DOI : https://doi.org/10.58993/ijh/2023.80.2.14

Indian J. Hortic. 80(2), June 2023: 218-224

Quality evaluation of wines prepared by blending grape juices

P. B. Tonge[1], R. M. Palghadmal, R. G. Kale, T.P.A. Shabeer, R. R. Samarth and A. K. Sharma*
ICAR-National Research Centre for Grapes, Manjiri Farm, P B, No 3, Solapur Rd, Pune-412307, Maharashtra, India.

ABSTRACT

An investigation was undertaken to prepare wines from the pure and blended juices of Sauvignon Blanc (SB) and Manjari Naveen (MN) grapes. Juices were blended according to plan, and wines were prepared following the standard vinification procedure and evaluated after two rackings. Alcohol in prepared wines ranged from 11.48 to 12.75 per cent. The acidity, volatile acidity, and pH of wines were within acceptable limits. Observed aroma compounds using 'GC×GC-TOF/MS' were mainly related to aroma notes in commercial wines. Wine prepared from T7 (SB-50% + MN 50%) attained a maximum score (4.7 out of 5 points hedonic scale) in overall acceptability. The wine quality got improved when the juices of Sauvignon Blanc and Manjari Naveen were blended before fermentation. However, there is a need to optimize crop load, suitable rootstock, maturity level at harvest, etc., for harnessing the aromatic nature by adopting a suitable juice combination of these two varieties.

Keywords: *Vitis vinifera* L., Aromas, Juice blend, Manjari Naveen, Vinification, Sauvignon Blanc.

INTRODUCTION

Grape (*Vitis vinifera* L.) is an important fruit crop of the world, belonging to the family *Vitaceae*. Armenia is well documented as the centre of origin for *Vitis vinifera* sub sp. *vinifera* (Margaryan *et al*., 13). India is fast emerging as one of the top grape-growing countries in the world. According to an estimate for 2021-22, grapevines occupy an area of 0.162 million ha with an annual production of 3.49 million tons (Anonymous, 2). Winemaking is concentrated mainly in EU countries. Italy is the leading wine producer, with a volume of 49.1 million hectolitres, followed by France and Spain (OIV report, 14). In India, the wine industry is only 35 years old; wine production in 2019 was about 30 million litres. Grape growing and winemaking under tropical conditions is a costly affair. Considering the worldwide demand for wines, the Indian wine industry adopted the grape varieties *viz*., Cabernet Sauvignon, Merlot, Shiraz, Sauvignon Blanc, Chenin Blanc, etc. (Adsule *et al*., 1), and wines are being appreciated and exported. Sauvignon Blanc is a ruling white variety and expresses floral to fruity aromas depending on the terroir. Microclimates of grape-growing regions of Maharashtra, specifically Nashik, are suited well to grow this variety with acceptable wine quality. A table variety Manjari Naveen has flavoured and seedless berries sensed when a TSS of 18° Brix is attained. The blending of juices is practiced to prepare balanced wine with improved quality in terms of colour, aroma, stability, consumer acceptability, etc. Considering the growing demand for wine, adaptability of Sauvignon Blanc, and availability of aromatic berries of Manjari Naveen, the present study was conducted to assess the wine quality after blending the juices of both varieties.

MATERIALS AND METHODS

The present investigation was conducted at the ICAR- National Research Centre for Grapes, Manjari Farm, Pune, during the fruiting year of 2021. The experimental site experiences tropical wet and dry climatic conditions, with an average temperature of 25 to 35 °C during the peak period of the growing season. The vines were planted on a North-South orientation at a 2.66 m × 1.33 m distance and trained to mini Y trellis with placed cordons horizontally. Sauvignon Blanc vines were grafted on 110 R rootstock, while Manjari Naveen was grown on Dogridge. Fruit pruning was performed in October 2020. The bunches with fully ripened undamaged berries attaining the desired TSS and pH were harvested early in the morning. After juice extraction from sound berries, potassium metabisulphite @125 ppm was added to kill the natural microflora, and the juice was stored at 4 °C overnight. The juice was separated from lees and inoculated with a yeast culture of *Saccharomyces cerevisiae* Rhone 2226 @ 20 g of yeast per 100 L of juice. The fermentation process was performed at the temperature of 16 ± 2 °C. Combinations of juices were blended accordingly, as mentioned in Table 1, before adding potassium metabisulphite.

