, with its widespread adoption during the mid-1900s due to its effectiveness in improving dough strength and bread quality (Omotoso, 2021). In the United States and other countries, it became a standard ingredient in commercial bread production, as it allowed bakeries to produce larger quantities of bread with superior texture and consistency. However, as research into its health effects grew, concerns emerged about the potential carcinogenic and toxic properties of potassium bromate, particularly when consumed in large quantities over extended periods. This led to regulatory scrutiny and, in many cases, its eventual ban in several countries, including the European Union, Canada, and some states in the U.S.

Despite these concerns, potassium bromate continues to be used in some countries, including Nigeria, where it remains a legal additive in the food industry. In Nigeria, the use of potassium bromate in bread production is still prevalent due to its cost-effectiveness and the high demand for bread that meets consumer expectations in terms of texture, volume, and appearance (Shanmugavel *et al.,* 2020). However, there have been increasing calls for stricter enforcement of food safety regulations, as the public becomes more aware of the risks associated with potassium bromate consumption. In response to growing health concerns, some bakeries in Nigeria have started exploring alternative flour improvers and additives that are both safer and

more compliant with international food safety standards.

1.2.3 HEALTH RISKS ASSOCIATED WITH POTASSIUM BROMATE

1.2.3.1 Carcinogenicity and evidence in humans and animals

Potassium bromate has been classified as a possible human carcinogen by several health authorities due to its ability to cause cancer in laboratory animals. Numerous studies have shown that when potassium bromate is consumed in large amounts, it can induce tumors in animals, particularly in the kidneys, thyroid, and other organs (Kurokawa *et al.,* 1990). These findings have raised significant concerns about its potential cancer-causing effects in humans, particularly as a food contaminant. The International Agency for Research on Cancer (IARC), which is part of the World Health Organization (WHO), has classified potassium bromate as a Group 2B carcinogen, indicating that it is possibly carcinogenic to humans based on animal studies (Shanmugavel et al., 2020). Although human studies directly linking potassium bromate to cancer are limited, the risk from consumption remains a significant concern, especially when the substance is used in food products such as bread that are consumed regularly.

The carcinogenic potential of potassium bromate arises from its ability to generate free radicals in the body, leading to oxidative stress and damage to DNA. This damage can contribute to the initiation and promotion of cancerous growths (Shanmugavel *et al.,* 2020). While the risk of cancer from consuming small amounts of potassium bromate in bread is not definitively proven, the cumulative effect of

consuming food products containing this additive over time raises alarm about the long-term health impacts on the population (Omotoso, 2021). Consequently, many countries have moved to regulate or ban its use in food products to protect public health.

1.2.3.2 Nephrotoxicity and other adverse health effects

In addition to its carcinogenic effects, potassium bromate has been shown to have nephrotoxic (kidney-damaging) properties, particularly when consumed in large quantities. Studies in animals have demonstrated that exposure to potassium bromate can lead to kidney damage, causing lesions, fibrosis, and even kidney failure in severe cases (Kurokawa *et al.*, 1990). This nephrotoxicity is of particular concern for individuals who are exposed to potassium bromate over extended periods, as the kidneys are critical organs responsible for filtering toxins from the body. Chronic exposure to the chemical may impair kidney function and lead to long-term health complications.

Potassium bromate has also been linked to other health issues, such as respiratory problems, neurological damage, and gastrointestinal disturbances. High doses of potassium bromate have been known to cause symptoms such as vomiting, diarrhea, and nausea. Additionally, some studies suggest that it may disrupt hormonal functions, particularly affecting thyroid function due to its interference with iodine metabolism. These adverse health effects further underscore the dangers of consuming products contaminated with potassium bromate, particularly in populations with limited access to safe food sources and regulatory oversight (Olusola *et al.,* 2024).

1.2.3.3 Public health concerns and international stance

The consumption of potassium bromate in bread has raised significant public health concerns, particularly in developing countries like Nigeria, where food safety regulations may not be as strictly enforced. Many consumers are unaware of the presence of this harmful additive in their bread, putting them at risk of exposure to its potentially dangerous effects (Dhouibi *et al.,* 2021). In countries where potassium bromate is still used, public health experts have called for increased awareness and education about its risks, urging consumers to avoid bread products that contain the substance. As consumers become more informed, demand for safer alternatives to potassium bromate is likely to increase, pushing for better food safety standards.

