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Comparative Evaluation of the Proximate and Micro-Nutritional Benefits of Pawpaw, Carrots, Turmeric and Coconut

CO Ajenu[1]*, C Imoisi[1], EE Imhontu[2] and UR Orji[3]

[1]Department of Chemistry, University of Benin, Nigeria

[2]Department of General Studies, Edo State School of Health Technology, Nigeria

[3]Department of Industrial and Production Engineering, Nnamdi Azikiwe University, Nigeria

ABSTRACT

Natural products are essential components in the human diet providing vital micronutrients such as vitamins (A, B, C, E) and minerals (calcium, potassium, sodium etc.) that are essential for proper growth and development as well as playing other roles in normal body function or metabolism. The aim of this study is to evaluate the proximate and micronutrient composition of some selected plant samples: pawpaw, carrots, turmeric and coconut. The proximate and micronutrient composition of the different fruits evaluation was carried out using methods. Results obtained shows that carrot have the highest moisture content of 84.1%, pawpaw have the highest fiber content of 23.8%, crude protein content of 12.8% and ash content of 9.6%. Coconuts have the highest fat content of 43.0% and the highest carbohydrate content was recorded in turmeric (68.59%). Highest vitamin C content was recorded in pawpaw 60.3 mg, while coconut have the highest zinc (8.0 mg), copper (4.2 mg) and iron (21.3 mg) content. Carrots have the highest sodium content of 84.0 mg. These fruits are cheap and rich in several micronutrients thus consuming them often will help reduce micronutrient malnutrition. They can also be processed into various forms domestically and on industrial scale for juices, soups, etc and can also be used to complement other foods to improve both nutrient and sensory attribute.

***Corresponding author**

CO Ajenu, Department of Chemistry, University of Benin, Nigeria. Tel No: +2347030803371; Email: imoisi.chinyere@gmail.com

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Introduction

Natural products are generally acceptable as good source of nutrients and supplement for food in a world faced with problem of food scarcity. They are known to be excellent source of nutrients such as minerals and vitamins; and also contain carbohydrates in form of soluble sugars, cellulose and starch [1]. Fruits are very vital portion of an adequate diet and they serve as food supplement, and an appetizer [2]. Fruits and Vegetables are essential components in the human diet providing vital micronutrients such as vitamins (A, B, C, E) and minerals (calcium, potassium, sodium etc.) that are essential for proper growth and development as well as playing other roles in normal body function or metabolism. Vegetables can be from various sources such as the leaves, roots or stems of plants. These are good sources of vitamins, minerals, fiber and protein.

Common vegetables such as spinach, carrots, onions, tomatoes, cucumbers, etc., are good sources of these essential nutrients. The variety and the deep pigmentations of vegetables also confer on them the ability to offer other benefits apart from the common nutrients such as the vitamins and minerals they are mostly known for instance, green, yellow and orange pigmented vegetables, such as cabbages, tomatoes, carrots and cucumbers, are rich sources of betacarotene, a precursor of vitamin A. Carrot (Daucuscarota) is a small delicious root vegetable. It may be as small as 50 mm to as long as 150 mm length and between 20 and 100mm thicknesses. It is best known for being a rich source of beta carotene, a precursor of vitamin A. Carrot (Daucus carota L.) is the most important crop of Apiaceae family. It is a root vegetable that has worldwide distribution [2].

Carrots were first used for medical purposes and gradually used as food. Written records in Europe indicated that carrots were cultivated prior to the tenth century. The colors of the carrot root flesh may be white, yellow, orange, red, purple, or very dark purple. Among 39 fruits and vegetables carrots have been ranked 10th in nutritional value. Carrot is a good source of dietary fiber and of the trace mineral molybdenum, rarely found in many vegetables. Molybdenum aids in metabolism of fats and carbohydrates and is important for absorption of iron. It is also a good source of magnesium and manganese. Magnesium is needed for bone, protein, making new cells, activating B vitamins, relaxing nerves and muscles, clotting blood, and in energy production. Insulin secretion and function also require magnesium. Manganese is helpful in carbohydrate metabolism, in coordination with enzymes in the body. Manganese is used by the body as a co-factor for

the antioxidant enzyme, superoxide dismutase. Potassium and magnesium in carrots help in functioning of muscles. Turmeric (Curcuma longa) is a rhizomatous herbaceous perennial plant belonging to the ginger family Zingiberaceae. In the past, turmeric was consumed in small quantities as a spice because of the flavour and colour it added to food [3-6].

