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Nutrient Composition of Selected Indigenous Apple Fruits Consumed in Imo State, Nigeria

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ABSTRACT

Fruit are sources of minerals fibre and vitamins which provide essential nutrients for the human health. This study tried to determine the nutrient content and health benefits of different apples consumed in Imo State. Apple fruits (star fruit (Averrhoa carambola), local fruit (Syzygum samarangensel) ,peer fruit (Pyrus rosaceae), Green foreign apple fruit (Malus domestica), Red foreign apple fruit (Malus domestica) were purchased from Amaraku Ehime Mbano market ,then the nutritional and sensory properties were investigated.Statistical analysis was carried out in Nutrition and Dietetics laboratory, Imo State University, Owerri using ANOVA (SPSS version 2.0) and tukey LSD AIPHA (0.05). Result from the proximate composition showed that there was a significant different ($p<0.05$) in all the nutrient composition of all the selected sampled Apple fruits. Peer apple fruit (type C) had the highest moisture content value (74.71%), crude protein value (0.54%) and crude fibre value (12.47%) while red apple fruit (type E) had the lowest value (60.03%) and crude fat value (0.08%). However, Green apple fruit and Red apple fruit showed no significant value ($p>0.05$) in crude fat value. Also Red foreign fruit showed no significant difference ($p>0.05$) in crude fat content value (0.08%). The vitamin and mineral result Revived significant differences ($p<0.05$) also existed among the tested samples. However, star fruit (sample A) and local fruit (sample B) showed no significant different ($p>0.05$) in the vitamin A content valued (19.10%0 while peer fruit showed the highest vitamin C value (53.390%) and potassium content value (128.030%) having green foreign fruit with the lowest vitamin C content value (22.355%) significant differences existed at the mean sensory scores, among all the tested apple, however star fruit and local fruit showed no significant difference ($p<0.05$) in all the tested mean sensory scores. Interestingly, peer fruit, Green foreign fruit and Red foreign fruit showed no significant different ($p>0.05$) in all the tested mean sensory scores. Peer fruit was very much liked by consumer (8.15) with over all acceptability. Star fruit has extremely dislike (5.0) with appearance (5.25). Green fruit and Red foreign fruit showed significant difference ($p<0.05$) in least overall consumer acceptability.

Keywords: Indigenous species; Fruits; Food composition; Nigeria; Nutrients

1. Introduction

Food is basic part for human endurance. Support of good wellbeing needs a fair eating routine including sufficient large scale and miniature supplements (Ihenetu et. al., 2019). So as to have a decent eating routine, supplement arrangement of nourishments must be made notable and accessible to the mass populace. It is utilized in research considers managing the impacts of diets on wellbeing, propagation and advancement. There is a noteworthy connection among diet and

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wellbeing and infections. Absence of legitimate of dietary propensities adds to the advancement of numerous infections. Diets lacking adequate nutrients and minerals actuate various wholesome inadequacy sicknesses. Nutrients and minerals are engaged with various biochemical cycles and a satisfactory admission of micronutrients can forestall healthful lack maladies (Leterme et al., 2006). It has been assessed in 2009 that over 925 million individuals on the planet were malnourished (FAO, 2010) and 33 % of the total populace was influenced by the iron lack ailment frailty (Kumari et al., 2004).

Like other developing nations, lack of healthy sustenance is a serious medical issue in Nigeria. Deficiency in some vitamins can result to public health issues. For example, deficiency in Vitamin D can cause bone and back pain, impaired wound healing, bone loss, hair loss and muscle pain while blindness may result from Vitamin A deficiency. So as to conquer this circumstance, much consideration has been focused on staple food just as on the misuse and usage of strange plant nourishments. Micronutrients are basic for acceptable wellbeing and sustenance, progressing physical and intellectual turn of events. Low dietary intake of micronutrient rich foods as well low absorption and lower bioavailabilty are the leading cause of the micronutrient deficiencies. It is, in this way, essential to recognize the micronutrient rich food sources that can give satisfactory adjusted eating routine to the support of good health.

Apple, ruler of all fruits have for some time been related with the scriptural story of Adam and Eve. Between the Caspin and the Black Sea, the fruit was started in the Middle East about 4000 years back. It is one of the most loved and famous fruits ever known (Eberhardl et al., 2000). While the investigation of apples medical advantages goes back to beginning phases, exploration to date proposes that its supplements may assume a part in advancing human health in various ways (Coffman, 2013; Dauda, 2014).

