In Vitro Assessment of Proximate and Phytochemical Quantifications of Some Edible Fruits

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Abstract

The present study was done to ascertain comparatively, the proximate and phytochemical compositions of some edible fruits; Citrullus lanatus (watermelon), Cucumis sativus (Cucumber), Ananas comosus (pineapple) and Annona muricata (soursop). Proximate and phytochemical analysis on wet weight basis among the four fruits were statistically significant ($p<0.05$). Proximate analysis revealed that watermelon had the highest total fat, crude fibre and moisture contents (0.24, 0.99 and 41.97%) respectively but least in total carbohydrate (45.26%) ; soursop exerted the highest ash, crude protein and total carbohydrate contents (0.39%, 13.34% and 74.66%) but least in total fat and moisture contents; 0.10% and 10.97% respectively. Phytochemical analysis revealed comparatively that; soursop had highest concentrations of phytate, oxalate, tannin, phenol and alkaloids among other fruits, but pineapple, cucumber and watermelon had least levels of phytate, oxalate, phenol tannin and alkaloid respectively. In view of the appreciable levels of the nutrients and phytochemicals in the fruits, the results therefore suggest that regular consumption of these fruits would be safe for human health and effective management of some pathological conditions.

Keywords: Ananas comosus, Annona muricata, Citrullus lanatus, Cucumis sativus, phytochemicals

INTRODUCTION

Humans possess great capacity to adapt physiologically to different types of foods. In spite of this, nutrition science has demonstrated that there are certain foods that cannot be eliminated, such as fruits and fresh vegetables (Pamplona-roger, 2008). As reported by Ngoddy and Ihekoronye (1985), fruits offer the most rapid methods of providing adequate supplies of vitamins, minerals and fibres to people living in the tropics. Most fruits and vegetables have low energy density and are recommended for weight management (Rolls et al., 2004). The optimal diet for everyone as recommended by the world health and food and agriculture organization is a low-fat and fibre diet rich in complex carbohydrate characterized by a frequent consumption of fruits and vegetables at least 400g daily as well as whole-grains, cereals and legumes at least 30g daily (WHO and FAO, 2003).

In Africa, fruits are on high demand. This is because they are complemented with food to ensure balanced diet, and some serve as raw materials to industries. Fruits contain a high percentage of water averaging 85%, fats and protein in very small varying amounts, a small proportion of carbohydrate present as cellulose and starch respectively. Besides their low energy value, they are known for their high micronutrient concentrations including carotene or provitamin A, vitamin K, ascorbic acid, riboflavin, iron, iodine and other mineral elements (Olusanya, 2008). The main contribution of fruits in nutrition is vitamins and the main source from which humans and animals derive their vitamins is from fruits and vegetables. Fruits and vegetables provide vitamins and minerals in quantities high enough to provide the body with its needs (Olusanya, 2008).

Also, some of these fruits are used in folklore medicine to salvage some diseases (Lawal et al., 2010; Okwu, 2005 and Rukangira et al., 2001). Some of these tropical fruits like soursop, cucumber, pineapple, and watermelon have increasingly gained global importance due to their medicinal, flavour, exotic aromatic and nutritional values (Adeola and Aworh, 2010).

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Fruit crops remain a part of human diet since the beginning of creation and are popular as ornamentals in many African homes [Wenkam, 1990; Okwu and Emenike, 2006].

Soursop, which is known scientifically as Annona muricata L.(Annonaceae family), is described by many other common names such as guanabana, graviola, corossol, guyabano, depending on the geographic location of the plant (Samson, 1986). It is a heavily fruited, low-branching tree crop belonging to the family "Annonaceae" with about 60 representative species known mostly for its edible fruits referred to as Anona (Okigbo and Obire, 2009). The fruits are large, variably shaped, highly prized for their pleasant aromatic, juicy flesh, distinctive flavor and may be consumed raw (fresh), cooked or fermented. It could also be processed into different products of economic values among which is juice, and it has many therapeutic properties such as; diuretic, antiurethritis, antihaematuria, antibacterial, anticancerous, astringent, sedative, and anti-aging attributes. Soursop fruit juice is also reported to be rich in nutrients such as amino acids, vitamins especially ascorbic acid, fibres, proteins, unsaturated fats and essential minerals (Bello et al., 2008 ; Okigbo and Obire, 2009)

The species Citrullus lanatus (watermelon) belong to Cucurbitaceae family, which consists of nearly 100 genera and over 750 species (Collins, et al., 2007). They are widely distributed in the tropics and subtropics, and a few species occur in temperate regions.

