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DETERMINATION OF NUTRITIONAL COMPOSITION AND ORGANOLEPTIC PROPERTIES OF AFRICAN LOCUST BEANS WRAPPED WITH DIFFERENT PACKAGING MATERIALS

Ogunlade, Ayodele Oluwayemisi
Department of Food Technology, the Federal Polytechnic, Ado Ekiti, Ekiti State, Nigeria
Corresponding email: ogunlade_ao@fedpolyado.edu.ng

ABSTRACT
The African Locust bean is a popular condiment used as taste and flavor enhancer in soup and dishes in Africa. It is one of the major sources of plant protein in African diet but packaging materials used to extend its shelf life has different effects on the products. This study therefore examined the nutritional composition and organoleptic properties of African locust beans processed and separately wrapped with plastic container, nylon and dry banana leaves and allowed to ferment for 5 days. Proximate analysis and Mineral content were determined using standard methods while the sensory attributes were assessed using a 9-point Hedonic scale. The results showed that African locust bean packaged with different packaging materials for moisture content ranged between 31.27 and 36.13%, Ash content (3.46 and 4.62%), protein content (17.90 and 30.21%), carbohydrate content (17.92 and 25.32%), fat content (5.76 and 10.60%) and crude fibre content (7.92 and 10.4%). Result of mineral analysis showed that African locust bean packaged with dry banana leaf had the highest values for Sodium, Calcium, Iron, Magnesium and Zinc while the sample packaged with plastic container had the highest values for potassium and manganese. However, Vitamin A content was higher in sample packaged with plastic container. Locust beans wrapped with plastic container was mostly preferred based on sensory attributes. Findings from this study showed that locust beans wrapped with plastic containers should be encouraged due to its high protein content and general acceptability in order to alleviate protein deficiency and its associated diseases in Africa.

Keywords: Locust beans, packaging materials, nutritional composition

INTRODUCTION
"African locust beans (*Parkia biglobosa*) also known as *iru*, among the Yorubas in South-west Nigeria, are popular condiment used as a taste and flavour enhancer in soup and dishes in Africa (Ogunlade *et al*., 2023). The fermented seeds of *P. biglobosa* are believed to possess nutritional and medicinal values; hence, they are used extensively as household spice in the preparation of various delicious foods (Ajaiyeoba, 2002; Ogunyinka *et al*., 2015). African locust bean (*Parkia biglobosa*) is one of the most popular indigenous fermented condiments produced from legumes. "*iru"* is the Yoruba name for the fermented condiment produced from African locust bean (*Parkia biglobosa*) (Omafuvbe *et al.,* 2004). It is also known as "*dawadawa*" in Hausa-land and by different names among ethnic groups. "*Iru*" have played major roles in the food habits of communities in the rural regions serving not only as a nutritious non-meat protein substitute but also as condiments and flavouring agents in soups and sauces (Odunfa, 1983). According to Steinkrans (2002), the traditional fermented foods contain high nutritive value, better digestibility and developed a diversity of flavours, aroma and texture in food substrates. In addition, African locust bean (*Parkia biglobosa*) "iru" contribute protein, minerals and calories in the diets (Orwa *et al.,* 2000). Although "iru" constituted significant proportion of the diet of many people, they are associated with some problems such as having a short shelf life, objectionable packaging material, the characteristic putrid odour and stickiness (Eka *et al.,* 2004). Food packaging is an important aspect part of food processing, which involves the use of some materials in the wrapping of foods. The success of most preservation methods depend on appropriate packaging. However, faulty packaging will undo all that a good processor has attempted to accomplish by the most meticulous manufacturing process (Ihemeje *et al*., 2022). Different packaging materials are therefore used for wrapping locust beans in order to extend their shelf life (Ogunlade *et al*., 2023).

The nutritive importance of eating food is to gets appropriate amount of nutrient for body growth and normal functioning. In Nigeria especially, the prevalence of malnutrition and obesity demands that particular attention should continuously be paid to nutritive value of food especially to that of local food (organic plant). The quality and quantity of nutrients present in the food consumed by people in developing countries is very low compared to the actual requirement from a balance diet for normal growth (FAO, 2004). There is therefore need to analyze the sensory evaluation and nutritional composition of this food condiment wrapped with different packaging materials in order to ascertain the best materials to be used for packaging for appropriate nutrient.

