Production and Quality Analysis of Wine Samples after Fermentation of Phyllanthus emblica, Passiflora edulis and Averrhoa bilimbi

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Abstract: Wine is referred a completely or partially fermented juice of the grape, also fruits other than grapes have also been utilized for the production of wines. Fruit has a significant role in human nutrition either as fresh or in processed form, due to the presence of numerous high-value secondary metabolites that provide inherent nutritional quality. The past decade has seen the rapid development of fruit wine production in many countries. Wine was prepared from wild fruits Phyllanthus emblica, Passiflora edulis, Averrhoa bilimbi by following tradition method of preparation and quality analysis was done by following standard procedure. Wine was produced by fermentation process using yeast. pH values ranged from 3.3 to 5 in Passiflora edulis, Phyllanthus emblica and Averrhoa bilimbi fruit wine, Temperature also increased from 17 t0 28 °C, when pH and temperature increased alcoholic content also increased which is also controlled by specific gravity. Percentage titratable and volatile acidity of all fruit wines also ranged between the normal range. Colour density and tint value are also responsible for the flavour, colour and longevity of wine samples. Sensory evaluation revealed that all the three wines had acceptable colour, aroma and taste. This study indicates that these fruit wine could be used in large scale wine production and other industrial applications.

Keywords: Averrhoa bilimbi, Fermentation, Passiflora edulis, Phyllanthus emblica, Wine.

INTRODUCTION

India is one of the largest producers of fruits in the world. Fruits are among the most important foods of mankind as they are not only nutritious but are also indispensable for the maintenance of health. Fruits both in fresh as well as in processed form not only improve the quality of our diet but also provide essential ingredients like vitamins, minerals, carbohydrates etc. (Shrikant et al., 2014). Wine has a long association with human artistic, cultural and religious activities and is considered as nutritious, safe and healthy drink. With increase in the socioeconomic status, the demand of the health and nutracetical food is increasing day-by-day. Wine contains a wide variety of the biologically active compounds including antimicrobial compounds (phenolics, acids, alcohols, bioamines, etc.) which possess the numerous health benefits. Wine is a beverage resulting from the fermentation of the juice by yeasts with proper processing and addition. Yeast consumes the sugar in the juice and converts it to ethanol and carbon dioxide, releasing heat in the process. A typical wine contains ethyl alcohol, sugars, acids, higher alcohol, tannins, aldehydes, esters, amino-acid, minerals, vitamins, anthocyanin and minor constituents like flavouring compounds, etc. (Amerine et al., 1980).

Wine is any alcoholic beverage produced from juices of variety of fruits by fermentative action of microorganisms either spontaneously or seeding with a particular strain mainly of yeast species to adopt a particular quality of wine. Wine is one of the most recognizable high value-added products from fruits. Most commercially produced wines are usually made from fermented grapes; this fermentation process is not done by introducing any chemicals or sugar but by adding different species of yeast to the crushed grapes. Yeast has the capability of converting grapes into an alcoholic compound and removing the sugar content in it to produce different types of wines. Sometimes wines are produced from different types of fruits like; Pawpaw, mango, Pineapple, Banana, Lemon, Watermelon etc., here the wine so produced bears the name of the fruit or fruit mixture used in its production (Robinson, 2010). This study is on wine production by using various wild fruits Phyllanthus emblica-Amla, Passiflora edulis-passion fruit, Averrhoa bilimbi-Bilimbi. An attempt was made to study the nutritional quality and pH, Color tint and Color density, Total Acidity, Volatile Acidity, Temperature and Alcohol content, Specific gravity of fruits and fruit wine.

MATERIALS AND METHODS: Sample collection: Different fresh wild fruits (Phyllanthus emblica-Amla, Passiflora edulis-passion fruit, Averrhoa bilimbi-Bilimbi) were collected from Nileshwaram, Kasaragod Kerala. Fruits
were washed thoroughly under tap water to remove dust and debris and surface sterilized with distilled water and wiped with fresh clean cloth. Sugar, wheat, clove, cinnamon, and yeast are purchased from Konaje grocery shop.