It is an economically important fruit crop and valuable alternative source of water in desert areas. It is a good source of lycopene, citrulline and important minerals and vitamins (Collins, et al., 2007). It has the highest lycopene content among fresh fruits and vegetables; watermelon contains 60% more lycopene than tomato. Lycopene in the human diet is associated with prevention of heart attacks and certain cancers (Seddon et al., 2004). Rind of watermelon contains an important natural compound called citrulline, an amino acid that the human body makes from food. Citrulline is found in high concentration in liver, and is involved with athletic ability and functioning of the immune system (Perkins-Veazie et al., 2001). It is a good source of fibre, which is important for keeping digestive tract operating properly by preventing constipation, hemorrhoids and diverticular disease (Sodeke, et al., 2005).

Pineapple is a source of bromelain, which is a protein digesting enzyme. Pineapple cultivation is confined to the area of the high rainfall and humid coastal regions in the peninsular India and to the hilly areas of North Eastern region of the country. Pineapple (Ananas comosus) is a tropical plant with an edible and multiple fruits consisting of coalesced berries named for resembling of the pine cone (Bello, 2008)). It is the most economically important plant in the Bromeliacea family. Pineapple is an important food, which can be eaten fresh or in a processed form. It is composed of nutrients, which are good for human health. This is due to researches carried out on the relationship between nutrients in pineapple and human health (Ekpete and Edori, 2013). According to Bajai (2001), pineapple contains antioxidants such as flavonoids, vitamin A and C respectively. These antioxidants reduce the oxidative damage caused by free radicals and chelating of metal ions. It also has the enzyme complex protease (bromelain).

The cucumber (Cucumis sativus) is a widely cultivated plant in the gourd family "Cucurbitaceae", which includes squash, and in the same genus as the muskmelon. Having an enclosed seed and developing from a flower, botanically speaking, cucumbers are classified as fruits. However, much like tomatoes and squash, they are often perceived, prepared and eaten as vegetables (Adebooye et al., 2005 ; Mallik and Akhter, 2012).

This study primarily focuses on the evaluation of proximate composition and phytochemical quantification of the aforementioned fruits with emphasis on their comparative predominance.

MATERIALS AND METHODS:

Chemicals

All chemicals or reagents used in this study were of analytical grades.

Collection and Preparation of Fruit Samples

The various fruits namely: Annona Muricata (soursop), Annanas Comosus (Pineapple), Cucumis Sativus (Cucumber) and Citrullus Lanatus (watermelon) were purchased from the local markets in Oghara (Oghareki and Ogharefe) in Ethiope West Local Government area of Delta State, and identified at the Department of Botany, University of Benin, Benin City, Nigeria. The fruits were thoroughly washed with tap water. The outer skin of the fruits were scrapped off using a sharp knife. The seeds were also removed. Each edible and tender portion of

the fruits was dried and a known weight of each fresh fruit was used for moisture content determination, while the rest of the samples were dried, pulverized and used for the determination of crude protein, lipid, fibre, ash content, carbohydrate and for phytochemical analysis.

Proximate analysis

Moisture content determination: Two grams of the fresh sample of each fruit was placed in the crucible and heated at 105˚ C until a constant weight was attained. The moisture content of each fruit was calculated as loss in weight of the original sample and expressed as percentage moisture content (FAO, 1980).

Determination of crude protein: The crude protein was determined by the Kjeldahl method with slight modification. 0.5 g of the powdery form of each fruit sample was digested with 5ml of concentrated sulphuric acid in the presence of Kjeldahl catalyst. The nitrogen from the protein in the sample was converted to ammonium sulphate that reacted with 2.5 ml of 2.5% Brucine reagent, 5 ml of 98 % sulphuric acid to give a coloured derivative and the absorbance read at 470 nm using spectrophotometer-23A(Spectrumlabs Inc, U.S.A).

The percentage nitrogen was calculated and multiplied by 6.25 to obtain the value of the crude protein (A.O.A.C., 1990).

Estimation of crude lipid: This estimation was performed using the Soxhlet extraction method. Ten grams of the powdery form of each fruit sample were weighed and wrapped with a filter paper and placed in a thimble. The thimble was covered with cotton wool and placed in the extraction column that was connected to a condenser. 200 ml of n – Hexane was used to extract the lipid for 2hours (A.O.A.C., 1990).

