



Experimental Authentication of Common Nigerian Consumer Food Products Reveals Absence of Food Fraud in Branded Products

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Abstract— Food adulteration is the act of addition or removal of valuable food components or substitution of these valuable ingredients with relatively cheaper substances for unfair economic gain. Adulterated foods affect consumers in different ways, such as lack of the expected food nutrients, being unsafe and it constitutes economic loss to the consumers. Several foods are susceptible to adulteration in Nigeria and the world at large, including milk, meat, wheat flour, honey, butter, juices, and sugar. In this study, chemical methods were used to determine the presence of adulterants in wheat flour (Honey Well brand), condensed milk (unbranded) and butter (Simas brand) consumed in Nigeria. The tests assayed for the presence of starch in milk, sand/ dirt, barn and chalk powder in wheat flour, and potato in butter. The results showed that none of the branded products were adulterated, but condensed milk (unbranded) showed the presence of starch. This is an indication that enforcement of compliance by the National Agency for Food Drug Administration and Control (NAFDAC) in the food industries is impactful, and also there is corresponding compliance.

Keywords— Adulteration, Fraud, Condensed Milk, Wheat flour, Butter

I. INTRODUCTION

Food is a product gotten from either plant or animal origin which in raw, processed or semi-processed form is taken in to the body in order to support the different biochemical and physiological activities of our body. Most times, these foods are prone to food fraud and adulteration, which put the health of consumers at risk. The term food fraud encompasses the deliberate substitution, addition, tampering or misrepresentation of food, food ingredients or food packaging, or false or misleading statements made about a product for economic gain [4]. Quality and safety of food including the factors affecting them is a major area of interest within the food supply chain and is attracting attentions of researchers, government and regulatory bodies [3]. Food authentication and food adulteration is one among these different emerging areas of science. The word adulteration can be viewed in different ways, either mixing or substitution of inferior substances to the one which is superior to the adulterants or removal of some of valuable constituents from a given food products [14]. Adulteration ultimately results to the consumer being cheated or being a victim of diseases. Such types of adulteration are quite common in developing countries.

The National Agency for Food and Drug Administration and Control of Nigeria describes adulterated foods and food products as food that has been prepared, packed, or held under condition that is unfit for human consumption

whereby it may have become contaminated with filth, chemical or microbial substances and it may have been rendered injurious to health. It includes the addition or subtraction to or from food so that the natural composition and quality of the food is affected.

Food adulteration has become a global practice among food producers, sellers, retailers and others in the food chain. Although the phenomenon has been reported from both high- and low-income countries, there has been a greater occurrence in low-economic zones like Bangladesh, Indonesia, India, Vietnam, and African countries [9]

Many a time, consumers fall into the traps of dishonest food dealers who engage in the practice of adulterating foods in order to boost profit using less capital or equipment. Such consumers often suffer mild to grave consequences from consumption of adulterated foods. [9,17]. Dangerous chemical substances such as calcium carbide, sodium cyclamate, cyanide, and formalin are widely used to ripen green tropical fruits, keeping them fresh and preserved until sales [1,22]. Low-cost textile dyes are used in coloring vegetables, fruits, popular sweetmeats, soft drinks, beverages, confectioneries to draw customers' attention (Billah, 2007). There has also been reports of preservation of fish using formalin by fishmongers to disguise internal decomposition of fish by maintaining a solid and fresh-looking skin [1,17,23].

Intake of such types of chemically treated food may cause complex diseases and has direct consequences such as liver and kidney failure, autism, metabolic dysfunctions, cancer [7,9]; and even death as reported by the National Agency for Food and Drug Administration and Control of Nigeria (NAFDAC) in 2021[21].

About 66% of Nigerians consume various brands of milk as staple food [11]. Wheat also makes up a large composition of Nigerian staples given its various applications in bread baking and preparation of local dishes. An average Nigeria home is known to regularly consume bread as breakfast. Butter becomes an item of research interest as it is usually consumed with bread and also used as oil for processing foods at home.

The term adulterated in legal term is used to mean that a food product fails to meet federal or state standards. It is equally important for the consumer to know the common adulterants and their effect on health.

II. RELATED WORK

In 2016, Su and Sun [20] identified various adulterants in four varieties of wheat sampled from Ireland using spectral imaging; Awasthi *et al.* [2] discovered the presence of adulterants in retailed wheat in Bangalore. In other studies, wheat was found as the adulterant in certain foods and food products [5]. Adulteration of butter has become a common practice as adulterants such as palm oil, matched potatoes and hydrogenated fats are often used in butter production [6,12,21]. According to Moore *et al.* [15], milk follows olive oil in the ranking of most adulterated food items. Milk adulterants may include vegetable protein, whey and watering, matched potatoes, detergents, and melamine [8,18,21]

Pakistan, which ranks fifth on the list of world largest producers of milk have often restricted the sales or distribution of milk because there were found to be adulterated with urea and comminated water [25] (FAO, 2021). This urea may have either been added directly or as a component of synthetic milk used to adulterate natural milk. While producers use urea to raise fat content, it is pertinent to be aware of the deteriorating effects of urea on intestinal tract and digestive system. Other cases include the adulteration of palm oil in Taiwan [25] (FAO, 2021) and a joint study carried out by Italian and Chinese scientist in which they a 58% adulteration level in fish samples [26] (Xiong *et al.*, 2017). Their research was based on the analysis of DNA materials. In the absence of such method (as is the case with consumers who only make decisions by physical observation), it is difficult and near impossible to identify such adulteration.

