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# Studies on preparation and storage of jelly from dragon fruit (*Hylocereus undatus*)

**Panchal JB, Gaikwad RS, Dhemre JK and UD Chavan**

**Abstract**
The objective of this research work was to analyze the proximate composition of dragon fruit (*Hylocereus undatus*) and to standardize the process for preparation of dragon fruit jelly. The proximate analysis of dragon fruit showed moisture 87.88 %, reducing sugars 4.32 %, total sugars 8.15 %, total soluble solids 11.40 $^0$Brix, acidity 0.44 % and vitamin-C 9.99 mg/100 g, phosphorus 29.33 mg/100 g, betacyanin 114.58 mg/100 g. The prepared jelly from 1000 ml fruit extract, 550 g sugar and 11 g of pectin was found to be best during organoleptic quality. And this was an ideal recipe for excellent quality of jelly making from dragon fruits. The prepared jelly was bottled in pasteurized PET bottles (500 ml capacity) and stored at ambient (30 ± 2 ºC) as well refrigerator (5 ± 2 ºC) temperature conditions upto 90 days. During storage study of jelly TSS, titratable acidity, reducing sugars and total sugars were increased, whereas moisture content, ascorbic acid and organoleptic quality was slightly decreased with increased storage period, there was no significant variation in phosphorous content of jelly during storage study. While microbial growth was slightly increased at both storage conditions. The microbial growth in jelly was under the limit up to the end of storage period. Hence, the prepared jelly was safe and suitable for consumption up to 3 month.

**Keywords:** dragon fruit, jelly, vitamin C, pectin**,** microbial growth

## 1. Introduction

Dragon fruit is a perennial, epiphytic tropical climbing cactus with a triangular fleshy jointed stems which belongs to family Cactaceae and of genus *Hylocerous* (Cheah *et al*., 2016; Tripathi *et al*., 2014 and Gunasen *et al*., 2006) [7, 36, 14]. There are three species of dragon fruit which include *Selenicereus megalathus* (white flesh with yellow peel dragon fruit), *Hylocereus undatus* (white-flesh with red peel dragon fruit) and *Hylocereus polyrhizus* (red-flesh with red peel dragon fruit). *Hylocereus undatus* is the most cultivated and consumed species of dragon fruit. The fruits of this species present market demand, due to its very attractive sensory characteristics (De Mello, 2014) [9]. Until recently, this fruit was unknown and has come to represent a growing niche in the exotic fruit market due to appreciation of the organoleptic characteristics when eaten raw or inserted in gastronomy (Granulado *et al*., 2012) [13]. The dragon fruit was introduced in India late 90s. But the area under dragon fruit is still very limited. In India, it is cultivated on very limited scale. A very few farmers of Karnataka, Kerala, Tamil Nadu, Maharashtra, Gujarat and Andhra Pradesh have taken up dragon fruit cultivation. The total area under dragon fruit cultivation is less than 100 acres (Tripathi *et al*., 2014) [36].

Now a day’s farmers of Karnataka and Maharashtra are gaining the much more knowledge about the cultivation of dragon fruit and the area under the dragon fruit will go too increased in future days because of its low requirement of water and tillage practices. The biggest advantage of this crop is that once planted, it will grow for about 20 years and one hectare could accommodate 1000 to 2000 dragon fruit plants. It bears fruit in the second year after planting and attains full production within five years. The fruit weight ranges from 300 to 800 g and each plant produces 40 to 100 fruits per year. One plant normally yields 15 to 25 kg of fruits (Tripathi *et al*., 2014) [36]. The dragon fruit features a mouthwatering light sweet taste, an intense shape, color, and not forgetting its outstanding flowers. The flower is so beautiful that its nick name is Novel woman” or “Queen of the night” (Luders *et al*., 2006) [21]. The dragon fruit is eaten by cutting the fruit and its texture is sometimes likened compared to that of the kiwifruit due to the presence of black, crunchy seeds. The flesh, which is eaten raw, is mildly sweet and low in calories. Seeds are eaten together with the flesh, have a nutty taste and are rich in lipids (Ariffin *et al*., 2009) [4]. In addition to being tasty and refreshing, this beautiful fruit boasts of a lot of water and other vital minerals with varied nutritional ingredients. The edible part of dragon fruit (64.50 % of total fruit wt.) contains moisture 82.5-83 %, protein

0.16-0.23 %, fat 0.21-0.61 %, calcium 6.3-8.8 mg, phosphorus 30.2-36.1 mg, iron 0.5-0.61 mg, vitamin-C 8-9 mg (Tripathi *et al*., 2014) [36]. It also contains nutrients, such as carbohydrate, flavonoid, thiamine, niacin, pyridoxine, glucose, and polyphenol (Vaillant and Imbert, 2006) [37]. The dragon fruit contains beta-carotene, lycopene and vitamin E, with average concentrations of 1.4 mg/100 g, 3.4 mg/100 g and 0.26 mg/100 g of edible portion, respectively (Charoensiri *et al*., 2009) [6]. The seed of dragon fruit contains 50 % essential fatty acids, i.e. 48 % linoleic acid and 1.5 % linolenic acid (Ariffin *et al*., 2009; Rui H *et al*., 2009 and Azis *et al*., 2009) [4, 31, 5]. Thus, dragon fruit has potential for use as a source of functional ingredients to provide nutrients that may prevent nutrition related diseases and improve physical and mental well-being of the consumers. Different studies conducted with the dragon fruit emphasized its functional properties helping to reduce the risk of chronic diseases in the human body and also helpful in reducing blood sugar levels in people suffering from type 2 diabetics (Stintzing *et al*., 2003; Yong *et al*., 2009 and Wichienchot *et al*., 2010) [35, 40, 39].

