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Nutritional Analysis of two Local Varieties of Papaya (*Carica papaya* L.) at Different Maturation Stages

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Abstract: Two varieties, Local-1 and Local-2 of papaya (*Carica papaya* L.) were analyzed at four maturity stages (green, mature, ripen and rotten) to obtain a comparative information on their nutritional parameters such as pH, moisture, ash, TTA protein, lipid, carbohydrate, free sugar, reducing sugar, carotene, riboflavin, thiamin, ascorbic acid, calcium, sodium, magnesium, potassium, iron and phosphorus content. The nutrient composition of papaya flesh was found to vary at different maturation stage. The pH, moisture content increases gradually with advancement of maturity in healthy papaya but decreases at rotten stage. The ash, TTA and fiber content was found to be maximum in mature stages and gradually decreases from ripen stage to rotten stage. The results on carbohydrate shown that ripe papaya is a good source of carbohydrate (23.5±0.04 g %) but the content decreases in rotten stage. The concentration of protein, lipid, riboflavin and thiamine are extremely low in ripe papaya. The free sugar, reducing sugar and starch content gradually increases up to ripen stage but decreases at rotten stage. Ripe papaya is a very rich source of vitamin A and vitamin C but their concentrations decrease abruptly at rotten stage. The minerals such as calcium, sodium, magnesium, potassium and phosphorus content of papaya flesh gradually increases with the advancement of maturity whereas the increasing level of iron declines at ripen stages.

Key words: Papaya, nutrients, vitamins, minerals

INTRODUCTION

Health and nutritional problem continues to be a world-wide concern. Health profile of a community is greatly influenced by its nutritional status and life style. Bangladesh is one of the poorest countries of the world where eighty percent of the populations live below poverty line^[1]. Earlier nutritional surveys carried out in this country have indicated that inadequate calorie intake is the principle impediment to better nutrition. Nutritionists have raised concern on the nutritive value of cooked food because density of the most nutrients content like protein, carbohydrate vitamins and minerals are lower compared to uncooked food^[2]. In Bangladesh different kinds of fruits are available which are rich in nutrients, vitamins and minerals but most of them are expensive and seasonal. Papaya is one of the cheapest but most nutritious fruit available round the year in Bangladesh. In Bangladesh green papayas is the most popular vegetable and ripen papaya is considered as a delicious fruit preferred by all ages of people.

Papaya is an excellent source of vitamin A and vitamin C^[3]. It also contains small amounts of thiamin,

riboflavin, calcium, iron, potassium, magnesium, sodium. Papaya is the only food known to contain papain, the active proteolytic enzyme^[4]. Analytical data on papaya indicate that it contains 106 volatile components^[5]. The value of papaya as a medicinal plant is well known^[6]. The United States Food and Drug Administration (FDA) approved the use of chymopapain for treatment of herniated lumbar intervertebral discs in human^[6]. In Bangladesh doctors always suggest to eat papaya, for those who suffer from indigestion problem. The present study examines the changes in nutritive values of two local varieties of papaya of Rajshahi, Bangladesh at different maturation stages including rotten papaya.

MATERIALS AND METHODS

For the experimental purpose, 16 Papaya plants (Eight plants of Local-1 and eight of Local-2 varieties) at Rajshahi Fruit Research Station, Rajshahi, Bangladesh were selected. Four stages of the Papayas *i.e.* green, mature, ripen and rotten were collected. Days required for fruit setting of Papaya and reaching different maturation stages have been indicated in the following table.

Papaya Variety	Stages of maturation	Age (days)
Local 1 and Local 2	Green	45
	Mature	105
	Ripe	118-120
	Rotten	122-125

The pH of papaya was determined by the conventional procedure using a pH meter. The Total Titratable Acidity (TTA) of papaya was determined by Folin method described by Oser^[7]. Moisture content was determined by the conventional procedure. Ash content was determined by following the method of A.O.A.C^[8]. Dry matter content was calculated from the data obtained for moisture percentage. Lipid content of papaya flesh was determined by the method of Bligh and Dyer^[9]. Protein content of papaya flesh was determined by the method of Micro-Kjeldahl^[10]. Free sugar content was determined colorimetrically by the Anthrone method of Morse^[11]. The starch content of papaya flesh was determined by the Anthrone method described by Jayaraman^[12]. Reducing sugar content was determined by DNS method of Miller^[13]. Vitamin C content was determined by the Bessey's titrimetric method^[14]. Carotene content of the different stages of the papaya was determined according to the methods of vitamin assay of Oser and Robert^[15,16]. Thiamin and riboflavin were estimated by the method of Coward and Gyorgi^[17-19]. Calcium content was determined by the titrimetric method^[20]. Iron content was determined Spectrophotometrically by thiocyanate method^[21]. Phosphorus content was determined by the method of Boltz^[22]. Sodium and potassium content of papaya flesh were determined by Atomic Absorption Spectroscopic method of Milner and Whiteside^[23].