Turmeric also possesses some vital minerals and vitamins that are critical for body metabolism and wellbeing. Sodium (Na), potassium (K), calcium (Ca) and magnesium (Mg) are among the vital minerals that reduce risk factors associated with cardiovascular diseases. Vitamin C, a co-factor in numerous physiological reactions, and β carotene are important antioxidants required for optimal functioning of the body. Nutrients found in turmeric do more than just prevent deficiency diseases. It has a high nutritional status that can be exploited. The curcumin contain vitamins or vitamin precursor which produces vitamin C, beta - carotene as well as polyphenol coupled with fatty acid and essential oil. Turmeric is a good source of spice compared with other spices [7-9].

Though consumed in Africa and some sub - Saharan countries, it has been regarded as an under exploited spice [8]. Cocos nucifera Palmae is a large palm, growing up to 30 meters (98 ft) tall, with leaves 4–6 meters (13–20 ft) long, and pinnae 60–90cm long. Coconut (L. Family-) is one of the most extensively grown and used nut in the world and is rated as one of the most important of all palms [10]. Coconuts contain a large quantity of "water" and when immature they are known as tender-nuts or jelly-nuts and may be harvested for drinking and this differentiates them from any other fruits.

When mature they still contain some water and can be used as seed nuts or processed to give oil from the kernel, charcoal from the hard shell and from the fibrous husk. Coconut water has also been reported as rehydration fluid in diarrhoea. Oral rehydration has been recommended for patients with diarrhoea to replace the fluid loss from gastrointestinal tract. Ewansiha et al. evaluated the proximate and mineral composition of the coconut shell and reported that the shell can be an effective material precursor in water and waste treatment among other uses. Pawpaw (Carica papaya) is a member of Caricaceae family [11-13].

It is a widely grown perennial, tropical tree and important fruit cultivated throughout the tropical and sub tropical region of the world. Papaya is short lived fast growing, woody, large, perennial herb, up to 10m in height with self-supporting stems [13]. The fruit is an excellent source of calcium and other minerals, which are widely used in diet. Papaya is rich sources of three powerful anti-oxidants: Vitamin C, Vitamin A and Vitamin E and also contain a digestive enzyme called papain that is effectively used for the treatment of trauma, allergies and spot injuries. Papaya seed has contributed to numerous health effect so also papaya skin posses various wound healing properties [14].

The seeds and skin pulp contains varieties of pyhtochemicals including natural phenol and flavonoids which have antioxidant properties. They have also content, thiamin, niacin and riboflavin. The fruit contains both macro and micronutrients which are Na, K, Ca, Mg, P , Fe, Cu, Zn and Mn. Papaya has several traditional medicinal applications in human and animals and the fruit is consumed for different digestive conditions, as diuretic and antiseptic. Those nutrients required in small or minute quantities are called micronutrients while those required in large amounts are called or referred to as macro nutrients [14-16].

Micronutrients are a combination of vitamins and minerals, which are all found in fruits and vegetables. With a great increase in global malnutrition, reports have it that about 2-3billion people is malnourished, micro nutrient deficiency has niches within the ecological confines of the hydra headed malnutrition [17]. Apart from the hidden hunger, diseases are transiting from, the usual protein energy malnutrition, stunting and wasting in most developing countries to the more complex non communicable diseases such as cardiovascular heart disease, cancer and obesity [18]. Hence this study is designed to evaluate the proximate and micro nutrients composition of some selected fruits such as carrot, turmeric, coconut and pawpaw. The aim of this study was to evaluate the proximate and micronutrient composition of carrot, turmeric, coconut and pawpaw in order to investigate their health benefits.

Materials and Methods

Collection of Samples

Matured and dried coconut, carrot, turmeric and pawpaw used in this study were purchased at the Uselu market, Benin City, Nigeria and transported to the laboratory for analysis in airtight polyethylene bags.

