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Physico-Chemical Analysis of Different Jams and Marmalade Prepared at Ari (Tarnab) Peshawar

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Abstract

Jams are made from fruit and sugar mixed in proportion so that the final product contains a minimum fruit content of 35% and 60° Brix minimum. The research work was on physico-chemical analysis and storage stability of different fruit jams and marmalade stored at ambient temperature. The research was conducted at ARI, Tarnab, Peshawar in the lab of Food technology section. The aim of the study was to study the physico-chemical characteristics and the effect of storage stability of different fruit jams and marmalade stored at at room temperature (18□ to 25□). All the samples to, which represents (apple jam), T1 which represents (guvava jam), T2 which represents (mixed fruit jam) while T3 which represents (citrus marmalade) were stored in sterilized glass jars and evaluation was carried out for total period of 60 days. Physico-chemical analysis; pH, TSS, acidity, moisture and sensory characteristics of color, taste, texture and overall acceptability (using Larmond scale) were evaluated at 15 days intervals. The results indicated that there was significant increase (P<0.05) in TSS of To (59.3° brix-62.7° brix), T1 (62.5° brix- 63.7° brix), T2 (63.4° brix-66.6° brix), T3 (59.4° brix-63.2° brix), acidity of To (0.66-0.82), T1 (0.69-0.78), T2 (0.68-0.76), and T3 (0.86-1.35). While, significant decrease (P<0.05) were examined in pH of To (3.36-3.22), T1(3.26-2.98), T2 (3.27-3.14), and T3 (3.17-2.76). The moisture content of To (36.8%-35.3%), T1 (37.57%-35.76%), T2 (37.32%-34.8%), and T3 (39.2%-35.3%) was observed, whereas colour value of To (8-7), T1 (7-7),T2 (9-6), and T3 (8-8), taste value of To (7-7), T1(8-6), T2 (9-8), and T3 (8-6), texture value of To (8-7), T1 (7-6), T2 (8-7.5), and T3 (8-6.5), and overall acceptability value of To (8-7), T1 (8-5), T2 (9-8), and T3 (8-5) were noticed. Statistical results concluded that the treatment T2 (mixed fruit jam) was found most acceptable in terms of physico-chemical and organoleptically as compared to To, T1 and T3. This study demonstrated that refrigeration storage was the best method to preserve the jam sample as compared to ambient storage temprature for the maintenance of product quality of different jams and marmalede.

Keywords

Jam; Storage; Physiochemical analysis; Organoleptic analysis

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Introduction

Jam is semi-solid mass, which attained from cooking fruit pulp and sugar followed by acid pectin, flavors and coloring substances. Jams contain about 68.5% total soluble substances and 45% at least fruit pulp, while the Codex revealed that jam should contain more than 65% total soluble solids in finished product. Jam, jellies and marmalade is one simple fruit product prepared from fruit individually or combination of different fruit.

Jam is prepared from cooked fruit or vegetable pulps after removal of stones and seeds. Good jam has a soft even consistency without distinct pieces of fruit, bright colour, good fruit flavor and semi-jellied texture that is easy to spread but has no free liquid. Jam is a fruit preserved with a stable shelf-life and that depends on high sugar content combined with the fruit acidity and prevented microbial invasion and growth. A good jam is a complex product that requires precise balance between sugar level, acidity and pectin content of fruit boiled together to produce a gel on cooling.

Pectin is a heteropolysaccharide found in the primary cell walls of many plants. It is a white to light brown powder, mainly extracted from citrus fruits, and is used as a gelling agent particularly in jams and jellies, and used also in medicines, sweets, as a stabilizer in fruit juices and milk drinks. Pectin always added in jam making for gelling purpose in proper pH and sugar, thus help in facilitating the establishment of pectin-pectin linkages. The desired texture of fruit jam can be achieved through utilizing a proper balance of sugar and pectin concentration and adjustment of pH, whereby pectin sets best at pH 3.2.

Acid performs a variety of functions in jam processing, the primary being acidifier, pH regulator, and preservatives [1].

Jams are product with high consumer acceptance. France has the largest jam production and intake in the world. In 2016, about 4 thousand tons were produced and 3.36 billion were consumed. Other countries stand out in the production of jam includes Turkey, Spain, Chile, India, China, the United States, and Brazil. In Brazil, jam production reached 15.5 million tons in 2017 (Table 1).

