EFFECT OF SEED STRORAGE ON THE PHYSICO – CHEMICAL PROPERTIES OF ITS OIL (*Adansonia digitata)*

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ABTSTRACT

The effects of seed storage on the physico-chemical parameters of Adansonia digitata seed oil on four different samples (2011–2014) were analyzed. The samples showed that the peroxide value (PV) for the four samples from 2011–2014 were 10.0mEq/kg, 8.8mEq/kg, 6.8mEq/kg and 5.6mEq/kg respectively. The saponification values (SV) recorded 126.23mg/KOH/g, 129.03mg/KOH/g, 130.43mg/KOH/g, and 133.24mg/KOH/g for 2011 – 2014 respectively. The % oil yields were found to be 26.47%, 28.00%, 30.00% and 32.02% from 2011 to 2014 respectively. The iodine value (IV) recorded 80.65g/100g, 86.35g/100g, 92.70g/100g and 95.25g/100g respectively. It can be seen that the PV increased with the storage time, while the IV, SV, % oil yield, and the viscosity of the oil decreased markedly with the storage period. The color of the entire samples was yellow and showed resistance to color change. Similarly, pH value and Acid Value (AV) showed an insignificant increase with the storage length. The specific gravity of the entire samples remained the same indicating that storage time has no effect on it.

Keywords: *Free fatty acid, saponification value, baobab seeds, specific gravity and iodine value.*

Introduction

In nature, the baobab plant exist in eight species with six found in mainland Africa and one each in Madagascar and Australia (National Research Council, 2008). In Nigeria, the plant is widely distributed in settlements or old settlements in most Northern states, for instance,

Bauchi, Gombe, Kano, Taraba and Borno. It is known in Tangale, Hausa, Tsawana and Tsonga as “Kwanne”, “Kuka”, “Mowana” and “Shimuwa” respectively.

It is the most widespread of the Adansonia species on the African continent, found in the hot, dry savannahs of sub-Saharan Africa. It also grows, having spread secondary to cultivation in populated areas. The English names of baobab include dead rat tree (from the appearance of the fruits), monkey-bread tree (the soft dried fruit is edible), upside-down tree (the sparse branches resemble roots) and cream of tartar tree (cream of tartar). The oldest tree is reputed to have lived for over 6000 years (Addy, 1984).

In 2008, the European Union approved the use and consumption of baobab fruit as an ingredient in smoothies and cereals bars. The fermented seeds are used as flavoring soups (Addy, 1984).

NKafamiya, *et al.,* (2007), studied chemical composition and physico- chemical properties of baobab seeds. The results of their research showed that the storage property of the oil from baobab seeds over a period of four week under conditions of light (ambient), darkness (ambient), and refrigeration revealed that the iodine value of the oil decreased in all cases but much more so on exposure to light. In contrast, the peroxide value of the oil showed very little change under conditions of darkness and refrigeration over the same period, thus indicating that the oil can withstand storage. The high Saponification value of the oil (196±0.05 mgKOH) is within the range of some edible oils such as palm oil (186-205), groundnut oil (186-196) and corn oil (187-96). The iodine value is 87.9±0.02/100g and is comparable with those of groundnut oil (84-99), olive (79-90), and castor oil (81-91) and may be classified as non-drying oil. The PV of the oil is relatively low (4.5MEq/kg) and was determined immediately after the extraction.

A research was carried out on the production and evaluation of storage stability of Honge Biodiesel by Natesan and Chandra (2011), the results of their research showed that the acid value of the biodiesel increased. This is because of the formation and decomposition of peroxides which results in the formation of aldehydes and higher acidity. From the storage stability of the honge biodiesel study, it was observed that the acid value, iodine value and saponification value of the honge oil biodiesel varies with the storage period.

Abdelmonem and Khogali (2012), carried out a research on sunflower oil oxidative stability. The results of their investigation revealed that, oil samples extracted from the new fresh harvested PAN/7411-variety seeds exhibited more resistance to color degradation compared to those of stored seeds seem to be the worst in terms of deterioration. This means that it is better to extract oil immediately after harvesting and store it as crude oil than to store the seeds itself (storing oils inside the seeds) and extracted thereafter. Nolen *et al*., (1967), reported that color intensity of edible oil is due to the natural pigments and their derivatives. On prolong storage, pigments and their derivatives undergo more oxidation that eventually leads to colorless products which affect oil color. In a similar study, the influence of storage duration of *Jatropha curcas* seed on oil yield and free fatty acid content was carried out by Akowuah and Kemausuor, (2012). The result of their research showed that there was a marginal increase in moisture content of the seeds from 6.39 to 6.48% during storage period. This could be due to the relatively steady state of the relative humidity and a decrease in temperature of the ambient environment during the storage period. The oil content of the seeds varied from maximum of 35.57% after one month of storage to minimum (after 4

months of storage) of 31.10%, respectively. The lowest percentage was recorded from the seed samples that were stored longer. Although some work had been done on the characterization of the seed oil from the fruit of the plant elsewhere, it does not provide a comparative study on the physico-chemical properties of the extracted oil based on the storage period. Hence, this work will fill in the gap by analyzing the effect of seed storage on the physico-chemical parameters of the oil extracted from different samples. Four different samples with the storage period of one year interval from 2011 to 2014 were collected and analyzed.

