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Research Article

Effects of Drying Methods, Fermentation Times and Containers on the Proximate Composition of Processed Locust Beans (*Parkia biglobosa*)

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Abstract

Locust bean seeds where dehulled, boiled at 110°C for 12hrs and allowed to cool at 45°C before fermenting using different fermentation containers of calabash, stainless steel and plastic respectively with different fermentation times of 24 hours, 48 hours and 72 hours respectively. The samples were further dried using sun and oven drying method to determine their respective effects on the proximate composition of fermented locust bean seeds. The results obtained for fermentation time of 24 hours, 48hours and 72 hours respectively, moisture content was between 5.6-6.5%, crude fat - 34.17-34.56%, Ash - 2.08-2.62%, Fiber - 2.62-3.50%, Protein - 40.67-43.00%, and carbohydrate - 9.83-14.94%. For fermentation containers of calabash, stainless steel and plastic was between 5.90- 6.31% for moisture content, 33.81-35.07% - crude fat, 2.35-2.45% - ash, 2.80-3.17% - crude fiber, 41.17-41.83% - crude protein, and 11.65-13.67% - carbohydrate difference. On method of drying which includes sun and oven drying (55°C) methods, moisture content was 5.27-6.44%, crude fat - 34.14- 34.51%, ash - 2.36-2.39%, crude fiber - 3.00-3.11%, crude protein - 41.22-42.00%, and 12.19-13.66% - carbohydrate difference. The effect of fermentation time brought about stability in crude fat formation, low ash content due to leaching of minerals and salt utilization by microbes during fermentation and low carbohydrate content due to leaching of sugars and utilization sugars by sugar utilizing enzymes with further increase in fermentation time. Crude fat was highest in samples from calabash gourd and the oven drying method at 55° C for 6 hours was very effective since there was significant difference in the moisture content when comparing the two forms of drying.

Keywords: *Proximate Composition, Drying, Fermentation, Containers, Time.*

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Introduction

Food fermentation is primarily aimed at removing anti nutrients and producing nutrients (Liman et al., 2012). Nutritionally, the main effects of processing seeds (pulses) are to detoxify, increase palatability and bioavailability of nutrients (Walker and Kochlar 1982). Fermentation makes seeds digestible (Odunfa and Oyewole 1986). Desired fermentation states are indicated by the formation of mucilage and ammonia production as a result of amino acid breakdown (Omafuvbe et al., 2004). Pulses which include locust beans, soya beans and it's like are among foods recognized and recommended for consumption for the noble purpose of neutralizing acids in the body system (Russel-Seddon, 1985).

The most popular form of consuming fermented pulses like locust bean are dadawa, a food condiment for seasoning traditional soups. Iru as it is called in Western Nigeria, a product of alkaline fermentation of locust bean seeds used popularly as food seasoning and condiments in West Africa especially Nigeria (Campbell-Platt, 1980).

African locust bean (*Parkia biglobosa*) a perennial tree which belongs to the sub family mimosodae and family leguminosae now fabaceae (Akande et al., 2010) is an indigenous tree with economic and social importance to the sub-Saharan – African people. It is a good source of plant protein especially for low income earners who cannot afford animal protein. It further contributes to intake in carbohydrate, calcium, phosphates, and iron content and essential fatty acids (Beamont, 2002; Oladele et al., 1995). Nutritional status of iru depicts values of 31.2- 47.4% crude protein, 2.0-6.8% ash, 31.2-42.9% crude fat, 3.6-23.6% carbohydrate by difference depending on conditioning of seeds (Campbell – Platt 1980; Eka, 1980). Klanjar et al. (2002), reported processed locust bean seeds having as high as 40% protein content, high vitamins, moderate in fat content (35%), carbohydrate and macronutrients., processing locust beans into fermented forms of food condiments follows the procedure below in figure 1.