Table 1: Nutritional composition of jam.

Nutritional value per 100 gm		Daily value	
Calories	278 kcal	Vitamin A	0%
Total carbohydrates	69 g	Vitamin C	14%
Dietry fiber	1.1 g	Vitamin B-6	0%
Sugar	49 g	Calcium	2%
Protein	0.4 g	Iron	2%
Sodium	32 mg	Magnesium	1%
Potasium	77 mg	Total fat	0.1 g 0 %

Marmalade is "a mixture, brought to a suitable gelled consistency, of water, sugars and fruit pulp, fruit purée, fruit juice, fruit peel or aqueous extract of fruit or any combination thereof, in every case obtained from citrus fruit, such that the quantity of citrus fruit used for every 1000 grams of the finished product is not less than 200 grams, of which not less than 75 grams is obtained from the endocarp" [2].

Marmalade is prepared from the citrus fruits like lemons, limes, grapefruits, mandarins, sweet oranges, bitter oranges and other citrus fruits, or any combination of them. But we prepared the innovative marmalade which includes the main ingredients rose petals, orange and its peel.

CODEX and PSQAC Standard for Marmalade

PH range (2.6–3.5)

TSS (60° brix-65° brix): Physicochemical analysis is the method of investigating the physicochemical system that makes it possible to determine the nature of the interaction between component of the system through a study of the relation between physical properties and composition. The physicochemical analysis involves in the measurement of jams and marmalades of several physical properties system which include pH, TSS, consistency, water content, moisture content, reducing sugar and ash content.

ARI (Agriculture Research Institute): Tarnab is situated 15 kilometers toward east from Peshawar city on the main gate trunk road. It was established in (1908) by British government which was further extended to the entire province over the formation and establishment of new research institution. About 15 research institute or research station is working and functioning under the supervision of ARI tarnab. The agriculture station tarnab has been the fountain head of agriculture development in the province. During 109 years it has a significance contribution to the economic prosperity of the farming community, high yield of fruits and vegetables, argonomic technique and plant protection [3].

Among all of these section, Food Technology (FT) is well developed and advanced section, working to determine and check the quality assurance of food and food products, some of the food products are also manufactured at FT section such as jams, squashes, jelly, vinegar, pickles, honey and many other food items which properly packed and provide all of the to the consumer. Most of the student are performing their research or internship from ARI tarnab for the completion of its graduate or post graduate degree [4-5].

Research Objectives

(a) To assess the physicochemical characteristics of jam and marmalades.

(b) To evaluate the changes occurred during the storage of these foods commodity.

Review of Literature

A group of scientists evaluated the effect of storage and treatment on overall quality of the apple olive blended jam, and to develop a suitable combination of olive and apple fruits pulps for jam preparation. Statistically it is concluded that storage and treatment has significant effect on the quality and stability of the apple olive blended jam. Jam prepared from various blends of apple and olive were studied for physico chemical properties such as percent acidity, pH, TSS, non-reducing and reducing sugar and for sensory attributes namely, taste, texture, color and overall acceptability during three months of storage with an interval of fifteen days. Results indicated that titratable acidity was increased from 0.64% to 0.77%, with reduction in pH from 3.57 to 3.40. Non reducing sugar was decreased from 44.57% to 27.52%. On the other hand reducing sugar of all jam samples increased from 16.62% to 30.52%. TSS of jam samples was increased during storage from 69.37° Brix to 70.43° Brix.

The physico-chemical properties (moisture, water activity, pH, acidity, ash, reducing sugar) using the chemical method and the values were found in average amount of jam, honey and jelly. The mean value of moisture in jam was found to be T1 (46.78), T2 (40.02) and T3 (25.00) and the mean value indicate that sample T1 has highest moisture value (46.78) followed by the sample T2 (40.02) and the lowest value was obtained by sample T3 (25.00). The mean value of water activity in Jam was found to be T1 (0.69), T2 (0.77) and T3 (0.85) and the mean value indicate that sample T3 has highest water activity value (0.85) followed by the sample T2 (0.77) and the lowest value was obtained by sample T1 (0.69).

