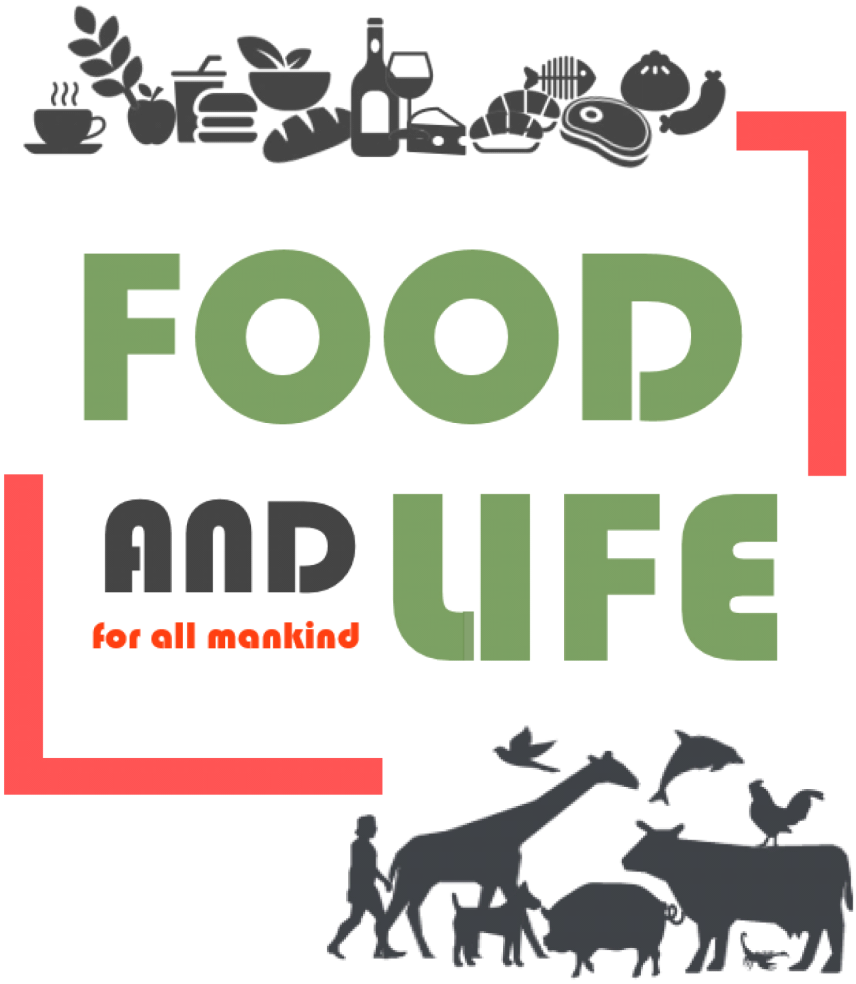

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Food and Life (2021) 2021(1):29-34
https://doi.org/10.5851/fl.2021.e3

Research Article Open Access

Quality characteristics of stored varieties of tiger nut oil

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Abstract

Quality characteristic of stored tiger nut oil was studied. Different tiger nut cultivars were sourced and their oil extracted using hexane. Oil were stored in plastic bottles for 12 weeks at room temperature revealed moisture content of 0.39%, 0.48%, and 0.30% for black, brown and yellow varieties respectively. Thiobarbituric acid value of stored tiger nut oil were 0.49 malondialdehyde/mg black tiger nut oil, 0.51 malondialdehyde/mg yellow, and 0.35 malondialdehyde/mg for brown cultivars respectively. The free fatty acids (FFA) of the tiger nut oil ranged between 0.75%-0.87%, 0.38%-0.41% and 0.20%-0.21% for varieties respectively. The black tigernut oil and the brown tiger nut oil free fatty acids increased during oil storage. Peroxide values decrease between 5.76 to 5.50 meq/kg, 5.85 to 5.68 meq/kg and 4.36 to 4.32 meq/ for varietal cultivars respectively. During storage periods tiger nut oil from varied sources confers oil stability. The properties measured revealed food grad and commercial use of varietal tiger nut oils because they are within limits as marked by standard.

