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Studies on Different Level of Wine Yeast and Sugar for Making Sapodilla Wine (*Manilkara zapota*)

Lemba S. Chang, Saket Mishra, Himanshu Mishra, Ashish Kumar Patel, Shashi Kant Ekka

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ABSTRACT

Completely Randomized Design (CRD) was used to perform the study, which included 9 treatments with three replications each. Treatments consisted of T_1 Sapota juice (750 ml) Wine yeast (1.25) + sugar (200 g), T_2 Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (250 g), T_3 Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (150 g), T_4 Sapota uice (750 ml) Wine yeast (0.75 g)+sugar (200 g),T_5 Sapota juice (750 ml) Wine yeast (0.75) +sugar (150 g),T_6 Sapota juice (750 ml) Wine yeast (1.25 g) + sugar (150 g), T_7 Sapota juice (750 ml) Wine yeast (0.75 g) +sugar (250 g), T_8 Sapota juice (750 ml) Wine Yeast (1.0g) + sugar (200g), T_9 Sapota juice (750 ml) Wine yeast(1.25 g)+ sugar (250 g). With longer fermentation times, the alcohol content, acidity, and sensory qualities increased while total soluble solids, pH, and specific gravity declined. According to the results of the aforementioned treatments, treatment T_8 was superior in terms of factors including total soluble solids, acidity, pH, alcohol concentration, and specific gravity. The optimum treatment in terms of appearance and color was discovered to be T_7. Additionally, T_8 received the highest grade for the taste treatment, T_2 for the aroma treatment, and T_7 for overall acceptability. In terms of cost benefit ratio, therapy T_8 had the highest Net Return and Cost Benefit Ratio. Since sapota fruit is high in sugars, minerals and polyphenols making wine from it may be a practical way to maintain the fruit's nutritive and anti-inflammatory qualities. By making wine from this fruit, wine diversity can be increased and post-harvest losses can be decreased. This study shown that sapota may be used to make respectable wine utilizing yeast, particularly *Saccharomyces cerevisiae.*

Keywords Wine, Sapota, *Saccharomyces cerevisiae,* Sugar, Fermentation.

INTRODUCTION

The delectable fruits of the Sapota (*Manilkara zapota*), commonly referred to as the "chickoo," are cultivated all across the tropics. Tropical America introduces it to other nations, including Southern Florida in the United States, India, Sri Lanka, Indonesia, Burma, Guatemala, the Philippines, and Caribbean Islands. While the exact date of sapota's introduction to India is unknown, its first commercial

Lemba S. Chang[1], Saket Mishra[*2], Himanshu Mishra[3], Ashish Kumar Patel[4], Shashi Kant Ekka[5]

[2]Assistant Professor, [3,4,5]PhD Scholar, Department of Horticulture Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj 211007, UP, India

Email: saket.mishra@shiats.edu.in
*Corresponding author

cultivation began in the Maharashtra region in the village of Gholwad in 1898. Tropical climates with high humidity are ideal for sapota cultivation. As a result, it is primarily grown in India's coastal regions. It is a lovely tree with moderate growth and thick foliage. Sapota belongs to family Sapotaceae. There are numerous species in various genera of the family Sapotaceae that have edible fruits. In various regions of India, there are numerous sapota kinds growing. There are two major groupings of these, one with round fruits and the other with oval fruits. This character is unfortunately unstable. The same cultivar can simultaneously produce both round and oval fruits.

Besides table purposes, ripe sapota fruits are also used for making value added products like intermediate moisture foods, beverages and bakery products. Being sugar-rich, the fruit can be converted to fermented product like sapodilla wine. Impressive progress has been made in development of technologies for preparation of wines using fruits like mango, apple, pear, plum, pineapple, cashew-apple, banana, ber, strawberry, litchi (Joshi and Attri 2005). However, research work carried out on standardization of a suitable methodology for sapodilla wine is very limited and earlier work mainly focused on influence of fruit maturity and pectinase enzyme on sapota juice fermentation at room temperature (Pawar 2009). Present paper describes the result of experiments on evaluation of popular sapodilla varieties for wine making, effect of fruit peel removal on wine quality, optimization of clarification agent, preparation of diverse styles of sapodilla wines, and analysis of head space volatiles of sapodilla juice and dry wine.

