Agro-Science Journal of Tropical Agriculture, Food, Environment and Extension
Volume 22 Number 3 (July 2023) pp. 72 - 76

ISSN 1119-745

CHEMICAL COMPOSITION OF PROCESSED FRESH AND DRIED GARDEN EGG (*Solanum macrocarpon* L.) AND UNRIPE PAWPAW (*Carica papaya* L.) FRUITS CHIPS

***Gbeyonron F.M. and Ortswen J.F.**

Department of Nutrition & Dietetics, Joseph Sarwaun Tarka University, Makurdi, Nigeria

Corresponding author's email: francamdg@gmail.com

ABSTRACT

The study examined the chemical composition of fresh and dried garden eggs (Solanum macrocarpon L.) and unripe pawpaw chips (Carica papaya L.). Unripe processed caricapapaya and garden eggs fruits chips in some Nigerian communities especially Benue State are utilised as ingredients in soups, however it's unclear how nutritious the variably processed versions are. This study's main focus was to determine the nutritional quality of traditionally processed unripe C. papaya and garden egg fruit chips.The fruits were processed and sundried for 72 h. Proximate and micronutrient compositions were determined using standard procedures. Data were analyzed using descriptive statistics. Duncan's new multiple range test at 5% probability was used to separate and compare means and was accepted at ($p \leq 0.05$). Proximate composition for fresh uncooked pawpaw fruits had higher carbohydrate 20.55± 0.01 mg, crude fibre 2.68±0.01 mg, protein 1.65±0.01 mg, ash 1.45±0.01 mg and fat 1.10±0.01 mg except for moisture relative to those of garden egg fruits moisture 90.54±0.01 mg, carbohydrate 3.92±0.01 mg, fibre 2.55±0.01 mg, protein 1.52±0.01 mg, ash 1.36±0.01 mg and fat 0.11±0.01 mg%, respectively. Dehydration increased nutrient values for garden egg fruits relative to pawpaw fruits. Vitamin profiles for fresh and sun-dried pawpaw and garden egg fruits had differences. Dehydration decreased ß-carotene, thiamin and vitamin C values for pawpaw. It increased thiamin, riboflavin, niacin and pyridoxine values for garden egg fruits. Both fruits were rich in nutrients; traditional processing may not adversely affect their proximate composition. Since these fruits are typically processed with soup thickness before eating, the evident loss of vitamins and minerals should be mitigated by adding extra high-quality sources.

Keywords: Pawpaw, garden egg, processing, proximate, mineral, vitamin

INTRODUCTION

Consumption of fruits and vegetables is an essential element of a healthy diet for humans and has been honed as a vital component of a healthy lifestyle, which is necessary and critical for protecting and preventing the body from various chronic diseases, including some cancers and cardiovascular diseases if consumed daily and in sufficient amount (Volken *et al.,* 2012). It has also been described as an appropriate diet for weight management and protection against overweight and obesity (Tavassoli *et al.,* 2015; Olatona *et al.,* 2018). They supply a wide variety of nutrients and phytochemicals to the body. Fruit and vegetable consumption is crucial to the availability of micronutrients to the body, and has been found to be a major obstacle to achieving healthy diets globally (Yazew and Daba, 2020). Fruits are also good source of vitamins, minerals and antioxidants. The major constituent of fruits (about 75-95%) is water. Other constituents of fruits include celluloses, fibers, pectin and tannins (Dhandevi and Jeewon, 2015).

The garden egg (*Solanum macrocarpon L*) is a traditional fruit used in traditional activities and everyday fruit in Nigeria. It is a highly valued delicacy and constituent of the African food called "Nghishii" in Tiv, "Anara" in lgbo, "Yalo" in Hausa and "Igba" in Yoruba. It contains many phytochemicals and aids in the digestion of other foods rich in vitamins A, B and C, which benefit human health (Auta *et al*., 2011). It can be eaten raw or cooked and commonly consumed during wedding ceremony because it symbolizes fertility and blessing. Apart from the fruit, being eaten raw and fresh it can be dried and will be used in soups among the Tiv people of Benue State (Agulanna, 2020).

