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Assessment of some biochemical and microbiological parameters on the processing of three selected species of melon

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Three species of melon seeds namely *Cucurbita pepo*, *Telfairia occidentalis* and *Citrullus lanatus* were used for this study. The raw, boiled and fermented samples of these melon seeds were analysed. For all the melon seeds considered, there was an increase in microbial load with an increase in fermentation time. The physicochemical properties increased progressively with processing while there was a decrease in the moisture content of the melon seeds. *Cucurbita pepo* and *Telfairia occidentalis* had the highest proximate composition while *Citrullus lanatus* had the least proximate composition in raw, boiled and fermented samples. *Telfairia occidentalis* had the highest total phenolic content (23.12^{b}±0.50) preceded by *Cucubita* pepo (17.4^{b}±0.2) while *Citrullus lanatus* had the least total phenolic content (15.16^{b}±0.01). The DPPH of the raw sample followed the same train as that of total phenolic with *Citrullus lanatus* having the lowest (37.54^{b}±0.01) DPPH followed by *Cucubita* pepo (38.89^{b}±0.02) while the *Telfairia occidentalis* had the highest (39.74^{b}±0.50). The result of boiled and fermented was observed to follow the same train as raw sample where *Citrullus lanatus* had the least total phenolic followed by *Cucubita pepo* and *Telfairia occidentalis* had the highest. The vitamin result shows *cucubita pepo and Telfaira occidentalis* had a negligible amount of vitamin juxtaposing *Citrullus lanatus.* However, *Cucurbita pepo and Telfairia occidentalis* are nutritious for consumption in large quantity over *Citrullus lanatus.*

Keywords: *Cucurbita pepo, Telfairia occidentalis, Citrullus lanatus,* anti-nutritional, anti-oxidant and proximate.

INTRODUCTION

Watermelons (*Citrullus lanatus*) refer to both fruit and plant of a vine-like (climber and trailer) herb originally from southern Africa and one of the most common types of melon are member of cucurbit family, which also includes rock-melons, honeydew melons, cucumbers, pumpkins, squash, zucchini and other gourds, common in

fruit platter or as a refreshing desert at picnic. Watermelons are available in a wide range of sizes and shapes. This flowering plant produces a special type of fruit know by botanists as pepo which has a thick rind pepo (exocarp) and fleshy center (mesocarp and endocarp); As part of characteristics of *Cucurbitaceae*, the watermelon fruit, loosely considered a type of melon (although not in the genius *Cucumis*), has a smooth exterior rind (green, yellow and sometimes white) and a juicy, sweet usually red, but sometimes orange, yellow or pink interior flesh. Dark red fleshed, black seeded varieties are the most popular on the market place. In certain semi-desert districts, the watermelon is an important source of water to the natives during dry periods; even today there are districts in Africa where it is cultivated for that purpose (Boswell, 2000). Preliminary results indicates that *Citrullus lanatus* seeds is a good sources of dietary oil and their defatted meals are exceptionally higher than in soya beans, peanut, or sunflower seed meals (Baker, 2008). The pulp is cooked and seeds eaten in Sudan, Nigeria and Egypt (Goda, 2007). *Citrullus lanatus* contains a significant amount of citrulline and after consumption of several kilograms an elevated concentration is measured in blood plasma (Mendel et al., 2005).

A farmer's hand gathering a matured fruit of *Citrullus lanatus*(water melon)

Sliced piece of *Citrullus lanatus*(water melon) in the market

Fluted pumpkin *Telfairia occidentalis* is a tropical vine grown in the West African part of Africa as a vegetable leave and also for its edible seeds. It is locally known as fluted gourd, fluted pumpkin, and ugu by Igbo people of Nigeria. Fluted pumpkin (*T. occidentalis*) is a delicious plant with both male and female chromosomes plants (Asiegbu *et al.* 1985). The oil of *T. occidentalis* seeds has high iodine and a high content of unsaturated fatty acids when compared to palm oil. The seed oil is also suitable for manufacturing of soaps, paints and vanishings (Nworgu et al. 2007). Seed residue after oil extraction is also used as animal feeds (Ajayi et.al. 2005). Fluted pumpkin seeds have been reported to be rich in proteins (Akwaowo *et al.* 2000). However, there is need to delve into the effect of processing on *T. Occidentalis* nutritional values.

