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Effect of Physico-Chemical Characteristics of Developed Mixed Fruits Wine during Fermentation Process

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The mixture of fruits pulp containing low sugar and thus sugar level was adjust from 25 ^{o}Brix by using sugar solution. The pH level of mixture was adjusted at 4. The juice was yeast by *Saccharomyces cerevisiae* with 1%. The Specific gravity of mixed fruit wine showed an increasing trend for all the treatments with fermentation period up to 0, 10, 20 and 30 days. The TSS largely affects the various physic-chemical parameters of fermented wine. Sugar is the main substrate for fermentation of fruits juice into alcohol. The specific gravity of the wine was found to be decreased with increase in sugar percent. The highest value of alcohol content was found 17.43% (v/v) in T_6 sample after last day of fermentation period with 1% of yeast concentration. It has been observed that the sample show the high alcoholic wine.

Keywords: Fruits; fermentation; TSS; specific gravity; alcoholic wine.

1. INTRODUCTION

In the case of fruits, India is one of the largest producers in the world. Fruits are encompassed by the most important foods of mankind as they are not only nutritive but are also indispensable for the maintenance of health. The fresh fruits as well as in processed form not only improve the

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quality of our diet but also hand over essential nutrients like vitamins, minerals, carbohydrates, etc. The fruit and vegetable preservation industry in India utilizes less than 2% of the total production of fruit and vegetables for conversion into products as against 40 to 50 percent in advanced countries [1].

Grapes are known to be the most commonly used raw material for the production of wine [2]. Winemaking is one of the most ancient technologies and is now one of the most commercially prosperous biotechnological processes. Most of the yeasts grow very well between pH 4.5 and 6.5 and nearly all species are not able to grow in more acidic or alkaline media. Low or high pH values are known to cause chemical stress on yeast cells [3].

Strains of *Saccharomyces cerevisiae* yeast which are known to deliver diverse unpredictable profiles have been regularly utilized for alcoholic maturation. Be that as it may, there is an absence of information on mango wine creation particularly managing the accessibility of neighborhood mango cultivars for wine creation and other yeast strains for enhancement states of aging and portrayal of its wine delivered [4].

Aging of the wine, utilizing acidic corrosive microbes changes liquor over to acidic corrosive accordingly bringing about the item known as vinegar [5]. Vinegar is a significant additive and fixing and it has an assortment of modern, clinical, and homegrown utilizations [6].

Wines are regular utilization characterized as a result of the typical alcoholic aging of the juice of sound ready grapes. Grape wines are maybe the most monetarily significant organic product juice liquor [7]. Non-accessibility and generally significant expense of getting successful financially alcoholic fermentative *Sacchahromycese cerevisiae* [8].

2. MATERIALS AND METHODS

2.1 Alcohol Content

Alcohol determination by specific gravity method provides an approximation of the alcohol content only. The method assume that the difference in specific gravity. Before and after fermentation is due solely to the conversion of sugars before fermentation. The alcohol content calculates by the following relation:

$$\text{Alcohol (\%v/v)} = (SG_2 - SG_1)/\ 0.0074$$

Where,

SG_1= Initial specific gravity measurement
SG_2= Final specific gravity measurement

2.2 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 [9] and this was expressed by the following formula:

$$\text{\% moisture content} = \frac{loss\ in\ weight\ due\ to\ dryness}{weight\ of\ sample\ taken} \times 100$$

$$= \frac{W2-W3}{W2-W1} \times \mathbf{100}$$

Where,

W_1 = Weight of empty crucible
W_2 = Weight of Crucible + Weight of sample before drying
W_3 = Weight of crucible + Weight of sample after drying

2.3 pH

The pH was determined directly during fermentation using a digital pH meter as described by Ochai and Kolhatkar [10].

2.4 Total Soluble Solids (TSS)

The total soluble solid content was determined in terms of degree brix by using hand refractometer at 20°C (68°F). It measures TSS in terms of refractive index. Brix is a measure of solids only in case of pure sucrose solutions. Generally, fruit juices contain more sugar than any other soluble constituents and hence brix provides a useful guide of soluble solid or sugar content [11].

2.5 Specific Gravity

The specific gravity was determined using specific gravity bottle. The empty bottle was weighed, filled with distilled water and reweighed. It was then filled with sample and weighed [12].

