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A COMPARATIVE STUDY ON ANTIOXIDANTS AND PHYTOCHEMICAL CONSTITUENTS OF LATEX, LEAVES, FRUIT AND SKIN OF *CARICA PAPAYA*

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ABSTRACT

Fruits and vegetables have gained increasing interest among consumers, researchers and neutraceutical companies because epidemiological studies have indicated that frequent consumption of natural antioxidants is associated with a lower risk of cardiovascular disease and cancer. The papaya, papaw or pawpaw is the fruit of the plant Carica papaya, in the genus Carica. Papaya (Carica papaya) is commonly known for its nutritional value as food source throughout the world. Papaya fruits and the parts of the plant possess medicinal property and are well known in traditional system of medicine. The present study was planned to evaluate nutritional value and antioxidant activity from various parts of papaya plant which may help for various health aspects. Fruits and leaves of Carica papaya L. were procured from Anand Agricultural University, Anand, Gujarat. Latex and skin of fruits, pulp of ripe papaya fruits and leaves of plant were analyzed for total protein, total phenol, free radical scavenging and total antioxidant activities. Highest amount of protein was found in leaves (2.4 gm %) followed by latex (1.7gm %), pulp (1.4gm %) and skin (1.16gm %). Maximum phenol content was found in papaya leaves followed by latex, skin and pulp (149 mg GAE/gm, 82.9 mg GAE/gm, 21.05 mg GAE/gm and 10.2 mg GAE/gm) respectively. Free radical scavenging activity was also maximum for leaves (53.69 %) followed by papaya skin, pulp and latex (30.16%, 25.7% and 25.3%) respectively. The present study indicates a significantly higher ($p>0.05$) antioxidant activity to Gallic Acid equivalent (GAE), Trolox equivalent (TE), and Vitamin-C equivalent for leaves while latex, skin and pulp exhibited these activities at 50 % lower than leaves. It can be used as untapped neutraceutical resources and for medicinal purpose.

Keywords: *Leaves, Latex, Skin and Fruits of Carica papaya, Total Phenolic Content, Radical Scavenging Activity, Total Antioxidant Activity*

Introduction

Fruits and vegetables contain a great number of essential bioactive compounds with antioxidant and antimicrobial capacity, from different chemical classes such as phenolic compounds, carotenoids and vitamins [1]. These constituents were shown to have beneficial effects against cardiovascular diseases [2], several types of cancer, along with other health benefits. [3]. Fruits possess antiviral, anti-inflammatory and immunomodulatory actions and as such consumption of fruits and vegetables is believed to reduce the risk of major chronic degenerative diseases [4]. The defensive effects of natural antioxidants in fruits and vegetables are related to three major groups: vitamins, phenols and carotenoids. Ascorbic acid and phenols which are the major contributors to antioxidant activity in guava fruit [5] are known as hydrophilic antioxidants, while carotenoids are known as lipophilic antioxidants [6]. Papaya is a fruit from well-known medicinal plant, affordable by rich as well as poor people. It is native to the tropics of the Americas and was first cultivated in Mexico several centuries before the emergence of the Mesoamerican classic cultures [7]. Various parts of plants are used for cure of many diseases. Papayas are also reported to boost immunity and are good for the skin and mucus membranes [8]. The plant is traditionally used for the treatment of gastric ulcers, dental caries, to expel intestinal worms, as heart tonic, for severe jaundice, for inflammation, hemorrhoids etc.[9] The pharmacological activities of C. papaya include antihypertensive, ulcer protective, antimicrobial and antioxidant, anti-fertility, antifungal, anthelmintic. [10]. Papaya has good quality protein is absolutely essential for our healthy being. [11]. Increase in platelet count has been found when the juice of leaves was fed to dengue patient for 2 days period [12]. Because of its high antioxidant content, papaya can prevent cholesterol oxidation [13]. The plant leaves extracts were found to be rich in nutritional value like carbohydrate (55.74%), lipids (8.27%) and protein (0.05%) therefore leaves can be used as a neutraceutical when taken as food or potent medicinal properties when used as an herb [14]. Papaya pulp is used as a familiar food portion and skin is used for skin treatment. The fruits, leaves, seed and latex are used for medicinal purpose [15]. Green papaya leaf is a source of essential nutrients while yellow papaya was a source of iron, therefore pawpaw leaves can be manipulated in the herbal treatment of various diseases and as a potential source of useful elements for drugs formulation [16]. The leaves of the papaya plant are rich in total phenol and antioxidant activity. Leaves are most frequently used part of the plant because it is the site of manufacture or storage of many chemical compounds through photosynthesis [17].