In India the indigenous fruits are processed into a number of value added products like, jam, juice, jelly, cheese, preserves etc. But the exotic fruits like kiwi, avocado, mangosteen, dragon fruit and their processed fruit products are rarely available in our markets as well as very little work has been done on processing of dragon fruit in our country. So there is scope for utilizing dragon fruit remains bright in India. A number of locally processed fruit products are now available in the market. If quality products from dragon fruit are developed, it might be welcomed by the consumers, because of this dragon fruit has gained much interest in the society due to its exotic features attractive colours, nutritional value and pleasant taste. Dragon fruit contains 0.20-1.04 % pectin (Kanjana *et al*., 2006) [16] so its jam and jelly usually calls for added pectin (Islam *et al*., 2012 and Sharma *et al*., 2017) [15, 32]. Different concentrations of added pectin bring variability in organoleptic and physico-chemical properties of jelly. Development of varieties of products like jam, jelly and squash utilizing local produces is critically important for expanding the country's developing food industries. Conversely, product diversification or preservation methods are not undertaken too much for this fruit in India. Therefore this study was planned keeping in view on medicinal and nutritional importance of dragon fruit, to utilize them by processing product as jelly including other value added product would provide opportunity for commercial exploitation of this fruits.

## 2. Materials and Methods

The experiment was conducted in the laboratory of Department of Food Science and Technology, Post Graduate Institute at Mahatma Phule Krishi Vidyapeeth, Rahuri during the year 2017-2018. The Dragon fruit was collected from the local market. The major ingredients for the preparation of products were sugar, citric acid, pectin and other chemicals were used from the laboratory store.

### 2.1 Process for fruit extraction

The fruits were cut into thin slices and boiled in the equal quantity of water. The slices were heated gently for about 20-30 minutes till they become soft with occasional stirring. Then boiled extract was drained through coarse muslin cloth to remove the small black seed and the strained extract was used for preparation dragon fruit jelly.

### 2.2 Extract Recovery

Total extract was collected in glass jar and measured by measuring cylinder. The per cent recovery was calculated against total materials used and expressed.

### 2.3 Chemical analysis of dragon fruit juice and jelly

The method described in AOAC (2005) [2] for determining moisture was used for moisture estimations in dragon fruit juice and jelly. The titratable acidity was determined by the procedure as reported by Ranganna (1986) [25]. The ascorbic acid content in the products was estimated by titrimetic method as summarized by Ranganna (2009) [27] using 2-6, dichlorophenol indophenol dye and sugars by Lane and Eynon (1923) [20] as reported by Ranganna (1986) [25] method. Phosphorus content in juice was estimated colorimetrically Method as reported by Ranganna, (2009) [27]. Total soluble solids (TSS) was determined with the help of Atago pocket Refractometer of 0-85 range in duplicate (AOAC, 1990) [1].

### 2.3 Formulation of dragon fruit jelly

The jelly prepared from dragon fruit with different treatments was coded as: Jelly $T_1$, $T_2$, $T_3$, $T_4$, $T_5$, and $T_6$. The formulation of different dragon fruit jelly was shown in Table 1.

### 2.4 Methods used for preparation of dragon fruit jelly

The clear fruit extract was poured in a stainless steel pan and boiled, then required amount of pectin (High Methoxy pectin: DE > 50) was mixed with small amount sugar in a stainless steel pot. The remaining sugar was mixed with fruit extract and mixture was boiled until the TSS become nearer to 55 °Brix. Then sugar mixed pectin was added and continued the boiling until TSS becomes nearer to 58 °Brix. The citric acid was added and continued the boiling till the desired consistency and TSS reaches to 67° Brix. Then the KMS was added the scum raised on the top of the boiling mass was removed occasionally with the help of laddle during preparation of jelly.

### 2.5 Determination of end point of jelly

When the mass become sufficiently thick in consistency, the end point was judged by sheet test. Sheet test: A small portion of jelly was taken out during boiling, in a spoon. It was then allowed to drop. If the product falls off in the form of a sheet or flakes instead of flowing in a continuous stream, was considered as the end-point of jelly.

**Table 1:** Treatment details

| Treatments | Dragon fruit extract (ml) | Sugar (gm) | Acidity (%) | Pectin (gm) |
|---|---|---|---|---|
| $T_1$ | 1000 | 450 | 0.5 | 10.0 |
| $T_2$ | 1000 | 500 | 0.5 | 10.5 |
| $T_3$ | 1000 | 550 | 0.5 | 11.0 |
| $T_4$ | 1000 | 600 | 0.5 | 11.5 |
| $T_5$ | 1000 | 650 | 0.5 | 12.0 |
| $T_6$ | 1000 | 700 | 0.5 | 12.5 |

### 2.6 Hot filling in PET bottles and cooling

After judging the end-point of jelly, the finished hot jelly was cooled down to 94.5 °C and then filled in clean and dried wide mouth PET bottles which were previously pasteurized in hot water (60 ºC for 30 min). The bottles were cooled and sealed. The flow chart for various steps in jelly making is presented in (Fig-1).

**2.7 Sensory evaluation of jelly**
The Sensory evaluation of dragon fruit jelly samples were carried out according to the standard method of Amerine *et al*. (1965) [3] on 9 point Hedonic scale, The mean score minimum 10 semi trained judges for each quality parameter *viz*., colour and appearance, taste, flavour, consistency, transparency and overall acceptability was recorded.