Keywords: oil, plantain chips, shelf stability, sensory, quality

Introduction

Cyperus esculentum is a perennial grass-like plant with spheroid tubers, pale yellow they are edible, sweet, nutty, flavoured tubers which contain adequate nutrients (Nina et al., 2020). According to Nina et al. (2019), modifying tiger nut via various processing techniques for sensorial acceptability has been opined. According to Nina et al. (2020), three varieties of tiger nuts namely: black, brown and yellow. Only yellow and brown could be readily found. However yellow cultivar is preferred for its yields of milk and functional bioactive components properties (Ndubuisi, 2009; Adejuyitan et al 2009). According to Nina et al. (2020), oil obtained from tiger tuber has better quality. Tiger nut oil could remain in a uniform liquid form at refrigeration temperature, and therefore has been opined suitable for food applications due to its high oleic acid and low polyunsaturated fatty acid (linoleic acid and linolenic acid) contents (Ezebor et al., 2005; Nina et al., 2020). The presence of polyunsaturated fatty acids and gamma-tocopherol contents in tiger nut stabilizes its oxidative tendencies. It is a quality oil and recommended for cooking compared to other oils because it resistant to chemical agent decomposition even at high temperatures (Nina et al., 2020; Shaker et al., 2009). However could be altered by visceral enzymes either *in-vitro* or *in-vivo*.

The importance of vegetable oils is increasing even as source of health enhancing compounds in which tiger nut oil has become one Nina et al. (2020). However oil stay are generally affected by chemical, physical and intrinsic agent against their shelf stay. This work seeks to investigate the quality of tiger nut oil when stored for future applications.

Materials and Methods

Raw materials

Brown, black and yellow tiger nuts were bought from open North bank market Makurdi, Benue State, Nigeria and identifications made at Department of Agronomy, Federal University of Agriculture, Makurdi (Fig. 1).

Tiger nut oil processing

Normal n-hexane, a non- polar solvent according to AOAC

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(A) Black tiger nuts

(B) Brown tiger nuts

(C) Yellow tiger nut

Fig. 1. varieties of tiger nut

Internatoinal (2012) method was used to extract tiger nut oil from the resulting flour. Flour samples (105.0 g sample A, 105.0 g for sample B and 105.0 g for sample C) were used for tiger nut oil extraction using soxhlet extractor (Fig. 2; Adejuyitan, 2011). The lipid was extracted for 5 h. with a 500 mL volumetric flask containing the solvent, which was heated with an electric heater at 70℃. Solvent extracts were evaporated off using rotary evaporator and later oil was oven dried at 105℃ for 1 h and stored in bottles to be analysis (Fig. 3).

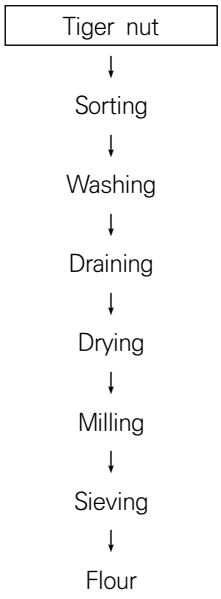

Fig. 2. Tiger nut flour production. Adapted from Adejuyitan (2011) with permission of open access Academic Journal

