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## Consumer Acceptability and Physico-chemical Content of Red Flesh Dragon Fruit Spread

Barcelon, E., Carreon, L., Guillermo, J., Jacob, E., Jocson, S., Panopio Jr., G., Rosalinas, S.

University of Santo Tomas, Department of Food Technology, College of Education, P. O. Box. 1390. Manila, Philippines

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### ABSTRACT

**Background:** Consumers nowadays are engaged in a healthy lifestyle. The potential of a nutritious fruit such as red flesh dragon fruit (*Hylocereus polyrhizus*) has remained largely underutilized. Red flesh dragon fruit is known to prevent colon cancer and diabetes, to neutralize toxic substance such as heavy metals, to reduce cholesterol and high blood pressure, and it is rich in phosphorus and calcium (Gunasena *et al.*, 2006). Moreover, its peel has antibacterial property (Nurmahani *et al.*, 2012). It is also a good source of fiber and pectin, and it is useful as a natural colorant (Jamilah *et al.*, 2011). **Objective:** This study aims to determine the consumer acceptability and physico-chemical content of the red flesh dragon fruit spread. **Results:** Sensory acceptability was performed with 50 untrained consumers. The consumer acceptability test of the red flesh dragon fruit spread is determined to be "very good". The following physico-chemical analyses were performed: water activity ( $0.82 \pm 0.01$ ), pH ( $4.90 \pm 0.10$ ), soluble solids ( $^{\circ}\text{Brix}$ ) ( $38.65 \pm 0.31$ ), moisture ( $46.63 \pm 1.64$ ), ash ( $0.68 \pm 0.04$ ) and fat ( $0.44 \pm 0.09$ ). **Conclusion:** Based on scores provided by 50 untrained consumers, red flesh dragon fruit spread was deemed to be "very good."

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## INTRODUCTION

Lifestyles of the consumers have evolved in the last century due to increase income and leisure time, as well as to reduce physical activity. These new means of living have substantial impact on health and as parallel development: there is an increase in health awareness and interest in healthier food options (Kempster, 2012). The food industry is, therefore, looking for better strategies to contain this trend.

This study introduces a fruit spread that utilizes the potential of an untapped nutritious crop such as red flesh dragon fruit. The FAO/WHO (2014) Codex Alimentarius Commission fruit spread has similarity to jams and jellies that are preserved by sugar but differ in the degree of gel formation, manner of preparation of fruit, and ingredient composition. According to Codex Standards (2003), fruit spread is specified to contain not less than 33% by weight of the fruit ingredient. And generally, it is made with reduced soluble solids content of 25-50 $^{\circ}$ Brix compared to jams that contain 65 $^{\circ}$ Brix soluble solid.

Red flesh dragon fruit (*Hylocereus polyrhizus*) belongs to the family Cactaceae with bright red skin studded with green scales. The origin of *Hylocereus* spp. is in the tropical and subtropical forest regions of Mexico and South America. Dragon fruit has spread in America, Asia, Australia and the Middle East where it is eaten raw or processed into a range of industrial products such as juice, sherbets, ice cream, yogurt, candy and pastries. Red flesh dragon fruit represents a significant source of antioxidants and vitamin C (Moshfeghi, *et al.*, 2013). It is known to prevent colon cancer and diabetes, to neutralize toxic substance such as heavy metals, to reduce cholesterol and high blood pressure, and it is rich in phosphorus and calcium, which helps develop strong bones, teeth and skin (Gunasena *et al.*, 2006). Moreover, its peel has antibacterial property (Nurmahani *et al.*, 2012). It is also a good source of fiber and pectin, and it is useful as a natural colorant (Jamilah *et al.*, 2011).

There is a limitation in the usage of red flesh dragon fruit in the Philippines. Red flesh dragon fruit is then utilized as a whole including the peel to make a fruit spread. The general objective of the study is to determine the consumer acceptability and the physico-chemical content of red flesh dragon fruit spread.

## MATERIALS AND METHODS

Red flesh dragon fruits were washed thoroughly to eliminate superficial dirt and dust. Withered and hard wooden portions of the peel were removed. The dragon fruits were sliced in half and the flesh was spooned out

**Corresponding Author:** Barcelon, E., University of Santo Tomas, Department of Food Technology, College of Education, P.O. Box. 1390. Manila, Philippines.  
Tel: +639183064411; E-mail: fbarcelon@yahoo.com

from the peel. Once the peel and flesh were separated, each underwent prior treatment, separately. The fruit peels were cut in 1 x 5cm strips, blanched for two minutes, then pureed using an osterizer, whereas the fruit flesh was mashed. Four parts of peel puree and six parts of mashed flesh were homogenized in an osterizer. The mixture was transferred in a sauce pan, then sugar was added, wherein two parts of sugar for every eight parts of dragon fruit flesh and peel mixture were used. The mixture was cooked at 70°C and was stirred continuously until desired smooth texture was obtained, followed by the addition of cinnamon powder and vanilla extract. After complete mixing of all the ingredients, the fruit spread was packed immediately in a sterilized jar.