The specific gravity, of the sample will be calculated, as follows:

$$\text{Specific gravity} = \frac{Ws}{Ww}$$

Where,

Ws = Weight of known volume of sample in gm

Ww = Weight of an equal volume of water in gm

2.6 Density

The density, ρ in kg/m^3, will be calculated as:

ρ=1000 x Specific gravity

2.7 Experimental Plan

The juice was extract by homogenizing the pulp mixer after washing the fruits. The mixture of fruits pulp containing low sugar and thus sugar level was adjust from 25 ^{o}Brix by using sugar solution. The pH level of mixture will adjusted at 4. The juice will yeast by *saccharomyces cerevisiae* with 1%. The complete mixture will be hold 30 days for fermentation at room temperature. The wine will racking pasteurization (60^{o}C, 3 min.) and bottling after fermentation process.

2.8 Fermentation Process

The good quality fruits were procured from the local market of Meerut. The fruits were washed with water and unwanted material like dust; dirt and surface adhering were removed. The fruits were peeled with the help of a stainless steel knife and boot the ends of the fruits were weighted according to the treatments ratio.

After setup the treatments of sample the sugar level in juices were adjusted at 25 ^{o}Brix and yeast *Sacharomyces cerevisiae* was added to the clarified juice to initiate fermentation for 30 days. The yeast percentages were used in the treatment 1% than the samples were fermented at room temperature. In red wine making the pulp, skins and seeds of grapes and other fruits are kept together after crushing and during all parts of the fermentation. This is done to extract color and flavor. The post fermentation process was necessary to ensure good conservation and presentation of produced mixed fruit wine.

3. RESULTS AND DISCUSSION

3.1 Effect on Specific Gravity

The experimental data are presented in Table 1. The data were analyzed to observe the effect of 1% yeasting concentration of mixed fruit wine during fermentation period as show in bar diagrams (Fig. 1).

The Specific Gravity of mixed fruit wine showed an increasing trend for all the treatments with fermentation period up to 0, 10, 20 and 30 days. The study revealed that specific gravity of the samples having yeast concentration of 1%.

Estimation of specific gravity of T_1, T_2, T_3, T_4, T_5 and T_6 has been conducted. It has been studied that as the number of day's increases, the specific gravity also increases gradually. The specific gravity ranges from 1.133 to 1.217 for T_1 on 1st day to last day of fermentation period. 1.087 was the starting specific gravity of T_2 which increased to 1.214 on 30th day. The initial specific gravity of T_3 was 1.110 which increased to 1.215 on the 30th day. For T_4, the specific gravity starts from 1.087 and increased to 1.220 on 30th day. On the 1st day the specific gravity was 1.097 for T_5 and then it increased to 1.214 on 30th day. In case of T_6, specific gravity was 1.120 on 1st day which increased to 1.216 on 30th day.

3.2 Effect on Total Soluble Solids (TSS)

The TSS content of mixed fruit wine showed a decreasing trend for all the treatments with fermentation period up to 30 days. The study revealed that TSS of the samples having 1% yeast was observed as 25 ^{o}Brix in fresh samples. From Table 2 and Fig. 2 it was observed that TSS of all the samples decreased with fermentation period (0, 10, 20, and 30 days).

The TSS largely affects the various physic-chemical parameters of fermented wine. Sugar is the main substrate for fermentation of fruits juice into alcohol. The specific gravity of the wine was found to be decreased with increase in sugar percent. This might be due to increase in alcohol percent with increase in sugar percent.

Estimation of TSS of T_1, T_2, T_3, T_4, T_5 and T_6 has been conducted. It was found that as the number of day's increases, the TSS (^{o}Brix) also decreases gradually. The TSS (^{o}Brix) ranges from 25 to 12.33 for T_1 on 1st day to last day of fermentation period. 25 was the starting TSS (^{o}Brix) of T_2 which decreased to 11.33 on 30th day. The initial TSS (^{o}Brix) of T_3 was 25 which decreased to 12.33 on the 30th day. For T_4, the TSS (^{o}Brix) starts from 25 and decreased to 11.33 on 30th day. On the 1st day the TSS (^{o}Brix) was 25 for T_5 and then it decreased to 10.67 on 30th day. In case of T_6, TSS (^{o}Brix) was 25 on 1st day which decreased to 10.67 on 30th day.

