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EFFECT OF SUGAR SOURCE ON QUALITY ATTRIBUTES OF WINE PREPARED FROM ROSE PETALS

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Abstract

An investigation was undertaken at ICAR-Directorate of Floriculture Research, Pune to study the effect of different sources of sugar on quality attributes of wine prepared from rose petals (*cv.* Rose Sherbet). The experiment was planned using five sources of sugars (S_1-Cane sugar, S_2-Honey, S_3-Jaggery, S_4-Glucose syrup and S_5-Sugar blended with stevia). The sugar syrup prepared with 22^{o}Brix TSS and pH 3.7. The sugar and rose petals (1:0.5 ratio) fermented with *Saccharomyces cerevisiae* (LALVIN ICV D254TM) @ 0.25g/lit yeast at 20^{o}C temperature till CO_2 bubbles evolving from airlock. The wine prepared from rose petals with different sugar sources was with attention-grabbing red colour, pleasant aroma of rose, transparent and sparkling. The wine prepared with cane sugar (S_1) was found superior in sensory evaluation, that recorded significant ethanol (8.78%), total acids (4.43 g/l), glucose /fructose (6.37 g/l), pH (3.51), volatile acid (0.05 g/l), Total Phenols (5.23 mg GAE/g), flavonoids (16.65 mg/g), anthocyanin (76.93 mg/l) and antioxidant activity (67.03 %). However the highest total acids (4.87 g/l) recorded in rose petal wine prepared with sugar blended with stevia (S_5) while maximum flavonoids (20.90 mg/g) found in rose petal wine prepared with jaggery (S_3). The maximum malic acid (1.03 g/l), volatile acid (0.063 g/l), total phenols (5.29 mg GAE/g) and antioxidant activity (67.33 %) were recorded in wine fermented with honey (S_2). The rose petal wine prepared with glucose syrup (S_4) was slightly dislike by sensory evaluators, it was recorded with lowest ethanol (2.93 %), total acids (2.50 g/l), total phenols (5.04 mgGAE/g) and antioxidant activity (55.00 %) but highest Glucose /Fructose (151.90 g/l), pH (3.55) and anthocyanin (103.23 mg/l), however malic acid as well as volatile acid were not recorded.

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Considering the physicochemical properties, biochemical composition, sensory evaluation and cost of production, it was concluded that cane sugar (S_1) is the most appropriate external sugar followed by jaggery (S_3) and Honey (S_2) for preparation of rose petal wine while glucose syrup (S_4) was inappropriate to prepared rose petal wine.
Keyword: Rose Petals ,Wine,Jaggary, Honey ,Cane Sugar,Glucose Sugar & Stevia

Introduction

Rose is highly popular flower commercially cultivated for loose flower and cut flower production. It has also several other pharmacological properties including antioxidant, astringent, antibacterial, antimicrobial, anti-inflammatory and analgesic (Cheng *et al.*, 2016). Many species of rose (*Rosa* spp.) were used in ancient Greece and Rome as relishes and flavour enhancers of many sweet and savoury dishes while in the Indian Ayurveda system, various rose preparations were used as tonic, laxative, astringent and antibacterial agent (Verma *et al.*, 2011).

Modern society seeks to consume foods that can treat and prevent disease, as well as increase longevity, and in this context stand out functional foods rich in antioxidant compounds with proven health benefits, as well as beverages that bring benefits to the health and are widely used by the population, such as wine. Wine has always been linked in some way to the history of man, either because it is a beverage with its own flavor and personality or because of the health benefits it brings. Studies carried out throughout the world show that wine, taken in a moderate amount, contributes to the health of the human organism, increasing the quality and the life time, being the polyphenols the main compounds present in the wine responsible for this contribution (Wurz, 2019).

Currently, phenolic compounds extracted from the rose petals are used to make functional beverages in the food industry (Vinokur *et al.*, 2006). Moderate long-term intake of red wine is known to lower the risk of cardiovascular disease (Leikert *et al.*, 2002), arteriosclerosis (Vinson *et al.*, 2001), and cancer (Middleton *et al.*, 2000). In addition,

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consumption of wine may be helpful in reducing the occurrence of neurological disorders such as dementia and Parkinson's disease, caused by oxidative stress (Sun *et al.*, 2008).

