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## DEVELOPMENT AND QUALITY EVALUATION OF FRUIT SPREAD USING DRAGON FRUIT

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### Abstract

Fruit spread is a popular food item since it has less sugar and more fruit ingredients. In today's world most food products are available in processed form. Food products that can be served quickly are needed in today's modern culture. As a result, the current research focuses on the development of readily available fruit spread using pulp and peel of dragon fruit. The main aim of the study is to develop fruit spread using dragon fruit and to do quality evaluation of the developed spread. The key ingredients used in the preparation of fruit spread were whole dragon fruit (*HylocereusPolyrhizus*), sugar, citric acid. The developed product was formulated with four variations by incorporating different proportions of peels. Product was subjected to sensory evaluation using 9- point Hedonic scale. Shelf-life assessment and proximate nutrient analysis of the fruit spread were conducted professionally. Variation 2 of developed fruit spread was highly acceptable with the overall acceptability score (8.7) statistically. The nutrient analysis of 100gm of dragon fruit spread showed energy 223.16 kcal, carbohydrate 54.79g, protein 1gm, fat 0gm, sugars 32.04 gm, fiber 3.22gm, vitamin C 325.14 mg. The shelf life of the product is for 30 days under refrigerated condition (0- 4°C).

**Key words:** Dragon Fruit, Fruit Spread, Nutrient Content, Peel, Shelf-Life.

### Introduction

More people nowadays are interested in leading a healthy lifestyle, which includes eating healthier foods. In response to the present trend, the formulation of a fruit spread from red dragon fruit (*Hylocereuspolyrhizus*) intends to maximise its consumption by incorporating both the flesh and peel of the dragon fruit to boost the nutritional value of the spread<sup>[1]</sup>

The dragon fruit has a very appealing colour and mellow mouth melting pulp with black-coloured edible seeds imbedded in the pulp, along with remarkable nutritional properties and is valued for its strong antioxidant potential, vitamins, and minerals content<sup>[2]</sup>.

*Hylocereus* is a genus of vine cactus belonging to the Cactoideae subfamily of the Cactaceae family<sup>[3]</sup>. The most extensively cultivated and studied *Hylocereus* species are *HylocereusUndatus* (white-flesh dragon fruit) and *HylocereusPolyrhizus* (red flesh dragon fruit). Due to its attractiveness, high antioxidant potential and sweet taste, *H.Polyrhizus* is utilised in the current study for the development of fruit spread<sup>[4]</sup>

Due to the enjoyment of the organoleptic features when eaten raw or incorporated into gastronomy, this fruit is occupying a rising niche in the exotic fruit market<sup>[5]</sup>

Dragon fruit seeds contain 50% essential fatty acids, including 48 percent linoleic acid and 1.5 percent linolenic acid<sup>[5]</sup>

Water soluble betacyanin pigments comparable to those found in red beets are detected in the flesh of *HylocereusPolyrhizus*. As dragon fruit contains only 0.2-1.04 percent pectin, pectin is frequently added to its jams and jellies. Red pitaya is also high in proline (1.1-1.6 g/l)<sup>[6]</sup>. The fruit is classified as a functional food and thus accounted as food product with high economic value<sup>[7]</sup>.

### Nutritional composition of dragon fruit:

Proximate nutraceutical values in g or mg per 100 g edible portion of red-flesh fruit is shown in table 1<sup>[8]</sup>

**Table 1: Nutritional composition of dragon fruit**

NUTRIENT	VALUE PER 100gm
Moisture %	82.5-83.0%
Protein	0.159-0.229gm



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DOI: http://ijmer.in.doi./2021/10.06.101

Fat	0.21-0.61gm
Crude fiber	0.7-0.9gm
Ascorbic acid	8-9mg

### Antioxidant property of dragon fruit

Dragon fruit is low in calories and wealthy in phenolics, flavonoids and antioxidant potential. Fruits with pink flesh have higher phenolics and flavonoids content (40-60mg GAE and 20-40 mg CE, respectively) compared to white fleshed fruits (15-20mg GAE and 10-20 mg CE, respectively). Phenols act as antioxidants [2]

### Acidic nature of the fruit

The acidity of the fruit is slightly acidic, ranging from 0.20 to 0.30 mg lactic acid equivalents. Organic acids, which are abundant in fruits, are key contributors to acidity and have a significant impact on organoleptic features such as flavour, colour, and aroma, as well as fruity taste. The presence of a significant amount of acidity and total soluble solids in the dragon fruit makes it very appealing to customers [2]

