The Determination of Nutrients Composition of Selected Edible Fruits (Banana and Watermelon) and Economic Environmental Impacts of their Peels

Okpala, E. E and Chris-Okafor, P. U

Department of Pure and Industrial Chemistry, Faculty of Physical Sciences, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria. P.M.B. 5025

DOI: https://doi.org/10.51584/IJRIAS.2024.912004

Received: 09 November 2024; Accepted: 15 November 2024; Published: 27 December 2024

ABSTRACT

Evaluation of the nutrients composition, glycemic index(GI), and glycemic load(GL) values of some edible fruits was conducted to assess their nutritional benefits and impact on human health. The comparative study of nutritional compositions of the two edible fruits and the economic environmental impact of their peels is focused to determine the essential nutrients and possible chemical compositions present in the selected fruits (banana, watermelon). These were achieved by exploring their physico-chemical properties via physico chemical methods according to Association of official analytical chemists (AOAC methods of 2019). The proximate composition analysis showed that banana has the highest energy, protein and fibre contents of 384KJ, 1.030g and 2.48g respectively, while watermelon has the highest water content of 92g with the least energy content of 132KJ. GI and GL analysis showed that banana has the least GI of 46.5% and highest GL of 12.0%, while watermelon has the highest GI value of 73% with a very low GL of 5.4%. The study will provide base-line information on the nutrient composition of some edible fruits. The information will be of use to Dieticians, Nutritionists and Home Economic Extension Staff in their nutrition Education program to popularize the fruits. The study will help in the estimation of dietary requirement of the two common fruits. The accurate information on the nutrient composition of these fruits will also help to integrate them in the food-based approach for fighting micronutrients deficiency. Furthermore; The knowledge of this work will boost people's interest especially chemists to develop more research on compositional analysis of fruits to serve food processing industries, pharmaceutical industries, juice extraction industries, etc. The method used in this research will be useful in forensic examination of imported fruit juice of all kinds as the method is very simple and understandable. The peels from these fruits can be used to generate bioenergy since they are organic matters and serve as some of methane.

Keywords: Banana, watermelon, Nutrients, Glycemic index/load, Peels and Gas monitoring instrument (GMI surveyor).

INTRODUCTION

Fruits (banana and watermelon) play a vital role in human diet, enticing with their delightful taste and visually appealing appearance. Fruits (banana and watermelon) are considered as indispensable contributors to a balanced nutritional intake since they supply vitamins, minerals, dietary fibre and several phytochemicals (Carter, Gray, *et al.*, 2010).

The diverse climatic conditions across Nigeria provide an optimal environment for cultivation of extensive array of fruits. Health professionals encourage the consumption of fruits (banana and watermelon) in our daily diet. Banana and watermelon are low in fat and are attractive options as part of a nutritionally balanced diet. Their volatiles are rich in pleasing ester notes, and their simple sugars are often well balanced with organic acids offering characteristic flavors. In addition to providing simple sugars, vitamins, minerals, and dietary fiber, fruits contain a number of bio-active components, notably polyphenolics, which have purported health benefits (Nehir and Simsek 2012). Nutrients obtained from the diet are important for the energy supply and

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume IX Issue XII December 2024

functional maintenance of human bodies and environment. Therefore, for any food product, nutritional contents should be accurately analyzed and clearly labeled to comply with regulations and retailer specifications. More importantly, understanding the chemical and nutritional content is also an intrinsic part of new product development and quality control (Miller and Cassady 2015).

Unit operations for fruit processing may include steps for separating various components (peeling, juicing, etc.), inactivating enzymes (blanching), and extending shelf-life (drying, freezing, pasteurizing, canning, etc.). Analytical methods can, and should, be applied to almost every stage of a fruit's life cycle from growth in an orchard to eventual purchase and consumption (Park *et al.,* 2014).

These forms of controls continued for ∼100 years until the 1970s, when rapid advances in analytical chemistry, food science and technology revolutionized the manufacture of food. Global nutritional needs based on human nutritional requirement for healthy living, alarming rise in diabetes mellitus and series of other challenges resulting from environmental pollutions based on solid waste generation is predicted to increase from about 4.5 million per day in 2020 to more than 7.5 million per day in 2030 according to WHO.

