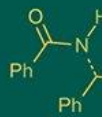


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Assessment of physico-chemical and sensory quality of wine prepared from different banana cultivars

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Abstract

The present investigation entitled "Assessment of Physico-Chemical and Sensory Quality of Wine Prepared from Different Banana Cultivars" was conducted at the Department of Postharvest Management, College of Horticulture, Mudigere, during 2025-26. Banana is an important tropical fruit with high nutritional value and considerable potential for value addition. However, overripe bananas are highly perishable and have limited shelf life, leading to considerable postharvest losses if not utilized promptly. Utilization of overripe bananas for wine production provides an effective means of reducing postharvest losses while converting the fruit into a value-added fermented beverage. The physicochemical composition of bananas varies among cultivars and can influence fermentation efficiency, wine quality and sensory acceptability. Hence, identification of suitable banana cultivars for wine production is important for effective utilization of overripe fruits. The experiment was laid out in a Completely Randomized Design (CRD) with seven treatments and three replications. The treatments comprised wines prepared from different commercial banana cultivars, viz., Grand Naine, Ney Poovan, Karpooravalli, Rajapuri, Poovan, Red Banana and Nendran. The wines were evaluated for wine recovery, alcohol content, pH, titratable acidity, tannin content, total phenol content and antioxidant activity, along with sensory quality attributes. Significant variation in wine quality parameters was observed among the cultivars. Among the treatments, T₅ (Poovan) recorded the most desirable overall wine quality, with the highest wine recovery (92.60%) and alcohol content (12.90%). It also recorded the highest tannin content (12.70 mg 100 mL⁻¹), total phenol content (69.80 mg GAE 100 mL⁻¹) and antioxidant activity (35.82%). The wine exhibited a desirable pH of 3.68 and titratable acidity of 0.61%, contributing to a balanced and acceptable wine quality. Thus, Poovan was found to be the most suitable cultivar for wine production from overripe bananas, offering an effective approach for value addition and reduction of postharvest losses.

Keywords: Banana cultivars, banana wine, wine recovery, Physico-chemical quality, sensory evaluation

Introduction

Banana (*Musa* spp.) is one of the most widely cultivated fruit crops in tropical and subtropical regions and belongs to the family Musaceae. India is the world's largest producer of bananas and is often regarded as the "banana basket of the world." During 2024-25, banana was cultivated over an area of approximately 0.97 million hectares with a production of 35.36 million metric tonnes and an average productivity of 36.50 tonnes per hectare (NHB, 2024-25) [21]. Owing to its year-round availability, high productivity and nutritional value, banana plays an important role in food security, rural livelihoods and the fruit processing industry. Bananas are rich in fermentable carbohydrates, dietary fibre, vitamins, minerals and several bioactive compounds, making them an excellent raw material for the production of fermented beverages. The fruit contains appreciable amounts of carbohydrates (26.90%), dietary fibre (3.07%), potassium (422-450 mg 100 g⁻¹), vitamin B₆ (0.43 mg) and vitamin C (10-12 mg 100 g⁻¹), along with phenolic compounds and antioxidants that contribute to its nutritional and functional properties (Kumari *et al.*, 2023) [15]. These bioactive constituents are associated with antioxidant, anti-inflammatory and cardioprotective activities, while the high potassium and dietary fibre contents contribute to cardiovascular and digestive health (Singh *et al.*, 2016) [30].

Despite its commercial importance, banana is highly perishable and undergoes rapid physiological and biochemical changes after ripening, resulting in considerable postharvest losses. Overripe fruits often become unsuitable for fresh consumption because of excessive softening, peel browning and bruising. Postharvest losses in banana have been reported to reach as high as 38.64 percent due to poor handling, inadequate storage and transportation facilities (Moreno *et al.*, 2021) [20]. The utilization of overripe bananas for processing into value-added products therefore provides an effective approach to minimize wastage, improve farmers' income and enhance resource utilization.

