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BIOCHEMICAL AND NUTRITIONAL PROFILES OF WINE GRAPE VARIETIES GROWN UNDER CUMBUM VALLEY REGION OF TAMIL NADU INDIA

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ABSTRACT

In order to evaluate the wine grape varieties for its biochemical and nutritional attributes, a study was carried out at Grapes Research Station, TNAU, Anaimalayanpatty, Theni, Tamil Nadu. The experiment was laid out in Randomized Block Design with three replications to evaluate the bunch quality characters of diverse group of wine grapes *viz.* Cabernet Sauvignon, Zinfandel, Shiraz, Merlot, Manjiri Medika, Muscat Hamburg, Chenin Blanc, Sauvignon Blanc, Symphony, and Viognier. According to the results of the present study, it was observed that, the variety Manjari Medika had the highest anthocyanin content (251.17 and 252.76 mg $100g^{-1}$), TSS: acid ratio (38.19 and 43.25), total soluble solids (22.50 and 22.90 ^{o}brix), and lowest acidity (0.59 and 0.53 %) in both the seasons. The highest glucose level was found in Viognier (11.19 and 11.42 g l^{-1}). Cabernet Sauvignon exhibited the highest Titratable acidity (0.85 and 0.81 %) in summer and winter pruning, while Chenin Blanc exhibited the highest total sugars (17.62 and 19.77%), Shiraz recorded the highest reducing sugars (15.66 and 17.05%) in both summer and winter pruning seasons, and the glucose: fructose ratio (1.08) in winter pruning. Muscat Hamburg displayed a greater value of non-reducing sugars (3.57%) in summer pruning, while Sauvignon Blanc showed the maximum fructose (11.94 and 12.27 g l^{-1}) in both pruning seasons.

Keywords **:** Wine grapes, qualitative attributes, bunch quality, pruning seasons, biochemical attributes.

Introduction

Grapes, a member of the Vitaceae family, are one of the notable fruit crops in the globe and Peninsular India. The world's leading grapes producers are France, Italy, Spain, the United States, China, Australia, Chile, South America, Mexico, and Eastern nations. They were introduced to India by the Persian invaders during 1300 A.D. In spite of coming from the temperate region closer to the Black Caspian Sea, they have adapted to the Indian subcontinent's tropical and subtropical agroclimatic conditions (Shikhamany, 2001). Grapes are produced commercially in an array of soil types and climates in India. Nearly 94 per cent of India is in the tropical region, despite the country being separated into three distinct regions: tropical (Maharashtra, Karnataka, Tamil Nadu, and Andhra Pradesh), subtropical (Punjab, Haryana, and Western Uttar Pradesh), and temperate (Jammu & Kashmir and Himachal Pradesh).

Grapes are a cool and refreshing fruit, rich in sugars, acids, minerals, vitamins and tannins. Carbohydrates (15 %), minerals (0.2-0.6 %), organic acids (0.3-1.5 %), nitrogenous substances (0.03-0.7 %), iron (0.003-0.017 %), calcium (0.004-0.025 %), potassium (0.15-0.25 %), and vitamin A (1-80 micrograms), vitamin B complex (391-636 mg/100g) and vitamin C (1-1.25 mg/100g) are the main components of the grape fruits (Winkler, 1965). Grapes are a juicy fruit found in variety of colours. Fruits of grapes are used for table purpose, juice, wine making and as a dry fruit (raisin). Besides, it is used in various forms *viz.,* jam, jelly, vinegar, crush, candy, seed

extract, seed powder and seed oil. Out of the total grapes production in India, 78 per cent is used for table purpose, 20 per cent is utilized as raisin and only two per cent is consumed in manufacturing of juice and wine.

In Tamil Nadu, the grapes are primarily produced in the Theni district, which covers an area of about 2,184 hectares. Around 184 hectares are utilized for seedless cultivars, while 2000 hectares are planted with Muscat Hamburg (Panneer). One of Tamil Nadu's major grape-producing regions is the Cumbum Valley. While the season ends with summer in the majority of wine growing states, the land and climate in the Cumbum Valley are extremely favorable for harvesting grape round the year. The grapes planted here are harvested twice a year or five times in two years utilizing staggered pruning procedures.

