



SENSORY AND SHELF-LIFE EVALUATION OF CHINCHIN SNACKS FRIED WITH AFRICAN ELEMI AND GROUNDNUT OILS

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ABSTRACT

This study investigates the sensory attributes and shelf-life stability of *Chinchin*, a Nigerian snack, fried using two locally produced oils: African Elemi oil (*Canarium schweinfurthii*) and Groundnut oil (*Arachis hypogaea*). *Chinchin* samples were analyzed immediately after frying, and after two and four weeks of storage. Sensory evaluation was performed based on appearance, texture, flavour, aroma, and general acceptability, using a 7-point hedonic scale. Shelf-life parameters such as moisture content, peroxide value, free fatty acid levels, and microbial growth were also assessed. Results revealed differences between the two oils. *Chinchin* fried with African Elemi oil showed increases in moisture (from 5.73% at frying to 8.58% after 4 weeks), peroxide values (5.3 to 9.7 mEq/kg), free fatty acids (0.48% to 0.55%), and microbial growth (5.40×10^3 to 6.8×10^3 CFU/g). In contrast, samples fried with Groundnut oil maintained greater stability, with moisture content remaining nearly constant (4.7–4.9%), peroxide values stable around 3.78–3.80 mEq/kg, free fatty acids between 0.40–0.42%, and microbial counts showing change (4.2×10^3 to 4.35×10^3 CFU/g). The superior performance of Groundnut oil was further supported by its higher smoking point (235 °C) compared to African Elemi oil (165 °C), which contributed to reduced rancidity and microbial proliferation. *Chinchin* fried with Groundnut oil scored higher in sensory appeal and exhibited greater shelf-life stability ($p < 0.05$). These findings highlight Groundnut oil's superior frying and preservation qualities, while suggesting the need for improved refining and stabilization of African Elemi oil to enhance its suitability for snack production.

Keywords: *Chinchin*, Groundnut oil, African Elemi oil, Sensory evaluation, Shelf-life stability, Microbial quality

INTRODUCTION

The snack food industry is expanding with new products becoming available each year. They are developed to be inviting, acceptable, satisfying and are available in different forms like *Chinchin*, cookies, cakes biscuit and bread with respective sensory, nutritional and shelf-life capacity (Arora *et al.*, 2020).

Chinchin a popular Nigerian snack made from wheat flour, butter and sugar, (Adegunwa *et al.*, 2014) typically relies on vegetable oils for frying (Owolabi *et al.*, 2024) and turns out cookie like (Ajiboso & Ajiboso, 2021). Overtime *Chinchin* is prepared using different vegetable oils as frying medium though during frying, due to hydrolysis, oxidation and polymerization processes, the composition of oil changes which in turn changes the flavour and stability of its compounds (Okparanta *et al.*, 2018). Some examples of oils used for frying include sun flower oil, cotton seed oil, soyabean oil, palm oil, groundnut oil to mention a common few. However, other plant-based oils that are not so common such as African Elemi oil are also used. Long shelf life of *Chinchin* makes large scale production and distribution possible (Akindele *et al.*, 2017), there for the oils used in frying should be without impurities, of high smoking point and low in free fatty acid content for good frying performance and oil stability.

African Elemi (*Canarium schweinfurthii* bursaraceae) also referred to as Atili in Hausa, ube mgba in Igbo and Ako in Yoruba languages respectively. It is rich in fat, protein, carbohydrate, water and sometimes ash is found in low quantity (Agu *et al.*, 2008). The oil has a fruity aroma, green

pigment with about 71% palmitic acid, 18% oleic acid (Orisa *et al.*, 2023) and a rich source of Vitamin C and flavor in snack (Madelosi & Angaye, 2015). It has a smoking point between 187°C- 203°C. (Marcus *et al.*, 2013). Groundnut oil also known as peanut oil is obtained from (*Arachis hypogaea*.) Nwagbo *et al.*, 2020 It generally has a mild nutty aroma and has been analyzed to have high concentration of oleic and linoleic acid respectively, 8% lauric acid and 0% capric acid. (Anyasor *et al.*, 2009). It has smoking point between 232°C- 282°C (Marcus *et al.*, 2013) and pigment slightly golden yellow.

