DEVELOPMENT OF WINE FROM DIFFERENT BLENDS OF LOQUAT (Eriobotrya japonica) AND Moringa oleifera

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***Abstract*- The present study reviews on potential of wine production from different blends of Loquat (*Eriobotrya japonica*) pulp and *Moringa oleifera.* The blending of *Moringa oleifera* and loquat pulp in different proportions was done to determine the sensory characteristics and physico-chemical properties of wine. Pulps of loquat and *Moringa* were blended in different ratios (100:0::L:M), (0:100::L:M), (99:1::L:M), (98:2::L:M) and (97:3::L:M) along with sugar and yeast (*Saccharomyces cerevisiae*) as starter culture, for the production of wine. The highest and lowest rate of fermentation of (0.076percent) and (0.065percent) was recorded in treatment Tc (100:0::L:M) and treatments T_2(98:2::L:M) and T_3 (97:3::L:M) respectively. On the basis of sensory quality characteristics of blended wine, Tc (100:0::L:M) and Tc(0:100::L:M) was adjudged the best having total soluble solids and volatile acidity, as 7.1, 7.3°Brix, 0.018percent,0.025percent.**

I. Introduction

Moringa oleifera belonging to the family of *Moringaceae* is an effective remedy for malnutrition. *Moringa* is rich in nutrition owing to the presence of a variety of essential phytochemicals present in the leaves, pods, seeds (Rockwood *et al*., 2013). *Moringa* is known by various vernacular names- drumstick tree & horseradish tree(English), saragvo (Guajarati), soaanjna (Hindi), sajna (Bengali), nugge (Kannada), sirgu (Malayalam), shevga (Marathi), murungai (Tamil), surajana (Punjab), sajiwan or swejan (Nepali) (Rajangam *et al*., 2001). The plant is native to northwestern india, widely cultivated in tropical and subtropical area (Flora and Pachauri, 2011) *Moringa* is also known by names 'Tree of life, Miracle tree.

It is the most widely cultivated species of genus *Moringa*, its young seeds, pods and leaves are used as vegetables. All the parts of *moringa* tree are edible and have long been consumed by humans (Prabhu *et al*., 2011). Infact *Moringa* is said to provide 7 times more vitamin- C than oranges, 10 times more vitamin- A than carrots, 17 times more calcium than milk, 9 times more protein than yoghurt, 15 times more potassium than bananas, 25 times more iron than spinach (Rockwood *et al*., 2013). The leaves of *M.oleifera* are rich in minerals like calcium, potassium, zinc, magnesium, iron, copper (Kasolo *et al*., 2010). Vitamins like beta-carotene of vitamin- A, vitamin B such as folic acid, pyridoxine, nicotinic acid, vitamin C,D,E also present in *Moringa oleifera* (Mbikay *et al*., 2012). Phytochemicals such as tannins, sterols, flavonoids, saponins and terpenoids, alkaloids and reducing sugar along with anti- cancereous agents glucosinolates, isothiocyanates, glycoside compounds (Berkovich *et al*., 2013).

Wine is the one of the most ancient of man's technologies, and is now one of the most commercially prosperous biotechnological processes (Moreno-Arribas and Polo, 2005). Wine is the distinctive product that influences major life events, from birth to death, victories, auspicious occasions, harvest and other events, due to is analgesic, disinfectant, and profound mind altering effects (Bisson *et al*., 2002 and Mcgovern *et al*., 2004) Apart from grapes, there are many other fruits available that can be used as substrate for winemaking. Among various fruits, grapes are the most technically and commercially used as substrate for winemaking.

Winemaking involves mainly three categories of operations, viz: pre-fermentation, fermentation and postfermentation operations (Iland *et al.,* 2000; Jackson,2000; Ribéreau-Gayon *et al.,* 2000).

Fermentation is a viable technique in the development of new products with modified physicochemical and sensory qualities especially flavour and nutritional components. Alcohol , acetic and lactic acid fermentations are important for quality in production. Out of these, alcoholic fermentation is widely employed for the preparation of beverages in which alcohol is major constituent. Fermented beverages have been known to mankind from time immemorial.