The effect of individual (aspartame, cyclamate and saccharine) and mix non-nutritive sweeteners on apple jam was investigated. All the samples were analyzed physio chemically (pH, %acidity, TSS and moisture) and organoleptic ally (color, texture, overall acceptability) fortnightly during 3 months of storage. A decrease was recorded in moisture content (82.43% to 71.71%), pH (4.34 to 3.01) while an increase was recorded in acidity (0.26% to 0.59%), TSS (59.2 brix to 63.4 brix). Sample T4 and T6 Apple jam were found most acceptable to the panel of judges during storage.

A comparative study was carried out on apple jam. All the jam samples were stored in sterilized glass jars and evaluated physio chemically for acidity, pH and TSS for an interval of 15 days during 3 months storage period. All the samples were significantly different at ($P<0.05$) during storage. A decreased was observed in pH 3.64 to 3.22. While increased was noted in % acidity from 0.60 to 0.78 and TSS 68.5 brix to 71.2 brix evaluation.

A group of investigators has reported that the development of marmalade from rose petals, orange juice and orange peels. These three were the main ingredients used in marmalade. Among different concentrations there were three samples taken for sensory analysis, in which sample A contains all the ingredients of recipe but it has 98.8% of orange juice in it which is more than other two samples, sample B contains all the ingredients and the addition of pineapple pulp 15.1%, in sample C the ingredients were the same just the addition of lemon juice 6% is taken. In the result of sensory analysis it is seen that marmalade prepared by blending 98.8% orange juice and 12.1% rose petals, 1.4% orange peels is more acceptable compared to other two samples prepared. In the result of chemical analysis, it is seen that marmalade contains total sugar 64.1%, protein 0.26%, ash0.28%, vitamin C 21.12 mg and crude fiber 3.15%. The utilization of by products such as orange peels in the preparation of marmalade is issue of innovativeness. Food containing phytoconstituents can provide many health benefits as well as such helping to maintain weight and lowering your risk of diabetes, cancer and heart disease.

The effect of storage stability of guava fruit jam when stored at ambient temperature was reported. All the treatments were studied physico-chemically and sensor ally for 90 days with 15 days" interval. The increased was observed in TSS of guava fruits jam from, % acidity and reducing sugars. It was found from statistical analysis that the value of non-reducing sugar of the jam reduced considerably ($p<0.05$) during 90 days of storage interval. While decreased was observed in pH (3.61 to 3.44), non-reducing sugars (42.9% to 23.45%), Ascorbic acid (92.8 mg/100 g to 71.52 mg/100 g), color score (7.1 to 4.31), taste score (7.60 to 4.71), texture score (7.21 to 4.41) and acceptability score (7.51 to 4.65). The mean sensory scores for texture of the jam

decreased significantly ($p<0.05$) on both treatments and storage intervals. The pH value decrease significantly, the high acidity of fruit jam might be due to the hydrolysis of starch to acid. Storage intervals and treatments significantly ($p<0.05$) affect the color of guava jam during storage interval. Further studies need to be done to study the effect of storage on jam preservation and quality effects [7].

A research was conducted to investigate the influence of different processing methods and ingredient mixing techniques to judge storage stability and consumer acceptability of guava jam. The results indicated that pH, water activity, color, firmness, ascorbic acid, non-reducing sugars, total phenolic contents, antioxidant activity and overall acceptability (sensory evaluation) showed a decreasing trend during storage. Opposite is the case with acidity, total soluble solids, total sugars as well as reducing sugars. Sensory analysis indicated that the order of preference for guava jam treatments was T4>T3>T2>T1. There was no significant effect of adding sugar and pectin in dry form or by making their pre solution for all the studied traits except for sensory parameters [8].

A comparative study was carried out on mixed fruit jam of (apple + pear) pulp, incorporated within the ratios 50:50 (T), 60:40 (T), 40:60 (T), 100% apple (T) and 100% pear (T). All the jam samples were 1,2,3,4,5 stored in sterilized glass jars and evaluated physicochemically for ascorbic acid, acidity, pH, total soluble solids, reducing sugars and non-reducing sugars for an interval of 15 days during 3 months storage period. All the samples were significantly different at ($p<0.05$) during storage. A decrease was observed in ascorbic acid from 17.40 mg/100 g to9.19 mg/100 g, pH 3.64 to 3.22 and non-reducing sugars 46.00% to 16.69%. While increase was noted in % acidity from 0.60% to 0.78%, reducing sugars 16.55% to 47.30% and TSS 68.5º brix to 71.2º brix during evaluation.

