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ERRATUM

Erratum to: Six Different Vineyard Treatments to Improve Chemical Properties and Taste Sensory Profiles of 'Syrah' (*Vitis Vinifera L.*) Wines

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Erratum to:
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The article contains incorrect values in Tables 1 and 4 and in the parts of the text which refer to these tables.

Here are the incorrect Tables 1 and 4 and the correct Tables 1 and 4 as they should have been displayed.

Text which refer to these tables

Abstract

The sentence beginning "Total phenolic compound ..." in this article, the text "Total phenolic compound, total anthocyanin, trans-resveratrol, catechin and malvidin-3-glucoside levels of AVLR wines increased by 74%, 56%, 20%, 42%, and 10%, respectively, compared to the control group wines."

should have read

"Total phenolic compound, total anthocyanin, *trans*-resveratrol, catechin and malvidin-3-glucoside levels of AVLR wines increased by 74%, 56%, **22%,** 42%, **23%,** respectively, compared to the control group wines."

Section "Effects of Treatments on Physical and Chemical Character of Grapes" in this article

The paragraph "Table 1 shows the effects of six applications on physical and chemical grape parameters at harvest. Thinning is the main factor that significantly reduced the number of clusters per vine and undoubtedly contributed to the reduction in yield and crop load (Kaya 2019). Compared to UNT vines, vine yield decreased because of applications ($p < 0.05$). The application that effected the decrease in yield most was V application (49% decrease) and the least effective application was LR application (0.3% decrease). Despite the decrease in yield, there was an increase in berry weight, skin weight, and cluster weight values ($p <$ 0.05). Berry and cluster weight were less effected by the applications: maximum increase in berry weight was 20% with V, while minimum increase was 5% with LR; maximum increase in cluster weight was 16% with V, and 0.1% with LR. On the other hand, the increases in skin weight were impressive: 96% increase was achieved as a result of V application compared to UNT grapes, which is a desirable increase since the skin weight will also determine the amount of anthocyanins that provide colour transition in vinification. pH and °Brix values increased, and total acidity decreased as a result of the applications (Table 1). It may be concluded that grape thinning applications accelerate maturation. Especially in cool ecologies, AV at the end of véraison may be recommended for rapid ripening to prevent the harvest from shifting to rainy seasons. Additionally, the level of °Brix increased as a result of LR application, which often results from increased exposure of vine to sunlight resulting from early leaf removal (Bubola et al. 2019), denser young leaves, better maturation and higher dry matter formation (Poni et al. 2006). While the results of pH, total acidity, °Brix, vine yield, and berry and cluster weights are in the same trend in the present study as reported by Condurso et al. (2016), Gil-Muñoz et al. (2009) detected an upward trend in grape and cluster weights as a result of

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Table 1 **Published version:** Physical and chemical grape parameters at harvest

Parameters	UNT	V	AV	LR	VLR	AVLR	LSD (0.05)
pH	3.11 d	3.41 b	3.22 c	3.40 b	3.24 c	3.49 a	0.038
Total acidity (mg/g)*	7.53 a	7.23 b	7.10 bc	7.07 bc	6.97 c	6.97 c	0.250
°Brix	24.00 c	24.37 b	25.17 a	24.80 b	24.93 ab	25.10 a	0.263
Vine yield (kg)	3.21 a	1.63 d	1.91 b	3.20 a	1.70 c	1.95 b	0.063
Berry weight (g)	1.66 c	2.00 a	2.01 a	1.75 c	1.89 b	1.97 ab	0.092
Skin weight (g)	0.26 e	0.51 a	0.29 d	0.39 c	0.46 b	0.30 d	0.025
Cluster weight (g)	250.00 d	290.00 a	255.00 c	250.33 d	261.00 b	259.67 b	3.587

Table 1 **Corrected version:** Physical and chemical grape parameters at harvest

Parameters	UNT	V	AV	LR	VLR	AVLR	LSD (0.05)
pH	3.11 d	3.39 b	3.21 c	3.40 b	3.24 c	3.49 a	0.038
Total acidity (mg/g)*	7.51 a	7.24 b	7.12 bc	7.11 bc	6.91 c	6.90 c	0.250
°Brix	24.00 c	24.37 b	25.17 a	24.80 b	24.93 b	25.10 a	0.263
Vine yield (kg)	3.19 a	1.62 d	1.90 b	3.26 a	1.73 c	1.98 b	0.063
Berry weight (g)	1.61 c	2.06 a	2.03 a	1.75 c	1.89 b	1.97 ab	0.092
Skin weight (g)	0.26 e	0.51 a	0.29 d	0.39 c	0.46 b	0.30 d	0.025
Cluster weight (g)	253.00 d	291.66 a	256.00 c	251.66 d	262.33 b	261.33 b	3.587