RESULTS AND DISCUSSION

The two papaya varieties, Local-1 and Local-2, at four stages, differ in respect to their nutritional composition. The pH value of papaya flesh was in the acidic side of the scale ranging from 5.42 to 6.01 (Table 1). The Total Titratable Acidity (TTA) has been expressed as mL of 0.1 N NaOH required per 100 g papaya flesh. The total titratable acidity was found to be vary between 0.0055 to 0.05 (Table 1).

The moisture content of Papaya varieties at different stages studied was found to be range between 87.2±0.6 g to 95.01±0.32 g (Table 1). The highest moisture content was recorded in Local-1 at rotten stage (95.01±0.32 g) and lowest in Local-1 at green stage (87.2±0.6 g). The ash content varies from 0.69±0.034 g to 0.89±0.40 g and the highest percentage was recorded in Local-1 at mature stage (0.89±0.040) and lowest at rotten stage (0.69±0.034) in the same. The highest fiber content was recorded at mature stage (1.3±0.07 g) of Local-1 variety, while the lowest was observed (0.8±0.01 g) at rotten stage of Local-2.

In the present study, protein, lipid and carbohydrate content of papaya flesh varies from 2.012±0.04 g to 0.41±0.07 g, 0.5±0.05 to 0.11±0.09 g, 23.5±0.4 to 14.9±0.7 g, respectively (Table 2). The highest free sugar was present in Local-1 at ripen stage (0.82±0.19 g), whereas lowest in Local-2 at green stage (0.471±0.11g). The starch and reducing sugar content varies from 5.68±0.10 to 2.05±11g, 0.9±0.08 to 0.4±0.07 g, respectively.

The major vitamins analyzed in Papaya are carotene, riboflavin, thiamine and ascorbic acid (Table 3). Highest

Table 1: pH, moisture, ash, TTA and fiber content of two varieties of papaya at different maturation stages (Values/100 g edible portion)

Varieties	Maturation stage	pH	Moisture (%)	Ash (%)	TTA (%)	Fiber (%)
Local-1	Green	5.68	87.2±0.6	0.75±0.07	0.005	1.1±0.04
	Mature	5.86	88.5±0.8	0.89±0.40	0.025	1.3±0.07
	Ripen	6.01	94.41±0.1	0.8±0.02	0.004	1.01±0.05
	Rotten	5.59	95.01±0.32	0.69±0.034	0.0055	0.95±0.01
Local-2	Green	5.42	88.07±0.7	0.771±0.097	0.0055	1.25±0.07
	Mature	5.59	88.45±0.9	0.815±0.043	0.05	1.05±0.02
	Ripen	5.96	92.70±0.3	0.79±0.20	0.04	0.9±0.03
	Rotten	5.56	93.05±0.6	0.75±0.13	0.005	0.8±0.01

Table 2: Protein, carbohydrate, lipid, free sugar, starch and reducing sugar content in two varieties of Papaya at four different stages (Values/ 100 g edible portion)

Varieties	Maturation stage	Protein (g%)	Carbohydrate (g%)	Lipid (g%)	Free sugar (g%)	Starch (g%)	Reducing sugar (g%)
Local-1	Green	0.43±0.04	14.9±0.	0.2±0.09	0.52±0.1	2.2±0.19	0.41±0.037
	Mature	1.14±0.07	16.0±0.9	0.5±0.05	0.75±0.17	4.8±0.71	0.58±0.09
	Ripen	2.012±0.04	23.5±0.4	0.37±0.08	0.82±0.19	5.68±0.10	0.9±0.08
	Rotten	1.706±0.05	21.2±0.2	0.31±0.05	0.77±0.14	4.01±0.11	0.57±0.05
Local-2	Green	0.41±0.07	15.25±0.5	0.11±0.09	0.471±0.11	2.05±0.11	0.4±0.07
	Mature	1.01±0.05	17.9±0.75	0.2±0.07	0.6±0.18	3.48±0.17	0.49±0.021
	Ripen	1.9±0.02	20.3±0.32	0.27±0.07	0.69±0.17	4.12±0.19	0.72±0.1
	Rotten	1.05±0.06	16.42±0.81	0.22±0.03	0.65±0.19	3.905±0.13	0.52±0.09