***Telfairia occidentalis* (Fluted pumpkin) fruit with few leaves hanging on cassava stem.**

***Telfairia occidentalis* (Fluted pumpkin) fruit with few leaves hanging on live tree.**

Cucurbita pepo plant is native to central Asia. Many of its cultivated varieties are widely grown in warm regions around the world. Most commercially important melons are sweet and eaten fresh. Melons are frost-tender annuals with soft hairy trailing stems and clasping tendrils. *Cucurbita pepo* is one of the oldest known cultivated species. It is widely cultivated by indigenous people throughout Mexico, central and North America. Ethno pharmacological studies show that *Cucurbita pepo* is used in many countries for treating numerous diseases, e.g., as an anti-inflammatory, antiviral, analgesic urinary disorders, anti-ulcer, antidiabetic and antioxidant (Wang et al. 2001). The seeds are used as a vermifuge, treat problems of the urinary system, hypertension, prevents the formation of kidney stones, alleviate prostate disease and enhanced the erysipelas skin infection (Dhiman et al. 2012). The seeds are rich in oil, used in Mexico with honey to prepare desserts. (Perez Gutierrez, 2016). Seeds of pumpkin are consumed either roasted or raw and used in cooking and baking as an ingredient of cereals, bread, cakes and salads. Pumpkin seed oil is accepted as edible oil and as a nutraceutical. Pumpkin seed and seed oil are a rich natural source of phytosterols (Phillips, 2005), proteins, polyunsaturated fatty acids (Sabudak T, 2007), antioxidant vitamins, carotenoids and tocopherols (Stevenson *et al*., 2007) and various elements (Glew et al. 2000) due to these components are attributed providing many health benefits.

MATERIALS AND METHODS

Samples Collection

The melon seeds were purchased from Oja Oba market in Ado- Ekiti, Ekiti state. The seeds were authenticated by a taxonomist in the Plant Science Department of Ekiti State University, Ado-Ekiti, Ekiti State Nigeria.

Sample Preparation

The undehulled melon seeds were sorted to remove grit, dirt and decomposing ones. These were divided into three groups and were kept in sterile polythene bags ready for laboratory further analysis.

Raw Sample:

The melon seeds were dehulled by abrasion. These were then cleaned and separated from grits; oven dried at 60^{o}C for 96 h, pulverized using blade homogenization and poured into a sterile container having screw cap for analysis.

Boiled Sample:

The unshelled melon seeds were firstly dehulled by abrasion. The seeds were washed using distilled water and cooked for 3 h in boiling water. The boiled seeds were then oven dried at 60^{o}C for 96 h, pulverized using blade homogenization and poured into a sterile container having screw cap for analysis.

Fermented Sample:

The unshelled melon seeds were dehulled by abrasion. The seeds were washed with distilled water, cooked for 4 h in boiling water and allowed to cool to about 30°C. The cooled walnut seeds were wrapped in aluminium foil and incubated at 35 °C for 120 h. The fermented seeds were then oven dried at 60 ^{o}C for 96 h, pulverized using blade homogenization and poured into a sterile container having screw cap for analysis.

MICROBIAL ANALYSIS

The total viable counts of the samples were analyzed daily by the method of Olutiola et al. (1991) which include isolation of microorganism from the sample, determination of total viable counts (microbial load), direct and microscopic observation and biochemical identification of the isolates.

Determination of pH

The pH was determined according to the method of AOAC (2005). Each sample (5 g) was weighed into a sterile mortar and mashed with clean pestle and 50 ml of distilled water was added. It was mixed thoroughly to form slurry and filtered with Whatman No. 14 filter paper. A standard buffer solution (pH 6.0) was prepared

and this was used to standardize the pH meter (Checker, produced by Hanna instruments, model no-16607). The electrode of the digital pH meter was dipped in the slurry. The pH readings were recorded.

Determination of Total Titratable Acidity (TTA)

The amount of lactic acid in the fermenting mass was determined as described by Omodara and Aderibigbe (2013). Twenty millilitres (20 ml) of filtrate obtained from 5 g seed dissolved in 20 ml distilled water was titrated against 0.1 M NaOH using phenolphthalein indicator. The titre value was then used to calculate the titratable acidity as percentage lactic acid using $M_1V_1= M_2V_2$.

Moisture Determination

This was determined according to AOAC (2005) by weighing a clean and well labelled Petri dish that has been oven dried (W1), 5 g of the sample was added to the dish and this was reweighed (W2). The dish and its content were transferred to the oven at 105 ^oC for about 24 h. After which it was transferred into desiccator and cooled for about one hour and weighed again. This was repeated severally to get a constant weight (W3).

% Moisture= [(W2 -W3)100]/(W2-W1).

Proximate analysis:

The proximate compositions of the raw, boiled and fermented samples were determined using standard procedures of AOAC (2005). The parameters determined were protein, ash, crude fibre, fat and carbohydrate.