MATERIALS AND METHODS

The current study, named " Effect of different levels of wine yeast and sugar in wine production from sapota (*Manilkara zapota*)," was conducted from March to June 2022 in the Post-Harvest Laboratory at the Sam Higginbottom University of Agriculture, Technology, and Sciences in Prayagraj. Completely Randomized Design (CRD) was used to perform the study, which included 9 treatments with three replications each. Treatments consisted of T_1 Sapota juice (750 ml) Wine yeast (1.25) + sugar (200 g), T_2 Sapota juice (750 ml) Wine yeast (1.0 g)+ sugar (250 g), T_3 Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (150 g), T_4 Sapota juice (750 ml) Wine yeast (0.75 g)+sugar (200 g), T_5 Sapota juice (750 ml) Wine yeast (0.75) +sugar (150 g), T_6 Sapota juice (750 ml) Wine yeast (1.25 g) + sugar (150 g), T_7 Sapota juice (750 ml) Wine yeast (0.75 g) +sugar (250 g), T_8 Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (200 g), T_9 Sapota juice (750 ml) Wine yeast (1.25 g)+ sugar (250 g).

Preparation of must

Mature sapota fruits were selected and washed with tap water, removed the seed, peeled, sliced and cut into pieces and pulverized using sterile philip electric blender with the addition of water. The slurry was further diluted in a ratio of 1:1 (water and pulp) and sieved with a muslin cloth of pore size 0.8 mm to obtain the filtrate "must". Chaptalization and supplementation of the "must". The methods of Amerine and Kunkee as used by Robinson were used. These bottled juices were cold stored till further experiments were conducted.

Preparation of yeast starter culture

The yeast starter culture was prepared from a known amount of fermentation must, a little amount of sugar, yeast, and a known volume of water. All of these ingredients were combined, treated, and left to stand for 24 hrs. 200 ml of water were boiled and allowed to reach a temperature of 37 °C before 200 ml of a mixture of sapota must and sugar were added. After centrifuging the yeast (S. *cerevisiae*), 3.7 ml of the mixture, or approximately 108 cfu/ml, (measured using McFarland standard) was added. The mixture was then thoroughly mixed and let to stand for 24 hrs before use. The following factors, including specific gravity, pH, titratable acidity, total soluble solids, and alcohol level, were evaluated both before and during the fermentation process.

Fermentation of must

The addition of the starting culture started the primary fermentation. For four days, the must was stirred every 12 hrs, and the specific gravity, pH, temperature, and alcohol level were recorded afterward. The wine was transferred into the secondary fermentation after

4 days. A tube was introduced into a clean bottle containing clean water to perform the secondary fermentation in an airtight container. The key was to keep an eye on the fermenting process. This was permitted until fermentation was complete, which was typically within three weeks and could be seen by the absence of bubbles appearing in the container. For 21 days, secondary fermentation was carried out. When the fermenting process was complete, the wine was quickly racked off the lees to ensure minimal oxygen exposure. The upper liquid was then transferred to another clean container to filter out any contaminants. The mixture then kept fermenting for several more days at 20°C. After that, aged for three months in a 20°C storage environment. At the conclusion of the secondary fermentation, the wine's pH, titratable acidity, specific gravity, and microbial analyses were all checked.

Clarification of wine

After fermentation was completed, the wine was extracted, filtered through a clean, sterile muslin cloth, Whatman No. 1 filter paper, sieve, and syphon tubes sterilized with 70% alcohol, and then stored in sterile glass jars. For three weeks, the wine was racked in order to clarify it. Before doing further chemical analysis, the residues were eliminated and the filtrates were given time to develop. Clarification is an important step in the wine-making process since fermented wine includes sediments.

Aging

The most crucial phase following wine manufacturing is wine ageing because of its potential to increase wine quality for consumption. After maturation, the supernatant was removed, put into new, sterile bottles, corked, and pasteurized for 20 minutes at 82°C. After cooling, further allowed to age in long neck 750 ml bottles for 17 days at 22-25ºC before analysis (Chowdhury and Ray 2007). At intervals of 30 days, i.e. 30, 60, and 90 days following fermentation, the wine was examined for its physico-chemical qualities. After maturation, wines were also organoleptically rated by a team of judges to determine their approval by various consumer demographics.

Packaging and preservation

For storage and marketing, the mature wine should be packaged in sanitary containers. Glass bottles are excellent for packaging since they are simple to maintain. To significantly lower the microbe burden, the bottles that the wine will be put in should be sanitized. Glass is a traditional choice for wine packaging because of its inertness and clarity.