The CO_2 generated during fermentation was removed by unplugging flasks for a fraction of a second. After the completion of the fermentation process (reducing sugar <2 g/l) on 12 days, the SO_2 level of 100 ppm was maintained by adding 200

*Corresponding author: Ajay.Sharma1@icar.gov.in
[1]V.D. College of Agricultural Biotechnology, Latur- 413 531, Maharashtra, India.

Table 1. Treatment details on blending of juices.

Treatments	Sauvignon Blanc (SB)	Manjari Naveen (MN)
T1	100%	0
T2	0	100%
T3	90%	10%
T4	80%	20%
T5	70%	30%
T6	60%	40%
T7	50%	50%

mg per L of potassium metabisulphite to kill yeast cells and to ensure microbial stability. Prepared wines were stored at 10°C and racked twice for one month. Wines from treatments were analysed by using the OenoFossTM (FTIR-based wine analyser) for parameters like contents ethanol (%), glucose/fructose (g/l), malic acid (g/l), total acid (g/l), pH and volatile acid (g/l). The total SO_2 (ppm) in prepared wine was estimated by adopting the method suggested by Zoecklein et al., 1994. Three biological replications from each wine were analysed separately. For the organoleptic study, a semi-trained group of 6 individuals was involved. The five-point hedonic scale was adopted to generate the data.

For extraction and analysis of volatile aroma compounds, the sample was prepared according to the methodology suggested by Carlin *et al*. (4), and extraction was carried out through Headspace Solid Phase Micro Extraction (HS-SPME). In a 20 mL headspace vial, 2 mL of the sample was added and incubated at 35 ºC for 5 min. Aroma compounds were extracted using SPME fibre -DVB/CAR/PDMS (Supelco, Sigma Aldrich, Milan, Italy), and desorbed for 5 min at 250 °C in split-less mode. A LECO Pegasus® 4D GC×GC-TOFMS was used to identify aroma-active compounds. The primary oven in the GC was fitted with a capillary column of DB-WAX (30 m × 0.20 mm × 0.20 mm) coupled with a smaller DB-5MS capillary column (1.8 m X 0.25 mm ID X0.25 mm). The injector was held at 250 °C in the split-less mode with a purge-off time of 30 sec, and a 22.5 mL/min split vent flow at 1 min. The temperature program was 40 °C for 5 min, ramped at 6 °C/min to 230 °C, and held at 230 °C for 3 min. The secondary oven program was offset by +5 °C from the primary oven program, and the modulator was offset by +25 °C from the secondary oven and -80 °C chiller temperature. Headspace volatile components were identified as different peaks of the chromatogram, and confirmed based on the retention time, retention index (RI), and spectral matching value of >700 with the NIST (2005) library. Internal standards n-Hexane, tetradecane, pentadecane and heptadecane were used to calculate the retention index.

Data on wine parameters were statistically analyzed by following Completely Randomized Design. A multivariate Principal component analysis (PCA) and clustering, i.e. - heatmap on chemical properties, volatile compounds, and sensory descriptors of wine samples, was performed by MetaboAnalyst 5.0 based on the Java Server Faces Technology using the Prime Faces library (version 11.0)

RESULTS AND DISCUSSION

Data recorded on the physico-chemical parameters of wines prepared are presented in Table 2. Reducing sugar content in wines ranged from 1.85 to 5.00 g/l, registering its highest value in T2 (5.00 g/l). The prepared wines were of a very dried type. The content of alcohol was highest in T4 (12.75%), while it was lowest in T2 (11.48%), where the juice of Manjari Naveen was fermented. The malic acid in wines ranged from 2.40 to 2.93 g/l, highest in T1 and lowest in T2. The total acidity ranged from 3.80 to 4.23 g/l. The same pattern was followed in volatile acidity (VA) also however, the wines failed to show any significant difference in respect of VA. Sauvignon Blanc wine had total acidity of 6.0-6.6 g/l and volatile acidity of 0.65-0.70 g/l, whereas residual sugar content ranged from 2.8 to 6.2 g/l (Korenika *et al.,* 10). Malic acid was highest in T1, as also observed by Deed *et al.(*5). Alcohol and volatile acidity in different blended varieties of wines ranged from 10.40 to 10.34% and 0.010 to 0.014 %, respectively (Joshi *et al.,* 9).