Loquat (*Eriobotrya japonica*) is a popular fruit in japan and belong to the same family as apples and plums. Though native to china, it is widely cultivated in Asia. Loquat fruits are 1-2 inch small and pear shaped. They have yellow coloured thin yet hard outer peel. The flesh depending on the variety is white, yellow, orange in colour, and is sweet, tangy, succulent and juicy. Loquat fruit is often consumed raw or processed into jam, jellies, juice, other similar

processed fruits products. Loquat is used in traditional medicine in Japan. Loquat syrup is used as a traditional medicine for cough. Loquat leaves and loquat seeds are utilized for various traditional medicinal purposes. Leaves are used to reduce pain and swelling.

Loquat has been used as medicinal plant in Japan and china. The fruit act as sedative also can stop vomiting and preventing thrist. Astringent leaves of loquat have been used for a long time to treat chronic bronchitis, cough, phelgan, high fever, gastroenteric disorders. Trepenoids isolated from loquat leaves have anti-tumor , antiviral, anti-immflamatory effect (kim *et al.*, 2009)

The peel is richer in caroteoids or vitamin – A activity compounds including beta carotene , lutein, other xanthophylls. Loquat fruit offers amount of dietary fiber, vitamin-C, vitamin B6, potassium, manganese, phosphorus, iron, calcium, copper. The fruit offers fruit sugars along with malic acid, ciric acid, tartaric acid, succinic acid. The fruit as also source of various phytochemicals. The fruit has also good amount of pectin. Loquat fruit offers vital vitamins and minerals which play important role in keeping skin healthy. Loquat leaves helps in reducing sugar cravings and suppressing appetite. Loquat offers benefits to eyes also by providing good amount of vitamin –A (anonymous 2014).

II. Objectives

1. To develop wine from different blends of*Moringa* & loquat fruit pulp.
2. To assess the effect of blending on physico-chemical & microbiological characteristics of developed product.
3. To assess the sensory quality.

III. Review of Literature

Fahey (2005) reported that it contains all the essential nutritional elements that are vital for livestock & human beings. *Moringa* is a miracle tree with a great indigenous source of highly digestible proteins, Ca, Fe & vitamin C.

Fuglie (1999) & Mathur (2006) demonstrated that the dry leaves of *M. oleifera* contain 7 times more vitamin C than orange, 10 times more vitamin A than carrot, 17 times more calcium than milk, 15 times more potassium than bananas, 25 times more iron than spinach & 9 times more proteins than yoghurt. In addition, it contains vitamin B, chromium, copper, magnesium, manganese, phosphorus & zinc (Fuglie, 2000). Thurber & Fahey (2009) reported *Moringa* leaves as rich protein source, which can be used by doctors, nutritionist & community health cautious persons to solve worldwide malnutrition or under nutrition problems.

Seshadri & Nambiar (2003) reported 40139 microgram/100g total carotenoides on fresh weight basis in *Moringa* leaves out of which 47.8percent or 19210 micrograms/100g was beta-carotene. Moreover, it was also found that *Moringa* contains ascorbic acid were at 6.6 mg/g on dry weight basis, Fe 0.26mg/g, Ca 22.4 mg/g, P 6.3 mg/g, oxalic acid 11.2 mg/g & fiber at 0.9 g/100 g. Some studies revealed that *Moringa* has the potential to combat vitamin A & other micronutrient deficiencies (Nambiar & Seshadri, 1998, 2001; Babu, 2000; Nambiar *et al*., 2006).

Srivastava *et al*., (1997) reported that 10percent inoculum size added in non chaptalized guava pulp led to the production of 5.8percent ethanol (w/v) by *Saccharomyces cerevisae*. An optimized inoculum level of 10percent v/v for alcoholic fermentation of guava, plum, apple, pear juice, jamun and 7.5percent inoculum size for kinnow wine production has been observed by Panesar *et al*., (2009).

Kumar *et al*., (2011) studied the effect of dilution of Custard apple (*Annona squamosa* L) pulp with water in ratio 1:2, 1:3, and 1:4, were kept with and without 0.1percent DAHP as a source of nitrogen, for the production of wine and found that the fermentation efficiency of must was maximum 88.05percent in 1:3 (pulp: water) dilution ratio along with DAHP and minimum of 79.98percent in 1:2 (pulp: water) dilution ratio using no DAHP. They also reported that the overall acceptability was rated good, for the wine prepared with a dilution ratio of 1:4 using DAHP as a source of nitrogen and fair for the ratio of 1:4 without DAHP as a source of nitrogen.