### Health benefits of dragon fruit

- Dragon fruit doesn't contain cholesterol, saturated fat, trans-fat, regular consumption can help manage blood pressure and cholesterol levels [9]
- They are high in fiber aiding in the elimination of toxins and healthy bowels as well as helping to stabilize blood sugar levels [9]
- Dragon fruits are high in Vitamin C, with 9 mg per serving or 10% of recommended daily intake [9]
- Minerals such as calcium for stronger bones and teeth, phosphorous for tissue building, and iron for blood health and vitality are also abundant in dragon fruits. One dragon fruit has 8.8 grams of calcium, 36.1 milligrams of phosphorus, and 0.65 milligrams of iron [9]
- The antioxidant effects of Phyto albumins and lycopene found in dragon fruit have been linked to cancer prevention [9]
- Dragon fruit flesh has been shown to be high in polysaccharides and mixed oligosaccharides, which have been shown to stimulate the growth of Lactobacilli and Bifidobacteria [9].
- One of the medicinal plants that has been linked to the treatment of diabetes mellitus is dragon fruit. Animal studies show that dragon fruit has anti-diabetic properties by regenerating pancreatic cells and reducing fibroblast growth factor-21 (FGF-21) resistance [10]
- Antifungal and antibacterial properties have been discovered in dragon fruit. These can assist boost the body's white blood cell count, which protects against toxins and prevents fungal or bacterial infections from entering in the organs. [11]

The current study intended to develop fruit spread employing dragon fruit, taking into account all of the aforementioned factors.

## Materials and Methodology

### 1. Fruit spread preparation

First, the red dragon fruits were cleaned to eliminate surface dirt and dust. Hard portions of the peel were removed. The fruits were sliced into half and the pulp was spooned out from the peel. Both the pulp and peel underwent prior treatment. The fruit peels were chopped into strips and blanched for few minutes, whereas the fruit flesh was mashed. The puree of treated pulp and peels were prepared and transferred into a sauce pan. The mixture was subjected to boiling for few minutes with continuous stirring, then sugar was added followed by addition of citric acid. The mixture was stirred continuously until a smooth texture was obtained. The prepared fruit spread was packed in a sterilized glass jar.

4 variations of the fruit spread were prepared.

### Formulation of fruit spread

The method of preparation of basic and variations is same for making fruit spread. In the variations different quantities of peel was added keeping the quantity of sugar and citric acid constant. The fruit spread prepared from dragon fruit with different variations was coded as V1, V2, V3, V4 as shown in table 2



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Table 2: Formulation of fruit spread

Variations	Pulp(gm)	Peel(gm)	Sugar(gm)	Citric acid(gm)
Basic	100gm	0gm	50gm	0.5gm
V1	75gm	25gm	50gm	0.5gm
V2	50gm	50gm	50gm	0.5gm
V3	25gm	75gm	50gm	0.5gm
V4	0gm	100gm	50gm	0.5gm

2. Sensory Evaluation

Sensory evaluation is an important part of any food research or product development endeavour. Evaluation of the product was carried using 9- point Hedonic scale. Sensory evaluation test was conducted for parameters such as colour, appearance, flavour, texture, taste, overall acceptability. A total of 50 untrained evaluators were randomly opted, served as panellists. Organoleptic evaluation was carried out on 5 samples (including the basic and 4 variations of the spread) using 9-point hedonic scale. The scale ran from like extremely (9) to dislike extremely (1).

3. Shelf-life study

Based on the results of sensory attributes of the 4 variations of the spread. Variation 2 was subjected to microbial, chemical and organoleptic analysis. Shelf-life study was carried out for a period of 30days in 3 phases under refrigerated condition (0- 4°C). The results of shelf-life study are presented in table 6

4. Nutrient analysis

From the developed product, variation 2 was subjected to nutrient analysis using established procedures. The results of nutrient analysis are presented in table 5

Materials: Dragon fruits were purchased from the local fruit market in Hyderabad, Telangana. Other ingredients for the spread, such as sugar and citric acid, were purchased from a local supermarket.