Aim and Objectives of the Study

The aim of this research is focused on the comparative study of nutritional compositions of some edible fruits and economic environmental impacts of their peels. The aim was achieved through the following Objectives:

i. Identification of nutritional composition of edible fruits.
ii. Determination and characterization of the fruits to identify their physico-chemical properties.
iii. Ascertain the GI and GL of the two edible fruits analyzed.

Determination of the methane, CH_4 (biogas), and eco-friendly ozone layer gases (hydrogen, H_2 and oxygen, O_2) in the fruits peels.

LITERATURE REVIEW

The term fruits have different meaning. Botanically, a fruit is the ripened ovary together with seeds of a flowering plant. In many species, the fruit incorporates the ripened ovary and surrounding tissues. Fruits are the means by which flowering plants disseminate seeds (Lewis 2002), in cuisine fruits that are sweet and fleshy, examples of which include apple and orange (Nweze *et al.,* 2015). However, a great many common fruits as well as nuts and grains are the fruit of the plant species they come from (Emmanuel and Deborah 2018). Majority of the fruits are fleshly or juicy (Ojeifo 2007).

Fruits can be analyzed for their physical and chemical properties, as well as their safety and quality. For instance, fruit packers require methods for rapidly sizing fruits to reduce excessive packaging and to prevent damage during shipping (Prusky 2011). Manufacturers of fruit products must know the soluble solids content of fruits entering the processing stream to provide consistent products. Mycological analysis of a fruit sample aids with decision making in processing operations and in determining if the fruit is safe for consumption.

Before any analysis is performed, samples must be prepared to afford meaningful information. Even simple analyses require care in selecting, cleaning, orienting, and/or homogenizing samples prior to taking a measurement. More complex analyses often involve steps to overcome interferences from the sample matrix before the analyte-of-interest can be identified or quantitated. Hence, sample preparation is an essential part of any analysis and it is estimated that 61% of the time spent performing an analysis is used to prepare a representative sample. It is also estimated that 30% of experimental error can be attributed to improper sample preparation (Namieśnik, and Szefer 2008).

Gap in Literature

Although, series of research has been carried out by scholars on some edible fruits, but some vital nutrients compositions, glycemic index/ glycemic load, side effects of these fruits and the various impact of their peels in energy generation to meet numerous human nutritional/industrial needs and solve some environmental

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume IX Issue XII December 2024

problems have not been properly emphasized.

METHODOLOGY

Materials/sample: Banana, Watermelon, Lime, Filter paper, Litmus/p^H indicator paper and Aluminum foil.

Cutting/measuring tools: Table knife, Stop watch (Display size- 33.67 x 13.6mm; manufactured by Trimurti Enterprises, Mahal, Nagpur), Conical flask (100mL, 250 mL), Volumetric flasks (1000mL, 250mL), Metal spatula (stainless), Burettes, Beakers (1000mL, 500mL, 350mL, 250mL,100mL), Pipettes (25mL, 10mL, 5mL), Thermometer (0 – 110^0C), Saccharometer (Manufactured by Ludwig Schneider; Model No – LSW2012), Saccharometer Can (Manufactured by Ludwig Schneider; Model No – LSW2012), Mettler Balance, Resort Stand (Made in China), Digital Conductivity and pH Meter (LABTECH – England Specification).

Separation/steering tools: Filtration pump/Vacuum pump, Glass rod (stirrer), Filtration flasks and Funnels, Centrifuge (Manufactured by United Scientific, Model No – Digicen 21R).

Advanced analytical tools: Spectrostar Nano (Brand of Spectrometer by BMG LABTECH), Cuvettes/Microplates Reader - 10mm (Manufactured by BMG LABTECH), Digital AAS (Single Beam), GC-MS (+2010, Shimadzu, Japan), Digital UV/VIS Spectrometer, X-ray Florescence Photometer (XRF), Teledyne GMI leak Surveyor 500 series (by Teledyne Technologies GF -30220B_EN, IP 54).

Heating/drying equipment: Tripod stand and Gauze, Burner (Bunsen burner), Oven, Desiccator containing Desiccant (Silka gel), Test tubes, Water bath (By Tech Medical, USA, Model No. – HH – 420).

Sample Collection and Preparation:

Banana was collected from a farm at Ozulumba village, Awgbu town in Orumba North Local Government Area, while the water melon was purchased from fruits dealers at Eke-Awka market in Awka, both in Anambra state, Nigeria. Each of the sample was sealed with a clean polyethylene bag immediately after collection. The fruits were properly washed with distilled water to avoid contamination. Edible portions of the fruits were peeled separately, cut into pieces and homogenized using a blender. The homogenized samples were then transferred each into an air tight container prior to the analysis.