Wine is an alcoholic beverage produced through the fermentation of fruit sugars by yeast and is traditionally prepared from grapes. However, several tropical fruits, including banana, possess sufficient fermentable sugars and desirable flavour compounds for wine production. Banana wine offers a sustainable alternative to conventional grape wine because bananas are available throughout the year and overripe fruits, which are often discarded despite their high sugar content, can be effectively utilized for fermentation. The conversion of surplus bananas into wine not only reduces postharvest losses but also generates a value-added product with considerable commercial potential (Akubor *et al.*, 2003; Fatima and Reddy, 2015) [1, 9]. Different banana cultivars vary considerably in pulp recovery, sugar content, acidity, phenolic composition and flavour characteristics, all

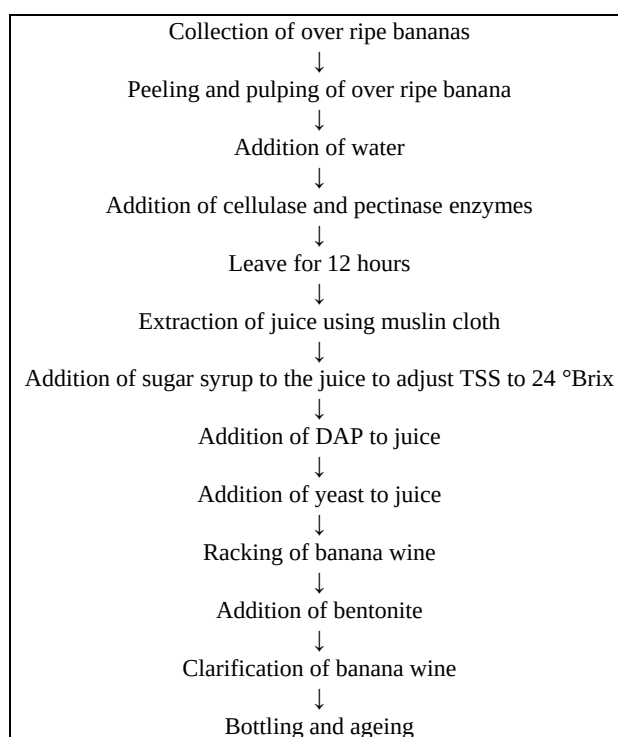
of which influence fermentation efficiency, wine composition and consumer acceptability. Therefore, the selection of a suitable cultivar is an important prerequisite for producing high-quality banana wine with desirable physicochemical characteristics and ageing stability. In view of these considerations, the present investigation was undertaken to evaluate different commercial banana cultivars for wine production and to assess the physicochemical, sensory and ageing characteristics of the wines prepared from them.

Materials and Methods

The present study was carried out during 2025-26 at the Department of Postharvest Management, College of Horticulture, Mudigere. The experiment was laid out in a Completely Randomized Design (CRD) with seven treatments and three replications.

Table 1: Treatment details.

Treatments	Banana cultivar
T ₁	Grand naine (AAA)
T ₂	Ney Poovan (AB)
T ₃	Karpooravalli Banana (AAB)
T ₄	Rajpuri Banana (AAB)
T ₅	Poovan (AAB)
T ₆	Red Banana (AAA)
T ₇	Nendran (AAB)



Flowchart for preparation of wine from different banana cultivars

Total soluble solids were determined using a digital refractometer following the method of Ranganna (1986) [25]. The pH was measured using a digital pH meter, while titratable acidity was estimated by the standard acid-base titration method (Ranganna, 1986) [25]. Alcohol content was estimated using FTIR spectroscopy following standard wine analytical procedures. Tannin content was determined by the Folin-Denis method (Ranganna, 1986) [25], whereas total phenols were estimated using the Folin-Ciocalteu method

described by Singleton and Rossi (1965) [31]. Ascorbic acid content was determined by the 2,6-dichlorophenol indophenol dye titration method (Ranganna, 1986) [25]. Antioxidant activity was estimated using the DPPH radical scavenging assay according to Brand-Williams *et al.* (1995) [5]. Colour parameters (L^* , a^* and b^*) were measured using a colourimeter, while sensory evaluation was carried out by a trained and semi-trained panel using a five-point hedonic scale.

Results and Discussion

Table 2: Effect of different banana cultivars on Total soluble solids (TSS), wine recovery (%) and colour values (L^* , a^* and b^*) of banana wine

