JOURNAL OF ADVANCEMENT IN
MEDICAL AND LIFE SCIENCES
Journal homepage: http://scienceq.org/Journals/JALS.php

Research Article Open Access

Bacteriological and Proximate Analyses of Hogplum [*Spondias Mombins*] and African Star Apple [*Chrysophyllum Albidium*] Fruits in ADO-EKITI STATE. EKITI STATE, NIGERIA.

[1]Falegan C.R., [2]Ayeni D., [3]Akoja S.O. and [4]Awe O.
[123]Department of Microbiology, Ekiti State University, Ado Ekiti. Ekiti State, Nigeria.
[4]Department of Microbiology, Kwara State University, Malete. Kwara State, Nigeria.
*Corresponding author: Falegan C.R, PH 08033850542, Email: Faleganchristopherrotimi@gmail.com
Received: November 2, 2017, Accepted: December 10, 2017, Published: December 10, 2017.

ABSTRACT:

Fruits are among the most important foods of mankind. Microbiological and Proximate/analyses of two Fruits [Hogplum [*Spondias mombins*] and African star Apple [*Chrysophyllium albidium*]] were studied. The samples were plated using pour plate methods. The total plate count was 3.8 x 10^4CFU/g and the total coliform count was 2.1 x 10^4CFU/g for *S. mombins* and 5.2 x 10^4 CFU/g and 1.9 x 10^4 CFU/g for *C. albidium*. A total of 29 bacteria were isolated with seven [7] bacteria genera were identified from the two fruit samples. *Bacillus cereus* 7[24.1%], *Staphylococcus aureus* 6[20.7%], *Pseudomonas vulgaris* 6[20.7%], *Escherichia coli* 5[17.2%], *Bacillus licheniformis* 2[6.9%], *Enterobacter aerogenes* 2[6.9%] and *Lactobacillus plantarum* 1[3.5%]. The nutritional and antinutitional compositions of ***S. mombins*** obtained were*:* Moisture[64.40%], Protein[2.11%], Ash[0.856%], Fibre[9.72%], Fat[13.02%] and Carbohydrate[9.84%]. Vitamin[mg/g]; C[23.21], A[456.12], B1[1.86], B2[1.17] and B3[0.36]. Antinutritional[mg/g]; phytate[30.48], Phytic[8.59], Tannins[0.25], glycosides[39.9] and phenols[6.25]. The mineral composition[mg/l] Na[26.90], K[394.0], Ca[85.0], Mg[36.0], Zn[0.75:], Fe[4.01], P[72.12], Pb[0.20], Ni[0.06] and Mn[0.28]. For the ***C. albidium*** were; Moisture[64.32%], Protein[1.71%], Ash[1.72%], Fibre[18.18%], Fat[2.66%] and Carbohydrate[11.41%]. Vitamin[mg/g]; C[26.63], A[628.22], B1[0.83], B2[0.34] and B3[0.41]. Antinutritional[mg/g]; phytate[18.12], Phytic[5.11], Tannins[0.93], glycosides[106.63] and phenols[26.19]. The mineral composition[mg/l] Na[25.34], K[202.0], Ca[26.0], Mg[21.0], Zn[0.02], Fe[0.51], P[58.00], Pb[0.01], Ni[0.00] and Mn[0.20]. The bacterial isolates were tested against some antibiotics, since antimicrobials are used in fruits production to control pathogens on the field. The antibiotics used includes; Ampicillin, Gentamycin, Nitrofurantoin, Erythromycin, Cefuroxime, Ceftazidine, Cefoxin, Tetracycline, Streptomycin, Co-trimoxazole, Ciprofloxacin, Augumentin, Chloramphenicol and Ofloxacin. Therefore, *S. mombins* and *C. albidium* amongst the wild fruits in the tropical forest that can serve as good source of vitamins and minerals and can be recommended as fruit snacks for the obese and diabetics.

Keyword: *Spondias mombins, Chrysophyllium albidium, Nutritional composition, Fruits.*

INTRODUCTION

Fruits and vegetables are among the important foods of mankind. They are valued for their attractive appearance, characteristic flavor, taste, nutritive value and are indispensable for the maintenance of health [1]. Fruits play important roles in the diet of most people in the tropics, providing essential minerals and vitamins and adding colour, flavor and variety to monotonous diet [2;3]. Fruits and vegetables are abundant during their various seasons with over 50% lost to wastage due to deterioration under tropical conditions of high ambient temperature and humilities, pest and disease infestation, poor handling and storage facilities. Hogplum [HP] [*Spondias mombin*] is a minor fruit which belongs to the family Anacardiaceae. It is an acid food found in Nigeria, Bangladesh, Asia and India. The plant has varying local identity names and uses among the major Nigerian tribes; Hausa- [Tsadarmasar]; Yoruba – [Iyeye]; and Igbo [Isikala or uvuru] [4]. African Star Apple [ASA] [*Chrysophyllum albidium*] is an indigenous plant and an edible tropical fruit known by various tribal names in Nigeria as Agbalumo in Yoruba, udara in Ibo, Efik and Ibiobio and agwalumo in Hausa [5]. It is classified as a wild plant and belongs to the family Sapotaceae. Hogplum [Hp] and African Star Apple [ASA] are rich sources of vitamins especially vitamin A and C. The fruits area usually eaten raw and can be used for preparation of pickles, jam and other processed food. The quality of ripe and green Hp and ASA highly depend on the collection at suitable time using correct methods [6].