Determination of vitamin A

The sample (1 g) was weighed and macerated with 20 mL of petroleum ether. It was evaporated to dryness and 0.2 mL of chloroform acetic anhydride was added and 2 mL of TCA chloroform were added and the absorbance measured at 620 nm. Then concentration of vitamin A was extrapolated from the standard curve.

Determination of Vitamin B1 (thiamine)

The samples (5 g) are homogenized with 50 mL of ethanolic sodium hydroxide solution. This was filtered into a 100 mL flask. The filtrate (10 mL) was pipetted into a beaker and color developed by the addition of 10 mL potassium dichromate. The absorbance is read at 360 nm. A blank sample was also prepared and read at the same wavelength. The values are extrapolated from a standard curve (Okwu, 2005).

Determination of Riboflavin (Vitamin B2)

Each of the samples (5 g) was extracted with 100 mL of 50 % ethanol solution shaken for 1 h. This was filtered into a 100 mL of 30 % hydrogen peroxide (H_2O_2) and allowed to stand over hot water bath for 30 mins. 2 mL of 40 % sodium sulphate added to make up the 50 mL mark and absorbance read at 510 nm in a spectrophotometer (Okwu, 2005).

Determination of Niacin (Vitamin B3)

The sample (5 g) was blended and 100 mL of distilled water added to dissolve all nicotinic acid or niacin present. the solution (5 mL) was drawn into 100 mL volumetric flask and make up to mark with distilled water. 10-50 ppm of Niacin stock solution was prepared. The absorbance of diluted stock solution and sample extract were measured at a wavelength of 385 nm on a spectrophotometer. Different concentrations of the standard stock solutions were read on the spectrophotometer for absorbance at the specified wavelength to obtain the Gradient factor. Amount of niacin in sample was calculated using the formula:

Mg/100 g niacin= Absorbance x dilution factor x Gradient factor stock solution / 10

Determination of Ascorbic Acid (Vitamin C)

Vitamin C content was determined according to the method of Baraket *et al*., (1973). Five grams (5 g) of the sample was weighed into an extraction tube and 100 mL of EDTA/TCA (2:1) extracting solution were mixed and the mixture shaken for 30 min. This was transferred into a centrifuge tube and centrifuged at 3000 rpm for 20 min. It was transferred into a 100 mL volumetric flask and made up to 100 mL mark with the extracting solution. 20 mL of the extract was pipetted into the volumetric flask and 1 % starch indicator was added. These were titrated with 20 % $CuSO_4$ solution to get a dark end point (Baraket et al. 1973).

Determination of Vitamin E

The sample (1 g) was weighed and macerated with 20 mL of ethanol. 1 mL of 0.2 % ferric chloride in ethanol was added, then 1 mL of 0.5 % α, α-dipyridyl was also added, it was diluted to 5 mL with distilled water and absorbance was measured at 520 nm. Then concentration of

Vitamin E was extrapolated from the standard curve.

DPPH Radical Scavenging Activity

The DPPH free radical scavenging activity of methanolic, hexanic, and aqueous extracts of sample was determined according to the method reported by Brad-Williams et al*.* (1995). The stock solution of the radical, prepared by dissolving 24 mg DPPH in 100 ml methanol, was kept in a refrigerator until further use. The working solution of the radical was prepared by diluting the DPPH stock solution with methanol to obtain an absorbance of about 0.98 (± 0.02) at 517 nm. In a test tube, 3 mL DPPH working solution was mixed with 100 µl plant extract (1 mg/ml) or the standard solution. The absorbance was measured at 517 nm for a period of 30 min. The percent antioxidant or radical scavenging activity was calculated using the following formula:

% Antioxidant activity = [(Ac-As)/ Ac] X 100

Where, Ac and As are the absorbance of control and sample, respectively. The control contained 100 µl methanol in place of the plant sample

Determinations of Antioxidant Activity

The antioxidant activity was determined by means of DPPH radical scavenging assay. To 0.2 ml of each extracted sample and the standard Trolox solutions, 3.8 ml of 0.1 mm DPPH solution was added in a test tube. The mixtures were shaken for 1 min and then left in the dark for 30 min after which the absorbance was read using spectrophotometer at 517 nm against the blank. Absorbance of a negative control (A control) was taken after adding DPPH radical solution to 0.2 ml of the extraction solvent (distilled water).

% DPPH radical inhibitor = x 100

From the equation, the free radical scavenging (antioxidant) activity was expressed as the mean micromole of Trolox equivalent (µMTE/g).