International health organizations have taken strong stances against the use of potassium bromate in food. The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) have set maximum allowable limits for potassium bromate in food products to minimize health risks. In many countries, such as the European Union, Canada, and the United States, potassium bromate has been banned or heavily regulated in food products due to its carcinogenic and nephrotoxic effects (Shanmugavel *et al.,* 2020). These organizations advocate for safer alternatives in bread production and recommend that countries implement stricter regulations to protect consumers from the dangers posed by this additive. Despite these international stances, its use continues in some regions, particularly in Africa and parts of Asia, highlighting the ongoing need for greater regulatory oversight.

1.2.4 PHYSICAL AND CHEMICAL PROPERTIES OF POTASSIUM BROMATE

1.2.4.1 Physical Properties of Potassium Bromate

Potassium bromate ($KBrO_3$) is a white, crystalline, odorless powder that is highly soluble in water. It forms colorless or white crystals and is stable under dry conditions but can decompose when exposed to heat or light. Potassium bromate has a molecular mass of 167.01 g/mol, which is an important characteristic when calculating its concentration in various applications. The compound has a relatively high melting point of approximately 380°C (about 716°F), which indicates its stability under typical storage conditions. However, it decomposes at higher temperatures, releasing oxygen and potentially harmful bromine gas. The density of potassium bromate is around 3.27 g/cm^3, which reflects its solid, crystalline structure. It is highly soluble in water, dissolving in approximately 2.9 g per 100 mL of water at room temperature, although its solubility is lower in organic solvents.

Potassium bromate is a strong oxidizer, making it highly reactive, especially when exposed to reducing agents. This reactivity is a critical property in its use as a flour improver and in various industrial applications. It can also cause damage to organic

materials and surfaces when mishandled (Yalçin and Çavuşoğlu, 2022). The compound is sensitive to light, and exposure to ultraviolet (UV) light can accelerate its decomposition into less reactive forms. Potassium bromate's ability to decompose into toxic bromine gas when exposed to heat is a safety concern, particularly in enclosed spaces, requiring careful handling and storage to avoid health hazards (Nkwatoh *et al.,* 2023).

1.2.4.2 Chemical Properties of Potassium Bromate

Chemically, potassium bromate is an inorganic salt with strong oxidizing properties. It is stable at room temperature but decomposes when subjected to high temperatures or light, releasing oxygen. This decomposition reaction occurs around 300°C, making the compound potentially hazardous when used in large quantities or under improper conditions. The compound's strong oxidizing nature makes it effective as a dough improver in bread production, where it strengthens the dough by enhancing the gluten network, improving volume, and contributing to a finer texture. Potassium bromate also reacts with reducing agents like sodium bisulfite or ascorbic acid, which are often included in the dough to control its oxidative properties.

While potassium bromate is effective in improving the quality of bread, its chemical properties also pose significant health risks. When the compound decomposes, it releases bromine, which is toxic and potentially carcinogenic. This is the reason why potassium bromate is classified as a possible human carcinogen by the International Agency for Research on Cancer (IARC). Its molecular structure and the ease with which it can release harmful chemicals upon thermal decomposition or UV exposure

make potassium bromate a subject of concern in food safety. Because of these risks, many countries have placed regulations on its use, with some even banning it in food products altogether (Shanmugavel *et al.,* 2020). Despite this, potassium bromate is still used in certain regions, raising ongoing concerns about public health and the safety of food products containing this additive.

1.2.5 IMPORTANCE OF POTASSIUM BROMATE IN BREAD PRODUCTION

Dough conditioner: Potassium bromate is a dough conditioner and maturing agent that improves the elasticity of dough. It oxidizes the gluten protein in flour, making the dough less extensible and more elastic. This allows the dough to retain carbon dioxide produced by yeast which helps the bread rise.

Improves other ingredients: Potassium bromate also improves the consistency, swelling and gelatinization of starches, and the volume and structure of proteins. It helps form a protein-fat structure to improve the quality of lipids (fats).

Bleaches dough: Potassium bromate also bleaches the dough.

