Plant Archives Vol. 14 No. 1, 2014 pp. 565-568 ***ISSN 0972-5210***

BIOCHEMICAL PROPERTIES IN PEEL, PULP AND SEEDS OF *CARICA PAPAYA*

Bharathi Parni and Yashodhara Verma*

Department of Biochemistry and Bioprocess Technology, Jacob School of Biotechnology and Bioengineering, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad (U.P.), India.

Abstract

Carica papaya (Family : Caricaceae) belongs to the fruits and vegetable class. Papaya is native of tropical America but has now spread all over the tropical world. The total global production of papaya averages about 10.0 million metric tons, and India and Brazil are the major producers with annual production of 3.6 and 1.9 million metric tons, respectively. The fruit is usually cylindrical, large (weighing 0.5-2.0 kg), and fleshy. The flesh is yellow-orange, soft and juicy. The central cavity contains large quantities of seeds that comprise about 15% of the wet weight of the fruit (Desai, 1995).

Key words : Carica papaya, lipid peroxidation, global production, potential source.

Introduction

Nutritionally, the major components of papaya fruit pulp dry matter are carbohydrates. At the early stage of fruit development, glucose is the main sugar but the sucrose content increases during ripening and can reach up to 80% of the total sugars. The edible portion of the ripe papaya fruit contains both macro and micro minerals and these are Na, K, Ca, Mg, P, Fe, Cu, Zn and Mn. *Carica papaya* is a source of carotenoids, vitamin C, thiamine, riboflavin, niacin, vitamin B-6 and vitamin K (Bari *et al*., 2006).

Papaya has also been shown to be helpful in the prevention of colon cancer. The fiber is able to bind to cancer-causing toxins in the colon and keep them away from the healthy colon cells. As papaya seed has contributed to numerous positive health effects, papaya peel too possesses wound healing properties (Anuar *et al*., 2008).

Papaya seeds have high oil content representing a potential source of oil rich in oleic fatty acid. The high proportion of unsaturated fatty acids would make the oil an acceptable substitute for other highly unsaturated oils. The seed has been shown to be a good source of oil (25.6%) that may be useful for medicinal, biofuel and industrial purposes (Afolabi *et al*., 2011). The seeds are medicinally important in the treatment of sickle cell disease, poisoning related disorder (Imaga *et al*., 2010).

***Author for correspondence:** E-mail: yashodhara.verma0@gmail.com

A proteolytic enzyme, papain is purified from papaya latex and used in the food and feed industries, as well as the pharmaceutical and cosmetic industries. Papain is used in food processing to tenderize meat, clarify beer and juice, produce chewing gum, coagulate milk, prepare cereals and produce pet food (Morton, 1987).

Materials and Methods

Collection of sample

The papaya was purchased from local market Allahabad (U.P.), India on daily basis. Care was taken to select the firm and mature fruit without bruises or damage to the fruit.

Extraction of sample

The papaya was washed under tap water and the peel, pulp and seeds separated. The peel and pulp was cut into small pieces and then put in hot air oven. The dried sample was used for proximate analysis.

Estimation of crude fibre

Crude fibre content was estimated by the method given by Sadasivam and Manikam (1992).

Calculation

$$\text{\% crude fibre content} = \frac{\text{Loss in weight on ignition}}{\text{Weight of sample (g)}} \times 100$$

Estimation of lipid peroxidation

Lipid peroxidation was measured by estimating the end product malondialdehyde as per the method of Heath and Packer (1968).

Calculation

Lipid peroxidation was calculated by estimating the end product malondialdehyde (MDA) using an extinction coefficient of 155 µM/g.

Determination of minerals

a) Estimation of phosphorus

Total amount of phosphorus was determined by Fiske and Subba Row (1925).

Calculation

The amount of phosphorus present in the sample was calculated by using the standard curve and expressed as percent or mg/100g.

b) Estimation of iron

The amount of iron was estimated by the method of Piper (1950).

Calculation

The amount of iron in the sample was calculated by using the standard curve and expressed as percent or mg/100g.

Estimation of ash

Ash content was estimated by the method given by AOAC (1990).

Calculation

W_1 = Weight of crucible + sample before ashing.

W_2 = Weight of crucible + sample after ashing.

$$\% \text{ ash content} = \frac{W_2 - W_1}{\text{Wt. of sample}} \times 100$$

Determination of carbohydrate

The method followed was given by Hedge and Hofreiter (1962).

Calculation

The total amount of carbohydrate was expressed in terms of mg/g.