In 1998, World Resources Institute reported that not only are loses clearly a waste of food but they almost represent a similar waste of human effort, farm imputs. Processing of fruits and vegetables to juice and other valuable products are the ways abundant fruits and vegetables can be utilized to reduce wastage and bring economic returns to farmers [1;7]. Hogplum and African Star Apple are sources of minerals, fibre and vitamins which also provide essential nutrients for human health [8]. These fruits have found to contain antinutritional factors such as phytates, phytic acids and traces of Tannins that can diminish the nutrient bioavailability if they are present at high concentrations [9]. It has been reported that these anti-nutritional factors could also help in the treatment and prevention of several important diseases and treating of heart disease [10]. This can as well create jobs for the teaming populase.

It has been observed that antibiotic susceptibility of bacterial isolates is not constant but dynamic and varies with type of crop, time and environment. This therefore demands the need for periodic screening of common bacterial pathogens for their antibiotic susceptibility profiles in different fruits sample. Since antimicrobials are used in livestock and crop production to control pathogens, there is concern about antibiotic resistance development in these pathogens and subsequent transfer to humans through contaminated food. Fruits [Orange, pineapple, hogplum, cashew, watermelon and African star apple] and Vegetables such as corn, green onion and cabbage absorb antibiotics when grown in soil fertilized with livestock antibiotics contaminated manure [11]. In addition, the presence of antibiotic resistances both in normal flora and pathogenic microorganisms in fresh vegetables may contribute to horizontal spreading of resistances between different isolates, species and

genera. The presence of resistance genes on transferable elements facilitates distribution of resistance and the widespread use of antibiotics allows direct selection or co-selection of resistances [12]. Hospitals and commercial animal husbandry are prime areas of antibiotic resistance development. The use of large amounts of antibiotics in plant agriculture could lead to a selection of resistant bacteria; applying manure from animal farming to agricultural fields or the use of contaminated water for irrigation could also spread resistant bacteria to plants [13]. Bacteria serving as a reservoir for resistance determinants may have great influence on resistance gene transfer in natural habitats, such as vegetal surfaces or human colon. Therefore, the presence of antibiotic-resistant bacteria in fresh vegetables constitutes an additional concern for consumer safety [14].
Therefore, the study is aimed to evaluate the microbiological and proximate/nutritional composition of hogplum [S*pondias mombins*] and African star apple [*Chrysophyllium albidium*] fruits in Ado-Ekiti State.

MATERIALS AND METHODS

Sample collection

Samples of fresh fruits of Hogplum and African Star Apple were harvested from a farm in Ado Ekiti and identified at the plant science Department of Ekiti State University, Ado Ekiti. The fruits were washed with tap water and drained in the laboratory before weighing and manually remove the seeds. The pulps were crushed and homogenized in a blender and were transferred in a conical flask and kept at 4^0C until the analyses were carried out.

Preparation of sample

The fruit samples were serially diluted plates of nutrient agar for total viable count, MaConkey agar were inoculated for total coliform count and malt extract agar for yeast count.

Bacteriological analyses

Bacterial plate count was carried out using pour plate method. The plates were incubated for 24hr at 37°C and identification of bacterial isolates was carried out according to standard procedures reported by Cowan and Steel [15]; Fawole and Oso [16].

Antibiotic sensitivity test

A suspension of the isolates is prepared to 0.5McFarland standards in trypton soy broth and then swab with sterile cotton swab evenly on Muller Hinton agar in a petri dish. The commercially antibiotics were placed aseptically onto the surface of the agar and then incubated aerobically at 370c for 24hours. Zone of inhibition were measured and was interpreted according to the Clinical Laboratory Standard Institutes [17].

CHEMICAL ANALYSES

Mineral composition which are the macronutrients [K+, Ca+, Na+, Mg, Cl] and micronutrients [Fe, Cr, Cu, Se, Zn, Rb] components of the hogplum fruits were determined using spectrophotometrically using Buck 200 atomic absorption spectrometer [Buck scientific, Norwalk] [18] and compared with absorption of standards of these minerals.

VITAMIN ANALYSIS

Ascorbic acid [Vitamin C] determination

Ascorbic acid in the fresh sample was determined by titrating its aqueous extract with solution of 2, 6-dichlorophenol-indophenol dye.

Thiamine [Vitamin B1] determination

Thiamine content of the fresh sample was determined by weighing 1 g of it into 100 ml volumetric flask and adding 50 ml of 0.1 M H_2SO_4 and boiled in a boiling water bath with frequent shaking for 30 min. Five milliliters of 2.5 M sodium acetate solution was added and flask set in cold water to cool contents below 50°C. The flask was stoppered and kept at 45-50°C for 2 h and thereafter made up to 100 ml mark. The mixture was filtered through a No. 42 Whatman filter paper, discarding the first 10 ml. Ten milliliters was pipetted from remaining filtrate into a 50 ml volumetric flask and 5 ml of acid potassium chloride solution was added with thorough shaking. Standard thiamine solutions were prepared and treated same way. The absorbance of the sample as well as that of the standards was read on a fluorescent UV Spectrophotometer [Cecil A20 Model] at a wavelength of 285 nm.

Riboflavin [Vitamin B2] determination

One gram of each fresh sample was weighed into a 250 ml volumetric flask. 5 ml of 1 M HCl was added, followed by the addition of 5 ml of dichloroethene. The mixture was shaken and 90 ml of de-ionized water was added. The whole mixture was thoroughly shaken and was heated on a steam bath for 30 min to extract all the riboflavin. The mixture was then cooled and made up to volume with de-ionized water. It was then filtered, discarding the first 20 ml of the aliquot. 2 ml of the filtrate obtained was pipetted into another 250 ml volumetric flask and made up to mark with de-ionized water. Sample was read on the fluorescent spectro-photometer at a wavelength of 460 nm. Standard solutions of riboflavin were prepared and readings taken at 460 nm, and the sample riboflavin obtained through calculation.

