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Evaluation of Some Baked Food for the Detection of Presence of Borax Using *curcuma longa lin* Indicator in Adamawa State

[1]Kidah, I. Maimunah; [1]Titus, T. Hannatu; [1]Madu Ibrahim & [2]Teri Waviche
[1]Department of Chemistry, [2]Department of Integrated Science
Federal College Education, Yola
masititus@gmail.com

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Abstract

Borax is a well-known toxic substance, had been banned as food additive in many countries such as Australia, China, Thailand, Indonesia and the U.S. The E.U banned the use of borax in 2010 due to negative impacts on reproductive health. However, many bakers in Nigeria still use it despite the health warning by WHO/FAO. Researchers investigated it use in Adamawa State. Radom sampling was use in collecting samples from the three senatorial zone, (Yola North, Yola Central and Yola South). The baked food items sampled were breads, small cakes and crackers. Experimental method was used and turmeric rhizomes (curcuma longa lin) solution was prepared. Turmeric (curcuma longa lin) papers was prepared and the performances of the prepared turmeric papers was evaluated relative to standard litmus papers (SLP). This research also determined the effect of turmeric solvent extraction and its utilization for borax detection in processed baked food within Adamawa State, Nigeria. The indicator was packaged and labelled as Turmeric Paper Test Kit. Snacks such as love cake, cupcake, buttered cake and diabetic wheat bread tested positive for borax. The government, as a policymaker, must make strict and controlled regulations for the distribution of borax sales in Nigeria

INTRODUCTION

The WHO, in cooperation with the UN FAO, is responsible for assessing risks of food additives to human health and safety. Risk assessment of food additives are done by an independent, international expert scientific group known as the Joint FAO/WHO Expert Committee on Food Additives (JECFA). Only the food additives that have undergone JECFA safety assessment, and found not to present appreciable health risk to the consumers, can be used (WHO, 2018). This applies whether the food additives come from natural source or just synthetic. National authorities, either based on a national assessment or the JECFA assessment, can then authorize the use of additives in food at specific levels for specified foods. The JECFA evaluations are based on the scientific reviews of all the available toxicological, biochemical, and any other relevant data on a given additive, such as research studies, mandatory tests in animals, and observations in humans, (WHO/FAO, 2000)

With the increasing use of processed food ever since the 19th century, the food additives are more in used worldwide. Many countries regulate the use of food additives. Boric acid was extensively used as a food preservative from 1870s to 1920s, but was banned after the World War I because of its toxicity, as demonstrated in the animal and human studies. During the World War II, urgent need for cheap, available food additives, mostly preservatives led to their use again, but was finally banned in 1950s (Bucci, 1995). Such cases led to general mistrust of food additives, and application of precautionary principle led to conclusion that only food additives known to be safe have to be used in foods. In the US, this led to adoption of the Delaney clause, which is an amendment to the 1938 Federal Food, Drug, and Cosmetic Act, stating that no carcinogenic substances could be used as additives in foods, (Chinaza *et al.,* 2020).

Borax Identification.

Various studies on borax identification have been carried out, both instrumental procedures and simple evaluation. Borax could be identified using spectrophotometer, UV-Visible (Colorimetry) (Adu *et al*., 2021). Instrumental methods mentioned above are expensive and so special alternative procedures at low cost is needed that is simple and easy to carry out. Meanwhile, a simpler way to identify borax is increasing rapidly, such methods as drop test (Rahma 2019), tooth picks (Samson 2015) flame test and turmeric paper test (; Rama *et al*., 2020). This work will use turmeric a natural organic indicator to evaluate substances adopted from (Harimurti *et al.*, 2020).

PROBLEM STATEMENT/JUSTIFCATION

Borax was commonly used as food preservative, increase food elasticity, strengthen and brighten the food, also make the chewy texture. However, FAO/WHO Expert Committee on Food Additives (JECFA) banned this compound, because it is inapplicable as a food additive. Borax accumulation in the body could give some adverse reaction such as vomiting, fatigue, and renal failure because it has a toxic effect that can harm the metabolic system of human health such as irritation of the respiratory tract, skin, eyes, and target organs such as blood, kidneys, heart, respiratory system, central nervous system, liver, lymph, digestive system, eyes, reproductive system, and skin (Aseptianova *et al*., 2017).

Oladunni (2018), a food expects, alerted the Federal Government of Nigeria on the continuous use of banned bromate in bakeries in Ibadan and Oyo State. In the study she conducted, 72% of bread samples contain borax.