#### A. Physico-Chemical Analysis of Red Flesh Dragon Fruit Spread:

The physico-chemical analysis was performed in triplicate with results expressed as mean  $\pm$  standard deviation. The following analysis was performed according to the standard methods of the AOAC (1998); water activity was determined using water activity meter (enBSK Sensor), pH using a Jenway 350 portable laboratory pH meter, total soluble solids ( $^{\circ}$ Brix) using Atagorefractometer and color using Minolta chromameter.

#### B. Sensory Evaluation of Red Flesh Dragon Fruit Spread:

Fifty untrained consumers participated in an acceptability test. The 7-point Hedonic scale was used to evaluate the spread with parameters such as appearance, color, aroma, spreadability and flavor. The scale ranged from excellent (7) to extremely poor (1). The 9 point Hedonic scale was used to evaluate the general acceptability. The scale ranged from like extremely (9) to dislike extremely (1).

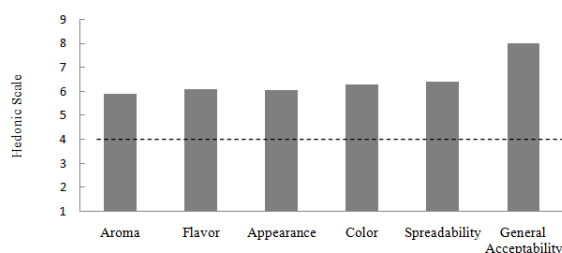
#### C. Microbial Analysis of Red Flesh Dragon Fruit Spread:

Aerobic plate count, yeast and mold count were analyzed for the red flesh dragon fruit spread. The method of National Food Safety Standards (2010) was followed with modification. One gram fruit spread was mixed with 9ml 0.1% peptone, then transferred 1ml into 2 sterile plates of sterilized plate count agar and 2 sterile plates of sterilized potato dextrose agar.

## RESULTS AND DISCUSSION

#### A. Consumer Sensory Acceptability of Red Flesh Dragon Fruit Spread:

The reduction in the amount of sugar and total soluble solids in the product changed the typical characteristics of the fruit spread. These characteristics included reduction of total taste sensation, balance between sweetness, acidity and fruit flavour. The color components became less stable, less deep, and color transparency were reduced (Zakour, 1999). Although red flesh dragon fruit spread contained less soluble solids, it showed high sensory evaluation scores.



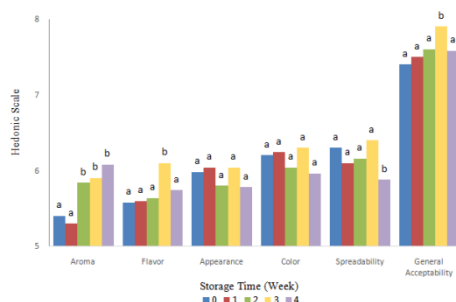
**Fig. 1:** Consumer acceptability scores of red flesh dragon fruit spread with 7-point Hedonic scale except for the parameter general acceptability with 9-point Hedonic scale. The broken line was fitted to indicate the acceptable level of sensory analysis adapted from Lim (2009).

Figure 1 showed the average points in appearance, in color, in aroma, in flavor, and in spreadability, as well as the general acceptability of the 50 untrained consumers, who evaluated the red flesh dragon fruit spread. The broken line shows the level of acceptability. The product was deemed acceptable if the bar was higher than the line and was rejected if otherwise. The mean scores for aroma (5.9), flavor (6.1), appearance (6.04), color (6.3), and spreadability (6.4) were evaluated and mentioned to be “very good” and its general acceptability (8.0) to be “liked very much”. Its relatively high fruit content (80% by weight) and reduced acid level (pH 4.9) that balanced with the flavor were the contributing factors for acceptable scores (Zakour, 1999).

Figure 2 revealed the changes of consumer sensory response in the storage of red flesh dragon fruit spread. The appearance, color, aroma, flavor, spreadability and general acceptability garnered a score of 5 and above indicating a high acceptability level. There was no statistical significance noted at 5% pertaining to the appearance and color as the storage weeks passed. The spreadability presented statistical significance at the 5% level by the fourth week with a value of 5.88, while other weeks showed values ranging from 6.1 to 6.4. The

aroma demonstrated statistical significance at the 5% level beginning from the second week until the fourth with values ranging from 5.84 to 6.08, while values ranging from 5.3 to 5.4 were garnered from the initial week of storage to the first week. The general acceptability revealed statistical significance at the 5% level by the third week with a value of 7.9, while the other weeks had values ranging from 7.4 to 7.58. The flavor displayed statistical significance at the 5% level by the third week with a value of 6.1, while the other weeks showed values ranging from 5.58 to 5.74.

