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Nutritive assessment of different plant parts of *Carica papaya* Linn of Jabalpur region

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ABSTRACT

Papaya (Carica papaya) is a common tropical fruit used for nutrition as well as medicinal purposes. Apart from fruit, seed, latex and other plant parts of papaya tree have been shown to have medicinal properties. Since, no systematic study has been performed on nutritional analysis of different parts of Carica papaya especially of central Indian region; the present study is an attempt to compare the nutritional values of different plant parts. Root, stem, leaf, fruit and seeds of C. papaya were subjected to proximate analysis and their nutritional potential was compared. Though the fruit showed maximum nutritional value as expected, the leaf and seed showed good amount of carbohydrates while stem showed good amount of protein. The nutritionally important minerals were found to be in good amount in all the plant parts. Finally, all the plant parts were found devoid any toxic heavy metal.

Key Words: *Carica papaya*, proximate analysis, nutritional value, ICP AES

INTRODUCTION

Plants whether as a whole or their parts, juices, extracts etc have been an exclusive part of animal and human life on earth. Since ancient times, human are dependent on plants for their health and healing. Plants and plant products are not just a food product now, but are being used and explored for every possible opportunity. This has revoked the scientists to re-discover each and every plant with a fresh new approach towards its possible use. Primary metabolites i.e. proteins, carbohydrates, vitamins, hormones and lipids are essential for plants to live and reproduce. These primary metabolites provide the world with the food and feed stuffs and are the basis of nutrition for the entire living world.

Estimation of nutritive value provides valuable data as it denotes the capability of any plant or plant part for being used as a food and/or drug [1]. The proximate analysis of nutritive ingredients gives a good insight especially when presented with additional data about their phytochemical contents as well as their biological activities. Hence, such analysis presents an overall view for the judgement of the data. The nutritional value describes mainly the percentage of major nutritional bio-molecules such as proteins, carbohydrates, lipids and fibre along with the presence of major minerals and their food value [1].

Papaya (*Carica papaya*) is a tropical fruit having commercial importance because of its high nutritive and medicinal value. Papaya fruit has been shown to aid in digestion and to be antioxidant [2]. Seeds have anti-helminthic activity [3], antimicrobial activity [4] and anti-amoebic activity [5]. Aqueous root extracts have been shown to be diuretic [6], while the leaves are used in jaundice and urinary complaints [7]. However, the nutritional studies have been confined to the fruit part only. Various studies have compared the nutritional values and/or phytochemical profile of green fruit versus ripe fruit, fruit skin vs. pulp or during different stages of storage. Keeping in mind the medicinal uses of different plant parts, the present study was undertaken to compare the nutritive potential of different edible parts of the *Carica papaya* Linn collected from Central Indian region of Jabalpur, so that the results help in formulating herbal preparations more effectively.

MATERIALS AND METHODS

Carica papaya is one of the major fruit crops of the Central India. The identity of the collected plants was confirmed using their morphological identification keys.

Collection of plant material:

For the study, good quality young plants of *Carica papaya* (Var. Pusa Dwarf) were collected from a local nursery during Monsoon season of year 2012. These plants were of same age and average length was 1 to 1.2 meter. From the aerial parts, stem and leaves were obtained. The root was obtained by uprooting the plants. The main juicy root was cut from the rest of the plant. The ripen seed bearing fruits were collected from the fully grown trees of the same variety and from the same nursery during the same season of year 2012. The seeds were separated from the pulp and washed. The fruit pulp was used as such without peeling off the outer payer of the fruit.

Preparation of plant material

For quick drying, the plant parts were cut into smaller pieces. All the parts were air dried under shade for one week or longer till a constant weight was achieved. The contaminated plant parts having fungal growth during drying were removed immediately.

The dried plant parts were grinded to make a uniform powder for extraction purposes. The leaf, seeds, fruit, stem and the roots were easily grinded using a household mixer grinder. Once ground, the powder was passed through a 100 µM test sieve (Sonar, India). The remaining course powder was again grinded and sieved and the process was continued till the material could not be ground further. The fine powder was immediately stored in an air tight container for further use.

Proximate analysis

For proximate analysis, was done according to AOAC [8] method unless stated otherwise.

1. Moisture Content

One gram of the powdered sample was weighed in a clean beaker of known weight. The sample was then dried in oven at 105°C for 8 h. The beaker was cooled and weighted to determine water loss in powdered sample.

2. Ash content

Weighed 2 g of each sample into the crucible and placed in to the Muffle furnace. Heating was stared gradually until temperature of 600˚C was reached. This temperature was maintained for 6 hours. The crucible was then put inside desiccators and cooled. After cooling the sample was reweighed and the percentage of ash calculated.

3. Total lipid content

The total fat was extracted with petroleum ether using Soxhlet extractor. To determine the percentage of fat, 2 g of the dried plant part was extracted with 1 L of petroleum ether. The plant part powder was dried and the percent loss of weight was calculated.