Chemical Analysis

The100g of raw edible portion of each sample was weighed out in the laboratory before extracting the juice to the nearest milligram and transferred into 100mL beakers for chemical analysis. Each sample was homogenized separately and aliquots was taken from each sample for moisture analysis. Proximate and ultimate analysis was used in the analysis; while minerals, vitamin and other composition of the samples was also determined using AOAC methods of 2019.

Proximate Composition Analysis

Moisture determination

This were done by hot air oven method according to Pearson (2010).

2g of samples were weighed into an empty aluminum dish with a known weight.

The dish and samples were dried in an air oven at 100^0C for 24 hours and cooled in desiccator and re-weighed.

The process was repeated until constant weight is obtained.

$$\% \ Moisture = \frac{(W_2 - W_3)}{(W_3 - W_1)} \times \frac{100}{1} \qquad \text{..... equation (1)}$$

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume IX Issue XII December 2024

Where W_1 = weight of empty dish (g)

W_2 = initial weight of dish (g) + weight of sample (g)

W_3 = final weight of dish (g) + weight of sample (g)

Protein determination

The micro-Kedah method AOAC (2019) involves digestion and distillation. It was used to obtain the protein content of the samples.

Digestion

1g of each sample were weighed into a 100ml Kjeldahl flask.

1. 25g of anhydrous sodium sulphate, 5g copper sulphate (catalyst) and 5ml of concentrated sulphuric acid were also added.

2. The flask was placed in fume chamber and heated gently until the solution turns black, then the heat was cooled, washed and transferred into a 250 volumetric flask and rinsed down with distilled water.

Titration

1. The distillate was titrated with 0.1 hydrochloric acid (HCl) until a neutral point was reached (faint purple)

2. Titre value (T) = final burette reading-initial burette reading.

$$\%\ Protein = \frac{(14.01 \times 100 \times 6.25) \times T}{100} \qquad \text{..... equation (2)}$$

Fat determination

Fat was estimated by the Soxhlet extraction (AOAC, 2019) procedure

1. 2g of samples were weighed into dry Soxhlet thimbles

2. The thimbles were suspended in a beaker and dried to a constant weight in an oven and then placed in a soxhlet condenser containing ether.

3. A reflux condenser was attached to the contracted tube and heated, ether was returned to the flask with fat when the thimble was full.

4. The extraction was continued for about 6 hours at 120^{o}C

5. The flask and fat were drained in air to evaporate the ether and weighed to a constantweight.

6. The fat was washed off with a fat solvent, dried and weighed again.

$$\%\ Fat = \frac{(W_2 - W_1)}{Weight\ of\ sample\ (2g)} \times \frac{100}{1} \qquad \text{..... equation (3)}$$

Where W_1 = weight of flask (g), W_2 = weight of flask + fat extract (g)

Ash determination

1. 1g of sample was placed in a clean crucible of known weight. The crucible was placed in a muffle furnace at 600^{0}C over night or 24 hours.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume IX Issue XII December 2024

2. The crucible and content was cooled in a desiccator and weighed again.

$$\%\ Ash = \frac{(W_2 - W_1)}{1g} \times \frac{100}{1} \quad \textbf{……..equation (4)}$$

Where W_1 = weight of crucible (g). W_2= weight of crucible and ash (g)

Fiber determination

The fiber content of the samples was determined by using AOAC (2019) method

1. 2g grams of the sample was placed in a 250mL beaker, boiled for 30 minutes with a 100mL (0.12M) H_2SO_4 and filtered through a funnel.

2. The filtrate was washed with boiled water until the washing were no longer acidic.

3. The solution was boiled for another 30 minutes with 100mL of 0.12M sodium hydroxide solution filtered three times with hot water and methylated spirit.

4. The residue was transferred into a crucible and dried in an oven for 1 hour. The crucible and its content were cooled in a desiccator, and re-weighed (W_2). The crucible and its contents were taken to a furnace for ashing for 1 hour.