### B. Shelf-life Study of Red Flesh Dragon Fruit Spread:



**Fig. 2:** Sensory acceptability of red flesh dragon fruit spread from storage. A 7–point Hedonic scale was used for all the parameters except for general acceptability with 9–point Hedonic scale. Values with same index are not significantly different at  $P < 5\%$  level.

### C. Physico-Chemical Contents of Red Flesh Dragon Fruit Spread:

Table 1 displayed the physico–chemical contents of red flesh dragon fruit spread. The water activity ( $0.82 \pm 0.01$ ) of the red flesh dragon fruit spread was insignificantly higher than the range value for fruit spread (0.80 – 0.85). This was due to the red flesh dragon fruit’s initial water activity, the reduced addition of sugar, and the amount of temperature while cooking. The pH ( $4.90 \pm 0.10$ ) of the red flesh dragon fruit spread was insignificantly higher to the range value for fruit spread (2.8 – 3.5). Since there was no addition of acid in the red flesh dragon fruit spread, its pH was determined to be within the red flesh dragon fruit’s pH of 4.7 to 5.1 (Jamilah, *et al.*, 2011).

**Table 1:** Physico–Chemical Composition of Red Flesh Dragon Fruit Spread.

Physico-Chemical Composition	Red Flesh Dragon Fruit Spread	Range of Values for Fruit Spread
Aw	$0.82 \pm 0.01$	0.80-0.85 <sup>a</sup>
pH	$4.90 \pm 0.10$	2.8 – 3.5 <sup>b</sup>
Soluble Solids (°B)	$38.65 \pm 0.31$	25 – 65 <sup>c</sup>
Moisture Content%	$46.63 \pm 1.64$	31–34 <sup>b</sup>
Ash Content%	$0.68 \pm 0.04$	0.1 – 0.5 <sup>b</sup>
Fat Content%	$0.44 \pm 0.09$	0 <sup>c</sup>
Color (L)	$19.41 \pm 0.02$	16.5-13.0 <sup>d</sup>
(a)	$14.12 \pm 0.06$	25.0-23.0 <sup>d</sup>
(b)	$5.47 \pm 0.03$	17.7-16.8 <sup>d</sup>

\*Mean values  $\pm$  standard deviation of three trials. <sup>a</sup>Zao, (2007), <sup>b</sup>Bourne, (2012), <sup>c</sup>USDA, (2014), <sup>d</sup>Wicklund *et al.*, (2005)

According to the FAO & WHO (1994), the total soluble solids of jam and jellies are exactly 65 °Brix. The total soluble solids ( $38.65 \pm 0.31$ ) of the red flesh dragon fruit spread were significantly lower (<40%) than jam and jellies (65 °Brix), but were within the given range value for fruit spread (25 – 65). The decreased in addition of sugar was done to reduce its sweetness and to promote a healthier alternative from the other types of fruit spread.

The moisture content ( $46.63 \pm 1.64$ ) of the red flesh dragon fruit spread was higher than the given range value for fruit spread (31 – 34). This was due to red flesh dragon fruit having high amounts of moisture (Jamilah *et al.*, 2011). The ash content ( $0.68 \pm 0.04$ ) garnered a greater value when compared to the given range value for fruit spread (0.1 – 0.5). The fat content ( $0.44 \pm 0.09$ ) of the red flesh dragon fruit spread was more than the range value for fruit spread (0); studies show that there are presence of essential fatty acids in the dragon fruit seeds (Ariffin *et al.*, 2009). The color of the red flesh dragon fruit spread revealed a lighter and slightly lower redness when contrasted with the given range values of fruit spread.

### D. Microbial Analysis of Red Flesh Dragon Fruit Spread:

Table 2 demonstrated the number of colony forming units, wherein both aerobic plate count and yeast and mold plate count resulted in <1 CFU/ml from the initial week of storage to the fourth week. According to

Peeler, J., & Maturin, L. (2001) and Tournas, M. (2001), any product tested resulting to <25CFU/ml in aerobic plate count and <1 CFU/ml in yeast and molds signifies its cleanliness. The results revealed that the red flesh dragon fruit spread was free from contamination and was processed while following good manufacturing practices.

**Table 2:** Microbial Load of red flesh dragon fruit spread.

Storage Time (Week)	Aerobic Plate Count (CFU/ml)	Yeast and Mold (CFU/ml)
0	<25	<1
2	<25	<1
4	<25	<1

### Conclusion:

The sensory results revealed the mean scores for aroma (5.9), flavor (6.1), appearance (6.04), color (6.3), spreadability (6.4) and general acceptability (8.0) of the red flesh dragon fruit spread was highly accepted by consumers. Moreover, the physico-chemical contents, except for water activity and total soluble solids, were minimally higher than the values for commercial fruit spreads. The mixture of red flesh dragon fruit's pulp and peel can, therefore, be used in making a good quality fruit spread. Stable qualities upon storage were also noted because of the minimal growth of microorganisms within the red flesh dragon fruit spread.

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