Estimation of protein

Protein was estimated by the method given by Lowry *et al*. (1951).

Calculations

Using a calibration curve, the results were expressed in mg ml^{-1}.

Statistical analysis

The data recording during the course of investigation were subjected to statistical analysis by "Analysis of variance" technique (Fisher and Yates, 1968) for drawing conclusion. The significant and non-significant treatment was judged with the help of F (variance ratio) table. The significant difference between the mean values was tested against the critical difference at 5% level.

Results and Discussion

The carbohydrate content was found to be maximum (268.67 mg/g FW) in seed while peel had minimum (74.83 mg/g FW) content. The content in pulp (93.13 mg/g FW) was approximate three times less than that of seed. Similarly Nwofia *et al.* (2012) have stated that the leaves and seeds have higher carbohydrates than fruit pulp. It varies from 6.50%-9.51% in the fruit pulp 43.61%-48.42% in the seeds and 72.02%-78.22% in the leaves. Haque *et al*. (2009) reported that the total carbohydrate present in fruits ranges between 3.89% and 28.25%. The highest amount of carbohydrate was present in burmese grape (28.25%), papaya (10.93%) and the lowest amount of carbohydrate was present in melon (3.89%).

The seeds had the maximum (289.92 mg/g FW) amount of protein followed by pulp (10.75 mg/g FW) and peel (5.03 mg/g FW). Nwofia *et al.* (2012) reported that the crude protein content in the fruit pulp ranges from 0.47% to 1.17% while the seeds contain 2.34% to 3.15%. Afolabi and Ofobrukweta (2011) observed that the seed coat has a relatively higher protein (32.680%). Malacrida *et al.* (2011) examined the papaya seeds showed high concentrations of lipid (29.16%) and protein (25.63%).

The pulp had very less amount of ash than other analyzed parts. The seed had maximum (6.08 %) ash content whereas pulp had minimum (0.49 %). The content in seed was three folds more than peel (2.49%). Nwofia *et al.* (2012) have shown that the ash content is generally higher in the seeds (3.35%-4.28%) than in the fruit pulp (0.31%-0.61%). Dakare *et al*. (2011) reported that the amount of ash present in whole seeds (10.30%) and unfermented seeds is (4.09%). Adetuyi *et al*. (2008) determined the ash content in pulp which reduces significantly (2.02%-1.41%, P = 0.05) as the storage time period passes by, though with respect to days in storage temperatures, no significant (P = 0.05) difference was observed.

The total crude fiber was found maximum in seed (17.95%) part of fruit followed by other part *i.e.* peel (5.23%) and pulp (1.73%). Adetuyi *et al*. (2008) determined the crude fiber content which reduces significantly (P = 0.05) as the storage period increases (1.95%-1.24%) though with respect to days in storage temperatures, there was no significant (P = 0.05)

Table 1: Biochemical parameters in *C. papaya*

Fruit parts	Carbohydrate (mg/g)	Protein (mg/g)	Ash (%)	Crude fiber (%)	Phosphorus (mg/g)	Iron (µg/g)	Lipid peroxidation
Peel	74.83±0.850	5.03±0.045	2.49±0.071	5.23±0.105	1.033±0.020	1.9±0.408	0.020±0.0031
Pulp	93.13±1.040	10.75±0.099	0.49±0.029	1.73±0.061	0.254±0.025	3.7±0.655	0.028±0.005
Seed	268.67±1.727	289.92±1.314	6.08±0.805	17.95±0.125	7.181±0.273	0.16±0.037	1.317±0.169
C.D.	3.032	1.826	1.120	0.241	0.018	0.380	0.0184

*Values are represented in the mean of three replicates ± Standard Deviation. *C.D at p<0.05 %.

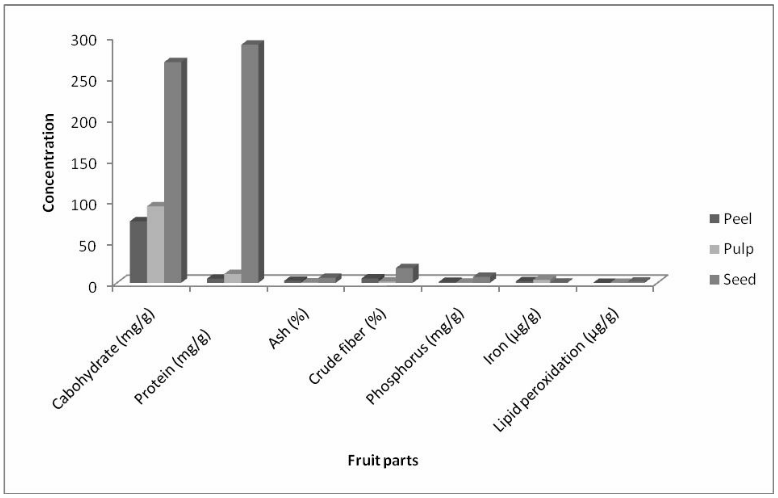

Fig. 1 : Biochemical parameters in *C. papaya*.