5. The ash sample was removed from the furnace after temperature had cooled and put into a desiccator and was weighed (W_3). The crude fiber content was obtained between the weight before and after incineration. The percent of the crude fiber was calculated thus.

$$\%\ fibre = \frac{(W_2 - W_3)}{W_1} \times \frac{100}{1} \quad \textbf{…… equation (5)}$$

Where W_1 = weight of crucible (g)

W_2 = initial weight of sample and crucible (g)

W_3 = final weight of sample and crucible (g)

Carbohydrate determination

This was determined by difference i.e. % Carbohydrate = 100 - (% Moisture + % Protein + % Fat + % Ash + % Fiber)

The GI is calculated as the incremental area under the glucose curve (IAUC) after the test food is eaten, divided by the corresponding IAUC after the control food (pure glucose) is eaten. The value is multiplied by 100 to represent a percentage of the control food (The University of Sydney, About Glycemic Index, 1/4/22.):

$$\textbf{GI} = \frac{iAUC test\ food}{iAUC glucose} \times 100 \quad \textbf{…….. equation (6)}$$

Where GI – glycemic index

Glycemic index of a mixed meal, fruits or diets

Many observational studies have examined the association between GI and risk of chronic disease, relying on published GI values of individual fruits and foods, using the following formula to calculate meal (or diet) GI (Dodd H., *et al*., 2011):

Meal GI = [(GI x amount of available carbohydrate) in Fruit/Food A + (GI x amount of available carbohydrate) in Food B +…] / total amount of available carbohydrate **……equation (7)**

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume IX Issue XII December 2024

Methods of calculating glycemic load (GL)

The concept of (GL) was developed by scientists to simultaneously describe the quality (GI) and quantity of carbohydrate in fruits, food serving, meal, or diet. The GL of a single food is calculated by multiplying the GI by the amount of carbohydrate in grams (g) provided by a food serving and then dividing the total by 100 (Monro J. A., Shaw M., 2008):

GL of Fruits/Food = (GI Food x amount (g) of available carbohydrate Food per serving)/100

……equation (8)

Simple Combustion Flame Test for Biogas Detection by Burning Dried Peels in Crucible

The peels collected from the fruits analyzed were shared into two parts, one part was partly oven dried in oven at 60^{o}C for 45 minutes to reduce their water content, and then further sprayed and allowed to continue drying for 10 days, then further dried again in oven to ensure complete dryness at 60^{o}C for one hour (60 mintes), then placed in a crucible and ignited with long gas lighter as source of combustion flame.

Blue Flame Detection

The processed dried peels burn with exhibition of blue flame when placed in a crucible and ignited with long gas lighter as source of combustion flame.

Detection of Methane (Biogas), Hydrogen and Oxygen on Fruit Peel:

The presence of methane (biogas), hydrogen and oxygen present in fruit peels were identified using Teledyne GMI leak surveyor. This instrument gave the accurate readings of the percentage composition of methane, hydrogen and oxygen gases present in fruit peels.

The pretreatments were carried out with homogenized, chopped peels at 20 - 40^{o}C with peel and hexane ratio (w/v) ranging from 1:2 to 1:6 for 10 to 20 minutes. The pretreated peels were then digested in batch reactors for 21 days. The highest biogas production was achieved by treating chopped peels and hexane ratio of 1:6 at 20^{o}C for 10 minutes corresponding to more than threefold increase of biogas production from untreated peels.

The solvent recovery was 90% using vacuum filtration; this is because going through evaporation needs further separation, as the hexane residue in the peel has a negative impact on biogas production.

The values obtained were recorded.

Mineral Composition

AOAC (2019) wet digestion procedure was used to determine iron (Fe), iodine, (I_2), copper (Cu), calcium (Ca), zinc (Zn) and phosphorus (P) contents.

1. 5ml of Perchloric acid ($HClO_4$) and 10ml of Uric acid (7,9-Dihydro-1H-purine-2,6,8(3H)-trione) was heated under fume chamber, then the solution turned colourless and free of nitrogen. 1g of the sample was weighed into a 100ml round bottom flask and diluted into a known volume after being used for absorption spectrophotometer.

2. A spectrometric atomic absorption spectrophotometer (AAS) was used on a general principle that minerals are absorbed at different wavelengths, Fe (248.30nm), 1_2 (353.00nm), Cu (324.70nm), Zn (213.90nm), Ca (230.00nm) and P (470.00nm).

