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**Anjali M Gaharwar**  
Vasantrao Naik College of  
Agricultural Biotechnology,  
Yavatmal, Maharashtra, India

**Jayashri D Ughade**  
Vasantrao Naik College of  
Agricultural Biotechnology,  
Yavatmal, Maharashtra, India

**Megha Madake**  
Vasantrao Naik College of  
Agricultural Biotechnology,  
Yavatmal, Maharashtra, India

**Chetan Lokhande**  
Vasantrao Naik College of  
Agricultural Biotechnology,  
Yavatmal, Maharashtra, India

**Ram Nagarkar**  
Vasantrao Naik College of  
Agricultural Biotechnology,  
Yavatmal, Maharashtra, India

## Study on preparation of roselle and fruits blended roselle wine using yeast *Saccharomyces cerevisiae*

**Anjali M Gaharwar, Jayashri D Ughade, Megha Madake, Chetan Lokhande and Ram Nagarkar**

### Abstract

The experiment conducted with roselle fruit juice to prepare different wines from roselle using different fruit blends aimed to obtain quality roselle wine with higher acceptability, to standardize the wine process and to study the physicochemical characteristics of wines. The experiment was conducted during the year 2017-18 with roselle, papaya and ginger juice to prepare wine of Roselle sweet wine, Roselle dry wine and Sweet wines of Roselle blended with papaya and Roselle blended with ginger. The procedure of wine making for all these wines were developed and standardized at the Biotechnology laboratory of the VNCAB, Yavatmal. These wines were screened for different biochemical compositions and sensory attributes at 30 days of fermentation. Among all the wines, papaya blended roselle sweet wine was found most suitable for wine making as scored maximum points for overall acceptability i.e. 16.4 and categorized as good quality wine. Regarding the physico-chemical parameters, the wine prepared from papaya blended with roselle recorded the highest contents of TSS, reducing sugar, non-reducing sugar, total sugar and alcohol and thus found most suitable for wine production among all the four tested roselle wines.

**Keywords:** Roselle, papaya, ginger, yeast, blends, organoleptic test, wine

### Introduction

Roselle, (*Hibiscus sabdariffa*) is a shrub belonging to the family – Malvaceae is thought to be a native to Asia (India to Malaysia) or Tropical Africa. In Indian languages it is called as Lal-ambari, Patwa (Hindi), Lal ambadi (Marathi), Gongura, Yerra gogu (Telugu), Pulichchai kerai (Tamil), Pulachakiri, Pundibija (Kannada), Polechi, Pulichchai (Malayalam) and Chukiar (Assam). Roselle calyx is a cheap source of vegetable protein, fat and minerals. Regular consumption of Roselle may reduce nutritional deficiency problems such as night blindness, scurvy and rickets (Babalola *et al.* 2001) [4]. Calyxes of the red and dark red coloured types are extracted and sweetened to produce a refreshing drink while calyxes and leaves of the green type are used for making vegetable stew (Babalola *et al.*, 2001) [4]. Anthocyanins present in Roselle are dephinidin 3-sambubioside, cyaniding 3- sambubioside, delphinidin 3-glucoside and cyanidin 3-glucoside. They contribute benefits for health as a good source of antioxidants as well as a natural food colourant.

The technology of manufacturing red wine from grapes is well known. However, production of red wines from roselle and roselle blended with different fruits have a great opportunity to standardize the quality wine making and extracting the nutritional qualities of roselle and its potential for winery industry. In the pharmaceutical industry, Roselle used to make antibacterial agents, astringent, choleric agents, lubricants, digestive agent, a diuretic, emollient, laxative freshener dissipated agent, sedative, stomachic and tonic. Ginger, *Zingiber officinale*, (family-zingibaeceae) since known from ancient times for its remedies in herbal and aromatic traditional treatments for curing inflammation and diarrhea, to boost bone health and relieve joint pain, now Ginger has been discovered to be a facilitator of the digestive process it was recently proven by researchers that it has been discovered to be a facilitator of the digestive process. In many places, it is mostly used in sweets and alcoholic beverages such as ginger beer and wine. *Carica papaya*, the widely cultivated papaya (also called papaw or pawpaw), is a tropical fruit plant. Papaya is rich in antioxidant nutrients such as carotenes, flavonoids, and vitamin C, as well as vitamin B (folate and pantothenic acid). It is also a good source of fiber and minerals such as magnesium. Together, these nutrients help improve cardiovascular health and protect against colon cancer. Some fruit juices are fortified with sugar to enable the yeasts produce enough alcohol. In recent times, there has been an increase in demand for fruits alcoholic beverages. Hence, harnessing the potential of these under-utilized roselle vegetable with papaya and ginger for wine production would enhance efficient