Storage

The evolution of the product in the bottle prior to consumption is highly significant since fresh wine must be matured until it is consumable and marketable, which is an important issue for storage when wine is stored for long-term ageing. Wine is one of the few products that can get better with age but can also quickly deteriorate if kept in unfavorable conditions, thus it is typically matured for a long length of time to allow the flavors to develop. Continuous changes in the composition of wine occur when it is in storage, and these changes are a function of factors like temperature, lighting, bottle location, oxygen concentration, and storage period. These changes are varied and intricate and can affect its aroma and color, as well as its phenolic composition. If adequate conditions are present during ageing, such as temperature, humidity and light, wines undergo important modifications so that their organoleptic characteristics improve. If a wine is placed at high temperatures, reactions among the components accelerate, often causing undesirable changes, whereas a wine stored at low temperature ages much slower and usually acquires preferable flavors and tastes. The wine bottles can be easily stored for more than six months at temperature between 10ºC to 25ºC but the bottles should be air tight to stop the effect of humidity. These bottles can be kept at any dry place for longer storage.

Sensory evaluation

Different treatments sensory evaluations were completed and given to a panel of judges for organoleptic assessment using a nine-point Hedonic scale (*Amerin et al.* 1965). For each assessment, the same judges were used. Before or after testing the provided sample, they were instructed to rinse their mouth. A judge-

ment form with a score card was given to each judge.

RESULTS AND DISCUSSION

Total soluble solids (TSS)

The TSS showed that there were significant differences among all the treatments during storage. There was subsequent decrease in TSS content at different periods of storage. In terms of Total Soluble Solids (TSS), as mentioned in Table 1, the lowest score of (15.7, 12.3, 9.4 and 6.2 °Bx) was observed in treatment T_8 Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (200 g), followed by treatment T_2 Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (250 g), with (16.7, 12.6, 9.8 and 6.7 °Bx) whereas the maximum score was observed in treatment T_5 Sapota juice (750 ml) Wine yeast (0.75) +sugar (150 g) with (16.9, 15.5, 13.2 and 9.0 °Bx) at Initial, 30, 60 and 90 days storage. The decrease in TSS content of wine indicates the utilization of the sugar present in the must during fermentation. The above results are similar with the findings of in banana wine, in jamun wine, Idise and Emmanuely (2011) in pineapple wine.

Alcohol content

The alcohol content showed that there were significant differences among all the treatments during storage. According to Table 1, the highest score of

Table 1. Physico- chemical parameters of effect of different levels of wine yeast and sugar in wine production from sapota.

Treatment	Treatment combination	TSS (°BRIX)				Alcohol content (%)			Titratable acidity (%)			
		Initial	30 Days	60 Days	90 Days	30 Days	60 Days	90 Days	Initial	30 Days	60 Days	90 Days
T_1	Sapota juice (750 ml) Wine yeast (1.25 g) + sugar (200 g)	15.9	13.5	11.2	7.2	3.79	6.41	8.77	0.29	0.48	0.55	0.66
T_2	Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (250 g)	16.7	12.6	9.8	6.7	4.19	7.59	9.17	0.27	0.47	0.53	0.64
T_3	Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (150 g)	15.2	13.9	10.7	7.6	3.66	6.28	8.51	0.30	0.47	0.54	0.67
T_4	Sapota juice (750 ml) Wine yeast (0.75 g) + sugar (200 g)	15.8	14.6	12.7	8.5	2.88	5.63	7.07	0.36	0.50	0.64	0.70
T_5	Sapota juice (750 ml) Wine yeast (0.75 g) + sugar (150 g)	16.9	15.5	13.2	9.0	2.09	4.32	6.41	0.33	0.53	0.62	0.76
T_6	Sapota juice (750 ml) Wine yeast (1.25g) + sugar (150g)	16.1	14.1	11.6	7.9	3.01	6.15	8.38	0.28	0.51	0.58	0.69
T_7	Sapota juice (750 ml) Wine yeast (0.75 g) + sugar (250 g)	17.2	15.1	12.3	8.3	2.35	4.71	7.46	0.34	0.52	0.61	0.74
T_8	Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (200 g)	15.7	12.3	9.4	6.2	4.32	7.72	9.56	0.25	0.48	0.56	0.60
T_9	Sapota juice (750 ml) Wine yeast (1.25 g) + sugar (250 g)	16.9	12.8	10.1	6.9	4.19	7.59	9.30	0.31	0.45	0.54	0.62
	F-Test	S	S	S	S	S	S	S	S	S	S	S
	SE (d)	0.080	0.293	0.147	0.152	0.090	0.106	0.189	0.007	0.010	0.012	0.016
	CD at 5%	0.170	0.621	0.310	0.321	0.191	0.224	0.400	0.014	0.020	0.025	0.035

Table 1. Continued.

