AATCC Review

01 April 2025: Received
22 May 2025: Revised
29 May 2025: Accepted
30 June 2025: Available Online

https://aatcc.peerjournals.net/

Original Research Article

Open Access

Evaluation of nutritional and quality characteristics of selected dragon fruit varieties of Telangana, India

Vippalapally Shivani*[1], T. Kamalaja[2], P. Janaki Srinath[3], And D. Rajani[4]

[1]*Department of foods and nutrition, Post graduate research center, College of community science, PJTAU, India*
[2]*AICRP on WIA, Department of foods and Nutrition, PJTAU, Hyderabad-500030, India*
[3]*Department of foods and nutrition, college of community science, Hyderabad-500004, India*
[4]*C-NARE Horticulture Component, PJTAU, Rajendranagar, Hyderabad-500030, India*

ABSTRACT

Now a days consumption of fruits and vegetables is gaining popularity in the functional food market due to their health-promoting components, dragon fruit is one among them. The consumption trend of dragon fruits in India is increasing due to their potential health benefits. Hence, the present study was conducted to the select best nutritional variety of dragon fruit through the biochemical analysis, by estimating the nutritional, phytonutrients and antioxidant activity in red-fleshed and white-fleshed dragon fruits. The moisture and fat content of white-fleshed dragon fruit comparatively had higher levels 84.70%, and 1.01% respectively compared to red-fleshed variety. Wherein, the red-fleshed dragon fruit exhibited higher levels of protein, crude fiber, carbohydrates, and energy: 0.70%, 0.87%, 20.99%, and 93.71 K cal per 100 g respectively when compared to the white-fleshed variety. The mineral composition of red-fleshed dragon fruit was high in iron (3.25 mg/100 g), calcium (47.52mg/100 g), sodium (9.11 mg/100 g), manganese (0.60 mg/100 g) and copper (0.14 mg/100 g) respectively compared to white-fleshed variety. However, Red-fleshed dragon fruit had higher levels of antioxidant activity, total phenols and total flavonoid contents. Thus, the present study highlights the nutritional richness of red-fleshed dragon fruit variety it can be also selected as a promising functional ingredient in food formulations and processing industries.

Keywords: *Antioxidants, Flavonoids, Total phenols, Nutrients, Telangana, and Functional ingredient.*

Introduction

Dragon fruit commonly called pitaya, belongs to the Cactaceae family is a perennial epiphytic vine cactus, and is scientifically known as *Hylocereus* spp. It is an exotic and healthy fruit grown in tropical and sub tropical regions around the world, mainly in Asian countries. Whereas, India has been an importer of dragon fruit but from late the 1990s dragon fruit was introduced in India and the area of cultivation has been increasing tremendously now a days [4].The dragon fruit has four types of species are classified based on their peel and pulp colour. *Hylocereus undatus* (pink peel with white flesh), *Hylocereus polyrhizus* (pink peel with red flesh or pink flesh), and *Selenicereus megalenthus* (yellow peel with white flesh). *Hylocerus costaricencis* (pink peel with violet-red pulp) [4].The edible portions of fruit were peel, pulp, embedded seeds in pulp and have a pleasant flavor which has a rich source of nutrients including proteins, carbohydrates, energy, and minerals like calcium, iron, potassium, and also other bio active compounds [16]. Dragon fruit peel is an agricultural waste in fruit processing industries previously it was used as fertilizer but now a days peel is used for value addition in food processing industries. The dragon fruit peel is a potential source of pectin-10.79%, betacyanin pigments-150.46 mg/100g, and total dietary fiber-69.30% [5].

The area under cultivation of dragon fruits was increasing tremendously and one of the major producing states in India is Karnataka. At present, the total area under cultivation of dragon fruit in India is more than 3000 ha [4]. To improve the consumption rate of dragon fruit it is essential to produce the data on the nutritional and biochemical composition.

Materials and Methods

The two varieties of dragon fruits were selected i.e., (*Hylocereus undatus* and *Hylocereus polyrhizus*) and analyzed the nutritional, phytonutrient, and antioxidant activity using analytical procedures. The fresh pulps of two varieties of dragon fruits were processed for further analysis. The pulps were analyzed to select the best nutritional properties of the fruit.