In Nigeria and in particular, Imo State, there are many indigenous species of apple fruits such as star fruit (Averrhoa carmbola), red apple (Malus domestica), green apple (Granny smith), wax apple pink (Syzygiun samaranfensel) and pear apple fruit (Pyrus rosaceae). These indigenous species have been cultivated and enjoyed by the populace without prior assessment. The aim of this study was assess the nutritional composition different indigenous species of apple in Imo State. This study is important as it generate data that could help in developing a food composition database. Food composition database is of great importance in addressing health and nutrition issue. It is essential for planning food, nutrition and health related policy tools. As a result there is a worldwide call to develop a National Food Composition Database. Unfortunately Nigeria does not have a food composition database of its own.

2. Materials and method

2.1 Sample collection

Five types of apples samples were gotten from Orie Amaraku Market in Mbano L.G.A in Imo state. Amaraku is a town located in Iheme Local Government Area. These apple types were coded: A = **Star Fruit** (Averrhoa carmbola), B = **Red Apple** (Malus domestica), C = **Green Apple** (Granny smith), D = **Wax Apple Pink** (Syzygiun samaranfensel) and E = **Pear Apple Fruit** (Pyrus rosaceae).

2.2 Proximate Analysis

2.2.1 Moisture Determination

The standard method of the associated of official analytic chemist (AOAC, 2000; Nwachukwu et. al., 2018; Enyoh et. al., 2017; 2019) hot air oven method was used. Three grams of each of the sample was weighed into dried weighed crucible. The sample was put into a moisture extraction. Oven at 60 oC and heated while checking it periodically until a constant weight is obtained. After drying, the sample was kept in desiccators and allowed to cool and reweighed. The operation was repeated until constant weight was obtained. The difference in weight was calculated as a percentage of the original sample percentage moisture

$$\% \text{ Moisture} = \frac{(x-y) \times 100}{z \quad 1}$$

Where x= sum of weight of dish crucible before drying

Y= Weight of dish + dried sample

Z= Initial weight of dish + dried sample

$$\%= \frac{\text{Weight loss (g)}}{\text{Total weight of sample}} \times \frac{100}{1}$$

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2.2.2 Ash Content Determination

The standard method of the association of official analytic chemist (AOAC; 2000). Three grams of each of the samples was weighed into crucibles, heated in a moisture extraction oven for about 2hours at 100oC before being transferred into a muffle furnace at 550oC until it turned white and free of carbon. The sample was then removed from the furnace, cooled in a dessicator to a room temperature and reweighed immediately. The weight of the residual ash was then calculated as percentage.

$$\% \text{ Ash} = \frac{\text{weight of Ash}}{\text{Weight of original sample}} X \frac{100}{1}$$

2.2.3 Crude protein Determination

The micro Kjedahl method described by AOAC (2000) was used. Two grams of each of the sample was mixed with 10ml of concentrated H_2SO_4 in a heating tube. One table spoon of selenium catalyst was added to the tube. The mixture was then heated inside a fame cupboard. The digest was now transferred into distilled water, ten millimeter portion of the digest was mixed with equal volume of 45% NaOH solution and poured into kjedahl distillation apparatus. The mixture was distilled and the distillate collection into 4%. Boric acid solution containing 3 drops of methyl red indicator.

A total of 60ml distillate was collected and titrated as well. This operation was duplicated and the average value taken. The nitrogen content was calculated and multiplied with 6.25 to obtain the crude protein content. This was given as percentage nitrogen.

$$= \frac{(100 \times N \times 14 \times vf)T}{100 \times va}$$

Where

N = Normally of the titrate (O.IN)

VF = Total volume of the digest = 100ml

Va = Aliquot volume distilled

2.2.4. Fat Content Determination

The standard method of the associated of official analytic chemist (AOAC, 2000) was used about 300ml clean boiling flask was dried in a oven first at 110 – 115oC for about 30minutes and transferred into a dessicator to cool. 3g each of the sample were now weighed out into well labeled thimbles. Correspondingly labeled cooled boiling flask was equally weighed out and their weight recorded. These flasks were now filled with about 350ml of petroleum other of boiling point between the range of 40 and 60oC. The extraction thimbles were also plugged lightly with cotton wool. An already set soxhlet apparatus was then heated and allowed to reflux for about 6hours. After this, the thimbles were removed carefully while the spent samples was kept and reweighed. Petroleum ether was collected in the top container of the set up and drained into a container for reuse.

