Assessment of The Quality of Oil in Snacks Sold by Street Vendors in Amuwo Odofin Local Government Area, Lagos State

Ani, I.F.[1], Adetola, A.B.[2], Bede-obayi R.C.[1], Oyekan J.G.[2], Matthew J.E.[2]

[1]*Department of nutrition and dietetics Babcock University Ilisan-Remo Ogun State.*
[2]*Department of dietetics Babcock University Teaching Hospital Ilisan-Remo Ogun State.*

Corresponding Author: *anii@babcock.edu.ng*

ABSTRACT
Introduction*: Regular eating of snack is on the increase as the diet pattern of people keeps changing due to lack of time to prepare adequate meals. Little attention has been given to evaluating the quality these snacks.*
Objective: *The study assessed the quality of oil in snacks sold by street vendors.*
Methods: *Samples were purchased from the street vendors in four different street; it was placed in an ice pack and labeled properly before taken to the laboratory for analysis. Extraction of oil was done using the AOAC Official Method 993.15 (AOAC, 2016).*
Results: *Saturated fatty acid levels were the highest, in the chinchin, puffpuff and buns samples, followed by monounsaturated fatty acids and polyunsaturated acid respectively. For doughnut, saturated fatty acid levels were the highest followed by monounsaturated fatty acids then polyunsaturated fatty acids and the least present is the trans fatty acids. The trans fatty acid were present in the form of elaidic acid and linoeladic fatty acid.*
The puff-puff sample had the highest level of iodine value of 73.40 ± 7.10c while the buns sample had the lowest iodine value of 49.0 ± 0.15a among all samples,
Conclusion: *The study showed that the snacks physio-chemical properties were mostly not in the range of the required standard and indicated that the oil used in the production of snacks in the geographical area is not suitable for consumption and it can cause any other health related issue like obesity and heart diseases.*

Keywords: Trans Fat, Oils, Fatty Acid

Introduction

Nowadays, the cases of chronic diseases have been on a rise, some of which are as a result of lifestyle and eating habits of individuals. What one consumes has a direct impact on their health status; the ingredients, how it was prepared and where it was prepared are all major contributors to general health and well-being. It is a common practice between individuals to skip meals like breakfast or dinner and substitute it with snacks that they buy from shops. The nutritional content of these snacks are questionable as they are packed with mainly two ingredients which are carbohydrates and fat (1).

Snacks that can be found being sold on the street for on-the-go consumption are doughnut, puff-puff, buns and chin-chin. The doughnut is a deep-

fried pastry that mainly comprises of flour, yeast, sugar and butter. It takes advantage of yeast fermentation; the purpose of yeast in baking is to act as a leavener which produces gas that makes dough rise during fermentation. It is a common street snack that comes either in a ring shape or ball like that can be filled with filling like jam of different flavors. Puff-puff is a popular fried dough snack that is shaped in small balls, it is made up of flour, yeast and sugar. It is deep-fried and its traditional recipe is sometimes altered with the addition of pepper in the snack, it is a very common snack that is loved by majority (2). Buns is a street pastry that is similar to the puff-puff but it is bigger, harder and less oily than the puff-puff, it also doesn't use yeast as a leavener and some other ingredients are added to the traditional recipe such as pepper and sometimes onions. It is also a deep-fried snack. Chin-chin is another popular street snack, it is crunchy and can be found in different shapes varying from slants to stars but the traditional shape of the chin-chin are uneven square cuts. It is a deep-fried snack that is majorly made of flour, sugar, butter and milk (2).

The quality of the oil used in the production of these snacks is an additional factor to the increasing health risks in the society, as the content and state of the oil being used is questionable, and vendors are known with the habit of reusing oil multiple times and trying to cut cost with ingredients in order to make profit from their sales (2). Due to improper storage and usage of the oil, the oil could be rancid; the complete or incomplete oxidation of fats and oil when exposed to bacterial action resulting in an unpleasant taste and odour, rancidity is measured by peroxide value, acid value and free fatty acid (3).The oil is broken down due to the exposure to oxygen and forms peroxides that eventually are further transformed into products such as ketones and hydrocarbons. free radicals in frying oils increased over frying time, and amounts of free radicals increased. Oleic and linoleic acids decreased significantly with the increasing frying time, indicating unsaturated fatty acids of oils degraded under frying process, and no significant change saturated fatty acids (4). Oil that is used frequently or stored improperly can turn rancid, and it is very undesirable for consumption (4). Rancid oil may not cause immediate harm from immediate consumption but rancid oil contains certain chemicals that the prolonged consumption would cause harm, chemicals like aldehydes and peroxide can damage cells and cause atherosclerosis (4). The oxidation that occurs produces a lot of free radicals which in the long term can damage the body cells and increase the risk of chronic conditions like cancer, cardiovascular diseases and inflammatory diseases (5-6).