Niacin [Vitamin B3] determination

Five gram of blended fresh sample was extracted with 100 ml of distilled water and 5 ml of this solution was drawn into 100 ml volumetric flask and made up to mark with distilled water. Standard solutions of niacin were prepared and absorbance of sample and standard solutions were measured at a wavelength of 385 nm on a spectrophotometer and niacin concentration of the sample estimated.

ANALYSIS OF ANTI-NUTRITIONAL FACTORS

Determination of Phytate

Phytate content was determined according to the method described by Pearson [19]. A quantity of 0.5g of the sample was weighed into a 500ml flat bottomed flask. The flask with the sample was placed in a shaker and extracted with 100ml 2.4 % HCL for 1hr at 25°C, it was decanted and filtered. Five milliliters of the filtrate was diluted to 25ml with distilled water. Fifteen milliliters of 0.1M sodium chloride was added to10ml of the diluted sample and passed through Whatman No.1 filter paper to elute inorganic phosphorus, and 15ml of 0.7M sodium chloride was also added to elute phytate. The absorbance was read at 520nm.

Determination of cyanide

Cyanide content was determined according to the method described by Onwuka [20]. A quantity of 5g of the sample was weighed into a conical flask, 50ml of distilled water was added and allowed staying overnight, filter. About 1ml of the sample filtrate was weighed into a test tube, and then 4ml of alkaline picrate was added and allowed to stand for 5min. the absorbance was read at 490nm. The reading was taken, with the reagent blank at zero.

Determination of Alkaloids

The gravimetric method of Harbone [21] was adopted. Five gram [5.0g] of the sample was dispersed into 50ml of 10% acetic acid solution in ethanol. The mixture was shaken well and allowed to stand for 4hr before filtering. The filtrate obtained was evaporated to one quarter [1/4] of its original volume. Concentrated ammonium hydroxide was added drop wise to precipitate the alkaloids. The precipitate was filtered with a weighed filter paper and washed with 1% NH_4OH solution. The precipitate in the filter paper was dried in the oven at 60°C for 30mins and reweighed:

$$\% \text{ Alkaloid} = \frac{W2-W1}{W} \times \frac{100}{1}$$

Where; W = Weight of sample. W1 = Weight of empty filter paper

W2 = Weight of filter paper plus precipitate.

Determination of Tannin

The Folin– Denis spectrophotometric method as described by Pearson [19] was used. One gram of the sample was dispersed in 10ml distilled water and agitated. This was left to stand for 30mins at room temperature and shaken every 5mins. After this, it was centrifuged at 3000rpm for 5mins to obtain the extract. A quantity of 2.5ml of standard tannic acid solution was dispersed into a separate 5ml flask. A quantity of 0.1ml folin– Denis reagent was measured into each flask, followed by 2.5ml of saturated Na_2CO_3 solution. The mixture was diluted to the mark in the flask [50ml] and incubated for 90mins at room temperature. The absorbance was measured at 250nm. The reading was taken, with the reagent blank at zero.

Tannin content was given as follows

Tannin [g/100g] = Conc. of standard X Absorbance of sample

PROXIMATE ANALYSIS

The fruit samples were analysed in triplicate for moisture, crude protein, crude lipid, crude fibre and ash using standard methods of AOAC [22]. The carbohydrate content was obtained by difference.

Determination of Crude Fibre Content

The crude fibre content of the sample was determined using the method described in AOAC [22]. About 2g [W1] of sample was weighed using Mettler HAS balance [P-163 England] and put in a 250ml beaker, then boiled for 30 minutes with 100ml of 0.12M H_2SO_4 and filtered through a funnel. The filtrate was washed with boiling water until the washing was no longer acidic. The solution was boiled for another 30 minutes with 100ml of 0.012M NaOH solution; filtered with hot water and methylated spirit three times. The residue was transferred into a crucible and dried in the oven [Gallenkamp, VWR, 1730 England] for 1 hour. The crucible with its content was cooled in a desiccator and then weighed [W2] using Mettler HAS balance [P-163 England]. The residue was then taken into a furnace for ashing at 600°C for 1 hour. The ashed sample was removed from the furnace and put into the desiccator to cool and later weighed [W3] using Mettler HAS balance [p-163 England]. The percentage crude fibre was calculated thus;

$$\text{Crude fiber} = \frac{W2-W3}{W1} \times 100$$

Where; W1 = weight of original sample. W2 = weight of crucible and residue. W3 = weight of final ashed sample

Determination of Crude Ash Content

The method described by AOAC [22] was adopted for ash content determination. A silicon dish was heated to 600°C in muffle furnace cooled in a desiccator and weighed using Mettler HAS balance [P-163 England]. About 5g of the sample was put into the silicon dish and transferred to the furnace. The temperature of the furnace was then allowed to reach about 525°C before placing the dish in it. The temperature was maintained until whitish grey colour was obtained indicating that all the organic matter content of the product had been destroyed. The dish was brought out from the furnace and placed in the desiccator, cooled and weighed. The percentage ash content was calculated as:

$$\text{Ash content} = \frac{C-A}{B-C} \times 100$$

Where;

A = weight of empty dish. B = weight of empty dish and sample before ashing, C = weight of dish and ash

Determination of Moisture Content:

