RESEARCH ARTICLE

Standardization of pomegranate (*Punica granatum L.*) wine with different levels of sugar concentration

Rajan Singh*, Saket Mishra, Mithun Tarafdar

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The present research work entitled Standardization of pomegranate (*Punica granatum L.*) wine with different levels of sugar concentration the study was conducted in Completely Randomized Design (CRD) with 5 treatments replicated four. The treatments were T1 Pomegranate juice (500 ml)+200brix+wine yeast (0.133%), T2 Pomegranate juice (500 ml)+250brix+wine yeast (0.133%), T3 Pomegranate juice (500 ml)+300brix+wine yeast (0.133%), T4 Pomegranate juice (500 ml)+350brix+wine yeast (0.133%), T5 Pomegranate juice (500 ml)+400brix+wine yeast (0.133%) Total soluble solids, pH and Specific Gravity decreased while the alcohol content, Acidity and the Sensory Qualities increased with increasing length of fermentation. From the above treatments, it is concluded that treatment T3 was found superior in respect of the parameters like Total Soluble Solids, Acidity, pH, Alcohol content, Specific gravity. With respectively colour and appearance, Taste, Aroma and Overall acceptability also T3 was found best. In terms of cost benefit ratio, the highest net return, Cost Benefit Ratio was found in T3. Since Pomegranate contains good sugar proportion which makes it suitable for wine making, the production of wine from this fruit can help increase wine variety and reduce post-harvest losses. This study showed that acceptable wine can be produced from Pomegranate using yeast especially *Saccharomyces cerevisiae*.

Key Words: *Wine; Pomegranate; Fermentation; Yeast; Sugar*

INTRODUCTION

Pomegranate (*Punica granatum L.*) Punicaceae is an ancient, beloved fruit crop. The name "pomegranate" follows the Latin name of the fruit *Malum granatum*, which means "grainy apple." The generic name Punica refers to Phoenicia (Carthage) as a result of mistaken assumption regarding its origin. The pomegranate and its usage are deeply embedded in human history and utilization is found in many ancient human cultures as food and as a medical remedy. The development of industrial methods to separate the arils from the fruit and improvement of growing techniques resulted in an impressive enlargement of the extent of pomegranate orchards. Fruit juice is full of sugar, which could cause weight gain. Consumption of wine, to get the benefits better, should be limited to a glass or two a day, as yeast converts some of the sugar during fermentation into alcohol. But the net loss of carbons going from sugar to alcohol is small (as carbon dioxide). These carbons get burned in body or get converted into fat. 100 ml of wine contains around 70 kcal, whereas 100 ml of pressed pomegranate juice will contain around 60 kcal. The soluble polyphenolic content of pomegranate juice (0.2 to 1.0%) includes anthocyanins, catechins, tannins, and gallic and ellagic acids. Kulkarnai and others reported that the antibacterial action of pomegranate juice varied with variety and depended on the contents of phenolic compounds, pigments and citric acid. New orchards are now planted in the traditional growing regions as well as in the southern hemisphere in South America, South Africa, and Australia. Pomegranate is a multiple fruit and the brilliantly colored arils have many nutritional value hundred grams of edible portion conations (3.5 g) energy 285 kcal (68 kcal), carbohydrates 17.17 g, sugars 16.57 g, dietary fiber 0.6 g, fat 0.3 g, protein 0.95 g, thiamine (Vit B1) 0.030 mg (2%), riboflavin (Vit B2) 0.063 mg (4%), niacin (Vit B3) 0.300 mg (2%), pantothenic acid (B5) 0.0596 mg (12%), vitamin B6 0.105 mg (8%), flute (Vit B9) 6 mg (2%), Vitamin C 6.1 mg (10%), calcium 3 mg (2%), iron 0.30 mg (2%), magnesium 3 mg (1%), phosphorous 8 mg (5%), potassium 259 mg (6%) and zinc 0.12 mg (1%) (LaRue and James, 1980). Wine is an alcoholic beverage resulting from the fermentation of grape juice by yeast with proper processing and addition. Different varieties of grapes and strains of yeasts are used depending on the type of wine being produced. Although other fruits such as apples, berries can be also be fermented, the resultant wines are normally named after the fruit from which they are produced for example, (pomegranate, jamun and amla wine) are generally known as fruit wine or country wine. The utilization of such fruits by processing into value added products is one of the better managements of non-marketable Pomegranate fruits as wine is an alcoholic beverage resulting from the fermentation of fruits juices by yeast with proper processing and additional sugar. The natural sugars and control (0.2% to 0.1%) which includes anthocyanins, catechins, tannins gallic and ellagic is ideal for wine from sorted preparation similar to grapes. Keeping health benefits of Pomegranate in view a possible preparation of wine sorted Pomegranate arils with different concentrations of sugar syrup is attempted in the present in investigation.