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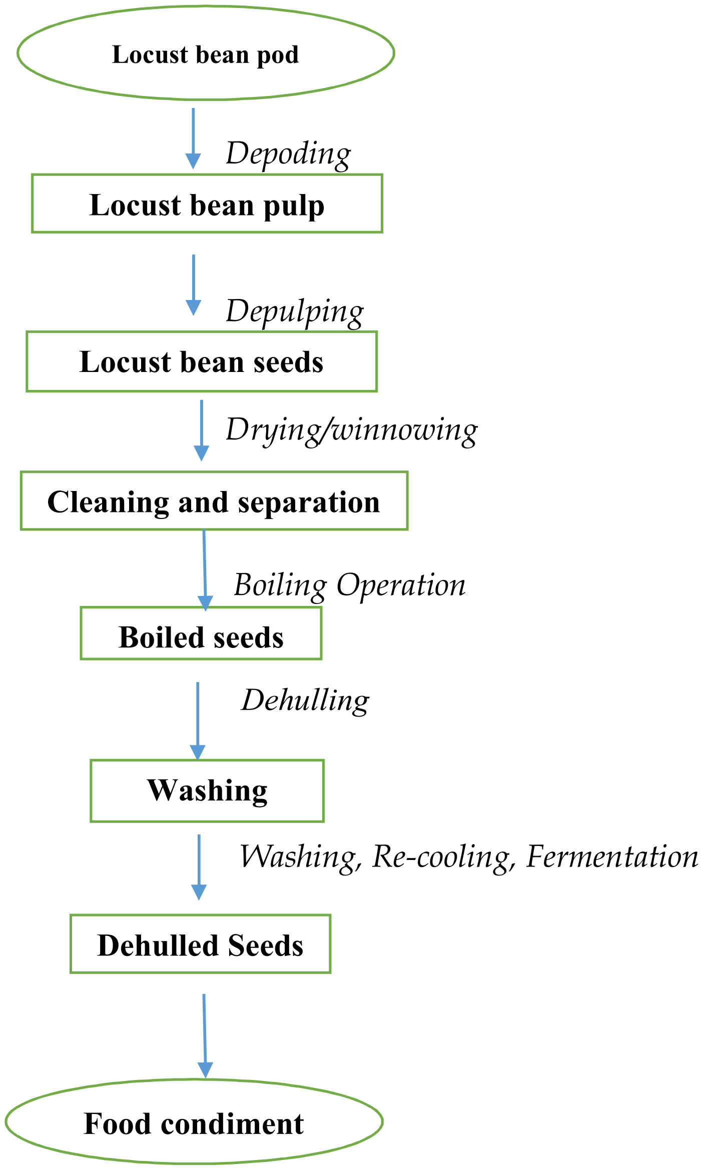

Figure 1: Flow chart for the processing of Locust bean food condiment

The traditional practice of processing fermented locust beans indigenously are practices by the aged especially women in our rural communities. The preference of calabash as fermentation containers during "iru" processing has stuck as a tradition and attempt to in-cooperate other types of containers for fermentation has met stiff opposition. But due to increase in demand of product due to population increase, other fermentation material that are available for use, stainless steel and plastics alongside calabash gourd will be undergoing trials on their effects on the proximate composition of fermented locust beans. Other parameters to be considered are different fermentation time of 24 hours, 48 hours and 72 hours respectively and different drying methods which includes sun dry and oven drying at 55 degrees centigrade respectively on their effects on the proximate composition as well.

Methodology

Collection and Preparation of Samples

Fresh locust bean seeds where purchased from the open market in Idofian, processed using the NCAM multi seed dehuller. The dehulled samples were boiled for 12 hours at 110 degrees centigrade, allowed to cool at 45 degrees centigrade and further left to ferment for 24, 48 and 72 hours respectively using calabash, stainless steel and plastic as fermentation containers. Samples were also dried using NCAM fabricated oven dryer at 55 degrees centigrade for 6 hours and sun drying for 3 days respectively.

Determination of Proximate Analysis

The proximate analyses of the fermented seeds were determined using standard AOAC methods 1999. These include moisture content, crude fat, ash, crude fiber, crude protein and carbohydrate by difference.

Statistical Analysis

Multivariate analysis (Hotel ling's trace) was used to determine the effect of fermentation time (24, 48 and 72 hrs. respectively), type of fermentation container (calabash, stainless steel and plastic) and drying method (oven and sun drying method) on the proximate composition of the fermented locust bean. The test was subjected into triplicates during data collection. Duncan method was used for difference in all parameters analyzed (Post Hoc Test).