Table 4 **Published version:** Phenolics and anthocyanins of wines

Parameters (mg/L)	UNT	V	AV	LR	VLR	AVLR	LSD (0.05)
Trans-resveratrol	4.24 d	4.56 c	4.63 c	4.84 b	5.02 a	5.07 a	0.090
Cis-resveratrol	0.23 c	0.23 c	0.21 c	0.28 b	0.29 ab	0.32 a	0.032
Catechin	57.13 d	59.11 c	59.81 c	70.33 b	80.66 a	80.97 a	0.540
Epicatechin	31.1 e	33.95 d	34.75 c	36.24 b	38.67 a	38.96 a	0.704
Rutin	12.38 c	13.04 b	13.04 b	14.10 b	14.73 a	15.03 a	0.343
Quercetin	6.83 c	7.49 b	7.50 b	7.70 b	8.15 a	8.23 a	0.315
Delphinidin-3-glucoside	69.30 c	74.06 a	70.61 bc	73.43 ab	74.66 a	74.90 a	3.097
Cyanidin-3-glucoside	46.75 d	49.84 abc	49.29 c	49.37 bc	50.85 a	50.78 ab	1.431
Petunidin-3-glucoside	9.16 c	10.23 b	9.43 bc	9.85 bc	11.57 a	9.61 bc	0.797
Peonidin-3-glucoside	17.31 c	18.18 b	18.01 bc	18.24 b	20.16 a	20.48 a	0.809
Malvidin-3-glucoside	722.67 c	761.67 b	771.67 b	765.33 b	790.00 a	793.33 a	12.723

Table 4 **Corrected version:** Phenolics and anthocyanins of wines

Parameters (mg/L)	UNT	V	AV	LR	VLR	AVLR	LSD (0.05)
Trans-resveratrol	4.14 d	4.56 c	4.63 c	4.84 b	5.02 a	5.07 a	0.090
Cis-resveratrol	0.22 c	0.23 c	0.21 c	0.28 b	0.29 ab	0.32 a	0.032
Catechin	57.13 d	59.11 c	59.81 c	70.33 b	80.66 a	80.97 a	0.540
Epicatechin	30.74 e	33.95 d	34.75 c	36.24 b	38.67 a	38.96 a	0.704
Rutin	12.88 c	13.08 b	13.05 b	14.10 b	14.73 a	15.03 a	0.343
Quercetin	6.23 c	7.44 b	7.59 b	7.60 b	8.35 a	8.46 a	0.315
Delphinidin-3-glucoside	13.37 c	14.22 c	14.04 c	17.73 b	17.85 a	18.00 a	3.097
Cyanidin-3-glucoside	19.40 d	21.72 bc	20.60 c	20.99 c	22.08 b	23.26 a	1.431
Petunidin-3-glucoside	0.95 c	1.11 b	1.15 b	1.92 ab	2.00 a	2.09 a	0.797
Peonidin-3-glucoside	3.21 c	4.24 b	4.03 b	5.23 a	5.21 a	5.17 a	0.809
Malvidin-3-glucoside	179.67 d	210.67 b	209.67 b	197.00 c	221.33 a	220.67 a	12.723

cluster thinning and concluded that there may be a natural compensatory increase in the rest of the clusters when yield decreases. Nicolosi et al. (2012) showed that leaf removal created a downward trend in skin weight in 'Syrah', 'Frappato', 'Cabernet Sauvignon', and 'Nero d'Avola' grapes, contrary to the present research. Ivanišević et al. (2020) highlighted that skin weight increases as a result of leaf removal."