4. Crude fiber content

For estimation of crude fiber, one gram of plant part powder was subjected to acid and subsequent alkali digestion for degradation of native cellulose and lignin. The residue obtained after final filtration was weighed, incinerated, cooled and weighed again. The loss in weight gives the crude fiber contents.

5. Nitrogen percentage and total protein content

The method of [9] and [10] was used for nitrogen estimation using Kjeldahl digestion and distillation technique. For this sample was digested by boiling with concentrated sulfuric acid in the presence of catalyst copper sulfate. The digestion converts all the nitrogen to ammonia which is trapped as ammonium sulfate. Completion of the digestion stage is generally recognized by the formation of the clear solution. The ammonia is released by the addition of excess sodium hydroxide and is removed by steam distillation. It is collected in boric acid and titrated with standard hydrochloric acid using methylene blue as an indicator. Total protein was calculated by multiplying nitrogen percentage by 6.25.

7. Total carbohydrates content

The phenol and sulfuric acid method was used as described by [11]. For this, 100 mg of sample was digested for 3 h with 2.5N HCl and all the carbohydrate was converted into glucose which was further dehydrated of hydroxyl methyl furfural. After neutralizing the solution with sodium carbonate, 1 ml of phenol was added followed by 1 ml concentrated sulfuric acid. The absorbance of the solution was read at 490 nm after 20 min and the amount of carbohydrate was calculated using a standard curve of D-glucose prepared in the same manner.

8. Nutritive value

After estimation of protein, fat and carbohydrate, the nutritive value was calculated as per the following formula.
Nutritive value (Kcal per 100 g) = 4 (Protein %) + 9 (Fat %) + 4 (Carbohydrate %)

9. Mineral contents

Organic matter of dry plant powder was wet oxidized with sequential combination (1:2.5:1) of perchloric acid, nitric acid and sulphuric acid at 125°C. After complete digestion, the sample was cooled and diluted with deionised distilled water up to final volume of 50 ml. The phosphorus content was estimated using biochemical method. Briefly, ammonium molybdate reacts with phosphorus under acidic conditions to form a heteropoly acid, molybdophosphoric acid. In the presence of vanadium, yellow vanadomolybdophosphoric acid is formed. The concentration of this yellow colour is measured at 410 nm using spectrophotometer and the amount of phosphorus was calculated using a standard curve of phosphorus. The estimation of other nutritionally important minerals i.e. Na, K, Ca, Fe, Mg, and Zn along with toxic heavy metals i.e. Hg, Pb, As and Se was done via Inductively coupled plasma-Atomic Emission Spectroscopy (ICP AES).

RESULTS

During the present study, different plants parts of *Carica papaya* were collected from plants obtained from a local nursery. The proximate analysis was done in order to find out the nutritional components of different plant parts of *C. papaya.* The analyses were performed in triplicate and the values are expressed as mean percentage ± SD.

Table 1 summarizes the results of proximate analysis. As far as the moisture is concerned, leaf showed minimum moisture percentage (7.30 ± 0.30%) while fruit showed highest moisture percentage (14.47 ± 0.25%). Similarly lowest ash percentage was with stem (6.90 ±0.20%) and highest ash percentage was with fruit (10.83 ± 0.55%).

When total fat percentage in different plant parts of *C. papaya* were investigated, stem showed minimum and leaves showed maximum percentage of lipid. Fruit and seed showed somewhat same amount of lipid contents. The crude fibre percentage in different plant parts of *C. papaya* also showed that lowest fibre was in fruit and highest in seed. Similarly the total protein percentage in different plant parts of *C. papaya* raged between 15.07± 1.10% in root to 44.40 ± 0.46% in fruit.

For estimation of total carbohydrates, the total digestible carbohydrates were converted into glucose units and the values are presented as glucose equivalent units. The conversion was done using standard curve of D-glucose (R^2=0.95) prepared with the same method. Root showed carbohydrate percentage to be 22.80 ± 1.71 %. Stem showed 26.87 ± 2.41, leaf 28.03 ± 0.90, fruit 44.77 ± 1.70 and seed showed 30.83 ± 1.48 % of carbohydrate.

Table 1: Proximate analysis of different plant parts of *Carica papaya*. The results are presented as mean ± SD.

Plant part	Moisture	Ash	Fiber	Carbohydrate	Lipid	Protein
Root	9.57±0.25	10.07±0.38	23.77±0.51	22.80±1.17	4.53±0.25	15.07±1.10
Stem	9.50±0.30	6.90±0.20	19.27±0.47	26.87±2.41	3.42±0.08	34.97±0.80
Leaf	7.30±0.30	8.27±0.32	18.53±0.40	28.03±0.90	5.57±0.49	17.63±1.07
Fruit	14.47±0.25	10.83±0.55	15.63±1.24	44.77±1.70	4.43±0.15	44.40±0.46
Seed	8.53±0.25	7.23±0.76	26.50±1.61	30.83±1.48	2.57±0.06	28.73±1.10

Nutritional value in terms of Kcal per 100 g was calculated using the formula for different plant parts. Root showed nutritional value to be 192.27 ± 3.92 Kcal per 100 g dry powder. Stem showed 278.08 ± 12.78, leaf 232.77 ± 7.88, fruit 396.57± 6.98 and seed showed 261.37 ± 10.25 Kcal per 100 g nutritional value. Highest nutritional value was observed in fruit and lowest nutritional value was found in root of *Carica papaya.*

Further, different plant parts show variation in the percentage of individual proximate content. Fig 1 shows the percent contribution of each proximate test to each plant part.