Wine grapes are harvested when their juicy content reaches 24 per cent of the total soluble solids level. They are smaller in size, typically include more seeds, have relatively thick skin and are typically quite delicious. Additionally, grapes have a wide range of polyphenols and antioxidants. By scavenging dangerous free radicals, these advantageous antioxidants stop the oxidation process that destroys cells. Worldwide, up to 84 per cent of the crop is used to make wine, but only 2 per cent is used in India. India now consumes a pitiful 7 ml of wine per person, compared to 60 and 50 liters in France and Italy, respectively (Patil, 2008). As the product was eventually commercialized for the industry purpose, the scientists have given the method the attention it deserves. The present study aims at appraising the bunch quality parameters of red and white coloured varieties under Cumbum Valley condition.

Materials and Methods

Ten distinct wine grape varieties were used in the experiment conducted at the Grapes Research Station, TNAU, Anaimalayanpatty, Theni. Cabernet Sauvignon, Zinfandel, Shiraz, Merlot, Manjiri Medika, Muscat Hamburg, Chenin Blanc, Sauvignon Blanc, Symphony and Viognier are among the wine grape varieties that were grafted on dogridge rootstock for this study purpose. The experiment was taken up in four years old *in situ* grafted grapes varieties on dogridge rootstock spaced at 3.0 × 2.0 m and trained on bower system.

The study used a Randomized Block Design with three replications. Vines were pruned leaving 4-7 buds for fruiting depending upon the varieties, twice in a year *i.e.,* First summer pruning was done during May and harvested during August; second winter pruning was given during December and harvesting was done during April during the study period. The harvested fruits were analyzed for various quality attributes and the methodology followed is given below.

The total soluble solids in the fruits were directly measured and reported as degree brix (ºbrix) using a digital refractometer with a range of 0-32 ºbrix. The Titratable acidity was estimated using the A.O.A.C. (1990) standard procedure and the results were expressed as percentage of citric acid in fresh sample. TSS: Acid ratio was calculated by dividing TSS (°brix) by acidity (%). The method proposed by Hedge *et al.* (1962) was used to estimate the total sugar content, which was then reported as a percentage. Using Somogyi (1952) method, the berries reducing sugar content was measured and expressed as a percentage. By deducting the amount of reducing sugars from the total sugars, the non-reducing sugar content was derived and expressed as percentage. The glucose and fructose content was quantified using the glucose oxidase method as outlined by Somogyi (1952) and A.O.A.C. (1990), respectively and expressed in g/L. Further, the above two values were used to calculate the Glucose: Fructose ratio. The anthocyanin content was estimated by using the methodology indicated by Cynkar *et al.* (2004) and the contents were represented in mg $100g^{-1}$. The analytical data were subjected to statistical scrutiny following the procedure outlined by Gomez and Gomez (1976).

Results and Discussion

Total soluble solids

The highest total soluble solids were found in Manjari Medika (22.50 and 2.90 °brix) in summer and winter pruning while it was the least in Cabernet Sauvignon (16.51 °brix) during summer pruning and Merlot (17.80 °brix) in winter pruning (Table 1). An increase in the total soluble solids was observed as a result of accumulation of more carbohydrates. Carbohydrate concentration was increased with increase in bunch number; however, the concentration was more in berries which led to achieve higher TSS. The TSS reduced with increasing crop load (Somkuwar *et al.,* 2019). The low TSS in the varieties tested may be due to the cooler temperature condition during berry development. The cool temperature was reported to reduce the sugar levels in berries (Karibasappa and Adsule, 2006).

Titratable acidity

The Titratable acidity was found to be low in the Manjari Medika (0.59 and 0.53 %) whereas it was high in Cabernet Sauvignon (0.85 and 0.81 %) during summer and winter pruning respectively (Table 1). As

the TSS content increased, the acidity got dropped. Additionally, our findings concur with the findings of Somkuwar *et al.* (2019a). The biochemical characteristics of table grape varieties (SSC, TA, sugars, amino acids, organic acids, phenolic compounds and total antioxidants) might differ depending on the site, locality, topography and environment (Khan *et al.,* 2011).