Treatments	TSS ($^{\circ}$ Brix)	Wine recovery (%)	Colour		
			L^*	a^*	b^*
T ₁ :Grand naine (AAA)	8.50 ^e	84.50 ^d	32.70 ^{cd}	-3.14 ^d	11.95 ^{ef}
T ₂ :Ney Poovan (AB)	11.30 ^d	86.20 ^c	33.10 ^{cd}	-2.96 ^{cd}	12.42 ^{de}
T ₃ :Karpooravalli Banana (AAB)	14.50 ^a	88.40 ^b	33.80 ^{bc}	-2.64 ^c	13.18 ^d
T ₄ :Rajpuri Banana (AAB)	9.90 ^f	91.80 ^a	36.60 ^a	-1.54 ^{ab}	16.93 ^b
T ₅ :Poovan (AAB)	10.50 ^c	92.60 ^a	37.40 ^a	-1.26 ^a	18.44 ^a
T ₆ :Red Banana (AAA)	12.10 ^c	85.70 ^c	32.10 ^d	-3.55 ^c	11.41 ^f
T ₇ :Nendran (AAB)	12.90 ^b	81.30 ^c	35.10 ^b	-1.84 ^b	15.22 ^c
S. Em $\pm$	0.11	0.23	0.34	0.08	0.21
CD @ 1%	0.48	0.91	1.45	0.36	0.89

Data presented in Table 2 represent the total soluble solids (TSS), wine recovery and colour values (L^* , a^* and b^*) of banana wine prepared from different commercial banana cultivars. Total soluble solids are an important quality attribute of wine, as they indicate the concentration of residual soluble solids remaining after fermentation and contribute to the body and sweetness of the final product. Significant differences were observed among the treatments with respect to TSS. T₃ (Karpooravalli) recorded the highest TSS of 14.50 $^{\circ}$ Brix, followed by T₇ (Nendran) (12.90 $^{\circ}$ Brix), whereas the lowest TSS was recorded in T₁ (Grand Naine) (8.50 $^{\circ}$ Brix). The higher residual TSS in T₃ (Karpooravalli) wine may be attributed to its comparatively higher initial sugar content and relatively lower conversion of fermentable sugars into ethanol during fermentation, whereas the lower TSS in T₁ (Grand Naine) may be associated with greater utilization of fermentable sugars by yeast during fermentation. Variations in TSS among the cultivars could be attributed to differences in carbohydrate composition, fruit maturity, initial sugar concentration and fermentation characteristics of the respective cultivars. Similar varietal differences in soluble solids and their influence on banana wine quality were reported by Akubor *et al.* (2003) ^[1], Fatima and Reddy (2015) ^[9] and Dash *et al.* (1997) ^[7].

Wine recovery is an important indicator of processing

efficiency and economic yield, as it reflects the quantity of finished wine obtained from the processed fruit after juice extraction, fermentation, clarification and racking. Significant differences were observed among the treatments with respect to wine recovery. The highest wine recovery was recorded in T₅ (Poovan) (92.60%), which was statistically on par with T₄ (Rajapuri) (91.80%), whereas the lowest recovery was recorded in T₇ (Nendran) (81.30%). The higher wine recovery in T₅ (Poovan) may be attributed to its favourable pulp-to-peel ratio, higher pulp yield and comparatively lower sediment formation during fermentation and clarification, which resulted in reduced processing losses. The recovery obtained in T₄ (Rajapuri) was also higher, indicating better juice extraction and comparatively lower losses during fermentation and racking. In contrast, the lower recovery observed in T₇ (Nendran) could be associated with its comparatively higher suspended solids and greater lees formation, resulting in increased losses during clarification and racking. Differences in fruit pulp characteristics, juice yield, suspended solids and sediment formation among cultivars can consequently influence the final wine recovery. Comparable observations regarding the influence of banana cultivar and pulp characteristics on juice and wine recovery were reported by Jackson (2014) ^[13], Chillet *et al.* (2013) ^[6] and Pino and Queris (2011) ^[23].