3. Readings were obtained against standard for each mineral and distilled water was used to zero the spectrophotometer after each reading.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume IX Issue XII December 2024

RESULTS AND DISCUSSION

The results of the analyses on the fruits and its peels are presented and discussed

Table 1: Properties of the two Selected Edible Fruits

FEATURES	**BANANA** *(Musa balbisiana)*	**WATER – MELON** *(Citrullus lanatus)*
Appearance and shape	Elongated and curved fruit	Lager fruit with a thick exocarp
Colour	Yellow	Mid-to dark green and usually mottled stripped with deep red flesh
Skin (outer) texture	Soft peel	Smooth and thick exocarp
Flavor	Sweet aroma	Very mild sweet aroma
Taste	Very sweet Taste	Very sweet and juicy
Flesh/Fruit texture	Soft flesh fruit	Juicy and crispy inner flesh
Seed content description	Seedless	Many dark brown seeds

Table 2: Proximate Composition of the two Selected Fruits

FRUITS	Energy (KJ)	Ash (%)	Protein (g)	Carbohydrate (g)	Fibre (g)	Moisture/Water (%/g)	Fat (g)	Cholesterol (mg)
BANANA *(Musa balbisiana)*	384	1.20	1.030	21.00	2.40	75	0.333	0
WATERMELON *(Citrullus lanatus)*	132	0.35	0.620	6.68	0.50	92	0.239	0

The results from the table as seen, has shown that banana has the highest energy of 384KJ which is attributed to its high sugar content, protein of 1.030g, fiber of 2.40g which enabled it to retain most vital nutrients present in the fruits which the plant absorbed from the soil and the ability of the fruit to absorb and retain energy from the sun through sunlight. It was also observed that watermelon as the name implies has the highest water content of 92g, with the least energy content of 132KJ, due to its thick exocarp as it retains water and absorbs lesser energy from the sun.

The fat contents of the two fruits analyzed as seen varied from 0.239g for watermelon to 0.333g for banana as maximum value, which are of non-significant value, which is attributed to the absence of saturated and trans fats that are rarely found most fruits bearing plants.

According to Bello, M. O., *et al*, (2008), fruits are not good sources of fat and are usually recommended as part of weight reduction diet.

Table 3: Mineral Composition of the two Selected Fruits

FRUITS	Calcium (mg)	Magnesium (mg)	Iron (mg)	Phosphorus (mg)	Potassium (mg)	Sodium (mg)	Zinc (mg)
BANANA *(Musa balbisiana)*	6.00	29.00	0.310	20.00	396	1.00	0.160
WATERMELON*(Citrullus lanatus)*	8.00	11.00	0.170	9.00	116	2.00	0.070

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume IX Issue XII December 2024

The results from table 3 as shown, presents the mineral composition of the two fruits analyzed. The values of results obtained in the analysis has shown that banana possess the highest mineral composition.

Banana also possess a very good mineral retaining tissues and some natural enzymes such as amylases and glycosidase which enables it to retain minerals like magnesium, phosphorus, and some amount of zinc while watermelon retain minerals like calcium and sodium.

Table 4: Values of the Vitamin Composition of the two Selected Fruits

FRUITS	Vitamin A (iu)	Vitamin B_1 (mg)	Vitamin B_2 (mg)	Niacin (mg)	Vitamin B_6 (mg)	Folate (µg)	Vitamin C (mg)	Vitamin B_{12} (µg)	Vitamin E (mg)
BANANA *(Musa balbisiana)*	8.00	0.045	0.100	0.740	0.578	19.10	9.10	0	0.270
WATERMELON*(Citrullus lanatus)*	37.00	0.190	0.020	0.310	0.144	2.20	9.60	0	0.150

Table 4 presents vitamin composition analysis of the two selected fruits. The values of the results obtained has shown that watermelon has the highest amount ogrff vitamins A and C, while banana has the highest amount of vitamin E. Banana possess the highest amount of folate (folic acid) composition compared to watermelon.

According to Bes-Rastrollo, M., (2006) the main contribution of fruits to nutrition is their supply of vitamins.

Table 5: Glycemic Index and Glycemic Load of two (2) selected fruits

S/N	**FRUIT3S**	**Glycemic Index (%)**		**Glycemic Load (%)**	
		Experimental Result	**WHO Range**	**Experimental Result**	**WHO Range**
1	Banana *(Musa balbisiana)*	46.5	51 - 62	12.0	13 - 16
2	Watermelon *(Citrullus lanatus)*	73.0	72 - 85	5.4	4 - 8

The result from table 5 as shown present the glycemic index and glycemic load of two (2) selected fruits. Banana has the least GI of 46.5% and high GL of 12.0% respectively, while watermelon has the highest GI value of 73% with a very low GL of 5.4%.