The percentage oil content is percentage fat

$$= \frac{W2 - W1}{W3} \times \frac{100}{1}$$

Where

W1 = weight of empty extraction flask

W2 = weight of the flask and oil extraction

W3 = weigh of the samples

2.2.5. Crude fibre Determination

The AOAC (2000) Method was used five grams of the processed sample was boiled in 150ml of 1.25% H_2SO_4 solution for 30minutes. The boiled sample was washed in several portions of hot water using two fold muslin doth to trap the particles. It was returned to the flask and boiled again in 150ml of 1.25% NaOH for another 30minutes under the same condition. After washing in several portions of hot water the sample was allowed to dry before been transferred quantitatively to a weighed crucible where it was dried at 150oCs to a constant weight it was hereafter taken to a muffle furance in which it was burnt until only ash was left of it. By difference, the weight of fiber is expressed as percentage of the weight of same analyzed it was given by the formula below;

$$\% \text{ Crude fibre} = \frac{W2 - W1}{\text{Weight of sample}} \times \frac{100}{1}$$

Where,

W2 = weight of crucible + sample after oven dry

W1 = weight of crucible

2.2.6. Carbohydrate Determination

The AOAC (2000) method was used, carbohydrate were determined by difference that is, 100 subtracted by weight in grams (Protein + Fat + Ash + Fibre + Moisture)

$100 - (A + B + C + D + E)$

Where;

A = % Moisture

B = % Ash

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C = %Crude Fat
D = %Protein
E = %Crude fibre

2.2.7. Mineral Determination

The minerals determined are calcium, Iron, Potassium, magnesium. AOAC (2000) methods were used to determined mineral composition of the samples. Two grams of samples was digested with sulphuric acid and was filtered with No 1 whatman filter paper, the fitrate was kept in a 5ml volumetric flask. The standard curve for calcium was prepared from known standards by weighing out 5, 10, 20, 40 and 60kg, the mineral value of sample estimated against that of standard curve.

2.3. Statistical analysis

The data collected was subjected to analysis of variance (ANOVA). According to the method of Iwe (2013) to determine the variance ratio. The least significant difference was calculated at 6% level of significance of between means using turkey lest (T-test), Ihekoronye and Ngoddy (1985).

3. Results

Table 1. Proximate Composition of Five Varieties of Apple

Variety of Apple	Moisture%	Crude Protein %	Ash %	Crude fat	Crude fiber	Total carbohydrate
Type - A	65.10^{c}±0.02	1.25^{a}±0.04	2.51^{c}±0.01	0.21^{a}±0.01	3.14^{a}±0.03	27.80^{c}±0.08
Type - B	72.20^{b}±0.02	0.40^{ef}±0.02	2.95^{a}±0.03	0.18^{ab}±0.01	2.35^{c}±0.01	21.93^{d}±0.07
Type - C	74.71^{a}±0.03	0.54^{b}±0.01	2.65^{b}±0.02	0.15^{b}±0.01	2.47^{b}±0.02	19.53^{e}±0.02
Type - D	62.24^{d}±0.01	0.31^{d}±0.01	1.90^{e}±0.01	0.09^{c}±0.02	2.10^{e}±0.02	33.38^{b}±0.04
Type - E	60. 03^{e}±0.02	0.47^{bc}±0.02	2.10^{d}±0.02	0.08^{c}±0.01	2.22^{d}±0.02	35.12^{a}±0.01
LSD	0.02646	0.02627	0.02191	0.01265	0.02366	0.05532

Mean scores with different superscript letter are significantly different (p>0.05)
LSD = least significant different

Table 1 shows the proximate composition of five varieties of apple, significant difference (p<0.05) were discovered of the proximate composition. The moisture of the apple fruit were within the range of 60.04 % to 74.71 %. Red foreign apple had least while peer show highest moisture content the high moisture content of the fruits discovered is an indication that fruit juice or drink can be obtained from them. The crude protein content ranged from 0.31% in green foreign apple fruit to 1.25% in star apple fruit. The Ash content of the samples ranged from 1.90% to 2.95%. The local apple fruit has the highest ash content, while the green foreign apple fruit has the least ash content. There was a significant difference in the ash content of the fruits.

