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Value Addition in Dragon fruit and Evaluation of the Products (*Hylocereus costaricensis*)

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ABSTRACT: Dragon fruit is an exotic fruit, rich in nutritional value and bioactive compounds. The fruits are low in calories and high in antioxidant and vitamin C. Processed products of dragon fruit offer value by diversifying food choices, reducing waste, and promoting economic growth while retaining nutritional benefits. The present experiment entitled "Value addition in dragon fruit and evaluation of the products (*Hylocereus costaricensis*)" was conducted during the year 2022-2023 in Tamil Nadu Agricultural University, Coimbatore. The study was about preparation of various value-added products such as jam, jelly, jujube, squash, RTS, cookies and ice-cream by using dragon fruit pulp and powder. After preparation, the value-added products were evaluated for various physico-chemical parameters such as TSS, pH, acidity, vitamin C, total sugars, reducing sugars and betalain compounds. On the basis of sensory evaluation, it was concluded that dragon fruit jam was found to be the best of all products as it recorded the higher sensory score of 8.6 in terms of overall acceptability.

Keywords: Dragon fruit, value added products, physico-chemical parameters, colour values, organoleptic evaluation.

INTRODUCTION

Dragon fruit or pitaya (*Hylocereus* Spp) belongs to the member of cactaceae family, is an exotic and healthy fruit, grown in arid locations around the world, mainly in Asian countries. Dragon fruit is originated in Mexico, Central and South America, received a significant attention from growers across India, due to its appealing colour and mouth melting pulp with black colour seeds, and its high nutritious properties (Mizrahi *et al*. 1997). Dragon fruit plant thrives during daylight hours but captivating flowers blooms at night, is often referred to as the "Queen of the Night". Besides its popular name, it is also recognized by various other names such as strawberry pear, night blooming cereus, belle of the night, Cinderella plant, and Jesus in the cradle (Zee *et al.* 2004).

Dragon fruit contains four types of species based on its peel and pulp colour. (i) red skin with white pulp- (*Hylocereus undatus*) originated from Vietnam and Thailand, (ii) red skin with red pulp- (*Hylocereus polyrhizus*) from Israel and Malaysia, (iii) red skin with purple pulp- (*Hylocereus costaricencis*) from Guatemala, Nicaragua, Ecuador, and Israel and (iv) yellow skin with white pulp- (*Selenicerus meglanthus*) from Colombia and Ecuador (Wakchaure *et al*., 2021). Dragon fruit is rich in nutrients such as antioxidants, calcium, fibre, vitamin B, vitamin C, and phosphorus. The edible portion of dragon fruit contains 64.50% of the total fruit weight, 82.5-83.0 % of moisture content, 0.16 -0.23% of protein, 0.21-0.61% of fat, 6.3-8.8 mg of calcium, 30.2-36.1 mg of phosphorus, 0.5-0.61 mg of iron and 8-9 mg/100g of vitamin-C (Tripathi *et al*., 2014).

The fruit is ovoid in shape, measures around 10–15 cm in diameter and weighs 250–600 g. Dragon fruit surface is covered with scales of varying sizes. The fruit flesh embedded with numerous small black seeds. It possesses a delightful texture and offers a characteristic taste (Wang, 1997). The seeds are consumed along with the fruit's flesh and gives a nutty flavour (Ariffin *et al*., 2009).

The flowers of *Hylocereus* Spp are hermaphrodite, large (20 to 35 cm in length and 34cm in diameter), bell-shaped, and tubular with nocturnal anthesis (Barbeau, 1990). The maturity of the fruit is influenced by edaphic factors like soil, climate, temperature, and rainfall. Dragon fruit is a non-climacteric fruit, should be harvested at its peak ripeness and the fruit's peel turns pink-red while the scales retain green colour. The peel starts to change colour from 25 to 30 days after flowering (DAF). Harvesting the fruits at the right maturity level facilitates better post-harvest management (Nerd *et al*. 1999).