Detected volatile compounds were divided into four chemical groups (Table 3); maximum detection was from the esters group (09), followed by alcohols/

Table 2. Physico-chemical properties of wines.

Treatments	Sugar (g/L)	Ethanol (%)	Malic acid (g/L)	Total acid (g/L)	Volatile acidity (g/L)
T1	2.30	11.50	2.93	4.23	0.31
T2	5.00	11.48	2.40	3.80	0.23
T3	2.28	12.50	2.85	4.10	0.29
T4	1.93	12.75	2.83	3.90	0.28
T5	2.10	12.50	2.80	3.98	0.29
T6	1.85	12.65	2.75	3.85	0.27
T7	1.85	12.20	2.78	3.85	0.28
S.E. (m)±	0.05	0.18	0.03	0.02	0.03
CD @ 5%	0.13	0.54	0.09	0.06	NS

T1=100% SB, T2=100%MN, T3=90:10 (SB:MN), T4=80:20 (SB:MN), T5=70:30(SB:MN), T6=60:40 (SB:MN), T7=50:50 (SB:MN)

Table 3. Identified aroma compounds in wines.

Class	Name	Similarity	1st RT(s)/ 2nd RT(s)	Formula	S/N	Area						
						T1	T2	T3	T4	T5	T6	T7
Acids	Acetic acid	929	1010, 2.615	C2H4O2	4879	10415020	923258	21676969	12495060	5082673	6512052	9487651
	Butanoic acid	893	1234, 2.055	C4H8O2	581.93	1308563	958218	444963	230754	252906	1036548	992785
	Hexanoic acid	936	1479, 0.540	C6H12O2	5282.1	9002967	2515956	19166046	772997	9294761	13039448	10322841
	2-Methyl-propanoic acid	916	1164, 0.105	C4H8O2	124.49	554442	517428	336499	314044	311383	824808	492317
Alcohols & Phenol	3-Methyl-1-butanol	961	674, 1.310	C5H12O	57414	434892510	290098734	401043363	402112880	432095435	401102427	423943046
	1-Propanol	927	366, 4.810	C3H8O	176.43	88150	32543329	920142	17825071	2179368	347372	695164
	2-Methyl-1-propanol	898	478, 3.895	C4H10O	9617.9	17907809	13321343	15103074	14720291	15050108	16219901	1905757
	Phenylethyl alcohol	943	1549, 2.945	C8H10O	28446	28475202	8830640	58635696	54383785	28799408	55795961	5322989
	1-Octanol	862	1157, 1.355	C8H18O	429.3	ND	1580962	571326	352858	659568	145714	281401
	Acetic acid-2-phenylethyl ester	901	1444, 3.555	C10H12O2	4910.7	4081878	2723701	4984938	5790571	6610163	6738728	6585645
Esters	Butanoic acid ethyl ester	919	352, 2.530	C6H12O2	6545.9	13537264	7455182	12093481	7726975	3866225	16091086	17728930
	Decanoic acid ethyl ester	927	1255, 0.275	C12H24O2	202.37	98295510	45337804	118670103	63602727	33207574	21042044	52258904
	Dodecanoic acid ethyl ester	879	1479, 3.135	C14H28O2	3631.8	1114573	585515	19614489	9489434	13881984	11219350	508020
	Heptanoic acid ethyl ester	891	849, 3.875	C9H18O2	193.37	111747	167806	133425	360493	290625	317986	252738
	Hexanoic acid ethyl ester	952	695, 6.040	C8H16O2	130.18	47363654	167836703	116531837	112445236	103412592	45885129	103773367
	Octanoic acid ethyl ester	923	996, 6.500	C10H20O2	154584	493122049	10762653	60158857	325391946	339464960	297896346	250040895
	Ethyl-9-decenoate	826	1311, 1.635	C12H22O2	1746.5	6188844	7342001	3075883	2671839	1348492	751410	1808753
	Ethyl Acetate	959	163, 6.335	C4H8O2	50892	513288228	11650073	49319699	471805442	475524472	510677643	533702625

T1=100% SB, T2=100%MN, T3=90:10 (SB:MN), T4=80:20 (SB:MN), T5=70:30(SB:MN), T6=60:40 (SB:MN), T7=50:50 (SB:MN)

phenol (5) and acids (4). Four acids, *viz*., acetic acid, butanoic acid, hexanoic acid, and propanoic acids, were found in all seven wines. Acetic acid showed dominancy, followed by hexanoic acid, which is related to vinegar odour (Fang and Qian, 6). The present findings agreed with the results of Weldegergis *et al*. (17). 2-Methyl-propanoic acid, hexanoic acid and acetic acid are found in wines (Louw *et al*., 12; Yan-Nan *et al*., 18); these compounds were also observed in wines prepared in the present study.