**Preparation of wine:** 3.5 L of water was boiled and allow to cool. Fruits were cleaned in fresh tap water and water was drained out. In an air tight container, a layer of fruits, sugar, wheat, cinnamon and clove where arranged. Boiled and cooled the water was added part by and mixed thoroughly to crush fruits. Yeast suspension was prepared and was added to the container and mixed it well. The container was capped and keep undisturbed for 1 week. It was mixed with clean glass rod from 8th to 21st day. After 3 weeks, the suspension of wine was filtered. The suspension was stored in the bottle for the further study.

Wine from three different wild fruits they are Phyllanthus emblica, Passiflora edulis, Averrhoa bilimbi, for preparing wine I have taken 1 kg of each fruit for that I have added 1.5 kg of sugar, 100g of wheat, cinnamon, clove and 3.5 litre of water. For the purpose of fermentation, I have added yeast. Then it kept for fermentation for 21 days with constant stirring once in a day.

**Proximate Analysis of the Fruits**

**Determination of Percentage Moisture Content:** 5 g of the sample was weighed into Petri dish and placed in air draught oven at 100 °C for 1 hour. The Petri dish was then weighed after cooling. The process was repeated thrice until a constant weight was obtained. Loss in weight was calculated as the percentage moisture content (Moronkola et al., 2011) and this was expressed by the following formula:

\[
\text{Moisture (\%)} = \frac{\text{loss in weight due to dryness} \times 100}{\text{Weight of sample taken}} = \frac{W_2 - W_3 \times 100}{W_2 - W_1}
\]

Where,
- \( W_1 \) = weight of empty crucible,
- \( W_2 \) = weight of crucible + sample before drying,
- \( W_3 \) = weight of crucible + sample after attaining constant weight on drying

**Determination of Percentage Ash Content:** This was carried out as describe by Moronkola et al. (2011), where porcelain crucible with lid was ignited in a hot Bunsen burner flame and transferred into desiccator to cool and the crucible was weighed. 5 g of the sample was accurately weighed into the crucible and gently placed in the muffle furnace set at 600 °C for 4 hours. The crucible was place in desiccator to cool. The ashed sample in the crucible was weighed after cooling without the lid and the process repeated thrice for the sample. The result was calculated using the following formula:

\[
\% \text{ of Ash Content} = \frac{W_3 - W_1 \times 100}{W_2 - W_1}
\]

Where,
- \( W_1 \) = weight of empty crucible,
- \( W_2 \) = weight of crucible + sample before ashing
- \( W_3 \) = weight of crucible + sample after ashing

**Determination of Percentage Crude Fat:** 2 g of the sample was transferred into a beaker and weighed as \( W \), 10ml of water was added, and the solid was dispersed by agitating it. 10 ml of concentrated hydrochloric acid was added and immersed in a boiling water bath until the solid particle dissolved and the mixture become brown in colour. This was allowed to cool and 10ml of alcohol added and agitated vigorously. A dried clean flask was weighed and recorded as \( W_1 \) and the ether layer was transferred into the flask and placed in a boiling water bath to evaporate the ether. The extraction was repeated by adding 50 ml diethyl ether in order to evaporate the ether living the fat behind. The fat and the flask were weighed and recorded as \( W_2 \), then the fat content was calculated as follows:

\[
\% \text{ Fat} = \frac{W_2 - W_1 \times 100}{W}
\]

**Determination of Total Carbohydrate Content:** The total carbohydrate content of the sample was obtained as described by Moronkola et al., (2011), where the results from fat, protein, moisture and ash content analyses were sum up and the carbohydrate content was calculated as follows:

100 % (% moisture + % protein + % fat + % ash).

**Estimation of Protein:** Protein content in sample was determined by Lowry’ method, (1951). Extraction of protein was done using buffers used for the enzyme assay. 500 mg of sample was grinded well with a pestle and mortar in 5-10 ml of the buffer. Centrifuged and the supernatant was used for protein estimation. 0.2 ml to 1ml of the working standard was pipette out into a series of test tubes. 0.1 ml and 0.2 ml of the sample extract was pipette out into other two test tubes. The volume was made upto 1ml in all the test tubes by using distilled water. A tube with 1 ml of water serves as
the blank. 5 ml of alkaline copper solution was added to all the test tubes, mixed well and allowed to stand for 10 min. Then 0.5 ml of Folin-ciocalteau reagent was added, mixed well and incubated at room temperature in the dark for 30 min. Blue colour is developed and read at 660 nm. The amount of protein content in the sample was found out using the standard graph and expressed in mg/g or 100g sample.

