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DEVELOPMENT, STANDARDIZATION AND SHELF LIFE STUDIES OF FIG SYRUP UNDER AMBIENT STORAGE CONDITIONS

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Abstract

Fruits and vegetables are important constituents of the diet and provide significant qualities of nutrients, especially vitamins, sugars, minerals, and fibers. Daily consumption of fruits and vegetables reduce the degenerative diseases. The perishable nature of the fruits and vegetables require immediate processing to avoid post-harvest losses (20-25 %).Figs can be eaten fresh, dried, or canned and are often used in preparation of jam. As a fresh fruit, it has a luscious taste. Fig is a highly nutritious fruit rich in calories, proteins, and calcium (higher than milk), iron and highest fiber content.The present study was aimed to prepare fig syrup and to notice the different quality evaluation characteristics like physical, chemical, sensory, nutritional, and microbiological studies during the different interval periods at ambient storage conditions. The results show the composition with 25% of fig pulp and 65% of sugar and citric acid was acceptable by the panelist using five points hedonic rating scale method.The developed fig syrup has significant difference ($P<0.05$) in moisture content,P^H, total soluble solids,total sugars, reducing sugar, carbohydrate, calcium, vitaminC,total plate count and yeast and mould count,but no significant difference ($P>0.05$) on titratableacidity, proteinbetween 0th, 30th, and 60th day of storage periods. Fig syrup is richer in iron and calcium content than most other fresh fruits as well as dry fruits and vegetables. Both fresh and dry fig fruits contain appreciable quantities of vitamin A, C and smaller quantities of B and D.Fig syrup can be replaced with white sugar and can be used for hot and cold beverages.

Keywords:-fig syrup, post-harvest losses, quality parameters, vitamin C, beverages

Introduction

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Fig (Ficuscarica L) Family Morraceae is under cultivation since ancient times. Fig is indigenous to Persia, Asia Minor, and Syria, but now it is cultivated on large scale in most of the Mediterranean countries. Remnants of fig have been found in excavations of sites traced to at least 5000 B.C. (Oztekin, 2006). It is not only ancient fruit but also a nutritive and has an account of 711 cultivars of fig(Kohinkar and Condit, 2014). Fig is now cultivated chiefly in the Mediterranean regions from Turkey to Spain and Portugal. In India its cultivation is mostly confined to western part of Maharashtra, Gujarat, Uttar Pradesh, Punjab, Anantapur, and Tamilnadu. The total area under fig in world is estimated about 6, 58,120 ha (Nagpal, 1966). According to FAQ production yearbook (1988) the world production totals to about 10, 93,000 tons. The total area in India under fig cultivation is about 1000 ha out of about 400ha in Maharashtra, which further increased to 883ha with the production of 2,650 metric tons (Oztekin, 2006). The Turkish union exports about 5000 tones fresh fig fruits annually to Europe and Arab countries compared with about 33,000 tones dried figs (Viduad, 1996). In recent years, India exported about 633 MT figs. The importance of this fruit as food can hardly be over emphasized that the total mineral content is two to four times that of other fresh fruits. Fig is richer in iron and copper content than most other fresh fruits as well as dry fruits and vegetables. Both fresh and dry fig fruits contain appreciable quantities of vitamin A, C and smaller quantities of B and D. The nutritive index of fig is reported as high as 11 as compared to 9 of apple, 8 of raisin,6 of dates and pears.According to Hummer (2012) Fig is a highly nutritious fruit. It is rich in calories (269), Protein and calcium (higher than milk) and highest fiber content.

Materials and methods

Procurement of raw materials

The basic ingredients required for the development of fig syrup were fig and sugar. These are procured from the local super market of Tirupati.

Preparation of syrup

Selected fig fruits were washed and peeling of the fruit is done. After peeling, the fruits are cut into slices. Add the equal amount of water to weight of the pulp. Heat the pulp at 80˚C for 10-15 min. Extract the juice by double folded muslin cloth. Separate the clear juice. Mix the juice with

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sugar syrup and add citric acid. Fill the product in pre-sterilized bottles. Store the product at room temperature.