Total Phenolics

The total phenolic content was measured using the Folin Ciocalteu reagent (McDonald et al. 2001). An aliquot of the extract (100 µl) was mixed with 250 µl of Folin Ciocalteu's reagent and incubated at room temperature for 5 min. 1.5 mL of 20 % sodium bicarbonate was added to the mixture and incubated again at room temperature for 2 h. Absorbance was measured at 765 nm using a UV-Vis spectrophotometer. The results were expressed in terms of µg gallic acid equivalents (GAE)/ mg dry extract, Soni et al. (2014).

Data Analysis

Data from all the determination were analyzed using analysis of variance (ANOVA) using IBM/SPSS 20.0 Statistical package for windows. Different means were separated using the Least Significant Different (LSD) method and significant difference was accepted at $p<0.05$.

RESULTS AND DISCUSSION

Table 1 shows the microbial load of raw, boiled and fermented result of the three (3) types of melon seeds on nutrient agar (NA) and potato dextrose agar (PDA). The sample CP had the highest bacterial load both in raw, boiled and fermented, while the sample of TO had the least bacterial load in both raw, boiled and fermented. There was a decrease in bacterial load CL compared to that of CP. Sample TO also have the least fungal growth in all the processes followed by sample CL. There was an increase in fungal growth sample CP. The microbial count showed that microorganisms were predominant in sample CP than other samples. Observation showed that the progressive increase noticed in microbial load in the fermented melon seed on NA was a function of time. The reduction in microbial load on NA when the seeds were boiled might be due to the death of some psycophiles which are not resistant to heat. The reciprocal effect observed on PDA might be due to multiplication of thermophiles in the culture.

Table 2 presents the physicochemical parameters of the melon seeds. Processing has a significant effect on the pH, TTA and moisture content of the seeds. The result of the ph showed that Citrullus *lanatus*, and Cucurbita *pepo* has almost the same pH ranging from 6.13±0.02-7.32±0.50 respectively. A keen interest is also taken from table 2 that processing (boiling and fermentation) increased the pH of the melon seeds connoting continued tendering towards alkalinity on pH scale. This is in line with the work of Ileola et al. 2018 where processing (boiling and fermentation) increased the pH of African walnut.

The proximate parameters are presented in Table 3. The ash content is the amount of an inorganic content of a sample. The ash result showed that *Citrullus lanatus*, *Telfairia ocidentalis* has the lowest value while *Cucurbita pepo* has the highest value compared to the other melon seed which was a little higher compared to 6.51 ± 0.28% reported for jack bean by Arawande and

Borokini, (2010). The crude fibre for the melon seeds has *Citrullus lanatus* ranging from 0.91 ^{c}±0.01-1.34 ^{b}±0.02, *Cucurbita pepo* ranging from 27.98^{c}±0.02-36.12^{a}±0.02 while *Telfairia ocidentali*s was found to be 1.70^{a}±0.50-2.03^{a}±0.50 which is lower compared to the report for fluted pumpkin by Adebisi and Olagunju, 2011. Crude fibre will help prevent constipation as it forms bulk during the process of digestion. The lipid value of the melon seeds in *Citrullus lanatus* has a similar value to those of sesame (53.5%) and peanut (45.6%) FAO, 1982. The protein content of *Telfairia ocidentali*s ranging from 27.41^{b}±0.50 - 32.79^{a}±0.49 was recorded to be the highest compared to the other melon seeds, which was higher than 24.69 ± 0.05 and 20 ± 0.12% obtained for unfermented groundnut and sesame seed by Ojokoh and Lawal, 2009 and Nzikou et al. 2009 respectively. *Telfairia ocidentali*s also has the highest value of carbohydrate content which was lower compared to that sunflower reported by FAO, 1982.

It was observed from the result presented in table 4 that boiling reduced DPPH but was notably increased by fermentation process in all the seeds. The same trend was observed for total Phenolic.

Table1: Microbial load of raw, boiled and fermented melon seeds

	MICROBIAL LOAD ON NA (log_{10} Cfu/ml)			MICROBIAL LOAD ON PDA(log_{10} Cfu/ml)		
SAMPLES	CL	CP	TO	CL	CP	TO
RM	7.77	8.41	6.02	0	5.83	0
BM	7.47	7.63	5.73	6.48	6.48	4.52
FM_{24}	8.08	8.12	6.99	6.01	6.30	0
FM_{48}	8.03	8.16	7.08	6.03	6.43	5.12
FM_{72}	8.39	8.26	6.10	6.03	6.37	5.22
FM_{96}	8.50	8.33	7.19	7.04	6.41	5.18
FM_{120}	8.52	8.41	6.26	7.23	6.90	6.30

