PHYSICOCHEMICAL CHARACTERISTICS AND OVERALL ACCEPTABILITY OF JAM FROM *PSIDIUM GUAJAVA* BLENDED WITH *RHODODENDRON ARBOREUM* FLOWER

[1]Divya Rawat, [2]Neelam Chaturvedi
[1]Research Scholar, [2]Associate Professor
Department of Food Science and Nutrition
Banasthali Vidyapith, Dist-Tonk (Raj.) 304022- India

***Abstract*:** The present study was carried out with the objective of determination of physico-chemical and overall acceptability of jam prepared from *Psidium guajava* pulp blended with *Rhododendron arborerum* flower stored for 180 days at ambient and refrigeration temperature. The jam was prepared in different ratio i.e. 100:0 (TPg), 80:20(TPgR$_1$) and 70:30(TPgR$_2$). The physico-chemical parameters such as total soluble solids, titrable acidity, pH, reducing sugars and total sugars were analysed as per standard procedures and overall acceptability was carried out by 9-point hedonic scale through semi trained panel members. Results indicated that the decrease was observed in pH (3.49±0.22 to 3.33±0.62) while increase was noted in TSS (63.27±1.02 to 69.74±0.24), Titrable acidity (0.78±0.04 to 0.98±0.62), Reducing sugars (22.46±1.04 to 28.21±0.26), Total sugars(64.36±0.68 to 70.12±0.46) for all the treatments (TPg, TPgR$_1$, TPgR$_2$) during 180 days of storage. The change in values of all physico-chemical parameters were higher in ambient temperature when compared to refrigeration temperature.Among all the jam treatments, the highest score for overall acceptability was assessed in the treatment TPgR$_2$(8.7±0.29) kept at refrigeration temperature for 180 daysand showed insignificant difference at $p \leq 0.05$ level when compared to initial day of storage. Treatment TPg (8.0±0.32) scored least mean value and showed significant difference at $p \leq 0.05$ level when compared to initial day of storage.The study demonstrated that refrigeration storage temperature is superior to ambient storage temperature for maintenance of product quality in humid region. Thus blending of *Psidium guajava* pulp and *Rhododendron arboreum* flower offers great scope to develop healthy blended jam with improved overall acceptability.

***Index Terms*: *Psidium guajava, Rhododendron arboreum,* physico-chemical characteristics, overall acceptability.**

I. INTRODUCTION

India is bestowed with varied agro-climatic conditions, so it can produce a wide variety of fruits and vegetables. It is the second largest producer of fruits after China sharing 13.28% production in world. India's production of fruits stands at 64 million tonnes, making up for around 12% of fruits production of world. The major fruits grown in India include mango, banana, papaya, orange, mosumbi, guava, apple, pineapple, sapota, ber, pomegranate, strawberry, litchi etc (Bairwa et al, 2012). Fruits produced during a particular season results in a glut in the market and become scarce during other seasons (Wu et al, 2005). It is estimated that about 20-25% of the harvested fruits are decayed by pathogens during post-harvest handling due to inadequate storage and transportation facilities (Al-Hindi et al, 2011). Realizing the importance of fruit, as a cheap, highly nutritious foodstuff, it is deemed necessary to make preserved products from fruit for human consumption. This opens up the avenues for development of other value added preserves viz jams, jellies, marmalade, nectar, cordial, squash, candy etc that can be stored for longer period.

Psidium guajava (Guava) is a delicious fruit of the family Myrtaceae. It is a popular fruit of the Asian subcontinent known as "Apple of Tropics" and locally called as Amrud, Peru, Piyara, Koyya, Sede, Pandu etc (Zamir et al, 2007). It is widely grown all over the tropics and subtropics regions of India viz, Uttar Pradesh, Bihar, Madhya Pradesh, Maharashtra, Andra Pradesh, Tamilnadu, West Bengal, Assam, Orissa, Karnataka, Kerala, Rajasthan and many more states (Imtiyaz and Soni, 2013). Main cultivars of *Psidium guajava* are Allahabad Safeda, Lucknow - 49, Chittidar, Nagpur Seedless, Bangalore, Dharwar, AkraMridula, Arka Amulya, Harijha, Allahabad Surkha, CISHG -1, CISHG - 2, CISHG -3 etc (Kadam et al, 2012). It is a rich source of ascorbic acid, pectin, minerals such as calcium, phosphorus and iron as well as vitamins like niacin, thiamine and riboflavin (Bal et al, 2014). It has various pharmacological activities such as anti-septic, anti-inflammatory, anti-allergic, anti-carcinogenic, anti-diarrhoeal, anti-diabetes and anti-hypertensive (Barbalho et al, 2012).