should have read

"Table 1 shows the effects of six applications on physical and chemical grape parameters at harvest. Thinning is the main factor that significantly reduced the number of clusters per vine and undoubtedly contributed to the reduction in yield and crop load (Kaya 2019). Compared to UNT vines, vine yield decreased because of applications, **except LR** ($p < 0.05$). The application that effected the decrease in yield most is V application (49% decrease). Despite the decrease in yield, there was an increase in berry weight, skin weight, and cluster weight values ($p < 0.05$). Berry and cluster weight were less effected by the applications: maximum increase in berry weight was 28% with V, minimum increase was **9**% with LR; maximum increase in cluster weight was 15% with V, and **0.5% decrease** with LR. On the other hand, the increases in skin weight are impressive: 96% increase was achieved as a result of V application compared to UNT grapes, which is a desirable increase since the skin weight will also determine the amount of anthocyanins that provide colour transition in vinification. pH and °Brix values increased, and total acidity decreased as a result of the applications (Table 1). It may be concluded that grape thinning applications accelerate maturation. Especially in cool ecologies, AV at the end of the véraison may be recommended for rapid ripening to prevent the harvest from shifting to rainy seasons. Additionally, the level of °Brix increased as a result of LR application, which often results from increased exposure of vine to sunlight resulting from early leaf removal (Bubola et al. 2019), denser young leaves, better maturation and higher dry matter formation (Poni et al., 2006). While the results of pH, total acidity, °Brix, vine yield, and berry and cluster weights are in the same trend in the present study as reported by Condurso et al. (2016), Gil-Muñoz et al. (2009) detected an upward trend in grape and cluster weights as a result of cluster thinning and concluded that there may be a natural compensatory increase in the rest of the clusters when yield decreases. Nicolosi et al. (2012) showed that leaf removal created a downward trend in skin weight in 'Syrah', 'Frappato', 'Cabernet Sauvignon', and 'Nero d'Avola' grapes, contrary to the present research. Ivanišević et al. (2020) highlighted that skin weight increases as a result of leaf removal."

Section "Effects of Treatments on Individual Phenolic and Anthocyanin Contents of Wines" in this article

The paragraphs "The phenolic compound and anthocyanin levels of wines which were obtained from the grapes under the influence of the applications are given in Table 4. The wines with the highest levels of both phenolics and anthocyanins were VLR and AVLR wines. Trans-resveratrol, which has proven health benefits (Haunschild and Marx 2022), had increased at rates of 7.5%, 9.2%, 14.2%, 18.4%, and 19.6, respectively, in V, AVLR, LR, VLR, and AVLR wines compared to UNT ($p < 0.05$). Individual phenolic compound content increased after V and AV applications with cluster thinning only and VLR and AVLR applications combined with leaf removal all of which were conducted at the end of véraison. The least effective application on the amount of trans resveratrol was V, which generated an increase of 7.5%. Nevertheless, the increase at this rate is also an undeniable rise. Cis-isomer is produced by UV irradiation of transisomer (Moreno et al. 2008). Very little is detectable in grapes (Careri et al. 2004), but both isomers are found in varying amounts in wines (Tahmaz and Söylemezoglu ˘ 2017). Although there is no agreement on this subject, it is thought that cis-resveratrol is derived from trans-isomer during vinification (Jeandet et al. 1995). Cis-resveratrol is stated to have less health benefits compared to trans-resveratrol, including its anti-inflammatory power (Orallo 2005). In a study which describes its physiological activity, cisresveratrol has been shown to have potential anticancer and antiplatelet activity, as trans-isomers, by inhibiting kinase activity which is a cancer-related factor (Bertelli et al. 1996; Morris et al. 2015). While the amount of cis-resveratrol was found to be 0.23 mg/L in UNT, the highest amounts were found at 0.29 mg/L and 0.32 mg/L in VLR and AVLR, respectively. The amount of cis-resveratrol at 0.28 mg/L in LR was only higher than those of V and AV because sun exposure is more intense in panicle area where leaf removal is applied.

Similarly to previous studies, catechin is found to be the one with the highest amount in wines among the phenolic compounds (Saucier and Waterhouse 1999). Catechin affects molecular mechanisms related to angiogenesis, extracellular matrix disruption, regulation of cell death, and multiple drug resistance in cancer and related disorders (Zanwar et al. 2014), and it is one of the most important phenolics in wines due to its antioxidant effect. The highest increase was measured as 41% in VLR and AVLR applications compared to UNT. There was a 3.5% increase in V and 4.7% in AV as a result of inflorescence alone, while 23.1% of catechin increase was observed as a result of LR. Along with catechins, epicatechins are associated with certain properties of wine, such as bitterness, body, and astringency (Pascual et al. 2016). Among other phenolics, epicatechin also increased as a result of the applications, and the highest increase was observed as from 31.10 mg/L to 38.96 mg/L in UNT and AVLR.