Red-flesh dragon fruit is rich in betalains pigment consisting of water soluble betacyanins and betaxanthin (Vinod *et al.*, 2021). Dragon fruit is rich in anti-oxidant due to the presence of betacyanin content (Wybraniec and Mizrahi 2004). Red fleshed dragon fruit acts as anti-cancer properties, anti- inflammation and antidiabetics and also dragon fruit improves hair and skin health, enhance appetite, and helps to maintain the cholesterol levels (Gunasena *et al*., 2007).

Dragon fruit is a recently introduced crop in India and gaining popularity due to its high nutritional and economic value. Shelf life of fresh dragon fruits are less when compare to its value-added products that can be stored for a longer period of time without any deterioration in the quality. Processing of dragon fruit into various value-added products results in extended shelf life. The aim of the present experiment is to develop the value-added products such as jam, jelly, Squash, Ready to Serve (RTS), cookies, jujube, ice cream and evaluation of its physico-chemical attributes.

MATERIALS AND METHODS

Dragon fruit for this experiment were harvested from Orchard, Tamil Nadu Agricultural University, Coimbatore. The red-skinned with purple fleshed dragon fruit (*Hylocereus costaricensis*), were harvested at the appropriate stage of maturity for the preparation of value-added products. The ingredients namely, sugar, citric acid, pectin, gelatin, sodium benzoate, and additional components were used.

A. Dragon fruit pulp extraction

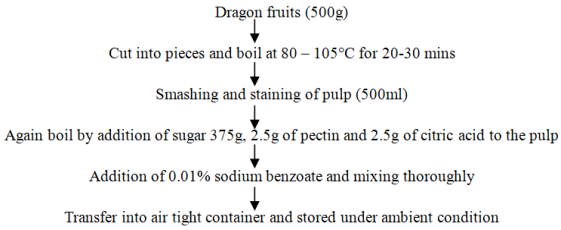
Dragon fruit pulp was extracted by selecting a clean and ripened dragon fruit, washed with water and removed the outer peel by using knife. Cut the edible part into slices, and smash the slices to extract the pulp. It is advisable to store the pulp at a chilled temperature of 4°C for further usage.

B. Dragon fruit powder

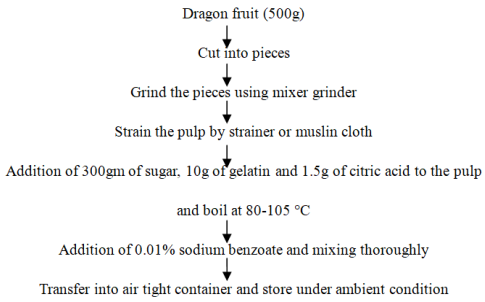
The Ripened dragon fruits were washed and peeled under hygienic conditions. The juice was extracted from the fruits using a mixer grinder and strained through a strainer and muslin cloth to remove the mucilage content and seeds, ensuring a smooth and pulp-free juice. The clarified juice was mixed with 300g maltodextrin and diluted with water at a ratio of 1:1 part of juice and water. Subsequently, the mixture was subjected to spray drying using a laboratory spray dryer from CPHT, TNAU, Coimbatore. The spray-dried powder was collected and carefully transferred into an airtight container for storage at room temperature, where it was kept for subsequent analysis and research purposes.