**Estimation of Ascorbic acid:** Ascorbic acid content in the samples was estimated by the method of Roe and Keuth (1943). 1g of powdered sample extract was homogenized in 10 ml of 4% TCA and centrifuged at 2000 rpm for 10 min. The supernatant was treated with a pinch of activated charcoal, shaken well and kept it for 10 min. Centrifugation was repeated twice to remove the charcoal residues. The volume of the clear supernatants obtained was noted. 0.5 ml and 1 ml of the supernatant was taken for the assay and the volume was made up to 2.0 ml with 4% TCA. Series of working standard ascorbic acid solution (0.2 to 1.0 ml) was made up to 2.0 ml with 4% TCA and to this 0.5 ml of Dinitrophenylhydrazine (DNPH) reagent and two drops of 10% thiourea solution to all the test tubes. The osazones formed after incubation at 37 ºC for 3 hrs, were dissolved in 2.5 ml of 85% H₂SO₄ in ice cold, with no appreciable rise in temperature. To the blank alone, DNPH reagent and thiourea solutions were added after the addition of 85% H₂SO₄. After incubation for 30 min. at room temperature, the solutions were read at 695 nm against blank. The experiment has been conducted in triplicates and values are expressed as equivalents of Ascorbic acid (mg)/g of the sample.

**Total antioxidant capacity:** The total antioxidant capacity was determined by Phosphomolybdenum method, the method described by Prieto et al., (1999). Methanol extract is added into a series of test tube containing methanol and mixed with 2 ml of Phosphomolybdenum reagent solution. Then the tubes have been kept in water bath for 90 min at 95 ºC. The resultant mixture was cooled to room temperature and the absorbance was read at 540 nm against blank. The experiment has been conducted in triplicates and values are expressed as equivalents of Ascorbic acid (mg)/g of the sample.

**Determination of Sensory evaluation of wine (Organoleptic analysis), pH, Colour Density and Colour Tint, Total Acidity and Volatile Acidity, Temperature and Alcohol Content, Specific Gravity by the method described by Bobai et al., (2017):**

- At day 1st, 8th, 15th and 22th the following parameters were conducted.

**Sensory Evaluation of the Fermented Fruits Wines (Organoleptic analysis):** Sensory evaluation of the fermented fruits wines was made by ten panellist comprising of staff and students of Biosciences, Department of Biosciences, Mangalore University. The samples were evaluated using a standard “Scoring Difference Test” method (Hodgson, 2008) following the instructions provided in the sensory evaluation questionnaires. Aroma was evaluated based on the intensely of flavours like yeast.

**pH:** The sample were taken in the clean beaker. The pH paper, meter and pH solution were used to determine the pH of the samples and the reading was noted.

**Colour density and colour tint:** The sample were taken in the cuvette and reading at 420 nm, 520 nm and 700 nm. Colour density was measured using formula.

\[
\text{Colour density} = \left( \text{Absorbance 520nm} - \text{Absorbance 700nm} \right) + \left( \text{Absorbance 420nm} - \text{Absorbance 700nm} \right)
\]

\[
\text{Colour tint} = \left( \text{Absorbance 420nm} - \text{Absorbance 700nm} \right) + \left( \text{Absorbance 520nm} - \text{Absorbance 700nm} \right)
\]

**Total acidity and volatile acidity of wine:** 5ml of each wine sample and 5ml of distilled water was taken in the conical flask 2-3 drops of 1% phenolphthalein indicator was added and mixed. The solution was titrated against 0.1N NaOH taken in the burette. Titration was continued till the solution turns from colourless to pink. The end point was noted. To find volatile acidity of wine, 5ml of wine sample and 5 ml of distilled water is taken in the conical flask. Keep the sample in hot air oven for 10 min. then add 2-3 drops of 1% phenolphthalein indicator and mix. The solution is titrated against 0.1N NaOH taken in the burette. Titration will continue till the solution turns colourless to pink. The end point is noted.

**Total acidity =** \[\text{volume of alkali x Normality of alkali ÷ volume of sample taken}\] x 7.5

**Volatile acidity =** \[\text{volume of alkali x Normality of alkali ÷ volume of sample taken}\] x 6

**Measurement of Temperature:** One hundred and twenty 120°C mercury bulb thermometer was inserted to the side arm of the fermentation tank through a sterile rubber cork. The periodic temperature change during fermentation was recorded.

