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EFFECT OF DIFFERENT FERMENTATION CONTAINERS AND TIME ON THE CHEMICAL AND FUNCTIONAL PROPERTIES OF PARKIA BIGLOBOSA SEED CONDIMENT (IRU)

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ABSTRACT: *African locust bean (Parkia biglobosa) is one of the major seed plants used for the production of the most popular indigenous fermented condiment. Parkia biglobosa seeds were fermented for 24, 48 and 72 hours using four different fermentation containers (stainless steel, plastic and calabash), and the effect of both time and type of container were examined. The chemical and functional properties of fermented iru were determined using standard methods. Crude protein, fat, fibre, ash, carbohydrate and moisture were significant ($p<0.05$), with values ranging thus: (40.51–43.71%), (33.44–36.06%), (2.50–4.12%), (2.0–2.75), (8.62–15.8) and (4.59–8.58%) respectively. Increase in fermentation time caused significant changes in the following functional properties: water absorption capacity (1.5–3.0), oil absorption capacity (0.70–1.65%), bulk density (1.5–3.0) and acid value (5.02–6.51 mgKOH/g). Fermentation time and type of container were observed to influence the chemical and functional properties of iru. However, fermentation time had a better influence compared to type of fermentation container. Stainless steel proved effective for the fermentation of iru compared to other containers used, while calabash and plastic were observed to ensure optimum fermentation condition, which influenced both functional and chemical composition.*

KEYWORDS: Fermentation, stainless steel, plastic, properties, calabash.

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INTRODUCTION

African locust bean (*Parkia biglobosa*) is one of the major seed plants used for the production of the most popular indigenous fermented condiments known as Iru by the Yorubas. It is also known as 'dawa dawa' in Hausa-land and by different names among different ethnic groups in Africa. The product has been reported to serve as a delicacy and a food flavoring agent as well as cheap protein source (Odunfa, 1986). Legumes and oil seeds used as raw materials for the production of condiments are fermented naturally by allowing the microorganisms to act on them, yielding condiments by extensive hydrolysis of carbohydrate and protein components, leading to reduction in the anti-nutritional factors, improved digestibility, nutritive value and flavours (Odunfa, 1995). Farinde *et al.* (2007) defines fermentation as a complex chemical transformation of organic substance into simpler forms, brought about by the catalytic action of enzymes. Although iru and other condiments constitute a significant portion of the food habit of most households in Nigeria, they have been reported to be associated with some setbacks, such as having a short shelf life, objectionable packaging, unacceptable odour, wetness and stickiness (Arogba, 1995). These traditional fermented foods contain high nutritive value, better digestibility and developed a diversity of flavours, aroma and texture in food substrates. Most of these traditional condiments are fermented using materials such as banana leaves, jute bags, calabashes or combinations. The problem associated with the traditional condiment is not limited to the products only but processing and preservation techniques available to extend storage time. Food preservation is the process of treating and handling food products in order to slow down spoilage and thus allow for extended storage (Balogun, 2014). Food security is not just that of inadequate food but it is also a problem of loss of food due to spoilage, lack of adequate food preservation methods and techniques is also a key factor of food insecurity in Nigeria and Africa at large. With available literature, the combined effect of different fermentation containers and fermentation time on the functional and chemical properties of *Parkia biglobosa* condiment (iru) has not been fully documented. This study therefore investigated the effect of different fermentation containers and time on the chemical and functional properties of iru from African locust beans.

MATERIALS AND METHODS

Materials

African locust bean (*Parkia biglobosa*), fermentation containers (plastic bowls, stainless bowls and calabash) were obtained at Oja Oba market in Ilorin metropolis.

Sample Preparation

The *Parkia biglobosa* seeds were sorted manually and washed to remove dirt, spoilt seeds and debris that were packed with the seeds during harvesting and processing. 3.2 kg of seeds were boiled under pressure for 3 hours in order to soften the cotyledons; this was followed by dehulling of the cotyledons using NCAM multi-seed dehulling machine; it was then washed thoroughly in water. The washed seeds were then re-cooked for another 30 mins and subsequently drained. The locust beans samples were later fermented in plastic, stainless steel and calabash, each for 24 hours, 48 hours and 72 hours. Samples were then packed and dried using oven and sun drying methods.

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Analyses

The proximate compositions of iru samples were determined using the recommended methods of Association of Official Analytical Chemists (AOAC, 2012). For the functional properties, oil and water absorption capacity, the method of Sosulski (1962), as described by Abbey (1988), was adopted, while the procedure of Onwuka (2005, 2018) was adopted for the determination of bulk density.

