IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS)
e-ISSN: 2278-3008, p-ISSN:2319-7676. Volume 6, Issue 4 (May. – Jun. 2013), PP 13-16
www.iosrjournals.org

Evaluation of Nutritional Components of *Carica papaya* L. At Different Stages of Ripening.

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Abstract: *The study compared the nutritive value of Carica papaya L. fruit at different ripening stages with the aim of advising consumers and biological world when best to consume the fruit. Proximate, mineral and vitamin analysis were carried out on the pulp, peel and seeds of fruits. Results showed that unripe papaya is a good source of carbohydrates, vitamins and proteins, and the content decreases as it ripens. Very ripe papaya is not a good source of protein because unripe papaya contains more protein. The vitamin C content of the hard ripe and very ripe pawpaw was found to be fairly high. Papaya at different stages is a good source of vitamin A and mineral elements (Ca, Mg, Na and K). Unripe pawpaw contains the highest amount of all the non-nutritive elements (Saponin, Alkaloid, Tannin, Flavonoid and Phenol) analyzed which are beneficial to the body. In view of these differences, though very ripe pawpaw is sweet and good for consumption, the unripe pawpaw is recommended for use due to its nutritive value.* `

Keyword: *Carica papaya, Nutrients, Vitamins and Minerals*

I. Introduction

Carica papaya is a vital plant that is predominant in tropical Africa, moreso Nigeria has been identified as the 3rd largest producer in the world [1].The economic and nutritional potential of the plant has made it a fruit and vegetable of choice. Papaya is a first rate source of vitamins A and C. It contains in small quantity thiamine, riboflavin, calcium, iron, potassium, magnesium and sodium [2]. One beneficial effect of seeds of *Carica papaya* is its ability to cure intestinal worms when chewed. *Carica papaya* fruit is used in remedying dyspepsia, utilized for the clarification of beer as well as the usage of the juice in meat tendering [3]. Imaga *et al* [4] and Okeniyi *et al* [5] reported that treatments of sickle cell diseases and poisoning related disorder is a possibility using seeds of *Carica papaya*. It has been reported that the nutritive value of cooked food is lower in comparison to uncooked food [6]. It behoves on people to increase their nutritional status by eating fruits such as pawpaw. This study compares the changes in the nutritional and non nutritional value of pawpaw at different stages of ripening. The result of this study will form basis of advising consumers and the biological world, when best to utilize this fruit.

II. Materials and Methods

Moisture content determination was carried out using the gravimetric method as described by [7]. Crude fibre content was determined by the method of [8]. AOAC [9] method was used for the determination of ash content. Micro-Kjeldahl method as reported by Bari *et al* [2] was adopted in the determination of protein content. The solvent extraction gravimetric method as described by Kirk and Sawyer [10] was used for the determination of fat. Carbohydrate was determined according to James [8]. The dry ash extraction method as described by James [8] was used for the determination of minerals. Determination of calcium and magnesium was carried out according to Versanate EDTA titrimetric method of James [8]. Phosphorus in the test samples was determined according to James [8] procedure. Sodium and Potassium were determined using the methods of Millner and Whiteside [11]. Vitamin A, C and E in the samples were determined according to methods adopted by Kirk and Sawyer [10]

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III. Determination Of Anti Nutritional Factors

Tanin content of the samples was determined by Folin Denis Colometric method as described by Kirk and Sawyer [10]. Determination of Saponin was done by the double solvent extraction gravimetric method [12]. Phenol was determined by using the method of AOAC [7]. Flavonoid was determined using the method described by Harborne [12].

Table 1: Proximate compositions of pulps, seeds and peels at different stages of ripening.

Sample	Moisture Content %	Dry matter %	Crude Fibre %	Ash %	Crude Protein	Fat %	Carbohydrate %
Unripe							
Pulp	81.39	18.61	11.62	4.84	1.46	0.55	18.47
Seed	5.91	94.09	5.32	7.35	14.41	5.10	32.18
Peel	54.48	45.52	14.52	5.25	10.56	0.23	30.35
Hard Ripe							
Pulp	86.68	13.32	8.29	5.24	0.64	0.45	14.63
Seed	6.10	93.90	5.26	4.91	13.77	5.11	29.03
Peel	58.22	41.78	13.67	4.84	9.04	0.31	27.87
Very Ripe							
Pulp	89.21	10.79	6.18	2.83	0.29	0.35	9.65
Seed	6.45	93.55	5.25	4.65	12.37	5.24	27.50
Peel	68.39	31.61	9.67	3.15	6.89	0.33	20.04

Table 2: Mineral compositions of pulps, seeds and peels at different stages of ripening.