Preparation of fig syrup

Selection of ripe fig fruits

Washing of fruits

Peeling of fruit

Cutting them into slices

Heat at 80ºc for 10-15 minutes

Mixing in mixer for homogenization

Extraction of juice by two-fold muslin cloth

Separation of clear juice

Mixing juice with sugar syrup and adding 1% citric acid

Filling the product in pre-sterilized bottles

Capping

Storage of the product at room temperature

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FIG: 1 FLOW CHART FOR THE PREPARATION OF FIG SYRUP

Results and discussion:-

Yield of the Fig fruit juice:-

Table No 1: yield of fig juice from the fruit

S.no	Particulars	Fig
1	Total initial weight(g)	2000g
2	After peeling and cutting (g)	1500g
3	Addition of water	750 ml
4.	After boiling	1250ml
5.	Filtering of juice	250 ml
6.	Yield o fig juice(g)	1000ml

The data from table no 1 reveals the total weight of fig taken for extracting juice is 2000g. After peeling and cutting 1500g of fruit is obtained. To 1500 g of fruit 750 ml of water is added and it is boiled to extract juice. The obtained 1250 ml of juice is filtered to remove the seed and fiber content. Finally, 1000ml of fig juice is obtained after processing of fig fruit.

Standardization of ingredients:

The formulated product has been standardized by repeated trials in the laboratory and by checking the organoleptic characteristics through semi trained panel members. Development of Fig syrup was made with different proportions of pulp and sugar. Various trials were worked out to developed fig syrup.In the first trial i.e. the fig syrup was developed with the ratio of ingredients mixed in the proportion of 50% fig juice and 50% sugar syrup. In the second trial i.e. the fig syrup was developed with the ratio of ingredients mixed in the proportion of 35% fig juice and 55 % sugar syrup. In the third trial i.e. the fig syrup was developed with the ratio of ingredients mixed in the proportion of 25% fig juice and 65 % sugar syrup. The prepared fig syrup trials were subjected to the sensory evaluation. The third trial which was scored the maximum score through sensory evaluation was considered as the standard sample. The developed fig syrup composition is 25 % juice and 65% sugar in fruit syrup is followed from the Reference (B. Sri Lakshmi 2018).

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Table no;-2 Composition of different ingredients (g) for fig syrup

S. No	Ingredients	Trial 1	Trial 2	Trial 3
1	Fig	50ml	35ml	25ml
2	Sugar	50ml	55ml	65ml

Sensory evaluation:

The quality parameters such as appearance, color, taste, flavor and overall acceptability was evaluated by panel of judges on a five-point hedonic rating scale method. Sensory evaluation techniques have been used to assess the progress of the product development in the food industry for many years. Sensory evaluation can also be used to determine whether additions of certain ingredients affect the flavor of a product. The standardized fig syrup product was developed through the acceptability, which was evaluated by the sensory evaluation techniques with the selected panel members.

Selection of panel members:

The first requirement for the sensory evaluation was a reliable and capable group of panel members. In the present study sensory evaluation was carried out by PG students with age group (21-24 years) as panel members for sensory evaluation. Care was taken that the panel members were available throughout the experimental period and they did not have any dislikes towards the product and suffer from ill health.

Evaluation of product by panel judges:

For each trial the product was subjected to sensory evaluation to the panel members by giving instructions before evaluation. The score cards were given separately for each trial. Five-point hedonic rating scale was chosen to test acceptability of the product. Hedonic rating scale was the test where judges express their evaluation according to the scores given for each sensory attributes on the score card provided. Separate column was given to write the remarks, based on that modifications were made in the product.

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Sensory attributes

In appearance there is a significant difference ($p \leq 0.05$) between 30th day and 60th day of storage periods. Similar observation was reported in lemon juice (Fitchettet al 2013), guava pulp mixed fruit beverages (Raut, et al, 2017)

In Flavor and taste there is no significant difference ($p \geq 0.05$) in all the storage days. Similar observation was reported by in strawberry RTS beverage (Malav et al .2014), Similarly in texture there is no significant difference ($p \geq 0.05$) between all the storage interval periods. The decrease in texture score of storage has been reported for Anola Juice by (Patidar et al,2010) and in Ber candy (Kumar et al, 2017). The results obtained are in coincidence with the fig syrup.

Finally in point of overall acceptability there is a significant difference ($p \leq 0.05$) between 0th day and 30th day. There is no significant difference ($p \geq 0.05$) between 0th and 60th day of storage periods. There was a significant difference ($p \leq 0.05$) between 30th day and 60th storage periods.

Kumar et al, (2017) reported that the RTS prepared by 100% custard apple pulp was scored that highest organoleptic score. Totad et al. (2014) reported that, sapota blended with jack fruit and avocado syrup was found to be acceptable with good organoleptic score for appearance, taste, and overall acceptability.