The consumption of fast food provided by street vendors has increased in recent years. Despite this rise in consumption, little attention has been given to evaluating food quality. This investigative gap is particularly concerning since most street food is deep-fried.

Materials and methods:

Study area/location

The study was carried out in selected locations in Amuwo Odofin Local Government Area of Lagos State, Nigeria. Amuwo Odofin is a Local Government Area in Lagos state that is divided into two local council development areas; Oriade and Amuwo that each have 7 wards and collectively have 67 communities. It has population density of approx. 300,000 people per square km. The four areas Satellite town, Festac town, Abule ado and Olute were randomly selected for this study. The study targeted 4 street vendors selling one sample each in 4 different areas.

Sample preparation

Samples were purchased from the street vendors, each sample gotten from a different geographical area. The samples were placed in ice packs that were marked according to the name of the sample and then it was transported to the analytical laboratory. The samples were labelled as appropriately, spread on a tray, cut into pieces and air dried. The dried samples were ground into smaller pieces with the aid of blender and poured into a dried cleaned sample jar.

Methods

The samples underwent fat extraction then methylation of the extracted fat and then gas chromatography to determine trans-fatty acid levels. The samples were also analysed for peroxide value, iodine value, saponification value and acid value analysis.

Extraction of oil

Extraction of oil was done using the AOAC Official Method 993.15 (AOAC, 2016). Oil was extracted in the pastry samples by Soxhlet extractor using petroleum ether as the extracting solvent. Samples were weighed in a filter paper, wrapped and sealed to avoid sample leakage in the

extractor chamber. The filter paper was placed in the thimble section and 250ml of petroleum ether was poured into a pre-weighed round bottom flask on a boiling water bath. The condenser was coupled, water holes was fixed and run through the condenser.
The extraction lasted for four hours after which the extracted oil was concentrated on the boiling water bath after the petroleum ether was recovered. The flask was further dried in the oven for one hour, cooled and weighed. The extracted oil was used for the analysis of peroxide value, acid value, iodine value, saponification value and trans-fat
Sample A; the oil extracted from the chin-chin sample.
Sample B; the oil extracted from the puff-puff sample.
Sample C; the oil extracted from the doughnut sample.
Sample D; the oil extracted from the buns sample

Procedures
- 20g of ground dried sample was weighed into a clean Whatman filter paper, wrapped and placed in the cellulose thimble. The thimble containing the test sample was then placed in a Soxhlet extractor.
- 150ml of petroleum ether was measured and poured into a pre-weighed round bottom flask and then the neck of the round bottom flask was fitted into the quick fit of the soxhlet extractor.
- Water holes were connected to the condenser and then the water bath was powered to commence the extraction.
- The extraction lasted four hours such that the extractor siphons 30 times per hour or at a condensation rate of 5-6 drops per seconds.
- When the extraction was completed, the solvent was recovered and the oil was concentrated on the water bath and dried in an oven for 1 hour.
-The flask was cooled and weighed to a constant weight.

$$\text{Oil content (\%)} = \frac{(\text{Weight of flask} + \text{Oil}) - \text{Weight of empty flask}}{\text{Weight of sample}}$$

Determination of iodine value in oils
Iodine value in the oils was determined using the AOAC Official Method 993.20 (AOAC, 2016).

Procedure
- 0.3g of extracted oil was weighed into a clean dry 500ml conical flask.
- 15ml of cyclohexane-acetic acid solvent mixture (equal volumes of each solvent) was pipetted into the test portion and was swirled to ensure complete dissolution.
- 25ml of Wij's solution was pipetted into flask containing the above solutions, it was shaken gently and incubated for 1 hour in the dark.
- The flask was removed from the dark, then 20ml of 15% potassium iodide and 150ml of water was added to the flask
- It was then titrated with 0.1M sodium thiosulfate standard solution until yellow color had almost disappeared
- 2ml of starch indicator was then added and titrated until blue colour had disappeared.
- A blank test was performed as well.
- Iodine Value = (Blank titer -Sample titer) x M x 12.69 / weight of oil taken