The influence of the desamerization of the mesocarpe on chemical composition and the sensorial quality of the jam, based on the bitter orange. The results of the various analysis show that desamerization decreases acidity, sugars, protein, and bioactive compound levels (carotenoids, polyphenols, and vitamin C), but desamerized jams still remain an important source of antioxidant compounds with antioxidant potential in the diet. Concerning the sensory analysis of the jams, the results show that the jam desamerized with water presents the same bitterness as the bitter jam and that the salt significantly reduces the bitterness of the jams. The hedonic analysis shows that the tasters preferred significantly the DJ NaCl 0.625% to all the other samples [9].

Jam was prepared from watermelon rind with different flavors (vanilla, pineapple, strawberry, lemon and no flavour). Five different samples were prepared at various compositions T1 (50-50), T2 (80-20), T3 (60-40), T4 (40-60) and T5 (20-80) of rind and sugar. T1 (50-50) gave the best jam set. Ten man panel (trained) evaluated the jam for its sensory characteristics and physicochemical analysis. Sensory evaluation conducted among five flavours was significantly different at ($p>0.05$). Chemical analysis showed that ascorbic acid reduced greatly among all treatments during three month storage. Soluble sugar and pH also decreased gradually for T1 (from 4.96 to 4.40), T2 (from 4.92 to 4.21), T3 (from 4.74 to 4.11), T4 (from 4.62 to 4.51) and T5 (from 4.52 to 4.25) upon storage. Strawberry flavored jam was most acceptable by the panel.

A group of researchers determined tropical fruits such as mango, cashew apple, pineapple, guava, lemon, and sour-sop were processed and their pectin strength evaluated. These processed fruit samples were used in the production of jams and marmalades to study the physicochemical and sensory qualities of the products to ascertain their suitability and acceptability. The result showed that Lemon (L) have high pectin strength, Mango (M) and Guava (G) have medium while Pineapple (P), Cashew Apple (CA) and Sour-Sop (SS) have weak pectin strength. The proximate result revealed that moisture content of the jam samples ranged from 23.29%-45.21% for PJ and GJ, ash 0.19 MJ-0.82% SSJ, protein 0.20 PJ-0.73% SSJ, crude fat 0.02 LJ-0.44% CAJ and carbohydrate 53.64%-74.87% for samples GJ and PJ, respectively. Results for the proximate analysis of marmalades showed that moisture content ranged from 24.92%-49.02%, ash 0.24%-0.62%, protein 0.28%-0.86%, fat 0.08%-0.22%, and carbohydrate 50.03%-74.19%. Physical properties of the jam samples were 0.36 pa.S-2.57pa.S for viscosity, 2.30-2.75 for pH, sugar 52.80%-721% and total titratable acidity 2.60%-4.63% while that of marmalade samples were 0.17 pa.S-2.21pa.S for viscosity, pH 2.40-2.95, sugar 44.00° Brix-68.20° Brix and total titratable acidity 1.83%-3.54%. The results for sensory scores of the fruit jams showed that all the samples were acceptable by the consumers [10].

Materials and Methods

The research was conducted in the laboratory of the section of food science and technology, Agriculture Research Institute (ARI) Tarnab, Peshawar.

Preparation of samples

Different ratios of artificial sweeteners were calculated for jam preparation according to the formula of (Awan and Rehman 1999). The jam was prepared in open stainless steel kettles. The fruit pulp was taken in an open kettle for each treatment and heated. At the same time commercial grade pectin with small amount were dissolved separately and added to the mixture in kettle. Preservatives and color was added at the end of cooking.

Preparation of the samples

These samples were analyzed for physiochemical and organoleptically. The analysis was carried out at the laboratory of the food science and technology section of ARI (Agriculture Research Institute) Tarnab, Peshawar at 15 days intervals for a total period of 60 days.

Proposed plan of study

Comparative study of ARI (Agriculture Institute Peshawar, Tarnab) different jams was at 15 days interval for a total period of 60 days. These sample were named To, which represent (apple jam) T1, which represent (guvava jam) T2, which represent mix fruit jam) while T3, represent (citrius marmalade).

Physiochemical

Analysis total soluble solids: To determine total soluble solids digital refrectrometre was used and was examined by standard method of AOAC (2012), method 932.14 and 932.12. The instrument was calibrated and put a minute quantity of jam sample in dry prism. Instruments were fixed and readings were taken accurately (Figure 1).