This study investigates the effect of frying oil type on the quality and shelf-life of *Chinchin* by comparing samples prepared with African Elemi oil and Groundnut oil. The research focused on evaluating sensory attributes, monitoring changes in physicochemical parameters and microbial growth during storage, and determining which oil offered better consumer appeal and preservation qualities, while identifying ways to improve the performance of African Elemi oil in snack production.

MATERIALS AND METHODS

Methodology

African Elemi oil (1.5 liters) was purchased from an open market in Gada Bui, Jos Plateau State while another 1.5 liters of ground nut oil was purchased from an open market in Oja Oba, Ilorin Kwara State. The materials for *Chinchin*, which include wheat flour, margarine, eggs, granulated sugar and nutmeg spice were purchased in Mandate market, Ilorin Kwara State. The *Chinchin* constituents were mixed, kneaded

and cut into specialized sizes and added to already heated respective oils of African Elemi and Groundnut oil to fry for 4mins. The product turned golden brown after which it was considered ready for cooling, chewing and storage respectively.

Sensory Evaluation

Sensory evaluation was carried out by 25 taste panelists consisting of staff and students on Industrial Training at the National Centre for Agricultural Mechanization Ilorin, Kwara State. The products were analyzed for immediate chew after fry, 2weeks and 4 weeks storage for the two products. The sensory parameters were appearance, texture, flavor, aroma and general acceptability

A seven-point hedonic testing was carried out on specific parameters pointed out for analysis of which 1=very poor, 2=poor, 3=slightly poor, 4= average, 5= slightly good, 6= good, 7= very good.

Shelf-life Determination

Shelf-life analysis which include the following parameters, moisture content, peroxide value, free fatty acid and microbial growth were carried out for the *Chinchin* fried with both oils respectively and stored at a temperature of 26°C for 2weeks and 4 weeks respectively.

Moisture Content

The moisture content is a measure of the percentage moisture loss due to drying at a temperature of 105°C. Moisture is necessary for the growth and proliferation of microbes and determines shelf life of snack food products. Ten (10)g of the sample extracted oil was weighed into pre weighed crucible(W₀) and placed into a hot dry oven at 105°C for 4 hr. at the end the samples were removed from the oven and placed in a desiccator and after getting cool, the samples weighed again to calculate moisture content in the samples. The process of weighing was repeated until constant weight (W₂) was obtained. The weight loss due to moisture was obtained using equation 1:

$$Moisture (\%) = \left(\frac{W_1}{W_2}\right) \times 100 \tag{1}$$

Peroxide Value

Peroxide value is the amount of peroxide oxygen generated per kilogram of fat or oil expressed in milliequivalents or millimoles per kilogram. Peroxides are intermediate compounds synthesized during autoxidation reaction; the peroxide value is therefore a measure of the degree of oxidation reactions (rancidity) in food samples. Autoxidation is a free radical reaction involving oxygen that leads to deuteriation of fats and oil which is responsible for off- flavor and off odors. Five (5)g of the sample extracted oil was added to 30 ml of acetic acid: isooctane (3:2) solution followed by swirling and then addition of 0.5 ml potassium iodide (KI). The solution was swirled again for 1 minute. The peroxides oxidized the iodide to iodine and the iodine was titrated against 0.1N Sodium thiosulfate solution with 1 ml of starch (10%) as an indicator. The amount of produced iodine was directly proportional to peroxide value (INSO 2018). The peroxide value was then calculated with regard to the amount of thiosulphate (Equation 2). If the value of the sample is less than 5mEq/Kg, the oil is considered safe, when the values are between 5-10mEq/Kg it is considered fair enough but if the sample is above 10mEq/Kg it is considered rancid or off.

$$Peroxide Value = 2 \left(\frac{a-b}{w}\right) m Eq/Kg \tag{2}$$

Where a= value of acid with sample,
b = value of sample without acid,

w = weight of oil.