3.3 Effect on Density

The Density of mixed fruit wine showed an increasing trend for all the treatments with

fermentation period up to 0, 10, 20 and 30 days. The study revealed that density of the samples having yeast concentration of 1%. The experimental data are presented in Table 3. The data were analyzed to observe the effect of 1% yeasting concentration of mixed fruit wine during fermentation period as show in bar diagrams Fig. 3.

Estimation of density of T_1, T_2, T_3, T_4, T_5 and T_6 has been conducted. It has been studied that as the number of day's increases, the density also increases gradually. The density ranges from 1133 to 1217 kg/m^3 for T_1 on 1st day to last day of fermentation period. 1087 kg/m^3 was the starting density of T_2 which increased to 1214 kg/m^3 on 30th day. The initial density of T_3 was 1110 kg/m^3 which increased to 1215 kg/m^3 on the 30th day. For T_4, the density starts from 1087 kg/m^3 and increased to 1220 kg/m^3 on 30th day. On the 1st day the density was 1097 kg/m^3 for T_5 and then it increased to 1214 kg/m^3 on 30th day. In case of T_6, density was 1120 kg/m^3 on 1st day which increased to 1216 kg/m^3 on 30th day.

3.4 Effect on pH Content

According to Mountnet, pH directly affects wine stability. This may be as a result of the fact that at a pH close to neutral (7.0), most microorganisms such as bacterial and molds including some yeasts become more active for fermentation and subsequent spoilage of wine, while pH below 3.5 eliminates most of the microbes and favors only a few of the microorganisms for fermentation. Molds and yeasts are usually low pH tolerant and are therefore associated with the spoilage of food with low pH. Yeasts can grow in a pH range of 4 – 4.5 and molds can grow from 2 – 8.5 but favor low pH.

The pH plays an important role in aging, clarifying or fining. As the strength of the relative charge of suspended particles decreases in the wine, the pH of the wine increases. At high pH, organic protein fining agents may possess a positive charge insufficient to bind to the negatively charged particulates, thus potentially increasing the turbidity of the wine [13].

Table 1. Specific gravity for 1% yeasting during fermentation period

Treatments ⇩	Days ⇨	0 Day	30 Day	60 Day	90 Day
T_1		1.133	1.181	1.211	1.217
T_2		1.087	1.171	1.202	1.214
T_3		1.110	1.188	1.214	1.215
T_4		1.087	1.171	1.208	1.22
T_5		1.097	1.190	1.208	1.214
T_6		1.120	1.195	1.214	1.216

Table 2. TSS of 1% yeasting during fermentation period

Treatments ⇩	Days ⇨	0 Day	10 Day	20 Day	30 Day
T_1		25	21	13	12.33
T_2		25	20	12.33	11.33
T_3		25	19	13.33	12.33
T_4		25	20	12.33	11.33
T_5		25	20	12.33	10.67
T_6		25	21	12	10.67

Table 3. Density of 1% yeasting during fermentation period

Treatments ⇩	Days ⇨	0 Day	10 Day	20 Day	30 Day
T_1		1133.33	1171.33	1211.8	1217.00
T_2		1086.67	1171.33	1202.03	1214.33
T_3		1110.00	1180.67	1214.00	1215.00
T_4		1086.67	1188.33	1207.66	1220.00
T_5		1096.67	1190.33	1208.00	1214.00
T_6		1120.00	1194.00	1213.66	1215.67

Table 4. pH of 1% yeasting during fermentation period

Treatments ⇩ Days ⇨	0 Day	10 Day	20 Day	30 Day
T_1	4.50	3.96	3.867	3.90
T_2	4.50	4.13	4.067	3.65
T_3	4.50	4.13	3.867	3.59
T_4	4.50	4.1	3.867	3.58
T_5	4.50	4.13	3.9	3.56
T_6	4.50	4.27	4	3.52

Estimation of pH content of T_1, T_2, T_3, T_4, T_5 and T_6 has been conducted. It has been studied that as the number of day's increases, the pH content also decreases gradually. The pH content ranges from 4.50 to 3.9 for T_1 on 1st day to last day of fermentation period. 4.50 was the starting pH content of T_2 which decreased to 3.65 on 30th day. The pH content of T_3 was 4.5 which decreased to 3.59 on the 30th day. For T_4, the pH content starts from 4.50 and decreased to 3.58 on 30th day. On the 1st day the pH content was 4.50 for T_5 and then it decreased to 3.56 on 30th day. In case of T_6, pH content was 4.50 on 1st day which decreased to 3.52 on 30th day. The experimental data are presented in Table 4. The data were analyzed to observe the effect of 1% yeasting concentration of mixed fruit wine during fermentation period as show in bar diagrams (Fig. 4).

