

Preparation and Characterization of Grape Wine

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Abstract

The present research placed its emphasis on the production of grape wine and study of the factors affecting the fermentation and quality of grape wine. In the investigation of grape wine production, the physico-chemical characteristics of grape (*Vitis vinifera*) such as sugar content (°Brix), specific gravity, acidity (%v/v), pH, and ash content were determined. In the present study, fermentation of grape was conducted by using the yeast, *Saccharomyces cerevisiae*. During the primary and secondary fermentation, an attempt has been made for the determination of changes in specific gravity, alcohol percent (%v/v), acidity (%v/v) and pH. In comparing the resultant physico-chemical characteristics of the processed wine with those of the commercial products and the standard values, it was observed that the wine sample processed with sugar (50g/100g of the grape) and yeast (0.03g/100 ml of must) were more favourable in quality than other processed wine samples.

Keywords: grape wine, fermentation, alcohol percent, specific gravity

Introduction

Wine is one type of the alcoholic beverages that contain ethanol. Fruit wines are un-distilled alcoholic beverages usually made from grapes or other fruits like peaches, plums, apricots, etc. Wine is prepared by undergoing the main processing steps of fermentation and ageing. There are several factors that influence the rate of yeast growth and fermentation. The most important factors are initial sugar concentration and pH value of the must, fermentation temperature and the strains of yeasts. During fermentation of the must, yeast feeds on sugar in the grape juice and converts it into alcohol, carbon dioxide and heat. The time needed for fermentation depends on fermentation temperature and varies from three days to six weeks at fermentation temperatures of 65 °F to 85 °F. The best temperature for fermentation of wine is 65 °F to 75 °F. Fermentation at higher temperature gives bitter wine. Ageing time of wine is 6 months to 2 years. The alcohol content of wine is in the range of 5 to 13 percent (Anderson, 1970).

Wine can be classified by colour, sugar content and utilization. There are three types of wine classified by their colour such as red wine, white wine and rose wine (Zhao, 2005). Red wine is prepared from red grape or other fruits that have red juice or red skin. White wine is not white at all but various shades of brown or yellow. Rose wine is neither red nor white but it has pink colour (Anderson, 1970). In classifying wine based on sugar content, sweet wine contains 1% or more (up to 14%) residual sugar after fermentation. Dry wines should not contain more than 1% of residual sugar and have no sweet taste. The flavour of dry wine is derived from the alcohol, enzymes, minerals, organic acids and esters (Jackson, 2000). Aperitif is a slightly sweet, fortified wine and it is usually drunk as an appetizer before dinner. Table wine is a type of dry wine containing 9% to 12 % alcohol by volume. This type of wine is meant to be drunk with the meal. Other type of wine grouped by usage is after-dinner wine. The most popular after-dinner wines are red and white ports (Gumus and Gumus, 2008).

Population studies for health benefit of wine have observed that the consumption of wine can prevent the consumer from getting the risk of heart disease. These studies have found that a protective effect was obtained from red wine as well as white wine. Laboratory studies suggest that red wine may possess superior health benefits, including the prevention of cancer because red wine contains more polyphenols than white wine (Anderson, 1970).

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The main aim of the research work is to find out the scientific production methods for the development of the quality of Myanmar grape wine. The objectives of this study are:

- To investigate the effect of some factors influence on the fermentation and quality of grape wine
- To evaluate the physico-chemical characteristics of grape wine

Materials and Methods

Materials

In this research work, grape, cane sugar (sucrose), citric acid and water were used as the main raw materials in the preparation of grape wine. Yeast (*Saccharomyces cerevisiae*) was used for fermentation of grape juice into wine. The ripe and sound grapes were collected from Meiktila Township, Mandalay Region. All the chemicals used in processing of grape wine were purchased from Able chemical shop, Chan Aye Thar Zan Township in Mandalay Region.

Methods of Preparation

Preparation of Grape Juice

Firstly, the grapes were thoroughly washed, de-stemmed and crushed. The mass of juice, pulp, skins and seeds is called the must.

Preparation of Sugar Syrup

In processing of grape wine, the most convenient way to add sugar is in the form of syrup. The sugar syrup was prepared by dissolving sugar in water in a ratio of 3:2.