Determination of crude fibre: The estimation was done using the method of A.O.A.C. (1990). Five grams of the powdery form of each fruit sample and 200 ml of 1.25 % H2SO4 were heated for 30 min and filtered with a Buchner funnel. The residue was washed with distilled water until it was acid free. 200 ml of 1.25% NaOH was used to boil the residue for 30 minutes, it was filtered and washed several times with distilled water until it was alkaline free. It was then rinsed once with 10% HCl and twice with ethanol. Finally it was rinsed with petroleum ether three times. The residue was put in a crucible and dried at 105oC in an oven overnight. After cooling in a desiccator, it was ignited in a muffle furnace, (Deluxe model-A12451, ATICO Medical Pvt. Ltd, India), at 550oC for 90 minutes to obtain the weight of the ash.

Determination of ash content: This was done using the method of A.O.A.C (1990). The total ash content of a substance is the percentage of inorganic residue remaining after the organic matter has been ignited. 2 g of the pulverized and dried fruit samples were placed in a crucible and ignited in a muffle furnace at 550oC for 6 hours. It was then cooled in a desiccator and weighed at room temperature to get the weight of the ash.

Carbohydrate determination: The carbohydrate content was determined by subtracting the summed up percentage compositions of moisture, protein, lipid, fibre, and ash contents from 100 (Otitoju, 2009).

Quantitative Determination of Phytochemicals in Fruit Samples:

Determination of phytate: Spectrophotometric method was used in the determination of phytate. 1g of the pulverized and dried fruit samples was dissolved in 25 ml of 0.5 M HNO3 and centrifuged at 4,000rpm for 10 min. 1ml of 0.03 M ferric solution was added to the supernatant and left to stand for 15 minutes in order to allow chelation of the iron molecules by the indigenous plant's phytate. At the end of the incubation, it was capped and heated for 20 min, 7.5 ml of distilled water was added to it and vortexed. Thereafter, 0.1 ml of 1.33 M NH4SCN (Ammonium sulphocyanide) solution was added and absorbance read at 465nm. The amount of phytate was extrapolated from a standard calibration curve for calcium phytate.

Determination of oxalate: The titrimetric method of Day and Underwood (1986) was used in the determination of oxalate in each fruit sample. 150 ml of 15N H2SO4 was added to 5 g of the pulverized fruit samples each, and the solution was carefully stirred intermittently with a magnetic stirrer for 30 minutes and filtered using Whatman No 1 filter paper, after which 25 ml of the filtrate was collected and titrated against 0.1 N KMnO4 solution until a faint pink color appeared that persisted for 30 seconds.

Determination of total phenol: Total phenols were determined by Folin ciocalteau reagent (Malik and Singh, 1980) A dilute solution of each fruit extract or gallic acid (standard phenolic compound) was mixed with Folin ciocalteau reagent (5ml of 1:10 diluted

with distilled water) and 2ml of aqueous Na2CO3 (20%). The mixtures were allowed to stand for 15minutes and the total phenol was determined by colorimetry at 765nm. The standard curve was prepared. The total phenol values are expressed in terms of gallic acid equivalent (mg/g of dry mass), which is a common reference compound.

Determination of alkaloid: Alkaloids were determined by gravimetric method of Harborne (1973). Five grams of the pulverized fruit samples were weighed into a conical flask containing 50 ml of 10 % ammonium hydroxide, the mixture stirred and allowed to stand for 4 hours, before filtering.The filtrate was evaporated to one quarter of its original volume on a hot plate and concentrated ammonium hydroxide solution was added drop-wise to the mixture in order to precipitate the alkaloids. The precipitate was filtered using a weighted filter paper and washed with 10 % ammonium hydroxide solution. The precipitate was dried with the filter paper in an oven at 60oC for 30 minutes and then reweighed.

Determination of tannin: Spectrophotometric method of Trease and Evans (1989) was used in the determination of tannin in the four selected fruit samples. Five grams each of the powdery form of fruit samples were extracted with 20ml of warm water and filtered. 0.5ml of the filtrate was added to 0.5 ml of 0.5M ferric solution in an alkaline medium and allowed to stand for 30 minutes for color development. The absorbance was read at 760 nm and the amount of tannin was extrapolated from a standard calibration curve for tannic acid.