C. Preparation of Value added products

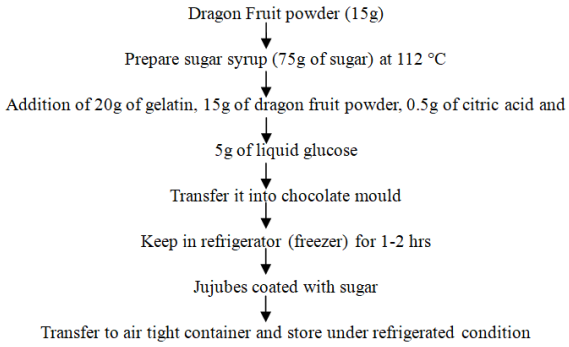
(i) Dragon fruit jam



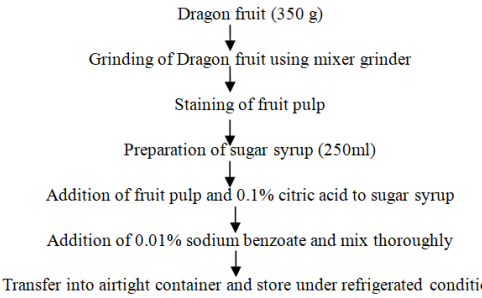
(ii) Dragon fruit jelly



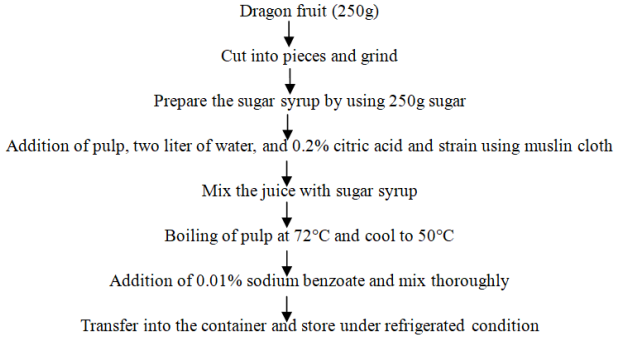
(iii) Dragon fruit jujube



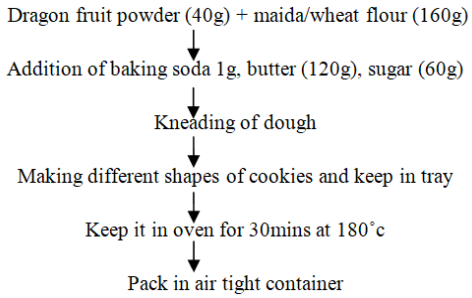
(iv) Dragon fruit squash



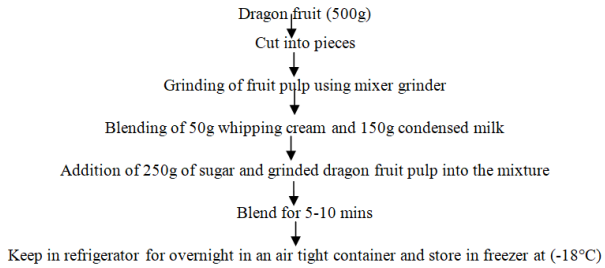
(v) Dragon fruit RTS



(vi) Dragon fruit cookies



(vii) Dragon fruit ice cream



D. Physiochemical Analysis

(i) TSS. The dragon fruit juice was extracted from the pulp and the total soluble solids (TSS) was calculated using a digital handheld refractometer.

(ii) Titratable acidity. Titratable acidity was assessed by a volumetric technique using phenolphthalein as indicator. The sample (5g) was ground, and dissolved in distilled water and made up to total volume of 30ml. The resulted solution was filtered through cotton. In 5ml of the filtrate, 2 drops of phenolphthalein indicator solution were added. The solution was titrated using 0.1 N NaOH until the appearance of a pink colour, indicating the endpoint of titratable acidity. The titratable acidity was expressed as a percentage (Paul *et al*., 2010).

(iii) Vitamin C. Vitamin C or ascorbic acid content was determined by using the volumetric method. A 10g sample was dissolved in 50 ml of oxalic acid. The solution was then filtered through filter paper, and 5 ml of the filtrate solution was diluted with 10 ml of 4% oxalic acid. The resulted sample solution was titrated with dye, prepared by dissolving 42mg of sodium bicarbonate and 52mg of 2-6 dichloroindophenol in a small volume of distilled water and then made up to 200 ml. The endpoint was reached when a pink colour appeared and disappeared after 30 seconds. Vitamin C content was expressed as mg per 100g of the sample (Ismail *et al*. 2014).

$$\text{Ascorbic acid (mg 100 g}^{-1}\text{ FW)} = \frac{\text{Titre value} \times \text{Dye factor} \times \text{Volume made up} \times 100}{\text{Aliquot} \times \text{wt. of sample}}$$

(iv) Colour values. The colour of the pulp and product was assessed at different stages of fruit growth. A chroma meter was used to measure the colour at three different portions (top, middle, and bottom) and the average colour was recorded. The colour was quantified using the L*, a*, and b* parameters. In this scale, L* represents the range between black and white, a* indicates the range between green and red, and b* represents the range between blue and yellow (Sugumaran *et al*. 2019).