The majority of the antioxidant capacity of a fruit may be from compounds other than vitamin C, vitamin E, or â-carotene. For example, some flavonoids (including flavones, isoflavones, flavonones, anthocyanins, catechin and isocatechin) that are frequently components of the human diet demonstrated strong antioxidant activities [18, 19, 20]. Therefore, it was of interest to measure the total antioxidant capacity, radical scavenging activity, protein and phenol of leaves, latex, skin and fruit of Papaya.

Materials and Methods

Plant Material

Fresh fruits and leaves of Carica papaya L. were procured from Anand Agriculture University, Anand, Gujarat.

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Qualitative Estimation

Phytochemical constituents of leaves, latex, skin and pulp of Papaya were qualitatively confirmed using protocol adapted by sofowora [21].

Quantitative Estimation

Extraction of Protein

All selected samples (leaves, latex, skin and pulp) were weighed and extracted with 100ml distilled water, centrifuged and the supernatant obtained was used for protein estimation.

Total Protein

Total protein was analyzed from the extract by using the method of Lowery et. al. [22]

Extract Preparation from Plant Sample

Ethanolic extract was prepared for Total phenol estimation, DPPH Radical Scavenging Activity Assay and FRAP-Ferric Reducing Ability Power Assay.

2gm of each of fresh papaya leaves, skin and pulp samples were crushed in mortar pestle with 100ml of 80% of ethanol and centrifuged it at 8000rpm for 15min and the supernatant was collected and it was stored at 4 C° for further study. The latex (2 ml) was leached out by sharp cut on raw papaya and volume was made to 100ml with ethanol.

Total Phenol Estimation

Total phenolic content was determined in the sample extracts using the method of Bray and Thorpe [23]. Gallic acid was used as the reference standard. The content of total phenol of plant samples was determined using U.V. Spectrophotometer (No. 117) and expressed as Gallic acid equivalent (GAE) on dry weight basis.

DPPH Radical Scavenging Activity Assay

With the use of U.V. spectrophotometer (Systronic model 117), DPPH radical scavenging activity was determined by Lee et al. method [24].

Total Antioxidant Activity

FRAP-(Ferric Reducing Antioxidant Power) of the sample extract was determined according to the method described by Benzie et al. [25]. The method is based on the ability of the sample to reduce Fe^{+3} to Fe^{+2} ions.

Statistical Analysis

Statistical analysis was carried out using statistical methods [26].

Results and Discussion

Qualitative Estimation

Phytochemical constituents analyzed from papaya leaves, latex, skin and pulp are presented in Table-1. Leaves of the ripe papaya showed the presence of tannins, saponins, phlobatannins, terpenoids and alkaloids whereas latex showed the presence of only saponins and terpenoids. Skin of ripe papaya showed presence of tannins, saponins and phlobatannins while the pulp indicates the absence of all the phytochemical constituents found in other organ analyzed under current study.

Table -1: Phytochemical Constituents Present in Different Parts of Papaya Plant

Test	Leaves	Latex	Pulp	Skin
Tannins	+	-	-	+
Saponins	+	+	-	+
Phlobatannins	+	-	-	+
Terpenoids	+	+	-	-
Alkaloids	+	-	-	-

Quantitative Estimation

Total Proteins

The quantitative analysis of this protein indicates highest amount of protein in leaves (2.4 gm %) followed by latex (1.7gm %), pulp (1.4gm %) and skin (1.16gm %). In contrast, Leaf protein significantly varied from pulp, latex and skin. Results obtained are presented in Table-2.