Determination of free fatty acids
Determination of free fatty acids was done using; Pearson's Chemical Analysis of Foods 8th Edition, 1981

Procedure
- 1-2g of the extracted oil was weighed into a dried clean 250ml Erlenmeyer flask
- 25ml of diethyl ether and 25ml of ethanol was measured into the sample
- 1ml of 1% phenolphthalein was added into the sample
- 0.1M NaOH was titrated with constant shaking until a pink colour was observed.
Acid Value = Titre value x 5.61 / Weight of oil

determination of peroxide value
Peroxide value was determined using the; AOAC Official Method 965.33 (AOAC,2016).

Procedure:
- 0- 1g of the extracted oil was weighed into a 250ml flask,
- 30ml of acetic acid – chloroform solution was added in ratio 3:2 and swirlled to dissolve,
- 0.5ml of Saturated KI solution was added and was occasional shaken for 1 minute and then 30ml of water was added into it,
- With 0.01M thiosulphate it was titrated till the yellow color almost disappeared,

then 0.5ml of starch solution was added and titration continued until a blue color appeared.

$$\text{Peroxide Value}\left(\frac{\text{mEq}}{\text{kg}}\right) = \frac{(\text{Sample titer value} - \text{blank titer value})\ \text{X}\ (\text{Normality sodium thiosulfate})}{\text{Weight of the sample}} X\ 1000$$

Determination of saponification value
Determination of saponification was done using;Pearson's Chemical Analysis of Foods 8th Edition, 1981

Procedure:

- 2g of the extracted oil was weighed into a conical flask and exactly 25ml of alcoholic potassium hydroxide solution was added.
- A reflux condenser was attached and the flask was heated on boiling water bath for 1 hour.
- 1 ml of phenolphthalein (1%) solution was added and titrated with 0.5M hydrochloric acid.
- A blank test was carried at the same time.
- Saponification Value: (b-a) x 28.05 / Wt of oil used

Procedure for gas chromatography-analysis of fatty acid profile (trans-fat)
50mg of the extracted fat content was saponified for 5minutes at 950C with 3.4ml of 0.5M KOH in dry methanol. The mixture was neutralized by using 0.7M HCL. 3ml of 14% boron trifluoride in methanol was added. The mixture was heated for 5 minutes at the temperature of 900C to achieve complete methylation process. The fatty acid Methyl Esters were extracted thrice from the mixture with re distilled n-hexane. The content was concentrated to 1ml for gas chromatography analysis and 1ul was injected into the automatic sampler of the GC.

Statistical analysis
The data collected was analyzed with the Statistical Package for Social Science (SPSS) version 20.0. The data was analyzed to obtain mean and mean deviation, the differences among the means were then established using Duncan Multiple Range Test.

Result
Saturated fatty acid in the samples
The table below shows the percentage of the presence of saturated fatty acids, fatty acid is high in all the samples. sample B has a total percentage of 60.66142% and sample C has a total percentage of 58.468639%. This indicates that Sample B has the highest level of saturated fatty acid with sample C being the lowest.

Monounsaturated fatty acid in the samples
Table 2 shows that the oil extracted from sample C has the highest percentage of monounsaturated fatty acid. Monounsaturated fatty acid levels are the second highest present in all the samples.

Polyunsaturated fatty acid in the samples.
Table 3 shows the presence of polyunsaturated fatty acids in the samples, the percentage polyunsaturated fatty acids in sample A was 9.42%, sample B was 9.18%, sample C was 9.57% and sample D was 10.69%. This indicates that sample D has the highest profile of polyunsaturated fatty acid.

Trans fatty acid in the samples
Table 4 below shows that trans fatty acid have an insignificant presence in the samples. Sample Sample C had the highest percentage among all four samples while sample B had the least.

Peroxide Value
There is a significant difference in the peroxide value in Buns, Doughnut and Puff puff according to the DMRT at 5% probability level. The table below shows that sample D had the highest peroxide value with sample C having lowest peroxide among the four samples.

Saponification Value
Table 5 shows that there is a significant difference in Buns, Doughnut, Puff-puff and chin chin according to the DMRT at 5% probability level. The table below indicates that sample C had the highest saponification number while sample A had the lowest saponification number among the four samples.