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Results and Discussion

Observations from Table 1 (Fermentation Time)

The results from Table 1 indicates insignificant difference in crude fat as a result of stability in fat content due to the activity of lipolytic enzymes which hydrolyzed fat to glycerol and fatty acids. The significant difference > 0.005 in moisture content due to fermentation time could be due to various pre fermentation process carried out on the raw seeds like dehulling boiling and the overnight soaking (Ojewumi et al., 2018). Significant difference >0.005 in low ash content could be due to leaching of minerals from long hours of boiling, soaking in water and dehulling. In addition, utilization of essential salts during fermentation by microbes could lead to low ash content (Ojewumi, 2016; Omafuvbe, 2004). Significant difference >0.005 reflects reduction in carbohydrate content with increase in fermentation time. This could be due to leaching of soluble carbohydrates like sugar into water used for boiling and soaking of the locust beans seeds as well as the utilization of some sugars by fermenting microbes for growth and metabolism. Bacillus spp have been found to be producers of amylase, galactanase, galactanase glucosidase, fructofuranicsidase and galactosidase. These enzymes are involved in carbohydrate degradation to sugars (Aderibigbe and Odunfa, 1990; Omufuvbe et al., 2002). Fiber and protein content could not be analyzed because of insignificant mean difference

Table 1: Proximate Composition with respect to Fermentation Time

Fermentation Time (Hrs)	Moisture content	Crude Fat	Ash	Fibre	Protein	Carbohydrate
24.00	5.96b	34. 17^{a}	2.62^{a}	2.67	40.13	14.94^{a}
48.00	5.05^{c}	34.56^{a}	2.42^{b}	3.00	41. 17	13.99^{a}
72.00	6.56^{a}	34.26 ^{a}	2.08^{c}	3.50	43.54	9.83^{c}
F. Value	1.3606.77	1.668	235.2	-	-	6524.95
Sign. Value	0.0001	0.203	0.0001	-	-	0.0001

Sign. Value – Significant Value

Observation from Table 2 (Fermentation Container)

From Table 2 moisture content and carbohydrate content had higher values in plastic than the calabash container. This was similarly reported by Farinde et al. (2007). Stainless steel had the highest value in carbohydrate by difference. This could be attributed to low retention of heat from stainless steel when compared to plastic and calabash since enzymatic reactions encourage lypolisis and proteolysis hence giving room for higher carbohydrate content from samples in stainless steel. Crude fat was significantly higher in calabash than the other containers signifying crude fat retention in calabash. Ash content value was significantly higher in stainless steel than calabash and plastic. This could be as a result of less usage of salts by microbes during metabolism since metabolic reactions are not sustained in stainless steel than in plastic and calabash. Results for fiber and crude protein were not analyzed due to insignificant mean difference.

Table 2: Proximate Composition with respect to Fermentation Container

Fermentation Container	Moisture content	Crude Fat	Ash	Fibre	Protein	Carbohydrate
Calabash	5.90[b]	35.07[a]	2.35[b]	3.17	41.83	11.65[c]
Stainless steel	5.36[c]	33.81[c]	2.42[a]	3. 17	42.12	13.67[a]
Plastic	6.31[a]	34.10[b]	2.35[b]	2.80	40.88	13.45[b]
F. Value	5388.85	17.367	235.2	-	-	1083.03
Sign. Value	0.0001	0.0001	0.014	-	-	0.0001

Observation from Table 3 (Drying Method)

From Table 3, moisture content was significantly lower (>0.005) in the oven dried samples due to high and constant air temperature and relative humidity in the oven than the sun drying method (Bankole et al., 2005). Carbohydrate by difference was significantly higher (>0.005) in oven dry, similar incidence was cited in works of Olausi et al. (2019) and Oladumoye (2007) which could be as a result of difference in air temperature on the course of drying. Significant difference was not noticed in crude fat and ash while there was no mean difference in crude fiber and crude protein.

Table 3: Proximate Composition with respect to Drying Method

Drying Method	Moisture content	Crude Fat	Ash	Fibre	Protein	Carbohydrate
Sundried	6.44 [a]	34. 14[a]	2.39[a]	3. 11	42.00	12. 19[a]
Oven dried	5.27[b]	34.51[a]	2.36 [a]	3.00	41.22	13.66[b]
F. Value	24280.49	4. 132	235.2	-	-	1440.036
Sign. Value	0.0001	0.049	0.0001	-	-	0.0001

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Conclusion

There was some stability in crude fat formation irrespective of fermentation time. Leaching of minerals and utilization of salts by microbes could have been responsible for low ash content in fermentation time. Leaching of different forms of sugars as well as sugar utilization from sugar utilizing enzymes could have resulted from prolonged fermentation time. Crude fat retention was observed in calabash over plastic and stainless steel. Drying was more effective using the oven drying method.

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