Treatment	Treatment combination	pH				Specific gravity			
		Initial	30 Days	60 Days	90 Days	Initial	30 Days	60 Days	90 Days
T_1	Sapota juice (750 ml) Win yeast (1.25 g) + sugar (200 g)	5.68	5.42	4.87	4.24	1.063	1.034	1.014	0.996
T_2	Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (250 g)	5.81	4.73	4.20	3.17	1.078	1.046	1.020	1.008
T_3	Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (150 g)	5.58	5.25	4.83	4.13	1.054	1.026	1.006	0.989
T_4	Sapota juice (750 ml) Wine yeast (0.75 g) + sugar (200 g)	5.66	5.37	4.58	4.18	1.065	1.043	1.022	1.011
T_5	Sapota juice (750 ml) Wine yeast (0.75 g) + sugar (150 g)	5.59	5.54	4.91	4.62	1.056	1.040	1.023	1.007
T_6	Sapota juice (750 ml) Wine yeast (1.25 g) + sugar (150 g)	5.54	5.11	4.75	4.06	1.058	1.035	1.011	0.994
T_7	Sapota juice (750 ml) Wine yeast (0.75 g) + sugar (250 g)	5.77	4.95	4.47	3.91	1.075	1.057	1.039	1.018
T_8	Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (200 g)	5.65	4.67	4.16	3.65	1.066	1.033	1.007	0.993
T_9	Sapota juice (750 ml) Wine yeast (1.25 g) + sugar (250 g)	5.79	4.83	4.26	3.77	1.079	1.047	1.021	1.008
	F-Test	S	S	S	S	S	S	S	S
	SE (d)	0.010	0.099	0.099	0.081	0.001	0.002	0.005	0.003
	CD at 5%	0.020	0.209	0.209	0.172	0.002	0.003	0.011	0.007

Alcohol content (4.32, 7.72 and 9.56) was observed in treatment T_8 Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (200 g), followed by treatment T_9 Sapota juice (750 ml) Wine yeast (1.25 g)+ sugar (250 g) with (4.19, 7.59 and 9.30) whereas the maximum score was observed in treatment T_5 Sapota juice (750 ml) Wine yeast (0.75) +sugar (150 g) with (2.09, 4.32 and 6.41) at 30, 60 and 90 days storage. The increase in Alcohol content of sapota wine with different levels of wine yeast and sugar during storage may possibly due to the variation in performance of the yeast to utilize the fermentable sugars affecting the fermentability, hence the varied alcohol production Amerine and Ough (2005). The above results are similar with the findings of Chowdhury and Ray (2007) in jamun wine, in mahua wine, in banana sorghum beverage.

Titratable acidity (%)

There was subsequent increase in acidity at different periods of storage. According to Table 1, the lowest score of acidity (0.25, 0.48, 0.56 and 0.60) was observed in treatment T_8 Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (200 g), followed by treatment T_9 Sapota juice (750 ml) Wine yeast (1.25 g)+ sugar (250 g) with (0.31, 0.45, 0.54 and 0.62) whereas the maximum score was observed in treatment T_5 Sapota juice (750 ml) Wine yeast (0.75) +sugar (150 g) with (0.33, 0.53, 0.62 and 0.76) at Initial, 30, 60 and 90 days storage. The increase in acidity of sapota wine with different levels of wine yeast and sugar during storage may possibly be due to the effect of different yeast strain and fermentation period as shown in Fig 1. The increase in acidity may be due to the increased alcohol production from the high initial sugar concentration (Attri 2009).

pH

The pH showed that there were significant differences among all the treatments during storage. There was subsequent decrease in pH at different periods of storage. As mentioned in Table 1, the lowest score of pH (5.65, 4.67, 4.16 and 3.65) was observed in treatment T_8 Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (200 g), followed by treatment T_9 Sapota juice (750 ml) Wine yeast (1.25 g)+ sugar (250 g) with (5.79, 4.83, 4.26 and 3.77) whereas the maximum score was observed in treatment T_5 Sapota juice (750 ml) Wine yeast (0.75) +sugar (150 g) with (5.59, 5.54,

4.91 and 4.62) at Initial, 30, 60 and 90 days storage. The decrease in pH with increase in acidity of wine observed may be due to dissociation of parental acids and formation of hydrogen ions. The above results are similar with the findings of Reddy *et al*. (2001) in mango fruit wine, in amla wine, in mixed fruit wine (Pawar *et al. 2011*) in sapota wine. The pH of the wine depends on composition of the must, amount of organic acids and sugars present in the wine.