Rhododendron arboreum is an evergreen shrub or small tree belongs to the family Ericaceae. In India, it is the state flower of Nagaland and state tree of Sikkim (Paul et al, 2005). It is commonly known as Burans, Bras, Buras or Barahke-phool' in local dialect. It includes 1200 species distributed throughout Northeast Asia and Eurasia, Western Europe and North America. *Rhododendrons* cover a vast section of South East Asia, comprising north-western Himalaya through Nepal, Sikkim, eastern Tibet, Bhutan, Arunachal Pradesh, western and central China, Japan, Myanmar, Thailand, Malaysia, Indonesia, Philippines and New Guinea (Sekar and Srivastava, 2010).The genus *Rhododendron* has long been regarded as a rich source of secondary metabolites such as phenols, flavonoids, alkaloids, steroids, glycosides, tannins, saponins, terpenoids and resins (Lal et al, 2017). The flower of *Rhododendron arboreum* exhibits many medicinal and aromatic properties such as anti-inflammatory, anti-nociceptive activity, hepatoprotective activity, anti-diabetic, anti-diarrhoeal Srivastava, (2012), anti-spasmodic, anti-microbial, anti-carcinogenic, anti-bronchitic, anti-ulcerogenic, anti-plasmodic, anti-ageing, anti-leukemic, anti-cancer, anti-dermatitic properties (Gautam et al, 2016).

In light of the above, the present study was taken up to develop jam from *Psidium guajava* blended with *R.arboreum* flower and to determine the effect of storage conditions (ambient and refrigeration) on physico-chemical characteristics and overall acceptability.

II. MATERIALS AND METHODS

2.1 Preparation of raw materials:

Psidium guajava near Banasthali Vidyapith and *Rhododendron arborerum* flower was collected from High Altitude Plant Physiology Research Center (HAPPRC), Hemwati Nandan Bahugana Garhwal University (HNBGU), Srinagar (Garhwal). The ripened *Psidium guajava* fruits and *Rhododendron* flowers were thoroughly washed to remove any adhering dust and dirt. The samples were identified and authenticated by Horticulturist, Rajasthan Agriculture Research Institute (RARI), Jaipur.

2.2 Development of fruit jam:

Psidium guajava fruit was processed into jams according to the Food and Agriculture Organization's guidelines with slight modifications. Fruits were washed in water and after removing their skin; they were cut or sliced in small pieces. These pieces were boiled with water and appropriate quantity of sugar was mixed with the pulp along with *R. arboreum* flower juice. The end point was established based on the final TSS of the jam i.e. 65-68º brix as measured using digital refractometer. When the temperature is around 60°C; citric acid was added. This mixture was then stirred for a while, cooled and then packed in bottles. Three treatment of jam were developed by varying the ratio of *Psidium guajava* pulp to *R. arboreum* juice (TPg;100%, $TPgR_1$;80:20, $TPgR_2$;70:30).

Psidiumguajava (Guava)
↓
Washing, peeling and slicing of fruits
↓
Pulping (remove seed and core)
↓ Addition of *Rhododendron arboreum* juice
Addition of sugar
↓
Boiling (with continuous stirring)
↓
Judging the end point by further cooking up to
105 °C or 65-68% TSS or by sheet test
↓
Removal of scum
↓
Filling hot in to sterilized bottles
↓
Cooling

↓
Waxing
↓
Capping
↓
Storage (Ambient and Refrigeration temperature)

Figure 1: Schematic diagram of the general process for the production of fruit leather

2.3Physico-chemical analysis

The jam treatments were assessed for various physico-chemical characteristics as per the standard method suggested by (Ranganna, 2001).

Total soluble solids:

TSS content was determined using a hand refractometer and the results were expressed as °Brix.

