STUDIES ON CHEMICAL COMPOSITION AND STORAGE STABILITY OF CUBED *Okpehe*

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Abstract
Prosopis africana seeds were fermented (*okpehe*) and cubed (whole and ground) with the addition of 20% corn starch as a binder. The chemical composition of the products was studied for a period of 4 weeks. The proximate composition, pH, Titratable acidity (TTA), sensory assessment and total bacterial count were studied. The proximate composition of whole and ground cubed *okpehe* decreased slightly with increase in the storage period. Whole cubed *okpehe* had a range of (11.90 - 11.96%) for moisture content, (33.12 - 33.17%) for protein, (14.11 - 14.19%) for fat, (3.94 - 3.99%) for fibre, (2.67 - 2.71%) for ash and (33.98 - 34.26%) for carbohydrate, while ground cubed *okpehe* had a range of (10.52 - 10.55%) for moisture content, (32.52 - 32.56%) for protein, (12.39 - 12.44%) for fat, (3.74 - 3.78%) for fibre, (2.58 - 2.62%) for ash and (38.05 - 38.75%) for carbohydrate. Generally, ground cubed *okpehe* had relatively lower pH and TTA values than whole cubed *okpehe*. Bacterial count ranged between (4.6 - 4.8×10^4) cfu/g) and (4.5 - 4.6×10^4 cfu/g) for whole and ground cubed *okpehe* respectively. Sensory evaluation revealed that whole cubed *okpehe* was more preferred since it had higher ratings for aroma, appearance, texture and overall acceptability than ground cubed *okpehe*. This study has shown the possibility of improving the quality and extending the shelf life of *okpehe* through cubing for increased utilization.

Keywords: *okpehe*, fermentation, cubing, chemical composition, stability

Introduction

Okpehe is a condiment derived from the fermentation of *Prosopis africana* seeds (Balogun and Oyeyiola, 2012). It is popular among the Igala people as *okpei* (Musa *et al*., 2011) and Idoma people as *okpehe,* both of North Central Nigeria. The trees of *P. africana* are found growing in Northern, Eastern and Southern parts of Nigeria (Aremu *et al*., 2006). The seeds are one of the lesser-known legumes used as food condiments (Oguntoyinbo *et al*., 2010). Balogun and Oyeyiola, (2011) reported that the condiment can serve as a low-cost source of protein especially for the rural populace. They serve not only as nutritious non-meat protein substitutes, but also as flavor enhancers in soups and other dishes (Achi, 2005).

Literature abounds on the processing of *Prosopis Africana* seed into *okpehe*. Balogun and Oyeyiola, (2012) reported changes in the nutrient composition of *okpehe* during fermentation, with the essential amino acid profile of the fermented seeds increasing steadily throughout the period of fermentation. Calcium, iron and copper contents also increased while potassium and manganese decreased. *Bacillus subtilis, Bacillus licheniformis, Bacilus megatarium, Bacillus pumilus, Staphylococcus aureus, Escherichia coli and Saccharomyces cerevisiae* were all isolated during the fermentation of *P. africana* seeds (Balogun and Oyeyiola, 2011). Although residual fungal contaminations were present during the fermentation of *P. africana* seeds, there was no risk associated with its consumption (Musa *et al*., 2011).

Protein malnutrition is a major problem in many parts of Africa and productions of fermented vegetable proteins have been used in recent times to increase the protein intake of many people particularly the rural dwellers because it is cheaper than animal proteins. Despite research efforts to increase the utilization of *P. africana* seed in a variety of ways, there is paucity of information on the cubing of *okpehe*. Therefore this study was carried out to evaluate the effect of milling on quality parameters of cubed *okpehe* stored for 4 weeks at ambient temperature.

Materials and Methods

Fresh matured fruits of *P. africana* seeds were obtained from the Main campus of the University of Ilorin, Ilorin, Nigeria and identified at the herbarium of the Plant Biology Department of the University of Ilorin.