As other phenolic compounds known to have health benefits (Pace-Asciak et al. 1995; Iriti et al. 2017; Patel and Patel 2019), the quantities of rutin and quercetin also increased with the applications compared to UNT. The quantities of both compounds increased at a similar rate in V and AV (rutin V: 5.3%, quercetin V: 9.7%; rutin AV: 5.3%, quercetin AV: 9.8%), and the highest amounts were observed in AVLR (rutin: 15.03 mg/L, quercetin: 8.23 mg/L) and VLR (rutin: 14.73 mg/L, quercetin: 8.15 mg/L). Higher amounts of rutin and quercetin were determined in LR compared to the cluster thinning performed without leaf removal.

In addition to having antioxidant activity, anthocyanins (Kharadze et al. 2018) are among the most important compounds responsible for the colour of wine. As noted in previous studies, 84% of the total anthocyanins in the present study is malvidin-3-glucoside (Torres et al. 2021). Its level of 722.67 mg/L in UNT increased to 761.67, 771.67, 765.33, 790, and 793.33 mg/L in V, AVLR, LR, VLR, and AVLR, respectively ($p < 0.05$). Increases have been observed in malvidin-3-glucoside, the main colour compound of wine, as well as other anthocyanin compounds. However, there are also studies in literature where the level of anthocyanin with canopy management is not affected (Torres et al. 2021) or increased (Yu et al. 2021). In the present study, delphinidin-3-glucoside, cyanidin-3-glucoside, and petunidin-3-glucoside levels were the highest in VLR, while peonidin-3-glucoside and malvidin-3-glucoside levels were the highest in VLR and AVLR, which are combinations of leaf removal and cluster thinning.

Vineyard applications certainly affect the quality of wines (Tardáguila et al. 2010; Reynolds 2022). In the study, that the increase in phenolics and anthocyanins in VLR and AVLR was at a higher rate than in other applications is likely to be attributed to the increased exposure of clusters to sunlight as a result of LR and the concentration of phenolic compounds in fewer products as a result of cluster thinning. In general, although VLR and AVLR yielded phenolic and anthocyanin results close to each other, they were found at higher levels in AVLR wines. This means that LR combination grape thinning at the end of véraison is the most effective application on these compounds. At the end of the véraison, the temperature also increases as the clusters are exposed to more sun as a result of LR, and phenolic concentrations also increase (Poni et al. 2006). Phenolic concentrations increased as product levels decreased by cluster thinning. The result is not expected, similar to the studies in which the composition of 'Syrah' wines are developed only by cluster thinning (Gil-Muñoz et al. 2009; Gil et al. 2013; Cañón et al. 2014; Wang et al. 2022) or in which the improvement in composition is achieved by leaf removal in other wine varieties (Guidoni et al. 2008; Gatti et al. 2012; Vander Weide et al. 2021; Artem et al. 2022), but the consistency of trends is quite remarkable. The important difference of this study compared to the others is that AVLR application at the end of véraison (cluster thinning at the end of véraison + leaf removal before flowering) created significantly more important effects on wine quality compared to only LR or only V and AV."