Titrable acidity:

Titrable acidity (TA) was determined by titration of a known quantity of sample (10 mL) against 0.1 N sodium hydroxide using 1% phenolphthalein solution as an indicator to a persisting fade pink end point. The results were expressed as percent anhydrous citric acid.

$$\text{Titrable acidity }(\%) = \frac{\text{Titer X Eqivalent weight of acid X 100}}{\text{Volume of sample taken X 1000}}$$

pH:

pH was determined using a digital glass electrode pH meter at room temperature, which was calibrated prior to sample pH measurement using buffer solution .

Estimation of reducing sugars:

The quantification of reducing sugars in the samples was carried out using Lane &Eynon method. Five grams of sample were placed in a measuring cylinder, to which 100 mL distilled water was added and stirred thoroughly. The samples wereneutralized with 1 N NaOH with a phenolphthalein indicator. It was followed by addition of 5 mL of 45% lead acetate and 5 mL of 22% potassium oxalate after 10 min. The final volume of 250 mL (using distilled water) was filteredand marked as solution “A”. It was used to titratethe Fehling’s solution on hot plate until brick red color was observed. After the addition of 5–7 drops of methylene blue, the same was again titrated to permanent brick red color.

$$\text{Reducing sugars}(\%) = \frac{\text{Factor} \times \text{Volume made up}}{\text{Titer} \times \text{Volume of sample taken}} \times 100$$

Estimation of total sugars:

A measured aliquot (100 mL) of the filtrate used for the estimation of reducing sugars was hydrolysed by 10 mL of 50% hydrochloric acid for 24 h at room temperature. After neutralization with 40% sodium hydroxide using phenolphthalein indicator, the volume was made upto 250 mL and titrated against Fehling’s solution.

$$\text{Total sugars}(\%) = \frac{\text{Factor} \times \text{Volume made up}}{\text{Titer} \times \text{Weight of sample taken}} \times 100$$

Overall acceptabilityappraisal:

The overall acceptability appraisal was done on the basis of9-point hedonic scale (9 = like extremely to 1 = dislike extremely) through communicative and descriptive panelof 30 judges from the department of Food Science and Nutrition, Banasthali Vidyapith, Rajasthan. Coded samples were presented to the judges in separate chambers to get unbiased judgments. Plain water was given to rinse their mouth in between the evaluation of samples.

Statistical analysis:

The overall acceptability data was analysed using SPSS version 16. One way ANOVA was conducted to determine significance difference in the mean values at $p \leq 0.05$ level.

III. RESULTS AND DISCUSSION

Table 1: Effect of Storage and Temperature on Total Soluble Solids (°Brix) of Jam Treatments

Storage period	Jam(Treatments)		
	Tpg	TPgR$_1$	TPgR$_2$
Initial day	63.27±1.02	65.40±2.01	65.36±1.04
AT$_1$	66.36±0.04	67.42±1.08	68.18±1.22

RT_1	65.12±0.08	66.51±0.04	66.17±1.62
AT_2	68.81±1.08a	69.36±1.06	69.74±0.24
RT_2	66.72±1.05a	67.81±1.05	67.62±0.16

Values are means of triplicate determination± SD.
TPg-*Psidium guajava*(100%),TPgR_1– *Psidium guajava* + *Rhododendron arboreum* (80:20), TPgR_2-*Psidium guajava* + *Rhododendron arboreum* (70:30), AT_1 and AT_2 = 90 days and 180 days at ambient temperature, RT_1 and RT_2= 90 days and 180 days at refrigeration temperature

The TSS is primarily represented by sugars, acids and minerals. According to the Codex Alimentarius standard, normal fruit conserves or preserves must contain P ≥ 60% soluble solids. The mean values of all the treatments were higher due to the addition of sugar. Data regarding changes in Total Soluble Solids (TSS) of the jam treatments revealed that there was a gradual increase throughout the storage period in all the treatments from initial day to 180 days of storage as depicted in Table 1. The TSS content for different treatment of Jam varied with temperature and storage period. At initial day, maximum TSS content was recorded in treatment TPgR_1 (65.40±2.01) while minimum mean score was recorded in TPg (63.27±1.02). The TSS content of all the jam treatment was different at ambient and refrigeration temperature. The TSS content was increased in all the treatment TPg(68.81±1.08), TPgR_1(69.36±1.06), TPgR_2 (69.74±0.24) stored under ambient temperature when compared to refrigeration temperature TPg (66.72±1.05), TPgR_1(67.81±1.05), TPgR_2(67.62±0.16), respectively for 180 days of storage.The TSS values reported by Ferreira et al, (2004) for quince jams which ranged between 59.2-75.1°Brix which was parallel to the present data.Increasing trend in TSS content during storage corroborate with the investigations on blending ratios of papaya and guava pulp by Jain et al, (2011) and guava jelly bar by Kuchi et al, (2014). However, the rate of increase in TSS content was relatively slower due to refrigerated storage of all treatments. The increase in TSS may be due to acid hydrolysis of polysaccharides especially pectin and gums along with solubilization of jam ingredients or components throughout storage (Kanwal et al, 2017).