3.5 Effect on Alcohol Content

The alcohol content production of mixed fruit wine showed an increasing trend for all the treatments with fermentation period up to 30 days. The experimental data are presented in Table 5. The data were analyzed to observe the effect of 1% yeasting concentration of mixed fruit wine during fermentation period as show in bar diagrams (Fig. 5).

The Alcohol content of mixed fruit wine showed an increasing trend for all the treatments with fermentation period up to 0, 10, 20 and 30 days. The study revealed that specific gravity of the samples having yeast concentration of 1%.

Estimation of alcohol content of T_1, T_2, T_3, T_4, T_5 and T_6 has been conducted. It has been studied that as the number of day's increases, the alcohol content also increases gradually. The alcohol content ranges from 0 to 9.92% (v/v) for T_1 on 1st day to last day of fermentation period. 0 was the starting alcohol content of T_2 which increased to 12.75% (v/v) on 30th day. The initial alcohol content of T_3 was 0 which increased to 13.70% (v/v) on the 30th day. For T_4, the alcohol content starts from 0 and increased to 16.67% (v/v) on 30th day. On the 1st day the alcohol content was 0 for T_5 and then it increased to 17.21% (v/v) on 30th day. In case of T_6, alcohol content was 0 on 1st day which increased to 17.43% (v/v) on 30th day.