**Determination of Alcohol:** This was determined using the %Sugar/Specific gravity/Brix/ PA equivalent table according to AOAC (2007).
**Determination of Specific Gravity (S.G):** Empty weight of the bottle was determined (M0). The weight of the bottle plus 5ml of the sample was noted (M1). The bottle and distilled water (M2), and the specific gravity further calculated:

\[
\text{Specific Gravity} = \frac{\text{Wt of volume of Sample (M1 – M0)}}{\text{Wt of an equal volume of water (M2 – M0)}}
\]

**Data Analysis**

Data generated were subjected to statistical analysis using one-way Analysis of Variance (ANOVA) and a significant difference was considered when \(P<0.05\).

**RESULTS AND DISCUSSION**

**Proximate and Qualitative Analysis of fruits**

**Table 1: Proximate Analysis of Fruit Samples**

<table>
<thead>
<tr>
<th>Parameters/Samples</th>
<th>Phyllanthus emblica</th>
<th>Passiflora edulis</th>
<th>Averrhoa bilimbi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture (%)</td>
<td>2.68±0.005</td>
<td>8.89±0.015</td>
<td>96.91±0.056</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>3.88±0.01</td>
<td>1.91±0.01</td>
<td>0.32±0.017</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>0.63±0.026</td>
<td>21.03±0.01</td>
<td>0.48±0.005</td>
</tr>
<tr>
<td>Crude Protein (%)</td>
<td>17.01±0.005</td>
<td>6.45±0.05</td>
<td>0.61±0.005</td>
</tr>
<tr>
<td>Carbohydrate (%)</td>
<td>24.21±0.026</td>
<td>38.28±0.056</td>
<td>98.36±0.055</td>
</tr>
</tbody>
</table>

The experimental results were expressed as mean ± standard error means (SEM) of triplicates, \(P<0.05\) considered as significant.

Table 1 and 2, showed the proximate composition and qualitative analysis of fruits i.e., Phyllanthus emblica, Passiflora edulis and Averrhoa bilimbi must having low protein content, total carbohydrate and Ascorbic acid content, but showed high antioxidant activity. Moisture content was high Averrhoa bilimbi when compared to Phyllanthus emblica and Passiflora edulis.

**Table 2: Quantitative Analysis of Fruit Samples**

<table>
<thead>
<tr>
<th>Samples</th>
<th>Protein (mg/g)</th>
<th>Ascorbic acid (mg/g)</th>
<th>Antioxidant activity (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phyllanthus emblica</td>
<td>12.5±0.05</td>
<td>21.32±0.025</td>
<td>50.325±0.001</td>
</tr>
<tr>
<td>Passiflora edulis</td>
<td>62.49±0.036</td>
<td>21.32±0.02</td>
<td>44.175±0.001</td>
</tr>
<tr>
<td>Averrhoa bilimbi</td>
<td>18.416±0.028</td>
<td>29.625±0.001</td>
<td>59.803±0.045</td>
</tr>
</tbody>
</table>

The experimental results were expressed as mean ± standard error means (SEM) of triplicates, \(P<0.05\) considered as significant.

**Study of organoleptic properties of wine sample:**

Sensory evaluation after of overlooked in most wine tasting. It involved the study of different composition of appearance, aroma and flavour with proper maturation and aging the wine. Many compositional change constituents to the improved taste. The improvement change includes polymerization of phenolic compounds and reduction activity. Polymerization of phenolic compound and reduction acidity. Phenolics compound play important role in taste and flavour of the wine.

On 1st day, taste, colour, aroma in different wine sample was tested. As day-by-day increases, the alcoholic content in wine sample increased. Hence, they produce alcoholic smell. pH is the equivalences measure of hydrogen ion concentration in a juice and wine. pH is negative logarithm of concentration of free hydrogen ion in juice and wine. pH is the fundamental element of the wine using in industry. pH strongly influences the property and as colour density, oxidation, biological and chemical ability. pH measures the quality of acids and effect of the property and the ingredients in the wine. Wine pH depend on these main factors, the total amount of acids presents in the ratio of malic acid to tartaric acid, the amount of potassium. pH value ranges from 2.9 to 4.9 in wine, lower pH values are known to improve the ability, wine that contain little acids and excess of acid, show high pH value.