(v) pH. The sample pH was measured using digital pH meter (AOAC, 2005).

(vi) Total sugars. The total sugar content was determined using the anthrone method, as described by (Hedge and Hofreiter 1962). 0.5 g of the sample was macerated using pestle and mortar with 10 ml of 80% ethanol and centrifuged at 3000 rpm for 5 minutes. The supernatant was collected and diluted to a final volume of 100 ml with distilled water. To prepare the blank, 0.5 ml of distilled water was mixed with 0.5 ml of the sample. Additionally, 4 ml of pre-cooled anthrone reagent was freshly added to the mixture and the shaked thoroughly. The test tubes were kept at 20°C for 10 minutes in a water bath at 60-70 °C for 8 minutes. Subsequently, the test tubes were cooled at room temperature for 5 minutes before measuring the absorbance at 630 nm using a UV spectrophotometer and a graph was plotted using the obtained data. The total sugar content of the sample was then expressed in terms of g/100g of the sample.

(vii) Reducing sugars. The estimation of reducing sugars was performed using the dinitro salicylic acid (DNS) method as recommended by Miller (1972). 1 g of the sample was macerated with 100 ml of distilled water and centrifuged at 10,000 rpm for 5 minutes, resulting in the collection of the supernatant (sample). Then 2 ml of the sample was transferred to a test tube, and 3 ml of DNS reagent was added. The test tubes were placed in a boiling water bath for 5 minutes and kept for cooling. Then 1 ml of sodium potassium tartarate was added to each test tube and allowed to cool in room temperature. The absorbance of the solutions was measured at 540 nm using a UV spectrophotometer. The reducing sugar content was calculated using a standard curve of glucose and expressed as g/100g of the sample.

(viii) Betalains. To determine the betalain levels in the fruit samples and products, the absorbance of the water-based extract was measured Singh *et al*. (2022). 1g of the sample was dissolved in 10 mL of distilled water and subsequently subjected to centrifugation. The resulting supernatant was suitably diluted, and the absorbance were measured at 538 nm using a spectrophotometer. The overall quantity of betalains present was calculated using the following formula:

$$\text{Total betalain content (mg betacyanin eq. 100 g}^{-1}\text{ FW)} = \frac{A \times MW \times DF \times 1000}{\varepsilon \times L \times w}$$

where A = absorbance at 538 nm, MW = molecular weight of betacyanin (535), DF = dilution factor, ε = molar extinction coefficient of betacyanin (60000), L = path length (1 cm), and W = wt. of sample (g).

RESULTS AND DISCUSSION

A. Dragon fruit jam

The dragon fruit jam recorded 64.6˚Brix of Total Soluble Solids (TSS), 0.48% of acidity, 2.64 mg/100g of vitamin- C, 4.7 pH, 68.8% of total sugars, 29.7% of reducing sugars and 12.19 mg/100g of betalains (Table 1). The colour values of dragon fruit jam were found to be L* (7.47), a* (25.62), b* (2.30) (Fig. 1). Similar findings was reported by Kanwal *et al.* (2017) in guava jam were recorded 63.28% of total sugars. Similarly, Nafri *et al.* (2021) reported that the papaya jam also recorded 64.8% of total sugars.

B. Dragon fruit jelly

The dragon fruit jelly recorded 62.3˚Brix of Total Soluble Solids (TSS), 0.41% of acidity, 2.1 mg/100g of vitamin- C, 4.8 pH, 64.9% of total sugars, 28.02% of reducing sugars and 9.35 mg/100g of betalain (Table 1). The colour value of dragon fruit jelly was found to be L* (25.17), a* (19.84), b* (-8.90) (Fig. 1). Similar findings was reported by (Islam *et al.* 2012) in dragon fruit jelly were recorded 65.02±0.07% of total sugars, 28.04±0.03% of reducing sugars and 4.20±00 pH. 0.51% of acidity was estimated in dragon fruit jelly (Panchal *et al.* 2018). Similarly, fig cultivar Tres Num Prato has recorded 0.37% of acidity (Curi *et al.* 2019).