Table 3: Vitamin content in two varieties of Papaya at different maturation stages (mg/100 g of edible portion)

Varieties	Maturation stage	Carotene (mg)	Riboflavin (mg)	Thiamine (mg)	Ascorbic acid (mg)
Local-1	Green	0.250±5	0.06±0.05	0.12±0.1	6.03±2.9
	Mature	0.500±9	0.05±0.01	0.14±0.4	8.09±1.5
	Ripen	0.810±21	0.09±0.04	0.17±0.6	31.0±2.2
	Rotten	0.420±11	0.095±0.02	0.13±0.13	28.1±1.7
Local-2	Green	0.200±12	0.07±0.01	0.137±0.2	4.2±1.9
	Mature	0.400±17	0.09±0.05	0.20±0.4	7.3±2.1
	Ripen	0.780±22	0.1±0.09	0.21±0.1	29.4±3.5
	rotten	0.400±19	0.91±0.02	0.9±0.2	25.02±3.7

Table 4: Major mineral content of two varieties of Papaya at different stages (mg/ 100 g edible portion)

Varieties	Maturation stage	Ca	Fe	Na	Mg	K	P
Local-1	Green	13.0±1.2	0.75±0.09	5.5±0.9	17±1.2	188±1.6	1.3±0.09
	Mature	20.0±1.5	0.9±0.1	5.9±0.1	16±1.6	198±1.1	2.5±0.02
	Ripen	31.0±1.9	0.5±0.082	7.1±0.4	22±2.2	275±1.3	5.0±0.07
	Rotten	25.0±1.7	0.45±0.04	6.9±0.8	19±0.8	230±1.9	4.7±0.05
Local-2	Green	11.5±0.8	0.68±0.1	5.1±0.4	14±1.2	165±1.5	1.28±0.1
	Mature	18.75±1.8	0.87±0.12	4.9±0.3	14±1.2	190±1.5	2.46±0.17
	Ripen	28.5±1.9	0.43±0.03	6.1±0.75	21±2.1	240±1.4	4.95±0.21
	Rotten	22.0±0.9	0.39±0.79	5.8±0.9	18±1.1	210±1.7	4.08±0.12

carotene content was recorded in Local-1 at ripen stage (0.810±21 mg). Both varieties of papaya contained little amounts of riboflavin and thiamine.

As represented in the Table 4, calcium was present in both varieties at all stages ranging from 11.5±0.8 to 31±1.9 mg). Iron, sodium, magnesium and potassium content ranged from 0.39±0.079 to 0.9±0.1, 4.9±0.3 to 7.1±0.4 mg, 14±1.2 to 22±2.2 mg, 165±1.5 to 275±1.3 mg, respectively. The highest potassium concentration was observed in Local-21 at ripen stage (5.0±0.7 mg) where as the lowest amount was present in Local-2 at green stage (1.28±0.1 mg).

Present evaluation on the nutritional quality (Table 1) of papaya indicates that pH value increases gradually with advancement of maturity in healthy papaya but decreases at rotten stage. The moisture content of papaya flesh increases gradually with the advancement of maturation and even in rotten stage. The ash content was found to be maximum in mature stages and minimum in ripe stages and further decreases in rotten stage (Table 1). In mature stages, the TTA of papaya flesh was increased about five times as compared to green stages (from 0.005 to 0.025% as shown in Table 1. On the other hand, TTA gradually decreases from ripe to rot stage. The fiber content of papaya is found to be gradually decreased from ripen stage to rotten stage in respect to mature stage.

The data presented in Table 2 suggested that papaya is not a good source of protein and contains only 2.012±0.04 g/100 g i.e. about 2% at ripen stage. The results on carbohydrate shown that ripe Papaya is a good source of carbohydrate (23.5±0.04 g %) and the content decreases in rotten stage. The lipid content of papaya is found to be very poor (maximum 0.37±0.08 g %). The free and reducing sugar concentration in papaya gradually

increases with the advancement in maturity but decreases at rotten stage (Table 2). The starch content gradually increases up to ripen stage but decreases at rotten stage.

From the data presented in Table 3 it can be concluded that ripe Papaya is a very rich source of vitamin A and vitamin C whereas their concentrations decrease abruptly at rotten stage. The values obtained for Vitamin A and Vitamin C content in this study are in good agreement with that reported by Duke^[24]. The results The highest amount of calcium, sodium, magnesium, potassium and phosphorus present in Local-1 in ripen stage. But only iron present in highest amount in Local-1 in mature stage. Therefore we would like to recommend Local-1 variety at ripen stage for all most all the nutrients except riboflavin and iron.

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