**2.8 Storage of dragon fruit jelly**
The PET bottles containing dragon fruit jelly after cooling were stored for 3 months at both ambient (30 ± 2 ºC) and refrigerated temperature (5 ± 2 ºC). The Chemical analysis, organoleptic evaluation and microbial analysis of stored dragon fruit jelly were carried out at an interval of 0, 30, 60, 90 day's storage.

**2.9 Microbiological analysis of jelly (yeast and mould count)**
The microbial contamination and growth were determined by standard plate count method using Potato dextrose agar (PDA). The sterile distilled water was used in control and the counting was done after incubating the plate at 38 ºC for 48 hours (Ranganna, 2010) [26].

**Flow Chart**

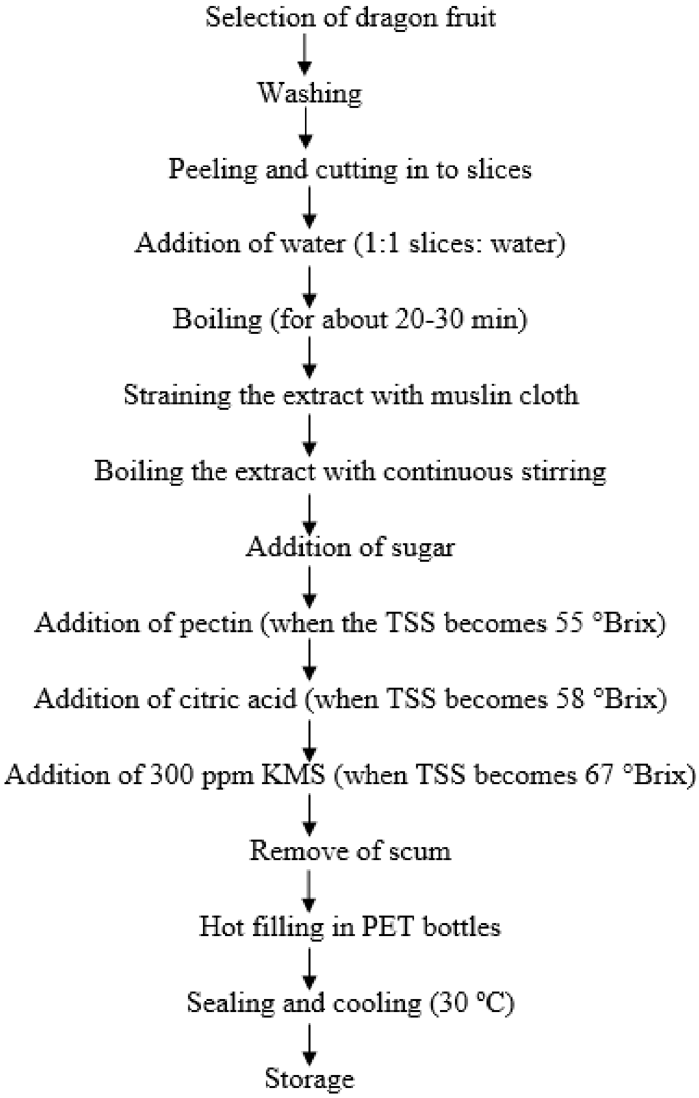


**Fig 1:** Flow sheet for preparation of jelly from dragon fruit

**2.9 Statistical analysis**
During storage study of jelly data were recorded at monthly interval on different parameters were subjected to statistical analysis using Factorial Completely Randomized Design (FCRD) using three replications (Rangaswamy, 2010).

**3. Results and Discussion**
The results of various experiments conducted during the study period are summarized below:

**3.1 Proximate composition of dragon fruit and juice**
The data on proximate composition of dragon fruit and juice such as average weight of dragon fruit, length, colour, diameter, extract recovery, waste material losses (peel, seed) and moisture content, TSS, reducing sugars, total sugars, acidity and vitamin C contents recorded in Table 2. The results obtained are in good agreement with those of Islam *et al*., (2012) [15] and Sharma *et al*., (2017) [32]. The result of average weight of dragon fruit, length, diameter, are comparable with those reported in the literature (Nurliyana *et al*., 2010; Vargas *et al*., 2013 and Dinh *et al*., 2015) [23, 38, 11]

**Table 2:** Proximate compositions of dragon fruit and juice

| Sr. no | parameters | Mean values |
|---|---|---|
| a | **Physical parameters of fruit** | |
| 1 | Weight of fruit (g) | 382 |
| 2 | Length (cm) | 12 |
| 3 | Diameter (cm) | 9 |
| 4 | Colour | Red peel with white flesh |
| 5 | Extract recovery (%) | 70 |
| 6 | Other materials losses (%) | 30 |
| b | **Chemical parameters of juice** | |
| 1 | Moisture, % | 87.88 |
| 2 | Titrable acidity, % | 0.44 |
| 3 | TSS, $^0$Brix | 11.40 |
| 4 | Reducing sugars, % | 4.32 |
| 5 | Total sugars, % | 8.15 |
| 6 | Ascorbic acid, mg/100 g | 9.99 |
| 7 | Phosphorus, mg/100 g | 29.33 |
| 8 | Betacyanin, mg/100 g (from peel) | 114.58 |

### 3.2 Standardization of recipe
The sensory scores for different treatments were graphically presented in Fig. 2 on 9 point hedonic scale. The score for colour and appearance, flavour, taste, consistency, transparency and overall acceptability was highest for $T_3$ (1000 ml fruit extract + 550 g sugar + 11 g of pectin + 0.5 % acidity) and it was 8.86 while minimum score was recorded in $T_6$ (1000 ml fruit extract + 700 g sugar + 12.5 g of pectin + 0.5 % acidity ). The minimum scores for the recipe blends $T_1$ and $T_2$ might be due to the amount of sugar added may not be sufficient to give fine consistency and flavour. The treatments $T_4$ $T_5$ and $T_6$ were not liked by the panel of judges due to presence of higher quantity of sugar and poor setting of jelly. On the other hand, treatment $T_3$ gave sharp edges when cut with a stainless steel knife and best mouth feel (easily melted in mouth when pressed against palate) with good transparent colour. So, the treatment $T_3$ was used for storage studies.