### Correspondence

**Anjali M Gaharwar**  
Vasantrao Naik College of  
Agricultural Biotechnology,  
Yavatmal, Maharashtra, India

Utilization of these abundant natural resources and would invariably increase the nation's Gross Domestic Product (GDP). The pigment of the extract of *H. sabdariffa* calyx anthocyanins possesses medicinal values (Haji and Haji, 1999) [8]. Wang *et al.*, (1997) reported anti-oxidative capacity of anthocyanins. Mazza, 2000 reported the anthocyanins as anti-inflammatory, antihepatotoxic, antibacterial, antiviral antithrombic and antiallergenic.

### Materials and Methods

The experiment on "Study on preparation of roselle and fruit blended roselle wine using yeast *Saccharomyces cerevisiae*" was carried out at Biotechnology laboratory of VNCA, Yavatmal. For the study, fresh uniform size, fully ripened fruits of roselle, papaya and ginger were collected. The fruits before processing were washed in lukewarm water. The skin and the pith of fruits were peeled and discarded that add bitter taste to wine for papaya and ginger. For Roselle, the calyx was separated washed with lukewarm water and boiled in water for 20 min at 100°C to get the juice. Ginger sliced into small pieces and then crushed in blender to get juice. Likewise papaya pulp crushed in blender and got the juice. Juice for fruit blended different Roselle like papaya and ginger were collected in different conical flasks. Papaya and ginger juice were added in Roselle juice in separate jars to make Roselle: papaya (1:1) and Roselle: Ginger (1:0.5) and Roselle juice in two different sets of flasks. Then dissolved yeast in lukewarm water. Stirred strain until yeast completely dissolved into it. Retained it for 10-15min and then used it as a starter culture for fermentation. Added the activated yeast inoculums in all 4 sets of juice samples Roselle for sweet wine, Roselle for dry wine, Roselle + Papaya and Roselle + Ginger. Then added appropriate amount of sugar (to make 25°B) sample for Roselle dry wine. Then maintained pH at 3.2 by adding sodium bicarbonate wherever necessary in must in all 4 wine samples replicated 5 times

The glass jar or containers were plugged with Rubber Cork to avoid the head spaces and place them at 10-15°C temperature for fermentation. After completion of fermentation in 2 to 3 weeks, racking was done 3-4 times at weekly interval. After final racking the wines were siphoned off and collected in sterile glass jars were clarified again by adding 400 mg/lit. Bentonite clay (0.1%) and the sample jar were left undisturbed for 4 days. The wines were analysed for physico-chemical properties at 30 days interval and also evaluated

organoleptically after maturation with panel of ten judges keeping grape wine and Golkonda wine as standard. Each panellist was served 30 ml of chilled wine in transparent glasses, which were coded with random three-digit numbers and served prior to sensory evaluation for sensory attributes (Jackson, 2002) [10]. Coded samples were assessed organoleptically using a 20-point hedonic scale developed by Amerine *et al.* (1972) [4], where 15-20 correspond to Good quality, 11-14.99 correspond to medium quality.

The chemical composition of roselle and fruit blended roselle wine samples were analyzed. pH was determined by using digital pH meter, TSS by Hand Refractometer of 0 to 32 scale. The titrable acidity, alcohol content, reducing sugar, non-reducing sugar, total sugar and ascorbic acid content of juice and wine samples were tested by Ranganna method (1977) [19].

### Results and Discussion

#### Physico-chemical Parameters of Juice

The data from the table 1 showing Physico-chemical parameters of different fruit juice of Roselle, papaya and ginger inferred that, Roselle contribute to maximum fruit juice recovery i.e. 75%, 4.8°B followed by Papaya and Ginger with 60%, 3.47°B and 40%, 0.62°B respectively. As contributed to higher percentage of juice recovery fruits of roselle are best suited for winery industry.

The maximum TSS of fruit juice was also found in Roselle juice 4.8°B followed by Papaya 3.47°B and Ginger with 0.62°B respectively.

**Table 1:** Physico-chemical parameters of different fruit juices screened for wine production

S.N.	Parameters	Roselle	Papaya	Ginger
1.	Average fruit weight	1 kg	1 kg	1 kg
2.	Weight of calyx/pulp	350g	750g	980g
3.	Colour	Deep Red	Pale yellow	Pale yellow
4.	pH	3.54	4.5	7.02
5.	Juice recovery percentage (Diluted with water)	75%	60%	40%
6.	TSS (°B)	4.8°Brix	3.47°Brix	0.62°Brix

#### Chemical Parameters of Wine

The wines prepared from roselle and blended with fruits were analyzed for physicochemical changes and the data are presented in table 2.