C. Dragon fruit jujube

The dragon fruit jujube recorded 32.6˚Brix of Total Soluble Solids (TSS), 0.47% of acidity, 3.25 mg/100g of vitamin- C, 4.5 pH, 30.8% of total sugars, 16.3% of reducing sugars and 9.43 mg/100g of betalains (Table 1). The colour value of dragon fruit jujube was found to be L* (16.79), a* (17.39), b* (-4.19) (Fig. 1). The similar findings are 5.07 pH and 32.92% of total sugars recorded in fig jujube (Swetha *et al.* 2021). Similarly, 20.51% of total sugar was recorded in strawberry jujube (Takeungwongtrakul *et al.*, 2020).

Table 1: Physico-chemical properties of the value-added products.

Parameters	TSS ˚Brix	Titratable acidity (%)	Vitamin-C (mg 100g^{-1})	PH	Total sugars (%)	Reducing sugar (%)	Betalain (mg 100g^{-1})
Jam	64.6	0.48	2.64	4.7	68.8	29.70	12.19
Jelly	62.3	0.41	2.10	4.8	64.9	28.02	9.35
Jujube	32.6	0.47	3.25	4.5	30.8	16.3	9.43
Cookies	30.5	0.22	1.58	5.4	32.7	15.2	4.94
Squash	48.5	1.18	4.32	4.1	40.2	28.6	10.68
RTS	39.2	0.24	2.13	3.8	41.5	30.5	3.77
Ice cream	35.4	0.19	5.22	6.2	37.2	13.9	9.48

D. Dragon fruit cookies

The dragon fruit cookies recorded 30.5˚Brix of Total Soluble Solids (TSS), 0.22% of acidity, 1.58 mg/100g of vitamin- C, 5.4 pH, 32.7% of total sugars, 15.2% of reducing sugars and 4.94 mg/100g of betalains (Table 1). The colour value of dragon fruit cookies was found to be, L* (41.94), a* (15.14), b* (13.09) (Fig. 1). The similar findings were recorded 4.26 pH in fig cookies (Khapre *et al.*, 2015). The colour values of white fleshed dragon fruit cookies recorded L* (43.73 ± 7.67), a* (7.43b ± 1.09) and b* (20.65b ± 1.89) respectively (Ho *et al.* 2016).

E. Dragon fruit squash

The dragon fruit squash recorded 48.5˚Brix of Total Soluble Solids (TSS), 1.18% of acidity, 4.32 mg/100g of vitamin- C, 4.1 pH, 40.2% of total sugars, 28.6% of reducing sugars and 10.68 mg/100g of betalains (Table 1). The colour value of dragon fruit squash was found to be, L* (20.51), a* (22.18), b* (-4.05) (Fig. 1). The similar findings were recorded 1.32% of acidity in jamun squash (Shahnawaz *et al.*, 2011). Similarly, 4.16mg/100g of betalains and 40.14% of total sugars was recorded in dragon fruit squash (Pradeepa *et al.*, 2021). Similarly, Niketa *et al.* (2023) reported that 36.53% of total sugar was recorded in bael squash.

F. Dragon fruit RTS

The dragon fruit RTS recorded 39.2˚Brix of Total Soluble Solids (TSS), 0.24% of acidity, 2.13 mg/100g of vitamin- C, 3.8 pH, 41.5% of total sugars, 30.5% of reducing sugars and 3.77 mg/100g of betalains (Table 1). The colour value of dragon fruit RTS, L* (18.50), a* (17.53), b* (-9.30) (Fig. 1). Similar finding was recorded by (Byanna *et al.*, 2021) in sweet orange and pomegranate blended RTS of (3.31) pH. Similarly, in dragon fruit RTS (0.051%) of acidity were observed (Virendra *et al.*, 2018) and in mango RTS (Chopra *et al.* 2014) recorded (0.30%) of acidity.

G. Dragon fruit ice cream

Ice cream is a delicious, wholesome and contains high nutritive value. The data indicates that the dragon fruit ice cream recorded 35.4˚Brix of Total Soluble Solids (TSS), 0.19% of acidity, 5.22 mg/100g of vitamin-C, 6.2 of pH, 37.2% of total sugars, 13.9% of reducing sugars and 9.48 mg/100g of betalains (Table 1). The colour value of dragon fruit ice cream was found to be, L* (32.22), a* (24.19), b* (-18.79) (Fig. 1). The similar findings were recorded in dragon fruit ice cream 31.5% of TSS, 0.15% of acidity and pH of 6.2 (Mufas *et al.*, 2013). Similarly, 6.62 pH was recorded in mango ice cream (Makwana *et al.*, 2017).