The use of Borax in Adamawa state food industries is unknown. This study is an investigation using turmeric an easy to obtain product to detect the presence of Borax which could be confirmed by discoloration from orange to red colour in food products containing borax (Grynkiewicz and Slifirski 2012). *C*urcumin can break the bonds of borax into boric acid and form curcumin boron cyano complex, a complex rosin compound. This reaction is easy to observe. No study however, have been carried out within Adamawa State to ascertain the safety of processed food from borax, an additive that is consumed on daily bases.

In this study, various turmeric extract with various solvents will be used. The purpose of this study is to determine the presence of borax in bakery food and to determine the best solvent for the identification using Turmeric Paper Strip-Test Kit.

OBJECTIVES OF THE STUDY

The main objectives of this study include:

i) To prepare turmeric powder from *Curcuma longa* (turmeric rhizomes)
ii) To extract curcumin, from *Curcuma longa* (turmeric rhizomes) using organic liquids such as alcohol, esters and alkanes, choosing the best
iii) To prepare indicator papers using the best extracting solvent of the *Curcuma longa* (turmeric rhizome).
iv) To investigate the presence of borax using the test paper, in processed food such as cracker's, children's snacks and bread in Adamawa State (North, South and Central Senatorial zones)

LITERATURE REVIEW

The use of turmeric dates back nearly 4000 years to the Vedic culture in India, where it was used as a culinary spice and had some religious significance. It probably reached China by 700 AD, East Africa by 800 AD, West Africa by 1200 AD, and Jamaica in the eighteenth century. In 1280, Marco Polo described this spice, marvelling at a vegetable that exhibited qualities so similar to that of saffron. According to Sanskrit medical treatises and Ayurvedic and Unani systems, turmeric has a long history of medicinal use in South Asia. Susruta's Ayurvedic *Compendium*, dating back to 250 BC, recommends an ointment containing turmeric to relieve the effects of poisoned food.

Today, turmeric is widely cultivated in the tropics and goes by different names in different cultures and countries. India produces nearly all of the world's turmeric crop and consumes 80% of it. In North India, turmeric is commonly called "haldi," a word derived from the Sanskrit word *haridra*, and in the south it is called "manjal," a word that is frequently used in ancient Tamil literature. The name turmeric derives from the Latin word *terra merita* (meritorious earth), referring to the color of ground turmeric, which resembles a mineral pigment. It is known as *terre merite* in French and simply as "yellow root" in many languages, [Sahdeo & Bhara, 2011].

Turmeric is a product of *Curcuma longa*, a rhizomatous herbaceous perennial plant belonging to the ginger family Zingiberaceae, which is native to tropical South Asia. As many as 133 species of *Curcuma* have been identified worldwide. Most of them have common local names and are used for various medicinal formulations. The turmeric plant needs temperatures between 20°C and 30°C and a considerable amount of annual rainfall to thrive. Individual plants grow to a height of 1 m, and have long, oblong leaves. Plants are gathered annually for their rhizomes, and are reseeded from some of those rhizomes in the following season. The rhizome, from which the turmeric is derived, is tuberous, with a rough and segmented skin. The rhizomes mature beneath the foliage in the ground. They are yellowish brown with a dull orange interior. The main rhizome is pointed

or tapered at the distal end and measures 2.5–7.0 cm (1–3 inches) in length and 2.5 cm (1 inch) in diameter, with smaller tubers branching off. When the turmeric rhizome is dried, it can be ground to a yellow powder with a bitter, slightly acrid, yet sweet, taste. (Sahdeo & Bhara, 2011).

Historically, evaluation of boric acid and it use as a preservative up till the 1920s was banned after world war I when it was discovered to be toxic to both human and animals, [European Parliament and Council (1995), WHO (1987)]. WHO (2020) estimated that unhealthy food is responsible for 600 million foodborne disease case, 420,000 deaths every year in the world and 33 million disability-adjusted life. More so, 40% of toddlers suffer from foodborne disease with 29% deaths every year.

METHODOLOGY

Turmeric powder preparation, objective one

The turmeric tuber was peeled, sliced and dried indoor to preserved the color which might be decolorized by heat and sunlight. After drying, turmeric was ground using a grinder until it becomes a fine powder. Then the sample was sieved through a 60-mesh sieve.