Chavda and Kumar, (2009), Hasegawa *et al*., (2010) and Hussain *et al*., (2011) stated that loquat (*Eriobotrya japonica*Lindl.) is a subtropical evergreen fruit tree, native to the southeast of China, belonging to the *Maloideae* subfamily of the Rosaceae. Loquat is cultivated in Cyprus, Egypt, Greece, Israel, Italy, Spain, Tunisia & Turkey. It is widely distributed in many European, Asian & American countries.

Joshipura *et al*., (1999), studied that citrus fruit and juice are especially beneficial for reducing the risk factor of an ischemic stroke. A diet rich in fruits has been claimed to be favourably affect the serum antioxidant capacity and provided protection against lipid peroxidation.

Temiz *et al*., (2012) and Jonathan, H.C. and Liliam, (2009) said that loquat fruit is usually eaten fresh without the peel, combined with other fruit in fruit salads, used as pie filling & made into sauces & gelatin desserts, jam, syrup, jellies, nectar, canned foods, yoghurt etc.

IV. Material and Methods

The present study entitled "Development of wine from blends of loquat (*Eriobotrya japonica*) pulp and *Moringa oleifera*" was carried out during 2017-2018 in the laboratory of Department of Food Science and Technology, Khalsa College (An Autonomous College), Amritsar. The study of the wine was divided primarily into two parts: product development and product evaluation. Experimental procedures and the materials used for developing loquat - *Moringa* blended wine and evaluation of its properties have been described in this chapter.

3.1 RAW MATERIAL USED

Loquat fruit, *Moringa oleifera*, enzyme, yeast, sugar, nitrogen source were used for the preparation of loquat-*Moringa* blended wine.

3.2 PROCUREMENT OF RAW MATERIAL (SAMPLE)

Fully ripened loquat fruit were purchased from the Amritsar fruit market during March-April, 2018 .

3.3 YEAST USED

The dried yeast *Saccharomyces cerevisiae* was purchased from an URBAN PLATTER , istore Direct Trading LLP.

3.4 ENZYME USED

The pectinase enzyme was purchased from M/S Triton Chemicals, Mysore,India under the brand name "Trizyme P 5000".

3.5 *MORINGA* POWDER USED

The *Moringa* was purchased from Perennial Lifesciences Pvt.Ltd.

3.6 PREPARATION OF PULP

Fully ripened loquat fruit were selected for the processing. Bruised and defected fruits were rejected. After washing fruit were cut into four pieces or slices and seeds were removed. The pulp was made by blending in food processor followed by homogenization. The obtained pulp was pasteurized, filled in hot pre sterilized bottles for further use.

Loquat
↓
Selection of fruits
↓
Washing of fruits
↓
Slicing of fruits
↓
Removal of seeds
↓
Pulp extraction
↓
Blending in mixture
↓
Pasteurization
↓
Cooling
↓
Filling in glass bottles

Flowsheet for the extraction of loquat pulp

A PROTOCOL FOR THE PREPARATION OF LOQUAT-*MORINGA* WINE

The pulp of loquat and *Moringa* were blended in different ratios(table 1) for the wine development. The experiment was carried out to check the fermentability of loquat pulp, for which the pulp was treated with diammonium hydrogen phosphate (DAHP) as a nitrogen source and pectinase enzyme, KMS, yeast and sugar. Analysis of physico-chemical properties of wine were carried out.

PREPARATION OF MUST (FRUIT PULP+SUGAR SYRUP)

For preparation of must, the pasteurized loquat pulp was diluted with water in the ratio of 1:1. The initial total soluble solids content of loquat fruit was 6˚Brix. The total soluble solids raised to 20° Brix by the addition of sugar syrup, followed by the addition of pectinase enzyme and DAHP at rate of 0.5 and 0.1 percent. Potassium metabisulphite was added at the rate of 200ppm for killing natural microflora.