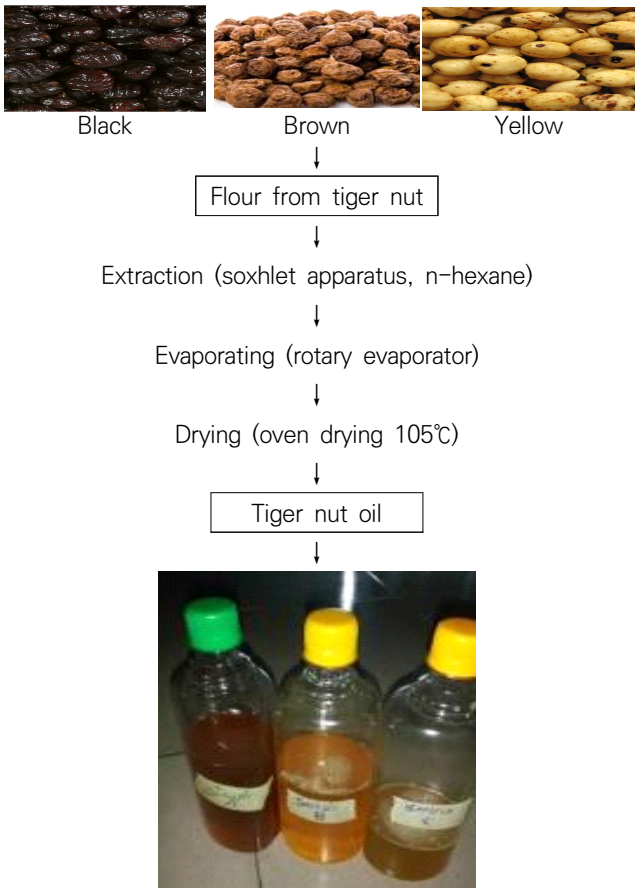

Fig. 3. Extraction of oil from tiger nut

Determination of moisture value

Moisture content was determined by the AOAC Official method, AOAC Internatilnal (2010). Dried and weighed moisture dishes were added 5 g of tiger nut oil repecively. This was heated in an oven Memmert at 105℃ for 1 h, then cooled in a desiccator containing phosphorus peroxide and then weighed. This was repeated until a constant weight was obtained.

$$\%\text{Moisture} = \frac{\text{Loss in mass on drying}}{\text{Weight of test sample}} \times 100 = \frac{Ws - Wh}{Ws - Wt}$$

Ws=weight of moisture dish+sample
Wh=weight of moisture dish+sample after heating
Wt=weight of tare/moisture dish

Thiobarbituric acid value

The method described by Benchamaporn et al. (2009) was used. Fifty milligram oil sample was accurately weighed into a twenty-five milliliter volumetric flask and dissolved in a

small volume of 1-butanol and made up to volume with 1-butanol. 0.5 mL of the oil sample was transferred to a dry test tube and 5 mL of thiobarbituric acid (TBA) reagent solution (0.2883G/100 ml of 90% glacial acetic acid) added. The test tube was closed with a ground-glass stopper, mixed thoroughly and placed in a thermostatic bath at 95℃. After 120 min, the tube was removed from the thermostatic bath and cooled under running tap water for 10 min until it reaches room temperature. The absorbance of the reaction solution was measured at 530 nm using distilled water in the reference cuvette. A blank was also prepared and read. The result was calculated using the equation below:

$$\text{TBAR value} = \frac{[50\times(A-B)]}{M}$$

A=absorbance of the test solution
B=absorbance of the reagent blank
m=the weight (g) of the test sample

Peroxide value

The AOAC (2012) method was adopted. Oil sample (2.0 g) was accurately weighed into a conical flask, and dissolved in a solvent mixture containing 12 mL chloroform and 18 ml glacial acetic acid. To the solution 0.5 ml of a saturated aqueous potassium iodide solution were added. The flask was stoppered and allowed to stand for 1 min. Thirty milliliters of water were added and the solution was titrated with 0.1 M sodium thiosulphate solution until the yellow colour gone. Starch solution (0.5 mL) was introduced and titration continued with the reagent added slowly until the blue-black colour disappeared. During titration, the flask was continuously and vigorously shaken to transfer the liberated iodine from the chloroform layer to the aqueous layer. A blank titration was also performed, and the peroxide value was obtained from the formula (Sadoudi and Ali, 2017):

$$\text{PV (meq}O_2\text{/Kg oil)} = \frac{(V - V_o)\times Nv}{m} \times 10^3$$

PV=peroxide value
V=volume of $Na_2S_2O_2$ solution used for the sample test
V_0=volume of $Na_2S_2O_2$ solution used for the blank test
N=normality of $Na_2S_2O_2$ solution
m=weight of the oil sample taken

Free fatty acid (FFA) content

Into dry beaker was measured 2 g of pre-heated oil to 50℃ and re-measured. Aliquots of ethanol were added to the oil to completely free the fatty acids. The ethanol-oil mixture was then titrated with 0.1N NaOH using phenolphthalein indicator. The volume (V) of NaOH required to produce the first permanent pink colour was recorded to evaluate free fatty acid (FFA) content of the oil from the formula (AOAC International, 2012).

$$\text{Free fatty acid (FFA)\%} = \frac{M\times V\times N}{10\times m}$$

M=relative molecular mass of palmitic acid=256
V=volume of NaOH used
N=Normality (concentration) of NaOH
m=weight of oil used
10=constant

Storage studies

The tiger nut oil was packaged and stored in bottles at room temperature (28℃) for a period of three months (12 weeks) away from visible ray of light. The samples were taken analysed at two weeks interval to evaluate FFA, thiobarbutirc acid and moisture content.