MATERIALS AND METHODS

The Preparation of wine from Pomegranate arils prepared with 5 treatments and four replications were stored for 90 days under ambient room temperature. which were T1 Pomegranate juice 500 ml+200brix+wine yeast 0.133%, T2 Pomegranate juice 500 ml+25%brix+wine yeast 0.133%, T3 Pomegranate juice 500 ml+300brix+wine yeast 0.133%, T4 Pomegranate juice 500 ml+35° brix+wine yeast 0.133% T5 Pomegranate juice 500 ml+400 brix+wine yeast 0.133% and four replications. After the preparation of wine that were stored for 90 days under ambient room temperature. The procedure of making Pomegranate wine is given below:

Preparation of juice

Preparation of juice, the pomegranate was be washed, then peeled and cored. After chipping and pressing, add 0.1 mg/L pectin for enzymolysis and held for 2 hr. in water at 40°C. The slurry was filtered through double folded cheese cloth. Adding SO2 to the juice immediately to prevent the growth of the bacteria. White sugar was added to the juice, for adjustment of sugar level and citric acid to pH enhance the flavor of the wine. Finally, the juice was pasteurized (65°C for 30 min) (Table 1).

Preparation of yeast

Prepared a specialized yeast medium 1 lit and autoclaved for 15 min at 121°C. After cooling to room temperature, 0.133% of active dry yeast was added and, activated for 24 hr. at 28°C. Then the culture medium that was prepared by 1 lit pomegranate juice was autoclaved for 15 min at 121°C. Lastly, adding 5% yeast has been activated for 24 hr at 28°C after cooling to room temperature (Table 2).

Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211007, India

Correspondence: *Singh R, Department of Horticulture, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj-211007, India, E-mail: rajansingh8323@gmail.com*

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Fermentation of pomegranate juice

The treated juice was added into the fermentation jar, and then sugar is adjusted for 20°Brix. The jar was inoculated with 5% activated yeast and closed. Then the mixture was incubated at 20°C for 7 days. The total sugar, total acid and alcohol content were monitored periodically during the fermentation. When the main fermentation finished, the upper liquid was transferred to the other clean container in order to remove impurities. Then the mixture continued to ferment at 20°C for 10 days. After that, under the storage conditions of 20°C aged for 2 months. The clarifying treatment of the fruit wine was followed by the gelatin tannin clarification method (Table 3).

TABLE 1

Studies on different level of sugar on colour and appearance, taste and aroma in pomegranate during storage