Ingredients used in fruit spread preparation: red flesh dragon fruit, sugar, citric acid

Results and Discussion

To know the significant difference between the variations from the information obtained from sensory evaluation where(n=50) statistically, standard deviation, Kruskal-Wallis tests were performed.

The results of statistical analysis are presented in following tables

The table below gives the statistical analysis of the sensory evaluation responses. The table compares the 5 variants and gives the level of significance.

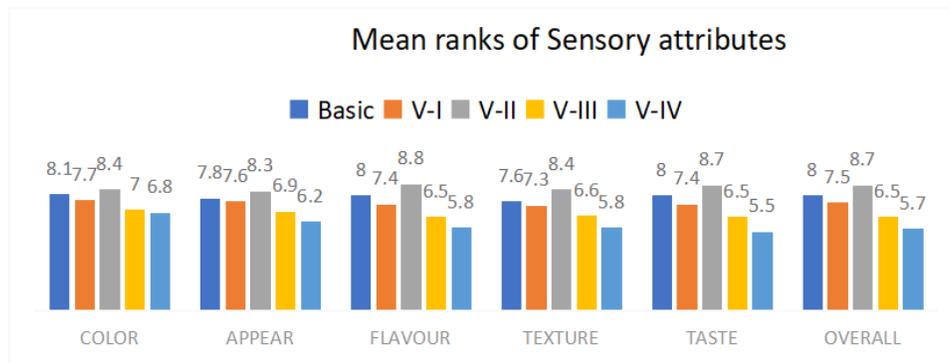
Table 3:Mean ranks of sensory attributes

	(n=50)	Basic	V-I	V-II	V-III	V-IV	P - value
Colour	Mean ±SD	8.1±0.9	7.7±0.9	8.4±0.8	7±1.1	6.8±1.3	<0.001*
	Median(P25P75)	8 (7 - 9)	8 (7 - 8)	9 (8 - 9)	7 (6 - 8)	7 (6 - 8)	<0.001*
Appearance	Mean ±SD	7.8±1.1	7.6±1	8.3±0.9	6.9±1	6.2±1.4	<0.001*
	Median(P25P75)	8 (7 - 9)	8 (7 - 8)	9 (8 - 9)	7 (6 - 7)	6 (6 - 7)	<0.001*
Flavour	Mean ±SD	8±1	7.4±1.2	8.8±0.5	6.5±1.2	5.8±1.6	<0.001*
	Median(P25P75)	8 (7 - 9)	7 (7 - 8)	9 (9 - 9)	7 (6 - 7)	6 (5 - 7)	<0.001*
Texture	Mean ±SD	7.6±1.1	7.3±0.9	8.4±0.9	6.6±1.4	5.8±1.7	<0.001*
	Median(P25P75)	8 (7 - 8)	7 (7 - 8)	9 (8 - 9)	7 (6 - 8)	6 (5 - 7)	<0.001*
Taste	Mean ±SD	8±1	7.4±1.2	8.7±0.6	6.5±1.2	5.5±1.9	<0.001*
	Median(P25P75)	8 (7 - 9)	8 (7 - 8)	9 (9 - 9)	7 (6 - 7)	5 (4 - 7)	<0.001*
Overall acceptability	Mean ±SD	8±0.8	7.5±1	8.7±0.7	6.5±1.2	5.7±1.4	<0.001*
	Median(P25P75)	8 (7 - 9)	8 (7 - 8)	9 (9 - 9)	7 (6 - 7)	6 (5 - 7)	<0.001*

Statistically Significant at P<0.001



Figure 1 Mean ranks of sensory attributes



All the attributes have a high level of significance. For parametric test, to calculate the mean ANOVA was used and for non-parametric test, to calculate the median Kruskal Wallis test was used.

From the above table it is noted that variation 2 is most liked and variation 4 is most disliked by the subjects. Table 4 gives the information of non- parametric test using Kruskal Wallis test (Non- Parametric Test)