Statistical analysis

Experiment was conducted in duplicate and subjected to analysis of variance (ANOVA) using statistical package of Social Sciences (SPSS) version 20.0. The means separation was done using Duncan multiple range test and significant difference was established at $p<0.05$.

Results and Discussion

Effect of storage on the moisture content of tiger nut oil

Storage time increased but the moisture content increased and decreased slightly as the storage time increased significantly at ($p<0.05$; Fig. 4). It was also in agreement with the acceptable limit for moisture content of oils. The moisture content of food however gives an indication of its shelf-stay and nutritive value, hence low moisture content is a requirement for long storage life (Okene and Evbuomwan, 2014).

Effect of storage on free fatty acid of tiger nut

Effect of storage on FFA of tiger nut oil is shown in Fig.

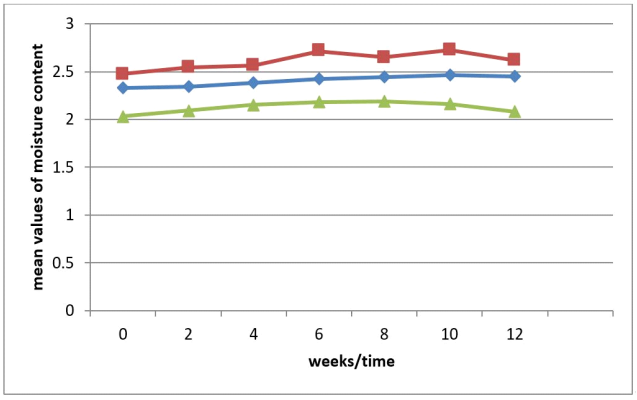

Fig. 4. Moisture content of stored oil from tiger nut. ◇, black variety; □, brown variety; △, yellow variety. Values are Means±SD of triplicate determinations. Means values down the column followed with different superscripts are significantly different (p<0.05).

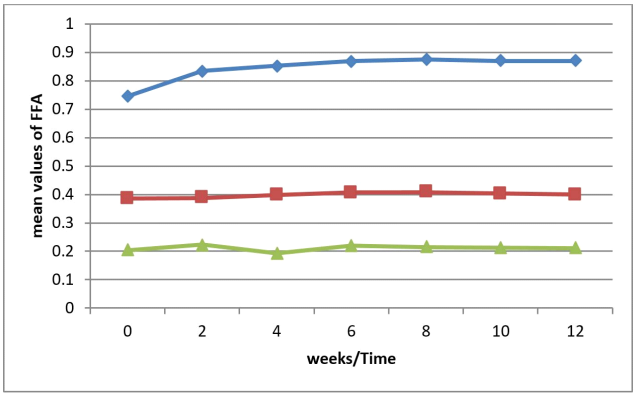

Fig. 5. Concentration of free fatty acid of stored tiger nut oil. ◇, stored black tiger nut oil; □, stored brown tiger nut oil; △, stored yellow tiger nut oil. Values are Means±SD of triplicate determinations. Means values down the column followed with different superscripts are significantly different (p<0.05). FFA, free fatty acid.

5. FFA values of the stored oil for sample of oil from black tiger nut from 0 to 12 weeks were ranged between 0.75-0.87, sample Brown (0.39-0.41) while sample yellow ranged from 0.19-0.22. The FFA values for sample black and brown increased during storage while in sample Yellow; there was an unsteady decrease in FFA during storage.

Effect of storage on the thiobarbituric acid of tiger nut oil

This procedure measures the malondialdehydes (MDA) formed as the split product of an endo peroxide of unsaturated fatty acids resulting from oxidation of a lipid substrate (Antolovich et al., 2002). Brown tiger nut oil seem stable from the graph. the black was stable for TBA but start decreasing with time. The yellow sample was unstable. These variation may be due to varieties of samples sources and ability to absorb transmit or deflect light.

Measures in secondary lipid oxidation products changes of the oils during storage for a period of 3 months are shown in Fig. 6. Significant (p<0.05) difference existed between black and brown and as storage time increased only for yellow, there was changes in the TBA values as the storage time increased. It seems that the increase and decrease of TBA value were as a function of time of heating depends on the number of malondialdehydes produced. This result values collaborated with Gulla and Waghray (2011) work that reported storage studies on sesame and rice bran oil. TBA measures secondary lipid oxidation products, which are also responsible for the rancid taste during storage (Decker et al., 2000).