Treatment	Treatment combination	Colour and appearance			Taste			Specific gravity (Pomegranate wine)		
		30 days	60 days	90 days	30 days	60 days	90 days	30 days	60 days	90 days
T_1	Pomegranate juice (500 ml)+20 brix+wine yeast (0.133%)	6.62	6.85	7.05	6.63	6.82	7.07	1.53	1.29	1.2
T_2	Pomegranate juice (500 ml)+25 brix+wine yeast (0.133%)	6.35	6.37	7.32	6.33	6.38	7.33	1.65	1.35	1.27
T_3	Pomegranate juice (500 ml)+30 brix+wine yeast (0.133%)	7.42	7.58	7.88	7.38	7.41	7.95	1.23	1.14	1.05
T_4	Pomegranate juice (500 ml)+35 brix+wine yeast (0.133%)	6.47	6.67	6.96	6.39	6.63	7	1.52	1.44	1.34
T_5	Pomegranate juice (500 ml)+40 brix+wine yeast (0.133%)	6.18	6.43	7.18	6.17	6.41	7.2	1.51	1.37	1.22
	F test	S	S	S	S	S	S	S	S	S
	C.D. @ 0.5	0.29	0.19	0.15	0.3	0.29	0.17	0.09	0.11	0.05
	S.Ed.	0.13	0.09	0.07	0.14	0.13	0.08	0.04	0.05	0.02

TABLE 2

Studies on different level of pH, overall acceptability, and TSS in pomegranate wine during storage

Treatment	Treatment combination	pH				Overall acceptability			TSS			
		Initial	30 days	60 days	90 days	30 days	60 days	90 days	Initial	30 days	60 days	90 days
T_1	Pomegranate juice (500 ml)+20 brix+wine yeast (0.133%)	3.76	3.54	3.28	3.06	6.64	7.05	7.06	12.47	6.39	5.42	4.4
T_2	Pomegranate juice (500 ml)+25 brix+wine yeast (0.133%)	4.07	3.79	3.38	3.16	6.37	7.1	7.32	12.21	6.17	5.22	4.36
T_3	Pomegranate juice (500 ml)+30 brix+wine yeast (0.133%)	3.67	3.31	3.09	2.96	7.46	7.88	7.93	13.75	7.45	6.29	3.37
T_4	Pomegranate juice (500 ml)+35 brix+wine yeast (0.133%)	4.08	3.76	3.35	3.18	6.49	7.05	6.98	11.64	6.2	4.65	4.14
T_5	Pomegranate juice (500 ml)+40 brix+wine yeast (0.133%)	4.11	3.94	3.21	3.29	6.21	7.11	7.19	11.71	6.15	5.09	4.2
	F test	S	S	S	S	S	S	S	S	S	S	S
	C.D. @ 0.5	0.2	0.18	0.16	0.13	0.29	0.18	0.16	0.93	0.3	0.43	0.28
	S.Ed.	0.09	0.08	0.08	0.06	0.13	0.08	0.07	0.43	0.14	0.2	0.13

TABLE 3

Studies on different level of sugar on alcohol, acidity and aroma in pomegranate wine during storage

Treatment	Treatment combination	Alcohol			Acidity				Aroma		
		30 days	60 days	90 days	Initial	30 days	60 days	90 days	30 days	60 days	90 days
T_1	Pomegranate juice (500 ml)+20 brix+wine yeast (0.133%)	8.39	9.45	10.17	0.54	0.35	0.27	0.22	6.67	6.81	6.58
T_2	Pomegranate juice (500 ml)+25 brix+wine yeast (0.133%)	7.46	8.08	9.34	0.55	0.44	0.23	0.19	6.42	6.35	7.44
T_3	Pomegranate juice (500 ml)+30 brix+wine yeast (0.133%)	10.58	11.39	11.9	0.32	0.25	0.18	0.13	7.58	7.72	7.96
T_4	Pomegranate juice (500 ml)+35 brix+wine yeast (0.133%)	6.69	7.49	8.42	0.51	0.46	0.26	0.19	6.62	6.67	6.89
T_5	Pomegranate juice (500 ml)+40 brix+wine yeast (0.133%)	7.1	7.73	6.37	0.47	0.48	0.24	0.15	6.29	6.51	7.21
	F test	S	S	S	S	S	S	S	S	S	S
	C.D. @ 0.5	0.25	2.67	0.21	0.1	0.07	0.05	0.05	0.33	0.27	0.39
	S.Ed.	0.11	1.23	0.1	0.05	0.03	0.02	0.02	0.15	0.12	0.18

Clarification of wine

After completion of fermentation, the obtained wine was siphoned off and filtered thrice through 5 µ, 1 µ and 0.001 µ filters. Clarification is an important procedure in wine production as the fermented wine contains sediments.