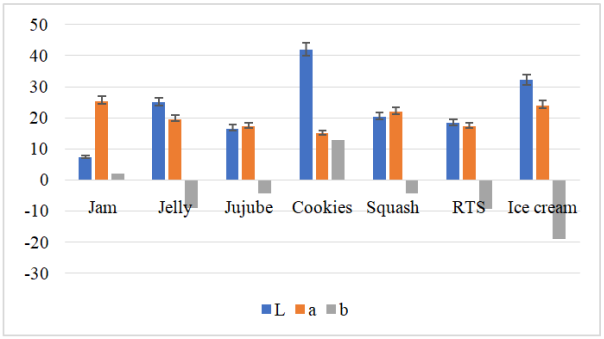


Fig. 1. Colour values of dragon fruit value added-products.

H. Organoleptic evaluation

The organoleptic evaluation was conducted using nine-point hedonic scale. The result of organoleptic evaluation of the dragon fruit value added products included colour and appearance, flavour, texture, taste and overall acceptability (Table 2). The appearance and colour of the products plays a significant role in sensory characteristics. The maximum colour and appearance observed in jujube (9.00), maximum flavour observed in jam and jelly (8.6), maximum texture observed in jam (8.6), maximum taste observed in jam (8.5) and the overall acceptability of products observed in dragon fruit jam (8.6) (Fig. 2). Among all products the dragon fruit jam scored higher in organoleptic rating.

Table 2: Organoleptic evaluation of the value-added products.

Attributes	Jam	Jelly	Jujube	Cookies	Squash	RTS	Ice cream
Colour and Appearance	8.6	8.7	9.0	8.8	8.9	8.6	8.5
Flavour	8.6	8.6	8.0	8.0	7.0	7.5	7.5
Texture	8.6	7.5	7.5	7.5	7.8	8.0	7.0
Taste	8.5	7.0	8.0	8.5	8.0	8.0	7.0
Overall acceptability	8.6	8.3	8.4	8.0	8.2	7.9	7.8

(Dragon fruit jam)

(Dragon fruit jelly)

(Dragon fruit jujube)

(Dragon fruit squash)

(Dragon fruit cookies)

(Dragon fruit ice cream)

(Dragon fruit RTS)

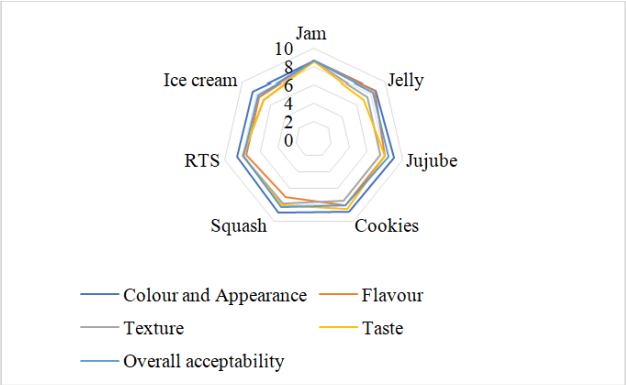


Fig. 2. Organoleptic evaluation of dragon fruit value added products.

CONCLUSIONS

Dragon fruit is rich in nutritional and medicinal properties, brings numerous benefits to human health. All the parts of the dragon fruit namely, pulp, peel, flowers and stem contain bioactive compounds such as betalains, flavonoids, tannins, alkaloids beneficial in biological activities in humans such as antioxidant, antimicrobial and anticancer properties. In this study, jam, jelly, jujube, squash, RTS, cookies and ice- cream were prepared using dragon fruit pulp and powder. On the basis of the result, dragon fruit jam scored higher sensory rating and also recorded high betalains (12.1 mg/100g), acidity (0.48%), ascorbic acid (2.64mg/100g), total sugars (68.8%) and reducing sugars (29.70%) among all the products.