Free Fatty Acid Test

Free fatty acid (FFA) is the result of fat oxidation. This is a reflection of the amount of specified fatty acids due to triacylglycerol hydrolysis that takes place upon the release of water from food while being fried. The determination of FFA is simple titration of an end point of pH 8.3 with sodium hydroxide, and the result are expressed as % FFA and acid value may be converted from one to the other using a conversion factor. The sample oil was obtained by using equation in which the acid value obtained was divided by two FFA of the extracted

$$FFA = Acid\ value / 2 \tag{3}$$

Where FFA = Free fatty Acid

The AOAC method was used to test the peroxide value while the acid -base titration method was used to ascertain the free fatty acid content

Microbial Analysis

The microbial quality of the Chinchin samples was evaluated to determine the effect of frying oil type and storage duration on shelf-life stability. Standard microbiological procedures were employed to assess the presence and proliferation of microorganisms. Samples were collected immediately after frying, as well as after two and four weeks of storage under ambient conditions. For the analysis, approximately 10 g of each Chinchin sample was homogenized in sterile distilled water, and the resulting suspension was subjected to serial dilutions. Aliquots of the diluted samples were inoculated onto nutrient agar to determine total viable bacterial counts, potato dextrose agar to assess fungal growth, and selective media for the detection of coliform organisms. The inoculated plates were incubated at appropriate temperatures, specifically 30–37 °C for bacterial growth and 25–28 °C for fungal development, and were monitored for colony formation.

Microbial loads were quantified by enumerating colony-forming units (CFU) per gram of sample. The results were expressed as logarithmic values to enable meaningful comparison across treatments and storage periods. This approach provided a clear indication of microbial proliferation patterns in relation to the type of frying oil used and the duration of storage.

Statistical Analysis

Data from sensory evaluation, physicochemical tests, and microbial counts were expressed as mean ± standard deviation of triplicate determinations. Differences between oil types and storage durations were analyzed using ANOVA, and significant means were separated with Duncan’s Multiple Range Test (DMRT) at *p* < 0.05. Sensory scores were treated as ordinal but analyzed with parametric methods after confirming normal distribution, while microbial counts were log-transformed prior to analysis.

RESULTS AND DISCUSSION

Sensory Evaluation of Chinchin Fried with African Elemi Oil and Groundnut Oil

The sensory evaluation results demonstrate that Groundnut oil consistently produced superior sensory attributes compared to African Elemi oil. Fresh samples fried with Groundnut oil scored highest in appearance, texture, flavor, aroma, and general acceptability, while African Elemi oil samples scored lower across all parameters. During storage, African Elemi oil samples showed significant declines in sensory quality, with flavor and general acceptability dropping most sharply by 4

weeks. This deterioration is consistent with the physicochemical changes observed later (higher moisture, peroxide values, and microbial counts), which negatively impacted sensory perception. By contrast, Groundnut oil samples maintained stable sensory scores, reflecting its higher smoking point and oxidative stability (Marcus, 2013; Anyasor et al., 2009).

These findings align with previous reports that oils with lower smoking points are more prone to rancidity and flavor deterioration during storage (Asokapandian et al., 2020; Nasir et al., 2003). The superior performance of Groundnut oil in sensory evaluation further supports its suitability as a frying medium for Chinchin, while African Elemi oil requires refining and stabilization to improve its sensory and storage performance.