Table 1: saturated fatty acid profile of samples

Saturated fatty acid											
Samples	**C8:0**	**C10:0**	**C12**	**C14:0**	**C16:0**	**C17:0**	**C18:0**	**C20:0**	**C22:0**	**C24:0**	**Total**
Sample A	N/D	N/D	N/D	1.47	53.64	0.01	3.58	0.31	0.02	0.04	59.10
Sample B	N/D	N/D	N/D	1.79	55.09	0.00	3.46	0.23	0.02	0.04	60.66
Sample C	N/D	N/D	N/D	1.58	52.91	0.019	3.62	0.20	0.03	0.08	58.46
Sample D	N/D	N/D	N/D	1.68	53.15	0.04	4.07	0.64	0.08	0.19	59.88

Table 2: Monounsaturated fatty acid profile of samples.

monounsaturated fatty acids				
Samples	C16:1 %	C18:1 %	C22:1 %	TOTAL %
Sample A	0.03	31.41	0.01	31.46
Sample B	0.03	30.09	0.01	30.14
Sample C	0.06	31.85	0.02	31.94
Sample D	0.14	29.20	0.04	29.40

Table 3: polyunsaturated fatty acid profile of samples

polyunsaturated fatty acid				
Samples	(C18:2)	(C18:3)	(C20:4)	TOTAL
Sample A	9.09	0.30	0.02	9.42
Sample B	8.85	0.30	0.02	9.18
Sample C	9.15	0.36	0.05	9.57
Sample D	9.94	0.62	0.11	10.69

Table 4: Trans fatty acid profile of buns sample

Trans Fatty Acids			
Samples	C18:1,trans-9 %	C18:2,n-6,9 %	TOTAL %
Sample A	0.0046	0.003	0.008
Sample B	0.0043	0.003	0.007
Sample C	0.008	0.006	0.015
Sample D	0.006	0.006	0.012

Table 5: Peroxide values of the samples

Samples	**Peroxide value (Meq/Kg)**
Sample A	56.25 ± 6.55c
Sample B	86.84 ± 2.05b
Sample C	36.67 ± 0.55a
Sample D	104.0 ± 0.10a

Table 6: Acid Value

Samples	Acid Value (Mg/Koh/g)
Sample A	1.59 ± 9.68d
Sample B	1.56 ± 6.40c
Sample C	2.10 ± 4.62b
Sample D	3.30 ± 1.18a

Table 7: Iodine value of snacks

Samples	**Iodine Value (g/100g)**
Sample A	61.20 ± 8.15d
Sample B	73.40 ± 7.10c
Sample C	57.30 ± 1.35b
Sample D	49.0 ± 0.15a

Acid Value of oil

Table 6 reveals that there is a significant difference in Buns, Doughnut, Puff puff and chin chin according to the DMRT at 5% probability level. The table below indicates that sample D had the highest acid value while sample B had the lowest acid value among the four samples.

Iodine value of snacks

There is a significant difference in Buns, Doughnut, Puff puff and chin chin according to the DMRT at 5% probability level. The table below indicates that sample B has the highest level of iodine value while sample D has the lowest level of iodine value.

Discussion

Street food hawking is a growing business in many developing countries today. Its expansion is linked with urbanization and the need for employment and food in urban populations.(7)

The fame analysis of chin chin, puff-puff and buns sample shows that saturated fatty acid levels were highest followed by monounsaturated fatty acids and then polyunsaturated acid respectively. For doughnut, saturated fatty acid levels are the highest followed by monounsaturated fatty acids then polyunsaturated fatty acids and the least present is the trans fatty acids. The trans-fatty acid were present in the form of elaidic acid and linoeladic fatty acid. This is consistent with the findings of Vandana et al. (2014) that was done in India (7).

The result obtained from the study revealed that doughnut had the highest saturated fatty acid percentage level. The highest monounsaturated fatty acid levels were found in puff-puff. The highest polyunsaturated fatty acid and trans-fatty acid levels were in Buns.

The findings from this study is similar to a study done in Ireland across different categories of processed food products, levels of trans fatty acid in surveyed products were low with 97.5% of products having ≤ 2% trans fatty acid as a percentage of total fat (8). Whereas a study done in Malaysia had high levels of trans fatty acid content in the bakery products, which exceeded 2g/100g fat (9).The buns sample had the highest peroxide value of 104.0±0.10a while the doughnut sample had the lowest peroxide value of 0.55a amongst the samples, when compared with the Nigerian standard for vegetable oil of 30-40 mEq/Kg. it was clear that the peroxide values were significantly higher than the normal range.(10).