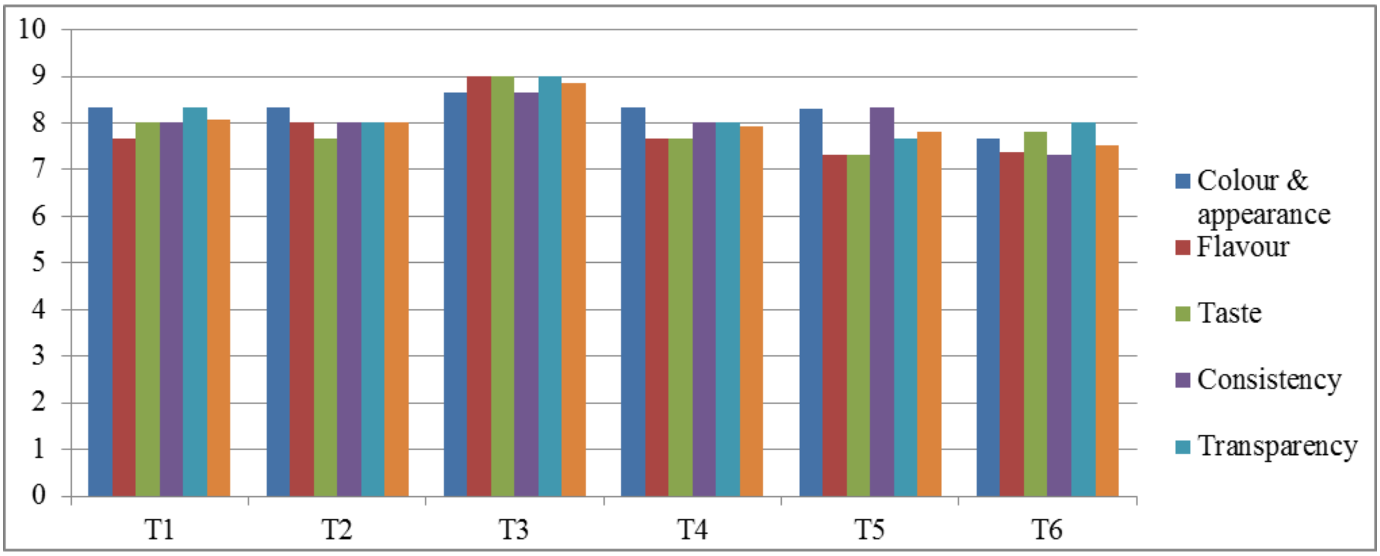


**Fig 2:** Standardization of recipe for dragon fruit jelly

### 3.3 Biochemical changes during storage of dragon fruit jelly during storage
The data on the chemical composition of dragon fruit jelly during storage are tabulated in Table 3.a and 3.b. The jelly stored in ambient as well as refrigerated condition were analyzed for moisture, TSS, acidity reducing sugars, total sugars, ascorbic acid and phosphorus content at 0, 30,60 and 90 days interval during storage study.

#### 3.3.1 Moisture
The data indicates that the moisture was decreased from 28.90 per cent to 27.15 per cent within storage period of 90 days at ambient temperature. However, slight decrease in moisture of jelly stored at the refrigerated temperature i.e. 28.90 per cent to 27.56 per cent was observed. The decrease in moisture content from 24.02 to 21.58 was observed in guava-carrot jelly during storage (Singh and Chandra, 2012) [33] and in karonda jelly from 35.44 to 30.87 per cent (Singh, 2010) [34]. This decrease in moisture may be due to reopening of the same pack during storage for analysis (Muhammad *et al.*, 2008) [22].

**Table 3a:** Biochemical changes during storage of dragon fruit jelly at ambient temperature

| Storage period (days) | Moisture (%) | TSS ($^0$Brix) | Titrable acidity (%) | Reducing sugars (%) | Total sugar (%) | Ascorbic acid (mg/100g) | Phosphorus (mg/100g) | Microbial growth ($10^3$cfu/ml) |
|---|---|---|---|---|---|---|---|---|
| 0 | 28.90 | 67.26 | 0.51 | 27.77 | 65.10 | 2.96 | 2.93 | 0.27 |
| 30 | 28.00 | 67.30 | 0.57 | 28.13 | 65.58 | 2.71 | 2.93 | 2.00 |
| 60 | 27.36 | 67.59 | 0.64 | 29.05 | 66.59 | 2.52 | 2.93 | 2.00 |
| 90 | 27.15 | 68.16 | 0.65 | 29.74 | 66.70 | 2.45 | 2.92 | 3.00 |
| SE m (±) | 0.104 | 0.018 | 0.002 | 0.125 | 0.036 | 0.009 | 0.001 | 0.11 |
| CD 5 % | 0.300 | 0.053 | 0.006 | 0.360 | 0.184 | 0.027 | 0.004 | 0.29 |