As described by AOAC [22]. First of all, weight of empty crucible with cover was taken and 5gms of sample was placed on it. Then the crucible was placed in an air oven [thermostatically controlled] and dried at a temperature of 105ºC for 24 hours, till constant weight was obtained. After drying, the crucible was removed from the oven and cooled in desiccator. It was then weighed with cover glass. The crucible was again placed in the oven, dried for 30 minutes; took out of the dryer, cooled in a desiccator and weighed. Drying, cooling and weighing were repeated until the two consecutive weights were same. From these weights the percentage of moisture in food samples were calculated as follows:

$$\% \text{ Moisture} = \frac{\text{Loss in weight}}{\text{Sample of Weight}} \times 100$$

Determination of Crude Protein Content

The crude protein content of the sample was determined by the semi-micro kjeldahl technique described by AOAC [22]. About 1g of the sample was put into a kjeldahl flask and 3g of hydrated cupric sulphate [catalyst] was added into the flask. Twenty milliliters [20ml] of anhydrous sodium sulphate and 1g of concentrated sulphuric acid [H_2SO_4] were added to digest the samples, stoppered and swirled. The flasks and its content then swirled occasionally until the liquid was clear and free from black or brown colour. The clear solution was then cooled and made up to 100ml with distilled water and a digest of about 5ml was collected for distillation. Five milliliters [5ml] of 60% sodium hydroxide solution was put into the distillation flask and distilled for five minutes. The ammonia that was distilled-off was absorbed by boric acid indicator which was titrated with 0.1ml hydrochloric acid. The titre value of the end point at which the colour changed from green to pink was taken. The crude protein was calculated as percentage crude protein.

$$\text{Percentage Crude Protein} = \frac{0.0001410 \times 6.25 \times 25 \times T}{W \times 5} \times \frac{100}{1}$$

Where, W = weight of sample [g]. T = Titre value

Determination of Crude Fat Content

The soxhlet extraction method of AOAC [22] was used in determining the fat content of the sample. About 2g of the sample [A] was weight out using electronic kitchen scale [SF-400 China] and put in the extraction thimble and plugged. It was then placed back in the soxhlet apparatus. A weighed flat bottom flask [B] was thereafter filled to about three-quarter of its volume with petroleum ether of 40-60°C boiling point range. The apparatus was then set up and the experiment was carried out for a period of 4-8 hours after which complete extraction was made. The petroleum ether was recovered by evaporation using water bath [Technicol, SE-20 England] and the remaining portion in the flask was dried in the oven [Gallenkamp, VWR 1730] at 80°c for 30 minutes and cooled in a desiccator and finally weighed using Mettler HAS balance [P-163 England]. The difference in the weight of the empty flask and the flask with oil [C] gave the oil content which was calculated as the percentage fat content.

$$\text{Fat content} = \frac{C-B}{A} \times \frac{100}{1}$$

Where; A = weight of sample. B = weight of empty flask. C = weight of flask and oil

Determination of Carbohydrate

Carbohydrate content of the samples was determined by the difference described by Oyenuga [23] using the equation below.

% Carbohydrate = 100 – [% moisture + ash + % protein + % crude fiber+%crude fat].

RESULTS AND DISCUSSION

Fruits are consumed for their nutritive values. The growing global markets for non-alcoholic fruit juices and transformation of many exotic juices of other easy to consume, preserve and marketable products underscore their economic value. As shown in table 1, the total plate count and total coliform count for the list fruits of Hogplum [Hp] and African Star Apple were 3.8 X 10^4 CFU/g; 2.1 X 10^4 CFU/g and 5.2 X 10^4 CFU/g; 1.9 X 10^4 CFU/g respectively. The total microbial counts observed in the fruit samples studied were above the limits [1.0 X 10^2] of the standard board recommendation for fruits. This value obtained is partly due to the high moisture content in fruit samples which has been found to promote the growth of bacteria [24].

Table 1: **The total aerobic bacteria counts of the fruits samples**

Sample	Total plate count	Total coliform count
Hogplum	3.8 X 10^4 CFU/g	2.1 X 10^4 CFU/g
African Star Apple	5.2 X 10^4 CFU/g	1.9 X 10^4 CFU/g

Table 2: Occurrence and percentage distribution of identified bacteria from the two fruits.

	Hogplum fruits		African star apple fruits	
Probable Bacteria	No of occurrence (n)	Percentage Distribution (%)	No of occurrence (n)	Percentage Distribution (%)
Staphylococcus aureus	2	11.8	4	33.2
Proteus vulgaris	4	23.5	2	16.7
Bacillus cereus	5	29.4	2	16.7
Enterobacter aerogens	2	11.8	-	-
Escherichia coli	3	17.6	2	16.7
Lactobacillus plantarum	1	5.9	-	-
Bacillus licheniformis	-	-	2	16.7
Total	17	100	12	100%

Table 3: Proximate composition of the fruits samples ±SD

Parameter	Hogplum	African Star Apple
	Value	Value
Moisture	64.40 ± 0.050	64.32 ± 0.12
Protein	2.11 ± 0.08	1.71 ± 0.09
Ash	0.856 ± 0.003	1.72 ± 0.03
Fibre	9.724 ± 0.002	18.18 ± 0.02
Fat	13.024 ± 0.102	2.66 ± 0.02
Carbohydrate	9.840 ± 0.002	11.41 ± 0.23

Table 4: Vitamin composition of the fruits samples (mg/g), ±SD

Parameter	Hogplum	African Star Apple
	Value	Value
Vitamin B_1	1.86 ± 0.01	0.83 ± 0.01
Vitamin B_2	1.17 ± 0.00	0.34 ± 0.00
Vitamin B_3	0.36 ± 0.01	0.41 ± 0.01
Vitamin C	23.21 ± 0.02	26.63 ± 0.02
Vitamin A	456.22 ± 0.02	628.22±0.02