Sampling

Four different samples were collected from Gombe Main market and stored at an interval of one year from 2011 to 2014 at room temperature in a polyethene bag. The samples were named A, B, C and D respectively. The samples were stored in same storage facility and under same temperature condition.

Sample Preparation

The seeds were separated from the pulp by breaking the ripe fruit with a hard object, precisely, a stone aimed at exposing and securing the powder. The seeds were then plugged out of the shell and then was separated using mortar and pestle after which the seeds were washed with water to remove the pulp. The seeds were crush with crusher mill into powdery form. It was then sieved using a mesh for finer size.

Method of Extraction

The oil was extracted with the aid of soxhlet extractor. 300ml of normal hexane was poured into a round-bottomed flask. A 100g batch of the sample was weighed, wrapped in filter paper and then inserted into the center of the extractor. The soxhlet was heated at 60^0C for 6 hours. When the solvent was boiling, the vapor rose through the vertical tube into the condenser at the top. Liquid condensed and dripped into the filter paper thimble in the center which contains the solid sample to be extracted. The extract seeped through the pores of the thimble and fills the siphon tube where it flows down back into the round-bottomed flask. This was allowed to continue for over 5 hours. The sample was removed from the tube, dried in an oven and cooled in the desiccators and then weighed again to determine the amount of oil extracted. The resulting extract containing the oil was heated to recover the solvent from the oil at the end of the extraction.

Determination of the Percentage of the Oil Content

A 100g sample was defatted exhaustively with normal hexane at 60^0C in a soxhlet apparatus. The extract was kept for about a day to remove any spill of the solvent and the extract recovered (weight of oil) was expressed as percentage of the weight sample of dry mass.

Determination of Acid Value

Shamsu (2008), described the method of achieving this, and this method was adopted where by 25ml of diethyl ether and 25ml of ethanol was mixed in a 250 ml beaker.

The resulting mixture was added to 10g of the oil in a 250ml conical flask and few drops of phenolphthalein were added to the end point with consistent shaking until a dark pink color was observed and the volume of the titration (0.1m NaOH) V_o was noted. The free fatty acid (FFA) was calculated as follows;

$\frac{V_o}{W_o} \times 2.82 \times$ 100ml of 1.0M NaOH= 2.83g of oleic acid W_o = sample weight.

Acid value = FFA ×2 (Lab, 1997).

Determination of Iodine Value

Wiji's method was adopted in determining the iodine value. A 0.3g of the oil was weighed in a 250ml conical flask. $10cm^3$ of CCl_4 was added to this and similar flask for a blank containing $10cm^3$ of CCl_4. To both flask, equal quantities of Wiji's reagent was added (about 25ml). The mixture was mixed well and was left in the dark for an hour. The contents of both flasks were titrated with standard 0.1ml sodium thiosulphate solution after $15cm^3$ of 10% potassium iodine solution and $100cm^3$ of distilled water was added. Starch solution was used towards the end point with continuous shaking during the titration to ensure that the iodine in the carbon tetrachloride layer was transferred to the aqueous layer. The weight of iodine absorbed by 100g of fat was estimated as follows:

100 × differences in titration × Thiosulphate factor divided by weight of oil used.

$1cm^3$of 0.1 sodium thiosulphate = 0.0127g iodine.

Determination of P^H Value

The method described by Arinola and Eunice (2013), was adopted. A 2g of the sample was poured into a clean dry 250ml beaker and 13ml of hot distilled water was added to the sample in the beaker and stirred slowly. It was then cooled in a water bath to 25^0C. The P^H electrode was standardized with buffer solution of known P^H. The electrode was then inserted into the sample and the P^H was read and recorded.

Determination of Peroxide Value

The method described by Nkafamiya *et al*., (2007), was adopted. A 5g of the oil was placed in 30ml glacial acetic acid/chloroform (3:2 $\frac{V}{V}\%$) and saturated solution of potassium iodide (0.5ml) was added to liberate iodine by reacting it with the peroxide. The resulting solution was titrated against sodium thiosulphate (0.0lm) solution using starch as indicator until the yellow color disappeared. The peroxide value was calculated as follows:

PV (MEq/kg) = (S - B)× M × $\frac{1000}{Sample\ weight\ (g)}$

Where:

B = blank titre value

PV = Peroxide value

S = Sample titre value

M = Molarity of sodium thiosulphate Solution (0.0lm).