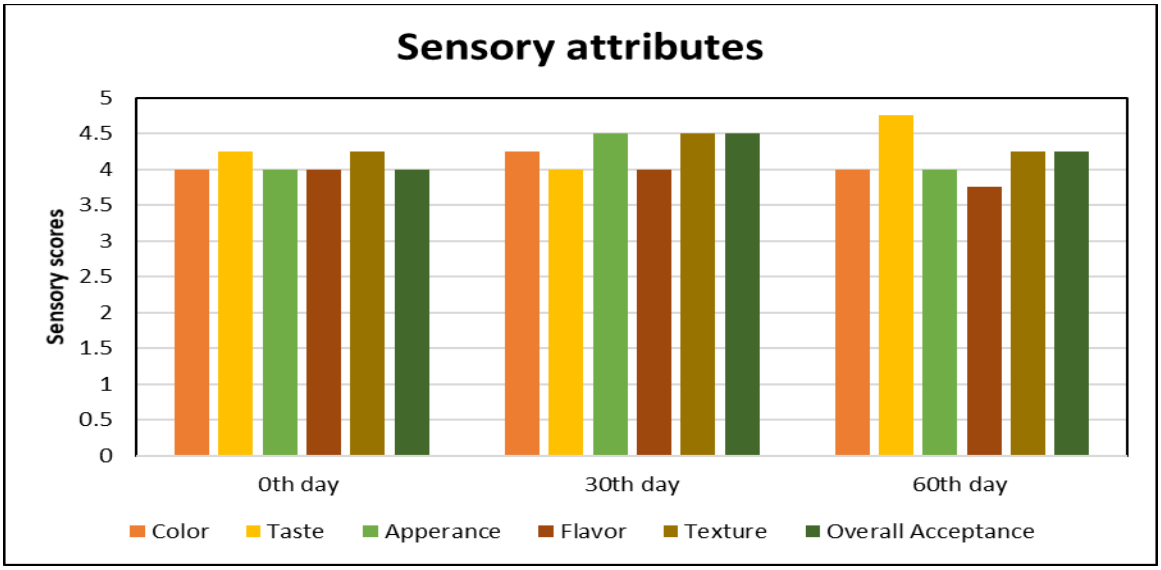

Fig no 2: Diagrammatic representation of the mean scores obtained for different organoleptic attributes of Fig syrup at different storage periods.

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Nutritive value for standardized product

The nutritive value of Fig syrup is calculated and all the specific nutrients (proximate analysis) like, Carbohydrates, Energy,Protein, Fat, Fiber, Iron, and are importance are mentioned below.

Table no 3: Nutrient composition for the standardized product

S. No	Nutrient	Amount
1	Energy	267.95 K. Cal
2	Carbohydrate	66.51g
3	Protein	0.097
4	Fat	0.05g
5	Fiber	0.55g
6	Iron	0.35mg

Physical and chemical analysis:-

Moisture content:-

Determination of moisture content also is necessary to calculate the content of other food constituents on a uniform basis (i.e., dry weight basis). The mean ± standard deviation for moisture content in fig syrup on initial day was recorded as 27.70±0.20. The mean ± standard deviation for moisture content on 30th day and 60th day storage period was 26.12 ± 0.20 and 24.90 ± 0.20 respectively. There is a significant difference ($P<0.05$) in moisture content between 0th, 30th, and 60th day of storage period. There is a significant difference ($P <0.05$) in moisture content between the 30th, and 60th day of storage period.

P^H:-

P^H is the most common of all analytical measurements in industrial processing and since it is a direct measure of acid content [H+], it clearly plays an important role in food processing. The mean ± standard deviation for P^H in fig syrup on initial day was recorded as 3.66±0.20. Similarly, the mean ± standard deviation for P^H content on 30th day and 60th day storage period was 2.55± 0.20 and 2.10 ± 0.20 respectively. There was significant difference ($P<0.05$) in P^H between 0th, 30th, and 60th day of storage period. There was no significant difference ($P >0.05$) in P^H between the 30th, and 60th day of storage period.

TSS:-

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Total soluble solids content of a solution is determined by the index of refraction. The mean ± standard deviation for total soluble solids in fig syrup on initial day was recorded as 68.00±0.20. Similarly, the mean ± standard deviation for total soluble solids on 30th day and 60th day storage period was 70.25±0.20 and 72.12±0.20 respectively. There was significant difference (P<0.05) in total soluble solids between 0th, 30th, and 60th days of storage period. There was a significant difference (P <0.05) is noticed in total soluble solids between the 30th, and 60th day of storage period.