Table 4: Results of mean ranking using Kruskal Wallis Test

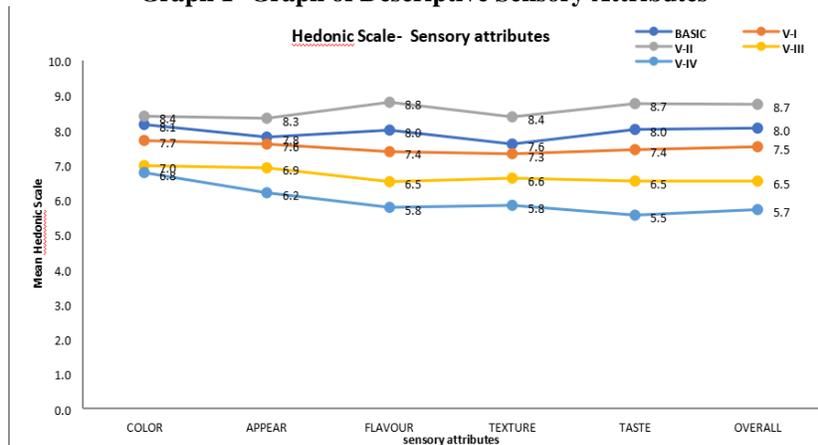
Ranks			
	Group_2	N	Mean Rank
Colour	Basic	50	157.37
	V-I	50	127.29
	V-II	50	174.70
	V-III	50	86.68
	V-IV	50	81.46
	Total	250	
Appearance	Basic	50	149.02
	V-I	50	135.21
	V-II	50	181.01
	V-III	50	93.80
	V-IV	50	68.46
	Total	250	
Flavour	Basic	50	156.13
	V-I	50	124.80
	V-II	50	202.43
	V-III	50	82.19
	V-IV	50	61.95
	Total	250	
Texture	Basic	50	145.21
	V-I	50	126.76
	V-II	50	189.20
	V-III	50	96.69
	V-IV	50	69.64
	Total	250	



Taste	Total	250	
	Basic	50	155.81
	V-I	50	125.54
	V-II	50	199.64
	V-III	50	81.98
	V-IV	50	64.53
Overall acceptability	Total	250	
	Basic	50	158.86
	V-I	50	129.91
	V-II	50	200.64
	V-III	50	81.86
	V-IV	50	56.23

Variation 2 has the highest mean rank in terms of colour, appearance, flavour, texture, taste, overall acceptability, followed by basic variant and variation 4 having the least mean rank in terms of sensory attributes.

Graph 1- Graph of Descriptive Sensory Attributes



The above graph represents the sensory attributes on the X axis and Mean Hedonic scale on Y axis which was calculated using ANOVA. The graph proves that variation 2 was most preferred in terms of sensory attributes during the sensory evaluation followed by basic variant and variation 4 being the least liked.

As per the results obtained from standard deviation, ANOVA, Kruskal-Wallis test it is evident that variation 2 was most preferred among all variants, statistically.

Table 5: Nutrient analysis results of variation 2

S.NO	Parameters	Units	Methods	Results of Analysis
1	Energy	Kcal/100g	SOP-CHM-29-00	223.16
2	Carbohydrate	g/100g	SOP-CHM-28-00	54.79
3	Protein	g/100g	By FSSAI Manual-5(14.9):2016	1.00
4	Fat	g/100g	By FSSAI Manual4(A8):2016	0.00



5	Sugar	g/100g	By FSSAI Manual-5(10.1): 2016	32.04
6	Dietary Fiber	g/100g	AOAC 985.29 20 <sup>th</sup> Ed.	3.22
7	Saturated Fat	g/100g	AOAC 996.06 20 <sup>th</sup> Ed.	BLQ
8	Trans Fat	g/100g	AOAC 996.06 20 <sup>th</sup> Ed.	BLQ
9	MUFA	g/100g	AOAC 996.06 20 <sup>th</sup> Ed.	BLQ
10	PUFA	g/100g	AOAC 996.06 20 <sup>th</sup> Ed.	BLQ
11	Vitamin C	mg/100g	IS 5838:1970 Reaff 2005	325.14

The laboratory results of nutrient analysis are presented in table 5. The analysis of variation 4 provided 223.16g/100g Energy, Protein-1g/100g estimated by method given by FSSAI Manual- 5(14.9):2016, Fat-0g/100 estimated by method given by FSSAI Manual4(A8): 2016, Sugar- 32.04g/100 estimated by using method given by FSSAI Manual-5(10.1): 2016, Dietary fiber- 3.22g/100gm estimated by using method AOAC 985.29 20<sup>th</sup> Ed. Saturated fat, trans fat, MUFA, PUFA were under below the limit of quantification(0.1g/100g), vitamin C- 325.1mg/100 estimated by method IS 5838:1970 Reaff 2005.