Determination of Cyanogenic Glycosides:

The AOAC, (1990) method was adopted. 4g of each fruit sample was soaked in a mixture containing 40ml of distilled water and 2ml of orthophosphoric acid. The mixture was stirred, stopped and left overnight at room temperature to set free all bounded hydrocyanic acid. The resulting sample was transferred to a distillation flask and a drop of paraffin was added. The distillation flask was fitted to the distillation apparatus before distillation. About 5ml of distillate was collected into the receiving flask containing 40ml of distilled water and 0.1gNaOH pellet. The distillate was then transferred into a 25ml volumetric flask and made up to mark with distilled water. 20ml aliquot of the distillate was measured into a conical flask and 1.6ml of 5% potassium iodide was added to the flask. The resulting mixture was titrated against 0.01MAgNO3 untill the end point was indicated by a faint but permanent turbidity. The blank was also prepared using distilled water instead of the distillate. Cyanogenic glycoside was then calculated on the basis of the difference in titre values of distillate and blank.

Statistical Analysis: Triplicate data of various assay results were expressed as mean ± standard error of mean (S.E.M). Statistical comparison, as test of significance, was performed by one factor analysis of variance (ANOVA;LSD, DUNCAN and SNK tests), using the statistical package for social sciences version 20.0,(SPSS Inc, Chicago II, USA). $P<0.05$ was considered significant.

RESULTS AND DISCUSSION

Proximate composition, which includes; moisture, ash, fat, protein, crude fibre and carbohydrate of the selected fruits as shown in Table 1.0 . indicated significant difference at $p<0.05$, and all data obtained in this part of the study were from wet basis and expressed as percentage (%). Although literature regarding the comparative investigation of these fruits is lacking, however, the proximate composition of each fruit, that is Annona muricata, Ananas comosus, Citrullus lanatus and Cucumis sativus is consistent with the reports given by Ekpete and Edori, (2013) and Okoye, (2013).

Moisture content was significantly different among the fruits with a range of 10.97% to 47.01%. Moisture determination in the selected fruits, therefore, showed the following trend; Annona muricata<Ananas comosus<Cucumis sativus<Citrullus lanatus. This trend of study does conform with the report of Ekpete and Edori, (2013) that involves a comparative study of Citrullus lanatus, Ananas comosus and Annona muricata among other fruits respectively.All the fruits studied had a considerable level of moisture content which is typical of fresh fruits at maturity (Umoh, 1998).The increasing magnitude of moisture content is consequently a function of degree of perishability as a result of microbial contamination with reference to adequate storage facilities. The moisture contents of the fruit samples were increasingly and relatively high, which invariably makes them good sources of hydration for the body as well as possessing the ability to quench thirst (Ogbonna et al., 2013).

There was a significant difference at $p < 0.05$ in the protein content among the four samples with the protein content ranging from 1.63% to 13.34%. Annona muricata had the highest protein content with 13.34% followed by 8.63% in Citrullus lanatus,

6.36% in Ananas comosus and 1.63% in Cucumis sativus respectively.

Table 1.0. Results of proximate analyses of four fruits

Samples	**%Moisture**	**%Protein**	**% Ash**	**% Fibre**	**%Lipids**	**%Carbohydrate**
Cucumis sativus	41.97 ± 0.60^{a}	1.63 ± 0.02^{e}	0.21 ± 0.00^{a}	0.39 ± 0.01^{b}	0.14 ± 0.00^{e}	55.66 ± 0.78^{a}
Ananas comosus	33.41 ± 0.72^{b}	6.36 ± 0.13^{f}	0.31 ± 0.01^{b}	0.62 ± 0.01^{a}	0.11 ± 0.00^{f}	59.19 ± 1.24^{b}
Annona muricata	10.97 ± 0.30^{c}	13.34 ± 0.37^{g}	0.39 ± 0.01^{c}	0.54 ± 0.01^{c}	0.10 ± 0.00^{g}	74.66 ± 0.21^{c}
Citrullus lanatus	47.01 ± 1.62^{d}	8.63 ± 0.29^{h}	0.37 ± 0.01^{d}	0.99 ± 0.04^{b}	0.24 ± 0.01^{h}	442.74 ± 1.56^{d}

* Values are % mean ± SEM of triplicate determinations. All values designated with superscript of different letters down each column were considered statistically significant at 95% confidence interval ($p<0.05$)

Proteins are essential components of diets needed for survival of animals and humans, their basic function in nutrition is to supply adequate amounts of required amino acids in nutrition (Pugalenthal et al., 2004). Protein deficiency causes growth retardation, muscle wasting, edema, abnormal swelling of the belly and collection of fluids in the body (Perkins – Veazie et al., 2005). In this present study, therefore, Annona muricata could be considered as the best source of dietary protein as compared with the other fruits.