MATERIALS AND METHODS

Sample collection

The raw African Locust bean seed (*iyere*) were purchased from (king's market) in Ado-Ekiti and thereafter transported to the Food Processing laboratory (Dry Lab) of the Federal Polytechnic Ado-Ekiti in an air tight polythene bag. All materials used in the production of locust beans were sterilized.

Sample preparation

Production of fermented *Parkia biglobosa* (African locust bean) "iru" using traditional method

Parkia biglobosa (Africa locust bean) seed was prepared according to the method of (Audu *et al.*, 2004). After fermentation the locust bean "iru" was packaged in three different materials (dry banana leaf, Plastic rubber and nylon) and preserved for 5 days (Ogunlade *et al*., 2023).

Sensory evaluation

Questionnaire was prepared and distributed to ten panelists for the assessment of organoleptic properties of the locust beans samples. This was achieved using descriptive statistics. The products were assessed for aroma, taste, texture, colour and general acceptability on a nine-point Hedonic scale where '9' represented 'like extremely' and '1' represented 'dislike extremely' (Ashaye *et al*., 2006).

Proximate analysis

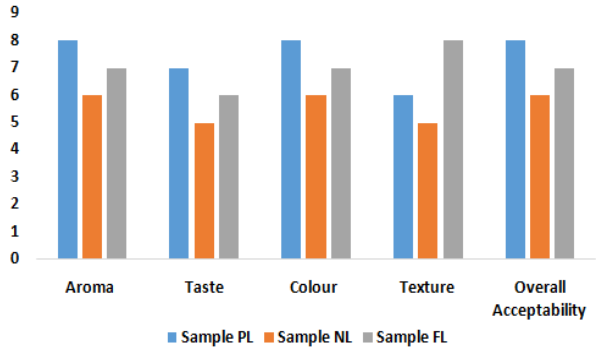
Proximate analysis was carried out on the fermented locust beans samples packaged for 5 days to ascertain the differential composition of the various nutritional components and the amount in which they are composed. Nutritional parameters such as ash content, moisture content, mineral composition, crude fat, carbohydrate, crude fiber, and total protein were determined using the method of AOAC (2012).

Mineral analysis

The official method of AOAC (2012) was adopted for the mineral analysis of the samples: the samples were previously ashed in a furnace for 5 h at 600°C, and then refluxed with 20% hydrochloric acid. The mixture was filtered into a 100 mL standard flask; the filtrate was then made up to the mark with deionized water. Sodium (Na) and potassium (K) levels of the samples were ascertained using a flame emission photometer with NaCl and KCl as standards. All other metals were determined by atomic absorption spectrometry (AAS).

RESULTS AND DISCUSSION

The results of the organoleptic properties and nutritional composition of locust bean wrapped with different packaging materials such as plastic container, nylon and dry banana leaves are represented in Figures 1 – 3.



PL-Plastic sample; NL-Nylon sample; FL-Leaf sample

Figure 1: Organoleptic properties of African Locust beans packaged with different packaging materials

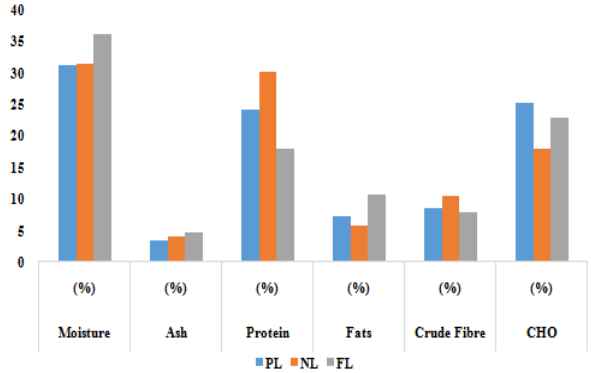


Figure 2: Proximate composition of locust beans packaged with different packaging materials

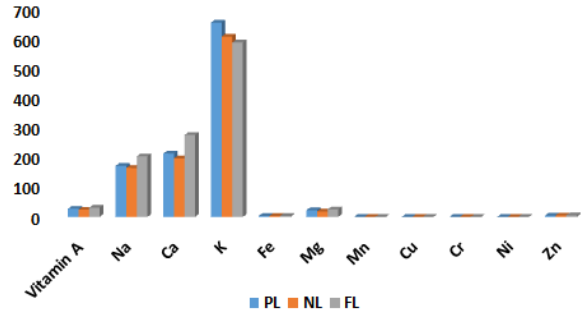


Figure 3: Mineral composition of locus beans packaged with different packaging materials

The results of organoleptic properties of the locust beans as described in Figure 1 shows that locust beans packaged with plastic containers were mostly preferred in terms of aroma, taste colour and overall acceptability with values of 800, 7.00, 800 and 8.00, respectively while those packaged with dry banana leaves were preferred than nylon in terms of texture. The preference for the texture of locust beans packaged with dry banana leaves could be attributed to the consumers being accustomed to the conventional fermented locust beans found in the market (Koledoye and Akanbi, 2020).

