ISSN: 2755-0206

Journal of Pathology Research Reviews & Reports

Research Article

Open Access

Quality Attributes of a Candy-Like Product Made from African Star Apple Fruit

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ABSTRACT

African star apple fruit relished as a snack, is rich in macro and micro nutrients and dietary phytochemicals, with great potential to improve the human health, nutrition, food security and income of communities engaged in its production, but has been highly under-utilized. To extend the shelf life and reduced losses on this highly perishable produce, candy-like product was made from the fruit pulp of the African Star Apple, in ratio 50% solid to 50% liquid, with mixture boiled at 300ºF for 30 minutes to produce candy-like product via evaporation of moisture and caramelization. Candy sample was analysed over 4-week storage, for physical properties, proximate, sensory, strength, and microbial load using standard methods. Results from the analyses showed that the candy gave a satisfactory and acceptable product, the moisture content (15-11%), crude fat, ash (0.51-0.43%) and protein content (6.54-4.08%) reduced with storage, while carbohydrate content increased, depicting concentration due to moisture loss. There was increase in microbial load (2-5.2x 10 4 Cfu/g) of the candy after week 4, which may be due to inadequate packaging and presence of micro-organisms in the storage environment. Total sugar significantly decreased but high (27.14-18.63%), as well as the water insoluble impurities of the candy, with hard and firm texture. It can be concluded that acceptable candy can be produced from African Star Apple, provided better quality packaging is provided to prevent moisture loss.

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Received: May 16, 2025; **Accepted:** May 21, 2025; **Published:** May 30, 2025

Introduction

Before discovering sugar, candy was made from honey since honey was then used to preserve fruits and flours by coating. Before the industrial revolution, candy was considered a form of medicine, to either calm digestive system or treat a sore throat, but a combination of spices and sugar was later used to digestion. Candy is a sugary treat usually made from crystalized sugar, are enjoyed by the very wealthy [1].

Sugar candies can either be non-crystalline or crystalline types. Non-crystalline types are homogeneous; it may be chewy or hard e.g. hard candies, caramels, toffees, and nougats, while the crystalline types incorporate small crystals in their structures. They are creamy and melt in the mouth or easily chewed and include fondants, fudges etc. Sugar candies are usually made by dissolving sugar in water or milk to form a syrup, and then boiled until it reaches the desired concentration or starts caramelizing [2]. These are usually soft and chewy to hard and brittle textured type, which equally depends on the ingredients and the temperatures used.

Higher temperatures and greater sugar concentrations result in hard, brittle candies, while lower temperatures result in softer candy type. During production, once the syrup reaches 171 °C (340 °F) or higher, the sucrose molecules break down into simpler sugars, creating an amber-coloured substance known as caramel, which should not be confused with caramel candy, although it is the candy's main flavoring, though minor differences in the machinery, operating temperature/timing of the candy-making process could create noticeable differences in the final product [3].

With high sugar content, shelf life of candy products is higher for most candies to be stored in their original packages at ambient temperature for months. Contamination by infectious agents like virus or bacteria is unlikely through sweets, including unwrapped sweets, as bacteria cannot replicate in the very dry and sweet environment of candy.

African star apple fruit, called “agbalumo” in Yoruba,” udara” in Igbo in Nigeria, or cherry, is a forest fruit that grows in tropical African countries including Nigeria, Cameroon, Uganda etc. Many specie of the fruit exists, and include Chrysophyllum africanum, grown in Central and West Africa, as well as Chrysophyllum oliviforme in Florida [4]. The name is derived from the fleshy pulp having five seeds centrally and radially-arranged in star-like form when cut horizontal. The fruit is usually green before ripening, and changes to yellow or orange when ripe; matured ripe fruits are found in the market in the dry season (December to March), and deteriorates easily in storage.

During planting and storage, microorganisms involved in the infection, degradation and deterioration of African Star Apple fruit includes bacteria specie: *Bacilus cereus, B. polymyxa, Escherichia coli, Proteus mirabilis, Pseudomonas aeruginosa and Staphylococcus aureus, while fungi species involved Aspergillus flavus, A. fumigatus, A. niger, A repens, Fusaruim sp, Mucor mucedo, Trichoderma viride, and Rhizopus stolonifer* [5,6].