Different wine showed different pH during initial days, pH increases as acidity of wine increases. From day-1, pH of various wine was noted and it was acidic in nature. On 1st day pH was 3 of Phyllanthus emblica, Passiflora edulis and Averrhoa bilimbi. On 8th day pH of Passiflora edulis and Averrhoa bilimbi was noted to be 4 and Phyllanthus emblica remained same. On 15th and 22nd day the pH remained same. After filtration Phyllanthus emblica, Passiflora edulis and Averrhoa bilimbi showed pH 5. The initial taste of each wine sample was sweet as fruit taste. As day increases the taste of wine changes to bitter, sour and alcoholic. The colour of wine before fermentation is same as fruit colour but later colour of wine changes. Aroma of wine also changes from fruity to alcoholic smell. Hence the changes in aroma, taste.
colour, increases in acidity indicates the wine is ready for consumption. Results are represented showing graphs (1, 2 and 3).

Temperature of the Phyllanthus emblica, Passiflora edulis and Averrhoa bilimbi fruit wines throughout the period of fermentation ranged from 16 to 28 °C. A similar observation has been reported by Reddy and Reddy (2009) where temperature values for quality mango fruit wine production was 5 to 30 °C. The rises in temperature recorded may be due to the catabolic processes of sugars by yeast cells resulting in metabolic heat that ultimately increased the temperature as reported by Ukwuru and Awah (2013). The production of heat during fermentation as an exothermic process means that the temperature of the fermentation in the vessel rises.

Generally, the percentage alcohol produced from the respective fruits at the end of fermentation with the same yeast was recorded as 6.5 %, 9.1 % and 8 % for Phyllanthus emblica, Passiflora edulis and Averrhoa bilimbi respectively and there was no significant difference (P>0.05) between the values. Similar findings by Chilaka et al., (2010) revealed that during fermentation of passion fruit, water melon and pineapple fruits must, the percentage alcohol content ranged from 10.14 to 12.8 %. This however, according to Okunowo and Okotore (2005) is comparable with moderate grape wine.
The current investigation revealed that the specific gravity values ranged from 1.813 to 0.790 for Phyllanthus emblica, 1.875 to 1.045 for Passiflora edulis and 2.0 to 1.222 for Averrhoa bilimbi respectively, and there was no significant difference (P>0.05) between the values during fermentation of three fruits must. Steady decreases in specific gravity values were observed to be inversely related to increase in alcohol content, as remarkable amount of alcohol was produced from the fruit wines during fermentation with the test yeast.

**Determination of colour density and colour tint:**

Colour density indicates age, fruit variety, density of flavour, acidity and more. The more concentration and opaque a wine colour, the higher its intensity. Common descriptors for colour intensity are pale, medium and dark. When evaluating aroma and flavour, the more pronounced or evident the characteristics, the more intense the wine.

**Table 3: Colour density and Colour tint of different wine sample (Before Filtration)**

<table>
<thead>
<tr>
<th>Samples</th>
<th>Phyllanthus emblica</th>
<th>Passiflora edulis</th>
<th>Averrhoa bilimbi</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DAY 1: 21-11-2023</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour Density</td>
<td>1.335±0.001</td>
<td>0.137±0.001</td>
<td>1.114±0.001</td>
</tr>
<tr>
<td>Colour Tint</td>
<td>1.336±0.001</td>
<td>0.136±0.001</td>
<td>1.114±0.002</td>
</tr>
<tr>
<td><strong>DAY 8: 29-11-23</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour Density</td>
<td>1.958±0.001</td>
<td>1.258±0.001</td>
<td>0.148±0.337</td>
</tr>
<tr>
<td>Colour Tint</td>
<td>1.956±0.002</td>
<td>1.257±0.001</td>
<td>0.921±0.001</td>
</tr>
<tr>
<td><strong>DAY 15: 06-12-23</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour Density</td>
<td>1.786±0.001</td>
<td>1.025±0.001</td>
<td>0.931±0.075</td>
</tr>
<tr>
<td>Colour Tint</td>
<td>1.782±0.005</td>
<td>1.023±0.002</td>
<td>0.969±0.004</td>
</tr>
<tr>
<td><strong>DAY 22: 13-12-23</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour Density</td>
<td>1.111±0.001</td>
<td>0.661±0.001</td>
<td>0.844±0.003</td>
</tr>
<tr>
<td>Colour Tint</td>
<td>1.113±0.002</td>
<td>0.661±0.001</td>
<td>0.845±0.003</td>
</tr>
</tbody>
</table>

The experimental results were expressed as mean ± standard error means (SEM) of triplicates, P<0.05 considered as significant.