Statistical Analysis

Data obtained (triplicate) were subjected to analysis of variance (ANOVA) procedures using the statistical package for social sciences (SPSS) version 17 for the window. Mean separation was performed using Duncan Multiple Range Test ($p \leq 0.05$).

RESULT AND DISCUSSION

Effect of Fermentation Time and Containers on the Proximate Composition of Iru

The proximate composition of iru produced using different fermentation containers (calabash, stainless steel and plastic container) is presented in table 1. Moisture contents of the iru varied significantly ($p<0.05$) from 4.59–8.58%. The highest moisture value was recorded for PLST72 while the lowest value was recorded for sample STLS48. The differences observed in the moisture content of African locust beans is in line with the report of Omafuvbe et al. (2004), who observed a decrease in the moisture content of African locust beans after 72 hours of fermentation. The variation in moisture content might be as a result of different fermentation containers and time, as it can be observed in table 1 that different containers recorded different moisture contents at different times. Moisture content gives an idea of the perishability nature of food materials in association with the rise in microbial activities (Hassan et al., 2005; Ruzoinah et al., 2007).

Table 1: Proximate Composition of African Locust Beans (Iru)

SAMPLES	MOISTURE CONTENT %	PROTEIN CONTENT %	FAT CONTENT %	ASH CONTENT %	CRUDE FIBRE CONTENT %	CARBOHYDRATE CONTENT %
STLS24	6.05±0.81d	40.90±0.15b	34.43±1.58c	2.00± 0.02a	2.90± 0.21b	13.98±1.06e
PLST24	5.51±1.58c	40.51±0.38a	33.44±1.69a	2.36±0.41c	2.50±0.35a	15.80±0.20g
CLBH24	6.43±1.72e	40.49±0.46a	34.50±2.74c	2.00±0.01a	2.60±0.37a	14.02±0.26e
STLS48	4.59±0.59a	41.49±0.51c	33.45±2.63a	2.50±0.01d	2.89±0.16b	15.01±3.38f
PLST48	4.96±0.99b	40.94±0.13b	34.07±2.13b	2.25±0.27b	2.86±0.27b	14.89±2.00f
CLBH48	5.53±0.49c	41.05±0.15b	36.06±2.27d	2.50±0.01d	3.00±0.06bc	11.73±2.26d
STLS72	5.10±0.19b	42.43±0.39e	34.48±2.65c	2.75±0.16e	3.63±0.60d	8.62±0.66a
PLST72	8.5847±0.67f	42.19±0.21d	33.91±0.99b	2.55±0.06d	3.20±0.18c	9.48±0.35c
CLBH72	5.91±0.07d	43.79±2.31f	34.52±0.53c	2.55±0.06d	4.12±0.94e	9.03±1.11b

Mean± SD

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There was a significant ($p<0.05$) difference in the crude protein content of iru (40.51–43.71%). It can be observed that the protein content of iru increases with increasing fermentation time, with the highest value recorded during 72 hours of fermentation for sample CLBH72. This is in agreement with the report of Makonjuola and Adebola, who recorded an increase in crude protein during the fermentation of parkia seeds. Also, a similar trend of crude protein increase has been reported in the works of Dakwa *et al*. (2005), Azokpota *et al*. (2006), Ogunjobi *et al*. (2005), and Omafuvbe *et al*. (2004). The proteolytic activity of the fermenting bacteria may have resulted in the increase in the protein content of parkia seeds as fermentation progressed. However, it was observed that there was no significant difference ($p<0.05$) in the crude protein content of iru fermented using stainless steel and plastic containers, particularly within 24 and 48 hours of fermentation. This might be attributed to the fact that the two aforementioned containers may not necessarily influence the protein content of iru.

The crude fat of iru varied significantly ($P<0.05$) and ranged from 33.44–36.06%. Higher fat values were observed during 48 hours of fermentation, particularly in calabash. Fat content was also observed to decrease as fermentation time increased. This is in agreement with findings of Omafuvbe *et al*. (2004). Low values of fat contents of less than 3% were recorded in all samples irrespective of the fermentation container used. This might be due to the degradation of fibre and carbohydrate.

Crude fibre (2.50–4.12%) of iru also varied significantly ($p<0.05$), which was observed to decrease as fermentation time increased. The decrease may have resulted from the degradation of the dietary fibre present in the seed by the fermenting bacteria during fermentation. This is in line with the findings of Babalola and Giwa (2012), who reported a progressive decrease in the crude fibre of fermented condiment. However, no significant difference was observed for all iru samples during the 48 hours of fermentation irrespective of fermentation container, while only slight difference was observed during the early hours and towards the last hours of fermentation. This simply explains that type of fermentation container may not have any effect on the crude fibre of fermented iru. However, lower crude fibre content of iru is an indication of less fibrousness as parkia seeds are generally low in fibre. The change in crude fibre, crude protein, ash and ether extracts of the African locust beans after fermentation may be as a result of selective reduction in carbohydrate content, due to the activities of the microorganisms which most likely derive their energy from carbohydrate metabolism (Azokpota *et al*., 2006).