The fruit is delicious, low in calories, and has a chewing gum-like texture. They can be used to make jam, jellies, marmalade, syrup and soft drinks, and the fruit reported to be high medicinally and to treat bruises, sprains, gum wounds, and diabetes [7-9]. Also, it is rich in natural antioxidants like tannins, terpenoids, phytochemicals, flavonoids, and vitamins E, C, and A, and mineral contents, and reported to protect cells against oxidative damage and promote heart health.

The seed of African Star Apple fruit is particularly said to be potent in hernia cure at early diagnosis, and skin infection treatment in some parts of Nigeria [5]. Fruit peel is said to be more nutritious than the pulp and leaves; the pulp however, has high contents of potassium, sodium, protein, carbohydrate, lactic acid, calcium, magnesium, while the leaves has zinc, copper, and vitamins (ascorbic acid, nicotinamin, pyridoxine, riboflavin, thiamine, and cyanocobalamin). The fruit is said to reduce constipation, sore throat and aids digestion. Alkaloids in the fruit have anti-inflammatory action, flavonoids act as powerful antioxidants to mop up free radicals, while saponins form insoluble complexes with cholesterol, reducing lipid and cholesterol levels in body [10].

As a result of its high perishability, the fruit is observed to be highly susceptible to microbial infections and insects attack, prompting disinfection and fungicide treatment prior to storage [8]. Micro-organisms involved in the infection, degradation and deterioration of the African star apple fruit includes bacteria specie: *Bacilus cereus, B. polymyxa, Escherichia coli, Proteus mirabilis, Pseudomonas aeruginosa and Staphylococcus aureus, and fungi species: Aspergillus flavus, A. fumigatus, A. niger, A repens, Fusaruim sp, Mucor mucedo, Trichoderma viride, and Rhizopus stolonifer* [5,6].

As such, substantial post-harvest losses (over 30% in some cases) are experienced during the production season due to inadequate utilization, storage and processing facilities, and these shortfalls could demoralize farmers from producing and marketing the fresh produce, most especially in developing countries of the world. Due to high postharvest losses and its nutritional value, numerous uses has been proposed, such as a major raw material for soft drink production, juice, fermented wine or production of alcohols, as well as jam and jelly production [2,7,11,12]. Processing African star apple fruit into products such as a candy extend its availability and utilization during off seasons, create varieties, give room for more elaborated foods in the food industry, curb wastage, reduce post-harvest loss, and make it available in different forms for both consumption and industrial use.

The general objective of the research was to evaluate the quality attributes of candy-like product made from African star apple through the determination the physical and chemical properties of the final product e.g. colour, texture; microbial the overall sensory quality of the product.

Materials and Methods

Sourcing of Materials

Fresh matured and ripe African star apple fruits sourced from an orchard in Ilorin town, Kwara State were properly sorted and accurately weighed, washed, peeled, with seeds separated from the pulp. The pulp was weighed and blended using electric blender to obtain fine puree, which was then sieved using a clean muslin cloth to obtain the Africa star apple juice (Figure 1).

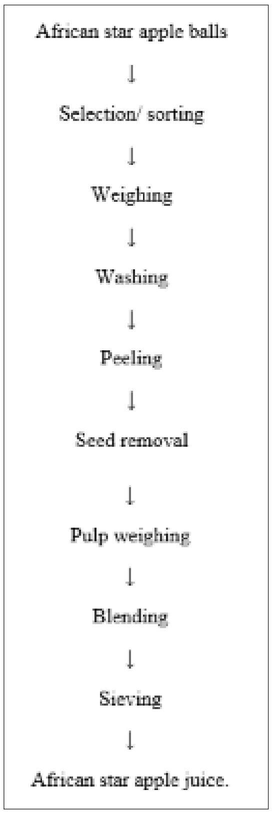

Figure 1: Production of African Star Apple Juice from the Fruit

Sample Formulation and Production of Candy from African Star Apple

The candy was produced from a blend of 150:150 ratio (solid: liquid) of the raw materials as given below: 100ml of African star apple juice + 50ml of clean water = 150 ml of Liquid; and 150g of white sugar. Juice obtained was boiled with measured amount of water and sugar at 300◦F (148.9°C) for 30 minutes to completely dissolve sugar to obtain crystalline syrup which when dropped into water, forms hard, brittle threads. It was put away from the heat source, poured in portions into the candy mold to cool and harden for an hour before being removed from the mold (Figure 2).