Fermentation process

The hot plate method described by Balogun and Oyeyiola (2011) was adopted for the preparation of *okpehe*. The seeds were removed from the fruits by beating the fruits with a club on a concrete surface to break the tough fruit coats. Subsequently the seeds were obtained from the pod. One thousand grams of seeds were boiled at 100^{o}C for 6hrs in a stainless steel pot on a hot plate until the seed coat became soft and the seeds swollen. Seeds were allowed to cool and the seed coat removed by pressing them between the palms. Clean cotyledons were rinsed with sterile water and cooked on the hotplate set at 60^{o}C for 30 minutes. Cooked seeds were drained through a sieve, wrapped with pawpaw leaves (disinfected with 70% alcohol and rinsed with sterile water). The seeds were covered in three layers of sterile aluminium foil and left for 72 hrs in the laboratory at ambient temperature (28±2^{o}C).

Cubing Process

Preliminary studies revealed that for every 100 g portion of *okpehe*, 20g of binder (corn starch) was appropriate. The fermented seeds were divided into two portions. The first portion was milled (ground) while the other portion was not milled (whole). Corn starch (25g) was weighed into 125ml of boiled distilled water at 95 ± 5^{o}C the mixture was then stirred thoroughly for 10 minutes until homogenous paste was obtained. The corn starch paste was added to the samples, mixed thoroughly with string rod to obtain the final products of the samples which were then transferred to the Department of Agricultural Engineering, University of Ilorin for cubing. The cubed samples (ground and whole *okpehe*) were further dried in the oven at 60^{o}C for 24 hrs and stored in aluminium foil (28±2^{o}C) for a period of four weeks. Storability test was carried out at an interval of one week for four weeks.

Quality Evaluation

Chemical Analysis: pH, titratable acidity, moisture, crude protein, ash, crude fat, crude fibre and carbohydrate contents were determined using methods described by AOAC, (2000).

Total Bacterial Count: The total bacterial count of the ground and whole cubed *okpehe* was determined using methods described by Fawole and Oso (2004).

Sensory Evaluation: A semi-trained twenty member panel consisting of students and staff of the University of Ilorin who are accustomed to the consumption of *okpehe* was selected for sensory evaluation. The panelists were instructed to evaluate the coded samples for taste, aroma, appearance, texture and overall acceptability. Each sensory attributes was rated on a 9-point hedonic scale (1 = dislike extremely while 9= like extremely) (Iwe, 2007).

Statistical Analysis

Data were analyzed by analysis of variance using statistical package for social sciences (SPSS). The difference between mean values was determined using Duncan's multiple range test. Significance was accepted at 5% probability level. Data reported are average values of duplicates

Results and Discussion

Proximate Composition: The proximate composition of whole and ground cubed *okpehe* as affected by storage period is presented in Table 1. The proximate composition of the samples was influenced by storage time. Protein content of both whole and ground *okpehe* decreased slightly with storage period. The protein content of both whole (33.17%) and ground (32.56%)

okpehe at 0 week of storage were lower than values (36%) reported by Gberikon *et al*., (2010) for *okpehe* produced during a 118hrs fermentation period and Balogun and Oyeyiola, 2011 (38.40%) for *okpehe* produced during a 72hrs fermentation period. This observed difference may be attributed to the use of starter cultures by those researchers. The use of starter cultures may account for better protein profile of fermented *P. africana* seeds since it has been reported as the best approach for obtaining a safe product with better nutritional and sensory properties (Ouoba *et al*., 2007).

Similarly, the ash and carbohydrate contents of whole and ground cubed *okpehe* were lower while crude fat and crude fibre contents were higher than those reported by Balogun and Oyeyiola, (2011). The moisture, protein, fat, fibre and ash contents of the whole cubed *okpehe* were higher than that of ground cubed *okpehe*. This is due to the milling of the ground *okpehe* where some nutrients might have been lost during the processing.

Total Bacteria Count of *Okpehe:* The total bacterial count of whole and ground cubed *okpehe* is presented in Table 2. The bacterial count of whole and cubed *okpehe* obtained ranged from 4.6 to 4.8×10^4 cfu/g and 4.5 to 4.6×10^4 cfu/g respectively. The total bacterial count of whole and ground cubed *okpehe* was constant throughout the storage period until the 4^{th} week of storage. This observation suggests that the microorganisms present in the *okpehe* did not multiply during the storage period and is probably due to reduction in water activity of the samples caused by drying. The slight reduction noticed at the 4^{th} week was probably due to competition among the organisms which may arise because of the reduction in the nutrient content of the samples with time.

