PHYSIOCHEMICAL PROPERTIES OF DIFFERENT OIL MEDIA DURING DEEP FAT FRYING OF AKRA CHIPS.

Abstract

The specific objective is to determine the physiochemical characteristics of frying and fresh palm oil, groundnut oil and olive oil under deep fat frying condition at a temperature of 120°θ Celsius in the production of akara chips derived from cowpea paste.The results showed that there was a significant ($p < 0.05$) variation among the three fresh (palm oil, groundnut oil and olive oils) and frying (palm oil, groundnut oil and olive oils) oil media, respectively, on the solidification point, iodine concentration, moisture content, melting point, fat levels and viscometric values. Frying reduced the moisture content and iodine value of palm, groundnut and olive oilsin comparison with than the non-frying, Fresh palm oil, groundnut oil and olive oils were high in visocometric and saponification values, respectively.

Key words: Deep fat frying,akarachips, palm oil, groundnut, oil, olive oil

1. INTRODUCTION

Fried akara chips is a popular food vended delicacy in the streets of Sub-Sahara Africa. It is a fast conveniently made food products that meet time requirement for a developing country, where people eat outdoors. Thus, it is a consumed as a snack in these societies. A variant of fried akarachips mostly consumed in Nigeria are fried in groundnut oil. Therefore, efforts to replace groundnut oil with palm oil and olive oil in the frying process for commercial purposes in such products may be of practical interest. Frying also initiates different physical and chemical changes which results in extensive degradation of oil sample. During this process, the fried food absorbs some amount of oil and as a result, certain proportions of degraded products from the oil are accumulated by the fried food. Codex Alimentarius Commission/FAO/WHO Food Standards (2000) and Emelike *et al*., (2020) reported that frequent frying of vegetable oils leads to deterioration and lipid oxidation results in the formation of peroxides which are responsible for primary oxidation in the oil. However, effect of repeated use of oil media on this food product is examined. Degradation of vegetable oils during frying result in loss of nutritive value and causes damaging health effects due to the toxic substances produced. Good (2012) also reported that repeated usage of vegetable oil for frying lowers the smoke point which makes the oil to smoke on heating at a lower temperature. There are physical qualities that can be used to identify oil samples on or after frying. Some of these characteristics are melting point, solidification point, viscometric studies and moisture content. These parameters affect the physical change of oil sample during deep fat frying while the chemical qualities that can be used to identify oil samples used during deep fat frying. Some of these characteristics are iodine value, saponification value, peroxide value, acidity. The main objective of this study is to determine the physiochemical characteristics of different oil media use in frying akara chips. The specific objective is to determine the physiochemical characteristics of frying and fresh palm oil, groundnut oil and olive oil under deep fat frying condition in the production of akara chips derived from cowpea paste.

2. MATERIALS AND METHODS

Formatted: Highlight
Formatted: Strikethrough
Formatted: Highlight
Formatted: Strikethrough
Formatted: Strikethrough
Formatted: Strikethrough
Formatted: Strikethrough
Formatted: Strikethrough
Formatted: Strikethrough
Formatted: Strikethrough
Formatted: Strikethrough
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight
Formatted: Strikethrough
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight

2.1Materials

Cowpea was purchased at the Enugu State Agricultural Development Programme office in the city of Enugu (Figure 1a). Palm oil, groundnut oil and olive oil samples were purchased from local market in Enugu (Figure 1b). The cowpea samples were selected and sorted taking into account the size and that they did not present damages by manipulation.

2.2. Akarachipspreparation

Cowpea samples were sorted and soaked in water for three minutes before mashing to remove chaff. It was then grounded into paste, weighed and the paste made in form of balls ready for frying. The fryer tank was parallelepiped-shaped and made of stainless steel. Its dimensions were: length 300 x 10^{-3}m; width 150 x 10^{-3}m; height 200 x 10^{-3}m. The bath had a volume of five liters. The temperature of the frying bath was determined by simultaneously measuring the temperatures with attached thermometer.