**Table 3b:** Biochemical changes during storage of dragon fruit jelly at refrigerated temperature

| Storage period (days) | Moisture (%) | TSS (⁰Brix) | Titrable acidity (%) | Reducing sugars (%) | Total sugar (%) | Ascorbic acid (mg/100g) | Phosphorus (mg/100g) | Microbial growth ($10^3$cfu/ml) |
|---|---|---|---|---|---|---|---|---|
| 0 | 28.90 | 67.26 | 0.51 | 27.77 | 65.10 | 2.96 | 2.93 | 0.27 |
| 30 | 28.83 | 67.34 | 0.58 | 28.08 | 65.46 | 2.75 | 2.93 | 1.00 |
| 60 | 27.73 | 67.65 | 0.71 | 29.03 | 65.90 | 2.57 | 2.93 | 2.00 |
| 90 | 27.56 | 68.17 | 0.72 | 29.33 | 66.57 | 2.47 | 2.92 | 2.00 |
| SE m (±) | 0.073 | 0.013 | 0.001 | 0.088 | 0.045 | 0.006 | 0.001 | 0.11 |
| CD 5 % | 0.212 | NS | 0.004 | NS | 0.129 | NS | NS | 0.33 |

### 3.3.2 Total soluble solids (TSS)
The data indicates that the TSS increased from 67.26 to 68.16 °Brix at ambient temperature while, at the refrigerated temperature it increased from 67.26 to 68.17 °Brix. The increase in total soluble solids from 68.20 to 77.20 °Brix was reported in guava-carrot jelly with the advancement of storage period (Singh and Chandra, 2012) [33], and also in wood apple jelly from 65.15 to 66.60 °Brix (Kumar and Deen, 2017) [19]. An increase in total soluble solids content in jelly during storage period probably was due to the conversion of polysaccharides into sugars in the presence of organic acids (Kumar and Deen, 2017) [19]. Similar observations were also observed by Deen and Singh, (2013) [10] in karonda jelly and Kuchi *et al.* (2014) [18] in guava jelly bar.

### 3.3.3 Titratable acidity
The data indicates that acidity increased from 0.51 to 0.65 per cent at ambient temperature while from 0.51 to 0.72 per cent at refrigerated temperature. The increase of acidity was slightly higher in case of refrigerated temperature as compared to ambient temperature condition. The gradual increase in titratable acidity of tamarind jelly stored at room temperature as well as refrigerated temperature for 180 days was reported (Kotecha and Kadam, 2002) [17], for wood apple jelly (Chopra *et al*., 2003) [8]. The titratable acidity in karonda jelly was found to be increased with increase in storage period from 1.30 to 1.90 per cent (Singh, 2010) [34] and from 0.57 to 0.77 per cent in wood apple jelly (Kumar and Deen, 2017) [19]. The reason for increase in titratable acidity might be due to formation of organic acids by the degradation of the ascorbic acid as it decreased with storage period of the jelly (Kumar and Deen, 2017) [19]. This is in consonance with the findings of Deen and Singh, (2013) [10] in karonda jelly and Kuchi *et al.*, (2014) [18] in guava jelly bar.

### 3.3.4 Reducing sugars
The data indicates that the reducing sugars was increased from 27.77 to 29.74 per cent at ambient temperature while, from 27.77 per cent to 29.33 per cent at refrigerated temperature within storage period of 90 days. The increase in reducing sugars was slightly higher in sample stored at the ambient temperature. The increase in reducing sugars during storage was reported from 26.68 to 33.47 per cent in karonda jelly (Singh, 2010) [34] from 32.84 to 59.60 per cent in pomegranate and sapota mixed (Raut, 2015) [29] and from 29.73 to 31.65 in sapota and beetroot blended jelly (Gaikwad, 2016) [12]. The increase in reducing content of jelly could be due to inversion of non reducing sugar into reducing sugars as decreases in non reducing sugars corresponded to increase in reducing sugars content. Hydrolysis of polysaccharides like pectin and starch could also be one of the reasons for increase in the sugars content (Kumar and Deen, 2017) [19]. Similar trend of increase in reducing sugar content of sapota jelly was observed by Relekar *et al*., (2011) [30] and Deen and Singh, (2013) [10] in karonda jelly.

### 3.3.5 Total sugars
The data indicates that the total sugars was increased from 65.10 to 66.57 per cent at ambient temperature while, at refrigerated temperature it increased from 65.10 to 66.70 per cent. The Increase in total sugars might be due to loss of moisture during storage. The identical increasing trend in total sugar content was recorded in sapota jelly by Relekar *et al*., (2011) [30]. The total sugars content was increased in wood apple jelly from 62.90 to 65.10 per cent during storage (Kumar and Deen, 2017) [19] and from 64.63 to 67.29 per cent in pomegranate and sapota mixed (Raut, 2015) [29].

### 3.3.6 Ascorbic acid
The data indicates that the ascorbic acid content decreased from 2.96 mg/100g to 2.45 at ambient temperature while, from 2.96 to 2.47 mg/100g at the refrigerated temperature within storage period of 90 days. The ascorbic acid content decrease from 6.3 to 2.07 mg/100g in guava-carrot jelly was reported by Singh and Chandra, (2012) [33] and from 0.40 to 0.28 mg/100g in wood apple jelly (Kumar and Deen, 2017) [19]. The reduction in ascorbic acid content of the jelly could be due to oxidation by trapped oxygen in PET bottles which results a formation of highly volatile and unstable dehydro ascorbic acid followed by further degradation to 2, 3-diketogulonic acid and finally to furfural compounds and also its oxidation due to temperature and greater catalytic activity of fructose in the catabolization of vitamin-C could be the reason for its decrease (Kumar and Deen, 2017) [19].