All five volatile compounds (alcohols/phenols) were estimated in all wines except 1-Octanol, which was detected in Sauvignon Blanc wine. The alcohols *viz*., 3-methyl-1-butanol, phenyl ethyl alcohol and 1-propanol were recorded with higher concentrations. The alcohol 1-octanol had waxy aromas, while 3-methyl-1-butanol had a fruity aroma. The presence of 1-octanol in wines was recorded by Losada *et al*. (11). Presence of phenyl ethyl alcohol and 1-octanol in wines was noted by Korenika *et al*. (10). A higher concentration of aroma compounds 3-methyl-1-butanol is also recorded indicating its influence in the aromatic complexity of the wine. A higher concentration of this compound represents a harsh aroma and taste, but it is degraded during wine ageing (Bejaei *et al.,* 4). Principal esters include ethyl hexanoate, ethyl octanoate, ethyl decanoate, ethyl-9-decanoate, isoamyl acetate, hexyl acetate, and 2-phenylethyl acetate characterized by fruity and floral notes of wines (Gambetta *et al.,* 8). The contents of hexanoic, octanoic, and decanoic acid esters in wine depend on the yeast strain, fermentation conditions, and grape must composition (Robinson *et al.,* 15).

A total of nine esters were observed in the wines of the present study (Table 3). Isoamyl acetate was reported to be an impact odorant characteristic of the Pinotage varietal (Van Wyk *et al.,* 16) and was detected at relatively high levels in all prepared wines. Acetic acid, 2-phenylethyl ester (odour type-floral), butanoic acid ethyl ester, ethyl-9-decanoate and heptanoic acid ethyl ester contribute to fruity aromas. Volatile compounds like decanoic acid ethyl ester, dodecanoic acid ethyl ester, and Octanoic acid ethyl ester are known for their waxy odour. Hexanoic acid ethyl ester and ethyl acetate express a pineapple-like fruity aroma. The presence of volatile ester compounds in wines like acetic acid methyl ester, butanoic acid ethyl ester, acetic acid heptyl ester, dodecanoic acid ethyl ester, etc., have also been recorded by Weldegergis *et al. (*17). Ethyl esters are the main compounds in wines, related to the tree fruit aroma note (Ferreira *et al.,* 7). The available compounds are related to fruity aromas to floral and waxy types. Due to the juices blending, the primary aroma was disintegrated during fermentation. It is not necessary that a compound found in the original wine has to be found in the blend, as their pathways become different when the juice gets blended and fermented further. Volatile compounds of wine can, of course, be detected at a much lower intensity than taste compounds, and are responsible for the aroma, detected both ortho and retro nasally.

A principal component analysis (PCA) 2D was performed on the detected chemical compounds in wines (Fig.1). Processed data contains 21 (samples)