The doughnut sample had the highest saponification value while the chin chin sample had the lowest saponification value among the samples. When compared with Nigerian standard for saponification value, it was noticed that the chin chin sample was slightly below normal range but the other samples were within the acceptable range (10).

The Buns sample was of the highest acid value while the puff-puff sample was of the lowest acid value among the four samples. All acid values of

the samples were significantly higher than Nigerian standard of vegetable oil.(11) The puff-puff sample had the highest level of iodine value of 73.40 ± 7.10c while the buns sample had the lowest iodine value of 49.0 ± 0.15a among all samples, when compared to the Nigerian standard for iodine value and it showed that the iodine levels of all the samples were lower than the normal range according to the Nigerian industrial standard for vegetable oil (11).

The quality of the oil extracted from the samples were not of optimal quality for consumption by individuals, this shows that a prolonged consumption of these snacks by the individuals will pose them at risk of health consequences from consumption of rancid oil which can become very toxic and produce free radical cells that can cause cell damage, increase the risk of diabetes, and even increase the risk of the presence of cancer

The iodine values gotten from (list the samples) this study were lower than a previous study that was done on locally made oils in Oyo state Nigeria where it was indicated that they had higher iodine levels which indicated that they were healthier in consumption (12). The iodine values in the samples in this study indicated that the oil was unhealthier when compared with the previous study as the low iodine values proved the oil was saturated which also means that a continuous consumption of the snacks would lead to the increasing the risk of the development of cardiovascular diseases.

Conclusion

The study showed that the snacks physio-chemical properties were higher than the range of the required standard, indicating that the oil used in the production of snacks in the geographical area is not suitable for consumption and it can cause any other health related issue like obesity and heart diseases.

REFERENCES

1. Baba, M.M., Musa, G. (2014). The burden of non-communicable diseases in Nigeria, in the context globalization. *Annals of African Medicine*. Vol.13, No.1:2014.
2. Adebiyi, J. (2016). Nigerian doughnuts (donuts). Available from: https://sisijemimiah.com/2016/04/14/nigeriandoughnuts-donuts. Retrieved 13/2/2021
3. Ahmed, M., Pickova, J., Ahmad, T., Liquat, M., Farid, A., Jahangir, M. (2016). Oxidation of lipids in foods. 32(3): 230-238.
4. Ying Liu, Jinwei Li, Yajun Cheng, Yuanfa Liu, Effect of frying oils' fatty acid profile on quality, free radical and volatiles over deep-frying process: A comparative study using chemometrics ,LWT, Volume 101, 2019, Pages 331-341, ISSN 0023-6438, https://doi.org/10.1016/j.lwt.2018.11.033.
5. American Heart association (2015).Saturated fat. Available at https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/fats/saturated-fats. Retrieved 24/3/2021.
6. American Heart association (2017). Trans fat. Available at https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/fats/trans-fat. Retrieved 14/1/2021.
7. Vandana, D., Neelam, G., Kulveer, S.A. and Bhupendar, K. (2014). Trans-fat-sources, health risks and alternative approach- a review. Journal of food science and technology-mysore 48(5): 534-41.
8. FSAI (2016). Survey of the trans fatty acid content in processed food products in Ireland. *Monitoring and surveillance series*.
9. Negash, Y.A., Amare, D.E., Bitew, D.B. and Dagne, H. (2019). Assessment of quality of edible vegetable oils accessed in Gondar city, Northwest Ethiopa. *BMC RES Notes* 12, 793.
10. Imma (2020). African bites. Immaculate bites- Ethnic fusion made easy.
11. Furman, D., Campisi, J., Verdin, E., Carrea-Bastos, P., Targ, S., Franceschi, C., Ferruci, L., Gilroy, D.W., Fasano, A., Miller, G.W., Miller, A.H., Mantovani, A., Weyanda, C.M., Effros, R.B., Rando, T.A., Goronzy, J.J., Barzilia, N., Lucia, A.,

Kleinstreuer, N. and Slavich, G.M. (2019). Chronic inflammation in the etiology of disease across the lifespan. *Nat.Med;* 25(12): 1822-1832.

12. Bello, M.O., Akindele, T.L., Adeoye, D.O. and Oladimeji, O.A. (2011). physiochemical properties and fatty acids profile of seed oil of Telfairia occidentals (Hook,F). *International journal of basic and applied sciences* 11(6), 9-14