TSS: Acid ratio

During summer and winter pruning, the TSS: acid ratio was noticed to be the least in Cabernet Sauvignon (19.48 and 22.21) whereas the highest TSS: acid ratio was recorded in the variety Manjari Medika (38.19 and 43.25) respectively (Table 1). The brix/acid ratio varies in different varieties of grape because the amount of TSS/TA ratio is determined by phenotypic characteristics, genetic makeup and day and night time temperatures, which often promote solute accumulation (Sahoo *et al.*, 2018). Similar findings in different grape varieties were also reported by Mehan *et al.* (2006), Ghosh (2006) and Gill and Arora (2009).

Reducing sugars

The variety Shiraz registered the highest reducing sugar content (15.66 and 17.05 %) during summer and winter pruning. The lowest reducing sugar content was found in Muscat Hamburg (11.44 %) in summer pruning and the variety Symphony (13.17 %) during winter pruning (Table 1). The difference in reducing sugars among the grape varieties might be because of the fact that the sugars in grapes are greatly influenced by varietal difference and environmental condition (Yinshan *et al.,* 2017 and Akram *et al.,* 2020). The results of present investigation were supported by the findings of Ratnacharyulu (2010) and Bahksh *et al.* (2022) in different grape varieties.

Non-reducing sugars

During summer pruning, the highest non-reducing sugar content (3.57 %) was recorded in Muscat Hamburg. The lowest non-reducing sugar content of 1.02 per cent was registered in Merlot (Table 1).

Total sugars

The highest total sugar content (17.62 and 19.77 %) was recorded in Chenin Blanc during both the pruning. The lowest total sugar content (11.42 %) was registered in Shiraz in summer pruning. In case of winter pruning, the variety Merlot (15.69 %) exhibited the lower total sugar content (Table 1). Balanced pruning leads to increased sugar content which will result in increased vegetative and reproductive growth. This may be because there is less competition for metabolites in developing berries and an ideal amount of bunches per vine. The results of Singh and Kumar (1980), Mohanakumaran *et al.* (1964) and Bahksh *et al.* (2022) further support these conclusions.

Glucose

The variety Viognier recorded the highest values of 11.19 and 11.42 g l^{-1} in summer and winter pruning respectively. The lowest glucose content was recorded in Merlot (8.44 and 9.27 g l^{-1}) in both the pruning seasons respectively (Table 2).

Fructose

In both the pruning, the fructose content was higher in the variety Sauvignon Blanc (11.94 and 12.27 g l^{-1}), while the fructose content was lower in Merlot (8.50 and 9.20 g l^{-1}) (Table 2).

Glucose: Fructose ratio

In case of winter pruning, the glucose: fructose ratio (1.08) was greater in Shiraz. Further, the lowest glucose: fructose ratio was observed in the Sauvignon Blanc (0.92) (Table 2).

Anthocyanin

The highest anthocyanin content (251.17 and 252.76 mg 100 g^{-1}) was recorded in Manjari Medika. The lowest value for anthocyanin content was found to be negligible in white coloured varieties (0.001 mg $100g^{-1}$) during both the pruning (Table 2). The red coloured varieties had higher anthocyanin content than white coloured varieties. Development of colour in berry as well as pulp may be related to more internal shading within the bunch than shading within the canopy. This result is in conformity with the findings of Rojas-Lara and Morrison (1989) who reported that anthocyanin accumulation in the fruit was affected more by shading within the cluster than by canopy shading. Intensity of colour was judged by higher anthocyanin content.

Conclusion

It has been noted that changes in the site, locality, topography and environment affect the pheno-physiological (bud burst, berry growth & development, berry size, number of berries per bunch, time of maturity and ripening) and biochemical (SSC, TA, sugars, amino acids, organic acids, phenolic compounds, and total antioxidants) characteristics of table grape varieties. Our findings showed that in order to ensure that the new varieties are more adaptable and economically significant, the fruit characteristics including berry ripening time, berry weight and SSC fluctuation due to environmental variation must be studied in a new set of climatic conditions.