Pawpaw (*Carica papaya L*.) called "Mbuer" in Tiv, "Okwuruezi" in lgbo, "Ibepe" in Yoruba and "Gwanda" in Hausa is a common fruit grown in almost all parts of Nigeria. It is adjudged to have many nutritional and health benefits including aiding digestion of other foods, rich content in vitamins A, B, C, etc. (Ugo *et al*., 2019; Ugbogu *et al*., 2023). Pawpaw is also one of the cheapest

Please cite as: Gbeyonron F.M. and Ortswen J.F. (2023). Chemical composition of processed fresh and dried garden egg (*Solanum macrocarpon* L.) and unripe pawpaw (*Carica papaya* L.) fruits chips. *Agro-Science*, **22 (3),** 72-76. DOI: https://dx.doi.org/10.4314/as.v22i3.10

economically important fruit grown and consumed for its nutritional content and characteristics in the country (Ivan *et al*., 2020). Besides, it is a perceived daily consumed fruit by rural and urban families and represents the primary income source for many households. While the general population typically recognizes this fruit as being consumed in its fresh and ripe states, it is noteworthy that among various Tiv communities, it is also frequently ingested in its unripe or green form, particularly in the context of traditional soups. The specific soup referred to as "Igyandembuer" in the Tiv language is prepared using the *Solanum macrocarpon* L. fruit, recognized as "Igyandemngishi" in the Tiv language.

The dearth of available data regarding the nutritional composition of commonly consumed foods in Nigeria has hindered the effectiveness of nutrition education campaigns in addressing the dietary needs of a significant portion of the Nigerian population. This has resulted in suboptimal dietary decisions, inadequate nutrient intake, and a postponement in adopting diversified food patterns. In specific regions of Nigeria, particularly in Benue State, unripe *Carica papaya* fruit and garden eggs gathered during the rainy season are preserved through drying. This preservation practice serves as a strategy to address the scarcity of leafy green vegetables during the dry season, as these dried ingredients are later utilized in soup preparation. To optimize nutritional outcomes in the handling and processing of locally sourced foods, it is imperative to comprehend the impact of processing on the chemical composition of these foods (Chikwendu *et al.*, 2014). This study aims to ascertain and compare the chemical composition of processed fresh and dried garden eggs and unripe pawpaw fruit chips.

MATERIALS AND METHODS

Materials

Unripe fresh pawpaw fruits (*Carica papaya* L.) were harvested from Mbakuha, Agan, Mbatsen, Mbakor and Agbeede communities in Tiv land, Benue State where the research was conducted. While garden egg (*Solanum macrocarpon* L.) fruits were purchased at Lessel, Wannune, Agasha, Abaji and Agbeede within the study area.

Processing of the Material

The unripe pawpaw fruits were plucked, and exposed to sunlight for 20 min. to reduce the amount of papain present (Okon *et al.,* 2017). Subsequently, the fruits underwent a thorough washing, peeling, and halving process. The seeds were manually extracted, and each half of the fruit was meticulously sliced into rectangular pieces using a stainless steel kitchen knife, achieving a thickness of 2 mm for creating the fresh chips. At the same time, another group of chips went through 72 h of being dried by the sun. This resulted in dried chips that are excellent for soups and can be eaten. Concurrently, garden egg (*Solanum macrocarpon* L.) fruits were obtained at the nearby market in the study location, cleaned, and cut into two halves. Afterwards, the halves were cut into 2-mm thick slices to make fresh chips, while another set of the half went through a 72-h sun-drying proce-dure to produce dried chips for cooking purposes.

Chemical Analysis

Proximate (protein, moisture, fat, fibre, ash and carbohydrate), minerals, and vitamins of the fresh and sundried unripe pawpaw and garden egg were determined in triplicates. The Protein, moisture, fat, fibre, ash were determined by the AOAC (2010). The carbohydrate content was obtained by difference. Mineral determination: Calcium (Ca), iron (Fe), magnesium (Mn) phosphorus (P), sodium (Na), potassium (K) contents were determined using atomic absorption spectrophotometer after ashing of the samples (IITA, 2002). Vitamins: The βeta-carotene, thiamine, riboflavin, niacin, pyridoxine, and vitamin C content of the samples was determined using (AOAC, 2010).