### 3.3.7 Phosphorus
The data indicates that among storage intervals, there was no significant variation in phosphorous content of jelly at both storage temperature conditions. Similar, results were reported in case of karonda fruit jelly there was no significant variation in phosphorous content of jelly from 2.35 to 2.34 mg/100g (Singh, 2010) [34].

### 3.3.8 Microbial quality of jelly
The microbial counts of jelly stored at ambient and refrigerated condition were $0.27 \times 10^3$ cfu/g at zero days. This may be due to the addition of potassium metabisulphite and presence of high percentage of sugar content in the jelly and high heating temperature during preparation of jelly. The microbial count was increased slightly from $2 \times 10^3$ cfu/g to $3 \times 10^3$ cfu/g at ambient temperature and from $1 \times 10^3$ cfu/g to $2 \times 10^3$ cfu/g at refrigerated temperature. The less microbial growth was observed in the jelly stored at refrigerated temperature than at ambient temperature. This indicated that the cold condition of storage helped controlling the microbial growth in refrigerator. Kumar and Deen, (2017) [19] reported that wood apple jelly stored at ambient temperature showed 3

× $10^3$ cfu/g microbial counts. Similar, results were found in case of sapota and beetroot blended jelly where the microbial count was 2 × $10^3$ cfu/g (Gaikwad, 2016) [12]. The microbial count should not exceed to $10^3$ per ml or g of jelly was reported by Ranganna, (2010) [26] and Kumar and Deen, (2017) [19]. In present findings, the microbial count had not exceeded this limit up till the jelly remained acceptable organoleptically.

### 3.4 Changes in sensory quality of jelly during storage

The data sensory scores of dragon fruit jellies during storage for parameters like colour and appearance, flavour, taste, consistency, transparency and overall acceptability of jelly samples are tabulated in Table 4.a and 4.b.

#### 3.4.1 Colour and appearance

The data indicate that score for colour and appearance of jelly was decreased from 8.93 to 8.65 at ambient temperature and from 8.92 to 8.55 at the refrigerated temperature during storage period of 90 days. The decrease in colour and appearance score from 8.65 to 8.19, 8.40 to 8.03 respectively was observed in karonda jelly (Singh, 2010) [34], from 7.10 to 6.12 in guava-carrot jelly (Singh and Chandra, 2012) [33] and from 7.60 to 5.70 in sapota and beetroot blended jelly (Gaikwad, 2016) [12].

**Table 4a:** Sensory quality of jelly after 90 days of storage at Ambient Temperature

| Storage Period days) | Colour & appearance | Flavour | Taste | Consistency | Transparency | Overall acceptability |
|---|---|---|---|---|---|---|
| 0 | 8.93 | 8.89 | 8.55 | 8.71 | 8.93 | 8.77 |
| 30 | 8.83 | 8.83 | 8.33 | 8.48 | 8.61 | 8.57 |
| 60 | 8.68 | 8.82 | 8.07 | 8.42 | 8.42 | 8.45 |
| 90 | 8.65 | 8.48 | 7.96 | 8.04 | 8.35 | 8.11 |
| SE m (±) | 0.015 | 0.014 | 0.154 | 0.151 | 0.155 | 0.054 |
| CD 5 % | 0.044 | 0.039 | 0.445 | 0.437 | 0.446 | 0.157 |

**Table 4b:** Sensory quality of jelly after 90 days of storage at Refrigerated Temperature

| Storage Period days) | Colour & appearance | Flavour | Taste | Consistency | Transparency | Overall acceptability |
|---|---|---|---|---|---|---|
| 0 | 8.92 | 8.91 | 8.55 | 8.61 | 8.89 | 8.81 |
| 30 | 8.63 | 8.85 | 8.27 | 8.53 | 8.59 | 8.62 |
| 60 | 8.59 | 8.81 | 8.11 | 8.40 | 8.31 | 8.48 |
| 90 | 8.55 | 8.53 | 7.71 | 7.91 | 7.88 | 8.31 |
| SE m (±) | 0.011 | 0.018 | 0.131 | 0.149 | 0.109 | 0.038 |
| CD 5 % | 0.031 | 0.054 | 0.393 | 0.447 | NS | NS |

#### 3.4.2 Flavour

The data indicate that score for flavour of samples decreased from 8.89 to 8.48 at ambient temperature and 8.91 to 8.53 at refrigerated temperature during storage period of 90 days. The loss of flavour was reported from 8.23 to 8.19 in karonda jelly (Singh, 2010) [34], from 7.55 to 6.15 in guava-carrot jelly (Singh and Chandra, 2012) [33] and from 7.70 to 5.20 in sapota and beetroot blended jelly (Gaikwad, 2016) [12].

#### 3.4.3 Taste

The data indicate that score for taste of samples decreased from 8.55 to 7.96 at ambient temperature and 8.55 to 7.71 at the refrigerated temperature during storage period of 90 days. The samples stored at ambient temperature were liked most by the judges. It was reported that there was decrease in taste from 8.66 to 7.81 during storage study of karonda jelly (Singh, 2010) [34].