Sulphitation of the Must

The calculated amounts of sugar syrup, water and citric acid were added into the must to obtain good quality grape wine. Then, potassium metabisulphite (0.05% w/w) was added into the must and left for 24 hours to kill all the wild molds, bacteria and yeasts.

Primary Fermentation

After sulphiting the must, wine yeast (*Saccharomyces cerevisiae*), 0.03% w/v of the must, was added into the fermentation vessel and covered with a perforated sheet with gas outlet pipe incorporated into the fermenter to exclude carbon dioxide. In this study, primary fermentation was carried out at room temperature for one week.

Secondary Fermentation

After one week of primary fermentation, the must was racked into a clean fermenter leaving any pulp and sediment. The secondary fermentation was carried out for about one to two weeks. After completing the secondary fermentation, 0.05% w/v of potassium metabisulphite was added to the light wine. The sediment was removed by racking the processed grape wine in every month.

Ageing

The resultant light wine was bottled and aged in a cold, well ventilated, dark and dry place for six months to two years.

Physico-chemical Properties of Grape and Grape Wine

Acidity, moisture and ash contents were determined by Association of Official Analytical Chemists (AOAC) tentative method. The soluble solids content (°Brix) was measured with a refractometer and pH with a pH meter (JENWAY, 3510). Absorbance and transmittance of grape wine were measured with a spectrophotometer. Specific gravity and alcohol percent were determined by using a hydrometer.

Organoleptic Properties of Grape Wine

Sensory attributes such as colour, odour and taste were determined on the basis of 9-point hedonic scale. Each wine sample was coded with symbols and the samples were presented in random manner. Then, the tests for taste, colour and odour were tested.