Data Analysis

The data generated were analysed using Statistical Package for the Social Sciences (SPSS) version 17 software. Analysis of variance was performed on the data, while Duncan stundentized multiple range test was used to separate and compare means at the 5% level of significance ($p < 0.05$).

RESULTS AND DISCUSSION

Proximate Composition of the Fresh and Dried *C. papaya* and *S. macrocarpon* Fruits (per 100 g)

The proximate composition for fresh pawpaw (FP) and fresh garden egg (FG) chips indicated that garden egg has higher moisture value relative to that of the pawpaw (90.57 and 72.57%) respectively (Table 1). While the dried pawpaw (DP) and the dried garden egg (DG) moisture values were comparable 9.98 and 9.45 %. This result agrees with Shalom *et al.* (2011) that reports that, garden egg had higher moisture (92.50%). The high moisture content in both fruits may be as a result of its bulkiness and low energy content and this could be a useful aid to weight loss when used to increase the bulk of soups. However, when the samples were sundried, the moisture content reduced drastically. This is not surprising since sun drying tends to reduce the moisture content of the product and improves its keeping quality and this is in line with the findings of Shalom *et al.* (2011) (7.5%).

Table 1: Proximate composition of the fresh and dried *C. papaya* and *S. macrocarpon* fruits (per 100 g)

Variables	Samples			
	FP	DP	FG	DG
Moisture	72.57 ± 0 .02	9.98 ± 0 .01	90.54 ± 0.01	9.45 ± 0.01
Protein	1.65 ± 0 .01	5.86 ± 0.03	1.52 ± 0.02	14.48 ± 0.01
Fat	1.10 ± 0.01	3.65 ± 0 .01	0.11 ± 0.01	1.15 ± 0 .01
Ash	1.45 ± 0 .01	4.76 ± 0 .01	1.36 ± 0.01	12.88 ± 0.01
Crude Fibre	2.68 ± 0 .01	9.93 ± 0 .06	2.55 ± 0.02	15.64 ± 0.01
Carbohydrate	20.55 ± 0.01	65.82 ± 0.00	3.92 ± 0.01	46.40 ± 0.02

Mean ± SD of three determinations, FP - fresh pawpaw, DP - dried pawpaw, FG - fresh garden egg, DG - dried garden egg

The protein level was lower in both samples in their fresh forms (1.65% and1.52%) for FP and FG respectively, but had higher values when sundry DG and DP (14.48% vs 5.86%). This agrees with Naz *et al.* (2018) who reported on some species of garden egg that the protein level was between 14.87% and 15.75%. However, the results are contrary to the study by Okon *et al.* (2017) which reported high values for raw and dried pawpaw pulp. The increase in protein may be as a result of sun drying which makes the nutrient to be concentrated in the samples.

The fat values from the fresh and dried samples were low and ranged from 0.11% to 3.65%, indicating DG having higher values (3.65%). A similar phenomenon exists in literature, which shows a low fat content of 1.65% in both pawpaw and garden eggs (Agoreyo *et al*., 2012). Dried pawpaw had a higher fat content than dried garden egg. This observation is worrisome because the higher the fat content of a given food is, the higher is its chances of becoming rancid.

The ash values for the fresh and the dried pawpaw and garden egg differed. They ranged from 1.36% for the FG to 12.88% for the DG. The DG ash content was much higher than that for the dried pawpaw fruit (12.88% vs 4.76%). The high ash content in dried garden egg is contrary to many studies on garden egg, except for Auta *et al*. (2011) who reported higher value on wet weight basis. This major variation might be due to varietal differences in the samples used.

The crude fibre value for the FP was higher relative to that of the FG (2.68% and 2.55%, respectively). The DG had higher crude fibre value than FP (15.64% vs 9.93%). This shows that dried garden egg contains much more crude fibre than pawpaw. Dietary fibre has beneficial effects on blood cholesterol; helps in body weight reduction and metabolic function and in healthy gut microbiome, and also improves colonic health (Barber *et al*., 2020).