**Table 2:** Physico-chemical parameters of different Roselle wines

S. No.	Parameters	Fruit wine			
		Roselle Dry wine	Roselle Sweet Wine	Papaya blended Roselle Wine (1:1)	Ginger Blended Roselle wine (1:0.5)
1.	pH	2.05	3.34	3.56	3.25
2.	TSS (°B)	1.34°B	5.04°B	8.10°B	7.22°B
3.	Titrable acidity (%)	2.0%	1.08%	0.68%	0.81%
4.	Reducing sugar (%)	1.23%	5.22%	6.13%	5.90%
5.	Non reducing sugar (%)	0.28%	0.70%	1.71%	0.95%
6.	Total sugar (%)	1.86%	5.92%	7.84%	6.85%
7.	Alcohol (%)	3.64%	9.22%	10.3%	8.76%

**pH of wine:** Among the different Roselle and fruit blended Roselle wine, maximum pH was recorded in dry Roselle wine (2.05), However the minimum pH (3.56) was recorded in Papaya mix Roselle wine. Fruit blended Roselle wine i.e. Roselle + papaya and Roselle + Ginger reported the pH ranging from 3.25 to 3.56 which are found to be suitable for red wine. During the fermentation of Roselle wine the pH from different wine samples except Roselle dry wine were

found to be decreased at 30 days of fermentation. The trend of decreased in pH values during the fermentation of wine was supported with the work of Mathapathi *et al.* (2004) [13] and Guleria *et al.* (2014) [2].

**Titrable acidity of wine:** Similarly, the maximum titrable acidity 2.0% was reported in Roselle dry wine sample and the minimum titrable acidity (0.68%) was found with papaya

blended Roselle wine sample. There found significant difference in titrable acidity content among all the Red wine samples under experiment. The titrable acidity of Roselle sweet wine (1.08%) was supported with the findings of Arubi P. Alobo and S.U. Offonry, 2009 [3]. Roselle and (0.68%) in Papaya mix Roselle wine with the findings of Okoro, Casmir Emeka 2003. The increase in titrable acidity percentage during the fermentation of wine are in agreement with the findings of Kulkarni *et al.*, 1980 [12], Vyas and Kochhar, 1993, S.S. Mathapathi *et al.*, 2004 [13] and Anjali *et al.*, 2017 [1]. The increase in titrable acidity in wine during the fermentation may possibly due to the production of certain salts derived from mineral acid or organic acid in wine due to fermentation by yeast *Saccharomyces cerevisiae*. Bellman and Gallander, 1979 [6] noted that, lower the pH reported the higher acidity in wine, Sonar *et al.*, 2004 [20].

**Total Soluble Solids (TSS):** Regarding the TSS, the maximum TSS was obtained in Roselle + Papaya wine (8.10°Brix) followed by Roselle + Ginger (7.2°Brix), followed by Roselle (sweet wine) i.e. (5.04°Brix), the minimum TSS was recorded in Roselle (dry wine) i.e. (1.34°Brix). The results are in conformity with the findings of Idolo Ifie, *et al.*, (2012) [9], Arubi p Alobo and S.U. Offonry, 2009 [3] in Roselle wine.

**Sugars (Reducing, Non reducing and Total sugar):** Data recorded in table 2 stated that, the maximum reducing sugar in wine at 30 days of fermentation was obtained in papaya mix roselle wine (6.13%) followed by ginger mix roselle wine (5.90%) followed by Roselle sweet wine (5.22%) and the least was found in Roselle dry wine (1.23%). It was observed that the sugar content of wine was found to be decreased as increased in the days of fermentation. This might be due to the utilization of sugar during the process of fermentation. The results are in accordance with the results obtained by Idolo Ifie *et al.*, 2012 [9], Taiwo O. Olurin and Johnson O. Aina (2012) [9].

The data recorded on non-reducing sugar, stated that Papaya mix Roselle wine recorded maximum Non reducing sugar (1.71%) followed by Ginger blended Roselle wine (0.95%) followed by Roselle sweet wine (0.70%) and the minimum non reducing sugar was obtained in Roselle dry wine i.e. (0.28%). The findings are supported with the findings of Sapna *et al.*, 2002 [21] who reported that, 1.13% non - reducing sugar in French basil wine followed by Mellisa wine 1.05% after 9 weeks of storage.