CHAPTER TWO

MATERIALS AND METHODS

2.1 MATERIALS

2.1.1 APPARATUS

- Mortar and pestle.
- 300 Micron Sieve
- 10ml measuring cylinder
- 10ml Pipette
- 250ml and 500ml Volumetric flask
- 250ml Beaker
- 20ml test tubes (for standard preparation).
- UV spectrophotometer (Jenway 6320D)
- Oven (Mermet UNB 300)
- Weighing balance (Ohaus PA214)
- Shaker (HY-4A Cycling vibrator)
- Centrifuge (800D Centrifuge)

2.1.2 REAGENTS

- Potassium bromate ($KBrO_3$)
- Distilled water (H_2O)
- Hydrochloric acid (HCl)
- Potassium iodide (KI)

2.2 METHODOLOGY

2.2.1 STUDY AREA

The study was carried out in Ovia North East Local Government Area (LGA) of Edo State, Nigeria. Ovia North East, with its administrative headquarters in Okada town, spans an area of approximately 2,301 km² and recorded a population of 153,849 in the 2006 census. Prominent communities within the LGA include Okada, Uhen, Utese, Okokhuo, Uhiere, Isiuwa, Ekiadolor, Oluku, Iguoshodin, Utoka, Oghede, Egbeta, Ora, and Ogbese. The University of Benin, a renowned institution, is also situated in this region.

Bread samples for this study were obtained from Ekosodin, a community within the LGA, which had an estimated population of 7,000 as reported in the 2006 census (Ogeah and Ajalaye, 2011). Ekosodin covers an area of 772 km² and is geographically located at coordinates 12° 52′ 5″ N and 11° 2′ 47″ E.

2.2.2 SAMPLE COLLECTION AND PREPARATION

Ten bread samples were collected from ten different bread brands commonly sold in

retail outlets within Ovia North East Local Government Area (LGA). From each loaf, 25g of the bread sample was taken from the center and dried for three to four days at room temperature, avoiding direct sunlight. After drying, the bread samples were pulverized into a powdery form using a mortar and pestle and then sieved with a 300 micron sieve. A 10g portion of the powdered bread from each sample was packaged in sampling polythene bags and stored for further analysis.

Fig 2.1: Grinding

Fig 2.3: Sampling

Fig 2.2: Sieving

2.2.3 PREPARATION OF STANDARDS

0.0001M, 0.0002M, 0.0004M, 0.0006M, 0.0008M and 0.0010M of standard solution were prepared in a 250ml volumetric flask.
Using the dilution formular;

n = CV
Where,

- n = Number of moles,
- C = Concentration in mol/L,
- V = Volume of volumetric flask (250 mL = 0.25 L)

Molar mass of $KBRO_3$ is 167g/mol

The respective mass of $KBRO_3$ for each molar concentration were calculated, weighed and transferred into a 250ml volumetric flask. Small amount of distilled water was added and the solution was shaken until the solid was completely dissolved. Distilled water was then added to fill up the flask to the 250ml mark. The mixtures were thoroughly shaken for 1 minute, and the absorbance of each was measured at 620 nm using a UV spectrophotometer (Jenway 6320D) against a reagent blank. These absorbance values were used to construct a 6 point calibration curve, which served as a reference for determining the potassium bromate concentration in the bread samples.

Fig 2.4: Standard solution preparation

2.2.4 PREPARATION OF 0.5% KI IN 0.1N HCl REAGENT

0.5% (w/v) = 0.5g of KI per 100ml of solution

- The mass of KI was determined and weighed using a Weighing balance (Ohaus PA214)., then transferred into a 500ml volumetric flask. About 250ml of 0.1N hydrochloric acid was added and stirred till it completely dissolved, more HCl was then added till it got to the 500ml mark.

Fig 2.5: 0.5% KI in 0.1N HCl

2.2.5 SAMPLE ANALYSIS

Each powdered bread sample was further dried in an oven at 70 °C for two hours. From each sample, 1.0g was weighed using an electronic balance and transferred into a test tube. To this, 10 ml of distilled water was added, and the mixture was shaken using a Shaker (HY-4A Cycling Vibrator) before being left to stand for 20 minutes at 28 ± 1°C.

Fig 2.6: Shaking of samples

The mixture was then decanted into a centrifuge tube and centrifuged at 3000 rpm for 10 minutes. A 5.0ml portion of the supernatant was collected and mixed with 5.0 ml of freshly prepared 0.5% potassium iodide solution in 0.1N hydrochloric acid. The colour changed from light yellow to purple, indicating the presence of potassium bromate. The absorbance of each sample was then measured at 620nm using a UV spectrophotometer. The potassium bromate concentration was calculated by comparing the absorbance values to a calibration curve constructed using a pure potassium bromate standard.