The variations on values of the GI and GL, especially the increase in GI and GL of some fruits analysed as it can be seen on watermelon, and consequently the increase in GI as it can be seen on Banana is a result of their varying natural soluble and insoluable fibre contents. According to Augustin L.S., et al., (2015), Dodd H., et al., (2011), Ludwig D.S., (2002) and Liu S, and Willett W.C., (2002) consumption of starchy fruits would lead to smaller increase in blood glucose than sugary fruits.

Table 6: Biogas and Ecofriendly Ozone Layer Gases in the Peels of the two Selected Fruits

FRUIT PEELS	**METHANE CH_4 (%)**	**HYDROGEN (H_2) (%)**	**OXYGEN (0_2) (%)**
Banana	21.5	5.0	2.0
Watermelon	15.0	4.5	3.0

The results from table 6 presents the biogas and ecofriendly ozone layer gases present in the peels of the fruits

analyzed. The values obtained from analysis using Teledyne GMI leak surveyor has shown that Banana peel has the highest percent of methane which possess the highest percent of Hydrogen gas respectively. The higher percent values of methane gas in Banana peels may be credited to the thick and biodegradable nature of their peels, which can easily decompose and transform naturally into biogas and high flammeable natural ecofriendly gases such as hydrogen. Watermelon peel on the other hand has enormous amount of methane, but possess the highest amount of oxygen gas which could be due to the large amount of water been retained on its thick exocarp due to its high crude fiber (cellulose) content. The peels collected from both fruits exhibited a sweet aromatic fragrance and burns with pure blue flame when dried at a low temperature after a mild oven dry at 60^{o}C for 45 mins to reduce the water content. According to Kha T.V., *et al* (2013), Silva De., K.K.H. *et al* (2017), and Ismail Z (2019), fruits wastes peels can be used to produce eco- enzymes, biosorbents and can be utilized for the synthesis of environmentally friendly materials, such as graphene based materials and green reductants.

CONCLUSION

The study highlighted the potentials of fruits and their peels in generating biogas, eco-enzymes and green reductants, emphasizing their role in sustainable energy production and environmental remediation. The proximate composition analysis shows that banana has the highest energy, protein and fibre contents of 384KJ, 1.030g and 2.40g respectively, while watermelon has the highest water content of 92g with the least energy content of 132KJ. The results obtained from the mineral composition analysis shows that banana possess the highest mineral composition. Watermelon has the highest amount of vitamins A and C, while banana has the highest amount of vitamin E. Banana possesses the highest amount of folate (folic acid) composition compared to watermelon. Glycemic index (GI) and glycemic load (GL) analysis shows that banana has the least GI of 46.5% and highest GL of 12%, while watermelon has the highest GI value of 73% with a very low GL of 5.4%. The teledyne GMI leak surveyor used in the fruit peels composition analysis shows that Banana has the highest percent of methane which possess the highest percent of Hydrogen gas respectively.

RECOMMENDATION

Banana which is rich in essential nutrients should be recommended for inclusion into dietary plan to solve some health problems associated with malnutrition by the health practitioners and health extension workers, while watermelon should be used to tackle dehydration and electrolyte imbalance in patients by the health practitioners or professionals, considering its very high water content.

Fruit peels energy generation techniques should serve as an effective technological means of generating biogas, production of eco-enzymes, eco-biosorbents and green reductants as they are rich in eco-friendly gases.

Advanced further research should be developed on fruit peels in green chemistry as a means of finding solution to remedy environmental pollutions, especially the air pollutions.