Since the rose flower petals has nutritional, medicinal, organoleptic and edible impotence. It was therefore thought to utilize rose petals for wine making. The total soluble solides contain in rose petals was stumpy for wine preparation required addition of external sugars to rise TSS of must. Hence the studies on "Effect of sugar source on quality attributes of wine prepared from rose petals" was carried out at ICAR-Directorate of Floriculture Research, Pune. The rose petal wine industry will help to generate rural employment and also will give higher returns to the farmers particularly during the seasonal glut.

Materials and Methods

The present investigation was conducted at ICAR-Directorate of Floricultural Research, Pune, during the year 2021-22 and 2022-23. The red color rose (*Rosa hybrida*) petals with high anthocyanin and superior in sensory evaluation *i.e. cv.* Rose Sherbet was selected for experiment. The five sugars (S_1-Cane sugar, S_2-Honey, S_3-Jaggery, S_4-Glucose syrup and S_5-sugar blended with stevia) were used to maintain sufficient TSS of fermenting juice. The yeast *Saccharomyces cerevisiae* (LALVIN ICV D254TM) @ 0.25g/lit of must was used as inoculums to start fermentation. The transparent narrow mouth glass bottles of 2 lit capacities with rubber cork and airlock were used as fermentation container.

Sugar syrup was prepared by dissolving known quantity of sugar in 1 liter of hot water with continuous stirring. TSS of sugar syrup was adjusted to 22^o brix. The pH of sugar syrup was maintaining 3.7 by addition of some drops of lemon juice. In all treatments sugar to petal ratio was maintain 1:0.5 by taking exactly half quantity of petals to required sugar. Firstly rose petals filled in fermentation jar and then sugar syrup and activated yeast added in to the fermentation container in that order. Air lock with rubber cork was used to close the bottle mouth. Very little amount of water was added in airlock which release CO_2 evolved during fermentation process

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and avoid entry of external air into the bottle. The fermentation of juice was carried out at 20^{o}C by keeping fermentation bottles in incubator.

Flow chart for wine Preparation

Picking matured rose flowers from the rose garden
↓
Separating petals from the rose flowers
↓
Washing the petals out with water followed by draining
↓
Boiling a measured quantity of water in a clean vessel
↓
Adding sugar into the boiling water to make sugar syrup (TSS-22°B)
↓
Addition of lemon juice to maintain pH 3.7
↓
Filtering the syrup of step to extract foreign particles
↓
Cooling down the syrup at the room temperature
↓
Adding the washed rose petals into fermentation Container
↓
Adding the prepared sugar syrup into fermentation Container
↓
Addition of fermentation yeast (*Saccharomyces cerevisiae*) 0.25g/lit
↓
Fermenting the resulting juice at 20°C temperature
↓
Stirring the mixture several times during the natural process of fermentation
↓
Filtration of the wine into containers
↓

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Deactivating yeast by Pasteurization (60-70^{o}C)

↓

Stored for sedimentation

↓

Clear, transparent, sparkling wine decanted into wine bottle and sealed with crown cap

The quality parameters of freshly prepared wine were evaluated. Alcohol, sugar, total acids, pH, ethanol, malic acid and volatile acid were estimated by FOSS wine analyzer. The total flavonoid content was determined by aluminium chloride colometric asaay. Total anthocyanins were measured as per the method described by Ranganna (1986). Total phenols were estimated using the spectrophotometer at 760nm (Singleton and Rossi, 1965). Antioxidant activity (free radical scavenging activity) was measured as per the method of Brand-Williams's *et al.,* (1995) using DPPH (2, 2-diphenyl-1- picryl hydrazyl) dye.

Sensory parameters like colour, sweetness, acidity, flavor, test, mouth feel and overall acceptability were evaluated by hedonic 9 point scale (9 - Extremely like, 8 - Like very much, 7 - Like Moderate, 6 - Like slightly, 5 - Neither like nor dislike, 4 - Dislike slightly, 3 - Dislike moderately, 2 - Dislike very much, 1 - Dislike extremely). Panel of ten trained and partially trained evaluators were serving with ample amount of wine sample for testing. They recorded points on evaluation sheet as per their sense.