#### 3.4.4 Consistency

The data indicate that score for taste of samples decreased from 8.71 to 8.04 at ambient temperature and 8.61 to 7.91 at the refrigerated temperature during storage period of 90 days. The samples stored at ambient temperature were liked most by the judges. It was reported that there was decrease in consistency from 8.63 to 8.03 during storage study of karonda jelly (Singh, 2010) [34].

#### 3.4.5 Transparency

The data indicate that score for taste of samples decreased from 8.93 to 8.35 at ambient temperature and 8.89 to 7.88 refrigerate temperature during storage period of 90 days. It was reported that there was decrease in transparency from 8.63 to 8.03 during storage study of wood apple jelly (Kumar and Deen, 2017) [19].

#### 3.4.6 Overall acceptability

The data indicate that the overall acceptability score gradual decreased from 8.77 to 8.11 at ambient temperature while, from 8.81 to 8.31 at refrigerated temperature. The average overall acceptability during 90 days storage was 8.47 and 8.55 at ambient temperature and refrigerated temperature respectively. The rate of decreased in overall acceptability was slightly higher in sample stored at ambient temperature as compared to refrigerated temperature during storage period. The acceptability of jelly was maintained up to three month of storage.The decrease in overall acceptability score was due to undesirable change in jelly. Temperature plays an important role in inducing certain undesirable biochemical changes in the jelly which leads to development of off flavour as well as discoloration (browning) and there by masking the original colour and flavour of the product.

The overall acceptability score decrease from 8.00 to 6.86 at ambient temperature while, from 8.00 to 7.15 at refrigerated temperature was reported in tamarind jelly (Kotecha and Kadam, 2002) [17], from 8.62 to 7.69 in karonda jelly (Singh, 2010) [34], from 7.70 to 5.40 sapota and beetroot blended jelly (Gaikwad, 2016) [12] and from 7.34 to 6.14 in guava-carrot jelly (Singh and Chandra, 2012) [33]. Similarly, reduction in organoleptic quality has also been reported in guava jelly (Paul *et al.*, 2007) and in karonda jelly (Deen and Singh, 2013) [10] and also in wood apple jelly (Kumar and Deen, 2017) [19].

### 3.5 Conclusion

It can be concluded from the present findings that the better quality of dragon fruit jelly can be prepared by using 1000 ml fruit extract, 550 g sugar, and 11 g of pectin with better organoleptic properties as well as chemical composition and good storage stability at both storage (ambient and refrigerated) conditions up to 3 months storage period.