Titratable acidity:-

Titratable acidity is determined by neutralizing the acid present in a known quantity (weight or volume) of food sample using a standard base. The mean ± standard deviation for Titratable acidity in fig syrup on initial day was recorded as 0.92±0.20. Similarly, the mean ± standard deviation for Titratable acidity on 30th day and 60th day storage period was 0.90 ± 0.20 and 0.89 ± 0.20 respectively. There was no significant difference (P >0.05) in Titratable acidity between 0th, 30th, and 60th day of storage period.

Total sugars:-

Total sugars are mono- and disaccharides present in food, derived from any source. The mean ± standard deviation for Total sugars in fig syrup on initial day was recorded as 66.41±0.20. Similarly, the mean ± standard deviation for total sugar content on 30th day and 60th day storage period was 51.12 ± 0.20 and 35.80 ± 0.20 respectively. From day 30 the total sugars start decreased and continued till the end of the storage period. There was significant difference (P<0.05) in total sugars between 0th, 30th, and 60th days of storage period. There was a significant difference (P <0.05) is noticed in total sugars between the 30th, and 60th day of storage period.

Reducing sugar:-

Reducing sugar is a sugar that is capable of acting as a reducing agent because it has a free aldehyde group or a free ketone group. The mean ± standard deviation for reducing sugar in fig syrup on initial day was recorded as 59.06±0.20. Similarly, the mean ± standard deviation for reducing sugar content on 30th day and 60th day storage period was 46.75 ± 0.20 and 29.40 ± 0.20 respectively. From day 30 the reducing sugar starts decreased and continued till the end of

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the storage period. There was significant difference (P<0.05) in reducing sugar between 0th, 30th, and 60th day of storage period. There was a significant difference (P <0.05) is noticed in reducing sugar between the 30th, and 60th day of storage period.

Table no: -4 ANOVA forPhysical and Chemical analysis of Fig syrup at different storage periods.

S.no	Parameters	0^{th} day Mean ± S.D.	30^{th} day Mean ± S.D.	60^{th} day Mean ± S.D.	TOTAL Mean ± S.D.
1.	Moisture	27.70 ± 0.20^{a}	26.12 ± 0.20^{bA}	24.90 ± 0.20^{cB}	26.24 ± 1.22
2.	P^{H}	3.66 ± 0.20^{a}	2.55 ± 0.20^{bA}	2.10 ± 0.20^{cA}	2.77 ± 0.71
3.	TSS	68.00 ± 0.20^{a}	70.25 ± 0.20^{bA}	72.12 ± 0.20^{cB}	70.12±1.79
4.	Titratable acidity	0.92 ± 0.20^{a}	0.90 ± 0.20^{a}	0.89 ± 0.20^{a}	0.90 ± 0.173
5.	Total sugar	66.41 ± 0.20^{a}	51.12 ± 0.20^{bA}	35.80 ± 0.20^{cB}	51.11±13.25
6.	Reducing sugar	59.06 ± 0.20^{a}	46.75 ± 0.20^{bA}	29.40 ± 0.20^{cB}	45.07 ± 1.90

Nutrient analysis:-

All the nutrients play a major factor for determining the shelf life of the product. Food energy is defined as the energy released from carbohydrates, fats, proteins, and other organic compounds. The mean ± standard deviation for energy in fig syrup on initial day was recorded as 267.95±0.20. The mean ± standard deviation for energy on 30th day and 60th day storage period was 268.34± 0.20 and 269.01 ± 0.20 respectively. There was significant difference (P<0.05) in energy between initial and 60th day of storage period. Similarly, there was significant difference (P<0.05) in energy between 30th, and 60th day of storage period.

The mean ± standard deviation for carbohydrate in fig syrup on initial day was recorded as 66.51±0.20. Similarly, the mean ± standard deviation for carbohydrate on 30th day and 60th day storage period was 65.20± 0.20 and 65.00 ± 0.20 respectively. There was a significant difference (P<0.05) in carbohydrate between 0th, 30th, and 60th day of storage period. Similarly, there was

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no significant difference (P >0.05) in carbohydrate between the 30th, and 60th day of storage period.

Proteins in foods can form complexes with other food components, including polyphenols, which lead to vital changes in their structural, functional, and nutritional properties. The mean ± standard deviation for protein in fig syrup on initial day was recorded as 0.09±0.20. Similarly, the mean ± standard deviation for protein on 30th day and 60th day storage period was 0.07± 0.20 and 0.05 ± 0.20 respectively. There was no significant difference (P >0.05) in protein between the 0th day, 30th, and 60th day of storage period. The similar observations were observed by (Egbekun,1996) in black plum syrup with low protein content.