Proximate analysis:

The proximate composition of dragon fruit pulps was analyzed using standard protocols. Moisture was determined by using a standard protocol [3] by drying 5 g of dragon fruit pulp sample at 105 °C for 2 h in a hot air oven, then cooling off in a desiccator, weighing, and expressing in g/100 g of sample. Crude protein was estimated by the Kjeldhal method [3] and the final value was calculated by multiplying with a factor N × 6.25 and expressed as g/100 g. Fat content was estimated by using the Soxhlet method [3].Total ash content was estimated using standard protocol [3]. The crude fiber was determined using a standard protocol [3] based on acid and base digestion. The samples (moisture and fat-free) were weighed accurately in fiber bags and subjected to a sample carousel by placing them

*Corresponding Author: ***Vippalapally Shivani***

DOI: https://doi.org/10.21276/AATCCReview.2025.13.03.319

with a glass spacer. After digestion the left over residue was weighed into crucible and dried at 100 ° C for 4 h and then crucible was incinerated in a muffle furnace at 600°C for 3 hrs, cooled, weighed and expressed in g/100 g of sample. Carbohydrate content [2] and energy was calculated using the following formula respectively:

Carbohydrate (g) = 100 – (moisture + protein + fat + ash + crude fiber)

Energy (Kcal) = (Protein x 4) + (Fat x 9) + (Carbohydrates x 4)

Estimation of Minerals

For mineral estimation, moisture-free dragon fruit samples were wet digested in a microwave digester using nitric acid. Iron, zinc, manganese, and copper were determined by using Atomic Absorption Spectrophotometry, While calcium, sodium, and potassium were estimated using Flame Photometry.

Antioxidant activity and Phytonutrients

Phytonutrients (Total phenol, Flavonoids) and antioxidant activity (DPPH) were determined for the two varieties of dragon fruit samples.

Sample extraction

Dragon fruit fresh and dry pulp samples of two varieties were extracted by using cold maceration with different solutions i.e., methanol and ethanol. The pulps were weighed (1.0 g) accurately in a centrifuge tube, and added 50 ml of acidified methanol and ethanol separately. The mixture was kept for 24 hours in a dark place followed by centrifugation at 3000 rpm and filtered through filter paper to obtain clear extracts.The clear filtrate was collected and preserved at 4°C until further use (9). This filtered extract was used to determine total phenol (TP), flavonoids, and 1,1-diohenyl-2-picrylhydrazyl (DPPH) activity.

Estimation of total phenol (TP)

To determine the total phenolic content Folin-Ciocalteu (FC) method described by Slinkard and Slingleton, [14] was used. Briefly; 1 ml of aliquot was taken in a test tube, 0.5 ml of distilled water and 1 ml of FC reagent, diluted with distilled water (1;1, v/v) was added, followed by 2.5 ml of (7.5%) sodium carbonate solution was incubated for 60 min at 37 ° C and measured at 750 nm using UV spectrophotometer. Gallic acid standard curve (200 µg-1000 µg) was prepared and total phenol content was determined by standard curve. Further, it was expressed as mg gallic acid equivalent (GAE)/ 100 g of the dragon fruit pulp sample.

Estimation of flavonoids

The standard procedure described by Zhishen *et al*., [10] with slight modification was used to determine flavonoid content. Briefly; 1 ml of aliquot was taken in a test tube and 4 ml of distilled water was added, followed by 0.3 ml of 5% $NaNO_2$. After 5 min 3 ml of $AlCl_3$ was added and after 6 minutes 2 ml of NaOH was added. The final volume was made up of 10 ml with distilled water. The solution was mixed properly and the absorbance was measured against a blank at 510 nm with UV spectrophotometer. Rutin was used to prepare the standard curve (y = 0.010x - 0.030 R^2 = 0.976) and expressed asµg Rutin equivalent (RE)/g of the dragon fruit pulp where 'y' is absorbance and 'x' is flavonoid content.