Specific gravity

The specific gravity showed that there were significant differences among all the treatments during storage. There was subsequent decrease in specific gravity at different periods of storage. According to Table 1, the lowest score of specific gravity (1.066, 1.033, 1.007 and 0.993) was observed in treatment T_8 Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (200 g), followed by treatment T_1 Sapota juice (750 ml) Wine yeast (1.25) + sugar (200 g) with (1.063, 1.034, 1.014 and 0.996), whereas the maximum score was observed in treatment T_7 Sapota juice (750 ml) Wine yeast (0.75 g) +sugar (250 g), with (1.075, 1.057, 1.039 and 1.018) at Initial, 30, 60 and 90 days storage. As the number of fermentation days in the wine grows, the specific gravity of the sapota wine produced in this study decreases. The type of yeast employed in the wine production may be the cause of the decline in specific gravity of sapota wine after storage when there are varying levels of wine yeast and sugar. Certain qualities of fruit wines have reportedly been diminished during fermentation (as observed in Fig 1.) by *Saccharomyces cerevisiae*. The above results are similar with the findings of *(*Amerine and Ough 2005), (Okafor *et al*. 2014), (Idise and Emmanuel 2011) .

Sensory evaluation

The color showed that there were significant differences among all the treatments during storage. According to Table 2, the maximum score of color and appearance (6.80, 7.10 and 7.50) was observed in treatment T_7 (Sapota juice 750 ml + Wine yeast 0.50 g + sugar 200 g), followed by treatment T_3 (Sapota juice 750 ml + Wine yeast 0.75 g + sugar 200 g with (6.75, 7.15 and 7.45), whereas the minimum score was observed in treatment T_6 (Sapota juice 750 ml + Wine yeast 0.75 g + sugar 150 g), with (4.00, 4.10 and 4.50) at 30, 60 and 90 days storage. The color and appearance of sapota wine showed increasing trend in all sapota wine during storage. Change in color of white wine from yellow to yellow-brown during the storage period as shown in Fig.1. Decrease in the values of the parameter in stored samples of rose wines during ageing ,these results suggested that the wines lost brightness and became darker.

The maximum score of taste according to Table 2, (6.55, 7.25 and 7.80) was observed in treatment T_8 (Sapota juice 750 ml + Wine yeast 1.0 g + sugar 150 g) followed by treatment T_2 (Sapota juice 750 ml + Wine yeast 1.5 g + sugar 250 g), with (6.85, 7.30 and 7.75), whereas the minimum score was observed in treatment T_5 (Sapota juice 750 ml + Wine yeast 1.15 g + sugar 250 g), with (4.15, 4.5 and 4.85) at 30, 60 and 90 days storage. The taste of sapota wine showed increasing trend in all sapota wine during storage. As the wine ages properly, the harsh taste and yeasty odour diminish and a smooth mellow flavor and clean odour are produced (Amerine and Ough 2005).

The maximum score of aroma according to Table 2. (6.90, 7.00 and 7.15) was observed in treatment T_2 (Sapota juice 750 ml + Wine yeast 1.5 g + sugar 250 g), followed by treatment T_7 (Sapota juice 750 ml + wine yeast 0.50 g + sugar 200 g), with (5.75, 6.50 and 6.75), whereas the minimum score was observed in treatment T_3 (Sapota juice 750 ml + wine yeast 0.75 g + sugar 200 g), with (4.00, 4.50 and 4.85) at 30, 60 and 90 days storage. The type and aroma produced during wine production is reported to depend on yeast, environmental factors and physico-chemical characteristics of the "musts". As the wine ages properly, the harsh and yeasty odour diminish and a smooth mellow flavor and clean odour are produced (Amerine and Ough 2005).