Table 2. Effect of Storage and Temperature on Titrable Acidity (%) of Jam Treatments

Storage period	Jam (Treatments)		
	Tpg	TPgR_1	TPgR_2
Initial day	0.78±0.04	0.80±1.06	0.85±1.08
AT_1	0.82±0.12	0.87±1.02	0.89±1.02
RT_1	0.79±1.06	0.81±0.01	0.86±0.83
AT_2	0.91±0.06	0.95±0.24	0.98±0.62
RT_2	0.79±0.13	0.81±0.42	0.86±0.12

Values are means of triplicate determination± SD.
TPg-*Psidium guajava* (100%), TPgR_1- *Psidium guajava* + *Rhododendron arboreum* (80:20), TPgR_2-*Psidium guajava* + *Rhododendron arboreum* (70:30), AT_1andAT_2 = 90 days and 180 days at ambient temperature, RT_1 and RT_2= 90 days and 180 days at refrigeration temperature

Titrable Acidity (TA) is one of the parameter which affects product quality; to a large extent, acidity protects against the development of microorganisms (Touati et al, 2014). It was observed from Table 2 that the physicochemical parameter TA of all the jam treatment gradually increased during 180 days of storage. The TA content for different treatment of Jam varied with temperature and storage period. At initial day, maximum TA content was recorded in treatment TPgR2 (0.85±1.08) while minimum mean score was recorded in TPg (0.78±0.04). The TA content was increased in all the treatment TPg(0.91±0.06), TPgR_1 (0.95±0.24) and TPgR_2 (0.98±0.62) stored under ambient temperature when compared to refrigeration temperature TPg (0.79±0.13), TPgR_1 (0.81±0.42) and TPgR_2 (0.86±0.12) respectively for 180 days of storage.The reason for high acidity in TPgR_2 (0.98±0.62) on 180 days of storage was their lower pH value as it possessed an inverse relation i.e., increase in value of one factor, decreases the value of other factor automatically. Titrable acidity of the entire treatments showed increasing trend with the passage of storage. These results are in agreement with results reported by Sakhale et al, (2012) with whey based mango RTS and for sapota-papaya bar, reported increased acidity with increase in storage period in the products.The increase in acidity may be due to acid formation, degradation of polysaccharides and oxidation of reducing sugars or by break down of pectin into pectenic acid (Sreemanthi et al, 2008).

Table 3: Effect of Storage and Temperature on pH (%) of Jam Treatments

Storage period	Jam(Treatments)		
	Tpg	$TPgR_1$	$TPgR_2$
Initial day	3.49±0.22	3.46±0.64	3.44±0.22
AT_1	3.46±0.41	3.44±0.06	3.41±0.24
RT_1	3.48±0.52	3.46±0.01	3.44±0.04
AT_2	3.37±0.42	3.34±0.42	3.33±0.62
RT_2	3.40±0.62	3.44±0.22	3.43±0.42

Values are means of triplicate determination± SD.

TPg-*Psidium guajava* (100%), $TPgR_1$– *Psidium guajava +Rhododendron arboreum* (80:20), $TPgR_2$-*Psidium guajava + Rhododendron arboreum* (70:30), AT_1 and AT_2 = 90 days and 180 days at ambient temperature, RT_1 and RT_2= 90 days and 180 days at refrigeration temperature

The pH value of a product plays an important role in the preservation (Kanwal et al, 2017). As regards, pH of different treatment kept in different storage condition, a decreasing trend was observed during the storage period.At initial day, maximum pH was recorded in treatment TPg (3.49±0.22) while minimum mean score was recorded in $TPgR_2$ (3.44±0.22). The pH was increased in all the treatment TPg (3.37±0.42), $TPgR_1$ (3.34±0.42), $TPgR_2$ (3.33±0.62) stored under ambient temperature when compared to refrigeration temperature TPg (3.40±0.62), $TPgR_1$ (3.44±0.22), $TPgR_2$ (3.43±0.42) respectively for 180 days of storage.Similar results were reported by Hussain and Shakir, (2010) who found that the pH of apricot and apple jam had gradual decrease at 60 days of storage. Muhammad et al, (2008) also observed a decrease in pH of apple jam during 90 days storage. The reduction of pH values could be due to formation of hydroxyl methyl furfural (HMF) by hydration of sugar during processing and storage which lead to conversion of HMF into levulinic and formic acids (Rababah et al, 2010).