DPPH radial scavenging activity

The protocol described by *Dorman et al*.,; Tadhani *et al*.,[7&15] was followed with slight modification used to estimate antioxidant activity. Briefly; 1 ml of aliquot sample was taken made volume up to 0.5 ml with methanol. Added 3 ml of DPPH reagent to it mixed the contents properly and incubated for 20 min at 37° C. Read the absorbance at 517 nm by using a spectrophotometer and expressed in percentage of DPPH against methanol as blank. L-ascorbic acid solution was used to prepare the standard curve.

DPPH scavenging activity (%) =

Control absorbance – sample absorbance/ Control absorbance ×100

Statistical analysis

All the experiments were conducted in triplicates and mean scores were recorded. Two sample

T-test assuming equal variance was performed for selecting best nutritional property of dragon fruit variety.

Results and discussion

The Fresh red-fleshed dragon fruit and white fleshed dragon fruit samples (FRPU and FWPU) were analyzed for proximate composition (Table 1); the moisture content in FRPU (82.11) and FWPU (84.70). Hence, a significant difference ($p<0.01$) was found among the two varieties. Previous studies have reported a higher moisture content in white variety dragon fruit than red variety dragon fruit [8] in contrast to a lower moisture content in the red dragon fruit variety exhibited in the present study may be due to the variability in climatic conditions.

Protein analysis showed that FRPU (0.705 g/100g) and FWPU showed (0.47 g/100 g). The fat content of two varieties of dragon fruit pulp in the present study ranged from 0.77-1.01 g/100 g. Similarly, previous researchers stated that the amount of fat content -0.57 in red dragon fruit was low [8]. Ash content in dragon fruit varieties showed in the range between 0.69 to 0.75 g/ 100 g on a fresh weight basis. Similar values were reported in previous studies [8].Crude Fiber content ranged from 0.86 to 0.97 g/ 100 in two varieties of dragon fruits. A significant difference was found in carbohydrate content in the two varieties of dragon fruits. The highest carbohydrate values and energy values are exhibited in FRPU. From the current study results, it can be recommended that red dragon fruit pulp can be used to prepare value-added products.

Estimation of Minerals

The mineral content of dragon fruit pulp of two varieties (Table 2) indicated that higher levels of iron content are 3.25 mg/ 100 g, calcium content is 47.52 mg/ 100 g, sodium content is 9.11 mg/ 100 g, the copper content is 0.14 mg/ 100 g and manganese content is 0.60 mg/ 100 g were exhibited in FRPU in the present study. Whereas, in FWPU iron content is 2.50 mg/100 g, calcium content is 45.93 mg/ 100 g, sodium content is 8.46mg/ 100 g, copper content is 0.11mg/ 100 g and manganese content is 0.27 mg/ 100 g. One of the most important micronutrients is iron which is necessary for immune functions, and mental, physical, and cellular growth. One of the studies reported that consumption of red dragon fruit during the pregnancy period elevated the levels of erythrocytes and haemoglobin [11]. High levels of calcium were found in red dragon fruit which is essential for the development of healthy teeth, bones, and tissues[6].

Phytonutrients and Antioxidant Capacity

The present study evaluated the antioxidant potential of two varieties of dragon fruits through ethanol and methanol extraction separately and the results were presented in Table 3.

The flavonoid content in FRPU and FWPU in methanol extraction were 1113.5, and 1000.25 µg RE/ 100 g respectively. Wherein, ethanol extraction of FRPU and FWPU were 235.75, and 199.75 µg RE/ 100 g respectively. However, red dragon fruit had significantly the highest flavonoid content in both methanol and ethanolic extraction ($p \leq 0.05$) of 1113.5 µg RE/ 100 g, and 235.75 µg RE/ 100 g respectively. Flavonoids play a vital role in maintaining heart health and keep blood pressure stable by acting on blood arteries and brain cells[13].