Fig. (1) Measurement of Specific Gravity

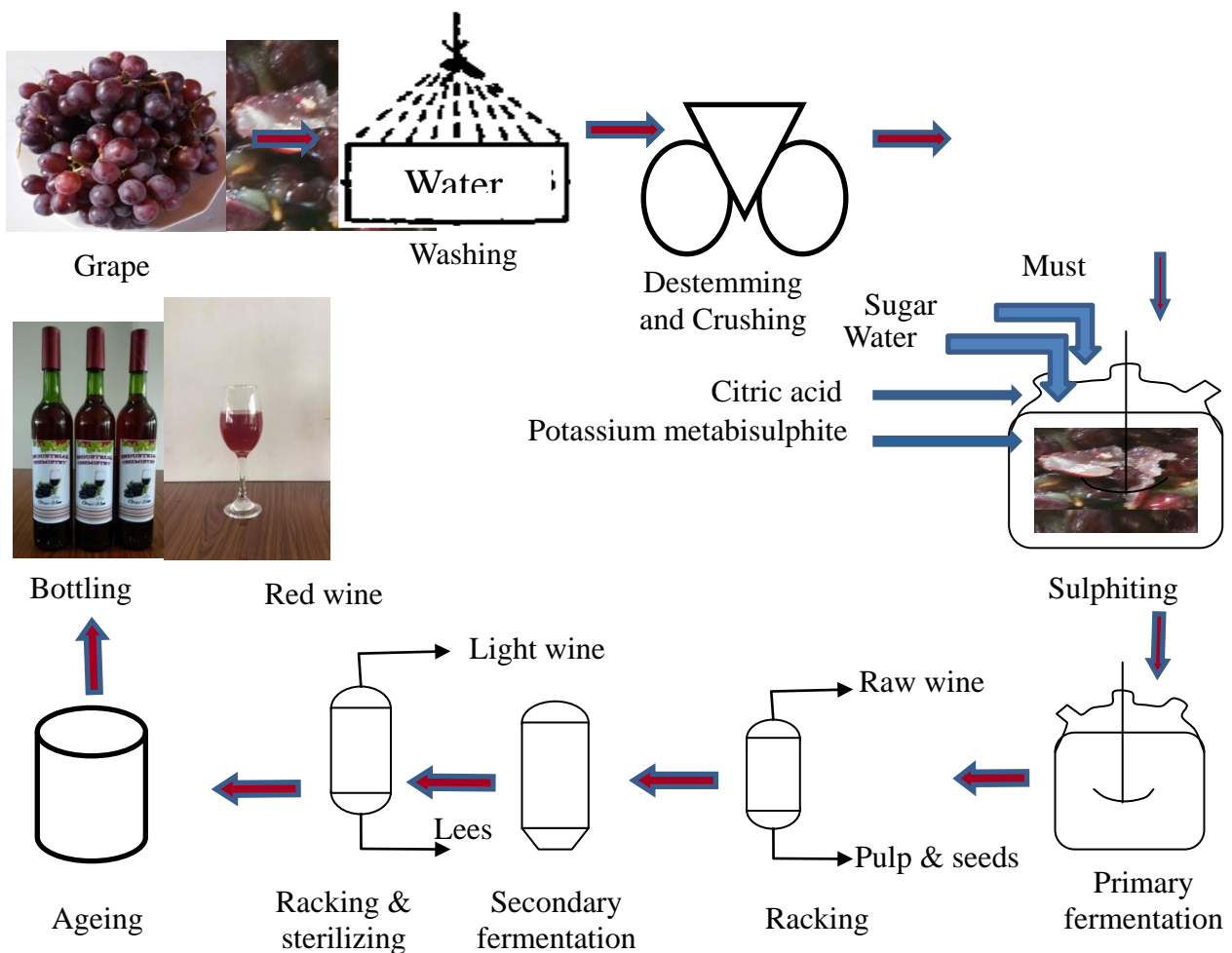


Fig. (2) Process Flow Diagram for Processing of Grape Wine

Results and Discussion

In this research work, red wine was produced by fermentation of grape. Table (1) shows the physico-chemical characteristics of grape. From the results of this Table, soluble solids, moisture, ash contents and pH of grape were found in the range of literature value. Effect of sugar on specific gravity of grape wine during fermentation was presented in Table (2). It was observed that the values of specific gravity were decreased and constant after 14 days of fermentation. The effects of sugar on acidity and pH of grape wine during fermentation were studied and the results were stated in Tables (3) and (4), respectively. In comparative studies of the results, the values of acidity were found to be increased during the primary fermentation period and then decreased in secondary fermentation. It was evident that the fermentation was complete after two weeks of fermentation because of the constant value of specific gravity during the fermentation period of two and three weeks. In Table (4), pH values were found to be decreased during fermentation.

Table (5) states the effect of sugar on alcohol percent of grape wine during fermentation. In comparison of the samples, the grape wine prepared from the addition of 50 g sugar for 100 g of grape was found to be more favourable in quality from the point of view of sensory evaluation. It was also observed that alcohol percent of this wine was in accordance with the standard alcohol percent of red wine (10-13%).

The physico-chemical characteristics of processed grape wine were compared with those of the commercial grape wine and literature values, and the resultant values were presented in Table (6). Table (7) shows the organoleptic properties of processed grape wine. It was found that grape wine obtained by processing 50 g sugar / 100 g of grape and yeast 0.03 %w/v of the must was more favourable in colour, odour and taste than other processed grape wine samples.

Table (1) Physico-chemical Characteristics of Grape

Sr. No.	Properties (% w/w)	Experimental value	Literature value *
1	Acidity	0.66	-
2	Moisture	82	85
3	°Brix	16	15-25
4	pH	3.0	3.0 -3.8
5	Specific gravity	1.06	-
6	Ash	0.60	0.57

*Manay and shadaksharaswamy, 2003

Table (2) Effect of Sugar on Specific Gravity of Grape Wine during Fermentation

Citric acid = 1g/100g of grape
 Water = 160 ml/100g of grape
 Yeast = 0.03 g/100g of must

Sample No.	Grape (g)	Sugar (%w/w)	Specific Gravity								
			Fermentation time (Days)								
			1	2	3	4	5	6	7	14	21
I	100	100	1.12	1.12	1.10	1.09	1.09	1.08	1.08	1.07	1.07
II	100	75	1.11	1.10	1.08	1.07	1.07	1.06	1.06	1.05	1.05
III*	100	50	1.08	1.07	1.05	1.04	1.03	1.02	1.02	1.00	1.00
IV	100	25	1.05	1.03	1.02	1.00	1.00	1.00	1.00	1.00	1.00
V	100	0	1.02	1.01	1.01	1.00	1.00	1.00	1.00	1.00	1.00

* More favourable sample of grape wine

Table (3) Effect of Sugar on Acidity of Grape Wine during Fermentation

Citric acid = 1g/100g of grape
 Water = 160 ml/100g of grape
 Yeast = 0.03 g/100g of must