Experimental data of different parameters were analyzed in completly randomized design with three replications for analysis of variance in OPSTAT (http://14.139.232.166/opstat) statistical software developed by Chaudhry Charan Singh Haryana Agricultural University, Hisar, Haryana, India (Sheoran, 1998).

Result and Discussion

Effect of sugar source on Ethanol content of rose petal wine

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The ethanol content in rose petal wine varies significantly, with source of sugar use to raise TSS of must. In present study wine prepared with cane sugar, recorded significantly highest ethanol (8.78%), among the studied sugar sources. The results obtained in this study related with source of sugar are in agreement with the findings reported by Kasture *et al.* (2018) in wine from sapota juice with sucrose sugar recorded highest alcohol. Joshi and Kumar (2017) also observed highest rate of fermentation and ethanol in the apple tea wine having sucrose as a sugar source and Tiwari *et al.* (2017) in wine prepared with hibiscus and sugar.

Effect of sugar source on Total acids content of rose petal wine

The treatment with stevia blended sugar (S_5) recorded significantly maximum total acids (4.87 g/l) followed by wine prepared with honey (S_2) (4.77 g/l). However minimum total acids content was recorded in rose petal wine prepared with glucose syrup S_4 (2.50 g/l). The stevia extract contents 37 bioactive components with their corresponding ratios, the most significant of which was hydroxi-de-hydro-stevic acid (steviol), *i.e.* 53.96%. Hence it shows higher total acids content in final wine. Nazarova *et al*. (2021) reported similar results in blended fruit wines based on stevia essence. The low total acids noted in glucose syrup used wine. The results are similar to finding of Steinkraus and Robinson (1967) in grape juice with glucose syrup wine.

Effect of sugar source on glucose/fructose content of rose petal wine

The wine prepared with rose petal and different sources of sugar revealed significant difference in glucose/fructose content, data presented in Table 1. The maximum glucose/fructose (151.9 g/l) content was recorded in wine prepared with glucose syrup (S_4). However wine prepared with jaggery (S_3) recorded minimum glucose/fructose (5.07 g/l). The wine prepared with glucose syrup was not fermented completely and shows maximum glucose/ fructose in prepared wine. Glucose syrup is synonymous to corn syrup which contents preservatives that inhibit yeast fermentation. Steinkraus and Robinson (1967) reported that, residual solids in the wines after fermentation were inversely proportional to degree of fermentability of the carbohydrate source used. Thus the corn syrup left the largest residues in the wine.

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Effect of sugar source on pH content of rose petal wine

Source of sugar used in preparation of rose petal wine show significant effect on pH of prepared wine. The highest pH (3.55) was recorded in S_4 (Glucose syrup) and it was followed by S_2 Jaggery (3.52). The lowest pH was recorded in S_5 stevia blended sugar (3.47) that was at par to the Honey (S_2). The sugars used in wine preparation were different in their polyphenols, carbohydrate and organic acids contents hence significant effect of sugar source was recorded on pH of final product. Stevia blended sugar S_5 recorded high total acid content hence pH of rose petal wine prepared with it was minimum. Honey (S_2) is rich in organic acids hence wine prepared with it show low pH. Similar findings were reported by Kadge *et al.* (2021) in Nagpur mandarin wine prepared with Honey as sugar source.

Effect of sugar source on Malic Acid content of rose petal wine

The data recorded in Table 1 revealed that, malic acid content in rose petal wine shows significant influence of sugar source. The maximum malic acid was recorded in wine prepared with rose petals and honey S_2 (1.03 g/l) that was followed jaggery S_3 (0.67 g/l). However malic acid was not detected in rose petal wine prepared with glucose syrup (S_4) and cane sugar (S_1) in both the years of study. According to Hui *et al.* (1994) sugars are the most common substrate of fermentation to produce ethanol, lactic acid, and carbon dioxide. Volschenk *et al.* (2006) concluded that, *Saccharomyces* are generally unable to degrade L-malic acid effectively in grape must during alcoholic fermentation hence sugars having high malic acids *i.e.* honey and jaggery produce maximum malic acid in wine. The malic acid was not detected in wine produce from malic acid lacking sugars *i.e.* glucose syrup and cane sugar.