The carbohydrate value for both fresh and dried pawpaw was higher. Fresh pawpaw had five times higher value than the fresh garden egg fruit (20.55% vs 3.92%). Sun drying increased carbohydrate value for the DP and the DG fruits (65.82% vs 46.40%). This indicates clearly that, the fresh and dried pawpaw and garden egg could supply energy to cells and fuel energy metabolism. Salehi and Aghajanzadeh (2020) stressed that dried fruits have higher fibre and carbohydrate and low fat and they have significant antioxidant value and their nutrients are concentrated. The primary role of carbohydrates (sugars and starches) is to provide energy to cells in the body, particularly the brain, which is the glucose-dependent organ in the body (Alasalvar *et al*., 2020).

The mineral composition for the fresh and dried pawpaw and garden egg fruits is presented (Table 2). The calcium (Ca) content for the FP was higher than that of the FG (58.64 vs 23.23 mg). Similar trend was found in the FP and DG (16.28 vs 12.24 mg). The higher Ca level in FP and FG fall within the range reported for pawpaw and garden egg, being from 63 mg (Michael *et al.*, 2017) to 24.10 mg (Isah *et al.*, 2022). The reason may be due to varietal differences, but is an indication that both fruits are good sources of calcium which is required for building healthy bones and teeth, absorption of vitamin B12 and formation of blood clot.

The values for iron content in all the samples were generally low. They ranged from 0.30 to 0.60 mg both in fresh and dried samples. The fairly low iron values in both fresh and dried pawpaw and garden egg show that they are not sufficient sources of iron. This agrees with earlier reports of iron values in garden egg of about 0.33 mg (Ukwela, 2010; Isah *et al.*, 2022), but not with where a higher value of 0.70 mg was obtained (Shalom *et al*., 2011).

The DG zinc content was higher than the zinc for the DP (0.63 vs 0.43 mg). The zinc value for the FG (0.47 mg) was higher than that for the FP (0.45 mg).

Table 2: Mineral composition of the fresh and dried *C. papaya* and *S. macrocarpon* fruits (per 100 g)

Variables	Samples			
	FP	DP	FG	DG
Calcium (mg)	58.64 ± 0.01	16.28 ± 0.01	23.23 ± 0.01	12.24 ± 0.01
Iron (mg)	0.30 ± 0.01	0.60 ± 0.01	0.30 ± 0.01	0.46 ± 0.01
Zinc (mg)	0.45 ± 0.01	0.43 ± 0.01	0.46 ± 0.01	0.63 ± 0.01
Magnesium (mg)	34.57 ± 0.01	63.23 ± 0.02	23.23 ± 0.01	53.25 ± 0.01
Phosphorus (mg)	36.35 ± 0.03	98.76 ± 0.01	47.34 ± 0.01	103.29 ± 0.06
Sodium (mg)	1.85 ± 0.01	26.58 ± 0.01	2.23 ± 0.01	24.19 ± 0.01

Mean ± SD of three determinations, FP - fresh pawpaw, DP - dried pawpaw, FG - fresh garden egg, DG - dried garden egg

The magnesium value for DP was higher than that of the DG (63.23 vs 53.25 mg). The magnesium values for the FP were also higher than that for the FG (34.57 vs 23.23 mg). This indicates that pawpaw chips are good sources of magnesium. The DG had higher value of phosphorus relative to that of the DP (103.29 vs 98.76 mg). Similar observation was made in the fresh samples; FG had higher value than the FP (47.34 vs 36.35 mg). The sodium content FG had higher value relative to that for FP (2.23 vs 1.85 mg). The DP had higher sodium than DG and DG 26.58 and 24.19 mg, respectively. The concentration value of Zinc, magnesium, phosphorus, sodium in fresh and dried pawpaw and garden egg showed that dried samples have higher values over the fresh ones. This shows that these fruits contain more micronutrients in their fresh than dry forms. And it is in agreement with the report by Ukwela (2010) who also recorded lower values of phosphorus (24.36 mg) and magnesium (15.20 mg) on determinations on three varieties of raw garden egg. This indicates that the higher presence of essential minerals in the sample will aid in prevention of bone diseases, retention of calcium in teeth and aid in bone formation and growth, all of which make it essential for those vulnerable age group when consumed in fresh form (Bonjour *et al*., 2009; Jones and Hodgson, 2020).

