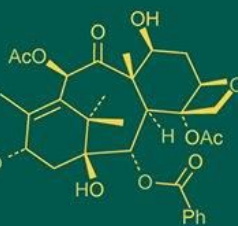
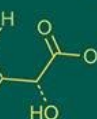


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Fermentation behaviour of mahua blended rose must in relation to rate of fermentation, fermentation efficiency and ethanol production

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Abstract

The experiment “Effect of different sugar sources and blending proportions on fermentation behaviour of must in relation to rate of fermentation, fermentation efficiency and ethanol production” was carried out at PHT Laboratory, Section of Horticulture, College of Agriculture, Dr. PDKV, Akola during the years 2021-22 and 2022-23. The experiment was laid out in FCRD with two factors, as factor ‘A’ constitutes different sugar sources (Cane sugar, Honey, Jaggery) and factor ‘B’ constitutes blending proportions [90:10, 80:20, 70:30 and 100:00 (Rose pulp: Mahua pulp)] with twelve treatment combinations and replicated thrice. Different sugar sources and blending proportions exerted significant effects on the fermentation behaviour of must. Significantly maximum rate of fermentation (1.27°Brix/24 hrs.), maximum fermentation efficiency (99.78%) and ethanol (9.67%) content after fermentation of must were observed in treatment combination S₂B₂ [Honey+80 :20 (Rose pulp: Mahua pulp)]. From the findings it can be concluded that, mahua blended rose wine prepared with Honey+80 :20 (Rose pulp: Mahua pulp) showed better results as compared to other treatment combinations.

Keywords: Mahua blended rose wine, sugar sources, blending proportions, fermentation behaviour

Introduction

Wine is a beverage results from the fermentation of fruits or flower pulp by yeast. Flower wines can be made from a variety of flowers, including rose, hibiscus, calendula, lavender, chrysanthemum, rhododendron, marigold, etc. Flower wines are usually undistilled, they contain nutrients from the flowers and also gain nutrients from the yeast during fermentation. Blending is an art to develop different colours, aroma, astringency, body and taste to suit the requirement. Low grade product would be upgraded to product of superior quality by blending of two or more different types of food entities having desired attributes. The goal of blending wine is to add more complexity to the flavor and texture of a wine. Sugars are the main source of perceived sweetness in wine also used as food for the yeast and turned into carbon dioxide and alcohol. The blending proportion and sugar sources of wine helps to improve sensory qualities. Understanding the fermentation behaviour of flower wines must is crucial for achieving consistency in production of wine and ensuring the optimal sensory experience for consumers. By exploring the underlying mechanisms, these techniques are essential to improve the fermentation process, enhance aroma development and maintain desirable floral characteristics. With these points of view, an experiment was undertaken to ascertain the fermentation behaviour of mahua blended rose wine.

Material and Methods

The laboratory experiment was conducted during the year 2021-22 and 2022-23 at PHT Laboratory, Horticulture Section, College of Agriculture, Dr. PDKV, Akola, Maharashtra. The experiment was laid out in a Factorial Completely Randomized Design (FCRD) with three replications and twelve treatment combinations. First factor comprising of three sugar sources i.e. Cane sugar, Honey and Jaggery. And second factor comprising of four blending proportions 90:10, 80:20, 70:30 and 100:00 (Rose pulp: Mahua pulp) and TSS was maintained 24°Brix. The experiment was conducted over two years and pooled data from two years were expressed in this article. Fully open *Rosa centifolia* (Cabbage rose) were

procured from the local market of Nagpur and dry Mahua (*Madhuca indica*) flowers were procured from Bhandara District during October 2021-22 and 2022-23. The fermentation behaviour of must have been analyzed before the fermentation process and after completion of the fermentation process by different standard procedures. The ethanol content was analyzed by standard procedure reported by FSSAI (2015) ^[1]. Total soluble solids was determined with the help of a digital refractometer, rate of fermentation was calculated by taking readings of (Initial TSS – Final TSS) / Time. While fermentation efficiency was calculated by (Actual Alcohol Produced / Theoretical Alcohol Produced X 100. Whereas, Theoretical alcohol = Sugar used X 0.64 and sugar used = Initial TSS – Final TSS. The entire process of preparation of mahua blended rose wine is shown diagrammatically in Fig. 1.