KEYS: RM-raw melon, BM- boiled melon, NA-Nutrient agar, PDA-Potato Dextrose Agar, TTA- Total titratable acidity, FM_{24}- fermented melon at 24 hours, FM_{48}- fermented melon at 48 hours, FM_{72}- fermented melon at 72 hours, FM_{96}- fermented melon seed at 96 hours, FM_{120} fermented melon at 120 hours, CL-*Citrullus lanatus*, CP- *Cucurbita pepo,* TO- *Telfairia ocidentalis*

Table 2: Physicochemical properties of raw, boiled and fermented melon seeds

SAMPLES	Ph			TTA			MOISTURE CONTENT		
	CL	CP	TO	CL	CP	TO	CL	CP	TO
RM	6.54^{d}±0.03	6.13^{g}±0.02	5.87^{a}±0.04	1.98^{d}±0.04	2.61^{b}±0.02	2.21^{b}±0.02	59.00^{a}±0.08	6.00^{f}±0.02	9.50^{e}±0.10
BM	6.71^{e}±0.01	6.49^{f}±0.09	6.39^{b}±0.20	0.54^{e}±0.01	0.68^{g}±0.02	1.89^{b}±0.20	48.25^{b}±1.02	49.60^{a}±0.02	36.97^{d}±0.03
FM_{24}	6.25^{c}±0.02	6.79^{e}±0.09	6.37^{b}±0.25	0.70^{d}±0.01	0.81^{f}±0.01	0.99^{c}±0.01	21.00c±0.00	41.00^{b}±0.02	50.78^{a}±0.02
FM_{48}	6.37^{b}±0.02	6.90^{d}±0.02	6.71^{bc}±0.50	0.95^{e}±0.02	1.30^{e}±0.01	1.17^{c}±0.50	23.05^{d}±0.01	40.00^{b}±0.02	50.28^{b}±0.50
FM_{72}	6.71^{a}±0.01	6.99^{c}±0.02	7.09 ^{cd}±0.19	1.10^{a}±0.02	1.53^{c}±0.03	2.16^{b}±0.03	27.57^{c}±2.34	38.00^{c}±0.02	48.57^{c}±0.02
FM_{96}	7.18^{b}±0.01	7.32^{b}±0.02	7.56^{de}±0.50	1.16^{b}±0.01	1.45^{d}±0.01	2.20^{b}±0.50	35.16^{d}±0.01	36.70^{d}±0.02	48.34^{c}±0.55
FM_{120}	7.28^{a}±0.01	7.49^{a}±0.09	7.77^{e}±0.07	1.20^{a}±0.00	5.22^{a}±0.02	2.88^{a}±0.02	36.88^{d}±0.01	34.29^{e}±0.02	48.28^{c}±0.03

KEYS: RM-raw melon, BM- boiled melon, NA-Nutrient agar, PDA-Potato Dextrose Agar, TTA- Total titratable acidity, FM_{24}- fermented melon at 24 hours, FM_{48}- fermented melon at 48 hours, FM_{72}- fermented melon at 72 hours, FM_{96}- fermented melon seed at 96 hours, FM_{120}- fermented melon at 120 hours CL-*Citrullus lanatus*, CP- *Cucurbita pepo,* TO- *Telfairia ocidentalis*

Table 3: Proximate composition of the raw, boiled and fermented melon seeds

Proximate (%)	*Citrullus lanatus*(Cl)			*Cucurbita pepo*(Cp)			*Telfairia ocidentalis*(To)		
	Raw	Boiled	Fermented	Raw	Boiled	Fermented	Raw	Boiled	Fermented
Ash content	3.70 ^{a}±0.01	2.91 ^{c}±0.01	3.24 ^{b}±0.02	31.84^{b}±0.02	29.12^{c}±0.02	32.46^{a}±0.02	4.81^{a}±1.00	4.25^{a}±1.00	4.18^{a}±1.00
Crude fiber	1.34 ^{b}±0.02	0.91 ^{c}±0.01	1.01 ^{a}±0.02	35.04^{b}±0.02	27.98^{c}±0.02	36.12^{a}±0.02	2.03^{a}±0.50	1.97^{a}±0.50	1.70^{a}±0.50
Fat content	30.91 ^{b}±0.02	32.31 ^{a}±0.01	27.31 ^{c}±0.01	4.14^{b}±0.01	3.17^{c}±0.02	5.01^{a}±0.02	31.72^{a}±0.50	28.76^{c}±0.55	30.05^{b}±0.50
Protein content	26.57 ^{c}±0.02	27.91 ^{b}±0.01	30.05 ^{a}±0.03	8.94^{a}±0.02	8.74^{a}±0.02	8.12^{b}±0.02	28.00^{b}±0.50	27.41^{b}±0.50	32.79^{a}±0.49
Carboh ydrate	28.47 ^{c}±0.01	26.9 ^{ab}±0.01	30.06 ^{b}±0.01	12.00^{b}±0.07	17.98^{a}±0.02	7.10^{c}±0.02	33.44^{b}±0.18	37.64^{a}±0.28	31.30^{c}±0.17