The maximum score of overall acceptability (6.47, 6.97 and 7.33) was observed in treatment T_7 (Sapota juice 750 ml + Wine yeast 0.50 g + sugar 200 g) According to Table 2, followed by treatment T_2 (Sapota juice 750 ml + Wine yeast 1.5 g + sugar 250 g), with (6.18, 6.58 and 6.98) ,whereas the minimum score was observed in treatment T_5 (Sapota juice 750

ml + Wine yeast 1.15 g + sugar 250 g), with (4.25, 4.58 and 4.83) at 30, 60 and 90 days storage. The overall acceptability of sapota wine showed increasing trend in all sapota wine during storage. High overall quality score observed in sapota wine may be due to original good sensory properties of juice, appreciable fermentation of juice by yeast which is indicated by high alcohol content. Maturation altered various components of wine, which are desirable for the sensory quality. The reduction in phenolic compounds in white wines produced a decrease in body and astringency.

Fig. 1. Plate: Wine during fermentation.

Cost benefit ratio

The Cost Benefit Ratio showed that there were significant differences among all the treatments in Cost Net Return, Gross Return and Cost Benefit Ratio of different treatments. According to Table 3, the maximum Gross return of Rs 2200 each was obtained in treatments T_2 (Sapota juice 750 ml+ Wine yeast 1.5 g + sugar 250 g), T_8 (Sapota juice 750 ml + Wine yeast 1.0 g + sugar 150 g) and T_9 (Sapota juice 750 ml + Wine yeast 1.25 g + sugar 250 g) and minimum was found in treatments T_4 (Sapota juice 750 ml + Wine yeast 1.0 g + sugar 250 g), T_5 (Sapota juice 750 ml + Wine yeast 1.15 g + sugar 250 g) and T_7 (Sapota juice 750 ml + Wine yeast 0.50 g + sugar 200 g), with Rs 1800 respectively. The highest Net Return of Rs 650, Cost Benefit Ratio 1:1.42 was recorded in treatment T_8 (Sapota juice 750 ml + Wine yeast 1.0 g + sugar 150 g), followed by Treatment T_9 (Sapota juice 750 ml

Table 2. Sensory evaluation of effect of different levels of wine yeast and sugar in wine production from sapota.

Treatment	Treatment combination	Color and Appearance			Taste			Aroma			Overall acceptability		
		30 Days	60 Days	90 Days	30 Days	60 Days	90 Days	30 Days	60 Days	90 Days	30 Days	60 Days	90 Days
T_1	Sapota juice (750 ml) Wine yeast (1.25 g) + sugar (200 g)	5.50	6.00	6.55	5.65	6.10	6.50	5.58	6.10	6.55	5.67	6.07	6.53
T_2	Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (250 g)	5.10	5.50	6.00	6.85	7.30	7.75	6.90	7.00	7.15	6.18	6.58	6.98
T_3	Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (150 g)	6.75	7.15	7.45	5.00	5.25	5.55	4.00	4.50	4.85	5.25	5.63	5.97
T_4	Sapota juice (750 ml) Wine yeast (0.75 g) + sugar (200 g)	5.25	5.35	5.80	6.00	6.15	6.40	4.55	5.25	5.55	5.27	5.58	5.92
T_5	Sapota juice (750 ml) Wine yeast (0.75 g) + sugar (150 g)	4.70	5.00	5.15	4.15	4.50	4.85	3.90	4.25	4.50	4.25	4.58	4.83
T_6	Sapota juice (750 ml) Wine yeast (1.25 g) + sugar (150 g)	4.00	4.10	4.50	6.30	6.55	6.80	5.15	5.30	5.60	5.15	5.32	5.63
T_7	Sapota juice (750 ml) Wine yeast (0.75 g) + sugar (250 g)	6.80	7.10	7.50	6.10	6.52	6.55	5.75	6.50	6.75	6.47	6.97	7.33
T_8	Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (200 g)	4.75	5.10	5.30	6.55	7.25	7.80	5.05	5.15	5.50	5.30	5.50	5.78
T_9	Sapota juice (750 ml) Wine yeast(1.25 g) + sugar(250 g)	5.00	5.15	5.45	6.20	6.45	6.70	5.00	5.10	5.25	5.40	5.57	5.80
F-Test		S	S	S	S	S	S	S	S	S	S	S	S
SE (d)		0.065	0.024	0.111	0.118	0.124	0.120	0.153	0.153	0.117	0.090	0.128	0.130
CD at 0.5%		0.137	0.263	0.236	0.251	0.262	0.253	0.325	0.325	0.248	0.190	0.272	0.275

Table 3. Economics of different treatments and benefit cost ratio.