2.3. Deep fat frying

Frying was carried out using processed palm oil, olive oil and groundnut oil.Each of the oil samplesweighed 1189g and poured in the fryer and heated to 120^0Celsius. A total of 121g of each of the pre-treated cowpea samples was weighed. The oil was allowed to heat up to first temperature of 120^0C at three to seven minutesbefore the samples were introduced. The full fried samples of chips were recovered after ten minutes of frying. Akara balls were placed on absorbent paper to remove the oil remaining on the surface

2.4. Determination of physicochemical properties.

2.4.1 Moisture content: The percent loss in weight of oil sample heated in a drying oven at 105°C for 2 h and weighed at an interval of 30 min till a constant weight was obtained. Initial weight of oil sample = a gm, final weight of oil sample after drying = b gm, the dry weight percent = (a/b)*100. Moisture content (x %) = (1-(a/b))*100.

2.4.2. Solidification point: The oil in a capillary tube was allowed to flat in watch glass on a water trough. Blocks of ice were added continuously until the oil solidified and the temperature recorded.

2.4.3. Viscometric studies: The time taken for the oil to fall between the two graduation marks on Oswards viscometer at room temperature was recorded (Ikhuoria and Maliki, 2007).

2.4.4.. Acid value determination (Ejim and Kamen,2013**):** Two grams of the oil sample was dissolved in 25ml diethyl either with 25ml ethanol was titrated with 0.1M NaOH solution and 1ml of phenolphthalein indicator until a faint pink colour persisted for 15 seconds.

$$\text{Acid value} = \frac{titration\ (ml)\times 5.61}{weight\ of\ oil\ sample\ used} \qquad \text{Equation (1)}$$

2.4.5. Determination of saponification value: Two grams of the oil was refluxed with 25 mL of alcoholic potassium hydroxide solution (0.5 M) for 1 h with frequent shaking. The excess alkali was titrated with 0.5 M hydrochloric acid and 1mL of phenolphthalein indicator. A blank titration was carried out alongside and the

$$\text{Saponification value thus:} \frac{(blank - titration\ \ value)\times 28.05}{weight\ of\ oil\ sample\ (g)} \text{Equation (2)}$$

2.4.6. Determination of iodine value: Twenty-fivemilliliters of iodine monochloride was added to 1 01 g of the oil, stoppered and left to stand in the dark alongside a blank without

the oil sample and 10 mL of chloroform added instead for 1 h. The flask was rinsed with 50 mL of distilled water and 10 ml of 10% KI solution was added. The liberated Iodine was immediately titrated with 0.1 M $Na_2S_2O_3$ until the iodine solution was brownish yellow then 1 mL of starch solution indicator was added. The titration was continued until the developed blue color disappeared.

The volume of the $Na_2S_2O_3$ was used to calculate the Iodine value =

$$\frac{(blank - titration) \times molarities of\ Na_2S_2O_3 \times 12.69}{weight\ of\ oil\ sample\ (g)} \quad \text{Equation (3)}$$

2.3. Data analyses

Data collected was subjected to analysis of variance (ANOVA) test forcompletely randomized block design as outlined by (Gomez and Gomez, 1984). Significant means was separated using Fisher's least significant difference (F-LSD) at 5% probability level and t-test was to compare the differences between means. Statistical analysis was executed using GENSTAT (2007) Statistical Software

3. RESULTS AND DISCUSSION

The results presented in Table 1a revealed the physiochemical composition of fresh and frying oil during deep fat frying of akara chips. The results showed that there was a significant ($p < 0.05$) variation among the three fresh (palm oil, groundnut oil and olive oil) and frying (palm oil, groundnut oil and olive oil) oil media respectively on the solidification point. Fresh palm oil (19) had significantly ($p < 0.05$) thehighest solidification point followed by fresh groundnut oil (6) and the lest was recorded in fresh olive oil (3). The solidificationpoint of the frying olive oil (22) was significantly ($p < 0.05$) the highest than the frying palm oil (20) and frying groundnut oil (10) respectively. Frying palm oil (20), groundnut oil (10), and olive oil (22) solidified more than the fresh palm oil (19), groundnut oil (6), and olive oil (3) respectively.