Table 4. Effect of Storage and Temperature on Reducing Sugars (%) of Jam Treatments

Storage period	Jam(Treatments)		
	Tpg	$TPgR_1$	$TPgR_2$
Initial day	22.46±1.04	24.28±1.41	24.62±0.28
AT_1	24.36±0.06	26.81±0.05	26.91±1.02
RT_1	22.50±1.06	25.61±0.02	25.75±0.44
AT_2	26.22±1.02	28.16±0.08	28.21±0.26
RT_2	23.12±1.42	25.17±1.04	26.26±0.21

Values are means of triplicate determination± SD.

TPg-*Psidium guajava* (100%), $TPgR_1$-*Psidium guajava + Rhododendron arboreum* (80:20), $TPgR_2$-*Psidium guajava + Rhododendron arboreum* (70:30), AT_1 and AT_2 = 90 days and 180 days at ambient temperature, RT_1 and RT_2= 90 days and 180 days at refrigeration temperature

Data with respect to reducing sugar at initial, 90 and 180 days of storage are presented in Table 4. There was slight increase in reducing sugar continuously with progress in storage from initial day of storage to 180 days of storage in all the treatments. At initial day, maximum reducing sugar content was recorded in treatment $TPgR_2$ (24.62±0.28) while minimum mean score was recorded in TPg (22.46±1.04). The reducing sugar content was increased in all the treatment TPg (26.22±1.02), $TPgR_1$ (28.16±0.08), $TPgR_2$ (28.21±0.26) stored under ambient temperature when compared to refrigeration temperature TPg (23.12±1.42), $TPgR_1$ (25.17±1.04), $TPgR_2$ (26.26±0.21) respectively for 180 days of storage.Comparable trend of increase in reducing sugars during storage has been recorded by Parab et al, (2014) in mango bar. Likewise, increased reducing sugar with increased storage time was observed for a cucumber–melon functional drink (Kausar et al, 2012) and bottle gourd–basil leave juice (Majumdar et al, 2011) during 6 months of storage. The increase in reducing sugars during storage might be due to inversion of non-reducing sugars to reducing sugars and conversion of polysaccharides to monosaccharide (Sharma et al, 2013).

Table 5. Effect of Storage and Temperature on Total Sugars (%) of Jam Treatments

Storage period	Jam(Treatments)		
	Tpg	$TPgR_1$	$TPgR_2$
Initial day	64.36±0.68	66.42±0.61	67.82±0.42
AT_1	66.12±0.42	67.12±0.82	68.36±0.64
RT_1	64.81±0.61	66.71±0.48	67.92±0.22
AT_2	67.56±0.28	68.26±0.62	70.12±0.46
RT_2	65.18±0.42	67.19±0.28	68.32±0.41

Values are means of triplicate determination± SD.

TPg-*Psidium guajava* (100%), $TPgR_1$-*Psidium guajava* +*Rhododendron arboreum* (80:20), $TPgR_2$-*Psidium guajava* + *Rhododendron arboreum* (70:30), AT_1 and AT_2 = 90 days and 180 days at ambient temperature, RT_1 and RT_2= 90 days and 180 days at refrigeration temperature

Data pertaining to total sugar of jam during storage reveals that there was a gradual increase throughout the storage period in all the jam treatments and data are presented in Table-5. At initial day, maximum total sugar content was recorded in treatment $TPgR_2$ (67.82±0.42) while minimum mean score was recorded in TPg (64.36±0.68). The total sugar content increased in all the treatment TPg (67.56±0.28), $TPgR_1$ (68.26±0.62) and $TPgR_2$ (70.12±0.46) stored under ambient temperature when compared to refrigeration temperature TPg (65.18±0.42), $TPgR_1$ (67.19±0.28) and $TPgR_2$ (68.32±0.41) respectively for 180 days of storage. Total sugar content was increased in both the conditions with increase in storage period but the increase was more pronounced under ambient temperature compared to refrigeration temperature. The results found are in agreement with findings of Sandhu et al, (2001) who showed that there was increase in TSS content of guava leather when stored for 3 months. The increase in total sugars might be due to inversion of non-reducing sugars during storage (Safdar et al, 2014).