FERMENTATION

Fermentation process involved the addition of prepared loquat must into 2.5 litre capacity narrow mouth brown glass bottles, which were filled upto 75percent of their capacity to which active dry yeast culture of *Saccharomyces cerevisiae* @ 5percent was added. The narrow round mouth of bottles were plugged or sealed with the help of cotton plug and also polythene bag were attached to the mouth of the bottle for the CO_2 formation (ballooning) during fermentation and incubation was carried out at 27° C, untill a stable TSS has been achieved and then the fermentation was considered as completed. Siphoning/ racking and filtration were carried out.

BOTTLING

The wine was filled into glass bottles which had the capacity of 200ml, then bottles were corked, pasteurized at 60° C for 20 minutes and kept for maturation.

Table-1: Treatment details

TREATMENT	TREATMENT COMBINATIONS
T_C	100:0::L:M
T_C	0:100::L:M
T_1	99:1::L:M
T_2	98:2::L:M
T_3	97:3::L:M

L: Loquat **M**: *Moringa*

The total soluble solids of the must was raised to 20° Brix using sugar syrup and 200ppm SO_2, 0.5percent pectinase enzyme and 0.1percent DAHP and respectively and *Moringa* powder was added as per the treatment. It was then inoculated with activated yeast culture. The fermentation of wine was carried out in 2.5 litre capacity narrow mouth glass bottles. Fall in total soluble solids was measured after varied time intervals during the fermentation process. Then the wine was siphoned, racked and kept for maturation after completion of fermentation.

Loquat pulp
↓
Adding DAHP@ 0.1percent, KMS@ 200ppm and enzyme@ 0.5percent
↓
Raising TSS to 20° Brix
↓
Addition of *Moringa* powder as per the treatment
↓
Adding starter culture @5percent (incubate at 28˚C)
↓
Fermentation (28˚C)
↓
Filteraton
↓
Racking
↓
Bottling of wine
↓
Pasteurization at 60℃ for 20 minutes

Flowsheet for the preparation of loquat-*Moringa* blended wine

ANALYSIS

The wine was analysed for Total soluble Solids (TSS), reducing sugars, pH, titrable acidity, volatile acidity, total phenols, ethanol content, antimicrobial activity and sensory characteristics as per the methods given below under different heads.

PHYSICAL CHARACTERISTICS

Rate of Fermentation

The decrease in total soluble solids during fermentation was noted after every 24 hours till its stabilization in all the samples and was calculated using below given formula.

$$RF = \frac{\text{Initial TSS - Final TSS}}{\text{Time}}$$

CHEMICAL CHARACTERISTICS

Total Soluble Solids:

The TSS were determined using hand refractometer (0-32°B) and the results were expressed as degree Brix (° B) (A.O.A.C, 1980).

Titrable acidity:

Titrable acidity was estimated by titrating a known aliquot of the sample against N/10 NaOH solution using phenolphthalein as an indicator. The total titrable acidity was calculated and expressed as percent malic acid (A.O.A.C, 1980).

Calculations:

$$\text{percent Titrable acidity(Malic acid)} = \frac{V \times N \times 67.05 \times 100}{V \times 1000}$$

Where

V = Volume of NaOH used for titration
N = Normality of NaOH solution
v = Volume for sample taken for titration

pH:

The pH of the samples were measured using pH meter and calibrated using pH 4 and 9 buffer solutions(Egan *et al*., 1981).

Reducing sugars:

The reducing sugars in sample was determined by Lane and Eyon method (Ranganna,1979). 20ml wine sample was taken in 250ml flask and 100ml distilled water was added. Add one drop of phenolphthalein indicator and neutralize the solution with 40percent NaOH drop by drop. 2ml (45percent) of lead acetate was added, stirred and allowed to stand for 30 minutes. It was deleaded with 5ml (22percent) potassium oxalate solution and filtered through Whatman number 4 filter paper. Volume was made upto 250ml was distilled water. The prepared sample was titrated against pre-standardized Fehling mixture of solutions(A and B) and note the volume of sugar solution used.