Analytical Procedure

The samples were thoroughly washed under tap water and then sliced into pieces with stainless steel knives on trays. The samples were oven dried at 70°C in an air circulated oven for 24 h and then cooled. The dried samples were then converted into powder by grinding first in an electric mill before using a grinder to obtain fine powder of larger surface area. The fine powder was then stored in a screw capped plastic containers until experiment commenced.

Proximate Analysis

The proximate composition of the samples was analyzed for moisture, ash, protein, fat and fibre by the method of AOAC [19]. The carbohydrate content was calculated by subtraction method [20].

Moisture Content Determination

5 g of each sample were weighed into different crucibles. It was then placed in an oven at 105°C for two hours, thirty and ten minutes respectively. Drying was stopped after obtaining a constant weight. The samples were cooled in a desiccator and weighed.

$$\% \text{ Moisture } \frac{\text{Loss in weight}}{\text{Weight of sample before drying}} \times 100 \quad \frac{W2-W3}{W2-W1}X100$$

Where W1= initial weight of empty crucible
W2= weight of empty crucible + sample before drying
W3= final weight of empty crucible + sample after drying

Ash Content Determination

Crucible were dried and cooled in dessicator before weighing. 5 g of the samples was weighed into the crucible and the weight taken. The crucible containing the samples were placed into the muffle furnace and ignited at 500°C. For three hours. The muffle furnace was the allowed to cool, the crucibles were then brought out, cooled and weighed. The ash content was calculated as follows.

$$\% \text{ Ash} = \frac{W2-W1}{\text{Weight of sample}} \times 100$$

W2= weight of crucible + ash
W1= weight of empty crucible

Fat Content Determination
1 g of each sample was wrapped in a filter paper and placed in a sohxlet reflux flask which is connected to a condenser on the upper side and to a weighed oil extraction flask full with 400 cm^3 of hexane. The hexane was brought to its boiling point, the vapour condensed into the reflux flask immersing the samples completely for extraction to take place on filling up the reflux flask siphons over carrying the extract back to the boiling solvent in the flask. The process of boiling, condensation and reflux was allowed to go on for hours before the defatted samples were removed. The oil extract in the flux was dried in the oven at 70°C for thirty minutes and then weighed.

$$\% \text{ Fat} = \frac{\text{Weight of fat}}{\text{Weight of sample}} \times 100$$

$$\frac{W4-W3}{W2-W1}X100$$

W1 =weight of filter paper + oven dried residue
W2 = weight of sample used,
W3=weight of filter paper

Crude Fibre Determination
2 g of each of the samples were boiled under reflux in the fume cupboard for thirty minutes with 200 ml of 15 ml H_2SO_4. The solution was filtered through filter paper in a Buchner funnel using a vacuum pump and washed with distilled water unto neutrality. The residue was then transferred to a round bottom flask and boiled for thirty minutes with 100 ml of 5% NaOH solution. The final residue was filtered through a filter paper into a crucible washed with distilled water and ethanol unto neutrality. The residue was then dried in an oven and weighed. The residue was incinerated in a muffle furnace. Cooled and weighed.

$$\% \text{ Crude fibre} = \frac{W2-W3}{W1}X100$$

W1=weight of sample used
W2=weight of crucible + oven dried sample
W3=weight of crucible + ash

Crude Protein Determination
Crude Protein of the samples was determined using the kjedahl method. 2 g of the sample was introduced into the digestion flask. 10 ml of HNO_3 was added, heated and filtered and was made up to 100 ml. 10 ml of digest was introduced into a 500 ml flask and diluted with 40 ml distilled water. 40% NaOH solution was added and stoppered very well with a condenser.