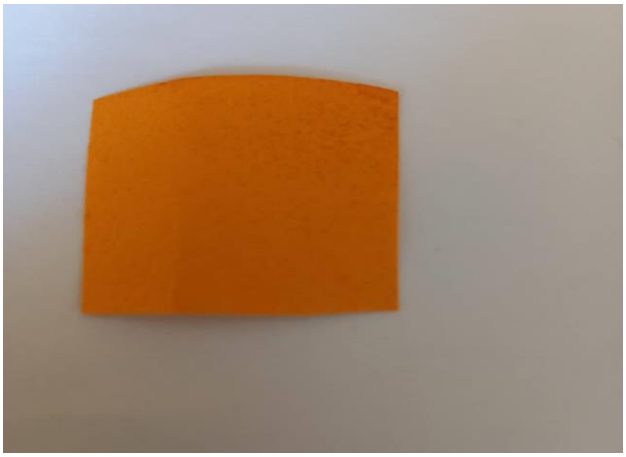
Fig. 1 Scraped and sliced Turmeric root **Grounded Turmeric root into powder form**

Turmeric extract preparation, objective two

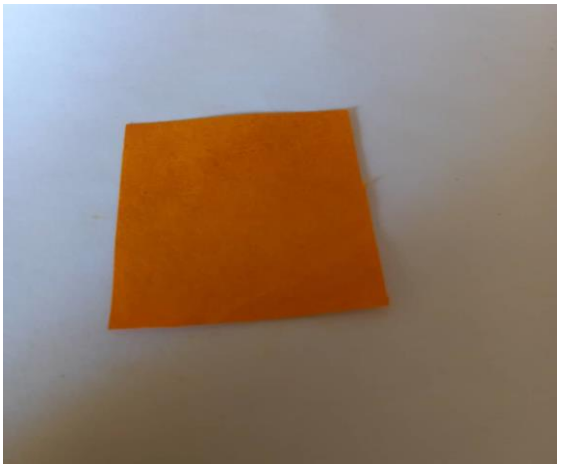
The turmeric powder that has been made is then added to the solvents in a ratio of 1:5 adopted from Yulianita *et al.,* (2022). Then macerated for 3 days. The collected macerate was then aerated at a cool temperature (air-conditioned room) until it became a thick extract.

Fig. 2 Maceration of Turmeric powder in different solvents

Turmeric extract was prepared in various solvents (methanol, ethyl acetate, n-hexane, methyl acetate and carbon tetrachloride). It was stirred until smooth and transfer to a wider container. Filter paper was dipped into the container containing the turmeric solution and using tweezers until evenly distributed over the entire surface of the filter paper. Then it was placed on a baking sheet to dry by aerating. After drying, it was stored in a closed container, (Fig 3).

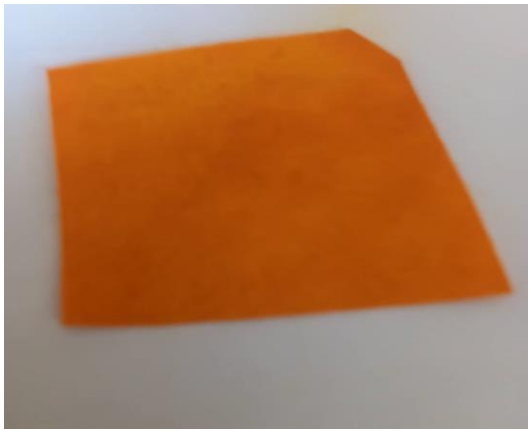


Methanol Extract

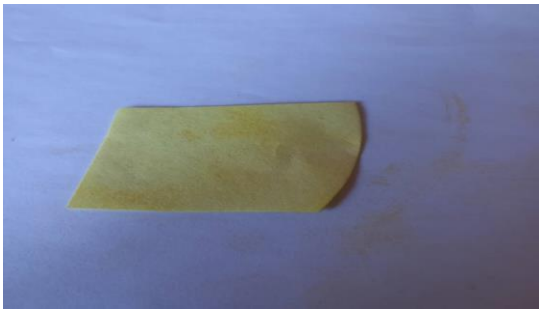


Ethanol Extract

Ethyl acetate Extract



Methyl acetate Extract



N-Hexane Extract

Carbon Tetrachloride Extract

Fig 3 Solvent Test

The concentration of 1,000 ppm of sodium tetraborate dehydrate gave the desired red color and this was used as standard for comparison. Turmeric Paper Strip-Test Kit is now prepared by cutting it into smaller rectangular shape and stored for use. (Hartati, 2017 in Yulianita *et al., (*2022).

Fig. 4 Turmeric Paper Test-Kit Preparations

Preparation of Borax Solution

A 1000 ppm borax, (sodium tetraborate dehydrate) solution was made by weighing 100 mg of borax into a 100 mL volumetric flask. Dissolve with distilled water up to 100 mL.