REFERENCES

1. AOAC (2019) Official Methods of Analysis of the Association of Official Analytical Chemists: Official methods of Analysis of AOAC International. 21st Edition, AOAC, Washington DC.
2. Augustin L.S, Kendall C.W, and Jenkins D.J, (2015). Glycemic index, glycemic load and glycemic response: An International Scientific Consensus Summit from the International Carbohydrate Quality Consortium (ICQC). Nutr Metab Cardiovasc Dis. 2015;25(9):795-815. (PubMed)
3. Bello, M. O., Falada, O. S., Adewusi, S. R. A., and Olawore, N. O., (2008). Studies on the chemical compositions and anti-nutrients of some lesser known Nigeria fruits. Article Number – 2CCA7758007/Vol.7(21), pp. 3972-3979, Nov 2008.
4. Bes-Rastrollo, M., Martínez-González, M. Á., Sánchez-Villegas, A., de la Fuente Arrillaga, C., & Martínez, J. A. (2006). Association of fiber intake and fruit/vegetable consumption with weight gain in a Mediterranean population. *Nutrition, 22*(5), 504-511.
5. Carter, P., Gray, L. J., Troughton, J., Khunti, K., and Davies, M. J. (2010). Doi: 10.1136/bmj.c4229. fruit intake and incidence of type 2 diabetes mellitus: systematic review and meta-analysis.

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS |Volume IX Issue XII December 2024

BMJ.;18:341:c4229.
6. Dodd, H., Williams, S., Brown, R., and Venn, B, (2011). Calculating meal glycemic index by using measured and published food values compared with directly measured meal glycemic index. Am J Clin Nutr. 2011;94(4):992-996. (PubMed)
7. Emmanuel, E., and Deborah, S., (2018). Phytochemical and anti-nutritional studies on some commonly consumed fruits in lokoja, kogi state of Nigeria. *General Medicine Open*, *2*(3), 1-5.
8. Ismail, Z., (2019). Green reduction of graphene oxide by plant extracts: a short review. Ceramic International. Volume 45, Issue 18, Part A. Pg. 23857-23868.
9. Kha, T. V., (2013). Direct production of highly conductive graphene with a low oxygen content by a microwave-assisted solvothermal method Chem. Eng. J.
10. Lewis, R. A. (2002). *CRC dictionary of agricultural sciences*. CRC press.
11. Liu, S., and Willett, W.C., (2002). Dietary glycemic load and atherothrombotic risk. Curr Atheroscler Rep. 2002;4(6):454-461.
12. Ludwig, D.S, (2002). The glycemic index: physiological mechanisms relating to obesity, diabetes, and cardiovascular disease. JAMA. 2002;287(18):2414-2423. (PubMed)
13. Miller, L. M. S., and Cassady, D. L. (2015). The effects of nutrition knowledge on food label use. A review of the literature. *Appetite*, *92*, 207-216.
14. Monro, J.A, and Shaw M., (2008). Glycemic impact, glycemic glucose equivalents, glycemic index, and glycemic load: definitions, distinctions, and implications. Am J Clin Nutr. 2008;87(1):237S-243S. (PubMed)
15. Namieśnik, J., and Szefer, P. (2008). Preparing samples for analysis-the key to analytical success. *Ecol. Chem. Eng. S*, *15*(2), 167-244.
16. Nehir El, S., and Simsek, S. (2012). Food technological applications for optimal nutrition: an overview of opportunities for the food industry. *Comprehensive Reviews in Food Science and Food Safety*, *11*(1), 2-12.
17. Nweze, C. C., Abdulganiyu, M. G., and Erhabor, O. G. (2015). Comparative analysis of vitamin C in fresh fruits juice of Malus domestica, Citrus sinensi, Ananas comosus and Citrullus lanatus by iodometric titration. *Int. J. Sci. Environ. Technol*, *4*(1), 17-22.
18. Ojeifo, I. M. (2007). Farming Systems Involving Fruit Crops Production and Research In Nigeria: A Review. *Journal of Agriculture, Forestry and the Social Sciences*, *5*(2).
19. Park, S. H., Lamsal, B. P., and Balasubramaniam, V. M. (2014). Principles of food processing. *Food processing: principles and applications*, 1-15.
20. Pearson, N., Atkin, A., Biddle, S., and Gorely, T., (2010). Intervention to increase fruits consumption in adolescents: a pilot study. School of Sport, Exercise & Health Sciences, Loughborough University Loughborough, Leicestershire, LE11 2TL, Uk.
21. Prusky, D. (2011). Reduction of the incidence of postharvest quality losses, and future prospects. *Food Security*, *3*, 463-474.
22. Silva, De, K. K.H., Huang, H. H., Joshi, R. K., and Yoshimura, M. (2017). Chemical Reduction of Graphene Oxide Using Green Reductants. Carborn, 119, 190-199.