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Comparative Study on the Microbiological and Nutritional Qualities of Fermented *Parkia Biglobosa* Produced Locally and in the Laboratory

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Abstract:

Fermentation makes the food condiment *Parkiabiglobosa* "Iru" to be more nutritious, digestible and safer with better flavour. Fermented *Parkiabiglobosa* 'Iru' is known to have high protein content, thus serving a dual purpose of flavouring as well as source of protein supplement. There is only little information available on comparative evaluation of the nutritional quality of the locally produced "Iru" condiment with the one produced in the laboratory. Hence, this present study focusses on the evaluation of proximate and anti-nutrient composition of fermented *Parkia biglobosa* produced locally and in the laboratory. Result from the microbial examination revealed the bacterial load for the locally produced *Parkiabiglobosa* 'Iru' ranged between $75.00 \times 10^3 \text{cfu/g}$ and $264.66 \times 10^3 \text{cfu/g}$ while that of laboratory produced sample ranged between $5.33 \times 10^3 \text{cfu/g}$ and $84.33 \times 10^3 \text{cfu/g}$. Lactic acid bacteria load was higher after de-hulling in the locally produced samples with a value of $84.33 \times 10^3 \text{cfu/g}$ and reduced significantly to $6.33 \times 10^3 \text{cfu/g}$ after 72hrs of fermentation. Fungal load of the laboratory produced *Parkiabiglobosa* 'Iru' reduced significantly ($P < 0.05$) as fermentation progresses. More so, the proximate analysis revealed that Ash content also increased significantly ($P < 0.05$) as fermentation progresses. The protein content also increased after 72hrs of fermentation in both local and laboratory produced 'Iru' samples. Carbohydrate content also reduced significantly from 34.35 to 14.47% and 32.82 to 20.80% for the locally produced and laboratory produced fermented *Parkiabiglobosa* respectively. Conclusively, this work had shown that contamination of fermented *Parkiabiglobosa* 'iru' might have originated from foot pressing during de-hulling, contaminated water, poor personal hygiene of food handlers and dirty environmental conditions during processing. Therefore, training about environmental sanitation is essential and highly recommended.

Keywords: *Parkiabiglobosa*, Iru, fermentation, proximate, anti-nutrient

1. Introduction

The African locust bean tree, *Parkiabiglobosa* are perennial trees legumes which belongs to the sub-family Mimosoideae and family Leguminosae (now family Fabaceae). A matured locust bean tree (20 - 30 years) can bear about a tone and above of harvested fruits (Achi, 2007 and Ademola et al., 2011).

The seeds of *P. biglobosa* have been shown to contain up to 29% crude protein and 60% saccharose; it is also rich in vitamin C and high in oil content (Akoma et al., 2001; Amao et al., 2013). Aside being a good source of plant protein to man, it serves as good source of protein for animal feeds, chick and fish (Amao et al., 2013).

Studies by Sackey and Kwaw, (2013) and Olanbiwoniu et al (2017) showed some changes in the nutritional and the anti-nutritional constituents of the processed samples of this important food supplement. The fermentation of African locust beans (*P. biglobosa*), initiated by *Bacillus* species to produce spices called "iru" or "dawadawa" in Nigeria had been described by several authors (Achi, 2007; Ademola et al., 2011; Adesoye et al., 2013 and Olanbiwoniu et al., 2017). The preparation of foods by fermentation has good advantages such as the destruction of undesirable flavours and odours, production of good flavour, increase digestibility, synthesis of desirable constituents, and changes in physical state, longer shelf-life, and destruction of inhibitors (Sackey and Kwaw, 2013).

Fermentation makes the food condiment "Iru" to be more nutritious, digestible and safer with better flavour. The cooked African locust beans are unpalatable but when fermented into the local condiment "Iru" the physical, chemical and nutritional characteristics of the seeds changed (Amao et al., 2013). Many strains of the *Bacillus subtilis* group have been isolated from "Iru" samples obtained from different sources in south-western Nigeria. The soup condiment is known to have high protein content, thus serving a dual purpose of flavouring as well as source of protein supplement (Akoma et al., 2001 and Akande et al., 2010). The fermentation of Locust bean seeds into "Iru" usually take five to seven days at the ambient temperature and relative humidity (Achi, 2007; Ibeabuchi et al., 2014 and Olanbiwoniu et al., 2017).