From the results of the study, it could be accomplished that, both storage temperature and period play a significant role in maintaining product shelf life. However, storage temperature had more influence than storage period. Also, this study validated that refrigeration storage temperature is superior to ambient storage temperature for maintenance of product quality in humid regions.

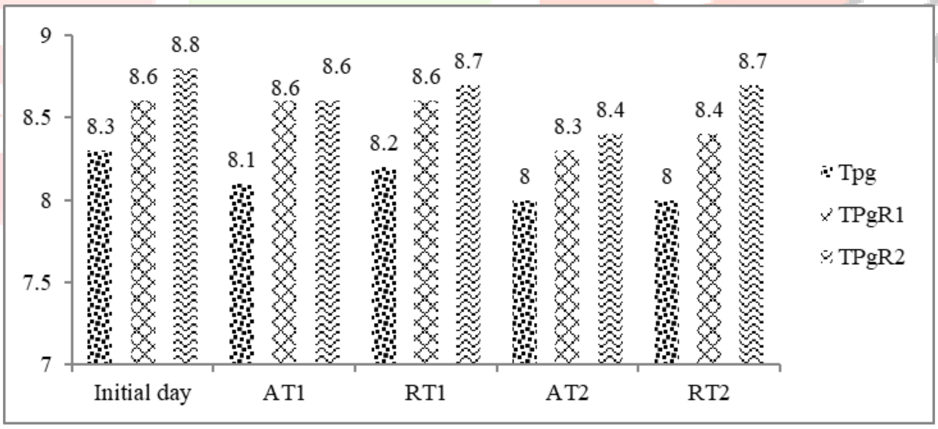

Figure 1: Effect on Overall Acceptability of Jam Prepared from *Psidiumguajava*and *Rhododendron arboreum*

TPg–*Psidium guajava* (100%), $TPgR_1$-*Psidium guajava* + *Rhododendron arboreum* (80:20), $TPgR_2$-*Psidium guajava* + *Rhododendron arboreum* (70:30), AT_1 and AT_2 = 90 days and 180 days at ambient temperature, RT_1 and RT_2= 90 days and 180 days at refrigeration temperature

The overall acceptability of jam treatments of *Psidium guajava* blended with *Rhododendron arboreum* is presented in Fig. 1.The result obtained showed that initially all the treatments tasted good, later on decrease in overall acceptability was observed with the advancement of storage period which was mainly due to absence of taste and flavor. At initial day, maximum mean score was recorded in treatment $TPgR_2$ (8.8±0.24), while minimum mean score was recorded in TPg (8.3±0.25).The mean scores of all the jam treatments were different at ambient and refrigeration temperature. The overall acceptability score showed decline in all the treatment TPg (8±0.22), $TPgR_1$(8.3±0.26) and $TPgR_2$ (8.4±0.21) stored under ambient temperature while highest mean score for overall acceptability was found in treatment TPg (8.0±0.32), $TPgR_1$ (8.4±0.21) and $TPgR_2$ (8.7±0.29) at refrigeration temperature for 180 days of storage because it possessed attractive texture, flavour and taste. Both treatments viz $TPgR_1$ and $TPgR_2$ showed insignificant difference at $p \leq 0.05$ level when compared to initial day while significant difference was recorded in treatment TPg at refrigeration temperature for 180 days.The overall acceptability of products showed decreasing trend more in ambient temperature than refrigeration.Possible explanation for good acceptability of blended jam with *Rhododendron arboreum* when kept in refrigerated storage might be due to the fact that the low temperature and high relative humidity did not cause any change in qualitative characters and palatability of stored products and helped in maintaining overall acceptability.