## 4. References


1. AOAC. Official methods of analysis, Association of Official Agricultural Chemists, Washington, DC.15th Edn, 1990.
2. AOAC. Official Methods of Analysis. 18th Edn. Association of Official Analytical Chemists, Virginia, USA, 2005, 321
3. Amerine MA, Pangborn RM, Rossler EB. Principles of Sensory Evaluation of Foods. Academic Press New York, 1965, 350-375.
4. Ariffin AA, Bakar J, Tan CP, Rahman RA, Karim R, Loi CC. Essential fatty acids of pitaya (dragon fruit) seed oil, Food Chem. 2009; 114:561-564.
5. Azis A, Jamilah B, Chin Ping T, Russly R, Roselina K, Chia CL. Essential fatty acids of pitaya (dragon fruit) seed oil. Food Chemistry. 2009; 114:561-564.
6. Charoensiri R, Kongkachuicha R, Suknicom S, Sungpuag P. Beta-carotene, lycopene, and alpha-tocopherol contents of selected Thailand fruits. Food Chemistry. 2009; 113:202-207.
7. Cheah LK, Eid AM, Aziz A, Ariffin FD, Elmahjoubi A, Elmarzugi NA. Phytochemical Properties and Health Benefits of *Hylocereus undatus* Nanomedicine & Nanotechnology Open Access. 2016; (1):103-109.
8. Chopra CS, Singh P, Singh RP. Studies on preparation of jelly from wood apple (*Limonia acidissima* L.) fruit. Beverage Food World. 2003; 30(3):13-14.
9. De Mello FR, Bernardo C, Dias CO, Bosmuler LC, Silveira JL, Amante ER *et al*. Evaluation of the chemical characteristics and rheological behaviour of pitaya (*Hylocereus undatus)* peel, Fruits. 2014; (69):381-390.
10. Deen B, Singh IS. Studies on preparation and storage of jelly from karonda (*Carissa carandas* L.) fruits. Beverage and Food World. 2013; 40(1):60-64.
11. Dinh-Ha Tran, Chung-Ruey Yen, Yu-Kuang H. Chen. Effects of bagging on fruit characteristics and physical fruit protection in red pitaya (*Hylocereus spp.*), Biological Agriculture & Horticulture. 2015; 31(3):158-166.
12. Gaikwad SU. Studies on preparation of sapota (*manilkara achras* (Mill.) fosberg): beetroot (*beta vulgaris*) blended jelly. M.Sc. (Phm) Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli Maharashtra, India, 2016.
13. Granulado Bioclástico, Rodrigo Amato Moreira, José Darlan Ramos, Neimar Arcanjo De Araújo, Virna Braga Marques. Produção e qualidade de frutos de pitaia vermelha com adubação orgânicae granulado bioclástico. Revista Brasileira de Fruticultura, Jaboticabal, E: 2012, 762-766.
14. Gunasena HPM, Pushpakurama DKHG, Kariyawasan M. Dragon Fruit (*Hylocereus undatus)* (Haw) Britt and Rose. Field manual for extension workers. Sri Lanka Council for Agricultural Policy, Wijerama Mawatha, Rokiah, R. Asmah Colombo 7, Sri Lanka. 2006, 23-27.
15. Islam MZ, Khan MTH, Hoque MM, Rahman MM. Studies on the processing and preservation of dragon fruit (*Hylocereus undatus*) jelly. The Agriculturists. 2012; 10(2):29-35.
16. Kanjana MJ, John AM, Grayh STT, Kevin G, Elizabeth AB. Total Antioxidant Activity and Fiber Content of Select Florida-Grown Tropical Fruits. Agricularal and food chemistry. 2006; 54:7355-7363.
17. Kotecha PM, Kadam SS. Processing of tamarind into value added products. Beverage Food World. 2002; 29(10):11-12.
18. Kuchi VS, Gupta R, Tamang S. Standardization of recipe for preparation of guava jelly bar. Journal of Crop and Weed. 2014; 10(2):77-81.
19. Kumar A, Deen B. Studies on preparation and storage of jelly from wood apple (*Limonia acidissima* L.) fruits Journal of Pharmacognosy and Phytochemistry. 2017; 6(6):224-229
20. Lane JH, Eynon L. Determination of reducing sugars by means of Fehling's solution with methylene blue as an indicator. Journal of Society of Chemistry, India. 1923; 42:32-37.
21. Luders L, Mcmahon G. The pitaya or dragon fruit (*Hylocereus undatus*). Agnote 778. No: D42. Department of Primary Industry, Fisheries and Mines, Northern Territory Government, Australia, 2006.
22. Muhammad A, Durrani Y, Zeb A, Ayub M, Ullah J. Developments of diet jam from apple grown in swat (NWFP). Agric. 2008; 24(3):461-467
23. Nurliyana R, Syed Zahir I, Mustapha Suleiman K, Aisyah MR, Kamarul Rahim K. Antioxidant study of pulps and peels of dragon fruits: a comparative study. International Food Research Journal. 2010; 17:367-375.
24. Paul SE, Chakrabarty S, Jana SC, Hasan MA, Mandal KK, Sarkar S. A multivariate approach to study the sensory parameters of guava jelly on the basis of physicochemical parameters of guava fruit. Acta Horticulture. 2007; 735:561-568.
25. Ranganna S. Handbook of analysis and quality control for fruit and Vegtable products. Mcgraw-Hill Tata pub. Co. Ltd., New Delhi. 1986, (7-12):109.
26. Ranganna S. Handbook of Analysis and Quality Control for Fruit and Vegetable Products, (Tata McGraw–Hill Education Pvt. Ltd.), New Delhi, 2010
27. Ranganna S. Handbook of analysis and quality control of fruit and vegetable products. 2nd Ed. Tata Mc Graw Hill Publishing Company Limited, New Delhi, 2009.
28. Rangswamy R. A Text Book of Agricultural Statistics, second edition and new age international publishers, 2010, 224-458.
29. Raut PS. Studies on preparation of pomegranate (punica granatum): sapota (manilkara achras (mill.) fosberg) blended jelly. M.Sc. (Phm). Thesis, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli Maharashtra, India, 2015.
30. Relekar PP, Naik AG, Padhiar BV. Qualitative changes in value added products of sapota cv kalipatti during storage. Indian Journal of Horticulture. 2011; 68(3):431-418.
31. Rui H, Zhang L, Zuowei L, Pan Y. Extraction and characteristics of seed kernel oil from white pitaya, J. Food Eng. 2009; 93:482-486.
32. Sharma RK, Thakur M, Raut G, Deshmukh VM. Studies on compositional profile of dragon fruit (*Hylocereus undatus*) and its utilization in manufacturing of jelly. An International Refereed, Peer Reviewed & Indexed

Quarterly Journal in Science, Agriculture & Engineering. 2017; 5(19):259-262

33. Singh J, Chandra S. Preparation and evaluation of guava-carrot jelly. International Journal of Food and Fermentation Technology. 2012; 2(2):197-200.
34. Singh S. Studies on suitability of cultivars and dates of picking of berries for preparation of imitation cherry and jelly from karonda (*carissa carandas* l.) fruits. Ph.D. Thesis, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar -263 145 (Udham Singh Nagar), Uttarakhand, India, 2010.
35. Stintzing FC, Schieber A, carle R. Evaluation of colour properties and chemical quality parameters of cactus juices. European Food Research Technology. 2003; 216:303-311.
36. Tripathi PC, Sankar GKV, Senthil kumar R. Central Horticultural Experiment Station. Chettalli- 571 248, Kodagu, Karnataka, 2014. E-mail: cheschettalli@yahoo.co.in
37. Vaillant F, Le Bellec F, Imbert E. Pitahaya (*Hylocereus spp*.): A new fruit crop, a market with a future, Fruits 2006; 61:37-250.
38. Vargas MDLV, Cortez JAT, Duch ES, Lizama AP, Méndez CHH. Extraction and stability of anthocyanins present in the skin of the dragon fruit (Hylocereus undatus). Food and Nutrition Sciences. 2013; 4(12):1221.
39. Wichienchot S, Jatupornpipat M, Rastall RA. Oligosaccharides of pitaya (dragon fruit) flesh and their prebiotic properties, Food Chem. 2010; 120:850-857.
40. Yong AC. The Effect of hot water treatment, different packaging methods and storage temperature on shelf life of dragon fruit (*Hylocereus polyrhizus*) by Department of Agro technology. Faculty of Agro technology and Food Science Universities Malaysia Terengganu, 2009.