difference. The decrease in the fiber could be due to the conversion of the fiber, cellulose to carbohydrate which is used during respiration. Dakare *et al*. (2011) examined the high value of crude fibre in the whole seeds (33.62%) as compared to the raw and fermented seeds (0.57%) indicating that the bulk of the fibre is in the husk. Bouanga-Kalou *et al.* (2011) determined that the seeds area rich source of protein (26.78%) and crude fiber (21.4%).

The seed (7.181 mg/g) had highest amount of phosphorus as compared to peel (1.033 mg/g) and pulp (0.254 mg/g). Nwofia *et al*. (2012) stated that the phosphorus content of seeds (241.50-203.38mg/100g) is high while leaves contain (221.08-199.47mg/100g) and in fruit pulp it varies from (29.80-16.47mg/g). Bouanga-Kalou *et al.* (2011) determined that the papaya seeds have Ca and P in appreciable quantities (1821±2.12 mg/ 100 g dry matter and 1156±1.8 mg/100 g dry mater, respectively). Balasubramanian *et al.* (2011) reported that the maximum amounts of nutritive compounds are present in papaya fruits and there phosphorus contents 6.8 to 8.9%.

The iron content in all the analyzed fruit parts was very less. The pulp (3.7µg/g) had more iron as compared to other parts. The seed (0.16 µg/g) had least amount of iron while peel (1.9 µg/g) had little bit less than pulp. Haque *et al.* (2009) reported about iron content which was found to be higher in the burmese- grape, 5.34 mg/100g, papaya, 0.6mg/ 100g and lower in pomelo, 0.2 mg/100g. Iron present in analysed fruits ranged between 0.2mg and 5.34 mg/100g. Nwofia *et al.* (2012) determined the amount of iron in pulp which ranged from 2.57mg/kg-2.15mg/kg and seeds had a value of 0.23mg/kg-0.15mg/kg.

Lipid peroxidation was measured in terms of malondialdehyde content. The highest value was recorded in seeds (1.317µM/g), while least value was recorded in peel (0.020µM/g) and these values were approximately similar to pulp (0.028µM/g). The result is supported by Afolabi and Ofobrukweta (2011), who observed that the high thiobarbiturate value (1.819±0.004 µM/g) indicates that the seed coat has a relatively high lipid peroxidation. The fact that the thiobarbituricacid value in the seed coat is higher than that of the oil (0.451±0.005 µM/g) indicates that it contains lesser antioxidants than the oil. Oliveira *et al*. (2009) compared lipid peroxidation (estimated by MDA content) and found that there was no significant difference ($P < 0.05$) between the healthy and gelling fruit, reinforcing the hypothesis of the maintenance of the cellular integrity.

Conclusion

On the basis of the results of the present study it can be concluded that papaya has a high nutritive value and is rich in minerals and vitamins. The papaya prevents a number of health conditions such as cardiovascular diseases, aging and cancer, especially of the colon. Papaya could be a rich source of dietary fiber which can have beneficial effects. But in the present investigation, it was found that the analyzed fruit parts (seed and pulp) are beneficial for human body.

References

Adetuyi, F. O., L. T. Akinadewo, S. V. Omosuli and L. Ajala (2008). Antinutrient and antioxidant quality of waxed and unwaxed pawpaw *Carica papaya* fruit stored at differenttemperatures. *Afri. J. Biote.*, **7(16)** : 2920-2924.

Afolabi, I. S., L.T. Marcus, T. O. Olanrewaju and V. Chizea (2011). Biochemical effect of some food processing methods on the health promoting properties of under-utilized. *Carica papaya* seed. *JNP*, **4** : 17-24.

Afolabi, I. S. and K. Ofobrukweta (2011). Physicochemical and nutritional qualities of *Caricapapaya* seed products. *J. Med. Plants Res.*, **5(14)** : 3113-3117.