According to Kumar et al, (2017), there was a gradual decrease in overall acceptability score in papaya and guava fruit bar with the advancement of storage period. Similarly, Balaswamy et al, (2011) studied storage stability of sour grape blended with phalsa beverage who reported that initially all the treatments scored good and decline in overall acceptability mean scores was observed with storage time. Bhatt et al, (2017) study showed that over all acceptability score of sugar and honey based *Rhododendron* squash, decreased with advancement of storage period under both ambient and refrigeration storage conditions.The gradual decrease in overall acceptability score during storage might be due to change in composition of the product.

IV. CONCLUSION

Indigenous fruits form a significant part of the diet and livelihoods of most rural people. In our country, processing and utilization of indigenous fruits at both household and commercial levels has been very limited. There are numerous ways of consuming and processing indigenous fruits at household and industry level. The study concluded that the physico-chemical analysis were within the standard limits of Codex Alimentarius in different treatments of guava jam and overall acceptability ensured a potential consumption of jam with addition of 20 and 30 % *R. arboreum*, which obtained highest scores. Hence, it is clear that the combination of *P. guajava* and *R. arboreum* was suitable for the preparation of jam having good keeping quality and high acceptability value.

REFERENCES

1. Al-Hindi, RR. Al-Najada, AR. and Mohamed, SA. 2011. Isolation and identification of some fruit spoilage fungi: screening of plant cell wall degrading enzymes. African Journal of Microbiology Research, 5(4): 443-448.
2. Bairwa, KC. Sharma, R. and Kumar, T. 2012. Economics of growth and instability: Fruit crops of India. Rajasthan Journal of Extension Education, 20(3): 128-132.
3. Bal, LM. Ahmad, T. Senapati, AK. and Pandit, PS. 2014. Evaluation of quality attributes during storage of guava nectar cv. lalit from different pulp and TSS ratio. Journal of Food Processing and Technology, 5(329):2-5.
4. Balaswamy, K. Prabhakara, PG. Nagender, A. and Akula, S. 2011. Preparation of sour grape (*Vitis vinifera*) beverages and evaluation of their storage stability. Journal of Food Process Technology, 2(3): 104-105.
5. Barbalho, SM. Farinazzi-Machado, FM. Goulart, R. Brunnati, AC. Otoboni, AM. and Ottoboni, B. 2012. *Psidium guajava* (Guava): A plant of multipurpose medicinal applications. Medical and Aromatic Plants, 1(104): 2-6.
6. Bhatt, M. Abrol, GS. Kumar, S. and Nautiyal, BP. 2017. Preparation and evaluation of functionally enriched squash from *Rhododendron* (*Rhododendron arboreum* Sm.) flowers. International Journal of Food and Fermentation Technology, 7(1): 191-196.
7. Ferreira, IM. Pestana, N. Alves, MR. Mota, FJ. Reu, C. Cunha, S. and Oliveira, MB. 2004. Quince jam quality: Microbiological, physicochemical and sensory evaluation. Food Control, 15(4): 291-295.
8. Gautam V, Sharma A, Arora S, and Bhardwaj R. 2016. Bioactive compounds in the different extracts of flowers of *Rhododendron arboreum*. Journal of Chemical and Pharmaceutical Research, 8(5): 439-444.
9. Hussain, I. and Shakir, I. 2010. Chemical and organoleptic characteristics of jam prepared from indigenous varities of apricot and apple. World Journal of Dairy and Food Sciences, 5(1): 73-78.
10. Imtiyaz, H. and Soni, P. 2013. Supply chain analysis of fresh guava (A case study). International Journal of Management and Business Research, 3(4): 373-382.
11. Jain, PK. Jain, P. and Nema, PK. 2011. Quality of guava and papaya fruit pulp as influenced by blending ratio and storage period. American Journal of Food Technology, 6(6):507-512.
12. Kadam, DM. Kaushik, P. and Kumar, R. 2012. Evaluation of guava products quality. International Journal of Food Science and Nutrition Engineering, 2(1): 7-11.
13. Kanwal, N. Randhawa, MA. and Iqbal, Z. 2017. Influence of processing methods and storage on physico-chemical and antioxidant properties of guava jam. International Food Research Journal, 24(5): 2017-2027.