The crude fat content of the fruits ranged from 0.08% to 0.21% with star apple fruit having the highest content and Red foreign apple fruit having the least content of crude fat. The crude fiber content of the apples ranged from 2.10% to 3.14%. and there was a significant difference in the crude fiber content of all the apples the total carbohydrate content of the apples type A, B, C, D, and E ranged from 27.80%, 21.93%, 19.53%, 33.38% and 35.12% respectively. With Red foreign apple fruit has the highest carbohydrate content and peer apple fruit having the least carbohydrate content. However, there was a significant difference in the carbohydrate content of all the apples.

Table 2 vitamin C, Vitamin A and mineral content of five varieties of Apple

Variety of Apple	Vitamin C mg/100g	Vitamin A mg/100g	Calcium mg/100g	Iron mg/100g	Potassium mg/100g	Magnesium mg/100g
Type - A	33.565^{c}±0.02	19.110^{b}±0.02	9.490^{d}±0.01	1. 095^{d}±0.02	78.310^{e}±0.01	8.015^{a}±0.02
Type - B	50.135^{b}±0.03	19.135^{b}±0.03	10.095^{c}±0.02	1.320^{c}±0.01	96.595^{b}±0.01	6.115^{ab}±0.01
Type - C	53.390^{a}±0.01	ND	8.295^{e}±0.02	0.250^{e}±0.04	128.030^{a}±0.03	5.210^{b}±0.01
Type - D	22.355^{e}±0.02	ND	10.865^{b}±0.06	3.295^{b}±0.02	86.125^{d}±0.02	7.820^{a}±0.03
Type - E	28.420^{d}±0.02	63.315^{a}±0.02	12.125^{a}±0.02	4. 020^{a}±0.02	88.425^{c}±0.02	7.435^{ab}±0.03
LSD	0.02510	17.0880	0.03347	0.02720	0.01975	0.62012

Mean scores with different superscript letter are significantly different (p>0.05) along the same column

Table 2 shows the vitamins and mineral contents of all the apple fruits. Analysis of this table indicates that the vitamin C content ranged from 22.355% to 53.390% with peer apple fruit having the highest and green foreign apple fruit having the least vitamin C content and there was a significant difference in the vitamin A content ranged from 19.10% to 63.31%. There was no significant difference in the vitamin A content of Star apple fruit and local apple fruit. The calcium content of the apple fruits ranged from 8.295% to 12.125%, with the Red foreign apple fruit having the highest and peer apple fruit having the least calcium content. However, there was a significant difference in the calcium content of all the apple fruit. The Iron content ranged from 0.250% to 4.020%. And there was a significant difference in the iron content of all the apple fruit,

The potassium content ranged from 78.310% to 128.030% with peer apple fruit having the highest and star apple fruit having the lowest potassium content. All the apple fruits were significantly different in their potassium content (p<0.05) The magnesium content ranged from 5.210% to 8.015% with star apple

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fruit having the highest and peer apple fruit having the least magnesium content.

Table 3 Mean Sensory Score of Sensory Properties of Five Varieties of Apple

Variety of Apple	Appearance	Texture	Taste	Overall acceptability
Type - A	5.25^{6}	5.70^{b}	5.00^{b}	5.95^{b}
Type - B	5.30^{b}	5.00^{a}	5.60^{b}	5.40^{b}
Type - C	7.80^{a}	7.75^{a}	8.15^{a}	8.20^{a}
Type - D	8.40^{a}	7.90^{a}	8.00^{a}	8.05^{a}
Type - E	8.10^{a}	7.75^{a}	8.05^{a}	8.05^{a}
LSD	0.44692	0.41990	0.42834	0.40633

Mean scores with different superscript letter are significantly different ($p>0.05$)

Table 3 shows the mean score of sensory properties of five varieties of apple significant difference ($p>0.05$) were discovered on the attributes of apple evaluated. The appearance mean score was within the range of 5.25 to 8.40 star apple fruit had the least rating while green foreign apple had the highest. In term of texture, the green foreign apple was rated highest (7.90), followed by Red and peer apple. The mean sensory scores for taste was ranged between 5.0 to 8.15. However, the foreign apple (green and rd verities had the highest mean score 8.05 each. This value shows that foreign apple varieties were the most preferred compared to local and star apple.