RESULTS AND DISCUSSION

The present investigation entitled "standardization of pomegranate (*Punica granatum L.*) wine with different levels of sugar concentration" was carried out under the horticulture post-harvest laboratory in the department of Horticulture, SHUATS during 2020-2022. The main objectives of the present investigation were to different levels of sugar concentration on the production of best quality wine from pomegranate and to find out its acceptability during storage.

Total soluble solids (TSS)

In terms of Total Soluble Solids, the lowest score of TSS (13.75, 7.45, 6.29, and 3.370brix) at Initial, 30, 60 and 90 days after storage was observed in treatment T3 (Pomegranate juice 500 ml+Sugar 300brix+Wine yeast 0.133%), followed by treatment T4 (Pomegranate juice 500 ml+Sugar 350brix+Wine yeast 0.133%) with (11.64, 6.20, 4.65 and 4.140brix) at Initial, 30, 60 and 90 days after storage, whereas the maximum score was observed in treatment T1 (Pomegranate juice 500 ml+Sugar 200brix+Wine yeast 0.133%) with (12.47, 6.39, 5.42 and 4.400brix during 90 days storage. The decrease in TSS content of wine indicates the utilization of the sugar present in the must during fermentation. Similarity has been seen in jamun wine, pomegranate wine and in banana wine [1-3].

Alcohol content

In terms of Alcohol content (%) The highest score of Alcohol content (10.58, 11.39 and 11.90) at 30, 60 and 90 days after storage was observed in treatment T3 (Pomegranate juice 500 ml+Sugar 300brix+Wine yeast 0.133%) followed by treatment T1 (Pomegranate juice 500 ml+Sugar 200brix+Wine yeast 0.133%) with (8.39, 9.45 and 10,17) at 30, 60 and 90 days after storage, whereas the minimum score was observed in treatment T5 (Pomegranate juice 500 ml+Sugar 400brix+Wine yeast 0.133%) with (7.10, 7.73 and 6.37) during 90 days storage. The increase in Alcohol content of pomegranate wine with different levels of sugar concentration during storage may possibly due to the variation in performance of the yeast to utilize the fermentable sugars affecting the ferment ability, hence the varied alcohol product. The above results are similar with the findings of in jamun wine, [4,5] in Mahua wine.

Titratable acidity (TA)

In terms of Acidity The lowest score of Acidity (0.32, 0.25, 0.18 and 0.13) at initial, 30, 60 and 90 days after storage was observed in treatment T3 (Pomegranate juice 500 ml+Sugar 300brix+Wine yeast 0.133%), followed by treatment T5 (Pomegranate juice 500 ml+Sugar 400brix+Wine yeast 0.133%) with (0.47, 0.48, 0.24 and 0.15) at initial, 30, 60 and 90 days after storage, whereas the maximum score was observed in treatment T1 (Pomegranate juice 500 ml+Sugar 200brix+Wine yeast 0.133%) with (0.54, 0.35, 0.27 and 0.22) during 90 days storage. The increase in acidity may be due to the increased alcohol production from the high initial sugar concentration, Attri reported that organic acids such as citric, malic, lactic, tartaric, oxalic and succinic acids were produced during fermentation in cocoa beans by *S. cerevisiae*. The increment of titratable acidity during fermentation is attributed to the production of different organic acids as observed in kiwi wine, Akubor, et al. [6] in banana wine, Pratima, et al. [7] who reported that level of inoculums had no effect on the TA of fermenting juice.

pH

In terms of pH The lowest score of pH (3.67, 3.31, 3.09 and 2.96) at initial, 30, 60 and 90 days after storage was observed in treatment T3 (Pomegranate juice 500 ml+300brix+Wine yeast 0.133%) followed by treatment T1 (Pomegranate juice 500 ml+Sugar 200brix+Wine yeast 0.133%) with (3.76, 3.54, 3.28 and 3.06) at initial, 30, 60 and 90 days after storage, whereas the maximum score was observed in treatment T5 (Pomegranate juice 500 ml+Sugar 400brix+Wine yeast 0.133%) with (4.11, 3.94, 3.21 and 3.29) during 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 [8] in mango fruit wine, [9] in sapota wine. The pH of the wine depends on composition of the must, number of organic acids and sugars present in the wine.