should have read

"The phenolic compound and anthocyanin levels of wines which were obtained from the grapes under the influence of the applications are given in Table 4. The wines with the highest levels of both phenolics and anthocyanins were VLR and AVLR wines. *Trans*-resveratrol, which has proven health benefits (Haunschild and Marx 2022), had increased at rates of **10.1**%, **11.8**%, **16.9**%, **21.3%,** and **22.5**% respectively in V, **AV**, LR, VLR, and AVLR wines compared to UNT ($p < 0.05$). Individual phenolic compound content increased after V and AV applications with cluster thinning only and VLR and AVLR applications combined with leaf removal all of which were conducted at the end of véraison. The least effective application on the amount of *trans*-resveratrol was V, which generated an increase of **10.1**%. Nevertheless, the increase at this rate is also an undeniable rise. *Cis*-isomer is produced by UV irradiation of *trans*-isomer (Moreno et al. 2008). Very little is detectable in grapes (Careri et al. 2004), but both isomers are found in varying amounts in wines (Tahmaz and Söylemezoğlu 2017). Although there is no agreement on this subject, it is thought that *cis*-resveratrol is derived from *trans*-isomer during vinification (Jeandet et al. 1995). *Cis*-resveratrol is stated to have less health benefits compared to *trans*-resveratrol, including its anti-inflammatory power (Orallo 2005). In a study which describes its physiological activity, *cis*-resveratrol has been shown to have potential anticancer and antiplatelet activity, as *trans*-isomers, by inhibiting kinase activity which is a cancer-related factor (Bertelli et al. 1996; Morris et al. 2015). While the amount of *cis*-resveratrol was found to be **0.22** mg/L in UNT, the highest amounts were found at 0.29 mg/L and 0.32 mg/L in VLR and AVLR, respectively. The amount of *cis*-resveratrol as 0.28 mg/L in LR was only higher than those of V and AV because sun exposure is more intense in panicle area where leaf removal is applied.

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As other phenolic compounds known to have health benefits (Pace-Aciak et al. 1995; Iriti et al. 2017; Patel and Patel 2019; Reale et al. 2020), the quantities of rutin and quercetin have also increased with the applications compared to UNT. The quantities of both compounds increased at a similar rate in V and AV (rutin V: **1.55**%, quercetin V: **19.42**%; rutin AV: **1.32**%, quercetin AV: **21.80**%), and the highest amounts were observed in AVLR (rutin: **15.03** mg/L, quercetin: **8.46** mg/L) and VLR (rutin: 14.73 mg/L, quercetin: **8.35** mg/L). Higher amounts of rutin and quercetin were determined in LR compared to the cluster thinning performed without leaf removal.

In addition to having antioxidant activity, anthocyanins (Kharadze et al. 2018) are among the most important compounds responsible for the colour of wine. As noted in previous studies, 84% of the total anthocyanins in the present study is malvidin-3-glucoside (Torres et al. 2021). Its level of **179.67** mg/L in UNT increased to **210.67, 209.67, 197, 221.33**, and **220.67** mg/L in V, **AV**, LR, VLR, and AVLR, respectively ($p < 0.05$). Increases have been observed in malvidin-3-glucoside, the main colour compound of wine, as well as other anthocyanin compounds. However, there are also studies in literature where the level of anthocyanin with canopy management is not affected (Torres et al. 2021) or increased (Bogicevic et al. 2015; Yu et al. 2021). In the present study, delphinidin-3-glucoside, cyanidin-3-glucoside, and petunidin-3-glucoside levels were the highest in **A**VLR, while and malvidin-3-glucoside levels were the highest in VLR and AVLR, which are combinations of leaf removal and cluster thinning. **Peonidin-3-glucoside were the highest in LR, VLR and AVLR**.

Vineyard applications certainly affect the quality of wines (Tardáguila et al. 2010; Reynolds 2022). In the study, that the increase in phenolics and anthocyanins in VLR and AVLR is at a higher rate than in other applications is likely to be attributed to the increased exposure of clusters to sunlight as a result of LR and the concentration of phenolic compounds in fewer products as a result of cluster thinning. In general, although VLR and AVLR yielded phenolic and anthocyanin results close to each other, they were found at higher levels in AVLR wines. This means that LR combination grape thinning at the end of véraison is the most effective application on these compounds. At the end of the véraison, the temperature also increases as the clusters are exposed to more sun as a result of LR, and phenolic concentrations also increase (Poni et al. 2006). Phenolic concentrations increased as product levels decreased by cluster thinning. The result is not expected, similar to the studies in which the composition of 'Syrah' wines are developed only by cluster thinning (Gil-Muñoz et al. 2009; Gil et al. 2013; Cañón et al. 2014; Wang et al. 2022) or in which the improvement in composition is achieved by leaf removal in other wine varieties (Guidoni et al. 2008; Gatti et al. 2012; VanderWeide et al. 2021; Artem et al. 2022), but the consistency of trends is quite remarkable. The important difference of this study compared to the others is that the AVLR application at the end of the véraison (cluster thinning at the end of véraison + leaf removing before flowering) has created much more important effects on wine quality compared to only LR or only V and AV."

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