The carbohydrate content of fermented iru varied significantly ($p<0.05$). It was observed that lowest and highest carbohydrate values were recorded for sample STLS during 72 and 48 hours of fermentation respectively. Carbohydrate content of iru was observed to decrease as fermentation time increased. The reduction in the carbohydrate may have resulted from the proliferation of the bacteria as they use it as the easiest source of energy for their growth and metabolism. However, only little variation was observed with the use of fermentation container as compared to the significant effect of fermentation time. This explains the fact that fermentation container may not necessarily influence the carbohydrate content of fermented iru. The value obtained for carbohydrate in this study is in line with findings of Yabaya (2006) carried out on fermented and raw locust beans.

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Effect of Fermentation Time and Container on Functional Properties of Iru

The bulk density of iru varied significantly ($p<0.05$) and ranged between 1.5 and 3.0. The bulk density of iru was observed to increase with increase in fermentation time. According to Udoro *et al.* (2014), bulk density can be described as being essential in the reconstitution of food products. Higher bulk density implies that less space is required for packaging, thereby reducing amount and cost of packaging materials (Olanrewaju, 2016). The highest value in all fermentation containers was recorded at 48 hours of fermentation. However, iru samples fermented in calash recorded the lowest value at this hour. The water absorption capacity (WAC) of iru samples varied significantly ($p<0.05$) and ranged from 1.5–3.0. This is in line with the result of wet iru reported by Koledoye and Akanbi (2020) but slightly different from that of dehydrated iru. The variation in WAC may be associated with fermentation time, drying process and fermentation container. Choonhahirun (2010) reports that water absorption capacity describes the flour-water association ability under limited water supply and it is also used as an indication of performance in several food formulations (Circle & Smith, 1972).

Oil absorption capacity (OAC) of iru varied significantly ($p<0.05$) and ranged between 0.70 and 1.65. OAC was observed to decrease as fermentation time increased in all samples except in samples fermented in stainless steel. Obatolu *et al.* (1995) report that oil absorption was attributed to the physical entrapment of oil which is related to the number of non-polar side chains in the protein that bind hydrocarbon chains of the fatty acid. Lawal (2003) attributes this behavior to the presence of non-covalent bonds, such as hydrophobic, electrostatic and hydrogen bonding forces that are involved in lipid-protein interactions. The acid value of iru samples fermented in different fermentation containers varied significantly and ranged between 5.02–6.51mgKOH/g. Acid value was observed to increase with prolongation of the fermentation period. A similar trend was reported by Omafuvbe *et al.* (2004), who fermented iru using calabash. Acid value is an indicator for edibility of oil and suitability for domestic and industrial use.

Table 2: Functional Properties of Fermented African Locust Beans (Iru)

SAMPLE	BULK DENSITY (gm^{-2})	ACIDIC VALUE (mgKOH/g)	WATER ABSORPTION CAPACITY (%)	OIL ABSORPTION CAPACITY (%)
STLS24	0.65±0.00c	6.07±0.55e	2.25±0.28e	1.50±0.13d
PLST24	0.68±0.04e	5.97±0.72d	3.00±0.09g	1.45±0.10d
CLBH24	0.64±0.05b	5.58±0.43c	1.80±0.09c	1.30±0.14c
STLS48	0.69±0.07f	5.35±0.16b	1.85±0.19cd	1.05±0.29b
PLST48	0.69±0.04g	5.02±0.06a	1.95±0.10d	1.65±0.19e
CLBH48	0.63±0.01a	6.45±0.35h	1.50±0.33a	0.70±0.14a
STLS72	0.67±0.01d	6.26±0.20f	2.20±0.09e	0.95±0.50b
PLST72	0.68±0.00e	6.43±0.26g	2.50±0.14f	1.00±0.09b
CLBH72	0.69±0.00g	6.51±0.29i	1.68±0.53b	1.50d

Mean± SD

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CONCLUSION

Fermentation time and type of container were observed to influence the functional and proximate properties of fermented iru. Stainless steel was observed to have greater influence on both functional and chemical properties of iru. Protein content of iru increased with increasing fermentation time. The result of this study has revealed that stainless steel, plastic and calabash can be used as fermentation containers and are therefore suitable for the fermentation of African locust beans (Iru).

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