Calculations:

$$\text{Reducing sugars(percent)} = \frac{\text{Factor}(0.052) \times \text{dilution} \times 100}{\text{Titer} \times \text{wt. Of sample}}$$

Volatile Acidity:

Volatile acidity of wine was estimated by distillation method (Amerine *et al.,* 1980). 10 ml of sample was taken in round bottom distillation flask along with 1gm of mercuric oxide, dissolved in 90ml water and 10ml H_2SO_4 and which was then allowed to distillate at 60℃. 10 ml of distillate was taken in 50ml conical flask and titrated against 0.025 N NaOH using phenolphthalein as an indicator till pink colour (end point) and volatile acidity was expressed as acetic acid(percent) and calculated as below.

$$\text{AceticAcid}\,(\%) = \frac{V \times N \times 60}{1000(v)} \times 100$$

Where

V = volume of NaOH used for titration
N = Normality of NaOH solution
v = Sample volume (ml)

Ethanol Estimation:

Ethanol estimation of wine was estimated by adding 1ml of wine directly to the distillation flask. Dilute the sample with 30ml distilled water. Place 50ml volumetric flask containing 25ml of $K_2Cr_2O_7$ beneath the condenser in such a way that the tip of condenser emerges in the solution, begin the distillation and collect 20ml of distillate. Then, lower the flask and rinse away dichromate sticking to the tip of condenser into the flask and distilled water. Heat the flask at 60℃ in a water bath for 20 minutes and bring to the volume. Mix, cool and measure the absorbance at a wavelength of 600nm with spectrophotometer. Determine the amount present in the fermented liquid by referring to the standard curve (Caputi *et al*., 1968).

Total phenols

The total phenols in wines were determined by Folin Ciocalteu procedure in which the absorbance was measured at 765 nm in a spectrophotometer against water blank. A standard curve of gallic acid was prepared using its different concentrations. Total phenols content was expressed as (mg/100ml). For this 0,1,2,3,4,5 and 10ml

gallic acid were taken separately in 100ml flasks and their volumes were made to 100ml with distilled water. From this, 1 ml of each was taken in separate 100ml flask, to this, 60 ml distilled water and 5ml Folin Ciocalteu were added to the respective flasks and fixed well (Singleton and Rossi, 1965).

Zone of inhibition (ZOI)

The agar well diffusion method was used to determine inhibitory effect of wine against the food borne pathogens *E. Coli.* The actively grown cultures in nutrient broth were selected for plate assay. 100 µl of each of the liquid culture was spreaded evenly on nutrient agar plate to create a bacterial lawn. 4 wells were punched in each nutrient agar plate and 100µl of wine was poured in each of the well under aseptic condition. The plates were left for 30 minutes at room temperature for the diffusion of the test samples before incubation at 37°C for 24 hours. The diameters of the zones of inhibition were measured after 24 hours (Deans and Ritchie, 1987).

Sensory analysis

The sensory analysis of loquat-*Moringa* blended wine was conducted by semi-trained panel of 10 judges. Coded samples were given to judges and were asked to rinse their mouth before or in between testing the given sample. Each sample was evaluated on twenty point scale (Amerine and Ough, 1980) based mainly on the colour, appearance, aroma, volatile acidity, total titrable acidity, sweetness, body, flavour, bitterness, astringency and overall acceptability on a prescribed performa. The panelists were required to score on the performa for each attribute based on the extent of desirability. The sum of the attributes score was used to evaluate overall quality. To draw the spider web diagram, sensory scores were taken for each attributes out of total scores of 20.

Statistical analysis

The results obtained were statistically analyzed using completely randomized design (CDR) and CRD factorial for interpretation of results through analysis variance.

V. Results and Discussion

The present investigation entitled "Development of wine from blends of loquat (*Eriobotrya japonica*) pulp and *Moringa oleifera*" was undertaken to develop wine from different combinations of loquat pulp and *Moringa oleifera*. Studies and findings on development of wine from loquat pulp and *Moringa oleifera* have been included in this chapter. The results obtained from the present study are as under:

4.1 FERMENTATION BEHAVIOUR AND PHYSICO-CHEMICAL ANALYSIS OF LOQUAT-*MORINGA* BLENDED WINE

4.1.1 Fermentability of must of different treatments:

The results depicted in figure 3 shows the fermentation behaviour of loquat- *Moringa* blended wine of different treatments. Figure 3 clearly depicted that during 168 hours of fermentation, the total soluble solids of loquat must decreased from the initial levels of 20˚ Brix to 7.1° Brix in the treatment Tc(100:0::L:M)whereas the total soluble solids of *Moringa* must decreased from the initial levels of 21° Brix to 7.3° Brix in the treatment Tc(0:100::L:M) and recorded the highest reduction followed by treatment T_1(99:1::L:M), treatment T_2(98:2::L:M) and treatment T_3(97:3::L:M) whose total soluble solids was reduced to 8° Brix, 9° Brix and 9° Brix respectively (Annexure 3).