Table 5: Mineral composition of the fruits samples, ±SD

Parameter	Hogplum	African Star Apple
	Value	Value
Sodium (Na^+)	26.90 ± 0.01	25.34 ± 0.03
Potassium (K^+)	394.00 ± 0.01	202.01 ± 0.02
Calcium (Ca^+)	85.00 ± 0.03	26.00 ± 0.01
Magnesium (Mg^{++})	36.00 ± 0.02	21.02 ± 0.02
Phosphorous (P)	72.12 ± 0.04	58.00 ± 0.02
Zinc (Zn^{++})	0.75 ± 0.01	0.02 ± 0.00
Iron (Fe^{++})	4.01 ± 0.01	0.51 ± 0.01
Lead (Pb^{++})	0.20 ± 0.00	0.01 ± 0.00
Nickel (Ni^{++})	0.06 ± 0.01	0.00 ± 0.00
Manganese (Mn)	0.28 ± 0.01	0.20 ± 0.01

Table 6: Antinutritional composition of the fruits samples, ±SD

Parameter	Hogplum	African Star Apple
	Value	Value
Phytates (mg/g)	30.48 ± 0.12	18.12 ± 0.08
Phytic acid (mg/g)	8.59 ± 0.04	5.11 ± 0.06
Tannins(mg/g)	0.25 ± 0.01	0.93 ± 0.04
Glycosides (mg/kg)	39.90 ± 0.27	106.63 ± 0.02
Phenols (%)	6.25 ± 0.27	26.19 ± 0.08

Table 7a: Resistant pattern of the bacteria isolated from African star apple sample analysed

Bacteria (n)	Resistant pattern	No of antibiotics	N	Tn
Staphylococcus aureus (4)	TET-CHL-COT-CXC-ERY-AUG-GEN	7	2	
	STR-TET-CHL-CXC-ERY-GEN	6	1	
	TET-CHL-COT-CXC-ERY-AUG	6	1	
				4
Proteus vulgaris (2)	TET-CHL-COT-CXC-ERY-AUG-GEN	7	1	
	CHL-COT-CXC-ERY-AUG	5	1	
				2
Bacillus cereus (2)	TET-CHL-COT-CXC-ERY-AUG-GEN	7	1	
	TET-CHL-CXC-ERY-AUG-GEN	6	1	
				2
Bacillus licheniformis (2)	TET-CHL-CXC-ERY	4	2	
				2
Escherichia coli (2)	CHL-COT-CXC-ERY-AUG-GEN	6	1	
	CHL-COT-CXC-ERY-AUG	5	1	
				2
				12

Keys: Ampicillin (AMP), Ceftazidime (CAZ), Cefuroxime (CRX), Gentamycin (GEN), Ciprofloxacin (CPR), Nitrofurantoin (NIT), Ofloxacin (OFL) and Augmentin (AUG).
n= number of occurrence, Tn= Total number of occurrence.

Table 7b: Resistant pattern of the bacteria isolated from Hog plum samples analysed.

Bacteria (n)	Resistant pattern	No of antibiotics	N	Tn
Staphylococcus aureus (2)	AMP-CRX-AUG	3	2	
				2
Proteus vulgaris (4)	AMP-CRX	2	4	
				4
Bacillus cereus (5)	AMP-CAZ	2	1	
	CAZ	1	4	
				5
Enterobacter aerogenes (2)	AMP-CRX-AUG	3	2	
				2
Escherichia coli (3)	AMP-CRX-AUG	3	1	
	CRX-AUG	2	2	
				3
Lactobacillus plantarum (1)	AMP-CRX-AUG	3	1	
				1
				17

Keys: Ampicillin (AMP), Ceftazidime (CAZ), Cefuroxime (CRX), Gentamycin (GEN), Ciprofloxacin (CPR), Nitrofurantoin (NIT), Ofloxacin (OFL) and Augmentin (AUG).
N= number of occurrence, Tn= Total number of occurrence.

The occurrence and percentage distribution of different bacteria isolated from the samples of Hp and ASA as shown in tables 2. Total of 29 bacteria isolates were isolated with seven [7] bacteria genera identified from the two fruit samples. *B. cereus* 7[24.1%], *S. aureus* 6[20.7%], *P. vulgaris* 6[20.7%], *E. coli* 5[17.2%], *B. licheniformis* 2[6.9%], *E. aerogenes* 2[6.9%] and *L. plantarum*

1[3.5%]. This is in accordance with the work of Akther et al. [6], where some bacteria which include *E. coli, P. vulgaris, S.aureus* etc. were isolated from fresh vegetables and to the work of Akoja et al. [25] who reported that *Escherichia coli*, *Enterobacter aerogens*, *Bacillus cereus*, *Proteus vulgaris* were among the bacteria isolated from carrots. Microorganisms cause spoilage or deterioration and considering the environment and methods employed in harvesting these fruits before analysis, it is apparent that practically all kinds of microorganisms may be isolated from them [26].

Resistant pattern of the bacteria isolated from African star apple sample and hogplum fruits samples was shown in table 7a and 7b. It has been observed from the study that antibiotic susceptibility of bacteria isolates is not constant but dynamic and varies with samples, time and environment. Antibiotic resistant bacteria and their corresponding resistance determinants are known to spread from animals to humans via the food chain [27]. Fresh vegetables that are eaten raw may contribute to this phenomenon, as epiphytic bacteria may develop antibiotic resistances as a consequence of the large amount of antibiotics used in agriculture. Also treating soil with organic fertilizers, such as sewage sludge, manure and contamination irrigation water may lead to vegetal contamination with resistant bacteria from animal and / or human sources [27].