Total Phenol

Phenol content was found to be maximum for papaya leaves followed by latex, skin and pulp (149 mg GAE/gm, 82.9 mg GAE/gm, 21.05 mg GAE/gm and 10.2 mg GAE/gm) respectively. The present study further showed high amount of phenolic compounds present in leaves which is in agreement with Syed et.al [27] reported for Rahnanus satiava L. plant.

The antioxidant activity of phenol is due to their redox properties which allow them to act as reducing agent, metal chelator and free radical quenchers. Plants having significant medicinal values have often been found to be rich in phenols and to have high antioxidant potentials [28]. Novel antioxidant compounds besides caffeic acid, p-coumaric acid and ferulic acid [29] may be present in papaya leaves, which need further analysis.

DPPH-Radical Scavenging Activity

Free radical scavenging activity was found maximum in leaves (53.69 %) followed by papaya skin, pulp and latex (30.16%, 25.7% and 25.3%) respectively.

Free radical scavenging activity observed in our study is in agreement with the study carried out for Carica papaya aqueous leaf extract [30]. The leaves extracts of C. papaya (dried) and P. nigrescens contain phenolic compounds and micronutrients which may be responsible for their observed antioxidant activities.

Table -2: Total Phenol, Total Protein and Radical Scavenging Activity of Papaya Plant

Parameters	Samples			
	Leaves	Latex	Pulp	Skin
Total Protein (gm %)	2.37±0.04	1.70±0.03	1.46±0.01	1.16±0.01
Total Phenol (mg GAE/gm)	149.10±0.11	82.99±0.05	10.21±0.00	21.05±0.07
% Radical Scavenging Activity	53.69 ±2.22	25.36±1.44	25.71±1.05	30.16±1.23

Values are mean of five trials ± SE (GAE=Gallic acid equivalent)

Total Antioxidant Activity (FRAP-Ferric Reducing Antioxidant Power)

Maximum antioxidant activity was found in leaves followed by latex, skin and pulp. The antioxidant activity equivalents to GAE, TE and Vitamin-C are presented in Figure-1. Antioxidant value is higher for the leaves, by 50% less in latex and again less by 50% for skin and pulp. These results of the study are in agreement with the study carried out by Patthamakamokporn et. al for papaya fruit [31]. Study indicates insignificant difference between pulp and skin, however significant difference was found compared to latex, which is commonly applied as an aid for digestive purpose.

Present study focus that the leaves of Carica papaya possess higher amount of antioxidant properties compare to other parts of the papaya may potentially serve as a good therapeutic agent for protection against many disorders / diseases such as dengue, ulcer, several cancer pathologies, respiratory diseases like asthma, etc.

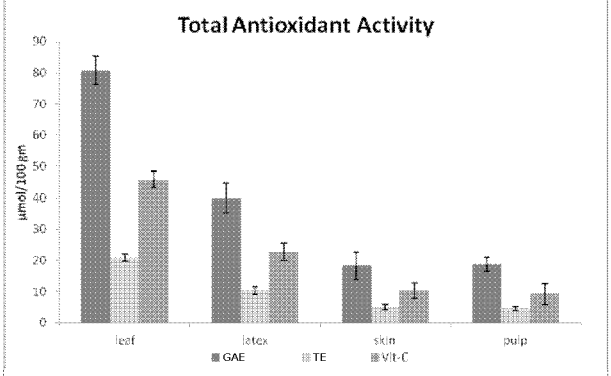

Figure-1: Total Antioxidant Activity of Different Parts of Papaya Plant
Values are mean of five trials ± SE
(GAE=Gallic acid equivalent, TE=Trolox equivalent and Vit-C=Vitamin-C equivalent)

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