Treatment No.	Treatment	Total cost (Rs)	Sapota wine output (liter)	Selling rate (Rs)/ liter	Gross return (Rs)	Net return (Rs)	Benefit cost ratio
T_1	Sapota juice (750 ml) Wine yeast (1.25 g)+ sugar (200 g)	1548.25	2.00	1000	2000	452	1.29
T_2	Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (250 g)	1556.75	2.00	1100	2200	643	1.41
T_3	Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (150 g)	1551.37	2.00	1000	2000	449	1.29
T_4	Sapota juice (750 ml) Wine yeast (0.75 g)+sugar (200 g)	1554.5	2.00	900	1800	246	1.16
T_5	Sapota juice (750 ml) Wine yeast (0.75 g)+sugar (150 g)	1555.17	2.00	900	1800	245	1.16
T_6	Sapota juice(750 ml) Wine yeast (1.25 g) + sugar (150 g)	1549.37	2.00	1000	2000	451	1.29
T_7	Sapota juice (750 ml) Wine yeast (0.75 g) +sugar (250 g)	1550.25	2.00	900	1800	250	1.16
T_8	Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (200 g)	1550.5	2.00	1100	2200	650	1.42
T_9	Sapota juice (750 ml) Wine yeast (1.25 g) sugar (250 g)	1555.62	2.00	1100	2200	644	1.41

+ Wine yeast 1.25 g + sugar 250 g) with Net Return of Rs 644 and Cost Benefit Ratio 1:1.41, whereas the lowest Net Return of Rs 245 and Cost Benefit Ratio 1:1.16 was recorded in treatment T_5 (Sapota juice 750 ml + Wine yeast 1.15 g + sugar 250 g).

CONCLUSION

Based on above findings of the present experiment it is concluded that treatment T_8 Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (200 g), was found superior in respect of the parameters like Total Soluble Solids, Acidity, pH, Alcohol content, Specific gravity. In terms of color and appearance the best was treatment T_7 Sapota juice (750 ml) Wine yeast (0.75 g) +sugar (250 g), In terms of taste treatment T_8 Sapota juice (750 ml) Wine yeast (1.0 g) + sugar (200 g) got the maximum score, In terms of Aroma treatment T_2 (Sapota juice 750 ml + Wine yeast 1.5 g + sugar 250 g), and overall acceptability was found best in T_7 Sapota juice (750 ml) Wine yeast (0.75 g) +sugar (250 g) . In terms of cost benefit ratio, the highest Net Return of Rs 650, Cost Benefit Ratio 1:1.42 was recorded in treatment T_8 (Sapota juice 750 ml + Wine yeast 1.0 g + sugar 150 g), followed by Treatment T_9 (Sapota juice 750 ml + Wine yeast 1.25 g + sugar 250 g) with Net Return of Rs 644 and Cost Benefit Ratio 1:1.41.

REFERENCES

Amerine CS Ough (2005) Handbook of Methods for Analysis of Musts and Wines. *1st edn.* Wiley – Interscience Publications, New York.

Attri BL (2009) Effect of initial concentration on the physico- chemical characteristics and sensory qualities of cashew apple wine. *Ind J Natural Produ Resour.*

Chowdhury P, Ray RC (2007) Fermentation of Jamun (*Syzgium cumini* L.) fruits to form red wine. *ASEAN Food J* 14 (2007) Impress.

Idise, Emmanuel Okiemute (2011) Studies of wine produced from pineapple (*Ananas comosus*). *Int J Biotechno1 Molecular Biol Res.*

Joshi VK, Attri (2005) Panorama of wine research in India. *J Sci Indu Res.*

Okafor Ihediohanma *et al*. (2014) Physico-chemical and sensory acceptability of soursop (*Annona muricata*) *Wine. Int J Life Sci* 3 (2014) Inpress.

Pawar (2009) Standardization of Wine Making Technology from Sapota *(Manilkara achras* (Mill) Forsberg. PhD Diss. Univ Agric Sci Dharwad.

Reddy *et al*. (2010) Analysis of volatile aroma constituents of wine produced from Indian mango (*Mangifera indica* L.) by GC-MS. *Ind J Microbiol.*