14. Kausar, H. Saeed, S. Mushtaq, AM. and Salam, A. 2012. Studies on the development and storage stability of cucumber-melon functional drink. Journal of Agricultural Research, 50(2):239-248.
15. Kuchi, VS. Gupta, R. and Tamang, S. 2014. Standardization of recipe for preparation of guava jelly bar. Journal of Crop and Weed, 10(2):77-81.
16. Kumar, AL. Madhumathi, C. Sadarunnisa, S. and Latha, P. 2017. Quality evaluation and storage study of papaya guava fruit bar. Journal of Pharmacognosy and Phytochemistry, 6(4): 2082-2087.
17. Lal, K. Ahuja, V. and Rajeshwer, and AK. 2017. *In Vitro* study of antimicrobial activity of *Rhododendron arboreum* plant extract on selected pathogenic bacterial isolates. Life Sciences International Research Journal, 4(1): 64-67.
18. Majumdar, TK. Wadikar, DD. Vasudish, CR. Premavalli, KS. and Bawa, AS. 2011. Effect of storage on physico-chemical, microbiological and sensory quality of bottlegourd-basil leaves juice. American Journal of Food Technology, 6(3):226-234.
19. Muhammad, A. Durrani, Y. Zeb, A. Ayub, M. and Ullah, J. 2008. Development of diet jam from apple grown in swat (NWFP). Sarhad Journal of Agriculture, 24(3): 461-467.
20. Parab, AY. Relekar, PP. and Pujari, KH. 2014. Studies on preparation of mango (*Mangifera indica* L.) bar from frozen Alphonso mango pulp. Asian Journal of Horticulture, 9(1):243-247.
21. Paul, A. Khan, ML. Arunachalam, A. and Arunachalam, K. 2005. Biodiversity and conservation of *Rhododendrons* in Arunachal Pradesh in the Indo-Burma biodiversity hotspot. Current Science, 89(4): 623-634.
22. Rababah, TM. Al-Mahasneh, MA. Kilani, I. Yang, W. Alhamad, MN. Ereifej, K. and Al-udatt, M. 2011. Effect of jam processing and storage on total phenolics, antioxidant activity, and anthocyanins of different fruits. Journal of the Science of Food and Agriculture, 91(6): 1096-1099.
23. Ranganna S. 2001. Handbook of analysis and quality control for fruit and vegetable products. 5th ed. Tata McGraw-Hill Publications, New Delhi: 719-724.
24. Safdar, MN. Mumtaz, A. Amjad, M. Siddiqui, N. Raza, S. and Saddozai, AA. 2014. Quality of guava leather as influenced by storage period and packing materials. Sarhad Journal of Agriculture, 30(2): 247-256.
25. Sakhale, BK. Pawar, VN. and Ranveer, RC. 2012. Studies on the development and storage of Whey based RTS beverage from Mango cv. Kesar. Journal of Food Processing and Technology, 3(3): 148-150.
26. Sandhu, KS. Singh, M. and Ahluwalia, P. 2001. Studies on processing of guava into pulp and guava Leather. Journal of Food Science and Technology, 38(6): 622-624.
27. Sekar, KC. and Srivastava, SK. 2010. Rhododendrons in Indian Himalayan region: Diversity and conservation. American Journal of Plant Sciences, 1(02): 131-137.
28. Sharma, SK. Chaudhary, SP. Rao, VK. Yadav, VK. and Bisht, TS. 2013. Standardization of technology for preparation and storage of wild apricot fruit bar. Journal of Food Science and Technology, 50(4): 784-790.
29. Sreemathi, M. Sankaranarayanan, R. and Balasubramanyan, S. 2008. Sapota-Papaya bar. Madras Agricultural Journal, 95(6): 170-173.
30. Srivastava P. 2012.*Rhododendron arboreum*: An overview. Journal of Applied Pharmaceutical Science, 02(01): 158-162.
31. Touati, N. Tarazona-Diaz, MP. Aguayo, E. and Louaileche, H. 2014. Effect of storage time and temperature on the physicochemical and sensory characteristics of commercial apricot jam. Food Chemistry, 145(2): 23-27.
32. Wu, J. Wan, Z. Yi, J. Wu, Y. Peng, W. and Wu, J. 2013. Investigation of the extracts from *Bidens pilosa* Linn. var. radiata Sch. Bip. for antioxidant activities and cytotoxicity against human tumor cells. Journal of Natural Medicines, 67(1): 17-26.
33. Zamir, R. Ali, N. Shah, ST. Muhammad, T. and Shah, SA. 2007. *In-vitro* regeneration of Guava (*Psidium guajava* L.) from shoot tips of mature trees. Pakistan Journal of Botany, 39(7): 2395-2398.