The FP had higher potassium relative to that for FG (563.34 vs 486.67 mg). The potassium value for the DP was also higher relative to that for the DG (112.34 vs 105.23 mg). These values were found to be higher than those reported by Jones and Layne (2009) (345 mg) and Milind and Gurditta (2011) (257 mg) in pawpaw. The difference may be attributed to varietal and environmental differences. But it shows that potassium is generally high in pawpaw and garden egg. Potassium aids nerve impulse transmission and muscle contraction, fluid balance in the body and formation of protein and glycogen (Kinabo and Salaam, 2015; Akinbule *et al.,* 2019).

The vitamin composition for the fresh and the dried pawpaw and the garden egg is presented in Table 3. The β-carotene (RE) value for the fresh garden egg (FG) was higher (0.98 and 0.91 RE) for fresh pawpaw. The dried garden egg had the highest value 0.90 and the dried pawpaw with lower value of 0.75 RE. The values in these work were much lower than the value reported in the work conducted by Milind and Gurditta (2011) on fresh pawpaw in which they reported higher value (276 RE).

The thiamin value ranged from 0.53 to 0.97 mg. The DG had higher value 0.97 mg. Riboflavin values for the dried samples were higher than the fresh sample (Table 3). The DP and the DG had higher values (0.72 and 0.68 mg), and the FG and the FP values were 0.66 and 0.26 mg, respectively. Niacin contents for the DG were higher (0.45 and 0.34 mg) relative to that for the DP. The FG had higher value as compared to that of the FP (0.30 and 0.27 mg). The pyridoxine values ranged from 0.32 to 0.43 mg (Table 3). Vitamin C value was higher for the fresh sample than the dried sample. The FP had higher value 61.57 mg as compared to that for the FG (43.64 mg). The dried samples (DP) had higher value (6.58 and 0.01 mg, respectively) than DG. The average concentration of thiamin, riboflavin, niacin and pyridoxine in fresh and dried pawpaw and garden egg indicates that these fruits are sufficiently good in water soluble. This agrees with the report of Milind and Gurditta (2011) who reported that pawpaw has 0.04 mg thiamin, 0.05 mg riboflavin, 0.33 mg niacin and 0.01 mg pyridoxine. The body requires them in minute quantity but they replenish and play vital role in metabolism. Similar phenomena were observed by İncedayi *et al*. (2016), who reported that sun drying caused the greatest β-carotene and vitamin C loss. The decrease may be as a result of different processing media which may result in losses of me nutrients, especially vitamin C (Wang *et al*., 2017). The higher concentration of vitamin C in fresh pawpaw and garden egg indicates that they are rich sources of the powerful antioxidant nutrients and iron enhancer (Olorunnisola *et al*., 2019). Vitamin C is necessary for proper formation of teeth, bone and blood vessels. Its lower content in dried samples is an indication that there was loss during sun drying (Selvamary *et al.,* 2020).

CONCLUSION

In conclusion, these fruits contain significant macro and micronutrients, especially when dried. This highlights their prospective nutritional qualities for consumers. Although processing can substantially deplete specific vitamins and minerals, these deficits can be mitigated by inserting alternate components such as fish, meat, and soup thickeners during cooking. Due to their high levels of dietary fibre and antioxidant components, these fruits can boost human immunity and positively impact general nutritional health.

Table 3: Vitamin compositions of the fresh and dried *C. papaya* and *S. macrocarpon* fruits (per 100 g)

Variables	Samples			
	FP	DP	FG	DG
β-Carotene (RE)	0.91 ± 0.04	0.75 ± 0.04	0.98 ± 0.04	0.90 ± 0 .04
Thiamin(mg)	0.62 ± 0.01	0.53 ± 0.01	0.61 ± 0.02	0.97 ± 0.01
Riboflavin (mg)	0.26 ± 0.01	0.72 ± 0 .01	0.66 ± 0 .01	0.68 ± 0.01
Niacin (mg)	0.27 ± 0.01	0.34 ± 0.01	0.30 ± 0 .01	0.45 ± 0.01
Pyridoxine (mg)	0.32 ± 0.01	0.32 ± 0.01	0.32 ± 0.01	0.43 ± 0.01
Vitamin C (mg)	61.57 ± 0.02	6.58 ± 0.01	43.64 ± 0.03	0.01 ± 0.01