Table 1 : Evaluation of wine grapes (*Vitis vinifera* L.) varieties on qualitative attributes

Varieties	TSS (°brix)		Titratable acidity (%)		TSS : Acid Ratio		Reducing Sugars (%)		Non-Reducing Sugars (%)		Total sugars (%)	
	Summer pruning	Winter pruning	Summer pruning	Winter pruning	Summer pruning	Winter pruning	Summer pruning	Winter pruning	Summer pruning	Winter pruning	Summer pruning	Winter pruning
Cabernet Sauvignon	16.51	17.97	0.85	0.81	19.48	22.21	14.79	15.86	2.04	3.01	16.62	18.87
Zinfandel	17.64	18.00	0.71	0.68	24.86	26.49	15.38	16.59	1.18	1.26	15.62	17.60
Shiraz	21.03	21.25	0.64	0.59	32.89	38.38	15.66	17.05	2.35	2.29	11.42	19.34
Merlot	17.13	17.80	0.69	0.65	24.85	27.40	13.67	14.66	1.02	1.12	13.37	15.69
Manjari Medika	22.50	22.90	0.59	0.53	38.19	43.25	14.65	16.78	1.71	2.56	16.36	17.37
Muscat Hamburg	20.61	21.10	0.68	0.61	30.34	34.62	11.44	13.21	3.57	2.72	15.05	15.93
Chenin Blanc	17.17	18.30	0.75	0.70	22.95	26.19	15.11	15.70	2.51	4.07	17.62	19.77
Sauvignon Blanc	19.16	19.60	0.73	0.67	26.29	29.27	13.21	14.03	2.04	1.79	15.22	15.82
Symphony	19.42	20.80	0.65	0.58	29.90	35.89	12.98	13.17	1.53	3.55	14.51	16.72
Viognier	22.20	21.40	0.61	0.55	36.39	40.99	13.18	13.65	1.14	2.28	14.32	15.93
S.Ed	0.55	0.70	0.02	0.01	0.64	0.73	0.75	0.70	0.61	1.00	0.75	1.23
CD (0.05%)	1.16	1.49	0.05	0.02	1.37	1.54	1.59	1.51	1.32	NS	1.58	2.60

Table 2 : Evaluation of wine grapes (*Vitis vinifera* L.) varieties on glucose, fructose and anthocyanin content

Varieties	Glucose (g l^{-1})		Fructose (g l^{-1})		Glucose : fructose ratio		Anthocyanin (mg $100g^{-1}$)	
	Summer pruning	Winter pruning	Summer pruning	Winter pruning	Summer pruning	Winter pruning	Summer pruning	Winter pruning
Cabernet Sauvignon	9.68	10.92	10.59	11.06	0.92	0.99	62.41	69.21
Zinfandel	9.06	10.53	9.86	10.15	0.93	1.04	83.24	84.13
Shiraz	9.34	10.83	9.55	10.06	0.98	1.08	124.62	125.68
Merlot	8.44	9.27	8.50	9.20	1.00	1.01	81.04	82.33
Manjari Medika	9.90	11.08	9.69	10.44	1.03	1.06	251.17	252.76
Muscat Hamburg	9.49	10.86	9.55	10.17	1.00	1.07	44.13	45.22
Chenin Blanc	9.27	9.91	9.49	10.04	0.98	0.99	0.001	0.001
Sauvignon Blanc	10.89	11.20	11.94	12.27	0.92	0.92	0.001	0.001
Symphony	9.17	9.86	9.16	9.72	1.01	1.02	0.001	0.001
Viognier	11.19	11.42	11.65	11.92	0.96	0.96	0.001	0.001
S.Ed	0.33	0.21	0.07	0.24	0.07	0.03	2.28	1.52
CD (0.05%)	0.71	0.48	0.16	0.52	NS	0.06	4.84	3.20

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