This is therefore demands the need for periodic screening of common bacterial pathogens associated with vegetables and fruits for their antibiotics susceptibility profiles in the fruits samples.

The proximate analysis of the fruits sample was determined as observed in table 3. The fat content of Hogplum 13.024% was higher compared to that obtained in African Star Apple 2.66%. Fat is an excellent source of energy, thus enhance transport of fat soluble vitamins, protect internal tissues and contribute to important cell activities [28]. The crude fibre obtained were 9.725% and 18.18% hogplum and African star apple respectively. The value obtained in the fibre content indicates that the fruits contain a portion of cellulose, hemicellulose and lignin. However, low fibre content is also known to reduce the rate of glucose and fat absorption [29]. Soluble Dietary fibres have health promoting properties as they have been implicated in lowering plasma and liver cholesterol concentration, Diarrhea treatment and detoxification of poisonous metals [30]. The carbohydrate contents are 9.81% and 11.94% for hogplum and African star apple respectively. These values were very low when compare with the work of Edem and Dosunmu, [31] where 78.34% was obtained from African star apple fruit.

The ash content obtained were 0.856% and 1.76% hogplum and African star apple respectively. These values are low when compare to that of Dauda, [32] where 3.13% ash was obtained. The ash content of 0.856% indicates the amount of inorganic matter and oxides present in the fruit samples. This value is very close to that mentioned by Munmun [33], who reported that ash content of fresh hog-plum was 0.79% and dried hog-plum contained 2.21% ash. Keramat Ali et al. [34] reported that the ash content of Bangladesh fresh hog-plum was 1.2%. Islam [35] found that ash content of green and ripe hog-plum were 0.473% and 0.476%, respectively. The low ash contents obtained in the fruit samples as observed in some other fruit samples was indicative of low mineral values most especially micro minerals [36] . The moisture content determined were 64.40% for hogplum and 64.32% for the African star apple. These values are low when compared to the work of Akther et al. [6] where 83.84% was obtained from fresh Barishal hogplum fruits. The high moisture content of the fruits underscore its high perishability and susceptibility to microbial attack. This is indicative of low solid matter in the pulp. This high moisture content characterizes the freshness of fruits since fruits kept for some time tend to lose moisture. These values obtained from the samples were lower than 66.67% moisture content reported by Eden and Dosumu [31] but higher than the values of 31.97% and 35.0% reported by Chukwumolume et al. [37]; Akubor et al. [2] respectively. Low moisture content of mature seed means it can be stored for a long period than the pulp and peel because of its better resistance to microbial attack [10].

The protein content observed in the fruit samples indicates that fruits are generally poor source of proteins. The protein content of fruits obtained from the analysis were [2.11%] and [1.71%] hogplum and African Star apple respectively, which is lower than [5.66%] earlier reported for *C. africanum* fruit [31]. The value is also lower than [14.87%] and [15.75 %] reported for *S. gilo* and *S. aubergine* respectively as studied by Edem et al. [38], [4.0%] reported for *A. carambola* fruits as studied by Edem et al. [39]. This result shows that these fruits are very low in its protein content. This value can be improved by the dehydration of the fruits [40].

The vitamin content of the fruit samples revealed that the samples are high in vitamins A and C as was shown in table 4. This supports the findings of Adeolu and Adeyemo [41] that wild fruits such as Hogplum and African Star Apple are rich in vitamins A and C which in addition to being an essential vitamin, a neutral antioxidant protecting our body from damage caused by free radials potentially reducing the risk of heart disease [10;28]. It was also found that these fruits contain some level of vitamin B_1, B_2 and B_3 in trace quantity.

The mineral content [table 5] of the fruit samples showed that the macronutrients [Na, K, Ca, Mg, P] are present in large quantity while the micronutrients [Zn, Fe, Pb, N, Ni] are present in small quantity. Minerals are important for bone and teeth formation, prevention of anemia and other related diseases [42]. They are also required in the plasma and extracellular fluid where it helps to maintain osmotic equilibrium [43]. Micronutrients are essential components of biological membrane.Ca^{2+} are tissue components of bones and teeth. They are also required for normal growth and other activities of muscle, skeletal development, cellular activity, oxygen transport, chemical reaction in the body [44]. Antinutritional composition of the fruits samples was shown in table 6. This attests to the desirability of the nutritive value of these fruits. The study of the anti-nutritional contents in the fruit samples is necessary because their presence can reduce essential nutrients bioavailability. Some of these anti-nutrients have been found to have protection against some diseases. The reduction in tannin level in both fruits samples could be attributed to the action of polyphenol oxidase enzymes which oxidises tannin to phenol [45]. Tannin has been reported to adversely affect protein digestibility but its minimum level required to elicit a negative growth response has not been fully established [46].

CONCLUSION AND RECOMMENDATION

The fruits studied were sources of essential macro and micronutrients, vitamins and since the level of their anti-nutritional factors is lower than what can cause mal-absorption of other nutrients, their consumption should be encouraged when available. In handling and processing, good manufacturing practices must be practiced because pathogens have been reported to survive in fruits despite their natural activity. The presence of *Escherichia coli* and *Proteus vulgaris* can cause infection in the body. The study has provided evidence for human pathogens to enter, survive and grow within intact fruits. Proper washing of the fruits must be done before eating.

However, it can be deduced that the fruits have great potentials as fruit snacks for the obese and diabetics and it can contribute to the healthy growth and as supplements in food industries.