It was connected to a 250 ml conical flask. 4% 50 ml boric acid was added to the 250 ml conical flask. Heating was increased and the distillate collected. 0.1N HCl was titrated against the distillate to obtain a faint pink colour sample and the initial and final results were recorded and the average titre value was calculated and recorded. The percentage protein of the samples was obtained from the following analysis.

$$\% \text{ nitrogen (wet)} = \frac{(A-B) \times 1.4007 \times 100}{\text{Weight (g) of sample}}$$

A = Vol (ml) Std HCl x Normality of Std HCl
B = Vol (ml) Std NaOH x Normality of Std NaOH

$$\% \text{ nitrogen (dry)} = \frac{\% \text{ nitrogen (wet)}}{100 - \% \text{ moisture}}$$

% protein = % nitrogen (dry) x 6.25 (protein nitrogen conversion factor)

Carbohydrate Content Determination
% carbohydrate = 100 - % (protein + fat + fibre + ash + moisture content).

Mineral Content Determination (Zinc, Copper, Sodium and Iron)
Mineral analysis was carried out after sample digestion with 24 cm^3 mixture of the conc. HNO_3, Conc. H_2SO_4 and 60% $HClO_3$ (9:2:1 v/v). Standard methods of AOAC [21] were used for elemental analysis. Sodium was analysed using a flame photometer. Copper, iron and zinc was analysed using Unicam 969 model atomic absorption spectrophotometer.

Determination of Vitamin C
Titremetric method was used for Vitamin C determination. Vitamin C content of the different samples was determined using 2, 4 DNPH method. 0.6 ml of the diluted fruits sample was pipette into different test tubes containing 2 ml of distilled water, 1 ml of 2, 4-DNPH was added into the test tubes mixed and incubated for 3 hours. 7 ml of 80% of H_2SO_4 was added to the incubated mixture, absorbance of the mixture was read at 540 nm using a UV-visible spectrophotometer.

Results and Discussion
Results

Table 1: The Proximate Composition of Pawpaw, Carrot, Turmeric and Coconut

Parameters	Pawpaw	Carrot	Turmeric	Coconut
Moisture content (%)	16.3	84.1	9.3	7.36
Fiber (%)	23.8	1.2	4.3	7.28
Crude Protein (%)	12.8	0.9	9.32	9.26
Ash content (%)	9.6	1.1	2.56	1.0
Crude fat (%)	1.12	0.2	5.93	43.0
Carbohydrate	36.38	12.5	68.59	32.1

Table 2: The Micronutrient Composition of Pawpaw, Carrot, Turmeric and Coconut

Parameters	Pawpaw	Carrot	Turmeric	Coconut
Vitamin C (mg)	60.3	7.2	1.7	0.18
Zinc (mg)	0.05	0.3	0.2	8.0
Copper (mg)	0.03	0.01	0.6	4.2
Sodium (mg)	0.10	84.0	2.4	18.7
Iron (mg)	0.21	0.2	2.8	21.3

Discussion
Table 1 above shows the results for proximate composition of pawpaw, carrot, turmeric and coconut fruit. Low moisture contents generally are an indication of high shelf life especially for foods that are properly packaged against external condition [14]. Carrots

have the highest moisture content of 84.1%, pawpaw (16.3%), turmeric (9.3%) and coconut (7.36%). Carrot have very high moisture content and this may underscore its high perish ability.

High moisture content characterizes the freshness of a fruit since fruits kept for some time tend to lose moisture. Low moisture content is an indicative of the fruit high dry matter content and possible long shelf-life.According to Eromosele and Eromosele fibre helps in the maintenance of human health and has been known to reduce cholesterol level in the body. Pawpaw have the highest fiber content of 23.8% which is the highest, coconut (7.28%), turmeric (4.3%) and carrot (1.2%) which is the lowest [22].

High fibre foods expands the inside wall of the colon, causing the passage of waste, thus making it an effective anti-constipation. Fibre also reduces the risk of various cancers, bowel diseases and improves general health and well-being of individuals [14]. Proteins are essential nutrients for the human body. They are one of the building blocks of body tissue and canal so serve as a fuel source. The protein content of the fruits samples is low. Pawpaw has the highest crude protein content of 12.8%, followed by turmeric (9.32%), coconut (9.26%) and carrot (0.9%) which is the lowest. Protein is an essential component of diet needed for the survival of both animal and human of which basic function is to supply adequate amount required. Slavin and Lloyd had reported that fruits are generally low in protein and mineral constituents, but could serve as a reliable source of these nutrients when taken in adequate quantities. The ash content of the different fruits range from 9.6% in pawpaw which is the highest to 1.0% in coconut which is the lowest. Coconut has the highest fat content of 43.0%, followed by turmeric (5.93%), pawpaw (1.12%) and carrot (0.2%). All fruits sample have low fat content except for coconut. The low fat content agrees with other studies of Champagne et al., that fruits are generally low in fat content and hence are usually recommended in weight-reducing diets [23-25].