CHAPTER THREE

RESULT AND DISCUSSION

3.1 RESULT

The concentration of potassium bromate in different bread samples was investigated.

The results obtained from the research are presented below:

Table 3.1: Standard Calibration Curve Data for Potassium Bromate

STANDARD SOLUTION (Mol/L)	ABSORBANCE
0.0001M	0.02
0.0002M	0.04
0.0004M	0.05
0.0006M	0.06
0.0008M	0.07
0.0010M	0.09

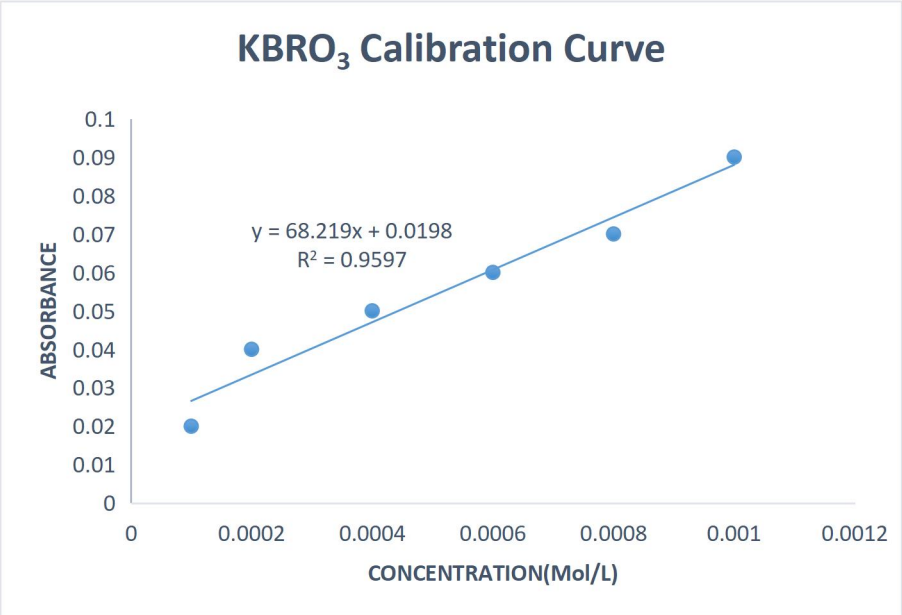

Fig 3.1:Graph of Absorbance against Concentration

Table 3.2: Potassium Bromate Levels in 10 different Bread Samples in Ovia North East Local government.

Sample	Conc (µg/g) Run 1	Conc (µg/g) Run 2	Mean ± SD
A (De right choice)	88.13	75.90	82.02 ± 8.65
B (Efe bread)	39.17	63.65	51.41 ± 17.31
C (Fola bread)	63.65	26.93	45.29 ± 25.96
D (Tastebud)	100.37	124.85	112.61 ± 17.31
E (Gladheart)	63.65	88.13	75.89 ± 17.31
F (Chabis tasty loaf)	173.82	137.10	155.46 ± 25.96
G (Nadia bread)	51.41	63.65	57.53 ± 8.65
H (Belle wise)	14.69	39.20	26.95 ± 17.33
I (Zuyi bread)	186.10	149.33	167.72 ± 26.00
J (klazzy special bread)	124.85	112.61	118.73 ± 8.65