Determination of Specific Gravity

A density bottle was used in determining a density of the oil. A clean and dry density bottle of 25ml capacity was weighed and labeled as W_1. The dried density bottle was filled with water to the mark and the new weight recorded as W_2. The water was substituted with oil of the same volume after drying and new weight recorded as W_2.

The water was substituted with oil of the same volume after drying and new weight recorded as W_3. The expression of specific gravity is as:

$$\rho = \frac{W_3 - W_1}{W_2 - W_1}$$

Determination of Saponification Value

In determining the saponification value, the Dimand and Denmark (1973), method was adopted. A 2g of the oil was weighed in a 25ml conical flask to which 5ml of 0.5ml alcohol and 20ml of 0.5M alcoholic KOH solution were added. Also 5ml of 0.5 alcoholic KOH solution were added for the blank and both were refluxed for an hour, after cooling, the contents of the flasks were titrated against 0.5 M HCl using phenolphthalein as indicator. The difference in titre between that of the blank and the sample solution is equivalent to the amount of the fatty acid present.

0.4MKOH = 28.05g/dm^3

The (SV) value was calculated from the expression:

SV = 56.1 IN ($V_o - \frac{V_1}{M}$)

Where;

V_o= Volume of acid solution sued for the blank

V_1= volume of acid solution used for the sample

M = Mass of the sample and

N = Normality of the HCl

Results and Discussions

Table: 1

Parameters	Sample A (2011)	Sample B (2012)	Sample C (2013)	Sample D (2014)
Color	Yellow	Yellow	Yellow	Yellow
% oil content	26.47	28.00	30.00	32.02
Volume of oil (ml)	31.00	32.00	33.00	34.00
PH	6.2	6.1	6.1	6.0
Specific gravity	0.910	0.910	0.910	0.910
Viscosity	38.19	39.33	40.01	41.04
Acid value (mgKOH/g)	0.508	0.451	0.434	0.338
Peroxide value (meq.Kg)	10.0	8.8	6.8	5.6
Saponification value (mg.KOH/g)	126.23	129.03	130.43	133.24
Iodine value (g/100g)	80.65	86.35	92.70	95.25

From table 1 above, the color of the oil obtained was yellow for all the samples which comply with the reported literature. This therefore means that the color of the samples is not affected by storage time. The % oil content of the four samples decreases slightly with the storage period. Suriyong (2007), also reported that ageing process naturally affects the quality of seeds during storage at various conditions, particularly the oil content which is sensitive to deterioration as a result of the oxidation process, a reaction between unsaturated fatty acids and oxygen. The volume (quantity) of oil extracted per 100g of the samples followed the same trend with that of the oil content.

The P^H value like acid value, increases slightly with storage period and the entire samples were slightly acidic. The marginal increased in the acid value is due to the formation and decomposition of peroxides which results in the formation of aldehydes and higher acidity (Natesan and Chandra, 2011). Similarly, a study Abdelmonem and Khogali (2012), reported that high acidity in oil samples extracted from stored seed may be attributed to the glycerol formation generated by fatty acid hydrolysis caused by enzymatic reaction.

The PV increased drastically with the storage period, i.e, the longer the storage time, the higher the PV. The higher PV (seen in 2011 sample) showed high oxidation compared to that of 2014 sample which is 5.6mEq/kg. The low value of peroxide is an indication of low level of acidity of the oil and also suggests the high level of the antioxidant (Kyari, 2008). The specific gravity of the entire samples was found to be unaltered having a constant value of 0.910 all through. It can then be concluded that storage period show no effect on the specific gravity.

In comformity with the result of the investigation carried out by Natesan and Chandra (2011), the iodine values of the samples under investigation decreases with the storage period having IV of 80.65g/100g, 86.35g/100g, 92.70g/100g and 95.25g/100g for the year 2011- 2014 respectively. The marked decreased in IV with storage time is attributed to the oxidation of double bonds.

CONCLUSION

In conclusion, the seed oil of *Adansonia digitata* analyzed in this research work marked a drastic increase in peroxide value with the storage period, that is, the longer the storage period, the greater the peroxide value. The iodine value portrayed contrary trend shown by peroxide, in other words, the iodine number decreases with the year of storage. The oil samples analyzed in this work showed resistance to color change. The volume of oil per 100g of sample is related to the % oil content as they decreased with the time of storage. The P^H and the acid value are closely related and showed an insignificant increase with the storage length. The viscosity of the oil samples decreases with Storage time. Similarly, storage period affected the saponification value of the oil samples resulting into marked decrease with the storage period.

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