The mean ± standard deviation for calcium in fig syrup on initial day was recorded as 13.00±0.20. Similarly, the mean ± standard deviation for calcium on 30th day and 60th day storage period was 11.20±0.20 and 8.87±0.20. There was a significant difference (P<0.05) in calcium between 0th, 30th, and 60th day of storage period. Similarly, a significant difference (p< 0.05) was noticed between 30th day and 60th day of storage period.

Vitamin-C also known as ascorbic acid is a solid soluble in water which is acidic in nature. The mean ± standard deviation for vitamin C in fig syrup on initial day was recorded as 147.86±0.23. Similarly, the mean ± standard deviation for vitamin C on 30th day and 60th day storage period was 107.00±0.20 and 37.76±0.20 respectively. There was significant difference (P<0.05) in vitamin C between 0th, 30th, and 60th day of storage period. Similarly, significant difference (p< 0.05) was noticed between 30th day and 60th day of storage period.

Table no: -5ANOVA forNutritional analysis of Fig syrup at different storage periods.

S.no	**Parameters**	**0^{th} day Mean ± S.D.**	**30^{th} day Mean ± S.D.**	**60^{th} day Mean ± S.D.**	**TOTAL Mean ± S.D.**
1	Energy	267.95 ± 0.20^{a}	268.34 ± 0.20^{aA}	269.01 ± 0.20^{bB}	268.43 ± 0.49
2	Carbohydrates	66.51 ± 0.20^{a}	65.20 ± 0.20^{bA}	65.00 ± 0.20^{cA}	65.57 ± 0.73
3	Protein	0.09 ± 0.20^{a}	0.07 ± 0.20^{a}	0.05 ± 0.20^{a}	0.07 ± 0.174
4	Vitamin –C	147.86 ± 0.23^{a}	107.00 ± 0.20^{bA}	37.76 ± 0.20^{cB}	147.86 ± 0.23^{a}
5	Calcium	13.00 ± 0.20^{a}	11.20 ± 0.20^{bA}	8.87 ± 0.20^{cB}	11.02 ± 1.80

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Microbial analysis:-

Microbial estimation of food may provide information concerning the quality of the food material. The total plate count was nil at initial storage period. The mean ± standard deviation for total plate count on 30th and 60th day was 4.00±0.20 and 102.00 ±0.20. There was a significance difference ($p \leq 0.05$) in TPC between 30th and 60th day of storage period.

The yeast and mould count were nil at initial storage period. The mean ± standard deviation for yeast and mould count on 30th and 60th day was 6.00±0.20 and 64.00 ±0.20. There was a significance difference ($p \leq 0.05$) in Y&MC between 30th and 60th day of storage period. The results of shelf life studies showed that fig syrup does not have microbial contamination. In the brands tested, mould count and yeast and spores count were not more than 10 cfu (colony forming unit) per gram. The count did not exceed the levels throughout the storage period and it is considered acceptable during shelf life period.

Table no: -6ANOVA forMicrobial analysis of Fig syrup at different storage periods

S.no	**Parameters**	**0^{th} day** **Mean ± S.D.**	**30^{th} day** **Mean ± S.D.**	**60^{th} day** **Mean ± S.D.**	**TOTAL** **Mean ± S.D.**
1	Aerobic plate count	0.00 ± 0.00	4.00 ±0.20^{a}	102.00 ±0.20^{b}	46.66 ± 67.02
2	Yeast and mould	0.00 ± 0.00	6.00 ± 0.20^{a}	64.00 ± 0.20^{b}	23.33 ± 30.61

Conclusion

From the present investigation, it could be concluded that fig syrup was found to be organoleptic ally acceptable not only at the time of preparation but also throughout the storage period of three months at room temperature. It is concluded that the best quality of fig syrup can be prepared by 25% of pulp and 65% of sugar and citric acid. The samples are stored at room temperature. The developed fig syrup can be consumed by all age group, it can be replaced with white sugar and can be used for hot and cold beverages. Fig syrup is richer in iron and calcium content than most

other fresh fruits as well as dry fruits and vegetables. Both fresh and dry fig fruits contain appreciable quantities of vitamin A, C and smaller quantities of B and D. Fig is valued for its laxative properties and is used in treatment of skin infection. The fruit helps to maintain acid alkali balance of the body. The fruit syrups becoming a bit of a trend for rich flavor used for dishes baked good and even beverages. Syrups are easy to use as sweetener for hot or cold beverages. In summer fruit syrups are amazing for making tasty mocktails or for sweetening homemade lemonade or iced tea as they are liquid and dissolve much better than granulated sugar.

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