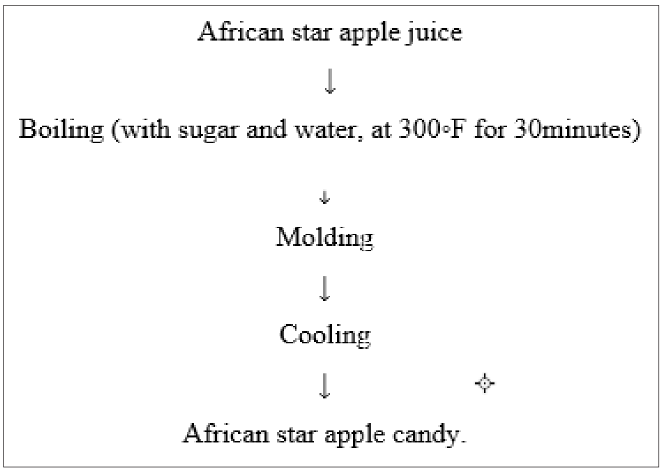

Figure 2: Production of Candy from the African Star Apple Juice

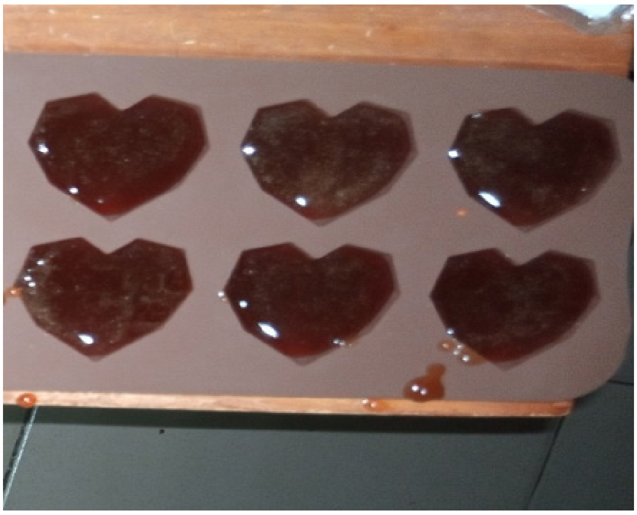

Plate 1: Samples of Candies made from the African Star Apple Juice

Analysis of Samples
Moisture Content
Moisture content was determined by the official method of AOAC with slight modification [13]. Two (2) grams of samples was weighed into a previously weighed petri-dish. The petri-dish plus sample was transferred into the oven set at 1050C for 3h to dry to a constant weight. Dried sample was cooled in a desiccator, cooled and weighed.

$$\text{Moisture Content (\%)} = \frac{W_1\text{-}W_3}{W_1\text{-}W_2} \times 100$$

Weight of empty petri-dish=W1 ; Weight of clean petri-dish plus sample before drying=W2
; Weight of petri-dish and dried sample=W3

Determination of Crude Protein
Crude protein of the sample was determined by the kjeldahl technique described by AOAC [13]. Two (2) grams of the samples was put into a kjeldahl flask, 10g of anhydrous sodium sulphate was added, and the addition of 0.5g copper sulphate. 25ml of conc. sulphuric acid was added into the mixture, heated for 30 min. with occasional shaking to assume a green colour. After solution cools, black particles showing on the neck and mouth of the flask was washed down with distilled water, and reheated gently until the green colour disappeared and re-cooled. The digest was transferred with several washing into 250ml volumetric flask and made up to mark with distilled water.

5ml of the digest was pipetted into the apparatus followed by 10ml of 40% NaOH solution, before steam distilling for about 10 min into 50ml conical flask containing 10ml of 1% Boric acid indicator. Boric acid indicator changed colour from blue to green meaning ammonia liberated has been trapped. Receiving flask removed and solution in the receiving flask titrated against 0.01N hydrochloric acid.