Anuar, N. S., S. S. Zahari, I. A. Taib and M. T. Rahaman (2008). Effect of green and ripe *Carica papaya* epicarp extracts on wound healing and during pregnancy. *Food Chem. Toxicol.*, **46** : 2384-2389.

AOAC Association of Official Analytical Chemists (1990). Official Methods of Analysis of the Association of Official Analytical Chemists. 15th ed. Arlington, VA, pp 1230.

Balasubramanian, K., V. Ambikapathy and A. Panneerselvam (2011). Studies on ethanol production from spoiled fruits by batch fermentations. *J. Microbiol. Biotech. Res*., **1(4)** : 158-163.

Bari, L. P., N. Hassen, M. E. Absar, M. I. I. E. Haque, M. M. Khuda, S. Pervin, Khatun and M. I. Hossain (2006). Nutritional analysis of two varieties of papaya (*Carica papaya*) at different maturation stages. *Pak. J. Biol. Sci.*, **9** : 137-140.

Bouanga-Kalou, G., A. Kimbonguila, J. M. Nzikou, F. B. Ganongo-Po, F. E. Moutoula, E. Panyoo-Akdowa, Th. Silou and S. Desobry (2011). Extraction and characteristics of seed oil from Papaya (*Carica papaya*) in Congo-Brazzaville. *As. J. Agri. Sci*., **3(2)** : 132-137.

Dakare, M. A., D. A. Ameh and A. S. Agbaji (2011). Biochemical Assessment of '*Daddawa*' Food Seasoning Produced by Fermentation of Pawpaw (*Carica papaya*) Seeds. *Pak. J. Nut*., **10(3)** : 220-223.

Desai, U. T., A. N. Wagh, D. K. Salunkhe and S. S. Kadam (1995). Handbook of fruit science and technology: Production, composition, storage and processing. p. 297-313.

Fiske, C. H. and Y. Subba Row (1925). Experimental Biochemical research techniques, *Cowgill, R.W. and Pardee, A.B.(eds.),* pp. 177.

Haque, M. N., B. K. Sahab, M. R. Karima and M. N. Huda Bhuiyanb (2009). Evaluation of Nutritional and Physico-Chemical Properties of Several Selected Fruits in Bangladesh. *Bangladesh J. Sci. Ind. Res*., **44(3)** : 353-358.

Heath, R. L. and K. Packer (1968). Leaf senescence, correlated with increase level of membrane permeability and lipid peroxidation and decrease levels of superoxide dismutase and catalase. *J. Exp. Bot*., **32** : 93-101.

Hedge, J. E. and B. T. Hofreiter (1962). Carbohybdrate Chemistry, 17 (Eds.Whistler R.L. and Be Miller, J.N.), Academic Press, NewYork.

Imaga, N. A., G. O. Gbenle, V. I. Okochi, S. Ademekan, T. Druo-Emmanuel, B. Onyeniyi, P. N. Dokai, M. Onyenuga, A. Otumara and F. C. Ekeh (2010). Phytochemical and anti-oxidant constituents of *Carica papaya* and *Parquetina nigrescens* extracts. *Sci. Res. and Essays*, **5(16)** : 2201-2205.

Lowry, O. H., N. J. Rosebrough, A. L. Farr and R. J. Rondall (1951). *J. Biol. Chem.,* pp-193.

Malacrida, C. R., M. Kimura and N. Jorge (2011). Characterization of a high oleic oil extracted from papaya (*Carica papaya* L.) seeds. *Cienc. Tecnol. Aliment.*, **31(4)** : 929-934.

Morton, J. F. (1987). "Papaya", In Julia F. Morton (publisher). *Fruits of Warm Climates* : 336- 346.

Nwofia, G. E., O. Philipa and E. Chinyere (2012). Chemical composition of leaves, fruit pulp and seeds in some *Carica papaya* morphotypes. *Int. J. Med. Arom. Plants*, **2(1)** : 200-206.

Oliveira, J. G. D., R. E. Bressan-Smith, E. Campostrini, M.D. Cunha, E. S. Costa, A. T. Netto, K. D. S. Coutinho, M. G. D. Silva and A. P. Vitória (2009). Papaya pulp gelling : is it premature ripening or problems of water accumulation in the apoplast. *Cienc. Tecnol. Aliment.*, **3(4)** : 9529-9534.

Piper, C. S. (1950). In: Soil and plant analysis, Interscience Publishers. Inc., New York, 342-343.

Sadasivam, S. and A. Manikam (1992). *Biochemical Methods for Agricultural Sciences,* Wiley Eastern Limited, New Delhi: 10-12.