On comparing the rate of fermentation of different musts, figure 3 depicts that the treatment Tc (0:100::L:M) recorded the highest rate of fermentation of 0.081, while the least rate of fermentation of 0.065percent was recorded in treatment T_2 (98:2::L:M) and treatment T_3 (97:3::L:M).

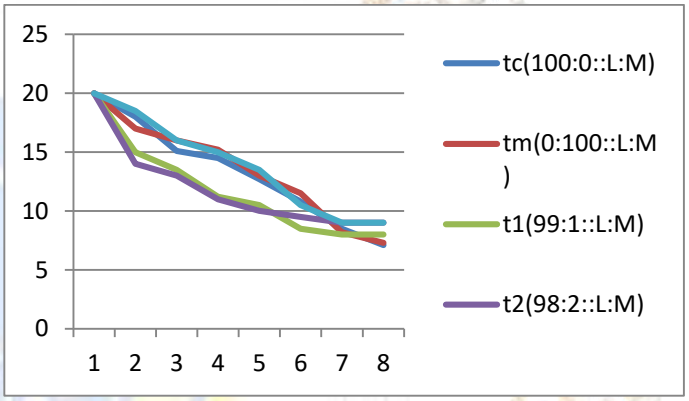

Figure-3: Change in total soluble solids of loquat-*Moringa* blended musts during fermentation

4.1.2 Physico-chemical characteristics of loquat - *Moringa* blended wines

4.1.2.1 Total soluble solids

Data pertaining to total soluble solids of loquat - *Moringa* blended wine as given in Table 1 showed the highest total soluble solids of 9° Brix was recorded in treatment T_3 (97:3::L:M) and T_2 (98:2::L:M) which was highly significant from rest of the treatments and was followed by TSS of 7.3° Brix in treatment T_c (0:100::L:M) ,8° Brix in treatment T_1 (99:1::L:M) ,7.1° Brix in treatment Tc (100:0::L:M), respectively. All treatments differed statistically at 5percent level of significance. DAHP was added as a source of nitrogeneous food and was necessary for rapid and complete fermentation (Amerine *et al*., 1980., Kerni and Shant, 1984; Joshi *et al*., 1990)

TABLE-1

EFFECT OF DIFFERENT TREATMENTS ON TOTAL SOLUBLE SOLIDS OF LOQUAT-*MORINGA* BLENDED WINE

Treatments	TSS (° Brix)
Tc(100:0::L:M)	7.1
Tc(0:100::L:M)	7.3
T_1(99:1::L:M)	8.0
T_2(98:2::L:M)	9.0
T_3(97:3::L:M)	9.0
CD	0.24

4.1.2.2 Titrable Acidity

The data in table 2 revealed that treatments T_3 (97:3::L:M) and Tc (100:0::L:M) recorded the highest and lowest titrable acidity of 0.818 and 0.724 percent respectively whereas the titrable acidity of treatment T_1 , T_2 and Tc(0:100::L:M) were 0.777, 0.811 and 0.785 percent respectively. All treatments differed statistically at 5percent level of significance. The decrease in titrable acidity is desirable in wines from more acidic fruits during maturation as it increases the palatability of wine (Joshi *et al.,* 1999). Similar results have been reported in strawberry wine, apple wine and mango wine (Sharma and Joshi, (2003), Joshi *et al.,* (2013) and Beera *et al.,* (2013)).