Titratable Acidity and pH: Figures 1 and 2 shows the changes in pH and TTA of whole cubed and ground cubed *okpehe.* Whole cubed *okpehe* had a pH range of 6.86 to 6.91 while ground cubed *okpehe* had a range of 6.70 to 6.76. The TTA values decreased from 1.21 to 1.15 for whole cubed *okpehe* and 1.35 to 1.3 for ground cubed *okpehe* as the period of storage increased. Although the pH and TTA values did not vary significantly ($p\leq0.05$), ground cubed *okpehe* had relatively lower pH and TTA values than whole cubed *okpehe*. This is probably due to the effect of increased surface area which may have led to the loss of some of the volatile acids produced during fermentation.

Sensory Evaluation: The mean sensory scores for whole and ground cubed *okpehe* are presented in Table 3. There were significant differences ($p\leq0.05$) between whole and ground cubed *okpehe* for all sensory parameters measured except for taste. Whole cubed *okpehe* had higher ratings for aroma, appearance, texture and overall acceptability than ground cubed *okpehe*. The higher ratings observed for whole cubed *okpehe* may be due to the fact that flavor compounds produced during the fermentation period were better retained in the whole cubed *okpehe* than the ground cubed sample due to higher surface area in the latter. This finding corroborates previous observations from sensory assessment of condiments as panel members and consumers prefer to have the condiments in the soup in the whole form rather than when milled.