Effect of sugar source on Volatile Acid content of rose petal wine

The volatile acid content in rose petal wine varies significantly with sugar source. The maximum volatile acids were recorded in wine prepared with rose petals and honey S_2 (0.63 g/l). The minimum volatile acid was observed in wine prepared with rose petals and stevia blended sugar S_5 (0.017 g/l). However volatile acid was not detected in rose petal wine prepared with

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glucose syrup S_4. The elevated sugar levels subject the yeast to osmotic stress, which can alter its metabolism, and may also lead to fermentation difficulties and the potential for spoilage by undesirable microorganisms. Additionally, the high sugar concentration can alter the aroma profile of the resulting wines and, as a response to the osmotic stress acetic acid, may be produced in high concentrations. Tochukwu and Oyinloye (2017) also recorded high volatile acid in wine prepared from honey and coconut milk blend.

Table 1: Effect of sugar source on physicochemical properties of rose petal wine

Sugar source	Ethanol (%)	Total Acids (g/l)	Glucose /Fructose (g/l)	pH	Malic Acid (g/l)	Volatile Acid (g/l)	Phenol (mg GAE/g)	Flavonoids (mg/g)	Anthocyanin (mg/l)	Antioxidant activity (%)
S_1-Cane sugar	8.78	4.43	6.37	3.51	ND	0.050	5.23	16.65	76.93	67.03
S_2-Honey	7.01	4.77	33.83	3.48	1.03	0.063	5.29	18.75	74.74	67.33
S_3-Jaggery	8.09	4.57	5.07	3.52	0.67	0.033	5.21	20.90	74.23	66.89
S_4-Glucose syrup	2.93	2.50	151.90	3.55	ND	ND	5.04	20.06	103.23	55.00
S_5-Stevia blended sugar	8.46	4.87	9.63	3.47	0.57	0.017	5.06	18.50	96.91	67.08
SE(m)	0.094	0.021	0.845	0.006	0.043	0.002	0.058	0.083	0.48	0.498
CD	0.268	0.061	2.415	0.017	0.122	0.006	0.167	0.238	1.371	1.425

(ND: Not detected)

Effect of sugar source on Phenol content of rose petal wine

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The sugar source used for preparation of rose petal wine shows significant influence on total phenols content in prepared wine. The data recorded in Table 1 revealed the maximum total phenols (5.29 mg GAE/g) in wine prepared with honey S_2, it was followed by wine prepared with cane sugar S_1 (5.23 mg GAE/g). However minimum total phenols (5.04 mg GAE/g) was recorded in wine prepared with glucose syrup S_4 (4.72 mg GAE/g) followed by stevia blended sugar S_5 (5.06 mg GAE/g). The findings are supported by Joshi *et al.*, (2013) prepared apple wine using different sources of sugars *i.e.*, honey, sugar, molasses and jaggary with addition of different herb extracts showed increased total phenols during maturation of wine. Kadge *et al.* (2021) observed maximum total phenol when Nagpur mandarin wine prepared with Honey as sugar source. Liu *et al.* (2022) prepared blueberry wines with added sucrose showed higher phenol levels early in the fermentation process, suggesting that additional sugar can prevent the degradation of phenols.

Effect of sugar source on Flavonoids content of rose petal wine

The flavonoids in rose petal wine vary significantly with sugar source. The maximum total flavonoids was recorded in rose petal wine prepared with jaggery S_3 (20.90 mg/l) and followed by glucose syrup S_4 (20.06 mg/l). However the minimum flavonoids was observed in wine prepared with rose petals and sugar S_1 (16.65 mg/l). Jaggery being a least processed sugar retains phenolics and other phytochemicals withpotent biological activities like antioxidant, cytoprotectiveand anthelmintic activity as reported by (Harish Nayaka *et al.* 2009; Prasad *et al.* 2010). Kokkinomagoulos *et al*. (2021) noted that, addition of sucrose and honey did not lead to increased values of flavonoids in pomegranate wine.