Sample No.	Grape (g)	Sugar (%w/w)	Acidity (%v/v)						
			Fermentation time (Days)						
			1	2	3	4	7	14	21
I	100	100	0.623	0.630	0.707	0.791	0.938	0.714	0.655
II	100	75	0.651	0.680	0.721	0.812	0.973	0.756	0.693
III*	100	50	0.707	0.750	0.882	0.875	1.071	0.826	0.777
IV	100	25	0.735	0.700	0.959	0.889	1.057	0.812	0.565
V	100	0	0.735	0.651	0.861	0.826	0.903	0.665	0.588

* More favourable sample of grape wine

Table (4) Effect of Sugar on pH of Grape Wine during Fermentation

Citric acid = 1g/100g of grape

Water = 160 ml/100g of grape

Yeast = 0.03 g/100g of must

Sample No.	Grape (g)	Sugar (% w/w)	pH						
			Fermentation time (Days)						
			1	2	3	4	7	14	21
I	100	100	3.95	3.45	3.03	3.12	3.33	3.06	3.11
II	100	75	3.92	3.50	3.25	3.08	3.39	3.09	3.21
III*	100	50	3.94	3.32	3.07	3.10	3.34	3.08	3.16
IV	100	25	3.93	3.34	3.05	3.10	3.35	3.05	3.16
V	100	0	3.00	3.01	3.03	3.09	3.32	3.06	3.18

* More favourable sample of grape wine

Table (5) Effect of Sugar on Alcohol Percent of Grape Wine during Fermentation

Citric acid = 1g/100g of grape

Water = 160 ml/100g of grape

Yeast = 0.03 g/100g of must

Sample No.	Grape (g)	Sugar (% w/w)	Alcohol (% v/v)		
			Fermentation time (Days)		
			7	14	21
I	100	100	5.24	6.55	6.55
II	100	75	7.86	9.17	9.17
III*	100	50	7.86	10.48	10.48
IV	100	25	7.86	7.86	7.86
V	100	0	2.62	2.62	2.62

* More favourable sample of grape wine

Table (6) Comparison of the Physico-chemical Characteristics of Processed Grape Wine with Commercial Grape Wine

Sr. No.	Characteristics	Processed Grape Wine	Commercial Grape Wine	Literature Value**
1	Acidity (% v/v)	0.77	0.65	0.6-0.75
2	pH	3.16	3.30	
3	Specific gravity	1.00	1.12	0.9-1.00
4	Alcohol (% v/v)	10.5-13.1	11-13	5-13
5	Absorbance (A ₄₂₀)	1.229	0.536	-
6	Transmittance (%)	5.9	29.2	-

**Anderson, 1970

Table (7) Organoleptic Properties of Processed Grape Wine

Sample No.	Grape (g)	Sugar (g)	Yeast (%w/v of must)	Organoleptic Properties		
				Colour	Odour	Flavour
I	100	100	0.03	Brown	Pleasant smell	Syrup
II	100	75	0.03	Brown	Pleasant smell	Sweet
III*	100	50	0.03	Red	Pleasant smell	Good
IV	100	25	0.03	Red	Unpleasant smell	Sour
V	100	0	0.03	Pale Red	Unpleasant smell	Sour
VI	100	50	0.01	Red	Pleasant smell	Light
VII	100	50	0.05	Red	Pleasant smell	Slight bitter

*More favourable sample of grape wine



Fig. (3) Grape Wine Sample (Processed with 25 g sugar / 100 g grape)



Fig. (4) Grape Wine Sample (Processed with 50 g sugar / 100 g grape)



Fig. (5) Grape Wine Sample (Processed with 75 g sugar / 100 g grape)

Conclusion

One interesting aspect of the present study pointed out the factors which influenced on the quality of grape wine. Sterilization of the equipment used before the preparation of raw materials and aseptic condition during the fermentation of wine is an essential step for the prevention of the growth of undesirable microorganisms. The physico-chemical properties of grape are one of the most important factors to be considered for the quality of grape wine. The must with correct values of specific gravity, acidity and soluble solids content before fermentation is the most important factor to be considered for producing good quality wine. Moreover, the amount of sugar added, yeast percent and fermentation period were found to influence on alcohol content, colour, odour and taste of wine.

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