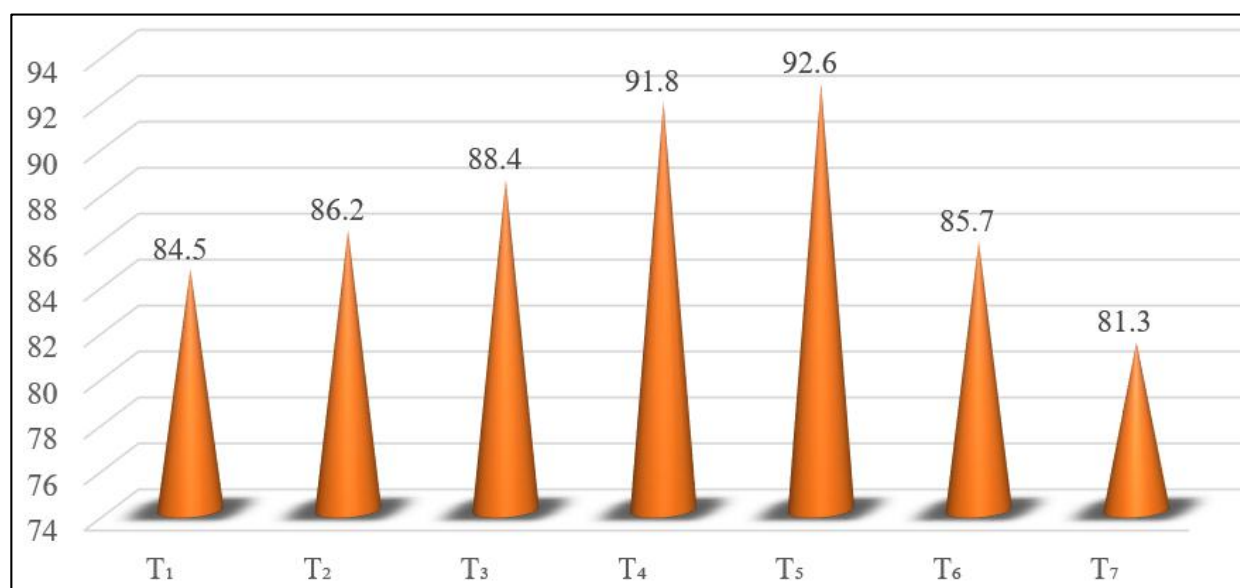


Fig 1: Effect of different banana cultivars on wine recovery of banana wine

Colour is one of the most important quality attributes influencing the visual appeal and consumer acceptability of wine. Significant differences were observed among the treatments with respect to all the colour parameters viz., L^* , a^* and b^* values.

The L^* value indicates the lightness or brightness of wine. The highest L^* value was recorded in T₅ (Poovan) (37.40), which was statistically on par with T₄ (Rajapuri) (36.60), whereas the lowest L^* value was recorded in T₆ (Red Banana) (32.10). The comparatively higher lightness observed in Poovan wine may be attributed to lower enzymatic browning, reduced pigment oxidation and better clarification during fermentation and ageing. In contrast, the lower L^* value recorded in Red Banana wine could be associated with the presence of higher concentrations of natural pigments and polymerized phenolic compounds, resulting in a comparatively darker appearance. Similar observations regarding changes in wine lightness associated with phenolic composition, oxidation and ageing were reported by Gomez-Miguez *et al.* (2007) [10], Moreno and Peinado (2012) [19] and Waterhouse *et al.* (2016) [33].

The a^* value represents the red-green colour component of wine and reflects changes in colour pigments and phenolic compounds during fermentation and ageing. In the present investigation, the highest a^* value (least negative) was recorded in T₅ (Poovan) (-1.26), which was statistically on par with T₄ (Rajapuri) (-1.54), whereas the lowest a^* value was observed in T₆ (Red Banana) (-3.55). The relatively

higher a^* value in Poovan wine may indicate better retention of the original colour characteristics and comparatively lower alteration of phenolic compounds during fermentation and ageing. Conversely, the lower a^* value observed in Red Banana wine may be associated with differences in pigment composition and oxidation-polymerization reactions of phenolic compounds, resulting in a greater shift towards the green component. Similar changes in wine colour associated with phenolic reactions and pigment evolution during ageing have been reported by Somers and Evans (1977) [32] and Perez-Magarino and Gonzalez-San Jose (2003) [22].

The b^* value denotes the yellow-blue colour component of wine and provides an indication of the intensity of yellow colour. The highest b^* value was recorded in T₅ (Poovan) (18.44), followed by T₄ (Rajapuri) (16.93), whereas the lowest b^* value was recorded in T₆ (Red Banana) (11.41). The higher b^* value observed in Poovan wine may be attributed to better retention of yellow-coloured compounds and comparatively lower oxidative deterioration during fermentation and maturation. In contrast, the lower b^* value in Red Banana wine could be related to differences in pigment composition and greater involvement of phenolic compounds in oxidation and polymerization reactions during processing and ageing. Comparable observations on changes in yellow colour components and colour evolution during wine processing and ageing were reported by Ribéreau-Gayonet *et al.* (2006) [27], Monagas *et al.* (2005) [18] and Moreno and Peinado (2012) [19].