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Conflict of Interest. None.

FUTURE SCOPE

The nutritional properties of the value-added products can be exploited for further commercialisation of the different products developed from dragon fruit.

REFERENCES

AOAC (2005). Official method of Analysis. 18th ed. The Association of Official Analytical Chemists. Washington DC, USA.

Ariffin, A. A., Bakar, J., Tan, C. P., Rahman, R. A., Karim, R., & Loi, C. C. (2009). Essential fatty acids of pitaya (dragon fruit) seed oil. *Food chemistry*, *114*(2), 561-564.

Barbeau, G. (1990). La pitahaya rouge, un nouveau fruit exotique. *Fruits*, *45*(2), 141-147.

Byanna, C. N., & Gowda, I. N. (2012). Standardization of sweet orange and pomegranate blended RTS beverage preparation and its storage. *Crop Research*, *44*(1and2), 109-115.

Curi, P. N., Albergaria, F. C., Pio, R., Schiassi, M. C. E. V., Tavares, B. D. S., & Souza, V. R. D. (2019). Characterisation and jelly processing potential of different fig cultivars. *British Food Journal*, *121*(8), 1686-1699.

Chopra, C. S. (2014). Evaluation of mango (*Mangifera indica* L.) varieties for making RTS beverage. *Journal of Hill Agriculture*, *5*(2), 198-202.

D. Swetha, C. Indu Rani, G. Gurumeenakshi, M.S. Aneesa Rani, G. Amuthaselvi and R. Neelavathi (2022). Evaluation of Quality attributes in fresh fig (*Ficus carica* L.) fruits. *Biological Forum – An International Journal*, *14*(3), 532-537.

Gunasena, H. P. M., Pushpakumara, D. K. N. G., & Kariyawasam, M. (2007). dragon fruit *Hylocereus undatus* (Haw.) Britton and Rose. *Underutilized fruit trees in Sri Lanka*, *1*, 110-141.

Hedge, J.E. and Hofreiter, B.T. (1962) Carbohydrate chemistry 17. Whistler, R.L. and Be Miller, J. N., Eds., Academic Press, New York.

Ho, L. H., & Abdul Latif, N. W. B. (2016). Nutritional composition, physical properties, and sensory evaluation of cookies prepared from wheat flour and pitaya (*Hylocereus undatus*) peel flour blends. *Cogent Food & Agriculture*, *2*(1), 1136369.

Ismail, M., Ali, S., & Hussain, M. (2014). Quantitative determination of ascorbic acid in commercial fruit juices by redox titration. *International Journal of Pharmaceutical Quality Assurance*, *5*(04), 22-25.

Mizrahi, Y., & Nerd, A. (1999). Climbing and columnar cacti: new arid land fruit crops. *Perspectives on new crops and new uses*, *1*, 358-366.

Miller, G.L. (1972) Use of Dinitrosalicylic Acid Reagent for Determination of Reducing Sugars. *Analytical Chemistry*, *31*, 426-428.

Mufas, A. H. M., & Perera, O. D. A. N. (2013). Study on development of pitaya fruit (*Hylocereus undatus*) incorporated ice cream; an alternative solution to the pitaya cultivators in Sri Lanka.

Makwana, A. N. K. I. T. A., Varu, D. K., Malam, V. R., Vagadia, P. S., Bhad, M. A. M. T. A., & Malam, K. V. (2017). Ice cream properties affected by various pulp concentrations of mango. *Trends in Biosciences*, *10*(16), 2894-2897.

Nerd, A., & Mizrahi, Y. (1999). The effect of ripening stage on fruit quality after storage of yellow pitaya. *Postharvest Biology and Technology*, *15*(2), 99-105.

Paul, V., Singh, A., & Pandey, R. (2010). Determination of Titrable acidity (TA). *Post-Harvest Physiology of Fruits and Flowers*, *44*.

Rosidi, N. A. S., Ghani, A. A., Yusof, N., & Yusof, N. (2021). Effect of blanching and drying temperatures on physicochemical properties of red dragon fruit (*Hylocereus polyrhizus*) peel powder. *Journal of Agrobiotechnology*, *12*(1S), 62-73.