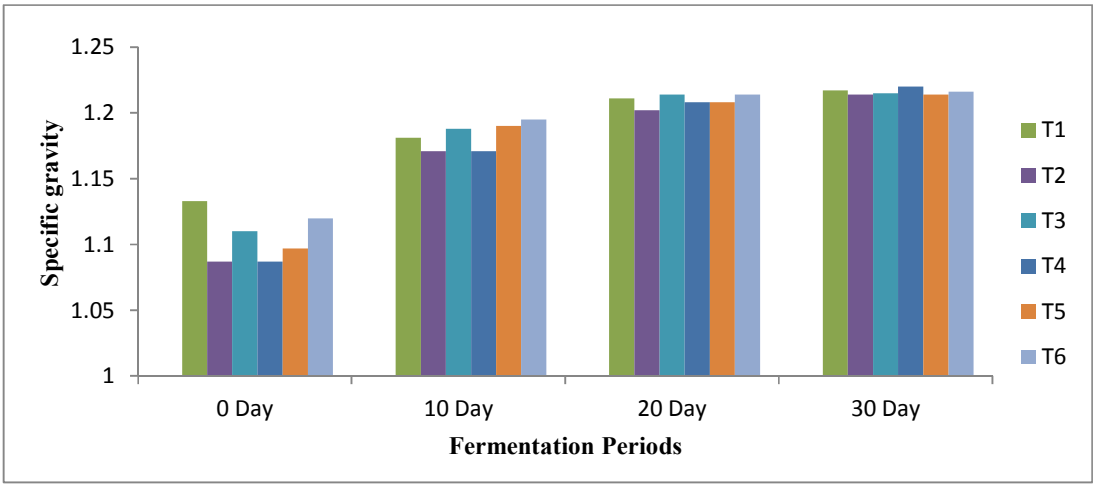

Fig. 1. Specific gravity for 1% yeasting during fermentation period

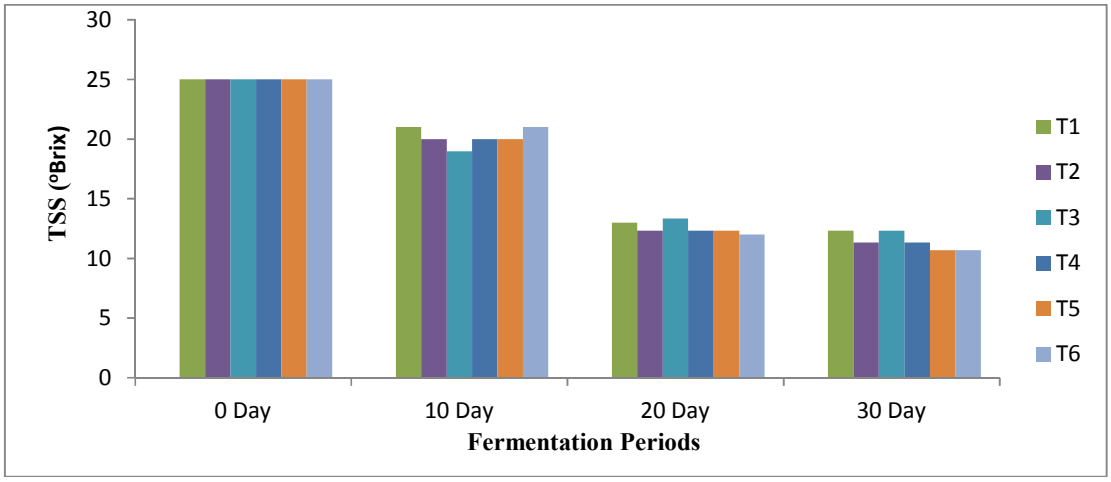

Fig. 2. TSS (°Brix) for 1% yeasting during fermentation period

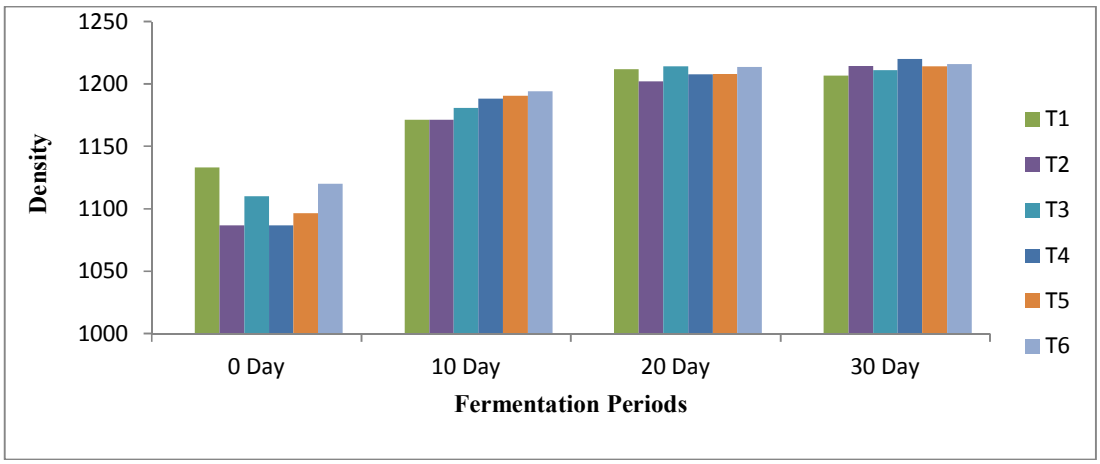

Fig. 3. Density for 1% yeasting during fermentation period

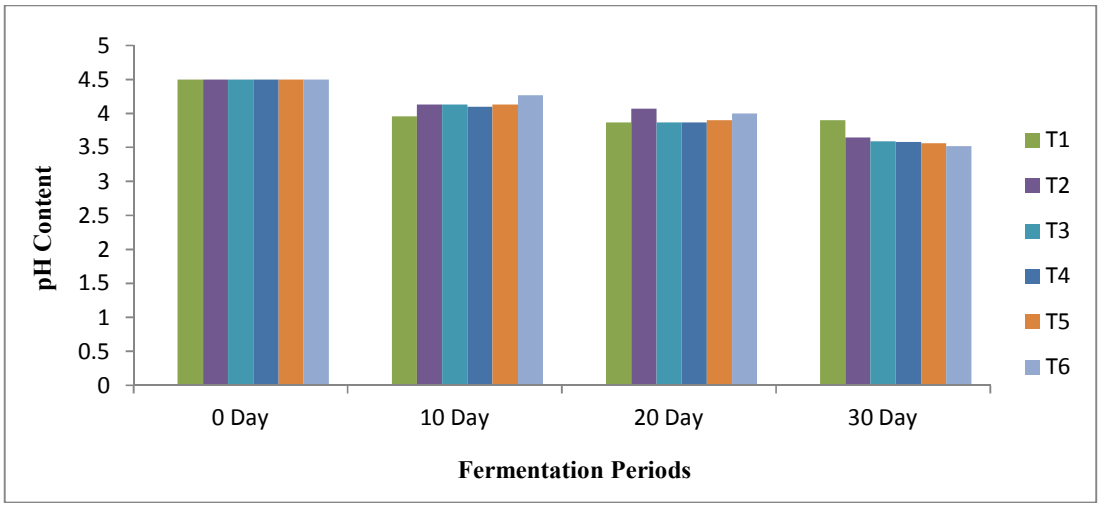

Fig. 4. pH content for 1% yeasting during fermentation period

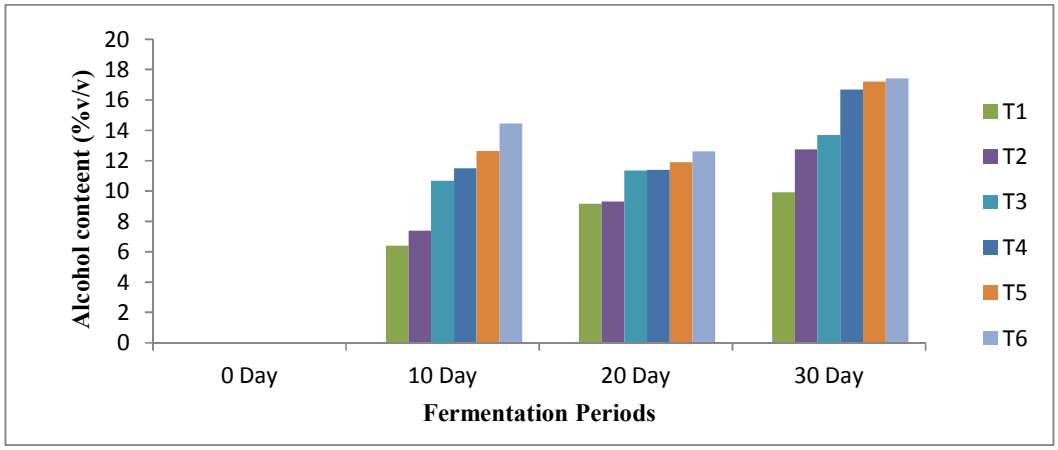

Fig. 5. Alcohol of 1% yeasting during fermentation period

Table 5. Alcohol of 1% yeasting during fermentation period

Treatments ⇩	Days ⇨	0 Day	10 Day	20 Day	30 Day
T_1		0	6.397	9.144	9.92
T_2		0	7.39	9.32	12.75
T_3		0	10.673	11.35	13.7
T_4		0	11.487	11.4	16.67
T_5		0	12.657	11.89	17.21
T_6		0	14.457	12.61	17.43

4. CONCLUSION

Winemaking involves mainly three types of fermentation process such as pre-fermentation, fermentation and post fermentation operations [14-16]. In the case of wines made from grapes, pre-fermentation involves crushing the fruit and releasing juice. In case of white wine, juices are separated from the skin whereas in red wine the skins are not separated from the juice. Fermentation involves a reaction that converts the sugar in the juice into alcohol and carbon dioxide. Yeast utilizes the sugars during the fermentation period. A stuck fermentation occurs when yeasts do not completely utilize the available sugar and the rate of fermentation slow down. The post fermentation practices are done after fermentation has reached the desired stage or when fermentation is completed.

The specific gravity of mixed fruits wine observed an increasing trend for all treatments with increasing in fermentation period upto 30 days. The T_6 sample has observed the maximum value of specific gravity (1.216) after last day of fermentation period with 1% of yeast concentration. The TSS (^{o}Brix) of mixed fruits wine observed a decreasing trend for all treatments with increasing in fermentation period upto 30 days. The T_6 sample has observed the minimum value of TSS (10.67) ^{o}Brix after last day of fermentation period with 1% of yeast concentration. The density of mixed fruits wine observed an increasing trend for all treatments with increasing in fermentation period upto 30 days. The T_6 sample has observed the maximum value of density (1216) after last day of fermentation period with 1% of yeast concentration. The pH content of mixed fruits wine observed decreased trend for all treatments with increasing in fermentation period upto 30 days. The T_6 sample has observed the minimum value of pH content (3.52) after last day of fermentation period with 1% of yeast concentration. The alcohol content of mixed fruit wine showed an increasing trend for all the treatments with increasing in fermentation period upto 30 days. The highest value of alcohol content was found 17.43% v/v in T_6 sample after last day of fermentation period with 1% of yeast concentration. It has been observed that the sample show the high alcoholic wine.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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