Table 3: Effect of different banana cultivars on pH, titratable acidity (%), TSS/acid ratio and colour values of banana wine

Treatments	pH	Titratable acidity (%)	TSS/acid ratio
T ₁ :Grand naine (AAA)	3.65 ^d	0.62 ^b	13.71 ^f
T ₂ :Ney Poovan (AB)	3.67 ^{cd}	0.65 ^b	17.38 ^c
T ₃ :Karpooravalli Banana (AAB)	3.70 ^{ab}	0.71 ^a	20.42 ^a
T ₄ :Rajpuri Banana (AAB)	3.68 ^{bc}	0.64 ^b	15.47 ^e
T ₅ :Poovan (AAB)	3.69 ^{abc}	0.61 ^b	17.21 ^{cd}
T ₆ :Red Banana (AAA)	3.71 ^a	0.73 ^a	16.58 ^d
T ₇ :Nendran (AAB)	3.67 ^{cd}	0.66 ^b	19.55 ^b
S. Em±	0.005	0.01	0.15
CD @ 1%	0.02	0.04	0.67

Data presented in Table 3 represent the pH, titratable acidity and TSS/acid ratio of banana wine prepared from different commercial banana cultivars. The pH is an important quality attribute influencing fermentation efficiency, microbial stability, colour stability, ageing potential and sensory acceptability of wine. In fruit wines, a pH range of approximately 3.2 to 3.8 is generally considered favourable for maintaining desirable flavour characteristics and microbial stability. Significant differences were observed among the treatments with respect to pH. The highest pH was recorded in T₆ (Red Banana) (3.71), which was statistically on par with T₃ (Karpooravalli) (3.70) and T₅ (Poovan) (3.69), whereas the lowest pH was recorded in T₁ (Grand Naine) (3.65). The pH values recorded in all the treatments were within the desirable range for fruit wines, indicating favourable conditions for wine stability and quality. The comparatively higher pH observed in T₆ (Red Banana) may be attributed to its relatively lower concentration of organic acids and differences in the buffering capacity of the fruit matrix. The slight variation in pH among the cultivars could also be associated with differences in varietal composition and the metabolism of organic acids by yeast during fermentation.

Titratable acidity is an important quality attribute of wine, as it contributes to flavour balance, freshness, palatability and keeping quality. In medium fruit wines, titratable acidity generally falls within a range that provides a desirable balance between acidity and sweetness. Significant variation was observed among the treatments with respect to titratable acidity. The highest titratable acidity was recorded in T₆ (Red Banana) (0.73%), which was statistically on par with T₃ (Karpooravalli) (0.71%), whereas the lowest titratable acidity was recorded in T₅ (Poovan) (0.61%). The titratable acidity recorded in the banana wines was within the desirable range for medium fruit wines, indicating a favourable balance between freshness and palatability. The lower acidity observed in T₅ (Poovan) may be attributed to greater utilization or transformation of organic acids during alcoholic fermentation and maturation, whereas the comparatively higher acidity in T₆ (Red Banana) could be associated with its naturally higher organic acid content and cultivar-specific acid composition. Variations in titratable acidity among cultivars may also result from differences in the initial acid composition of the fruits and changes in organic acids during yeast metabolism and fermentation. Comparable observations regarding the influence of organic

acid composition and fermentation on wine acidity were reported by Amerine and Ough (1980) ^[2], Reddy and Reddy (2005) ^[26] and Selli *et al.* (2008) ^[29].

TSS/acid ratio is an important quality index of wine, as it reflects the balance between sweetness and acidity and consequently influences flavour, palatability and consumer acceptability. Significant differences were observed among the treatments with respect to the TSS/acid ratio. The highest TSS/acid ratio was recorded in T₃ (Karpooravalli) (20.42), whereas the lowest ratio was recorded in T₁ (Grand Naine) (13.71). The TSS/acid ratios recorded in the different banana wines were within the desirable range for medium fruit wines, indicating a favourable balance between residual soluble solids and acidity. The higher TSS/acid ratio observed in T₃ (Karpooravalli) may be attributed to its

comparatively higher residual TSS coupled with moderate titratable acidity after fermentation, resulting in a more favourable sweetness-to-acidity balance. In contrast, the lower ratio recorded in T₁ (Grand Naine) could be associated with its lower residual TSS and comparatively higher acidity. The variation in TSS/acid ratio among cultivars may mainly be influenced by differences in initial sugar concentration, organic acid composition, sugar utilization and acid metabolism during fermentation. A balanced TSS/acid ratio contributes to improved flavour harmony and overall wine quality. Similar observations regarding the influence of soluble solids and acidity on the sensory quality and palatability of wines were reported by Zoecklein *et al.* (1995) ^[34], Bisson (2001) ^[4] and Jackson (2014) ^[13].