Data are expressed in mean ±SD from triplicates experiments (n=3). Values having different superscript letters in a row differ significantly at P≤0.05

Table 4: Antioxidants Properties of raw, boiled and fermented melon Seeds

Antioxidant	*Citrullus lanatus* (Cl)			*Cucurbita pepo* (Cp)			*Telfairia ocidentalis* (To)		
	Raw	Boiled	Fermented	Raw	Boiled	Fermented	Raw	Boiled	Fermented
Total phenolics	15.16^{b}±0.01	11.01^{c}±0.01	17.34^{a}±0.01	17.4^{b}±0.2	15.12^{c}±0.02	22.12^{a}±0.02	23.12^{b}±0.50	16.31^{c}±0.50	26.17^{a}±0.50
DPPH scavenging Activities	37.54^{b}±0.01	35.87^{c}±0.01	39.40^{a}±0.01	38.89^{b}±0.02	31.14^{c}±0.02	40.16^{a}±0.02	39.74^{b}±0.50	34.34^{c}±0.50	41.01^{a}±0.50

Note: Data are expressed in mean ± SD from triplicate experiments (n=3). Values having different superscript letters in a row are differ significantly at p≤0.05.

Table 5: Vitamin contents of raw, boiled and fermented melon seeds

Vitamin	*Citrullus lanatus*(Cl)			*Cucurbita pepo*(Cp)			*Telfairia ocidentalis*(To)		
	Raw	Boiled	Fermented	Raw	Boiled	Fermented	Raw	Boiled	Fermented
Vitamin A	21.2^{c}±0.16	29.41^{b}±0.02	32.10^{a}±0.01	20.74^{c}±0.45	23.47^{b}±0.77	31.00^{a}±1.31	35.26^{c}±0.50	39.01^{a}±0.50	37.67^{b}±0.50
Vitamin B1 (Thiamine)	0.214^{b}±0.00	0.101^{c}±0.00	0.271^{a}±0.00	0.12^{a}±0.06	0.04^{a}±0.01	0.20^{a}±0.14	0.23^{a}±0.38	0.10^{a}±0.01	0.18^{a}±0.21
Vitamin B2 (Riboflavin)	0.158^{a}±0.00	0.073^{a}±0.00	0.103^{b}±0.00	0.14^{a}±0.01	0.09^{b}±0.01	0.15^{a}±0.01	0.15^{a}±0.05	0.05^{b}±0.04	0.17^{a}±0.07
Vitamin B3 Niacin	1.336^{c}±0.00	0.642^{c}±0.00	1.336^{a}±0.00	1.11^{a}±0.02	0.61^{b}±0.09	1.14^{a}±0.01	2.43^{a}±0.50	0.77^{b}±0.55	2.58^{a}±0.50
Vitamin C	24.01^{b}±0.02	10.43^{c}±0.020	23.01^{a}±0.02	19.06^{b}±0.72	10.02^{c}±0.40	21.33^{a}±0.49	25.12^{a}±0.50	16.01^{b}±0.50	26.01^{a}±0.50
Vitamin E	20.12^{b}±0.01	22.67^{a}±0.01	15.09^{c}±0.01	19.74^{b}±0.39	24.47^{a}±0.64	15.09^{c}±0.40	23.10^{b}±0.50	26.04^{a}±0.50	19.01^{c}±0.22

Note: Data are expressed in mean ± SD from triplicate experiments (n=3). Values having different superscript letters in a row are differ significantly at p≤0.05.