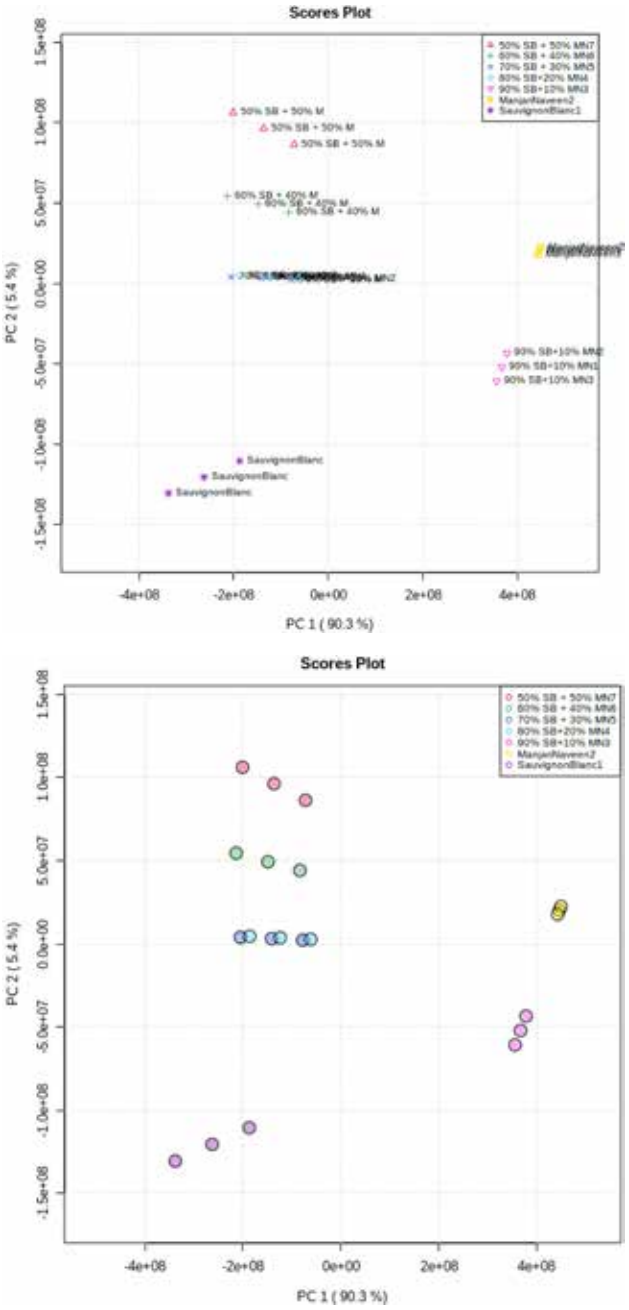

Fig. 1. PCA analysis of wine samples (2D scores plot).

i.e. seven treatments triplicated by 18 (compounds) data matrix. The first two principal components, PC1 and PC2, accounted for 95.7 per cent of the total variance. PCA analysis highlighted that most data could be explained by the first and second principal components, with a 90.3 and 5.4 per cent variance, respectively. Samples are distributed in six quadrants of the PCA graph. The PC1 explained 90.3 per cent of variability and showed treatment T2 away from T3, but both dispersed in the positive side of PC1, while the rest of the treatments, namely T1 and T7 (where equal part of both juices), showed clear opposition.

The Second factor of PCA was driven by attribute treatments closely placed in the positive quadrant of PC2, while only two treatments, T1 and T3, dispersed in the negative side of PC2, indicating that the treatment with a higher concentration of Sauvignon Blanc juice was noted in negative quadrant of PC2.

The heat map built (Fig. 2) with the content of wine volatiles provided a comprehensive and easy-to-understand overview of the effects of different treatments and wine compositions. Regarding the comparison of pure and blending treatments, there was a differentiation in the volatile composition of the samples. The red colour represents the high concentrations, while blue represents the low concentrations. Wine prepared from pure Sauvignon Blanc juice (T1) comprises of higher concentration of octanoic acid ethyl ester followed by butanoic acid ethyl ester, ethyl-9-decanoate and decanoic acid ethyl ester. In contrast, in lower quantities, ethyl acetate, 3-methyl-1-butanol and 2-methyl-1-propanol were observed.

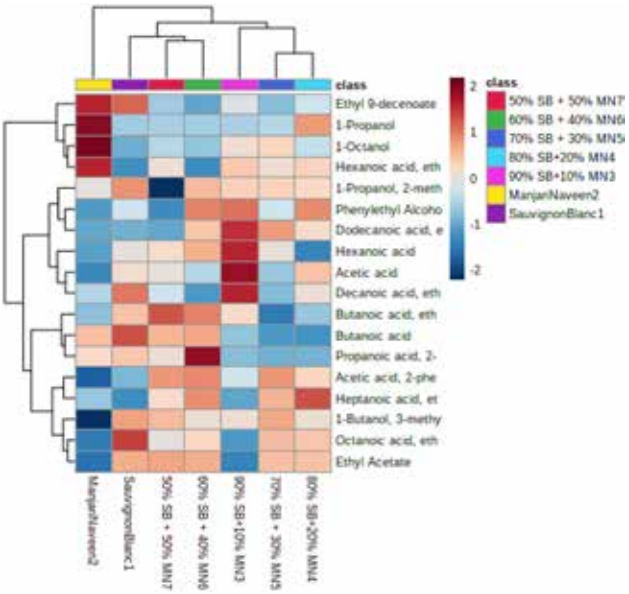

Fig. 2. Heatmap representation of 18 volatile compounds.