Table 4: Effect of different banana cultivars on alcohol (%), tannin (mg 100 mL⁻¹), total phenols (mg GAE 100 mL⁻¹), ascorbic acid (mg 100 mL⁻¹) and antioxidant activity (%) of banana wine

Treatments	Alcohol (%)	Tannin (mg 100 ml ⁻¹)	Phenol (mg GAE 100 ml ⁻¹)	Ascorbic acid (mg 100 ml ⁻¹)	Antioxidant activity (%)
T ₁ :Grand naine (AAA)	12.20 ^{bc}	11.50 ^c	52.50 ^f	3.90 ^d	24.17 ^c
T ₂ :Ney Poovan (AB)	12.50 ^{ab}	11.70 ^c	54.30 ^{ef}	4.70 ^{bc}	28.65 ^c
T ₃ :Karpooravalli Banana (AAB)	11.10 ^d	12.20 ^{cd}	58.20 ^d	5.50 ^a	27.31 ^d
T ₄ :Rajpuri Banana (AAB)	12.70 ^a	12.50 ^{ab}	68.10 ^b	4.50 ^c	30.44 ^b
T ₅ :Poovan (AAB)	12.90 ^a	12.70 ^a	69.80 ^a	4.90 ^{bc}	35.82 ^a
T ₆ :Red Banana (AAA)	12.00 ^c	12.00 ^d	56.20 ^{de}	5.90 ^a	24.02 ^c
T ₇ :Nendran (AAB)	12.60 ^{ab}	12.30 ^{bc}	62.10 ^c	5.00 ^b	30.40 ^b
S. Em±	0.09	0.06	0.80	0.10	0.21
CD @ 1%	0.39	0.26	3.40	0.46	0.92

Data presented in Table 4 represent the alcohol content, tannin, total phenols, ascorbic acid and antioxidant activity of banana wine prepared from different commercial banana cultivars. Alcohol is the principal constituent responsible for the body, flavour, mouthfeel and overall quality of wine. In medium fruit wines, the alcohol content generally ranges from 10.5 to 13.5 percent, providing desirable body and flavour characteristics. Significant differences were observed among the treatments with respect to alcohol content. The highest alcohol content was recorded in T₅ (Poovan) (12.90%), which was statistically on par with T₄ (Rajapuri) (12.70%), whereas the lowest alcohol content was recorded in T₃ (Karpooravalli) (11.10%). The alcohol content recorded in T₅, T₄, T₇ and T₂ was within the desirable range for medium fruit wines, indicating satisfactory fermentation and favourable body and flavour development. The comparatively higher alcohol content in T₅ (Poovan) may be attributed to the greater availability and efficient utilization of fermentable sugars by yeast, resulting in greater ethanol production. In contrast, the lower alcohol content observed in T₃ (Karpooravalli) could be due to varietal differences in fermentable sugar availability and fermentation efficiency. Differences in alcohol production among cultivars are mainly influenced by the initial sugar concentration, composition of fermentable sugars and efficiency of yeast in converting sugars into ethanol during fermentation. Similar observations regarding the influence of fermentable sugars and yeast fermentation efficiency on alcohol production in fruit wines were reported by Joshi *et al.* (1991) ^[14], Amerine and Ough (1980) ^[2] and Reddy and Reddy (2005) ^[26].

Tannins are important phenolic constituents that contribute to the astringency, body, mouthfeel and ageing stability of wine. In medium fruit wines, tannin content generally ranges from 10 to 15 mg 100 mL⁻¹, contributing to desirable structure and ageing potential. Significant variation was observed among the treatments with respect to tannin content. The highest tannin content was recorded in T₅ (Poovan) (12.70 mg 100 mL⁻¹), which was statistically on par with T₄ (Rajapuri) (12.50 mg 100 mL⁻¹), whereas the lowest tannin content was recorded in T₁ (Grand Naine) (11.50 mg 100 mL⁻¹). The tannin content recorded in all the treatments was within the desirable range for medium fruit wines, indicating favourable contribution to wine structure, mouthfeel and ageing potential. The comparatively higher tannin content observed in T₅ (Poovan) may be associated with its naturally higher concentration of phenolic constituents, which were extracted into the wine during processing and fermentation. In contrast, the lower tannin content in T₁ (Grand Naine) may be attributed to comparatively lower levels of tannin and phenolic compounds in the fruit or differences in their extraction during fermentation. Variations in tannin content among the cultivars could therefore be related to differences in the inherent phenolic composition of the fruits and the extraction and transformation of these compounds during fermentation and maturation. Similar observations regarding the role and variation of phenolic compounds and tannins in wine quality were reported by Ribereau-Gayon *et al.* (2006) ^[27], Jackson (2014) ^[13] and Waterhouse *et al.* (2016) ^[33]. Phenolic compounds are important constituents of wine, contributing to antioxidant potential, colour stability, oxidative stability and overall functional quality. In medium