Specific gravity

In terms of Specific gravity The lowest score of Specific gravity (1.23, 1.14 and 1.05) at 30, 60 and 90 days after storage was observed in treatment T3 (Pomegranate juice 500 ml+30 0brix+Wine yeast 0.133%) followed by treatment T1 (Pomegranate juice 500 ml+200brix+Wine yeast 0.133%) with (1.53, 1.29 and 1.20) at 30, 60 and 90 days after storage, whereas the maximum score was observed in treatment T4 (Pomegranate juice 500 ml+Sugar 350brix+Wine yeast 0.133%) with (1.52, 1.44 and 1.34) during 90 days storage. The decrease in Specific gravity of pomegranate wine with different levels of wine yeast and sugar during storage may possibly due to the type of yeast used in the wine production. *Saccharomyces cerevisiae* has been reported to reduce specific quality of fruit wines during fermentation. The above results are similar with the findings of Okafor, et al., Idise, et al. [10-12].

Sensory evolution

In terms of colour and appearance. The maximum score of colours (7.49,7.58 and 7.88) at 30, 60 and 90 days respectively was observed in treatment T5 (Pomegranate juice 500 ml+Sugar 300brix+Wine yeast 0.133%), whereas the minimum score was observed in treatment T4 (Pomegranate juice 500 ml+Sugar 300brix+Wine yeast 0.133%) with (6.47, 6.67 and 6.96) during 90 days storage.

In terms of taste, the maximum score of Taste (7.38, 7.41 and 7.95) at 30, 60 and 90 days respectively was observed in treatment T3 (juice 500 ml+Sugar 300brix+Wine Yeast 0.133%) whereas the minimum score was observed in treatment T1 (Pomegranate juice 500 ml+Sugar 200brix+Wine Yeast 0.133%) with (6.63, 6.82 and 7.07) during 90 days storage.

In terms of Aroma, the maximum score of Aroma (7.96, 7.72, and 7.58) at 30, 60 and 90 days respectively was observed in treatment T3 (Pomegranate juice 500 ml+Sugar 300brix+Wine yeast 0.133%), whereas the minimum score was observed in treatment T1 (Pomegranate juice 500 ml+Sugar 200brix+Wine yeast 0.133%) with (6.58, 6.81 and 6.67) during 90 days storage.

In terms of Overall acceptability, the maximum score of Overall acceptability (7.46, 7.88 and 7.93) at 30, 60 and 90 days respectively was observed in treatment T3 (Pomegranate juice 500 ml+300brix+Wine yeast 0.133%), whereas the minimum score was observed in treatment T4 (Pomegranate juice 500 ml+350brix+Wine yeast 0.133%) with (6.49, 7.05 and 6.98) during 90 days storage.

CONCLUSION

Based on findings of the present experiment it is concluded that treatment T3 (Pomegranate juice 500 ml+30 brix+Wine Yeast 0.133%) was found superior in respect of the parameters like Total Soluble Solids, Acidity, pH, Specific gravity, Alcohol content with respectively color and appearance, taste, aroma and overall acceptability also T3 was found best. The increase in Alcohol content of pomegranate wine with different levels of sugar concentration during storage may possibly due to the variation in performance of the yeast to utilize the fermentable sugars affecting the ferment ability, hence the varied alcohol product. The pH of the wine depends on composition of the number of organic acids and sugars present in the wine.

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