Qualitative Test of The Turmeric Paper Test Kit on Food, objective four

1. The test paper was dipped into various solution to ascertain whether acid or base. The test paper remained orange in acids and turned reddish in basic solutions.
2. Test was carried out by dipping the turmeric paper test kit that had been made into the solutions of the food items, such as bread, cup cakes, love cakes, crackers and buttered cake obtained from all the senatorial zones. This was allowed to stand for few minutes until the paper dries and the resulting colour become stable. The colour change observed was snapped and presented below.

RESULTS

Figures 5-10 shows the results of the Turmeric paper test for borax in different snacks, bread and cakes. The compound that plays an important role in turmeric is *curcuma* (BPS, 2019). According to Halim *et al* (2013), *curcuma* binds to boric acid which then forms a red rosocyanine component so that it can be used as a borax detection test.

Fig 5 Turmeric paper before Test

Love Cake (Yola Zone)

Turmeric paper turns brick red, Borax present

Fig 6 Turmeric paper before Test, buttered bread (Yola zone)

Turmeric paper turns red, borax present

Fig 7 Turmeric paper before Test cake (Mubi zone)

Turmeric paper turns brick red, borax present

Fig 8 Turmeric paper before Test, love cake, (Yola zone)

Turmeric paper turns brick red, Borax present

Fig 9 Turmeric paper before Test, cupcake, (Hong zone)

Turmeric turns brick red, borax present

Fig 10 Turmeric paper before Test, Turmeric paper turns red, Borax Present

Diabetic wheat bread (Yola zone)

DISCUSSIONS

Food Safety is an essential element of food security. Food security is a basic human need and right of every citizen. The quality of food we eat guarantee a better future. Following the series of experiment carried out on the baked foods, the results from the research revealed that bakers still use Borax in baking in Adamawa State. Positive results for borax came from Yola Central bakery shops, Mubi and Hong local government areas. These are Urban areas of Adamawa State which are densely populated and higher institutions are located. However, from Ganye, Tongo, Mayo/Belwa, Michika, song and Gombi local government areas showed negative test for borax for the breads, crackers and small cakes.

As shown in Figures 5, 6, 7, 8, 9 and 10 the turmeric papers have changed colour from orange to brick red indicating the presence of borax in the food items and rendering those foods as unhealthy for consumption. This confirms the study by Oladunni (2018), a food expects, who alerted the Federal Government of Nigeria on the continuous use of banned bromate in bakeries in Ibadan and Oyo State, Nigeria. In another study, Syelomita *et al* (2022) reported that in Gorontalo Province, Indonesia, the presence of borax is found in food such as crackers and meat balls. Some other researchers who discovered the use of borax in food include Sari *et al* (2021) and Ermawati *et al*.,

(2021). They said, “in many local communities, both in the city and in the countryside in Java in Indonesia, many food producers add borax to several products, such as meatballs, school children's snacks, bread, pempek, tofu and crackers. Tofu whose production process uses borax is sharp, very tasty and has a bitter taste on the tongue. Meatballs containing borax tend to be white, not brownish like the use of meat. When bitten, the meatballs return to their original texture, chewy and tend to be hard”.

When one of the bakers was interviewed, he said, the purpose of adding borax is to make cakes and bread to provide a dense, crunchy texture, increase elasticity and provide a savory, long-lasting taste and preservation against spoilage. He also stated that profit making is one of the major reasons for their use of borax in baking. They challenged researchers to provide an alternative for them to use.

RECOMMENDATIONS

1. The government, as a policymaker, must make strict and controlled regulations for the distribution of borax sales in Nigeria
2. The government must make strict regulations for any violation of the misuse of the use of borax for food.
3. Borax sellers must have official permission from the government. The buyer must also have an official document and be responsible for the intended use of the borax purchased.
4. Awareness workshops and seminars be organized by the government, non-governmental organizations, and academics on how to easily and practically know the presence of borax or other non-food grade additives in food
5. Efforts to find a substitute for borax as a food preservative and thickener with natural ingredients that are safe through research
6. Cook your food to be consumed by collecting lots of good recipes and setting aside special time for cooking rather than buying baked foo

CONCLUSIONS

The result of experimental tests for the borax in small cakes, (love cake, buttered cake & cup cake) and diabetic wheat bread showed a positive test with turmeric paper changing colour from orange to brick red. Other bread types and crackers showed negative test with the turmeric test paper. It can be concluded that some bakers in Adamawa State use Borax, a non-food additive which has been banned. The presence of borax in food as a non-food grade additive is an act of violation of the law that threatens the assurance of food security for the community, which in turn will hurt the health of individuals and society, and can even lead to death.

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