Furthermore, frying palm oil (39^0Celsius), groundnut oil (38^0Celsius) and olive oil (38^0 Celsius) significantly ($p < 0.05$) melted faster than the fresh palm oil (38^0 Celsius), groundnut oil (28^0 Celsius) and olive oil (38^0 Celsius) under deep fat frying condition at a temperature of120^0CelsiusSimilarly, frying palm oil, (39^0 Celsius) groundnut oil (38^0 Celsius) and olive oil (38^0Celsius) had significantly ($p < 0.05$) higher melting point value than the fresh palm oil (38^0Celsius), ground nut oil (28^0Celsius) and olive oil (38^0Celsius) respectively under deep fat frying (Table 1a). Moreso, in Table 1a, there was a significant ($p < 0.05$) differences among the three fresh and frying (palm oil, groundnut oil and olive oil) oil media respectively on the melting point value. Fresh palm oil (5%) had significantly ($p < 0.05$) thelowest melting point followed by fresh groundnut oil (4.88%) and the lest was observed in fresh olive oil (4.24%). The melting point of the frying palm oil (4.99%) was significantly ($p < 0.05$) the highest than the frying groundnut (4.96%) and frying olive oil (4.96%) respectively. The saponification (Table 1 a) value of fresh palm oil (255.62) and olive oil (325.38) were significantly ($p < 0.05$) higher than the frying palm oil (194.94) and olive oil (211.74) respectively. While in the frying groundnut oil (226.60) saponification value was higher than the fresh groundnut oil (19.63) under deep fat frying at a temperature of 120^0 Celsius. There was a significant difference ($p < 0.05$) in the peroxide value among the fresh and frying palm oil, groundnut oil and olive oil under deep fat frying at a temperature of 120^0Celsius (Table 1b). Frying oil [olive oil (5.8) < palm oil (31.4)] had significantly more peroxide value than the non-frying oil [olive oil (4.7) < palm oil (17.6)] respectively. Both non-frying and frying groundnut had the same peroxide value (5). Table 1b also showed that there was a significant

($p < 0.05$) variations on the visometric value of the three oil media. Fresh palm oil (467.7) had the highest ability to resist flow due to friction than fresh groundnut (126.1) and olive oil (32.20) respectively. The viscometric value of the frying oil increased in the order; palm oil (362.3) > groundnut oil (173.8)> olive oil (166.1) respectively. The iodine level of the fresh olive oil (29.80) was significantly ($p< 0.05$) the highest among the frying and non-frying palm oil, groundnut oil and frying olive oil respectively. Fresh palm oil (25.30), groundnut oil (28.40), and olive oil (29.80) contained more iodine than the frying palm oil (13.20), groundnut oil (25.30), and olive oil (25) respectively under deep fat frying condition. The fat content (Table 1 b) of fresh olive oil (4.80) was significantly ($p < 0.05$) the highest than the fresh groundnut oil (4.40). The lest was recorded in the fresh palm oil which had a fat concentration of 1.80. Similar trend was observed in the frying oil media, under deep fat frying condition, frying olive oil (4.70) contained the highest fat levels followed by groundnut oil (4.50) and palm oil (2.00) respectively.Diop *et al.*, (2014) reported that during frying and oils are oxidized to form hydroperoxides that can decompose further to yield the secondary oxidation products, such as alcohols, ketones, aldehydes and acids. In deep fat frying, however, acids are also produced by hydrolysis of fats to form free fatty acids (Stevenson *et al.*, 1984). Dun *et al*., (2016) reported that deviation in the FFA values may be attributed to the high temperature attained by the oil as well as the water from the fresh food sample causing the natural fatty acids in the oil to get hydrolyzed into free fatty. According to Emelike *et al* (2017), low moisture in oil decreases the fatty acids content while high moisture leads to its increased.

Formatted ...

4. CONCLUSION

The results of the physiochemical composition of the oil samples are useful in food processing industry. The results obtained from this work provide vital information on the physiochemical effect of reused oil on food sample.It can be concluded fryingreduced the moisture content and iodine value of palm, groundnut and olive oil than the non-frying, Fresh palm oil, groundnut oil and olive oil were high in visocometric and saponification values respectively.