Sample	Calcium (mg)	Sodium (mg)	Potassium (mg)	Phosphorus (mg)	Magnesium (mg)
Unripe					
Pulp	58.78	25.68	58.67	9.48	12.80
Seed	45.43	13.68	19.12	33.33	28.00
Peel	46.76	19.33	98.93	21.82	20.80
Hard Ripe					
Pulp	46.76	25.76	56.27	8.80	10.40
Seed	33.40	14.44	18.50	26.67	22.40
Peel	38.74	20.27	98.13	20.93	16.00
Very Ripe					
Pulp	14.69	27.25	36.00	3.10	6.40
Seed	24.05	15.23	18.15	25.33	20.00
Peel	30.73	20.67	96.80	15.37	13.60

Table 3: Vitamin compositions of pulps, seeds and peels at different stages of ripening.

Sample	Vitamin A (iu/mg)	Vitamin C (iu/mg)	Riboflavin (mg)	Thiamine (mg)	Niacin (mg)
Unripe					
Pulp	1354.87	150.12	0.04	0.086	0.24
Seed	87.18	11.73	0.01	0.05	0.10
Peel	731.28	71.01	0.05	0.04	0.37
Hard Ripe					
Pulp	2308.12	149.00	0.06	0.096	0.27
Seed	135.38	14.67	0.02	0.03	0.11
Peel	1232.82	68.03	0.06	0.04	0.41
Very Ripe					
Pulp	2085.13	112.00	0.07	0.125	0.33
Seed	128.21	14.67	0.02	0.03	0.11
Peel	1164.10	65.70	0.08	0.06	0.45

Table 4: Non-nutritive components of pulps, seeds and peels at different stages of ripening.

Sample	Phenol %	Alkaloid %	Flavonoid %	Tannin %	Saponin %
Unripe					
Pulp	0.11	0.41	0.34	0.37	1.31
Seed	0.16	0.67	0.89	0.36	1.35
Peel	0.38	1.35	0.47	0.61	1.47
Hard Ripe					
Pulp	0.09	0.25	0.15	0.32	0.71
Seed	0.13	0.51	0.83	0.30	1.31
Peel	0.30	1.23	0.41	0.54	1.43
Very Ripe					
Pulp	0.01	0.05	0.10	0.11	0.09
Seed	0.01	0.44	0.71	0.18	1.17
Peel	0.17	0.39	0.33	0.35	0.49

IV. Result And Discussion

Variation exits in the proximate, mineral and vitamin composition among the different stages of ripening. Papaya moisture content ranged between 5.91-89.21% (Table 1).The highest moisture content was observed in the pulp at a very ripe stage (89.21%) and lowest in seed at unripe stage (5.91%). Results of nutritional analysis at the three stages of ripening in papaya showed that the moisture content was highest at the very ripe stage; with the pulp at 89.21, the seed 6.45 and the peel 68.39 and lowest at the unripe stage; with the pulp at 81.39; seed at 5.91 and the peel at 54.48. This agrees with Hunt *et al.*[13] who reported that the moisture content of very ripe pawpaw to be higher than the hard ripe and unripe ones. There was an increase in moisture content from one ripening stage to another (Table 1). In the study conducted by Nwofia *et al* [14], they recorded high moisture content in the pulp. These results agree with Ahuja *et al*.[15] statement that the moisture content in papaya fruits ranges from 85-92%. Also the QECD [16] asserted that unripe papaya fruits ranges between 86.5 -89.3% and the ripe 92.16-92.60%.

Dry matter varies between 13.32-94.09% (Table 1). The highest percentage dry matter was observed in the seed at the unripe stage (94.09%) and lowest in pulp at the hard ripe stage. It has been reported that dry matter content of *Carica papaya* increases during fruit development from unripe to ripe stages [16].

Crude fibre content was highest in the unripe followed by hard ripe and lastly very ripe (Table 1).The highest crude fibre content was found in the peel at the unripe stage (5.25%). The crude fibre content in pulp obtained in this study is higher compared to the values obtained by Nwofia *et al* [14]. Papayas contain soft, easily digestible flesh with a good amount of soluble dietary fibre that helps to have normal bowel movements; thereby reducing constipation and aids nutrient absorption [17].