Crude Protein(%)= Titre Value × 0.35× 6.25; ;Titre Value= Final Value – Initial Value

;6.25 is the Conversion Factor

Determination of Crude Fat
The soxhlet extraction method of AOAC was used for fat content determination [13]. A washed 250ml boiling flask was dried in an oven at (1050C) and cooled in desiccator. 2g sample was placed in a filter paper in the extraction thimble placed in the soxhlet apparatus. The flask was filled with 30mls petroleum ether of 40-600C boiling point range allowed to flush for about 4h for complete extraction. The thimble was then carefully removed and the petroleum ether in the top of container drained for reuse. Sample was removed and dried in the oven for 2h, cooled in desiccators and re-weighed.

$$\text{Crude fat (\%)} = \frac{\text{Initial weight} - \text{Final weight} \times 100}{\text{Sample weight}}$$

Determination of Total Ash
Ash content was determined by AOAC method using muffle furnace [13]. The crucible was dried in a muffle furnace regulated at 6000C for 30 min, removed with a thong and cooled in a desiccator. The crucible was weighed and recorded. Two grams of sample (a well-mixed grinded sample) was properly spread at the base of the crucible and weighed accurately. It was transferred into muffle furnace and heated at 6000C for 3hours until a grey ash residue results. Crucible with ashed sample was removed and placed in a desiccator to cool for 15 min and weighed.

$$\text{Ash content (\%)} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100$$

Determination of Carbohydrate
Carbohydrate content was calculated by difference according to Onwuka [14].

Determination of Colour Attributes of the Candy
Sample colour was measured with a colour measuring instrument (CM 700d Spectrophotometer (Konica Minolta), with values expressed on the L*, a*, b* tristimulus scale, where L*-value represents the lightness index; a*-value represents the degree of redness (-a*) or greenness (+a*); and b*-value represents the degree of yellowness (-b*) or blueness (+b*). Instrument was standardized (L*=90.29, a*=1.37, b*=0.06) with white reference standard (white duplicating paper, 80g/m2) [12].

Texture Determination of the Candy
Hardness, fracturability, springiness, chewiness and gumminess of candy samples were determined with TA-XP Plus texture analyser (Stable Micro Serial No.5014 England) as described by Ahmed & Hussein [15]. Analyser was set to perform single-cycle operation that determine first bite force of products, with measurement sped of 2mm/s and 5mm distance applied. Force-time plots analysed for hardness for breaking force (g) and fracturability (mm) to reach the peak, and textural attributes measured in 6 independent samples [16].

Sensory Evaluation of the Candy Samples
The 9-point hedonic scale assessment as described by Obi et al., 2010 was used. Organoleptic properties/attributes of the candy were analyzed by 50 untrained panelists using a scale of "9" representing liked extremely, while "1" represented disliked extremely. Attributes evaluated include appearance, texture, taste, aroma and overall acceptability, with mean and standard deviation of data obtained calculated and evaluated

for significance difference with analysis of variance (ANOVA) (p<0.05). Differences in means separated using turkey test as packaged by spss software (version 20.0).

Microbial Load of the Samples
28g nutrient agar was weighed into one litre of distilled water in a conical flask, covered with cotton wool, later with aluminum foil and autoclave for 15minutes. 9ml of distilled water was measured into test tubes and autoclaved with pipettes. Sample was serially diluted, using sterile distilled water as diluent (Prescott et al., 2005), inoculated, and total bacterial count determined by standard plate count [17]. Same for fungal counts, as total fungal count was determined by standard plate count [17].

Result and Discussion

Proximate Composition
Table 1 showed the proximate composition of candy-like product made from the African star apple. Moisture content decreased significantly (P>0.05), with storage time, which was similar to the report of Ahmad & Ahmad, on bottle gourd candy sample [18]. Fresh candy had moisture content of 15.058%, but reduced to 12.658% and 11.648% relatively over the 4-week storage, likely due to evaporation taking place around the sample [19]. The crude fat was 0.106% on production day; however, it reduced to 0.064% and 0.063% respectively on week two and four of storage, with no significant difference (P>0.05) observed. The crude fibre was not significant all through the period of analyses. Total ash and crude protein contents decreased with storage, and not significant after two weeks, but the values obtained by the fourth week were significantly different from the earlier ones. The percentage of carbohydrates was 75.45% on production day, increased to 78.19% after two weeks of storage, and significantly increased (P>0.05) to 81.62% at the end of week four of storage. The increase in carbohydrate may be attributed to the decreased moisture content of the product. However, candy with high carbohydrate has been reported to enhance the taste but increased susceptibility to moisture absorption [18,20].