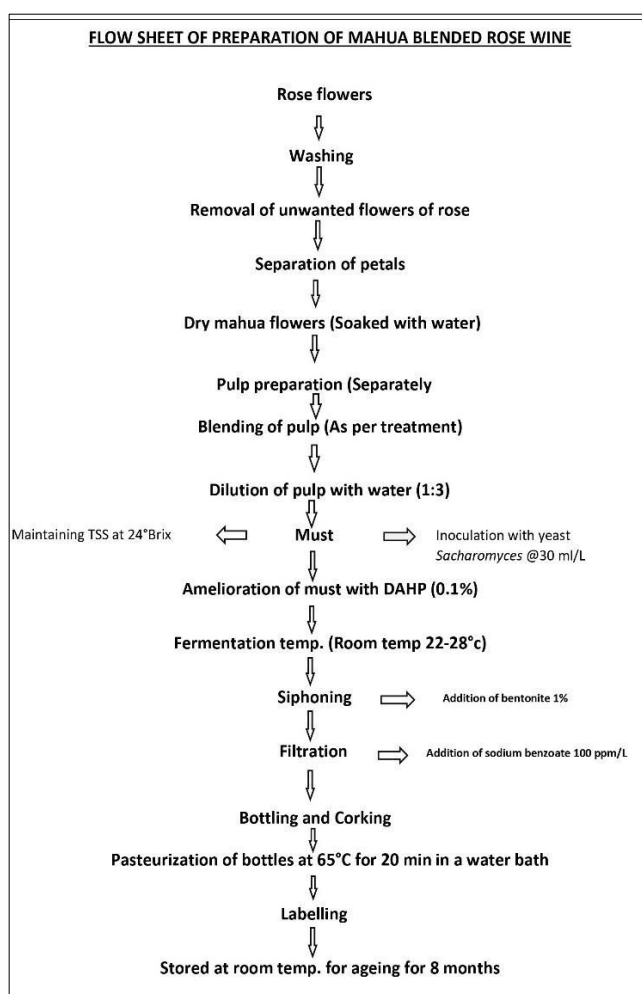


Fig 1: Procedure for preparation of mahua blended rose wine

Results and Discussion

Rate of fermentation: The data with respect to effect of different sugar sources, exhibited significant effect. Significantly maximum rate of fermentation (1.17 °Brix /24 hrs) was observed in treatment S₂ (Honey). However, a minimum rate of fermentation (0.99 °Brix/24 hrs.) was observed in treatment S₃ (Jaggery). In terms of the effect of pulp blending proportions, significantly maximum rate of fermentation was observed in treatment B₂-80:20 (Rose pulp : Mahua pulp) i.e. 1.17 °Brix /24 hrs. However, a minimum rate of fermentation i.e. 1.03 °Brix /24 hrs. was observed in treatment B₄-100:00 (Rose pulp :Mahua pulp). Significantly maximum rate of fermentation due to interaction effect of

different sugar sources and blending proportions was observed in treatment combination S₂B₂ (1.27 °Brix/24 hrs). However, significantly minimum rate of fermentation was recorded with the treatment combination S₃B₄ (0.97 °Brix/24 hrs).

After completion of fermentation, the highest rate of fermentation in must observed in treatment combination S₂B₂ [Honey + 80:20 (Rose pulp: Mahua pulp)] which was attributed due to more availability of sugar content than that of other treatments which attributed to the higher fermentability of must. Similar findings were reported by Minh *et al.* (2019) ^[4] in gooseberry wine fermentation. Similarly, Sevda and Rodrigues (2011) ^[6] in guava wine observed that higher the sugar content higher will be the fermentation rate.

Fermentation efficiency

Significantly maximum fermentation efficiency (98.25%) due to different sugar sources was recorded in treatment S₂ (Honey). However, a minimum fermentation efficiency (95.22%) was recorded in treatment S₃ (Jaggery). In terms of the effect of blending proportions, significantly maximum fermentation efficiency (98.44%) was recorded in treatment B₂-80:20 (Rose pulp: Mahua pulp). However, it was minimum (95.76%) in treatment B₄-100:00 (Rose pulp: Mahua pulp). Due to interaction effect of different sugar sources and blending proportions, significantly maximum fermentation efficiency was observed in treatment combination S₂B₂ (99.78%). However, minimum fermentation efficiency was recorded in treatment combination S₃B₄ (94.26%).

The results showed that, more availability of sugar increases the ethanol production because sugar molecules are readily available for the yeast to use it for fermentation to convert it into alcohol. The results obtained are in agreement with the report of Satav and Pethe (2017) ^[5] who studied wine production from banana, Kumar *et al.* (2011) ^[3] in custard apple wine.