There is only few information available on comparative evaluation of the nutritional quality of the locally produced "Iru" condiment with the one produced in the laboratory. Hence, this present study focused on the evaluation of proximate and anti-nutrient composition of fermented *Parkia biglobosa* 'Iru' produced locally and in the laboratory.

2. Materials and Methods

2.1. Collection of Samples

The study was carried out in Ondo city and Akure metropolis of Ondo state. Ondo state covers an area of 15,195.2 squarekilometres and lies at latitude 7° 10' North and longitude 5° 05' east. Samples were obtained from 25 Iru vendors, a local producer and also produced in the laboratory. The vendors' samples were collected randomly from five different markets namely; Ojaoba market, Sabo market, Isikan market, NEPA market and FUTA south gate. The samples from each location were collected in a sterile plastic container identified with codes and transferred to Microbiology Postgraduate Laboratory, Federal University of Technology, Akure for analyses within 1hr of collection.

2.2. Determination of pH

A wrap of the fermenting seeds was taken at 24h interval for 3 days. Five grams (5g) of each sample was weighed into a sterile mortar and mashed in clean beaker and 50ml of distilled water was added. It was mixed thoroughly to form slurry. A standard buffer solution (pH 6.0) was prepared and this was used to standardize the pH meter. The electrode of the digital pH meter was dipped in the slurry. The pH readings were recorded. (Ibeabuchiet al., 2014).

2.3. Determination of Total Titratable Acidity

Acidity of samples, expressed as citric acid content per unit of volume, was determined by titration with 0.01mol/L of sodium hydroxide solution using phenolphthalein as indicator (AOAC, 2015)

2.4. Isolation of Microbial Load

Serial dilution was done to reduce the microbial population. 1g of Iru samples were taken aseptically and were thoroughly mashed with 9ml of distilled water as diluents in bijoux bottles and the content were thoroughly shaken. Subsequent serial dilutions were made from this solution by adding serially 1ml of solution from preceding concentration to 9ml of the diluents, using sterile syringes. A 0.1ml aliquot of Iru samples were introduced into the Petri dishes using sterile pipette. The media after cooling down were aseptically poured in Petri dishes under laminar flow hood using pour plate technique and allowed to solidify. The plates were later incubated at 37°C for 24hours. The bacterial isolates were sub-cultured on freshly prepared media to obtain pure culture.

2.5. Proximate Estimation

The moisture, crude protein, crude fibre, crude fat, ash and soluble carbohydrate (by difference) were determined in accordance with AOAC (2015). The proximate analyses were carried out in triplicate and reported in percentage.

2.6. Data Analysis

All the experiments were carried out in triplicate and data obtained from the study were subjected to One-way analysis of variance (ANOVA) using SPSS version 23. Treatment means were compared using Duncan's New Multiple Range Test (DNMRT) at 5% level of significance.

3. Results and Discussion

The pH of the locally produced fermented *Parkia biglobosa* 'Iru' ranged between 6.97 and 7.93 as shown in Figure 1. There was no significant difference ($P < 0.05$) in the pH of the laboratory produced samples. This is an indication that the fermentation process is tending towards alkalinity. This agreed with the report of Omafuvbe et al. (2004) who reported that the fermentation of locust bean to produce fermented *Parkia biglobosa* is an alkaline fermentation. Popoola (2007) also reported that pH rise towards alkalinity as fermentation progresses during fermentation of *Parkia biglobosa*. Total Titratable acidity (TTA) of the locally produced sample ranged between 3.66ml and 6.86ml, while the laboratory produced sample ranged from 3.00ml and 11.20ml as shown in Figure 2.