Colour Parameters of the Candy Samples
The colour of the candy samples is as presented in Table 2. The values ranged from (16.24-24.26) for L*, (17.76-21.86) for a* values, and (9.96-11.53) for b* values. The result showed that the values for L* and a* significantly (P>0.05) decreased from 24.26 to 16.24, and 21.86 to 17.76 respectively after four weeks of storage. There was no significant different (P>0.05) in b* values at production and after four weeks, the value significantly decreased to 9.96 after the first two weeks of storage.

Table 1: Result of the Proximate Composition of Candy-like Product

Samples	Moisture (%)	Crude Fat (%)	Crude Fibre (%)	Crude Protein (%)	Ash (%)	Carbohydrate (%)
CND week 0	15.06±0.00^{a}	0.11±0.00^{a}	2.34±0.03^{a}	6.54±0.02^{a}	0.51±008^{a}	75.45±0.05^{c}
CND week 2	12.66±0.00^{b}	0.064±0.01^{b}	2.16±0.01^{a}	6.42±0.01^{a}	0.51±0.00^{a}	78.19±0.01^{b}
CND week 4	11.65±0.00^{c}	0.063±0.00^{b}	2.15±0.01^{a}	4.08±0.02^{b}	0.43±0.02^{b}	81.62±0.07^{a}

Key; Mean values with the same letter within the same column are not significantly (P> 0.05) different.
CND week 0; candy on the day production; CND week 2; candy 2 weeks after production
CND week 4; candy 4 weeks after production.

Table 2: Result of the Colour Parameters of the Candy-like Product

Samples	L*	a*	b*
CND week 0	24.26±0.94^{a}	21.86±0.28^{a}	11.01±0.48^{a}
CND week 2	19.66±0.33^{b}	20.38±0.24^{b}	9.96±1.15^{b}
CND week 4	16.24±0.59^{c}	17.76±0.75^{c}	11.53±1.163^{a}

Key; Mean values with the same letter within the same column are not significantly (P> 0.05) different.
CND week 0; candy on the day production; CND week 2; candy 2 weeks after production
CND week 4; candy 4 weeks after production.

Water Insoluble Impurities and Total Sugar Contents
Table 3 showed the results of water insoluble impurities and total sugar contents of the candy samples. Water insoluble impurities decreased from 2.00 to 1.84 after week four of storage, which could be as a result of moisture loss through evaporation or absorption into surrounding environment. There was also significant decrease (P>0.05) in total sugar from 27.14% to 20.03% at the end of week two of storage and to 18.63% at the end of week 4. The decrease in both water insoluble impurities and total sugar may be due to the activities of microorganisms, such as bacteria or fungi, which may have metabolized the sugars and other organic compounds present in the candy product, leading to a decreased water-insoluble impurities and total sugar content as reported by [21].

Microbial Loads of the Samples
The initial bacterial load in the candy product was 2 x104 cfu/g, which could have come from handling during and after production. After week 2, the bacterial load increased to 3.20 x104 cfu/g, and to 5.20 x104 cfu/g after four weeks. The gradual increase noticed may be due to product contamination during manufacture and/or handling of the product.

Fungal load was nil at week 0 of production, but the load increased to 0.80 after week 2, and to 1.70 after 4 weeks. The increased fungal growth may be due to decreased sugar content that diminished the inhibitory effect of micro-organisms [22].

Table 3: Total Sugar and Water Insoluble Impurities of Candy-Like Sample

Samples	Water Insoluble Impurities (%)	Total Sugar (%)
CND week 0	2.00±0.006a	27.14±0.03a
CND week 2	1.86±0.00b	20.03±0.02b
CND week 4	1.84±0.01b	18.63±0.02c

Key; Mean values with the same letter within the same column are not significantly (P> 0.05) different.
CND week 0; candy on the day production
CND week 2; candy 2 weeks after production
CND week 4; candy 4 weeks after production.

Table 4: Total Microbial Load (x10^4 cfu/g) of Candy-like Product

Sample	Total Bacterial Count (cfu/g)	Total Fungi Count (cfu/g)
CND week 0	2.00±0.28	0.00±0.00
CND week 2	3.20±0.28	0.80±0.28
CND week 4	5.20±0.57	1.70±0.14

Key; Mean values with the same letter within the same column are not significantly (P> 0.05) different.
CND week 0; candy on the day production
CND week 2; candy 2weeks after production
CND week 4; candy 4 weeks after production.