Crude protein variation is between 0.29-14.41% (Table 1). The highest amount of crude protein was found in the seed at an unripe stage, while the lowest was found in the pulp at a very ripe stage (0.29%). Very ripe papaya is not a very good source of protein and has its highest value at 0.29% for the pulp, 12.37% for the seed and 6.89% for the peel, which is in line with Jari [18] report that very ripe papaya is not a recognized high source of protein. There was reduction in protein content from one ripening stage to another. OECD [16] reported that protein ranged between 3.74-8.26% and 5.48-10.8% in the ripe and unripe pawpaw fruit respectively.

The percentage ash varies between 2.83 -7.35% (Table 1).The highest percentage ash was found in seed at very unripe stage and lowest in the pulp at a very ripe stage. Fat ranged between 0.23- 5.24%. The seed recorded the highest amount of fat at very ripe stage (5.24%) and peel the lowest at an unripe stage (0.23%).

Data recorded for carbohydrate ranged between 9.65-32.18 %. The highest percentage was found in the seed at the unripe stage, while the pulp in the very ripe stage recorded 9.65% (Table 1). There was a reduction in carbohydrate content as the papaya fruit moves from one ripening stage to another (Table 1). Data recorded for carbohydrate in the different ripening stages ranged between 18.47-32.18%, 14.63-29.03% and 9.95-27.50% for Unripe, Hardripe and Very Ripe respectively. These values are lower compared to range of mean values (64.5–87.8%) for ripe obtained by USDA [19]; Saxholt *et al* [20] and Wills *et al* [21] as well as for unripe carbohydrate values (81.1-87.5%) obtained by Ahuja, *et al* [15] and Puwastien *et al* [23].

The mineral composition of pulp, seeds and peels of papaya at different stages of ripening is as outlined in Table 2. Calcium content was recorded highest in the pulp at the unripe stage (58.78mg) Table 2, while the lowest value was recorded in pulp at the very ripe stage. Calcium plays an important role in photosynthesis and in teeth development [24].

Sodium ranged between 13.68-27.25mg and was highest in pulp (27.25mg) at very ripe stage, while the lowest value of 13.6mg was observed in the seed at the unripe stage. Potassium (98.93mg) was highest in the peel and lowest (18.15mg) in the seed at a very ripe stage. Data on riboflavin, thiamine and niacin content in the pulp, seed and peel of pawpaw at the different stages of ripening were very low (Table 3).

Phosphorus and magnesium ranged from 3.10- 33.33mg and 6.40-28mg respectively. The highest phosphorus (33.33mg) and magnesium content (28.00) was found in the seed at the unripe stage, while the lowest value phosphorus (3.10mg) and magnesium (6.40mg) was recorded at the pulp at the very ripe stage. Papaya from the data at the three stages are rich sources of mineral elements (calcium, magnesium, sodium and potassium), which explains the reason why pawpaw added to its other benefits is a much sought after food crop because potassium contributes to fight against bacteria and cleanses the digestive system, sodium takes part in the metabolism of water, promotes digestion, assimilation, osmosis and alkalizes the blood; then calcium helps to strengthen the bones and magnesium assist in the assimilation of phosphorus. This is in line with the contribution of Claude and Paule [25].

The pulp had higher content of vitamin A than the seed and peel at the different stages of ripening. It varies between 0.73 – 1.36mg in the unripe, 0.14 – 2.31mg in the Hard Ripe and 0.13-2.09mg in the very ripe.(Table 3). The unripe value is below USDA [26] obtained value of 9.79mg for unripe pawpaw fruit. Low vitamin C content was observed in the seed and peel, but the pulp had relatively higher vitamin C (0.11-0.15mg) at all the stages of ripening. The result also showed that low content of hard ripe papaya and very ripe papaya

are very rich source and fairly rich source of vitamin A respectively, whereas the vitamin C content was slightly highest in the unripe pawpaw; while the hard ripe and very ripe pawpaw are fairly rich with vitamin C; the values obtained for vitamin A and C content in this study are in agreement with that reported by Duke [27].
The result also revealed that unripe pawpaw contains the highest amount of all the non-nutritive elements (Table 4). It has Saponin which gives the unripe pawpaw a bitter taste and it stimulates also the reflex of the upper digestive tract. It also has alkaloid; which increases the efficiency of the heart and at the same time steady excess heart beats without strain to the organ. Tannin, though present is in very small amount, it is in agreement with Okwu [28] assertion. In view of these differences, though very ripe pawpaw is sweet and good consumption, the unripe pawpaw is recommended for use due to its nutritive value.

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