Total phenols content in the red-fleshed variety and white variety using methanol extraction were 5.09, and 5.12 mg GAE /100 g respectively. Whereas, the ethanol extraction of FRPU and FWPU exhibited 4.39 and 4.51 mg GAE /100 g respectively. Among two extractions methanol extraction exhibited higher total phenolic content. While, the study conducted by Lim *et al*., [17] reported higher phenolic content in the pulp of red-fleshed dragon fruit was 21.00 mg GAE/100 g, which is relatively higher than the results obtained in the present study. This difference may be due to environmental conditions of cultivation and differences in the maturation stage of fruits. Mainly phenols and flavonoids are sources of natural antioxidants that help in promote health and prevent various degenerative diseases caused by oxidative stress [12].

The antioxidant activity in methanol extraction of FRPU and FWPU was 79.83, and 79.79% respectively. In ethanol extraction of FRPU and FWPU were 47.26, and 35.83% respectively. Among the two extraction methods highest antioxidant activity was found in the present study for FRPU (47.26%) in the ethanol extraction method. No significant difference was found between FRPU and FWPU in methanol extraction (79.83 to 79.79%) concerning DPPH.

Table.1 Proximate composition of dragon fruit varieties

Samples	Moisture (%)	Ash (g/100g)	Fat (g/100g)	Protein (g/100g)	Crude Fiber (g/100g)	Carbohydrate (g/100g)	Energy (K cal/100g)
FRPU	82.11±0.15	0.75±0.03	0.77±0.01	0.705±0.01	0.86±0.02	20.99±0.10	93.71±0.33
FWPU	84.70±0.39	0.69±0.03	1.01±0.03	0.47±0.01	0.97±0.02	12.17±0.34	59.76±1.68
t value	13.92	3.15	8.08	14.54	3.89	52.90	40.32
p value	0.00**	0.08	0.01	0.00**	0.05	0.00**	0.00**

FRPU- Fresh red dragon fruit pulp;
FWPU-Fresh white dragon fruit pulp
*Note: The values are presented as the mean±SD of (n=3) replications. NS-non-significant, *Significant at 5%, **Significant at 1%. Values with a different superscript in the same column are significantly different ($p \leq 0.05$).*

Table.2 Mineral composition of dragon fruit varieties

Sample	Copper	Iron	Manganese	Zinc	Potassium	Calcium	Sodium
FRPU	0.14±0.02	3.25±0.02	0.60±0.01	0.48±0.02	220.89±9.42	47.52±3.08	9.11±1.37
FWPU	0.11±0.00	2.50±0.03	0.27±0.01	0.50±0.01	223.08±31.13	45.93±5.67	8.46±1.23
t value	1.95	16.98	16.15	0.70	0.40	0.42	0.54
p value	0.18	0.00**	0.00**	0.55	0.72	0.71	0.63

***FRPU**- Fresh red dragon fruit pulp;*
***FWPU**-Fresh white dragon fruit pulp*
***Note:** The values are presented as the mean±SD of (n=3) replications. NS-non-significant, *Significant at 5%, **Significant at 1%. Values with a different superscript in the same column are significantly different ($p \leq 0.05$).*

Table.3 Total Phenols, Flavonoids and Antioxidant activity of dragon fruit varieties

Sample	Methanol Antioxidant (%/0.1ml)	Ethanol-Antioxidant (%/0.1ml)	Methanol-Phenols (mg/GAE/100g)	Ethanol-Phenols (mg/GAE/100g)	Methanol-Flavonoids (mg RE/100g)	Ethanol-Flavonoids (mg RE/100g)
FRPU	79.83±0.00	47.26±0.15	5.13±0.00	4.39±0.00	1113.5±0.86	235.75±12.84
FWPU	79.79±0.04	35.83±0.23	5.18±0.00	4.51±0.00	1000.25±1.89	199.75±1.89
t value	1	44.97	2.04	25	453	101.82
p value	0.42	0.00**	0.17	0.00**	0.00**	0.00**

***FRPU**- Fresh red dragon fruit pulp;*
***FWPU**-Fresh white dragon fruit pulp*
***Note:** The values are presented as the mean±SD of (n=3) replications. NS-non-significant, *Significant at 5%, **Significant at 1%. Values with a different superscript in the same column are significantly different ($p \leq 0.05$).*

Conclusion

The biochemical characterization of two dragon fruit varieties of *Hylocerus spp*. Revealed significant differences in moisture, crude fat, crude protein, crude fiber, carbohydrates, Energy, minerals like iron, calcium, manganese, flavonoid content, and antioxidant activity among the two varieties. The red-fleshed variety (*Hylocereus polyrhizus*) exhibited significantly higher levels of crude protein, energy, carbohydrates, iron, calcium, manganese, sodium, copper, flavonoids, and antioxidants. Wherein, *Hylocereus undatus* had higher moisture and fat content than *Hylocereus polyrhizus*. These findings underscore distinct biochemical compositions between the two varieties of dragon fruit, particularly emphasizing the nutritional richness of the red-fleshed dragon fruit.