It is important to note that fermentation may be the best processing method for consumption of these melon seeds so that they can be able to exercise their maximum potential to efficiently mop up free radicals. DPPH and Phenolic compounds are known to exhibit antioxidant properties and played important role in cancer prevention and treatment (Lacatusu et al. 2010). Ileola and Omodara (2017), reported increase in antioxidant activity of fermented *Citrullus vulgaris.*

In table 4 The vitamin *Citrullus lanatus*, *Telfairia ocidentalis* and *Cucurbita pepo* showed that the most abundant vitamin in the melon seed at all levels of processing was vitamin A (a fat soluble vitamin which is a very powerful antioxidant) with 39.01^{a}±0.50mg/100 mg while the lowest concentration was obtained in vitamin B_1 with 0.05^{b}±0.04mg/100mg. Vitamin A functions in various capacities as collagen breakdown, keratinization, mucopolysaccharide and glycoprotein synthesis, gene expression and tissue differentiation. Ileola and Omodara (2017) reported increase in vitamin content of fermented *Citrullus vulgaris.* This work also revealed high Vitamin C content of *Telfairia ocidentalis* 26.01^{a}±0.50 mg. High intake of vitamin C reduces wrinkles and dryness of skin (Minocha, 2015). Vitamin E was observed to reduce in *Citrullus lanatus*. There was significant difference ($p<0.05$) in the vitamin content of the melon in which *Telfairia ocidentalis* has the highest content. Virtually all the vitamins analysed in these seeds appeared not to be heat resistant as the quantity decreased in each seed when boiled but increased when fermented except in vitamin E. However, to be biased with vitamin, fermentation may be considered the best processing method for human and animal consumption of these seeds.

CONCLUSION

The effect of processing on the microbial composition, proximate composition, physiochemical properties, anti-nutritional antioxidant activity and vitamins were successfully determined and compared between three different types of melons. The number of microorganism present in the sample were more in the *Citrullus lanatus* than *Cucurbita pepo* and *Telfairia ocidentalis*. This research work revealed that the nutritional composition of *Telfairia ocidentalis and Cucurbita pepo* are higher than that of *Citrullus lanatus.* Therefore, *Cucurbita pepo and Telfairia occidentalis* had a nutritive value that can encourage consumption in large quantity than *Citrullus lanatus* while the processing method preferred among others is fermentation.

RECOMMENDATION

1. Consumers should be enlightened on the nutritional and health benefits of these melon seeds especially *Telfairia ocidentalis* and

Cucurbita pepo.
2. These melon seed should be cultivated in large quantity and be commercialized across the world for consumption.
3. Close attention should be paid to its preservation procedure to achieve round the year availability of these melon seeds.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

AUTHOR CONTRIBUTIONS

This work was carried out among all the authors. Author TRO designed the study and wrote the first draft of the manuscript. Author AOI performed the statistical analysis and wrote the protocol. Author OAA managed the literature searches. Authors AOI and TRO managed the analysis of the study. All authors read and approved the final manuscript.

REFERENCES

Adebisi GA, Olagunju EO, 2011. Nutritional potential of the seed of fluted pumpkin (Telfairia occidentalis). Journal of New Trends in Science and Technology Application 1(1):7-18.

Ajayi SA, Dulloo ME, Vodouhe RS, Berjak P, Kioko JI, (2005). Conservation status of *Telfairia* sp. In sub-Saharan Africa. 89-95.

Akwaowo EU, Ndon, BA, Etuk EU (2000). Minerals and Antinutrients in Fluted Pumpkin (*Telfairia Occidentalis* Hook F.) Food Chemical 70: 235-240.

AOAC (2005). Association of Official Analytical Chemist Official Method of Analysis. Washington, DC. USA.

Arawande JO, Borokin, FB, (2010). Comparative study on chemical composition and functional properties of three Nigerian legumes (Jack beans, pigeon pea and cowpea). Journal of Emerging Trends in Engineering and Applied Sciences 1(1):89-95.

Asiegbu JE, (1985). Characterization of sexes in fluted pumpkin growth and yield in the male and female sexes, Gartenbauwissenschaft. Horticultural Science 50 (6): 251-255.

Baker, T.P., Corwin B. and Jett L.W. (2012). Medicinal value on Citrullus lanatus (watermelon). Research on Pharmaceutical and Biomedical Science 4: 1305-1312.

Barakat MZ, Shehab SK, Darwish NS, and Zahenmy EL, (1973). Determination of ascorbic acid from plants. Anal. Biochemistry 53: 224-245.

Boswell VR, (2000). Watermelon, An African Native of World Popularity. Our Vegetable Travellers. National Geographic Magazine. 96 (2) 1 – 4.

Brad–Williams W, Cuvelier ME, Berset C, (1995). Use of a radical method to evaluate antioxidant activity. *lebensm-wiss* A Technol./Food Science and Technology 28: 25-30

Dhiman K, Gupta A, Sharma DK, Gill NS, Goyal A, (2012). A review on the medicinally important plants of the family Cucurbitaceae. Asian Journal of Clinical Nutrition 4:16-26.