High colour come from high anthocyanin content and high tannins associated with red wines. colour varies with wine processing practices, particularly, fermentation temperature. Co-pigmentation in the wine and berry colour (related to presence of anthocyanins) enhances the wine colour.

The colour density and colour tint go on decreasing day by day. The changes take place in colour density and colour tint in the different wine sample in the different period of time as shown in table 3 and 4.

**Table 4: Colour density and Colour tint of different wine sample (After filtration)**

<table>
<thead>
<tr>
<th>Samples</th>
<th>Phyllanthus emblica</th>
<th>Passiflora edulis</th>
<th>Averrhoa bilimbi</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AFTER FILTRATION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour Density</td>
<td>1.141±0.006</td>
<td>0.592±0.005</td>
<td>0.602±0.001</td>
</tr>
<tr>
<td>Colour Tint</td>
<td>1.343±0.169</td>
<td>0.542±0.079</td>
<td>0.501±0.003</td>
</tr>
</tbody>
</table>

The experimental results were expressed as mean ± standard error means (SEM) of triplicates, P<0.05 considered as significant.

**Total Acidity and Volatile Acidity:**

Total acidity is a measure of the total organic acids in a juice or wine being analysed. The test may be quick method to calculate the acidity of the sample. In this method NaOH is used to titrate and end point is mentioned using phenolphthalein indicator (1%). It is difficult to the end points in the red wine. The major interference with this method is CO₂. Therefore, it is important to degree of the sample price to stability list. Other interference includes, using the important incorrect concentration of phenolphthalein and net measuring the correct volume of wine.

Malic acid and tartaric acid are the primary acids in grape wines, and these acids have direct influence on growth and vitality of yeast during fermentation (Bellman and Gallander, 2009). The measure of the amount of acidity in wine is known as the “titratable acidity or total acidity” which refers to the test that yields the total of all acids present, while the strength of the acidity is measured according to pH, with most wines having pH values between 2.9 and 3.9. Generally, the lower the pH the higher the acidity in the wines (Bellman and Gallander, 2009). Also, acetic acid is a two-carbon organic acid produced in wine during or after the fermentation period. It is the most volatile of the primary acids associated with wine and is responsible for the sour taste (Bobai Mathew et al., 2017).
pH and temperature increased percentage titratable plasticity and
anthocyanin, which keep the skin bright and glowing. Wine contains high levels of antioxidants in the form of flavonoids which can combat unwanted clotting by keeping the blood vessels flexible. Antioxidants rejuvenate the skin, increase skin care mainly responsible for keeping us healthy. Polyphenols, a certain type of antioxidants present in red wines prevent for prevention of diseases and promotion of health.

Wine contains phytochemicals, essential nutrients, flavonoids, alkaloids, anthocyanin, carotenoids and phenolic compounds for prevention of diseases and promotion of health. The seasonality of all alcoholic content also increased which is also controlled by specific gravity. Carbon dioxide enters the gaseous phase from the liquid phase at room temperature. The total amount of relative concentration of volatile acids is small compound to initial acidity. When alcohol content increases day by day the total acidity and volatile acidity decreases. The variation in total acidity and volatile acidity of different wine sample are shown in table 5 and 6.

The experimental results were expressed as mean ± standard error means (SEM) of triplicates, P<0.05 considered as significant.

Volatile acidity is the correct volume of wine, more volatile (more vaporized). Volatile acidity is used routinely as an indication of wine spoilage. Volatile acidity is generally interpreted as acetic acid content (g/l). In this procedure sample is diluted with water followed by titration with standard sodium hydroxide. Volatile acids are those that can enter the gaseous phase from the liquid phase at room temperature. The total amount of relative concentration of volatile acids are small compound to initial acidity. When alcohol content increases day by day the total acidity and volatile acidity decreases. The variation in total acidity and volatile acidity of different wine sample are shown in table 5 and 6.