Texture Profile of the Candy-Like Samples

Texture profile (TPA) is also known as the two-bite test because of twice compression with a suitable probe. A preliminary test showed appropriate compression for the sample to be 40% from its original height, which was similar to that of Sow & Yang [23]. Hardness or firmness was the most significant sensorial parameter for TPA (Figure 3), which was used to evaluate the mouth feel defined as the force required to attain a given deformation [24]. The result showed the candy had strong firmness and adhesiveness, but strength was higher than the standard limit of candy according to the standard organization of Nigeria (SON), but similar to the work of Mutlu et al. on candies from honey and fresh fruit juices [25].

Sensory Evaluation

The result of the sensory evaluation is as shown in Table 5. The mean score of appearance, texture, taste, colour, aroma are 7.22, 6.74, 6.48, 6.92, 6.80, and 7.10 respectively, using a 9-point Hedonic scale with 1 representing the least score (dislike extremely) and 9 the highest score (like extremely). The overall rating of the candy was 78.89%, similar to that of Onyekwelu that reported mean scores of 5.60-7.80 on sensory evaluation of candies made from tiger nut and coconut blends [26].

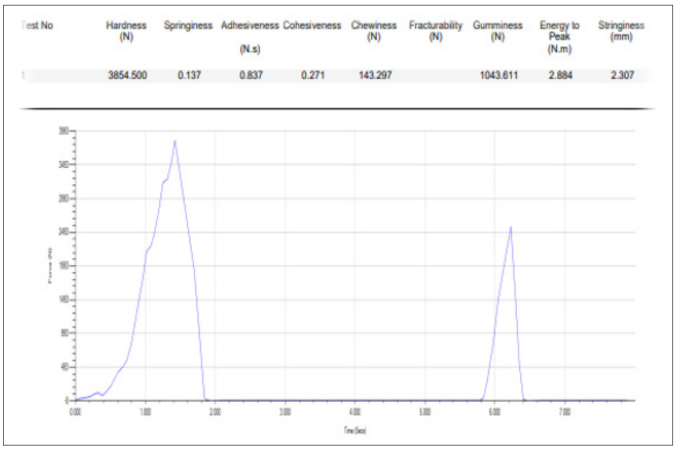

Figure 3: Texture Profile Analysis (TPA) of Candy like Product made from African Star Apple

Table 5: Sensory Evaluation of Candy-Like Sample

Sample	Appearance	Texture	Taste	Colour	Aroma	Overall Rating
Candy	7.22±0.996	6.74±0.96	6.48±1.37	6.92±1.08	6.80±1.01	7.10±1.01

Key; Mean values with the same letter within the same column are not significantly (P> 0.05) different.

Conclusion and Recommendation

It can be concluded that satisfactory and acceptable candy-like product can be produced from African Star Apple fruit. The product was advantageous because its high sugar level made it shelf stable. The candy had appreciable quantity of carbohydrate, crude protein, and crude fibre, and well as total sugar. Judging by the sensory scores, the candy was accepted. The reduction noticed in the chemical properties and moisture content could be due to inadequate packaging. It can then be said that further studies is ongoing on improving the packaging and size of the candy [27-28].