Apart from the major nutrients, it is always important to know the minerals in any plant part. The analysis of minerals was done not only to find out the percentage of nutritionally important minerals but also to find out the toxic heavy metals in order to show the full spectrum of plant parts of *C. papaya*. Phosphorus was estimated using biochemical methods and compared with standard curve of phosphorus (R^2= 0.98). Root showed phosphorus to be 5.33 ± 0.58 ppm. Stem showed 5.0 ± 0.0, leaf 5.33 ± 0.58, fruit 25.33 ± 2.52 and seed showed 4.0 ± 1.0 ppm of phosphorus. Fruit showed highest amount of phosphorus among all plant parts (table 2).

Table 2 also shows the other minerals in different plant parts of *C. papaya* as obtained with ICP AES analysis. In root, the zinc was 23.91 ppm. Similarly stem, leaf fruit and seed showed zinc to be 31.05, 10.97, 0.28 and 18.75 ppm respectively. Fruit showed minimum zinc content while stem showed maximum zinc concentration.

As far as the iron content was concerned, root showed iron content as 8.14 ppm. Similarly stem, leaf fruit and seed showed iron content as 7.73, 6.07, 2.73 and 2.58 ppm respectively. Seed showed minimum iron content while root showed maximum iron concentration.

In root, the calcium was 186.64 ppm. Similarly stem, leaf fruit and seed showed calcium to be 262.18, 628.63, 153.91 and 300.20 ppm respectively. Fruit showed minimum calcium content while leaf showed maximum calcium concentration.

Potassium concentration in root was 781.44 ppm. Similarly stem, leaf fruit and seed showed potassium to be 775.12, 316.4, 711.23 and 573.81 ppm respectively. Leaf showed minimum potassium content while root showed maximum potassium content.

In root, the sodium was 63.68 ppm. Similarly stem, leaf fruit and seed showed sodium to be 87.08, 17.72, 26.31 and 13.28 ppm respectively. Seed showed minimum sodium content while stem showed maximum sodium concentration.

As far as magnesium is concerned, root showed magnesium content to be 23.16 ppm. Similarly stem, leaf fruit and seed showed magnesium to be 27.71, 10.64, 0.84 and 19.71 ppm respectively. Fruit showed minimum magnesium content while stem showed maximum magnesium concentration.

Table 2: Estimation of nutritionally important minerals in different plant parts of *Carica papaya* (values are in ppm).

Sample	Minerals					
	Zn	Fe	Ca	K	Na	Mg
Root	23.91	8.14	186.64	781.44	63.68	23.16
Stem	31.05	7.73	262.18	775.12	87.08	27.71
Leaf	10.97	6.07	628.63	316.40	17.72	10.64
Fruit	0.28	2.73	153.91	711.23	26.31	0.84
Seed	23.91	8.14	186.64	781.44	63.68	23.16

When ICP AES analysis was done for identifying concentrations of toxic heavy metals in different plant parts of *C. papaya*, only lead was found to be present in small quantityies. Lead was present in amount of 0.103, 0.135, 0.035, 0.084 and 0.167 in root, stem, leaf, fruit and seed of *C. papaya*. Selenium, mercury and arsenic could not be detected in any plant part with ICP AES suggesting that the concentration of these heavy metals was beyond the lowest limit of detection (0.01 ppm) for ICP AES and hence are reported as absent.

DISCUSSION

During proximate analysis, higher fat content was found in leaf and roots. Krishna et al. (2008) showed presence of fatty acids in seeds and fruits of *C. papaya* though they did not showed any information about other parts as far as the fat and fatty acids are concerned. Similarly roots and seeds showed higher amount of crude fibre. Bruneton [12] described that seeds of *C. papaya* contain high amount of crude fibres along with protein. Higher amount of protein was also found in plant parts of *C. papaya* as was carbohydrates.

Fruits showed a nutritional value of 396 Kcal per 100 g. One must note that the value obtained was with the dried fruit powder, and may not necessarily mimic that of fresh fruit. Fresh fruit contains high amount of water (~90-95%), and hence nutritional value is low when calculated per 100 g basis. Various sources on internet have compared the nutritional value of green and ripe papaya fruit and the values were in the range of 27 to 32 Kcal per 100 g of fresh fruit. Further, our study tells that the papaya fruit can be dried up and stored for a long time without losing its nutritional and medicinal qualities. In this way, the utility of this fruit increases especially among local small scale drug manufacturers. Further, the young roots, leaves, seeds and stem have potential to be used as food as well. If not for human use, these plant parts can be used as animal fodder at least.

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