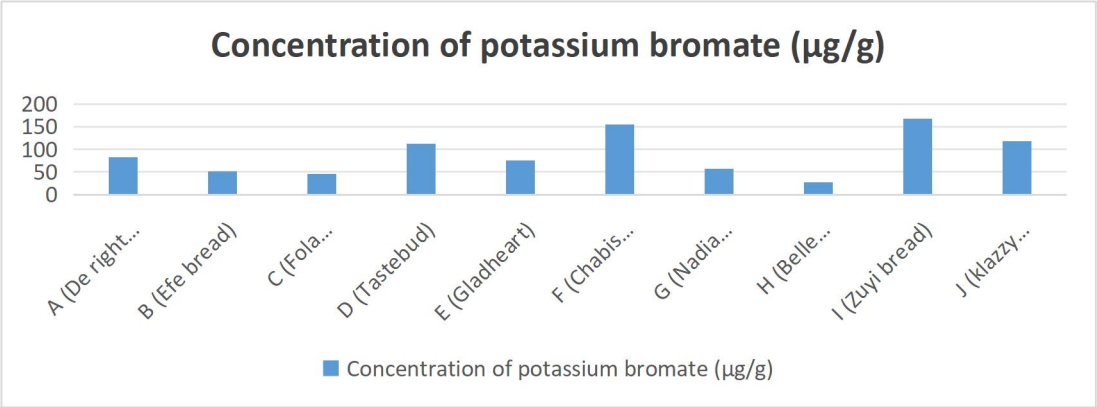

Figure 3.2: Potassium Bromate Levels in 10 different Bread Samples in Ovia North East Local government.

3.2 DISCUSSION

In Nigeria, the use of potassium bromate in bread production has raised significant concerns regarding its potential health impacts. The results in Table 3.2 show that potassium bromate levels in bread samples from Ovia North East Local Government exhibit considerable variation, and many of these concentrations exceed regulatory standards set by Nigerian food safety authorities.

According to Nigerian food safety regulations, potassium bromate is banned in bread production due to its known carcinogenic and nephrotoxic effects. This ban is enforced by agencies such as the National Agency for Food and Drug Administration and Control (NAFDAC), which ensures that food products, including bread, do not contain harmful levels of additives like potassium bromate (Mode *et al.,* 2023). However, despite these regulations, the levels observed in many of the bread samples in this study are alarmingly high, indicating that enforcement may be insufficient, or that some bakeries are ignoring these regulations altogether.

Zuyi bread (167.72 ± 26.00 µg/g) and Chabis Tasty Loaf (155.46 ± 25.96 µg/g) recorded the highest concentrations, indicating a high likelihood of excessive bromate usage, which poses health risks. Similarly, *Klazzy Special Bread* (118.73 ± 8.65 µg/g) and *Tastebud* (112.61 ± 17.31 µg/g) also displayed concerning levels, suggesting that these brands may not be adhering strictly to safe baking practices. The elevated values in these samples could imply poor regulatory enforcement or a preference for bromate as a dough improver despite its known carcinogenic risks. Consumers who frequently purchase these brands may be at greater risk of exposure to potassium bromate's harmful effects.

In contrast, *De Right Choice* (82.02 ± 8.65 µg/g), *Gladheart* (75.89 ± 17.31 µg/g), and *Efe Bread* (51.41 ± 17.31 µg/g) fall within a moderate range, though their potassium

bromate levels are still relatively high. While these values may suggest a more controlled usage of bromate compared to the previously mentioned brands, they still raise concerns about long-term consumption. A noteworthy observation is that *Nadia Bread* (57.53 ± 8.65 µg/g) and *Fola Bread* (45.29 ± 25.96 µg/g) exhibit slightly lower concentrations, implying that these brands might be either using less bromate or employing alternative baking improvers. Despite this, their values are still not negligible, highlighting the need for routine monitoring and possible consumer awareness initiatives to promote safer food choices. On the lower end of the spectrum, *Belle Wise* (26.95 ± 17.33 µg/g) recorded the least potassium bromate concentration, making it the safest among the analyzed samples. However, the presence of bromate, even at low levels, underscores the need for complete elimination rather than just reduction. Ideally, all bread samples should contain zero potassium bromate, aligning with health recommendations. The significant differences observed across the brands may be due to differences in production methods, ingredient sourcing, and adherence to regulatory standards. To ensure public safety, stricter regulatory enforcement, increased awareness among bakers, and improved consumer education on the risks of potassium bromate consumption are necessary.

3.3 CONCLUSION

The analysis of bread samples from Ovia North East Local Government shows that some brands are using way too much of this harmful chemical, which is really dangerous for people who eat them regularly. While a few brands had lower amounts, the fact that bromate was found in all the samples is worrying because it's not supposed to be there at all. Some breads, like *Zuyi* Bread and *Chabis Tasty* Loaf, had extremely high levels, which means they could be a serious health risk. On the other hand, *Belle Wise* had the least, but even that isn't completely safe. This shows that a

lot of bakers are not following the rules, and more needs to be done to stop them from using potassium bromate. People should be more aware of what they are eating, and authorities need to take stronger action to make sure bread is safe for everyone.

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