Ethanol

Ethanol content was not observed in any treatment combination in must before fermentation. While, in must after fermentation, maximum ethanol content (9.48%) due to different sugar sources was observed with treatment S₂ (Honey) which was significantly superior than rest of all treatments. However, significantly minimum ethanol content (9.10%) was observed in treatment S₃ (Jaggery). In terms of the effect of effect of blending proportions, maximum ethanol content (9.48%) was observed in treatment B₂-80:20 (Rose pulp: Mahua pulp) which was significantly superior than rest of all the treatments. However, minimum ethanol content (9.18%) was observed in treatment B₄-100:00 (Rose pulp: Mahua pulp). Due to interaction effect of different sugar sources and blending proportions maximum ethanol content (9.67%) was recorded in treatment combination S₂B₂ [Honey+80 :20 (Rose pulp: Mahua pulp)] which was significantly superior than rest of all treatment combinations. However, significantly minimum ethanol content (9.04%) was recorded with the treatment combination S₃B₄ [Jaggery +100:00 (Rose pulp: Mahua pulp)].

From the above result it can be concluded that, must having 80:20 (Rose pulp: Mahua pulp) inoculated with yeast by maintaining the TSS at 24 °Brix by using honey as a sugar

source converted more sugars to alcohol. Because high sugar content present in honey predisposes it as a good substrate for yeast fermentation to produce alcohol. The present findings are in conformity with research work carried out by Seveda and Rodrigues (2011)^[8]. And also it is in conformity with the study of Pratima *et al.* (2006)^[6] in Kinnow must), Lenkannavar *et al.* (2015)^[4] in pomegranate must and Kadage (2021)^[2] in blended mandarin must.

Table 1: Effect of different sugar sources and blending proportions on rate of fermentation, fermentation efficiency and ethanol of must.

	ROF (°Brix/24 hrs.)	FE (%)	Ethanol (%)	
Factors	Sugar sources			
Factor A			MBF	MAF
S1 (Cane sugar)	1.14	98.05	ND	9.42
S2 (Honey)	1.17	98.25	ND	9.48
S3 (Jaggery)	0.99	95.22	ND	9.10
F Test	Sig.	Sig.	-	Sig.
SE(m)±	0.010	0.090	-	0.007
CD at 5%	0.031	0.261	-	0.021
Factor B	Blending proportions			
B1 (90:10)	1.12	97.57	ND	9.38
B2 (80:20)	1.17	98.44	ND	9.48
B3 (70:30)	1.07	96.86	ND	9.28
B4 (100:00)	1.03	95.76	ND	9.18
F Test	Sig.	Sig.	-	Sig.
SE(m)±	0.012	0.010	-	0.008
CD at 5%	0.036	0.302	-	0.024

Table 2: Interaction effect of different sugar sources and blending proportions on rate of fermentation, fermentation efficiency and ethanol of must.

Interactions (SXB)	ROF (°Brix/24 hrs.)	FE (%)	Ethanol (%)	
			MBF	MAF
S1B1	1.16	98.43	ND	9.47
S1B2	1.23	99.75	ND	9.63
S1B3	1.10	97.57	ND	9.36
S1B4	1.04	96.27	ND	9.23
S2B1	1.19	98.91	ND	9.53
S2B2	1.27	99.78	ND	9.67
S2B3	1.13	97.54	ND	9.42
S2B4	1.08	96.76	ND	9.29
S3B1	0.99	95.36	ND	9.14
S3B2	1.01	95.79	ND	9.17
S3B3	0.97	95.46	ND	9.08
S3B4	0.99	94.26	ND	9.04
F Test	Sig.	Sig.	-	Sig.
SE(m)±	0.021	0.174	-	0.014
CD at 5%	0.062	0.522	-	0.042

ROF= Rate of fermentation, FE= Fermentation efficiency and ND= Not detected

Conclusion

From the results, it is concluded that the mahua blended rose wine prepared with different sugar sources and blending proportions had a positive effect on the rate of fermentation, fermentation efficiency and ethanol production of the mahua blended rose wine. Along with other fermentation techniques, it's crucial to maintain TSS of must at 24° Brix by using honey as a sugar source and selecting a blending proportion of 80:20 (Rose pulp : Mahua pulp) while making mahua blended rose wine.

Future scope

The findings of this study will be extremely valuable to assist in reducing major flower losses that occur during the handling chain. There is a need to emphasize the health benefits of rose and mahua flowers. Setting up a small-scale wine-making sector in rural locations will provide jobs and enhance the indigenous population's living conditions. The exploitation of underutilized mahua flower can provide a solution to nutrition, livelihood and economic security of tribal farmers.

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