Table 1: Mean Sensory Scores of Chinchin Fried with African Elemi Oil and Groundnut Oil at Different Storage Periods

Storage period	Oil type	Appearance	Texture	Flavor	Aroma	General Acceptability
Fresh (A1/B1)	Atili (Elemi)	5.6 ^b	5.0 ^b	5.1 ^b	5.6 ^b	5.2 ^b
	Groundnut	6.9 ^a	6.8 ^a	6.9 ^a	6.5 ^a	6.9 ^a
2 weeks (A2/B2)	Atili (Elemi)	5.5 ^b	5.2 ^b	5.0 ^b	5.5 ^b	5.1 ^b
	Groundnut	6.8 ^a	6.6 ^a	6.6 ^a	6.6 ^a	6.7 ^a
4 weeks (A3/B3)	Atili (Elemi)	5.3 ^b	5.0 ^b	4.9 ^b	5.1 ^b	5.0 ^b
	Groundnut	6.7 ^a	6.5 ^a	6.6 ^a	6.6 ^a	6.7 ^a

Values are mean of 25 panelists. Means with different superscripts within a column differ significantly at $p < 0.05$ (ANOVA followed by DMRT)

Shelf-life Analysis of Chinchin Fried with Africa Elemi Oil
ANOVA revealed that storage duration had a significant effect ($p < 0.05$) on all measured parameters of Chinchin fried with African Elemi oil. DMRT separated the means clearly, showing a progressive deterioration pattern across storage periods ($A3 > A2 > A1$). Moisture content Increased significantly from 5.73% (A1) to 8.58% (A3). This rise reduced crispiness and created favorable conditions for microbial growth. The values remained within the allowable range for snacks (WHO, 2023) and were comparable to moisture levels reported in Chinchin produced from flour blends of wheat, defatted peanut, and orange peels (Bongjo et al., 2023). Peroxide value Rose sharply from 5.30 mEq/kg (A1) to 9.70 mEq/kg (A3), with significant differences across all storage times. Although values fell within the acceptable range for fried snacks (Awuchi et al., 2018), the increase reflects lipid oxidation and rancidity progression. The relatively low smoking point of African Elemi oil (165 °C)

likely accelerated this deterioration (Asokapandian et al., 2020).

Free fatty acids (FFA) Increased modestly but significantly, from 0.48% (A1) to 0.55% (A3). These values were lower than those reported in edible oils evaluated for rancidity (Adelagun et al., 2023), but the upward trend indicates hydrolytic breakdown of triglycerides, contributing to off-flavors. Microbial growth Counts rose significantly from 5.40×10^3 CFU/g (A1) to 6.80×10^3 CFU/g (A3). The increase is consistent with higher moisture levels and reduced oil stability, making the product more susceptible to spoilage. Overall, statistical analysis confirmed that Chinchin fried with African Elemi oil deteriorated significantly during storage, with measurable declines evident by 2 weeks and substantially worsened by 4 weeks. The low smoking point of African Elemi oil contributed to reduced crispiness, higher rancidity, and microbial susceptibility compared to more stable frying oils.

Table 2. Shelf-life Analysis for Chinchin Fried with African Elemi Oil and Stored for 2 and 4 Weeks

Sample	Moisture content (%)	Peroxide value (mEq/kg)	Free fatty acid (%)	Microbial growth (CFU/g $\times 10^3$)
A1 (Freshly fried)	5.73 ^c	5.30 ^c	0.48 ^c	5.40 ^c
A2 (2 weeks)	6.58 ^b	6.20 ^b	0.51 ^b	6.10 ^b
A3 (4 weeks)	8.58 ^a	9.70 ^a	0.55 ^a	6.80 ^a

Values are mean of triplicate determinations. Means with different superscripts within a column differ significantly at $p < 0.05$ (ANOVA followed by DMRT)

Shelf-life Analysis of Chinchin Fried with Groundnut Oil
ANOVA revealed no significant differences ($p > 0.05$) in moisture content, peroxide value, free fatty acid, or microbial growth across storage periods for Chinchin fried with groundnut oil. DMRT confirmed that all samples (B1, B2, B3) were statistically similar, indicating remarkable stability during storage. Moisture content Remained nearly constant (4.7–4.9%), maintaining crispiness throughout storage. This stability is consistent with reports that deep-fried snacks often retain low moisture due to evaporation during frying (Debnath et al., 2003).

approved range of 232–282 °C (Marcus, 2013). Free fatty acids Showed only a slight, non-significant increase (0.40–0.42%), remaining lower than values reported for rancid edible oils (Adelagun et al., 2023). Microbial growth Counts remained stable (4.20 – 4.35×10^3 CFU/g), with no significant proliferation during storage. This suggests that groundnut oil’s stability limited microbial susceptibility compared to African Elemi oil.