The treatment T2 comprised of higher concentration of volatile compounds 1-propanol and 1- octanol. The moderate concentration of ethyl-9-decanoate and hexanoic acid ethyl ester was also noted. Wine samples of treatment T3 showed higher levels of acetic acid followed by dodecanoic acid ethyl ester; hexanoic acid ethyl ester, decanoic acid ethyl ester and phenyl ethyl alcohol were observed in lower concentrations. Only three volatile compounds, *viz*., heptanoic acid ethyl ester, phenyl ethyl alcohol and 1-propanol were observed in treatment T4. In T5, four compounds, *viz*., dodecanoic acid ethyl ester, acetic acid-2-phenylethyl ester, 3-methyl-1-butanol and heptanoic acid ethyl ester, were present moderately. The treatment T6 showed the highest concentration of 2-methyl propanoic acid, followed by phenyl ethyl alcohol and butanoic acid ethyl esters. Some volatiles, *viz*., ethyl acetate, butanoic acid and hexanoic acid, were found in lower concentrations.

Of the various treatments, the wine under T7 proved superior regarding clarity, aroma, acidity, body, alcohol, length and overall quality (Fig.3). The organoleptic score of wine prepared under T1 was lower, even compared to wine prepared in T2. Organoleptic scores of wines were increased with the increase in the concentration of Manjari Naveen juice. It showed that the presence of Manjari Naveen directly improved the sensory quality of the wine. Overall acceptability also showed a similar trend. The sense of aroma in the wines impacts consumer preference. However, the varietal aroma has its importance. Blended wines are being prepared to give a unique selling proposition (USP) and attract a consumer base. Wine quality was improved when the juices of Sauvignon Blanc and Manjari Naveen were blended before fermentation. A combination of 50% proved best, which was also evidenced by the score assigned through sensory evaluation.

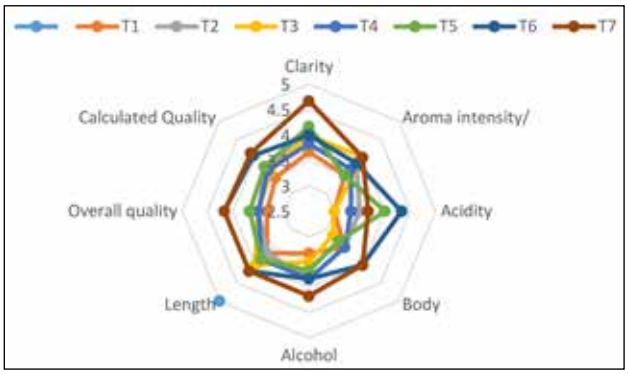

Fig. 3. Organoleptic evaluation of prepared wines.

AUTHORS' CONTRIBUTION

The research idea was conceptualized (AKS, RSS, ASTP), technical support (RGK, ASTP, AKS), work expedited (PBT, RGK), statistical analysis, and interpretation of results (PBT, RMP, RGK).

DECLARATION

The author declares that there is no conflict of interest.

ACKNOWLEDGEMENT

The authors are thankful for the technical support of the Director, ICAR-National Research Centre for Grapes, Pune. Furthermore, we acknowledge the financial support of the Indian Council of Agricultural Research, New Delhi, in conducting this study.

REFERENCES

1. Adsule, P.G., Sharma, A.K., Upadhyay, A., Sawant, I.S., Satisha, J., Upadhyay, A.K. and Yadav, D.S. 2012. Grape research in India: a review. *Prog. Hortic*. **44**:180–93.

2. Anonymous. 2022. Area and Production of Horticulture Crops Category-wise: All India. https://agricoop.nic.in/sites/default/files/2020-21% 20 (Final) % 20 Advance % 20 Estimates %202020-21%20(1).pdf.

3. Bejaei, M., Cliff, M.A., Madilao, L.L. andVanVuuren, H.J. 2019. Modelling changes in volatile compounds in British Columbian varietal wines that were bottle aged for up to 120 months. *Beverages* **5:** 57.https://doi.org/10.3390/beverages5030057

4. Carlin, S., Vrhovsek, U., Franceschi, P.,Lotti, C., Bontempo, L., Camin,F. and Mattivi, F. 2016. Regional features of northern Italian sparkling wines, identified using solid-phase micro extraction and comprehensive two-dimensional gas chromatography coupled with time-of-flight mass spectrometry. *Food Chem.* **208**:68-80.