There was a significant difference in the ash content among all the samples at $p < 0.05$ as well. The amount of ash in the samples was generally low, which includes metal salts and trace minerals. Amongst the four fruits, there is an increasing magnitude of ash composition in this order; Cucumis sativus<Anonas comosus<Citrullus lanatus<Annona muricata. The amount of ash present can be translated to be the quantity of minerals present in the fruit samples (Coimbra and Jorge, 2011). The ash content value conformed favourably with most fruits value (Brain and Alan, 1992) but lower than those reported by (Amoo and Lajide, 1999 and Bello et al., 2008). This study revealed that Annona muricata had the highest ash value, though significantly low. Therefore, samples with high percentages of ash contents are expected to have high concentrations of various mineral elements, which are expected to speed up metabolic processes and improve growth and development (Bello et al.,2008 ; Ekpete and Edori, 2013).

As for fibre content, the values only indicate a part of the actual dietary fibre available in the samples. There was significant difference among the four fruits; Citrullus lanatus had the highest crude fibre content followed by Ananas comosus, Annona muricata and Cucumis sativus respectively. Hassan et al.,(2009) reported that foods rich in dietary fibre contributes to the prevention of various diseases such as constipation, hemorrhoids, colon cancer, excess cholesterol, diabetes and diverticulitis.In view of the comparative assessment of the four fruits, Citrullus lanatus may be the best source of dietary fibre for the management of the aforesaid pathological conditions.

Fat content in the samples was very low overall, which is common for fruits (Lim and Rabeta, 2013). Although the fat contents in the fruits were generally and significantly very low, Citrullus lanatus had the highest fat content followed by Cucumis sativus, Ananas comosus and and Annona muricata respectively. Sheila, (1978) also reported that fruits are not very good sources of fats and are thus recommended as part of weight reducing diets as observed in the pulps of the selected fruits.

Last but not least, significant difference was found among the four fruit samples in their carbohydrate content at $p < 0.05$. The carbohydrate content ranged from 42.76% to 74.66% , which were considerably high and can be good sources of energy (Adeleke and Abiodun, 2010). The increasing magnitude of carbohydrate in the respective fruit samples may be given as Citrullus lanatus< Cucumis sativus < Ananas comosus <Annona muricata. Citrullus lanatus and Annona muricata comparatively formed the minimum and maximum range limits by 45.26% and 76.67% respectively. It was reported that fruit samples with low carbohydrate content might be ideal for diabetic and hypertensive patients requiring low sugar diets (Ekpete and Edori, 2013).Therefore, Annona muricata with the highest carbohydrate content among other comparable fruits may not be a recommendable fruit source in the management of diabetes and other related diseases.

Phytochemicals also known as phytonutrients are naturally occurring substances found in plants (Udeme et al., 2012;Ugwu et al., 2013). These substances have been found to be beneficial to human health as well as possessing antioxidant activity (Rafat et al., 2008).However, some of these bioactive substances are also anti-nutrients since they render some of the essential nutrients unavailable for human nutrition (Okunrobo et al., 2012).The quantitative phytochemical screening as shown in Table 2.0 revealed that the four fruits confirmed the presence of tannins, phenols, alkaloids, phytate, oxalate, but devoid of cyanogenic glycosides. Results obtained in this study showed significant difference among the four fruits at $p<0.05$. Although literatures regarding the comparative study of these fruits are lacking, however, the phytochemical screening of the individual four fruits is in line with the report of Ramesh et al.,(2013); Ikeyi et al.,(2013); Mallik and Akhter, (2012), and Okunrobo et al.,(2012).

Table 2.0: Quantitative results of phytochemicals of four fruits expressed in mg/100gfresh weight of fruit.

Samples	**Phytate**	**Oxalate**	**Tanins**	**Phenol**	**Alkaloid**	**Glycoside**
Cucumis sativus	1.95 ± 0.30^{a}	5.12 ± 0.07^{e}	0.84 ± 0.01^{a}	5.78 ± 0.08^{e}	0.74 ± 0.01^{a}	0.00 ± 0.00^{a}
Ananas comosus	0.18 ± 0.01^{b}	12.48±0.27f	0.73 ± 0.14^{b}	13.47 ± 0.29^{f}	0.63±0.01b	0.00 ± 0.00^{a}
Annona muricata	2.79 ± 0.08^{c}	21.90 ± 0.61^{g}	0.94 ± 0.03^{c}	23.41 ± 0.69^{g}	0.84 ± 0.03^{c}	0.04 ± 0.00^{a}
Citrullus lanatus	0.24 ± 0.01^{d}	13.39 ± 0.46^{h}	0.69 ± 0.02^{d}	13.50 ± 0.47^{h}	0.59±0.21d	0.00 ± 0.00^{a}