These findings confirm that groundnut oil provided superior frying and preservation qualities, maintaining sensory appeal and shelf-life stability for up to 4 weeks. The results align with earlier studies highlighting groundnut oil’s oxidative stability and suitability for frying (Anyasor et al., 2009; Nwagbo et al., 2020).

Peroxide value Stayed stable around 3.78–3.80 mEq/kg, well below rancidity thresholds (Awuchi et al., 2018). This reflects strong oxidative stability, attributable to the high smoking point of groundnut oil (235 °C), which falls within the

Table 3: Shelf-life Parameters of Chinchin Fried with Groundnut Oil at Different Storage Periods

Sample	Moisture content (%)	Peroxide value (mEq/kg)	Free fatty acid (%)	Microbial Growth (CFU/g ×10 ³)
B1 (Freshly fried)	4.70 ^a	3.79 ^a	0.40 ^a	4.20 ^a
B2 (2 weeks)	4.70 ^a	3.78 ^a	0.40 ^a	4.33 ^a
B3 (4 weeks)	4.90 ^a	3.80 ^a	0.42 ^a	4.35 ^a

Values are mean of triplicate determinations. Means with the same superscript within a column are not significantly different at $p < 0.05$ (ANOVA followed by DMRT).

Smoking Point Values of Oils Used for Frying Chinchin
ANOVA revealed a significant difference ($p < 0.05$) between the smoking points of African Elemi oil and Groundnut oil. DMRT separated the means, ranking Groundnut oil (235 °C) significantly higher than African Elemi oil (165 °C).

The lower smoking point of African Elemi oil explains its reduced frying stability and higher susceptibility to rancidity and microbial proliferation during storage. Oils with low smoking points tend to degrade faster under frying conditions, producing off-flavors and reducing shelf-life stability (Asokapandian et al., 2020). By contrast, Groundnut oil's

high smoking point falls within the approved range of 232–282 °C (Marcus, 2013), which contributed to its superior oxidative stability and preservation qualities observed in Tables 1 and 2.

This finding is consistent with earlier reports that frying oils with higher thermal stability, such as Groundnut oil, maintain product crispiness and limit rancidity during storage (Anyasor et al., 2009; Nwagbo et al., 2020). The difference in smoking points therefore provides a mechanistic explanation for the contrasting shelf-life outcomes between Chinchin fried with African Elemi oil and Groundnut oil.

Table 4: Smoking Point Values of African Elemi Oil and Groundnut Oil

Oil	Measured smoking point (°C)	Approved smoking point range (°C)
African Elemi Oil	165 ^b	187–203
Groundnut Oil	235 ^a	232–282

Values are mean of triplicate determinations. Means with different superscripts within a column differ significantly at $p < 0.05$ (ANOVA followed by DMRT).

CONCLUSION

This study demonstrated that the type of frying oil significantly influences both the sensory attributes and shelf-life stability of *Chinchin*. Groundnut oil consistently produced samples with superior sensory qualities, including better appearance, texture, flavour, aroma, and overall acceptability. In addition, *Chinchin* fried in Groundnut oil exhibited greater resistance to rancidity and microbial proliferation during storage, maintaining quality for up to four weeks. By contrast, *Chinchin* fried with African Elemi oil showed lower sensory scores and reduced stability, with higher peroxide values, free fatty acid levels, and microbial growth over time. These findings suggest that while African Elemi oil has potential as a local frying medium, its current processing and stability limitations reduce its suitability for extended snack preservation.

Overall, Groundnut oil proved to be the more effective frying medium for *Chinchin*, ensuring both consumer appeal and longer shelf-life. Future work should focus on improving the refining and stabilization of African Elemi oil to enhance its performance in snack production and broaden its application in food processing.

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