fruit wines, total phenol content generally ranges from 50 to 80 mg GAE 100 mL⁻¹. Significant differences were observed among the treatments with respect to total phenol content. The highest total phenol content was recorded in T₅ (Poovan) (69.80 mg GAE 100 mL⁻¹), which was statistically on par with T₄ (Rajapuri) (68.10 mg GAE 100 mL⁻¹), whereas the lowest total phenol content was recorded in T₁ (Grand Naine) (52.50 mg GAE 100 mL⁻¹). The total phenol content recorded in T₅, T₄, T₇ and T₃ was within the desirable range for medium fruit wines, indicating favourable antioxidant potential and oxidative stability. The comparatively higher phenol content observed in T₅ (Poovan) may be attributed to its greater accumulation of naturally occurring polyphenolic compounds, which were extracted and retained during fermentation and consequently contributed to enhanced antioxidant and oxidative stability of the wine. In contrast, the lower phenol content recorded in T₁ (Grand Naine) could be associated with comparatively lower levels of phenolic constituents in the fruit or differences in their extraction and retention during fermentation. The variation in total phenol content among the cultivars may therefore be influenced by differences in inherent phenolic composition, fruit maturity and the extraction and transformation of phenolic compounds during fermentation and maturation. Comparable observations regarding the contribution of phenolic compounds to the antioxidant properties and quality of fruit-based wines were reported by Singleton and Rossi (1965) [31], Ignat *et al.* (2011) [12] and Li *et al.* (2009) [17].

Ascorbic acid is an important nutritional constituent that enhances the nutritional value of wine and contributes to its antioxidant properties and oxidative stability. In medium fruit wines, the ascorbic acid content generally ranges from 3.5 to 6.5 mg 100 mL⁻¹. Significant variation was observed among the treatments with respect to ascorbic acid content. The highest ascorbic acid content was recorded in T₆ (Red Banana) (5.90 mg 100 mL⁻¹), whereas the lowest ascorbic acid content was recorded in T₁ (Grand Naine) (3.90 mg 100 mL⁻¹). The ascorbic acid content recorded in all the treatments was within the desirable range for medium fruit wines, indicating good nutritional quality and antioxidant potential. The comparatively higher ascorbic acid content observed in T₆ (Red Banana) may be attributed to its naturally higher vitamin C concentration, with a considerable proportion being retained during processing and fermentation. In contrast, the lower ascorbic acid content in T₁ (Grand Naine) could be associated with its comparatively lower initial vitamin C content and possible losses during fermentation and maturation. Differences in ascorbic acid content among the cultivars may therefore be influenced by inherent varietal differences in vitamin C concentration, fruit maturity and the degradation of ascorbic acid during processing and fermentation. Similar observations regarding varietal differences and the stability of ascorbic acid in fruit products were reported by Davey *et*

al. (2000) [8], Lee and Kader (2000) [16] and Hailu *et al.* (2013) [11].

Antioxidant activity is an important functional quality attribute that reflects the ability of wine to neutralize free radicals and is largely influenced by the concentration of phenolic compounds and other antioxidant constituents. In medium fruit wines, antioxidant activity generally ranges from 20 to 40 percent. Significant differences were observed among the treatments with respect to antioxidant activity. The highest antioxidant activity was recorded in T₅ (Poovan) (35.82%), whereas the lowest antioxidant activity was recorded in T₆ (Red Banana) (24.02%). The antioxidant activity recorded in T₅, T₄ and T₇ was within the desirable range for medium fruit wines, indicating good functional quality and free radical scavenging potential. The comparatively higher antioxidant activity observed in T₅ (Poovan) may be attributed to its higher concentration of phenolic compounds, particularly the polyphenolic constituents capable of donating hydrogen atoms or electrons to neutralize free radicals and thereby enhance oxidative stability. This observation is also supported by the higher total phenol content recorded in Poovan wine, indicating a positive contribution of phenolic compounds to its antioxidant potential. In contrast, the lower antioxidant activity observed in T₆ (Red Banana) may be associated with its comparatively lower concentration or availability of antioxidant phenolic constituents after fermentation and maturation. Differences in antioxidant activity among the cultivars could therefore be related to variations in their inherent phenolic composition and the retention or transformation of antioxidant compounds during fermentation. Similar findings regarding the contribution of phenolic compounds to free-radical-scavenging activity in fruit-based beverages were reported by Brand-Williams *et al.* (1995) [5], Rice-Evans *et al.* (1996) [28] and Prior *et al.* (2005) [24].