The process of winemaking has existed for around 7,000 years, but only in the last 150 years has the science behind it been understood. Engineers and scientists have since improved the process by making it more consistent and efficient, but there is still much about wine making that remains elusive.

CONCLUSION

Wine contains a wide variety of the biologically active compounds including antimicrobial compounds (phenolics, acids, alcohols, bioamines, etc.) which possess the numerous health benefits. Wine is a beverage resulting from the fermentation of the juice by yeasts with proper processing and addition. After fermentation process of Passiflora edulis, Phyllanthus emblica and Averrhoa bilimbi fruit wine, quality analysis was carried out using standard procedures. During fermentation process of the Passiflora edulis, Phyllanthus emblica and Averrhoa bilimbi fruits, the pH values ranged from 3.3 to 5. Temperature also increased from 17 to 28 °C, when pH and temperature increased alcoholic content also increased which is also controlled by specific gravity. Percentage titratable and volatile acidity of all fruit wines also ranged between the normal range. Colour density and tint value are also responsible for the flavour, colour and longevity of wine samples. Sensory evaluation revealed that all the wines samples had acceptable colour, aroma and taste. There was significant difference (P<0.05) between temperature and volatile acidity values. These fruits, contains phytochemicals, essential nutrients, flavonoids, alkaloids, anthocyanin, carotenoids and phenolic compounds for prevention of diseases and promotion of health.

Wine is enriched with powerful antioxidants like resveratrol, epicatechin, catechin, and proanthocyanidins and are mainly responsible for keeping us healthy. Polyphenols, a certain type of antioxidants present in red wines prevent unwanted clotting by keeping the blood vessels flexible. Antioxidants rejuvenate the skin, increase skin elasticity and keep the skin bright and glowing. Wine contains high levels of antioxidants in the form of flavonoids which can combat strongly against viruses. Most of the fruits, contains phytochemicals, essential nutrients, flavonoids, alkaloids, anthocyanin, carotenoids and phenolic compounds for prevention of diseases and promotion of health. The seasonality of some flowers, fruits and vegetables and absence of industrial utilization makes them underutilized. The study includes

| Table 5: Total acidity and Volatile acidity of different wine sample (Before Filtration) |
|---------------------------------|-----------------|-----------------|-----------------|
| Samples                        | Phyllanthus emblica | Passiflora edulis | Averrhoa bilimbi |
| DAY 1: 21-11-2023 (Before Filtration) |
| Total acidity                  | 0.623±0.020       | 0.943±0.040     | 0.348±0.004     |
| Volatile acidity               | 0.63±0.026        | 0.743±0.011     | 0.264±0.001     |
| DAY 8: 29-11-23                |
| Total acidity                  | 0.763±0.015       | 0.946±0.001     | 0.361±0.007     |
| Volatile acidity               | 0.655±0.012       | 0.748±0.006     | 0.264±0.001     |
| DAY 15: 06-12-23               |
| Total acidity                  | 0.813±0.008       | 0.916±0.001     | 0.283±0.004     |
| Volatile acidity               | 0.356±0.005       | 0.766±0.001     | 0.613±0.001     |
| DAY 22: 13-12-23               |
| Total acidity                  | 0.764±0.001       | 0.915±0.001     | 0.254±0.001     |
| Volatile acidity               | 0.613±0.001       | 0.636±0.001     | 0.217±0.001     |

The experimental results were expressed as mean ± standard error means (SEM) of triplicates, P<0.05 considered as significant.

| Table 6: Colour density and Colour tint of different wine sample (After Filtration) |
|---------------------------------|-----------------|-----------------|-----------------|
| Samples                        | Phyllanthus emblica | Passiflora edulis | Averrhoa bilimbi |
| AFTER FILTRATION               |
| Total acidity                  | 1.022±0.002      | 1.05±0.01       | 0.217±0.001     |
| Volatile acidity               | 0.791±0.002      | 0.194±0.002     | 0.828±0.001     |

The experimental results were expressed as mean ± standard error means (SEM) of triplicates, P<0.05 considered as significant.
the utilization of all these in making wine. It gives an opportunity to ferment all these into value-added product such as wine to preserve their nutrients, minerals, aroma and taste and make them available to consumers all year round.

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