Regarding the total sugar content the maximum total sugar was obtained by Papaya blended Roselle wine (7.84%) followed by Ginger blended Roselle wine (6.85%), followed by Roselle sweet wine (5.22%) and the minimum obtained by Roselle dry wine (1.86%). The maximum total sugar content in Roselle sweet wine might be due to the availability of blended fruit sugar in papaya fruit as compared to Ginger blended Roselle and plain Roselle wine. From the data it was

reported that, sugar content in all the treatments of Roselle wine was found to be deceased at 30 days of fermentation period then initial days of fermentation. The decrease in the sugar content of wine during fermentation period might be due to the utilization of sugar in fermentation process. The results are in conformity with the findings of Anjali *et al.*, 2017 [1] who reported the decreasing in trend of sugar during the red wine preparation from different pomegranate varieties.

**Alcohol content:** The data recorded on the changes in alcohol percent of fermented wine from Roselle and fruit blended Roselle wine are presented in Table 2. Maximum alcohol content among the different red wines was reported in Papaya blended Roselle wine (10.3%) followed by Roselle sweet wine (9.22%), followed by Ginger blended Roselle wine (8.76%). The minimum alcohol content was reported in Roselle dry wine (3.64%). The alcohol content in Roselle sweet wine was in agreement with the findings of Arubi *et al.*, 2009 who reported who reported 9.6% and 9.2% alcohol in Roselle wine. Okro 2007 reported 10.5% alcohol in Paw-paw mix Roselle wine. The 10.65% alcohol reported in apricot wine Joshi *et al.* 1990 and alcoholic contents ranged between 10.26 and 11.61% in Jambal wine reported by Shukla *et al.*, 1991. During ageing the alcohol level in all the wine samples were found to be increased, this was due to slow fermentation of wine. Reddy and Reddy, 2009 in mango wine.

**Organoleptic evaluation of wine:** The quality of Roselle wine samples was assessed by Organoleptic or sensory evaluation by panel of five judges using 20 point hedonic scale as suggested by Amerine *et al.*, (1972) [4]. The wine scoring less than 10 points are considered as poor quality wine, points ranged from 11 to 14.99 be considered as medium quality wine and points scored more than 15 be considered as good quality wine.

The results from table 3 showed that, the highest score for appearance, colour, aroma, bouquet, total acidity, sweetness, body, flavour, astringency and general quality were achieved by Papaya blended roselle wine with overall acceptability score of 16.4 points contributed to good quality wine. High alcohols are to be important for adding the pleasant aroma in wine, reported by Clementine *et al.*, 2007.

However, Roselle sweet wine and Ginger blended roselle wine scored overall acceptability points 14.2 and 12 next to papaya blended Roselle wine contributed to medium quality wine. The least sensory score of 5.8 points for overall acceptability was found in Roselle (dry wine) contributed to poor quality wine which is not acceptable. Papaya blended Roselle wine as score 16.4 points of overall acceptability, it was found most suitable for winery. Pradyuman Kumar *et al.*, 1999 [19], reported from the sensory evaluation of banana wine that the beverage from blend (75: 25) by two membered culture was highly acceptable followed by the beverage prepared from banana alone.

**Table 3:** Organoleptic evaluation of pomogranate wine from four different cultivars of pomogranate after 30 days of ageing (Judge on the mean of 5)

S.N.	Samples	Appearance (2)	Colour (2)	Aroma (2)	Bouquet (1)	Vinegar (2)	Total acidity (2)	Sweetness (2)	Body (1)	Flavour (2)	Astringency (2)	General quality (2)	Overall acceptability (20)
1.	Roselle (Dry wine)	0.7	1.0	1.0	0.9	0.5	0.6	1.0	1.0	0.4	0.3	0.2	5.8
2.	Roselle (sweet wine)	1.5	1.6	1.7	0.6	1.9	1.5	1.7	1.8	1.5	1.4	1.0	14.2
3.	Roselle + papaya	1.8	1.8	1.8	0.9	1.6	1.8	1.8	1.9	1.8	1.7	1.5	16.4
4.	Roselle + Ginger	1.2	1.5	1.6	0.6	1.4	1.5	1.6	1.6	1.4	1.4	1.4	12.

**Source:** Organoleptic evaluation score card as suggested by Amerine *et al.* (1972) [4].

## Conclusion

From the different roselle wines prepared under the 'Study on preparation of roselle and fruits blended roselle wine using yeast *Saccharomyces cerevisiae*, the maximum points 16.4 for organoleptic evaluation analysis was scored by papaya blended wine and categorized as good quality wine. Hence, it was concluded that, papaya blended roselle wine was found to be the most suitable for winery industry.

However, the other wines from roselle viz., Roselle sweet wine and Ginger blended Roselle wine are categorized as medium quality wine and dry wine prepared from roselle as showed poor performance for overall acceptance was found not suitable for wine making.

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