Storage effect on the peroxide value of tiger nut oil

Storage time increased but the peroxide value decreased as the storage time increased. Fig. 7. The graph indicate a stable peroxidicity of the oil samples, implying that the oil could be readily stable under favourable state. The Peroxide value of an oil or fat is used as a measurement of the extent to which oxidation reactions have occurred during processing and storage. Autoxidation in this oil are relatively stable, involving less oxygen that could leads to deterioration of fats and oils which could have form off-flavors and off-odors. The values obtained

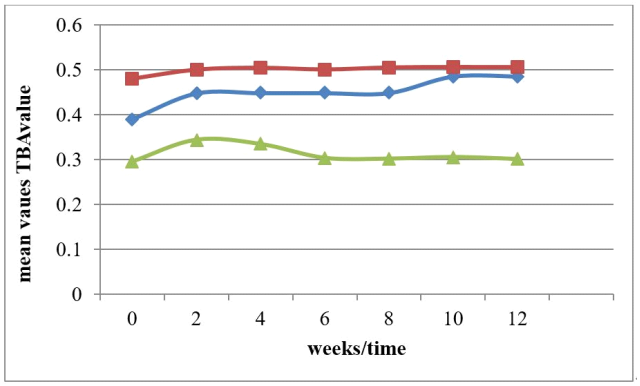

Fig. 6. Concentration of TBA of stored oil from different varieties of tiger nut. key: ◇, stored black tiger nut oil; □, stored brown tiger nut oil; △, stored yellow tiger nut oil. Values are Means±SD of triplicate determinations. Means values down the column followed with different superscripts are significantly different (p<0.05). TBA, thiobarbituric acid.

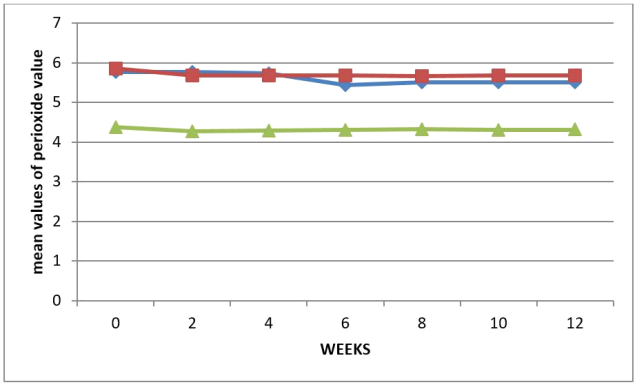

Fig. 7. Concentration of peroxide value of stored tiger nut oil. ◇, stored black tiger nut oil; □, stored brown tiger nut oil; △, stored yellow tiger nut oil. Values are Means±SD of triplicate determinations. Means values down the column followed with different superscripts are significantly different (p<0.05).

during storage did not exceed the limit of 10 meq/kg (SON, 2000). According to Alhibshi et al. (2016) these varietal sample oil are safe. Peroxide values of this oils are less than 10 milliequivalents /kg Rancidity set in at peroxide value between 30 and 40 milliequivalents/kg,. However, high peroxide values are a definite indication of rancid fat, but moderate values may be the result of depletion of peroxides after reaching high concentrations (Kamsiah and Yusof, 2012).

Conclusion

Quality parameters of stored tigr nut oil showed that there was change during storage but the changes in FFAs, perioxide values, thiobabeturic acid values for all varietal samples are with recommended limits by standared hence food and home application plausible. The properties of the stored tiger nut oil for the 12 weeks showed that the oil is could be useful and can play important roles in providing food security. Because the sources are relatively cheap and abundant, these could enhance livelihoods, improve nutritional status and social wellbeing for vulnerable groups.

Conflicts of Interest

The authors declare no potential conflict of interest.

Acknowledgments

The authors acknowledged the Department of Food science and Technology in Nigeria for support in the course of this research.

Ethics Approval

This article does not require IRB/IACUC approval because there are no human and animal participants

Author Contributions

Conceptualization: ogori AF, Ukeyima M.
Data curation: Ogori AF, Nina C.
Formal analysis: Nina C, Ukeyima M.
Methodology: Ogori AF, Nina C.
Software: Nina C.
Validation: Ukeyima M.
Investigation: Nina C.
Writing-original draft: ogori AF, Nina C.
Writing-review and editing: Ogori AF, Nina C, Ukeyima M.

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Date Received Mar. 2, 2021
Date Revised Mar. 25, 2021
Date Accepted Mar. 25, 2021