* Values are % mean ± SEM of triplicate determinations. All valuesdesignated with superscript of different letters were considered significant at 95% confidence interval ($p<0.05$)

Although there was low significant difference in the concentration of tannins among the four fruits at $P<0.05$ confidence interval, Annona muricata constitutes the highest level of tannin concentration by 0.94mg/100g fresh weight(FW) of fruits followed by 0.84mg/100gFW tannin in Cucumis sativus, 0.73mg/100gFw in Ananas comosus and 0.69mg/100gFW in Citrullus lanatus respectively. Tannins have been found to form reversible complexes with proline-rich proteins, resulting in the inhibition of the cell protein synthesis. Plants that have tannins as their main components are astringent in nature and are used for treating of intestinal disorders such as diarrhoea and dysentery (Bajai, 2001).

There was a rematkable significant difference at $p<0.05$ in the concentration of phenols in the respective fruits. However, Annona muricata had the highest phenolic content followed by Ananas comosus,. Citrullus lanatus, and least in Cucumis sativus. Therefore, the increasing trend of phenolic concentration in the respective fruits is; Cucumis sativus < Ananas comosus < Citrullus lanatus < Annona muricata. Phenolics essentially represent a host of natural antioxidants, used as nutraceuticals, and found in other fruits for their enormous ability to combat cancer, and are also thought to prevent heart ailments to an appreciable degree and sometimes are anti-inflammatory agents (Vlietinck, 2000; Sarker and Nahar., 2007).

With respect to alkaloids in the fruit samples, there was marked significant difference ($p<0.05$). However, Annona muricata holds the highest concentration of alkaloid followed by Cucumis sativus, Ananas comosus and Citrullus lanatus respectively. Alkaloids have pharmacological applications as anesthetics and CNS stimulants (Madziga et al., 2010). Therefore, the comparative study clearly indicates that Annona muricata may likely elicits the highest pharmacological property as an anesthetic and CNS stimulant.

All four fruits were significantly devoid of cyanogenic glycoside as this confirmed the report of Sarker and Nahar, (2007) that excessive ingestion of cyanogenic glycoside may be fatal. The absence of cyanogenic glycoside in the fruits is recommendable for healthy state, and therefore, falls within the set lethal value of 0.07mg/kg put forward by EPA, (1998).

The concentrations of phytate in the fruits were significantly low ($p<0.05$). The increasing trend in the concentration of phytate in Ananas comosus, Citrullus lanatus, Cucumis sativus and Annona muricata, are 0.18, 0.24, 1.95 and 2.79mg/100gFW.The knowledge of phytate levels in food is necessary because high concentration can cause complicated effect in human system including indigestion of food and flatulence (Nwoko and Bragg, 2000). Phytic acid intake of 4.00– 9.00mg/g, reduces iron absorption by 4–5 folds in humans (Hurrel, 2003). But phytate in moderate levels has an antioxidant effect and also prevents colon cancers by reducing oxidative stress in the lumen of intestinal tracts. On the other hand, there was low significant difference in the oxalate content of the fruit samples.

This was observed in Annona muricata with maximum oxalate concentration of 21.90mg/100gFW and Cucumis sativus with the minimum limit of oxalate concentration of 5.12mg/gFW compared to Citrullus lanatus (13.39mg/100gFW) and Ananas comosus (12.49mg/100gFW) respectively. WHO and FAO, (2003) reported that a daily intake of 450mg of oxalic acid has been reported to interfere with various metabolic processes. Therefore, the values obtained for phytate and oxalate are lower than the lethal dosage reported in other studies, while the toxic effect of these anti-nutrients may not occur when these fruits are consumed because their levels are not enough to elicit toxicity.

CONCLUSION

The results of this comparative study explicitly demonstrates conclusively that Ananas comosus (pineapple), Citrullus lanatus (watermelon), Cucumis sativus (cucumber) and Annona muricata are rich sources of nutrients and phytochemicals, though with predominant amount in some of the fruits, and should be strongly recommended for the maintenance of good health. However, further toxicity studies, identification and characterisation of the nutritional and anti-nutritional constituents of these fruits should be carried out in order to know more of the nutritional constituents of the fruits and safe consumption levels of these fruits.

ACKNOWLEDGEMENT

We are highly thankful to the Department of Biochemistry, Western Delta University Oghara for providing necessary facility to complete this work.

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