Effect of sugar source on Anthocyanin content of rose petal wine

The anthocyanin in rose petal wine varies significantly with sugar source. The maximum anthocyanin was recorded in rose petal wine prepared with glucose syrup S_4 (103.23 mg/l), followed by stevia blended sugar S_5 (96.91 mg/l). However the minimum anthocyanin was observed in wine prepared with rose petals and jaggery S_3 (74.23 mg/l). Sugar source play

important role in binding anthocyanin in fermented wine. Tsai *et al.* (2004) showed that sucrose was a good anthocyanin protector. Sun *et al.* (2022) also reported that, added sucrose show significantly higher anthocyanin levels and suggested that additional sucrose can improve anthocyanin stability during fermentation. In present study wine prepared with glucose syrup recorded highest anthocyanin.

Effect of sugar source on Antioxidant activity content of rose petal wine

Significant influence of sugar source on antioxidant activity of rose petal wine was noted in Table 1. The maximum antioxidant activity of rose petal wine was observed in rose petal wine prepared with honey S_2 (67.33%) that was at par to the wine prepared with stevia blended sugar S_2 (67.08 %) while minimum antioxidant activity (55.00 %) was recorded in rose petal wine prepared with glucose syrup S_4. A diet high in antioxidants may reduce the risk of many diseases (including heart disease and certain cancers). Antioxidants scavenge free radicals from the body cells and prevent or reduce the damage caused by oxidation. Hence wine with high antioxidant activity exhibit more health benefits. In present research rose petal wine prepared with honey recorded highest antioxidant activity among the studied sugars. This finding supported by previous finding of Joshi and Kumar (2017) recorded highest antioxidant activity (81.79%) in apple tea wine when honey used as a sugar source. Ameer *et al.* (2020) noted that, addition to providing sweetness, stevia exhibits strong antioxidant potential as a sugar substitute.

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Sensory evaluation of rose petal wine

Sensory evaluation of the rose petal wine from different sugar sources was presented in Fig 1. The score points recorded clearly reveal that, the rose petal wine prepared with addition of cane sugar was significantly superior than wine from other sugars. All the sensory characters colour, sweetness, acidity, flavor, mouthfeel and overall acceptability recorded highest score points 7.92, 7.12, 6.40, 7.66, 7.43, 7.44 and 7.49 respectively. The rose petal wine prepared with cane sugar was moderate to very much like by evaluators. The wine prepared with honey, jaggery and sugar blended with stevia show more than 5 score points and the wine was like by evaluators. The wine prepared with glucose syrup recorded less than 5 score point in sweetness, acidity, flavor, mouthfeel and overall acceptability it was slightly dislike by evaluators. Due to its appearance, acidity, flavor, taste and mouthfeel rose petal wine prepared with addition of cane sugar had been evaluated as best wine sample. Acceptance of wine depends on its flavour, taste and mouthfeel. With ageing and racking of wine quality of wine can be enhanced.