5. Deed, R.C., Fedrizzi, B. and Gardner, R.C. 2017. Influence of fermentation temperature, yeast strain, and grape juice on the aroma chemistry and sensory profile of Sauvignon Blanc wines. *J. Agric. Food Chem.***65**: 8902-12.

6. Fang, Y. and Qian, M. 2005. Aroma compounds in Oregon Pinot Noir wine determined by aroma extract dilution analysis (AEDA). *Flavour Fragrance J*. **20**:22-29.

7. Ferreira, V., Fernández, P., Peña, C., Escudero, A. and Cacho, J.F. 1995. Investigation on the role played by fermentation esters in the aroma of young Spanish wines by multivariate analysis. *J. Sci. Food. Agric*. **67**: 381-92.

8. Gambetta, J.M., Bastian, S.E., Cozzolino,D. and Jeffery, D.W. 2014. Factors influencing the aroma composition of Chardonnay wines. *J. Agric. Food Chem*. **62**: 6512-34.

9. Joshi, V.K., Kumar, V., Debnath, M. K., Pattanashetti, S., Variath, M.T. and Khadakabhavi, S. 2014. Assessing quality of blended wine prepared from white and red varieties of grape (*Vitis vinifera* L.). *Int. J. Agric. Food Sci.* **5**: 1612.

10. Korenika, A.J., Bilos, J., Kozina, B., Tomaz, I., Peiner, D. and Jeromel, A. 2020. Effect of different reducing agents on aromatic compounds, antioxidant and chromatic properties of Sauvignon Blanc wine. *Foods* **9**: 996.

11. Losada, M.M., Lopez, J.F., Anon, A., Andres, J. and Revilla, E. 2012. Influence of some oenological practices on the aromatic and sensorial characteristics of white Verdejo wines. *Int. J. Food Sci. Technol*. 47:1826-34.

12. Louw, L., Tredoux, A.G.J., Van Rensburg, P., Kidd, M., Naes, T. and Nieuwoudt, H.H. 2010. Fermentation-derived aroma compounds in varietal young wines from South Africa. *S. Afr. J Enol. Vitic*.**31**: 213-25.

13. Margaryan, K., Gagik Melyan, F.R., Reinhard, T. and Erika M. 2021. Genetic diversity of armenian grapevine (*Vitis vinifera* L.) Germplasm: Molecular characterization and parentage analysis. *Biology,* **10**: 1279.

14. OIV. 2021. State of the world vitivinicultural sector. 2020. https://www.oiv.int/js/lib/pdfjs/web/viewer.html?file=/public/medias/7909/oiv-state-of-the-world-vitivinicultural-sector-in-2020.pdf

15. Robinson, A.L., Boss, P.K., Solomon, P.S., Trengove, R.D., Heymann, H. and Ebeler, S.E. 2014. Origins of grape and wine aroma. Part 1. Chemical components and viticultural impacts. *Am. J. Enol. Vitic*.**65**:1-24.

16. Van Wyk, C.J., Augustyn, O.P.H., De Wet, P. and Joubert, W.A. 1979.Isoamyl acetate-a key fermentation volatile of wines of *Vitis vinifera* cv. Pinotage. *Am. J. Enol. Vitic.* **30**: 167-73.

17. Weldegergis, B.T., Tredoux, A.G. and Crouch, A.M. 2007. Application of a headspace sorptive extraction method for the analysis of volatile components in South African wines. *J. Agric. Food Chem.* **55**:8696-702.

18. Yan-Nan, H., Peng-Fei, N., Tai-Xin, Y. and Zhen-Wen, Z. 2017. Volatile profiles of Cabernet Gernischet wine under rain-shelter cultivation and open-field cultivation using solid-phase micro-extraction–gas chromatography/mass spectrometry. *Int. J. Food Prop.* **20**: 2181-96.

19. Zoecklein, B.W., Fugelsang, K.C., Gump, B.H. and Nury, F.S., 1995. Wine analysis and production. Chapman and Hall, New York. pp. 338-496.

Received : December, 2022; Revised : May, 2023;
Accepted : June, 2023