Mean ± SD of three determinations, FP - fresh pawpaw, DP - dried pawpaw, FG - fresh garden egg, DG - dried garden egg

REFERENCES

Agoreyo B.O., Obansa E.S. and Obanor E.O. (2012). Comparative nutritional and phytochemical analyses of two varieties of *Solanum melongena*. *Sci. World J.*, **7 (1),** 5-8

Agulanna F.T. (2020). The role of indigenous and underutilized crops in the enhancement of health and food security in Nigeria. *Afr. J. Biomed. Res.,* **23 (3),** 305-312

Akinbule O.O., Akinbule A.S., Oladoyinbo C.A. (2019). Standardization, proximate composition, mineral contents and mineral ratios of selected indigenous soups in South-West, Nigeria. *Niger. Food J.,* **37 (2),** 44-56

Alasalvar C., Salvadó J. S. and Ros E. (2020). Bioactives and health benefits of nuts and dried fruits. *Food Chem,,* **314,** 126192

AOAC (2010). Official Methods of Analysis of the Association of Official Analytical Chemists, Washington D.C, 18th ed.

Auta R., James S.A., Auta T. and Sofa E.M. (2011). Nutritive value and phytochemical composition of processed *Solanum incanum* (bitter garden egg). *Sci. World J.,* **6 (3),** 5-6

Barber T.M., Kabisch S., Pfeiffer A.F., and Weickert M.O. (2020). The health benefits of dietary fibre. *Nutrients,* **12 (10),** 3209

Bonjour J.-P., Guéguen L., Palacios C., Shearer M.J. and Weaver C.M. (2009). Minerals and vitamins in bone health: the potential value of dietary enhancement. *Brit. J. Nutr.*, **101 (11)**, 1581–1596. https://dx.doi.org/10.1017/S0007114509311721

Chikwendu J.N., Igbatim A.C. and Obizoba I.C. (2014). Chemical composition of processed cowpea tender leaves and husks. *Int. J. Sci. Res.,* **4 (5),** 16-22

Dhandevi P.E.M. and Jeewon R. (2015). Fruit and vegetable intake: Benefits and progress of nutrition education interventions-narrative review article. *Iran. J. Public Health,* **44 (10),** 1309

İncedayi B., Tamer C.E., Sinir G.Ö., Suna S. and Çopur Ö.U. (2016). Impact of different drying parameters on color, β-carotene, antioxidant activity and minerals of apricot (PrunusarmeniacaL.). *Food Sci. Technol., **36,*** 171-178

IITA (2002). Methods of mineral analysis, atomic absorption spectrophotometer. International Institute of Tropical Agriculture (IITA)

Isah L.R., Orishagbemi C.O., Netala J., Zubair A.B., and Onekutu A. (2022). Proximate, anti-nutrients, minerals and sensory properties of biscuits produced from wheat flour and three varieties of eggplant (*Solanum aethiopicum, S. Incanum, S. Molengena*). *Int. J. Agric. Econs. Manage. Dev.,* **10 (2),** 26-38

Ivan E.Ş., Nițu O.A., Jerca I.O. and Stănică F. (2020). Preliminary results regarding the postharvest pathology of pawpaw (Asiminatriloba Dunal) fruits. *Sci. Papers Ser. B Hortic.,* **64 (1),** 125-128

Jones G.P. and Hodgson J.M. (2020). Minerals. In: Wahlqvist M.L. (ed.), *Food and Nutrition*, 3rd edn. (pp. 361-373), Routledge, London. https://doi.org/10.4324/9781003115663

Jones S.C. and Layne D.R. (2009). Pawpaw Description and Nutritional Information, Kentucky State University Cooperative Extension Program. Pawpaw Research Project, Community Research Service, Atwood Research Facility, pp. 310-420

Kinabo J.O.Y.C.E. and Salaam D. (2015). Role of potassium in human and animal nutrition. In: *First National Potash Symposium Dares Salaam*