Figure 1: Digital refractometer.

Figure 2: pH meter.

Titratable acidity

To examine percent acidity standard method of AOAC (2012), 942.15 was applied.

Preparation of standard solution 0.1 NaOH: In distilled water 6.30 g of oxalic acid was taken in volumetric flask and volume was made up to 1 liter. 4.5 g of NaOH pellets was taken in 1000 ml of distilled water. In flask 10 ml of 0.1N solution of NaOH was taken. It was titrated against 10 ml of 0.1N solution of oxalic acid. Phenolphthalein was used as an indicator and the readings were recorded when pink colour appears. For one minute the color was persists.

Titration of sample

In volumetric flask 10 g of sample was taken in 100 ml distilled water. In burette 0.1 N NaOH solutions was filled. In flask 10 ml of sample was taken and titrate it against 0.1 N NaOH solution. 2 to 3 drops of phenolphthalein as an indicator was dropped in flask. Readings were noted when pink colour appears. The formula is used.

$$\text{Acidity } (\%) = \frac{\text{C.F} \times \text{N} \times \text{T} \times \text{D} \times 100}{\text{V} \times \text{S}}$$

Whereas follows

C.F = Correction Factor

N=Normality of sodium hydroxide

T=ml of sodium hydroxide used

D=Dilution Factor

V=Sample taken for dilution

S=Sample taken for titration

pH

pH is determined for the concentration of hydrogen ion. Scale of pH is 1-14 which indicates acidity and alkalinity, in that order 7 is the pH of pure water which is considered neutral. To examined pH the standard method of AOAC (2012), method 2005.02 was applied. pH meter is standardized against buffer solution of 4 g and 7. 10 g of sample was taken in clean beaker and place pH meter. Three times pH reading was recorded. The device was washed and cleaned after every reading (Figure 2).

Sensory evaluation

Different jam was analyzed for organoleptic assessments like color, taste, texture and overall suitability. Different trials were inspected by 10 judges by using 9 hedonic scales as explained by Larmond (1977). Samples were presented to trained judges to compare them and assign them score between 1-9, where 1 represent extremely disliked and 9 represent extremely liked.

Moisture content

Moisture content was determined by standard method of AOAC (2010). In this method, a wet sample is weighed on a balance, placed in an oven, and heated until the end of the drying period. The weight loss is the moisture content of the sample (Figure 3).

Figure 3: Moisture analyser.

Statistical Analysis

All the data concerning treatments and storage interval were statistically analyzed by mean of two factorial CRD (Completely Randomized Design) and the means were separated by applying LSD Test at 5% probability level as described by (Steel and Torrie, 1996).

Results and Discussion

pH

The statistical analysis showed significantly ($P<0.05$) results which may be due to the effect of treatment and storage intervals on the pH value of different jams and marmalade during storage. The mean were

separating by applying LSD test at 5% probability level (Table 2). The initial pH value of apple jam, guvava jam, mixed fruit jam and citrius marmalade T0 (3.36), T1 (3.26), T2 (3.27) and T3 (3.17) which was gradually decreased to 3.22, 2.98, 3.16 and 2.76 respectively during storage (Table 1). The maximum mean value was observed in T0 (3.28) while the lower mean value was recorded in T3 (2.93). During storage highest fall in pH was recorded in T3 (12.93%) in compare to lower fall was observed in T2 (3.97%). During a study Ehsan et al. reported a decreasing trend in pH of all treatments of mixed jam prepared from watermelon and lemon during storage [30]. In another study Torezan, formulated two types of mango jams and observed a decreased in pH during storage [31]. The decrease in pH may be attributed to formation of free acids and pectin hydrolysis.

Total Soluble Solid (TSS)

The statistical analysis showed significantly (P<0.05) results which may be due to the effect of treatment and storage intervals on the TSS value of different jams during storage. The mean were separating by applying LSD test at 5% probability level (Table 3). The initial TSS value of T0 (59.3), T1 (62.5), T2 (63.4) and T3 (59.4) which was gradually increased to 62.7° brix, 63.7° brix, 66.6° brix and 63.2° brix respectively during storage. The maximum mean value T2 (64.9) while the less value was recorded in To (60.8). During storage highest fall in percentage was recorded in T3 (6.39%) in compare to minimum fall was detected in T1 (1.92%). Ehsan et al. reported increased in TSS of watermelon lemon jam from 68.6o brix to 68.9o brix and grape fruit marmalade from 70° to 70.8° during 60 days of storage. The increase in TSS of the product may be due to the solubilization of jam constituents during storage.