III. METHODOLOGY

Study Area and Sample collection

Sampling of food items was carried out in the Eastern region of Kogi State (Anyigba). Anyigba is a major town

in Dekina Local Government Area of Kogi State, Nigeria, located between latitude 7°27'-7°31' North of the equator and longitude 7°09' - 7°12' East of the Greenwich Meridian [10]. All samples were collected from Anyigba Central Market, the samples collected are: Wheat flour (Honeywell brand), Condensed milk (unbranded) and Butter (Simas brand).

Qualitative Determination of Adulterants

Detection of Starch in Milk

Along with water, a very common adulterant of milk is starch. Milk consists of three basic components which are water (about 80%), fat (about 3.5%) and solids containing protein, lactose and mineral matters (about 8.5%). Milk is adulterated with starch to maintain the thickness of fat extracted milk or diluted milk. The presence of starch can be detected by adding iodine solution to milk. The reagent used was iodine solution, and the procedure includes; addition of 5 ml of milk sample into the test tube and boiling for 4 minutes. Then cooling, and addition of 1-2 drops of iodine solution which was shaken vigorously. It is expected that the appearance of blue coloration indicates the presence of starch in the sample

Detection of Adulterant in Wheat Flour

Wheat flour most times are adulterated with the addition of sand, chalk powder and other additives to increase the quantity of the products. The reagents used were carbon tetrachloride and dilute hydrogen chloride. For the detection of Sand/ Dirt: Wheat sample (5 g) was weighed and poured into a conical flask, 10 ml of carbon tetrachloride (CCl₄) was added. The mixture was shaken and allowed to stand. It is expected that sand present will be collected at the bottom. For the detection of barn: Wheat sample (5 g) was added into distilled water without shaking. Barn if present will float on water surface. For detection of chalk powder: wheat sample (5 g) was mixed with dilute HCl. It is expected that the occurrence of effervescence will indicate the presence of chalk powder.

Detection of Mashed Potato or Sweet Potato in Butter

The reagent used was iodine solution. The sample was boiled, and 5 ml was taken in a test tube and allowed to cool and a drop of iodine solution was added. Blue colour indicates the presence of starch.

IV. RESULTS AND DISCUSSION

Table 1: Results of determination of Adulteration in Wheat Flower (Honey Well), Butter (Simas), and Condensed Milk

Sample	Adulterant	Observation	Result
Wheat flour (Honey Well)	Sand/Dirt	Sand absent	Adulterant absent
	Barn	No effervesce	Adulterant absent
	Chalk powder	Did not float	Adulterant absent
Condensed milk (unbranded)	Starch	Blue coloration	Adulterant present
Butter (Simas)	Mashed potato	No blue coloration	Adulterant absent

The result of this study reveals the absence of adulterants of interest in the samples of branded food products but the presence of adulterants in the samples of unbranded food products. This contrasts the findings of Rao *et al.* [16] who in 2019 reported that 28 % of wheat samples from Hyderabad was contaminated with sand and dirt, 9% adulterated with chalk powder and 7.9% with excessive bran among other adulterants. The variation in these reports could have resulted from the handling techniques during processing or an intentional act of food fraud to increase profit realization at the expense of reduced food quality and jeopardized consumers' health.

While there was no adulterant in butter, there was a detectable level of starch present in our milk samples. The presence of starch is a common indicator of the adulteration of milk and milk products. Too much starch in milk can result in health impairment causing diarrhea (as a result of the reaction of undigested starch in the colon). In people with diabetes, accumulated starch can also have deleterious effects [19]. The condensed milk contains adulterant (starch) which must have been added by the manufacturing company to increase the quantity of the product and as well make the milk thick when it comes in contact with water either warm or cold. And most of its nutritional content might be of low quality and quantity as well. And this could contribute to malnutrition and poor immunity of the system.

This research found no adulterants in branded products (Honeywell wheat flour and Simas butter) but found adulterants in unpackaged and unbranded condensed milk. This is also an indication of the effect of regulation on food quality as branded products usually face more scrutiny than unbranded ones. Hence, the quality of many unbranded food items cannot be guaranteed as there are usually less inspected and regulated.

To effectively reduce the rate of food adulteration in Nigeria, we recommend that the National Agency for Food and Drug Administration and Control, NAFDAC; Standard Organization of Nigeria, SON; and other quality regulating agencies pay close attention to the quality of unbranded foods and foods sold in open markets. These foods are usually cheaper and more affordable to the masses and perpetual adulteration can pose unfavorable and deleterious health effect among a wide range of consumers.

Consumers are also advised to only purchase food items which have been certified to be of high quality by these regulating agencies as much as possible as foods licensed by NAFDAC are most likely to have been processed under ideal conditions.

V. CONCLUSION AND FUTURE SCOPE

After having studied different chemical reactions for detection of different adulterants in selected food items. We report no adulteration of the assayed batch of wheat flour (Honey Well), and butter (Simas) consumed in

Nigeria, but condensed milk (unbranded) was adulterated with starch.

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