Turmeric has the highest carbohydrate content of 68.59% followed by pawpaw (36.38%), coconut (32.1%) and carrot (12.5%) which is the lowest. All the fruits have high carbohydrate content suggesting that these fruits can be considered as a potential of carbohydrate for energy. Table 2 shows the result for the micronutrient composition of pawpaw, carrot, turmeric and coconut fruit. The highest vitamin C content was recorded in pawpaw (60.3 mg). Vitamin C or ascorbic acid is an essential nutrient for humans and certain other animal species, in which it functions as a vitamin. In living organisms, ascorbic acid is an anti-oxidant, since it protects the body against oxidative stress.

Pawpaw fruits are very nutritious. They are high in vitamin C, magnesium, iron, copper, and manganese [26]. Coconut have the highest zinc concentration of 8.0 mg followed by carrot (0.3 mg), turmeric (0.2 mg) and pawpaw having the lowest zinc concentration of 0.05 mg. Zinc is an essential component of many metallo-enzymes which are involved in virtually all aspect of metabolism. The metabolic functions of zinc are based largely on its presence as an essential component of many metallo-enzymes. Zinc is second to iron as the most abundant trace element in the body; tissues and fluid that are rich in zinc are prostrate, semen, liver, kidney, retina, bone, and muscle [27].

Copper is an essential trace mineral necessary for survival. It is found in all body tissues and plays a role in making red blood cells and maintaining nerve cells and the immune system. Coconut have the highest copper concentration of 4.2 mg followed by turmeric (0.6 mg), pawpaw (0.03 mg) and carrot have the least copper concentration of 0.01 mg. Sodium has also been found to be present in coconut.

Aside from its role in ionic exchange and balance in the kidneys, it has other numerous health benefits like maintenance of balance of positive and negative ions in the body fluid and tissues, and it also helps in signal transmission and muscle contraction [27]. Carrot has the highest sodium concentration of 84.0 mg followed by coconut (18.7 mg), turmeric (2.4 mg) and pawpaw having the least concentration of 0.10 mg. Coconut have the highest iron concentration of 21.3 mg followed by turmeric (2.8 mg), pawpaw (0.21 mg) and carrot having the least concentration of 0.2 mg.

Iron is of great importance in human nutrition for healthy blood and vitality. Although it is considered as a trace element, it is responsible for oxygen transport and cellular respiration. Dietary iron is of two types; Heme iron and Non heme iron, heme iron is present in red meat, fish and poultry and it is absorbed better at 15 to 20% than non heme iron. Non heme is the one that can be found in cereal, vegetable and fruits in which coconut belongs; for non heme iron, absorption is 1.5% but its absorption can be increased with the help of vitamin C which is also present in coconut [27].

Conclusion

Results obtained in this study clearly shows that fruits such as pawpaw, carrot, turmeric and coconut have good proximate (moisture, fiber, protein, fat, ash and carbohydrate) qualities and good micronutrient (vitamin C, Zinc, Copper, Sodium and iron) content. These plant samples are cheap and rich in several micronutrients thus consuming them often will help reduce micronutrient malnutrition. They can also be processed into various forms domestically and on industrial scale for juices, soups, etc and can also be used to complement other foods to improve both nutrient and sensory attribute. Also, evaluation of the proximate composition showed that it is very rich in nutrients and therefore good for consumption by humans for the sustenance of vitality and health.

Recommendations

It is therefore recommended that fruits consumption should be encouraged as these fruits can help to supplement micronutrients deficiency in other foods. Also more studies should be carried out on a blend of these fruits (pawpaw, carrot, turmeric and coconut) to produce different juice. And their sensory evaluation should be carried out also. Public awareness should be carried out to enlighten the public on its importance, usefulness and nutritional benefits.

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