Acknowledgement

The authors thank the honorable Vice-Chancellor, Central Instrumentation Cell, PJTAU, AICRP lab, and PGRC of Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad for their logistical support.

Conflict of interest: No conflict of interest

References

1. AOAC. 1990. Official Methods of Analysis. *Association of Official Analytical Chemists*. 15th Edition.Arlington Virginia, USA.(mine)

2. AOAC. 2006. Official Methods of Analysis. *Association of Official Analytical Chemists*. 18th Edition. Washington, DC, USA(cho).

3. AOAC.2005.Official Methods of Analysis. *Association of Official Analysis Chemists International.* 18th Edition. Arlington VA, USA.(all)

4. Arivalagan, M., Karunakaran, G., Roy, T. K., Dinsha, M., Sindhu, B. C., Shilpashree, V. M., and Shivashankara, K. S. 2021. Biochemical and nutritional characterization of dragon fruit (*Hylocereus species*). *Food Chemistry*. *353*:1294 26.

5. Chia, S. L., and Chong, G. H. 2015. Effect of drum drying on physico-chemical characteristics of dragon fruit peel (*Hylocereus polyrhizus*). *International Journal of Food Engineering*. *11*(2): 285-293.

6. Choo, W.S. and Yong W.K. (2011). Antioxidant properties of two species of Hylocereus fruits. *Adv. Appl. Sci. Res.,* 2(3): 418-425.

7. Dorman, H.J.D., Bachmayer, O., Kosar, M and Hiltunen, R. 2004. Antioxidant properties of aqueous extracts from selected La-miaceae species grown in Turkey. Journal of Agricultural and Food Chemistry. 52(4): 762-770.

8. Ghorband, A. S., Joshi, B. H and Bhatt, H. G. (2023). Studies on physicochemical and nutritional properties of dragon fruit (*Hylocereus polyrhizus*). *Journal of Pharmacognosy and Phytochemistry*. *12*(6): 223-226.

9. Harbourne, J.B.1993. photochemistry. Academic press, London. 89-131.

10. J. Zhishen, T. Mengcheng, W. Jianming. (1999)*Food Chem*. 64(4): 555-559

11. Nurliyana, R., Syed O.I., Syed Z.I. and Koya (2010). Antioxidant study of pulps and peels of Dragon fruits: a comparative study. *J. Int. Food Research*. 17 (2): 367-375.

12. P.F. Suma, A. Urooj, (2014)Antioxidants. 3: 55–66.

13. Patel, S.K. and Ishnava K.B. 2019. *In-vitro* Antioxidant and Antimicrobial activity of Fruit Pulp and Peel of *Hylocereus undatus* (Haworth) Britton and Rose. Asian *J. Ethno pharmacol. Medicinal Foods*. 5(2):30-34.

14. Slinkard, K and Slingleton. 1997. Total phenolic analyses: Automation and comparison with manual method. American Journal Enology and Viticulture. 28: 49-55.

15. Tadhani, M.B., Patel, V.H and Subhash, R. 2007. In vitro antioxidant activities of Stevia rebaudiana leaves and callus. Journal of Food Composition and Analysis. 20: 323-329.

16. Tran, D.H., Yen, C.R., and Chen, Y.K.H. 2015. Effect of bagging on fruit characterisation and physical protection in red pitaya (*Hylocereus spp*.). *Biol. Agric. Hortic.* 31(3): 158-166.

17. Y.Y. Lim, T.T. Lim, J.J.Tee, 2007.*Food Chem*.,103:1003