Khapre, A. P., Satwadhar, P. N., & Syed, H. M. (2015). Studies on processing technology and cost estimation of fig (*Ficus carica* L.) fruit powder enriched Burfi

(Indian cookie). *Journal of Applied and Natural Science*, *7*(2), 621-624.

Kanwal, N., Randhawa, M. A., & Iqbal, Z. (2017). Influence of processing methods and storage on physico-chemical and antioxidant properties of guava jam. *International Food Research Journal*, *24*(5).

Nafri, P., Singh, A. K., Sharma, A., & Sharma, I. (2021). Effect of storage condition on physiochemical and sensory properties of papaya jam. *Journal of Pharmacognosy and Phytochemistry*, *10*(2), 1296-1301.

Islam, M. Z., Khan, M. T. H., Hoque, M. M., & Rahman, M. M. (2012). Studies on the processing and preservation of dragon fruit (*Hylocereus undatus*) jelly. *The Agriculturists*, *10*(2), 29-35.

Panchal, J. B., Gaikwad, R. S., Dhemre, J. K., & Chavan, U. D. (2018). Studies on preparation and storage of jelly from dragon fruit (*Hylocereus undatus*). *Journal of Pharmacognosy and Phytochemistry*, *7*(4), 2648-2655.

Singh, A., Swami, S., Panwar, N. R., Kumar, M., Shukla, A. K., Rouphael, Y., & Kumar, P. (2022). Development changes in the physicochemical composition and mineral profile of red-fleshed dragon fruit grown under semi-arid conditions. *Agronomy*, *12*(2), 355.

Shahnawaz, M., & Shiekh, S. A. (2011). Analysis of viscosity of jamun fruit juice, squash and jam at different compositions to ensure the suitability of processing applications. *International Journal of plant physiology and Biochemistry*, *3*(5), 89-94.

Pradeepa T, Dr. Ramachandra Naik K, Dr. N Srinivas, Dr.Mahantesha, Naika, B.N. and Praveenakumar, S.G., (2021). Standardization of protocol for dragon fruit (*Hylocereus polyrhizus* L.) squash.

Patel Niketa, B., Mayani, J. M., & Sangani, S. L. (2023). Standardization of bael [*Aegle marmelos* (Linn.) Corr] fruit squash.

Tripathi, P. C., Sankar, G. K. V., Senthil Kumar R. (2014). Central Horticultural Experiment Station. Chettalli-571 248, Kodagu, Karnataka.

Takeungwongtrakul, S., Thavarang, P., & Sai-Ut, S. (2020). Development of Strawberry gummy jelly with reduced sugar content from strawberry syrup. *International Journal of Agricultural Technology*, *16*(5), 1267-1276.

Virendra, F., Amit, Z., Gaikwad, D. M., & Nikhil, A. (2018). Studies on ready to serve (RTS) beverage from dragon fruit. *International Journal of Processing and Post Harvest Technology*, *9*(2), 55-59.

Vinod, B. R., Ramachandra Naik K., Gorabal, K., Terdal, D. and Patil, S. N. (2021). Physicochemical Characteristics of Microencapsulated Red-Fleshed Dragon Fruit Juice Powder Through Spray Drying. *Biological Forum – An International Journal*, *13*(3), 86-94.

Wybraniec, S., Platzner, I., Geresh, S., Gottlieb, H. E., Haimberg, M., Mogilnitzki, M., & Mizrahi, Y. (2001). Betacyanins from vine cactus *Hylocereus polyrhizus*. *Phytochemistry*, *58*(8), 1209-1212.

Wang, X. (1997). Biology of ripening of apple cactus [*Cereus peruvianus* (L.) Miller]. Ph.D. Thesis, BenGurion Univ. of the Negev, Beer-Sheva, Israel.

Wakchaure, G. C., Kumar, S., Meena, K. K., Rane, J., & Pathak, H. (2021). Dragon Fruit Cultivation in India: Scope, Constraints and Policy Issues. *Technical Bulletin*, *27*, 47.

Zee, F., Yen, C. R., & Nishina, M. (2004). Pitaya (dragon fruit, strawberry pear).

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