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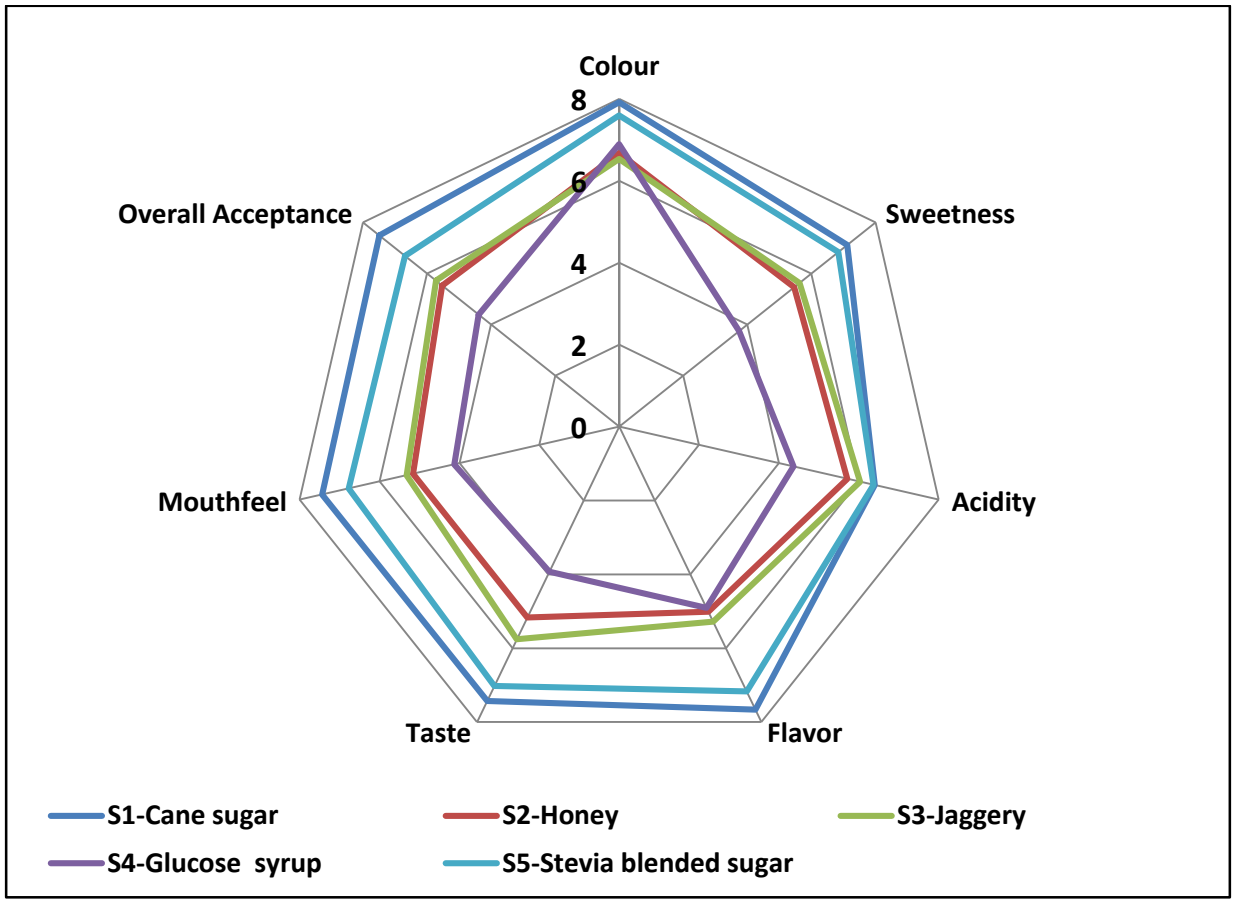

Fig 1: Sensory evaluation of rose petal wine

Effect of different sources of sugars on cost of production

The cost of production includes cost A, cost B and cost C. In all the treatments cost A and cost C were constant and cost B is variable cost that changes with change in input cost. Hence the cost B is proportional to cost of production. The cost B of rose petal wine production was minimum in S1 (Rs. 20.72) that was followed by S3 (Rs. 25.72), however high cost of production recorded in S2 (Rs. 102.72) followed by S4 (Rs. 73.72)

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Table 2: Effect of different sources of sugars on cost of production (per lit of wine)

Sugar source	Sugar		Petal		Yeast		Cost B
	(g)	(Rs)	(g)	(Rs)	(g)	(Rs)	(Rs)
S_1-Cane sugar	200	7	100	10	0.25	3.72	20.72
S_2-Honey	220	88	110	11	0.25	3.72	102.72
S_3-Jaggery	200	12	100	10	0.25	3.72	25.72
S_4-Glucose syrup	220	55	110	11	0.25	3.72	69.72
S_5-Stevia blended sugar	200	60	100	10	0.25	3.72	73.72

Conclusion

Wine can be prepared from rose petals by rising TSS of must with addition of sugar. Considering the physicochemical properties, biochemical composition, sensory evaluation and cost of production of wines prepared from different sources of sugars, it is concluded that cane sugar is the most appropriate external sugar followed by jaggery and honey for preparation of rose petal wine while glucose syrup is inappropriate for rose petal wine preparation.

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