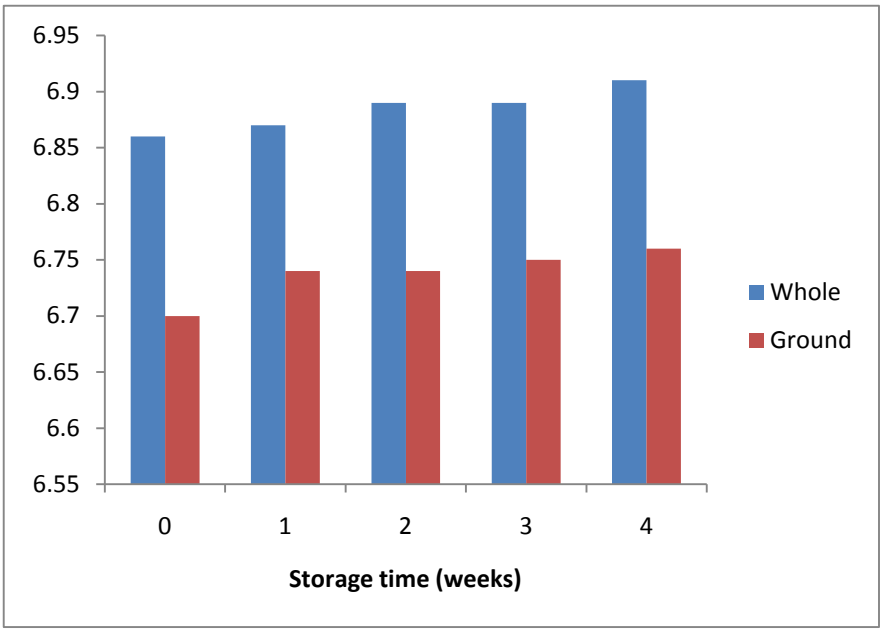

Figure 1: Changes in pH during storage of whole and ground cubed *okpehe*

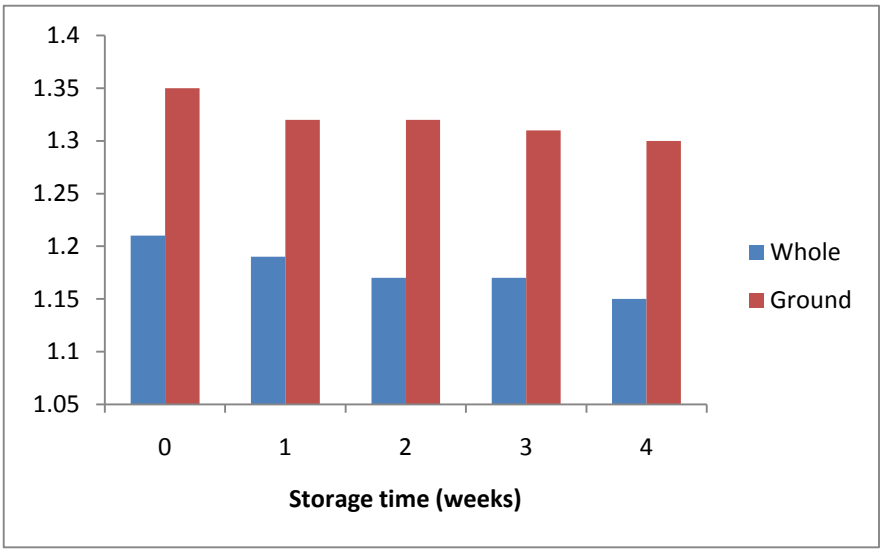

Figure 2: Changes in titratable acidity during storage of whole and ground cubed *okpehe*

Table 1: Proximate Composition (on wet basis) of Whole and Ground Cubed *okpehe*

Storage time (weeks)	Moisture (%)		Protein (%)		Fat (%)		Fibre (%)		Ash (%)		CHO(%)	
	Whole	Ground	Whole	Ground	Whole	Ground	Whole	Ground	Whole	Ground	Whole	Ground
0	11.96±0.5^{a}	10.55±0.1^{a}	33.17±0.1^{a}	32.56±0.1^{a}	14.19±0.5^{a}	12.44±0.5^{a}	3.99±0.5^{a}	3.78±0.1^{a}	2.71±0.1^{a}	2.62±0.1^{a}	33.98±0.1^{a}	38.05±0.5^{a}
1	11.95±0.5^{a}	10.54±0.1^{a}	33.15±0.5^{a}	32.55±0.1^{a}	14.19±0.1^{a}	12.44±0.1^{a}	3.98±0.5^{a}	3.77±0.1^{a}	2.70±0.1^{a}	2.61±0.1^{a}	34.03±0.1^{b}	38.09±0.5^{a}
2	11.94±0.5^{a}	10.53±0.1^{a}	33.15±0.1^{a}	32.55±0.1^{a}	14.17±0.1^{a}	12.42±0.1^{a}	3.97±0.1^{a}	3.76±0.1^{a}	2.69±0.1^{a}	2.60±0.1^{a}	34.08±0.5^{c}	38.14±0.1^{b}
3	11.91±0.5^{ab}	10.52±0.1^{a}	33.13±0.1^{ab}	32.53±0.1^{b}	14.12±0.5^{b}	12.41±0.1^{ab}	3.96±0.5^{ab}	3.75±0.1^{a}	2.68±0.1^{ab}	2.59±0.1^{ab}	34.15±0.1^{d}	38.20±0.1^{c}
4	11.90±0.5^{b}	10.52±0.1^{a}	33.12±0.5^{b}	32.52±0.1^{b}	14.11±0.5^{b}	12.39±0.1^{b}	3.94±0.5^{b}	3.74±0.1^{b}	2.67±0.1^{b}	2.58±0.1^{b}	34.26±0.1^{e}	38.75±0.1^{d}

Means with the same superscript along a column are not significantly different ($p \leq 0.05$)

Table 2: Total Bacteria count of Whole and Cubed *okpehe*

Storage time (weeks)	Bacteria Count (Cfu/g) x10^{4}	
	Whole	Ground
0	4.8	4.6
1	4.8	4.6
2	4.8	4.6
3	4.8	4.6
4	4.6	4.5

Table 3: Mean Sensory Scores of Whole and Cubed *okpehe*

Samples	Taste	Aroma	Appearance	Texture	Overall Acceptability
Whole	5.5^{a}	6.2^{a}	6.2^{a}	6.4^{a}	6.1^{a}
Ground	5.5^{a}	6.1^{b}	6.0^{b}	5.9^{b}	5.7^{b}

Means with the same superscript along a column are not significantly different ($p \leq 0.05$)

Conclusion

Results from this study have shown the potential of producing whole and ground cubed *okpehe* from *P. africana seeds* with comparable quality attribute with other food condiments. Similarly, this study provided an alternative way of improving the quality and shelf life of o*kpehe.* Based on the results obtained from the proximate composition and sensory evaluation, whole cubed *okpehe* is therefore recommended.

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