Table 2: Effect of the pH value of different jams and marmalade during storage.

Treatment	Storage intervals					Decrease%	Means
	0	15	30	45	60		
T_o	3.36	3.3	3.28	3.27	3.22	4.16%	3.28
T_1	3.26	3.2	3.16	3.11	2.98	8.58%	3.14
T_2	3.27	3.2	3.18	3.16	3.14	3.97%	3.19
T_3	3.17	3	2.93	2.81	2.76	12.93%	2.93

Table 3: Effect of the TSS value of different jams and marmalade during storage

Treatment	Storage intervals					Decrease%	Means
	0	15	30	45	60		
T_o	59.3	59.8	60.7	59.9	62.7	5.73%	60.48
T_1	62.5	62.6	63.1	63.4	63.7	1.92%	63.06
T_2	63.4	63.8	64.9	65.5	66.6	5.04%	64.9
T_3	59.4	60.7	61.5	61.4	63.2	6.39%	61.24

Acidity (%)

The statistical analysis showed significantly (P<0.05) results which may be due to the effect of treatment and storage interval on the acidity value of different jams. The mean were separated by applying LSD test at 5% probability level (Table 4). The initial value of acidity of T0 (0.66), T1 (0.69), T2 (0.68) and T3 (0.86) which was gradually increased to 0.82, 0.78, 0.76 and 1.35 respectively during storage. The maximum mean value was recorded in T3 (1.096) while minimum value was observed in T2 (0.70) during 60 days of storage. During storage highest increase was observed in T3 (48.97%) while lowest increase was recorded in T2 (11.76%). In study of Torezan, observed the acidity up to 0.9% in jam prepared by continuous process and 0.6% from jam prepared by conventional method. The increase in acidity may be due to the breakdown of pectin into pectonic acid.

Table 4: Effect of the acidity % value of different jams during storage.

Treatment	Storage intervals					Decrease%	Means
	0	15	30	45	60		
T_o	0.66	0.67	0.75	0.77	0.82	24.24%	60.48
T_1	0.69	0.71	0.73	0.76	0.78	13.04%	63.06
T_2	0.68	0.69	0.67	0.7	0.76	11.76%	64.9
T_3	0.86	0.95	1.04	1.28	1.35	48.97%	61.24

Moisture (%)

The statistical analysis showed significantly (P<0.05) results which may be due to the effect of treatment and storage intervals on the moisture % of different jams and marmalade. The mean were separated by applying LSD test at 5% probability level (Table 5). The initial value of moisture of T0 (36.8%), T1 (437.57%), T2 (37.3%) and T3 (39.2%) which was gradually decreased to 35.3%, 35.76%, 34.8% and 35.3% respectively during storage. The maximum mean value was recorded in T3 (37.42) while the minimum mean value was recorded in T2 (35.96). During storage highest fall was recorded in T3 (9.94%) in to lower decreased percent was observed in T0 (4.07%). In the study of Anjum et al. observed decreased in % moisture from 79% to 77% after 60 days of storage in dried apricot jam. This decrease may be due to reopening of the same pack during storage for analysis.

Table 5: Effect of the moisture % value of different jams during storage.

Treatment	Storage intervals					Decrease%	Means
	0	15	30	45	60		
T_o	36.8	36.2	36.4	35.8	35.3	4.07%	36.1
T_1	37.57	37.56	36.47	35.88	35.76	4.81%%	36.6
T_2	37.3	36.7	35.9	35.1	34.8	6.70%	35.96
T_3	39.2	38.7	36.8	37.1	35.3	9.94%	37.42

Sensory evaluation of different jams and marmalade: Results of sensory evaluation has been given below in table Total 4 samples were presented to a pannel of 7 trained judges and they were asked to give a score to the prouducts according to their liking preference by using 9-hedonic scale.