Discussion

The proximate composition minerals, vitamin and sensory properties of different kinds of Apple fruits (Star fruit, local fruit, foreign fruits and peer fruit)

Proximate composition

The proximate composition of Apple fruits showed in table 2 their moisture contents ranged from 65.10% to 60.03%. The moisture content of the sample differed significantly ($P<0.05$). This variation could be as a result of storage production after harvest. The importance of moisture in the body of organisms cannot be overstated. It acts as a dissolving medium for substrates, transport material; regulate temperature etc (Uwakwe and Ayalogu, 1998). Ash content of the samples also differed significantly ($p<0.05$) with the fruits recording 2.10% while the highest value recorded 2.51%. Ash constituents of the investigated samples could be related to their mineral contents and these minerals, which are mostly in forms of chemical compounds, play numerous functions towards the improvement of health in the body of organisms. (Olusanys, 2008; Onmuka, 2005). The protein contents of the investigated sample ranged from 1.25% to 0.47% and the values obtained did not differ significantly ($p<0.05$). Aside contributing to diets, the relative impact of proteins in body system should not be over looked. As chemical compounds, they repair and replace worn out cells, from structural and globular materials that holds the body, form blood proteins, boost immune system, etc (Olusanya, 2008). The highest fat content 0.21% of star apple fruit compared to red foreign apple fruit 0.08%. This may be an indicator that could be an oil fruit. Generally, fat have many functions. Aside insulation and conservation of body temperature in organisms, their fatty acid components such as laurie acid etc, have been reported to improve health (Fite, 2000). Crude fiber content of the samples differed significantly ($p<0.05$) with the star apple fruit recording the higher value 3.14% and the green foreign apple fruit recording the lower value 2.10% fibres alter the colonic environment in such a way as to protect against colorectal diseases it provide protection by increasing faecal bulk, which dilutes the increased colonic bile acid concentrations that occur with a high fat diet (Dillard and German, 1990). Evidence from content in the body of organisms could reduce indigence of disease like diabetes, high blood pressure, piles, digestive disorders etc (SACN, 2008). Carbohydrate content of the samples differed significantly ($p>0.05$) ranging from 27.80% to 35.12%. Observed carbohydrates in the investigated samples may be an indication that the samples could produce energy to power the cells and tissue of the body on consumption.

Mineral, Vitamin C and Vitamin A content

Mineral elements in plants become important when their health benefits are considered in the body of organisms. Most of these minerals occur as chemical compounds in solution from hence, they are able to diffuse to different part of plants. Table 3 showed the very vital minerals contained in Apple fruits for proper growth and development of the body. The apple fruit studied contained appreciable amounts of calcium (9.490 to12.125mg/100g), magnesium (8.015 to7.435mg/100g), Iron (1.095 to 4.020mg/100g) and potassium

(78.310 to 88.425mg/100g) respectively. These are very important to health of humans. They are required for formation of bones and teeth, formation of blood dot, formation of cyclic Amp and other second messengers, for body mechanisms, etc (Olusanya, 2008). Magnesium was the highest to other minerals investigated in this study. Potassium maintains Nervous system balance. Magnesium plays a key role in the activity of our MMDA receptors. Research studies have shown that when magnesium in our diet is low, we increased risk of depression. Calcium and Iron contents of apple fruit range from 9.490 to 12.125mg/100g and 1.095 to 4.020mg/100g calcium plays the role of maintain total body health while iron is known for hem formation (Diduagh et al. 2013).

Sensory properties of five varieties of apple

From the result, there was a significant difference ($p>0.05$) in the appearance of the varieties of apple but there is no significant difference between type A and B apple and also no significant different ($p<0.05$) among the type C, D and E and apple. Generally, the appearance of varieties of apple were all accepted by the panelist. There was also a significant difference ($p>0.05$) in the texture of the varieties of apple, there is no significant difference ($p<0.05$) between type A and B apple and also no significant difference in type C, D and E apple. But the texture was generally accepted by the panelist. There was also a significant difference ($p>0.05$) in the taste of the varieties of Apple, there is no significant difference ($p<0.05$) A and B apple and also no significant difference in type C, D, and E apple but the taste was accepted by the panelist. There was also a significant difference ($p>0.05$) in the overall acceptability of the varieties of apple. There is no significant difference ($p<0.05$) between type A and B apple and also no significant difference ($p<0.05$) among type C, D and E apple. Generally, there were all acceptable by the panelist.

Conclusion

The varieties of apple studied possess the good qualities and can be processed into other valued products. Overall, the proximate composition of the fruits was of acceptable standard.

Conflict of interest

The authors declare no conflict of interest

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