TABLE-2

EFFECT OF DIFFERENT TREATMENTS ON TITRABLE ACIDITY OF LOQUAT-*MORINGA* BLENDED WINE

Treatments	Percent Titrable acidity(citric/malic)
Tc(100:0::L:M)	0.724
Tc(0:100::M:L)	0.785
T_1 (99:1::L:M)	0.777
T_2 (98:2::L:M)	0.811
T_3 (97:3::L:M)	0.818
CD	0.02

4.1.2.3 pH

Table 3 revealed that the pH of different treatments differed significantly from each other. The pH of different wines ranged from 3.0 to 4.0. The highest pH (4.0) treatment T_c (100:0::L:M) and lowest pH (3.0) of treatment T_c (0:100:L:M). The pH of *Moringa* wine is 3.0. Similar findings regarding the titrable acidity were obtained earlier (Joshi *et al.,* 2013) while working on the production of apple wine.

TABLE-3

EFFECT OF DIFFERENT TREATMENTS ON pH OF LOQUAT-*MORINGA* BLENDED WINE

Treatments	pH
Tc (100:0::L:M)	4.0
Tc (0:100::L:M)	3.0
T_1 (99:1::L:M)	3.2
T_2 (98:2::L:M)	3.5
T_3 (97:3::L:M)	3.8
CD	0.31

4.1.2.4 Volatile acidity

Perusal of data in table 4 indicated that significant difference in volatile acidity of various treatments of loquat - *Moringa* blended wine and it ranged between 0.025 to 0.009percent (percent acetic acid). The highest volatile acidity of 0.025percent was recorded in treatment Tc (0:100::L:M) and the lowest volatile acidity of 0.009 percent was recorded in treatment T_3(97:3::L:M). All treatments differed statistically at 5percent level of significance. Amerine *et al*., 1980 reported that the wines which have volatile acidity less than 0.04% as acetic acid are recognised as the sound wines; whereas high volatile acidity indicates their acidification.

TABLE-4

EFFECTS OF DIFFERENT TREATMENTS ON VOLATILE ACIDITY OF LOQUAT – *MORINGA* BLENDED WINE

Treatments	Volatile acidity (percent acetic acid)
Tc (100:0::L:M)	0.018
Tc (0:100::L:M)	0.025
T_1 (99:1::L:M)	0.021
T_2 (98:2::L:M)	0.010
T_3 (97:3::L:M)	0.009
CD	0.002

4.1.2.5 Ethanol Content

The highest ethanol content of 9.5 percent was recorded in treatment T_3(97:3::L:M) followed by ethanol content of 9.3 percent in treatment T_2 (98:2::L:M), 8.6 percent in treatment T_1(99:1::L:M) and 8.4 percent in treatment T_c (100:0::L:M).The lowest ethanol content of 8.4 percent was recorded in treatment T_c (100:0::L:M). All treatments differed statistically at 5percent level of significance. Similar findings have been reported by Kumar *et al.,* (2011) who observed that the alcohol content and fermentation efficiency in all the treated samples ranged from 6.61 (v/v) to 8.14 (v/v) and 79.98% to 88.05%, respectively while studying the dilution

effects on physico chemical characteristics of custard apple wine.

TABLE 5

EFFECT OF DIFFERENT TREATMENTS ON ETHANOL CONTENT OF LOQUAT- *MORINGA* BLENDED WINE

Treatments	Ethanol (percent v/v)
T_c(100:0::L:M)	8.4
T_c(0:100::L:M)	9.2
T_1 (99:1::L:M)	8.6
T_2 (98:2::L:M)	9.3
T_3 (97:3::L:M)	9.5
CD	0.37

4.2.2.6 Total Phenols

Data in Table 6 summarizes the total phenol content of different wines. The total phenols of wines of different treatments differed significantly when compared to each other. Total phenols of Loquat – *Moringa* blended wine ranged from 0.845 to 0.326mg/100ml.The highest of the phenol content of 0.845mg/100ml was found in treatment T_3(97:3::L:M) where as lowest total phenol content of 0.326 mg/100ml was recorded in treatment T_c(100:0::L:M). The interaction effects of treatments were found to be significant at 5 percent level of significance. The total phenols decreased from 0.814 to 0.265 mg/100 ml which was in accordance with the findings of Sharma and Joshi, (2003), Joshi *et al.*, (2013) and Many *et al.*, (2014), in strawberry, apple and tomato wine respectively.