However, Ogunlade *et al*. (2023) stated that the microorganisms isolated from locust beans packaged with dry banana leaves is higher than other packaging materials and this might be due to the contamination from leaves used as packaging materials. These microorganisms might affect the final product thereby rendering the taste and aroma unpalatable. The major causes of consumer rejection in packaged food include off-flavors, off odors and loss of crispiness. These changes result from gain of oxygen and moisture through the package and reactions between packaging components with the food components (Han *et al*., 2018).

For the proximate analysis of the sample, the result of the moisture content shows that locust beans wrapped with leaves has the higher moisture content than other samples. This is similar to the work reported by Murtala *et al*. (2016) who also observed high moisture content in locust beans and stated that the presence of high moisture content can encourage microbial growth and enhance spoilage by organisms such as bacteria and fungi. The amount of time a food product can remain fresh can also be shortened by high moisture content. The Ash and Fat content of locust beans wrapped with dry banana leaves appears to be higher than others. Higher ash content has been linked with higher micronutrient composition of foods (Sule *et al.,* 2019). The high ash contents of locust beans wrapped with leaves suggest that they can be incorporated in several food systems to improve micronutrient composition, thereby reducing hidden hunger especially in vulnerable regions of the world (Tersoo-Abiem *et al.,* 2021).

Makanjuola and Ajayi (2012) observed that operations such as boiling, soaking in water and dehulling of the bean seeds prior to fermentation, decreases the ash content of condiments. The increase in fat content of the fermented condiments may be attributed to the activities of lipolytic enzymes, which hydrolyze fat to glycerol and fatty acid. This result agrees with the observations of (Omodara *et al*., 2015). Other researchers (Oboh, 2006), (Ndukwe *et al*., 2017) observed higher values for fermented locust bean and soybean condiments. The protein and crude fibre content of locust beans wrapped with nylon were higher than those wrapped with dry banana leaves and plastic containers. Dietary fats have been shown to enhance the taste and acceptability of foods, slow gastric emptying and intestinal motility, thereby prolonging satiety and facilitate the absorption of lipid-soluble vitamins (FAO, 2010). The values obtained in this study were lower than those reported by Tersoo-Abiem *et al.* (2021). Apparent increase in protein in this sample could be due to microbial proliferation of microorganisms in form of single cell protein. Anigo *et al.* (2010) also reported that micro-organisms which were involved in the fermentation process but may have died could contribute to the high crude protein content. The carbohydrate content of samples wrapped with plastic containers were higher than those wrapped with other packaging materials. The biological system's main source of energy is carbohydrate. Although proteins and fats can also give the essential energy, carbohydrates are significantly more affordable, easier to digest, and absorb, making them a potential good source of energy. Locust beans wrapped with dry banana leaves has the highest vitamin A content. The higher content of vitamin A in fermented food substrates could be attributed to the fermentation processes carried out by microbial contents as previously reported by Steinkraus (1995). Vitamin A supports healthy reproduction, maintains clear vision, and strengthens immunity to illnesses. All the samples were rich in mineral elements such as (Na, Ca, K, Mg, Mn, Fe, Cu, Cr, Ni, Zn). With potassium content value of samples wrapped with plastic container being the highest, sodium and calcium content of locust beans wrapped with dry banana leaves had the highest values. Intracellular and extracellular cations with high potassium concentrations and low sodium levels play important roles in cellular signaling, metabolism, and regulation. Calcium is very important for bone formation and its maintenance.

CONCLUSION

This study showed the variations in sensory, proximate, mineral and vitamin composition of the locust beans samples which are attributable to the different packaging materials used. Locust beans wrapped with different packaging materials contain appreciable amount of nutrient such as protein, fats, vitamin A, potassium, calcium, sodium that can enrich the diet in addition to flavour enhancement. Findings from this study therefore suggest that locust beans wrapped with plastic containers should be encouraged due to its high protein content and general acceptability in terms of organoleptic properties in order to alleviate protein deficiency and its associated diseases in Africa.

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