Organoleptic evaluation of banana wine prepared from different banana cultivars is presented in Fig. 4. Sensory attributes such as clarity, colour, flavour, aroma, sweetness, acidity and body greatly influence the quality and consumer acceptability of wine. In the present study, T₅ achieved the highest clarity (4.92), colour (4.84), sweetness (4.90) and acidity (4.82) scores, followed by T₄ clarity (4.71), colour (4.63), sweetness (4.69) and acidity (4.58), whereas the lowest scores for these attributes were recorded in T₁ clarity (3.48), colour (3.42), sweetness (3.46) and acidity (3.39).

With respect to flavour and aroma, the highest scores were recorded in T₅ flavour (4.78) and aroma (4.86) followed by T₄ flavour (4.55) and aroma (4.60), whereas the lowest flavour and aroma scores were observed in T₁ flavour (3.31) and aroma (3.37). For body, T₅ recorded the highest score (4.74), while the lowest was observed in T₁ (3.28). In terms of overall acceptability, T₅ recorded the highest score (4.84), followed by T₄ (4.61), T₃ (4.28) and T₆ (4.08), whereas the lowest overall acceptability was noted in T₁ (3.39).

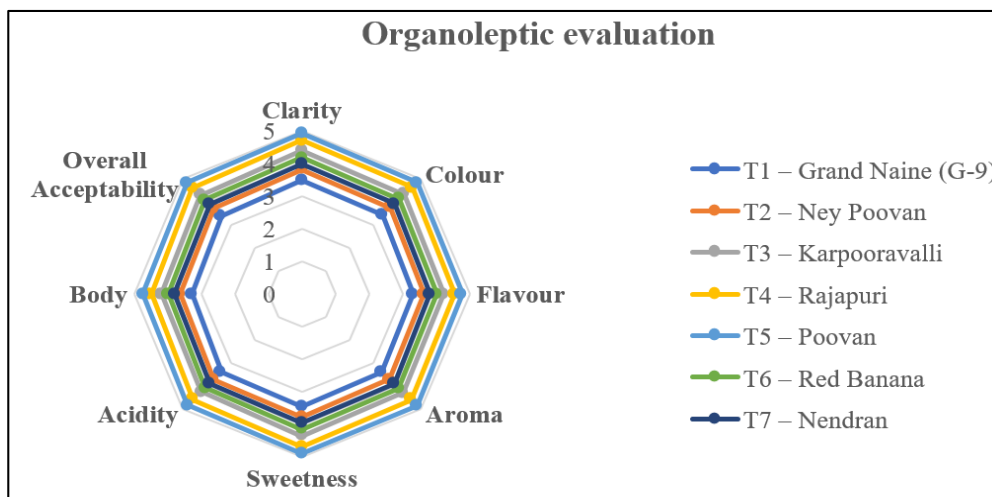


Fig 2: Effect of different banana cultivars on the organoleptic evaluation of banana wine



Plate 1: Effect of different banana cultivars on colour parameter

Conclusion

Among the seven cultivars evaluated, Poovan banana (T₅) was found to be superior with respect to fruit recovery (67.18%), desirable chemical composition and bioactive constituents. The wine prepared from Poovan banana recorded the highest wine recovery (92.60%), alcohol content (12.90%), tannin content (12.70 mg 100 mL⁻¹), total phenol content (69.80 mg GAE 100 mL⁻¹), antioxidant activity (35.82%), desirable pH (3.68), lowest titratable acidity (0.61%) indicating its superior quality and economic feasibility. In contrast, (T₃) Karpooravalli owing to its higher total soluble solids (TSS) content, was found to be the most suitable cultivar for the production of sweet banana wine. In terms of sensory evaluation, Poovan wine received the highest scores for clarity (4.92), colour (4.84), flavour (4.78), aroma (4.86), sweetness (4.90), acidity (4.82), body (4.74) and overall acceptability (4.84), followed by Rajapuri wine. The study demonstrates the successful utilization of overripe banana for wine production, providing an effective avenue for value addition.

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