Color

The statistical analysis showed significantly (P<0.05) results which may be due to the effect of treatment and storage intervals on the color value of different jams and marmalade during storage. The means were separating by applying LSD test at 5% probability level (Table 6). The initial color value of To (8), T1 (7), T2 (9) and T3 (8) which was gradually decreased to 7, 7, 6 and 8 respectively during 2 months of storage (Table 6). The maximum mean value was noted in T3 (8) while the less mean value was recorded in T1 (7.2). During storage highest decrease percent value was shown in T2 (18.33%) while the lower decrease percent was shown in T1 (2.86%). In the study of Ehsan et al. investigated that color mean was decrease from 9 to 7 in strawberry jam. The color of food product is the most important parameters regarded consumer opinion. Decline in color may be due to degradation of ascorbic acid and enzymatic browning.

Taste

The statistical analysis showed significantly (P<0.05) results which may be due to the effect of treatment and storage intervals on the taste value of different jams and marmalade during storage. The means were separating by applying LSD test at 5% probability level (Table 7). The initial taste value of T0 (7), T1 (8), T2 (9) and T3 (8) which was gradually decreased to 7, 6, 8 and 6 respectively during 2 months of

storage. The maximum mean score was shown in T2 (8.4) while the lower mean value was detected in both T3 (6.9). The highest decrease percent was shown in T3 (25.23%), while the minimum decrease % is detected in T0 (3.38%). However, Husain et al. recorded a decline in the taste scores of watermelon and lemon jam during 5 months of storage. Decline in taste score might be due to fluctuations in acids or decrease in pH [11].

Table 6: Effect of the color value of different jams during storage.

Treatment	Storage intervals					Decrease%	Means
	0	15	30	45	60		
T_o	8	9	8	7	7	12.50%	7.8
T_1	7	8	8	6	7	2.86%	7.2
T_2	9	8	8	7	6	18.33%	7.6
T_3	8	9	8	7	8	4.72%	8

Texture

The initial texture value of T0 (8), T1 (7), T2 (8) and T3 (8) which was gradually decreased to 7, 6, 7.5 and 6.5 respectively during storage (Table 7). The highest average score was detected in T2 (8.3), in compare to lower fall in T1 and T3 (7). During storage highest decrease% was observed in T3 (18.75%), while minimum score was detected in T2 (6.25%). The statistical analysis showed significantly ($P<0.05$) which may be due to the effect of treatment and storage intervals on the texture value of apple jam during storage (Table 7). The mean were separating by applying LSD test at 5% probability level. Similarly, Rathore et al. analyzed decreased in texture score from 9 to 7 in apple jam. Texture consists of those properties of product which is judges visually or by touch.

Table 7: Effect of the texture value of different jams and marmalade during storage.

Treatment	Storage intervals					Decrease%	Means
	0	15	30	45	60		
T_o	8	7	9	8	7	12.50%	7.8
T_1	7	8	7	7	6	14.28%	7
T_2	8	9	9	8	7.5	6.25%	8.3
T_3	8	7	7	6.5	6.5	18.75%	7

Overall acceptability

The statistical analysis showed significantly ($P<0.05$) results which may be due to the effect of treatment and storage intervals on the overall acceptability of apple jam during storage. The mean were separated by applying LSD test at 5% probability level (Table 8). The initial value of T0 (8), T1 (8), T2 (9) and T3 (8) which was gradually decreased to 7, 5, 8 and 5 respectively during storage (Table 8). The highest mean value was recorded in T2 (8.4) while minimum mean value was detected in T1 (6.5). During storage highest decrease percent was recorded in T1 and T3 (37.5%) while minimum percent was shown in T2 (11.11%). In the study of Hussain et al. found decline in the overall acceptability of lemon and watermelon jam [11].

Table 8: Effect of the overall acceptability value of different jams and marmalade during storage.

Treatment	Storage intervals					Decrease%	Means
	0	15	30	45	60		
T_o	8	9	8	7	7	12.50%	7.8
T_1	8	7	6	6.5	5	37.50%	6.5
T_2	9	9	8	8	8	11.11%	8.4
T_3	8	7.5	7	6	5	37.50%	6.7

Conclusion

The aim of this work was to check the qualitative assessment of different jams and marmalade through its physico-chemical and organoleptic analysis. Based on results, it is concluded that storage and treatment has significant effect on the quality and stability of different jams and marmalade. The result indicated that T2 (mixed fruit jam) was found most acceptable both physiochemical and organoleptically.

Recommendations

- Study should be done to determined nutritional composition of different jams.
- Study should be carried out to analyze effect of different chemical preservatives on jams.
- Further research work should be carried out on the effect of different packaging materials on jams.

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