The bacterial load for the locally produced Fermented *Parkia biglobosa* ranged between 75.00×10^3 cfu/g and 264.66×10^3 cfu/g while that of laboratory produced sample ranged between 5.33×10^3 cfu/g and 84.33×10^3 cfu/g as shown in Figure 3. Lactic acid bacteria load was higher after de-hulling in the locally produced samples with a value of 84.33×10^3 cfu/g and reduced significantly to 6.33×10^3 cfu/g after 72hrs of fermentation (Figure 4). Fungal load of the laboratory produced fermented *Parkia biglobosa* reduced significantly ($P < 0.05$) as fermentation progress as revealed in Figure 5. These may be due to the direct exposure of the sample to fungal spores in the laboratory during cooling.

The moisture content of both the locally produced and the laboratory produced samples increased as fermentation progress (Figure 6). The increase observed in moisture content as fermentation progresses could be attributed to soaking, de-hulling and boiling of the raw seeds prior to fermentation process. It could also be due to metabolic activities of some microorganisms during fermentation which gives out moisture as one of their end products (Aderigbigbe, 2013). Locally produced fermented *Parkia biglobosa* have lower moisture content compared to the laboratory fermented *Parkia biglobosa* with value ranged between 5.00 and 8.93%. Ash content also increased significantly ($P < 0.05$) as fermentation progresses as revealed in figure 7. The increase in the ash content during fermentation could be due to the activities of lactic acid

bacteria involved in the fermentation. This agreed with the report of Edema and Fawole (2006), who reported that cultures of lactic acid bacteria significantly ($P < 0.05$) increased the ash content of fermented *Parkia biglobosa*. Fibre content decreased significantly as the fermentation was prolonging in both the locally produced and the laboratory produced samples (figure 8). The protein content increased after 72hrs of fermentation in both local and laboratory produced samples as shown in figure 9. This could be attributed to the activities of the fermenting microorganisms. Fat content of both samples also increased as fermentation progress as revealed in figure 10. This could also be attributed to the increase of lipolytic enzymes which hydrolyses fat to glycerol and fatty acids. Carbohydrate content also reduced significantly from 34.35 to 14.47% and 32.82 to 20.80% for the locally produced and laboratory produced fermented *Parkia biglobosa* respectively (figure 11). Reduction in carbohydrate during fermentation may also be a result of the fermenting microorganisms utilizing some of the sugar for growth and metabolic activities. This is in consistent with the report of Abiola and Oyetayo (2015) during liquid fermentation of Kersting's groundnut.

Figure 1: pH Variation

Figure 2: Total Titratable Acidity Variation

Figure 3: Total Bacterial Load

Figure 4: Lactic Acid Bacterial Load

Figure 5: Total Fungal Load

Figure 6: Moisture Content (%) Of Fermented Parkiabioglobosa

Figure 7: Ash Content (%) Of Fermented Parkiabioglobosa

Figure 8: Fibre content (%) of Parkiabiglobosa
Fermented Parkiabiglobosa

Figure 9: Protein Content (%) of Fermented

Figure 10: Fat Content (%) of
Parkiabiglobosa Fermented Parkiabiglobosa

Figure 11: Carbohydrate Content Fermented

4. Conclusion and Recommendation

This study provides comparative information on the microbiological and nutritional qualities of fermented *Parkia biglobosa* produced both locally and in the laboratory. The result obtained from the microbial load revealed that the locally produced fermented *Parkia biglobosa* recorded the highest bacterial load as compared to the laboratory produced. The predominant microorganisms observed during both local and laboratory productions of fermented *Parkia biglobosa* were: *Bacillus subtilis*, *Bacillus polymyxa*, *Lactobacillus plantarum*, and *Mucormucedo*. Proximate analysis revealed that Protein content of *Parkia biglobosa* increased with simultaneous decreased in the anti-nutrient content during the fermentation process. *Bacillus subtilis* and *Bacillus polymyxa* showed significant inhibitory properties against all the common pathogenic bacteria and fungi examined. *Bacillus subtilis* and *B. polymyxa*, were positive for amylase, lipase and protease producing activity. Therefore, contamination of locally produced fermented *Parkia biglobosa* 'Iru' might have originated from dirty environment used for production, foot pressing during de-hulling, contaminated water and poor personal hygiene of the food handlers. Hence, training about environmental sanitation and proper hygiene during processing is essential and highly recommended. Furthermore, application of dry de-hulling system to reduce direct contact with the skin should also be encouraged among producers.

5. References

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