REFERENCES

1. Adepoju, Oladejo Thomas and Adeniji, Paulina Olufunke, (2012). Nutrient composition and micronutrients potential of three widely grown varieties of African star Apple (C*hrysophyllum albidium*) from Nigeria. *African Journal of Food science* Vol. 6 (12) pp, 344-351.
2. Akubor, P.I., Yusuf, D. and Obiegunam. J.E. (2013). Proximate compositions and some functional properties of flour from the karnel of African star apple (*Chrysophyllum albidium*).*International Journal of Agriculture Policy and Resources*. Vol. 1(3), pp. 062-066.
3. Florence,Abolaji Bello and Adiaha, Abigail Hanry (2015). Storage effects and the post harvest quality of African star apple fruits (*Chrysophyllum africanum*) under ambient conditions. *African Journal of Food Science and Technology.* (ISSN: 2141-5455) Vol. 6(1) pp. 35-43.
4. Amaechi. O. L. (2015) Evaluation of uses and marketing potential of *Spondias mombin* Linn (Hogplum) in Ibadan Metropolis. *International Journal of Agriculture, Forestry and Fisheries,* 3(1): 1-6.
5. Arindam, D., Dato, I Badaruddin, N., Amiya, B. (2010). A brief review on *Crypsophyllum cainito*. Journal of Pharmacognosy and Herbal Formulations.1:1-4.
6. Akther, G.Y., Arogba, S.S., Ajoke, A.A., Ifeayi, J.O., (2012). A physiochemical study of Nigerian velvet tamarind (*Dialium guineense L*) fruit, *Journal Food Biochemistry.*
7. Eze, J.I., Okafor, G.I. and Okoyeuzu, C.F., (2014), Effects of blanching on the proximate composition and Antinutritional factors of products from African Star Apple (*Chrysophyllum albidium*) peels and cotyledons. *International Journal of scientific and Engineering Research,* volume 5, issue 7.
8. Ali, Beroumand and Deokunle, S.S., (2009), Studies on Nutritional values of some edible plants from Iron, India. *Pakistan Journal of Nutrition.* 8(1): 26-31.
9. Ojako, O.A., and Igwe, C.U. (2008). The nutritive, antinutritive and hepatotoxic properties of trichosanthes anguina (Snake tomato) fruits from Nigeria. *Pakistan Journal of Nutrition.* 7:85-89.
10. Ukana, D.A., Aniekan, E.A., and Godwin N.E. (2012). Evaluation of proximate compositions and mineral elements in the star apple peel, pulp and seed. *Journal of Basic and Applied Science Resources*. 2(5) 4839-4843.
11. Kumar, K., S. C. Gupta, S. K. Baidoo, Y. Chander, C. J. Rosen. 2005. Antibiotic uptake by plants from soil fertilized with animal manure. *Journal of Environmental Qualitative*. 34: 2082-85
12. McManus, P.S., Stockwell, V.O., Sudin, G.W. and Jones, A.L. (2002). Antibiotic use in plant agriculture. *Annual Review of Phytopathology*. 40: 443-465.
13. Blanco, G., Lemus, J. A. and Grande, J. (2009). Microbial pollution in wildlife: linking agricultural manuring and bacterial antibiotic resistance in red-billed choughs. *Environmental Research*. 109:405-412.
14. Walsh, C. and Fanning, S. (2008). Antimicrobial resistance in foodborne pathogens: a cause of concern? *Current Drugs Targets* 9:808-815.
15. Cowan, S.T., Steel, K.J. (2004). Manual for the Identification of Medical Bacteria (3rd ed). Cambridge University Press. London, pp. 33l
16. Fawole., M.O., Oso, B.A. B.A. (2008). Laboratory Manual of Microbiology. Spectrum Books ltd Nigeria. Pp 127.
17. Clinical and Laboratory Standards Institute (CLSI), (2009). Performance standards for antimicrobial disk and dilution susceptibility tests for bacteria isolated from animals; Approved standard-Third edition, CLSI document M31-A3, Clinical and Laboratory Standards Institute, 940 West Valley Road, Wayne Pennsylvania, USA, 28: 1-99.
18. Essien, A.I., Ebana, R.U.B, Udo, H.B (1992). Chemical evaluation of pod and pulp of the fluted pumpkin (*Telfairia occidentalis*) fruit. *Food Chemistry* 45: 175-178.
19. Pearson,O (1976). Fruits and vegetable products. The chemical analysis of food (7th edition). Churchill livingstone, Edinburg London and New York. Pp 158-203.
20. Onwuka,U.N.(2007). Design and Fabrication of Ohmic heater on a Static medium proceedings of Nigerian Institute of food Science and Technology. *Abuja Oct. 22-25*.Pp. 350-351.
21. Harbone, J.B., 1973. Phytochemical Methods, a Guide to Modern Technique of Plant Analysis. 2nd Edn. Chapman and Hall, New York.
22. Association of Official Analytical Chemists (A.O.A.C). (2010). Official method of Analysis. 2nd edition, Association of Official Analytical Chemists, Washington D.C., pp. 807-928.
23. Oyenuga, V. A. (1986). *Nigerian's food and feeding stuffs* 3rd ed. Ibadan University Press, Ibadan, Nigeria, 1988.
24. Macrae, R., Robinson, R.K., Saddler M.J., (1993) Wine: In Encyclopedia of Food Science and Technology, Vol. 7, Harcourt Brace., London.
25. Akoja, S.O., Falegan, C.R., Ogunmoroti, O. S**.** and Adebule P. (2017). Plasmid Profile of Antimicrobial Resistant Bacteria Isolated from Carrot (*Daucus carota* l. Subsp. *Sativus*) in some selected markets in Ekiti State. Nigeria. *Journal of Advancement in Medical and Life Sciences*. 5(2): 1-7. India
26. Awe, S., Eniola K.I.T., Kayode-Isola, T.M. (2013) Proximate and mineral composition of locally produced pawpaw and Banana wine. *American Journal of Research communications.* Vol. 1 (12).
27. Boehme, S., Werner, G., Klare, I., Reissbrodt, R. and Witte, W. (2004). Occurrence of antibiotic-resistant enterobacteria in agricultural foodstuffs. *Molecular Nutrition and Food Research*. 48:522-531
28. Swami, Shrikant Baslingappa, Thakor, N.J., Divate, A.D. (2014). Fruit wine production: A Review. *Journal of Food Research and Technology*. Vol. 2. Pp 93-100.
29. Idise, O.E., (2011). Studies on wine production from coconut (*Cocos nucifera*). *Journal of Brewing and Distilling* vol. 2(5), pp. 69-74.
30. Cohn R., Cohn, A.L (1996). The bye-products of fruit processing in: Fruit processing, ed Arthey D, Ashurst PR, Chapman and Hall, London, U.K pp. 196-220.
31. Edem, O.A., Dosumu, M.I. (2011). Chemical evaluation of proximate composition, ascorbic acid and anti-nutrients content of African star apple *(Chrysophyllum africanum)* fruit. IJRRAS (9) 1: 146-149.
32. Dauda, A.O. (2014). Quality attributes of Fruit Juices Made From Blends of Indigenous Fruit (African Star Apple) with conventional Fruit (Papaya). *International Journal of Research In Agriculture and Food Sciences.* Vol. 2, No.1 ISSN 2311 -2476
33. Munmun, R. (2005). Study on air and osmotic dehydration of hog-plum (*Spondius mangifera*). M.S. Thesis department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh

34. Keramat, T.A. (2002). Nutritional composition and antinutritional factors of chick peas (*Cicer arietinum* L.) undergoing different cooking methods and germination. *Plant Foods Hum. Nutr.,* 57: 83-97.
35. Islam A (2002). "Kiraz" Cherry laurel (*Prunus laurocerasus)* New Zealand *Journal of Crop Horticulticultural Science.* 30:301- 302.
36. Alwood.W.B.(2011Composition of grape juice. http://chstofbooks.com/food/beverages/Adulteration-origi/compositionof-grape-juice.
37. Chukwumalume, R.C., Garba, S.A., Ijah, L., Agary, A. (2010). Chemical composition of African star Apple (*Chrysophyllum albidium*) fruit juice. Book of Extended Abstract of the 34th Annual conference and Annual General Meeting of Nigerian Institute of food science and technology; pp. 238-329.
38. Edem C.A. Dosunmu M.I, Bassey F.I. Wilson, C and Umoren,P. (2009). A Comparative Assessment of the proximate composition, Ascorbic Acid and heavy metal content of of two species of Garden Egg solarium gilo and and solarium anbergrine *Pakistan journal of nutrition* 8(8) 582-584.
39. Edem, C.A. M.I. Dosunmu, A.C. Ebong and M. Jones (2008): Determination of Proximate composition of Ascorbic acid and heavy metal content s of star fruit (Averrhoa Carambola) global journal of p and App. Sciences 14 (2) 193-195
40. Igboh,M.Ngozi, Ikewuchi,C.Jude and Ikewuchi,C.Catherine (2009). Chemical profile of Chormolaena odoratal. *Pakistan Journal of Nutrition* 8(5):521-524.
41. Adeolu, A. and Adeyemo, V (2011). Gender and Urban Agriculture:The case of vegetable marketing in Lagos State of Nigeria (in) Adeyemo, R (ed), (2011). Urban Agriculture,cities and climate changer Cuviller Verlag, Gottingen.Pp. 217.
42. Oluyemi, E.A., Akilua, A.A., Adenuga, A.A. and Adebayo M.B. (2006). Mineral contents of some commonly consumed Nigerian foods, Science Focus, (11); 153157.
43. Gafar, M.K and Itodo, A.U. (2011). Proximate and mineral composition of hairy indigo leaves. *Electronic Journal of Environmental Agricultural food chemistry*. 10(3); 2007-2018.
44. Ibrahim, G., Mahmud, N., Yaro, A.H., Ahmed, A. (2006). Phyto-chemical and toxicology evaluation of the stem bank of *Fiscus sycomprus LINN* (Moraceae). *Biology and Environmental Science for Journal for the tropics* 3(3): 37-40.
45. Getashew, A.G., Asfaw, Z., Singh, V, Woldu, Z., Baidu – Fprson, J.J. and Bhattacharya, S. (2013). Dietary values of wild and semi-wild edible plants in southern Ethiopia. *African Journal of Food and Agricultural Development* (13) 2:7485-7503.
46. Elemo BO, Elemo GN, Agboola, OO, Oyedun, AB. (2001). Studies on some antinutritive factors and in-vitro protein digestibility of *Thaumatococcus daniella* (Benth) waste. *Nigerian Journal of Biochemistry and Molecular Biology.* 16:43-46.

Citation: Falegan C.R. A *et al*. (2017). Bacteriological and Proximate Analyses of Hogplum (*Spondias Mombins*) and African Star Apple (*Chrysophyllum Albidium*) Fruits in ADO-EKITI STATE. EKITI STATE, NIGERIA, DR Congo. J. of Advancement in Medical and Life Sciences. V6I1. DOI: 10.5281/zenodo.1116747

Copyright: © 2017 Falegan C.R. A. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.