Michael U., Banji A., Abimbola A., *et al.* (2017). Assessment of variation in mineral content of ripe and unripe African eggplant fruit (*Solanum aethiopicum* L.) exocarps. *J Pharmacogn Phytochem,* **6 (5),** 2548-2551

Milind P. and Guraditta (2011). Basketful benefits of papaya. *Int. Res. J. Pharm.,* **2 (7),** 6-12. http://www.irpjonlines.com

Naz S., Anjum M.A., Naqvi S.A.H., Siddique B. and Zulfiqar M.A. (2018). Assessment of proximate, nutritional and mineral contents in some traditional vegetables consumed in Multan, Pakistan. *Pakistan J Agri. Res.,* **31 (4),** 7-11

Okon W.I., Ogri A.I., Igile G.O. and Atangwho I.J. (2017). Nutritional quality of raw and processed unripe *Carica papaya* fruit pulp and its contribution to dietary diversity and food security in some peasant communities in Nigeria. *Int. J. Biol. Chem. Sci.,* **11 (3),** 1000-1011

Olatona F.A.1, Sosanya A., Sholeye O.O., Obrutu O.E. and Nnoaham K.E. (2018). Knowledge of fruits and vegetables, consumption pattern and associated factors among adults in Lagos State, Nigeria. *Res. J. Health Sci.,* **6 (2),** 11-15

Olorunnisola O.S., Ajayi A.F., Okeleji L.O., Oladipo A.A. and Emorioloye J.T. (2019). Vitamins as antioxidants. *J. Food Sci. Nutr. Res.,* **2 (3),** 214-235

Salehi F. and Aghajanzadeh S. (2020). Effect of dried fruits and vegetables powder on cakes quality: A review. *Trends Food Sci.,* **95,** 162-172. https://dx.doi.org/10.1016/j.tifs.2019.11.011

Selvamary V.N., Brundha M.P. and Girija A.S. (2020). Role of vitamin c in immune function of human body. *Indian J. Forensic Med. Toxicol.,* **14 (4),** 8-16

Shalom N.C., Abayomi C.O., Okwuchukwu K.E., Opeyemi C.E., Olajumoke K.A. and Damilola I.D. (2011). Proximate and phytochemical analyses of *Solanum aethiopicum* L. and *Solanum macrocarpon* L. fruits. *Res. J. Chem. Sci.,* **3,** 63-71

Tavassoli E, Ramezankhani A., Mirmiran P., Mehrabi Y. and Hafez A.A. (2015). Knowledge and perceptions of obesity prevention and consumption of fruits and vegetables among high school girl students in Shahrekord. *Brit. J Med Medic. Res.,* **6**, 200-211

Ugbogu E.A., Dike E.D., Uche M.E., *et al.* (2023). Ethnomedicinal uses, nutritional composition, phytochemistry and potential health benefits of carica papaya. *Pharmacol. Res. - Mod. Chin. Med.,* 100266

Ugo N.J., Ade A.R. and Joy A.T. (2019). Nutrient composition of *Carica papaya* leaves extracts. *J. Food Sci. Nutr. Res.,* **2 (3),** 274-282

Ukwela G.U (2010). *Physico-Chemical and Sensory Qualities of Three Species of Garden Egg Commonly Sold and Consumed in Benue State*. Unpublished Undergraduate Work, Department of Food Science & Technology, University of Agriculture, Makurdi

Volken T., Rüesch P. and Guggisberg J. (2012). Fruit and vegetable consumption among migrants in Switzerland. *Public Health Nutr.,* **16 (1),** 156-163. https://dx.doi.org/10.1017/S1368980012001292

Wang J., Law C.L., Mujumdar A.S. and Xiao H.W. (2017). The degradation mechanism and kinetics of vitamin C in fruits and vegetables during thermal processing. In: Nema P.K., Kaur B.P. and Mujumdar A.S. (eds). *Fundamentals & Applications* (Part III), 227-253

Yazew T. and Daba A. (2020). Health benefits of fruit and vegetables consumption: preventive implications for non-communicable diseases in Ethiopia. *Adv. Tech. Biol. Med.,* **8 (3),** 275