Formatted ...

REFERENCES

1. Codex Alimentarius Commission/FAO/WHO Food Standards, Codex standards for named vegetable oils: CODEX STAN 210. CXSTAN 210-1999, 2000
2. Chebet J., Kinyanjui T. and Cheplogoi P.K (2016). Impact of frying on iodine value of vegetable oils before and after deep frying in different types of food in kenya. Journal of science innovation research Vol.5 pp 193-196.
3. Emelike N.J.T, Ujong A.E, Achinewu S.C2020. Physiochemical and antioxidant properties of oils used by local vendors in D/line-portharcourt, River State. Agricultural and Food Science Research, vol 7, No 1, 89-96.
4. Ejim, I. F and Kamen, F.L (2013). Physiochemical Characterization of Algae oil from Microalgae of Nike Lake Enugu, J. of Engineering and Applied Science, Vol. %, No.1, Pp 181-187.
5. Emelike .N, Akusu .M and Ujong .A (2017). Antioxidant and physicochemical properties of oil extracted from cashew(Anacardium occidentale L) Kernals. International journal of food science and nutrition , vol 2, pp.122-128
6. Diop A, Sarr SO, Ndao S1, Cissé M, Baldé M, Ndiaye B, and YM Diop (2014). Effect of deep-fat frying on chemical properties of edible vegetable oils used by Senegalese households. African journal of agriculture, nutrition and development; Vol 14 no 16

Formatted: Highlight

Formatted ...

Formatted ...

Formatted ...

Formatted ...

Formatted ...

7. Ikhuoria EU,Maliki M (2007). Characterization of avocado pear (Persea Americana) and African pear (Dacryodesedulis) extracts. Afr. J. Biotechnol. 6(7):950-952
8. Idun-Acquah N., George Y.O and Ebenezer M, (2016). Repetitive use of vegetable cooking oil and effects on physic-chemical properties- Case of frying with redfish (Lutjanus fulgens), science and Technology, vol. 6, pp.8-14.

Formatted: Highlight
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight
Formatted: Highlight

Table 1a. Physiochemical composition of fresh and frying oil during deep fat frying of akara chips

Samples	Solidification point			Melting point (°C)			Moisture content (%)			Saponification value		
	fresh	frying	t-test	fresh	frying	t-test	fresh	frying	t-test	fresh	frying	t-test
Palm oil	19	20	0.4	38	39	0.3	5	4.99	0.1	235.62	194.94	21.11
Groundnut oil	6	10	1.7	28	38	6.2	4.88	4.96	0.2	19.63	228.60	67.22
Olive oil	3	22	5.3	38	38	1	4.24	4.96	0.2	325.38	211.74	34.33
FLSD $_{(0.05)}$	2	1.5		5.2	0.4		0.3	0.1		76.22	25.11	

Table 1b. Physiochemical composition of fresh and frying oil during vacuum frying

Samples	peroxide value			Viscometric value (s)			Iodine value			Fat content		
	fresh	frying	t-test	fresh	frying	t-test	fresh	frying	t-test	fresh	frying	t-test
Palm oil	17.6	31.4	7.2	467.7	362.3	31.2	25.30	13.20	5.3	1.80	2.00	0.1
Groundnut oil	5.0	5.0	1	126.1	173.8	20.4	28.40	25.30	2.1	4.40	4.50	0.1
Olive oil	4.7	5.8	0.1	32.20	166.1	45.6	29.80	25.00	2.4	4.80	4.70	0.1
FLSD $_{(0.05)}$	0.1	0.1		19.3	28.2		0.3	0.2		0.4	0.2	

Acronym??????

Formatted: Highlight

Formatted: Highlight

Formatted: Highlight

Formatted: Highlight

Formatted: Highlight

Formatted: Highlight

Formatted: Highlight

Formatted: Highlight

Formatted: Highlight

Formatted: Highlight

Figure 1b. Oil samples

Figure 1a. Oil samples

Formatted: Highlight