References

1. Woloson, Wendy (2012) The Oxford Encyclopedia of Food and Drink in America. Oxford University Press.
2. Schlumbach K, Pautov A, Flöter E (2017) Crystallization and analysis of beet and cane sugar blends. Journal of Food Engineering 196: 159-169.
3. Toussaint-Samat M (2009) A History of Food. New Jersey: Wiley-Blackwell https://www.wiley.com/en-us/+History+of+Food%2C+2nd%2C+New+and+Expanded+Edition-p-9781444305135.
4. Dauda AO (2014) Physicochemical Properties of Nigerian-Typed African star apple fruit. International Journal of Research in Agriculture and Food Sciences 2: 1-6.
5. Sunmonu MO (2017) Effect of Storage Environment and Packaging Media on the Disease Incidence and Weight Loss of Stored African Star Apple (Chrysophyllum albidum) Arid Zone. Journal of Engineering, Technology and Environment 13: 31-37.
6. Chandrasekaran M, Basheer S, Chellappan S, Krishna JG, Beena PS (2015) Enzymes in Food and Beverage Processing. CRC Press 206.
7. McWilliams M (2007) Nutrition and Dietetics' 2007 Edition. Rex Bookstore, Inc 177-184.
8. Ugwu JA, Umeh VC (2015) Assessment of African Star Apple (Chrysophyllum albidum) Fruit damage due to insect pests in Ibadan, southwest Nigeria. Research Journal of forestry 9: 87-92.
9. Ureigho UN, Ekeke BA (2010) Nutrient Values of Chrysophyllum albidum Linn African Star Apple as a Domestic Income Plantation Species. Indexed African Journal Online an International Multi-disciplinary Journal, Ethiopia 4: 50-56.
10. Gibson Lucky Arueya, Grace Febechi Ugwu (2017) Development and evaluation of African star apple (Chrysophyllum albidum) based food supplement and its potential incombating oxidative stress. Journal of Functional Foods 33: 376-385.
11. Dauda AO, Abiodun OA, Maiyaki TD, Kayode RMO (2017) Microbiological evaluation of watermelon juice treated with serendipity berry (Dioscoreophyllum cumminsii) extract. Croatian Journal of Food Science and Technology 9: 19-24.
12. Kemp SE, Gilbert AN (2017) Odor intensity and color lightness are correlated sensory dimensions. The American journal of psychology 110: 35-46.
13. Horwitz W, Latimer GW (2005) Official method of analysis

(18th Ed.) Washington DC. AOAC (Association of Official Analytical Chemists) https://search.worldcat.org/title/Official-methods-of-analysis-of-AOAC-International/oclc/62751475.
14. Onwuka GI (2005) Food analysis and instrumentation; Theory and practice, Lagos. Nigeria: Naphtali prints 133-137.
15. Ahmed ZS, Hussein AM (2014) Exploring the Suitability of incorporating tiger nut Flour as Novel Ingredient in Gluten-Free Biscuit. Polish Journal of Food and Nutrition Sciences 64: 27-33.
16. Abiodun AA, Ohizua ER (2018) Physical, Chemical, and Sensory Properties of Biscuits prepared from Flour Blends of Unripe Cooking Banana, Pigeon Pea, and Sweet Potato. Journal of Food Science and Nutrition 6: 532-540.
17. Fawole MO, Oso BA (2007) Laboratory manual of microbiology. Spectrum book Limited Ibadan, Nigeria 123.
18. Ahmad MD, Ahmad I (2021) Study and quality evaluation of candy prepared by using bottle gourd. In IOP Conference Series: Earth and Environmental Science 756: 012015.
19. Tandon DK, Yadav RC, Sood S, Kumar S, Dikshit A (2003) Effect of blanching and lye peeling on the quality of aonla candy. Indian Food Packer 57: 147-152.
20. Efe N, Dawson P (2022) A Review: Sugar-Based Confectionery and the Importance of Ingredients. European Journal of Agriculture and Food Sciences 4: 1-8.
21. Varjani S, Rakholiya P, Ng HY, You S, Teixeira JA (2020) Microbial degradation of dyes: An overview. Bioresource Technology 314: 123728.
22. Olaitan PB, Adeleke OE, Iyabo OO (2007) Honey: a reservoir for microorganisms and an inhibitory agent for microbes. African health sciences 7: 159-165.
23. Sow LC, Yang H (2015) Effects of salt and sugar addition on the physicochemical properties and nanostructure of fish gelatin. Food Hydrocolloids 45: 72-82.
24. Garrido JI Lozano JE, Genovese DB (2014) Effect of formulation variables on rheology, texture, colour, and acceptability of apple jelly: Modelling and optimization. LWT - Food Science and Technology 1-8.
25. Mutlu C, Tontul SA, Erbaş M (2018) Production of a minimally processed jelly candy for children using honey instead of sugar. LWT - Food Science and Technology 93.
26. Onyekwelu OM (2018) Chemical Composition and Sensory Evaluation of candies from Tiger Nut and Coconut Milk Blends. Annals of Food Science and Technology 19: 739-745.
27. (2009) Agribusiness Handbook: Sugar beet white sugar. Food and Agriculture Organization, United Nations https://www.fao.org/fileadmin/user_upload/tci/docs/AH1-(eng)Sugar%20beet%20white%20sugar.pdf.
28. Spence C (2019) On the relationship (s) between color and taste/flavor. Experimental psychology 66: 99-111.