FAO, Food composition table for the near East nuts and seeds, FAO food and nutrition paper, 26:1982-1985

Glew RH, Glew RS, Chuang LT, Huang YS, Millson M, (2006). Amino acid, mineral and fatty acid content of pumpkin seeds (Cucurbita spp) and Cyperu: esculentlls nuts in the Republic of Niger. Plant Foods and Human Nutrition 61: 51-56.

Goda M, (2007). Diversity of Local Genetic Resources of Watermelon (*Citrullus lanatus*): Matsum and Nakai, in Sudan. *Biodiversity centre*: Master Thesis, No. 35 Swedish.

Ileola AO, Omodara TR (2017). Effect of Fermentation on Physiochemical Properties and in vitro radical scavenging ability of *Citrullus vulgaris.* International Journal of biochemistry Research & Review 19 (2): 1-7.

Ileola AO, Omodara TR, Fatoba OS, (2018). Effect of Processing on Microbial Load, Physicochemical Properties and Nutritional Composition of *Plukenetia conophora* (Africa walnut). Microbiology Research Journal Int. Vol. 25(4): 1-9.

Lacatusu, LoanaBadea, Nicoleta, Nita, Rodica,

Murariu, Alina, Miculescu, Florin, Losub, Megbea, Aurelia, (2010). "Encapsulation of Fluorescence Vegetable Extracts within a Template sol-gel matrix".Optical Materials 32(6):711-718.

Mandel H, Levy N, Izkovitchs, Korman SH, (2005). Elevated Plasma Citrulline and Arginine due to consumption of (*Citrullus vulgaris)* Watermelon. Berichte der deutschenchemischen Gesellschaft 28(4):467-472.

McDonald S, Prenzler PD, Antolovich M, Robards K. (2001). Phenolic content and antioxidant activity of olive extract. Food Chemistry 73:73-84.

Minocha S, (2015). An Overview of *Lagenaria siceraria* (Bottle Gourd). Journal of Biomedical and Pharmaceutical Research 4(3): 04-10.

Nworgu FC, Ekemezi AO, Ladele AO, Akinrolabu, BM, (2007). Performance of broiler chickens served heat-treated fluted pumpkin (*TelfairiaOccidentalis*) leaves extract supplement. African Journal Biotechnology. 6: 818-825.

Nzikou JM, Mat EL, Bouanga-kalou G, Ndangui CB, Pambou-Tobi PG, Kimbonguila A, Silo T, Linder M, Desobry S, (2009). Chemical composition of the seeds and oil of sesame (*Sesamun indicum* L.) grown in Congo-Brazzaville. Advance Journal of food Science and Technology 1(1):6-11.

Ojokoh AO, Lawal RT, (2009). Changes in nutrient content of popcorn and groundnut composite flours subjected to solid substrate fermentation. International Journal Tropical Medical & Public Health 1(1):50-53.

Okwu DE. (2005). Phytochemicals, vitamins and mineral contents of two Nigerian medicinal plants. International Journal of Molecular Medicines and Advanced Sciences 1(4):375-80.

Olutiola PO, Sonntag HG, Famurewa O, (1991). An Introduction to General Microbiology- A Practical Approach. *Verlagsantalt and Druckerei Heidelberg* 42-53

Omodara TR, Aderibigbe EY, (2013). Effects of the use of Starter Culture on the quality of fermented *Parkia biglobosa*. International Journal of Bio-Technology and Research 3 (4): 33-40.

PerezGuiterrez RM (2016) Review of Cucurbita Pepo (Pumpkin) its phytochemistry and pharmacology. Medical Chemistry. 6:012-021.

Phillips KM, Ruggio DM, Ashraf-Khorassani M, (2005). Phytosterol composition of nuts and seeds commonly consumed in the United States. J Agric Food Chem 53: 9436-9445.

Sabuda T, (2007) Fatty acid composition of seed and leaf oils of pumpkin. Walnut almond, maize, sunflower and melon. Chemistry Natural Compounds 43: 465-467.

Soni N, Mehta S, Satpathy G, Gupta RK, (2014). Estimation of nutritional, phytochemical, antioxidant and antibacterial activity of dried fig (*Ficuscarica*). Journal of Pharmacognosy and Phytochemistry. 3(2):158- 165.

Stevenson DG, Eller FJ, Wang L, Jane JL, Wang, T, (2007). Oil and tocopherol content and composition of pumpkin seed oil in 12 cultivars. Journal of Agric Food Chemistry. 55: 4005-4013.

Wang XL, Liu J, Chen ZHB, Gao F, Liu, JX, Wang XL, (2001). Preliminary study on pharmacologically effect of *Curcurbita pepo* cv Dayanggua. Journal of Traditional Chinese Veterinary Medicine. 20: 6-9.