TABLE-6

EFFECT OF DIFFERENT TREATMENTS ON TOTAL PHENOLS OF LOQUAT-*MORINGA* BLENDED WINE

Treatments	Total phenols(mg/100ml)
T_c(100:0::L:M)	0.326
T_c(0:100::L:M)	0.814
T_1 (99:1::L:M)	0.546
T_2 (98:2::L:M)	0.749
T_3 (97:3::L:M)	0.845
CD	0.003

4.2.1.7 Reducing Sugars

The table 7 summarizes the reducing sugars present in wines of different treatments. The treatment T_c (0:100::L:M) recorded maximum sugar content of 0.84percent followed by treatments T_3(97:3::L:M), T_2(98:2::L:M) and T_1(99:1::L:M) having reducing sugar contents as 0.81percent,0.80percent,0.71percent respectively. The lowest reducing sugar content of 0.64percent was recorded in treatment T_c (100:0::L:M). All treatments were differing significantly at 5percent level of significance.

TABLE -7

EFFECT OF DIFFERENT TREATMENTS ON REDUCING SUGARS OF LOQUAT- *MORINGA* BLENDED WINE

Treatments	Reducing sugars (percent)
T_c(100:0::L:M)	0.64
T_c(0:100::L:M)	0.84
T_1 (99:1::L:M)	0.71
T_2 (98:2::L:M)	0.80
T_3 (97:3::L:M)	0.81
CD	0.02

4.2.1.8 Zone of inhibition (ZOI)

The perusal of data regarding antimicrobial activity of wine against the common pathogens as presented in table 8 showed that the maximum zone of inhibition for *E.coli* as 2.2cm was recorded in treatment T_C(0:100::L:M) where as the minimum zone of inhibition for *E.coli* as 1.3cm was recorded in treatment T_C (100:0::L:M) respectively. It was observed that with the increase in *Moringa* concentration in different treatments, a significant increase in antimicrobial activity was observed. Source of sugar had a significant effect on antimicrobial activity of wine. A combination of organic acids, ethanol and low pH have been reported to have significantly stronger antimicrobial activity than the effect of these components individually against food-borne pathogens, indicating potential synergistic interactions between these components leading to an enhancement of anti microbial activity.

TABLE-8

EFFECT OF DIFFERENT TREATMENTS ON ANTIMICROBIAL ACTIVITY OF LOQUAT-*MORINGA* BLENDED WINE

Treatments	Anti microbial Activity
T_c(100:0::L:M)	1.3cm
T_c(0:100::L:M)	2.2cm
T_1 (99:1::L:M)	1.5cm
T_2 (98:2::L:M)	1.8cm
T_3(97:3::L:M)	2.0cm
CD	0.43

4.2.1.9 Sensory Analysis

Table 9 summarizes the results of composite scoring of Loquat-*Moringa* wine. The mean score of overall acceptability of Loquat-*Moringa* blended wine of different treatments were ranked as per the score/ preference as treatment T_3(97:3::L:M) followed by treatments,T_2(98:2::L:M), T_c(100:0::L:M), T_c (0:100::L:M), T_1 (99:1::L:M) having scores as 16.5,16.7, 17.0,17.0 and 16.0 respectively(Annexure 2). All differed significantly at 5percent level of significance.

V. SUMMARY AND CONCLUSION

Organic products assume an imperative part in human eating regimen and sustenance. They are key wellspring of basic dietary supplements and vitamins other than giving unrefined fiber and minerals. They give flavour, shading and assortment to the generally dull eating regimen. Because of high dampness substance of fruits, they are perishable and are inclined to microbial, compound and physical decay. The timeframe of realistic usability and nature of organic products can be improved by changing over them into quality items with the assistance of preparing. Quality handled items have a higher shopper esteem in national and universal market. A noteworthy objective of nourishment preparing is to change over such perishable wares into stable items that can be put away for broadened periods.

Pulp of loquat and *Moringa oleifera* were mixed in various proportions (100:0::L:M), (0:100::L:M), (99:1::L:M), (98:2::L:M) and (97:3::L:M) alongside sugar and yeast (*Saccharomyces cerevisiae*) as starter culture for the wine advancement. Physico-compound properties and tactile attributes of mixed wine were analysed.

VI. References

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