Table 6:Microbial analysis results

Phase	Units	Phase 1 Zero day	Phase 2 Real time- 15 days	Phase 3 Real time 30 days	Specified limits
Total viable count	cfu/g	<10	<10	<10	10 <sup>2</sup>
Coliform	cfu/g	<10	<10	<10	<10
Ecoli	Org/g	Absent	Absent	Absent	Absent
Salmonella	Org/g	Absent	Absent	Absent	Absent
Staphylococcus aureus	cfu/g	Absent	Absent	Absent	Absent
Yeast	cfu/g	<10	<10	<10	Max 50
Mold	cfu/g	<10	<10	<10	Max 50

In all the 3 phases, the total viable count was found to be less than 10cfu/g where the maximum limits were 10<sup>2</sup>, Coliform count was found less than 10cfu/g where maximum limits specified were <10. The E.coli species, Salmonella, and Staphylococcus aureus, were found to be completely absent. The yeast and mould count were reported less than 10cfu/g

Table7:Chemical analysis results

Phase	Units	Phase 1	Phase 2	Phase 3	Specified limits
pH(5% aqueous solution)	-	4.34	4.30	4.47	Not specified
Acidity as citric acid anhydrous	g/100g	0.67	0.71	0.76	Not specified
Moisture	g/100g	31.89	32.05	44.11	Not specified

Chemical analysis of the product was done in 3 phases

**Phase 1:** The chemical analysis results revealed pH, acidity and moisture of the product in the range of 4.34, 0.67, 31.89 respectively.

**Phase2:** The developed product was evaluated on 15<sup>th</sup> day (0-15day time interval) compared with phase-1 the pH of the sample slightly decreased from 4.34 to 4.30, acidity increased from 0.67 to 0.7, moisture increased from 31.89 to 32.05, respectively.

**Phase 3:** The developed product was evaluated on 30<sup>th</sup> day (0- 30day time interval). Compared with phase 1 and 2 the pH of the sample increased from 4.30 to 4.47, acidity increased from 0.7 to 0.76, moisture increased from 32.05 to 44.11, respectively.



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DOI: http://ijmer.in.doi./2021/10.06.101

Table 8: Organoleptic analysis results

Phase	Phase 1	Phase 2	Phase 3	Specified limits
Appearance in terms of colour	5	5	5	3to5
Odour	5	5	5	3to5
Taste	5	5	5	3to5
Texture/ consistency	5	5	5	3to5

1-dislike very much; 2- dislike moderately; 3-neither like nor dislike; 4-like moderately; 5- like very much

In all the 3 phases organoleptic analysis was done and the product was highly acceptable.

The sensory attribute score was 5 (like very much)for appearance, odour, taste, texture.

In terms of customer acceptability, it is clear that variation 2 developed by including the same volumes of pulp and peel is favoured above other developed varieties. In the expanding market trend, the development of such preservative-free ready-to-eat fruit spread can improve the quality of product procurement by customers. As a result, the developed fruit spread prepared from dragon fruit flesh and peel serves the needs of a rising number of health-conscious consumers while also reducing waste generated during the dragon fruit processing process.

Conclusion

According to the findings of this study, the most widely accepted variant of fruit spread made with dragon fruit is nutritionally rich. The microbiological count maintained below prescribed limits during a 30-day shelf-life testing of the product, chemical parameters such as pH, acidity, and moisture increased slightly with prolonged storage period, and the product was highly accepted organoleptically. According to the results of a shelf-life research, the product is safe to consume for 30 days. As a result, once the spread is marketed, the produced dragon fruit spread has a higher chance of being consumed. More research into manufacturing value-added products with higher nutritional content and longer shelf life for better marketing can be done using underutilised nutritious fruits and their by-products.

Suggestions

- The current product, dragon fruit spread, has a refrigerated shelf life of 30 days and a room temperature shelf life of 7 days. By adding natural preservatives, the product's shelf life can be extended.
- In the expanding food sector, the use of underutilised yet nutritious by-products of fruits should be encouraged in order to generate value-added products
- The research could be expanded to see how dragon fruit consumption affects glycemic control in those with prediabetes and type 2 diabetes.
- New value-added products can be made, such as dragon fruit-based yoghurts, fruit bars, ready-to-serve drinks, and sweets like barfi.

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