

COMPARATIVE STUDY OF QUALITATIVE AND QUANTITATIVE CHARACTERS OF GRAPE CULTIVAR 'MAVRODAFNI' (*VITIS VINIFERA* L.) GROWN IN DIFFERENT REGIONS OF THE PDO MAVRODAFNI PATRAS

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Abstract:

Context and purpose of the study - 'Mavrodafni' (*Vitis vinifera* L.) is considered one of the oldest grapevine cultivars indigenous to the Greek vineyard, with western Peloponnese being its primary center of cultivation. 'Renio' is considered to be either a variant of 'Mavrodafni' or an altogether different cultivar. Both 'Mavrodafni' and 'Renio' can be found in the vineyards of the centers of cultivation, since 'Renio' is considered to be more productive compared to 'Mavrodafni', and for this reason, it has gradually replaced 'Mavrodafni' from cultivation over the course of time. The aim of the present study was to assay the mechanical properties, the polyphenolic content and the antioxidant capacity of skin extracts and must of berries coming from 'Mavrodafni' and 'Renio', cultivated in the same vineyard as well as in the different regions of cultivation of the PDO Mavrodafni Patras.

Material and methods – Samples of 'Mavrodafni' and 'Renio' were collected from six different regions of cultivation of the PDO Mavrodafni Patras. The samples collected in the different regions originated from the same vineyards. In view of the study's aim, the samples were studied and analyzed using High Performance Liquid Chromatography (HPLC) coupled with a diode array detector and spectrophotometer in order to determine total soluble solids, pH, total titratable acidity, polyphenol content and antioxidant capacity.

Results - The results revealed that, in general, 'Mavrodafni' and 'Renio' exhibited different polyphenolic profile in the case where the samples originated from the same vineyard as well as in the case where the samples originated from different regions of the PDO Mavrodafni Patras. In particular, the must of 'Mavrodafni' exhibited higher concentration in sugars, with a statistically significant difference compared to 'Renio', while there were no differences recorded neither in total titratable acidity of the must nor in the average weight of bunch. 'Mavrodafni' recorded the highest concentrations in skin total phenolics, skin total anthocyanins, skin total tannins in all studied regions, with a statistically significant difference compared to 'Renio'. 'Mavrodafni' and 'Renio' contained appreciable amounts of quality characters of grape and must, depending on the different regions where they are cultivated, and they would be worthy of further study and use for the production of different types of wines.

Keywords: Anthocyanins, Grape skins, Must, Polyphenols, Tannins, *Vitis vinifera* L.

1. Introduction.

Comparative study of qualitative and quantitative characters of grape cultivar 'Mavrodafni' (*Vitis vinifera* L.) grown in different regions of the PDO Mavrodafni Patras

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Materials and Methods

Vineyards and Plant material

The vineyards from where the samples were collected are located in the greater area of Achaia (Table 1). The vines were selected for study via an assay of their polyphenolic profile on the basis of (a) their being the most representative ones of each cultivar and (b) their morphology.

Sampling process

Grapes were randomly selected from different vines of each cultivar and three (3) sampling processes took place. The grapes were collected from the main shoots of different positions. Each sampling constituted one replication. A total of three (3) replications per treatment (cultivar) took place. The sampling process and samples preparation for spectrophotometric and HPLC analyses as well as the data analysis described in Stavarakaki et al. (2018) were followed for the needs of this experiment.

Measurements

- Bunch and berry mechanical properties (weight, length, and width)
- Determination of total soluble solids, pH and total titratable acidity
- Determination of total polyphenol content in berry skins
- Determination of total anthocyanins in berry skins
- Determination of total flavonoid content
- Determination of total flavanols
- Determination of flavone and flavonol content
- Determination of total tannins in berry skins
- Determination of antioxidant capacity in berry skins

Reagents and chemicals

The various polyphenolic compounds analyzed were identified according to their order of elution and the retention times of the pure compounds. The reagents and chemicals used were the same as in Biniari et al. (2018).

Introduction

The vineyard of the Peloponnese is one of the oldest vineyards of Greece and includes a large number of grapevine cultivars, among which are some of the most important cultivars of the Green Vineyard.

During the past years, the problems related to the knowledge of varietal potential as well as to sanitation of grapevine propagating material have increased to such an extent that they threaten the viticultural production as well as the establishment of productive vineyards.

In addition, in the viticultural PDO region Mavrodafni Patras, factors such as the application of cultivation techniques related to vineyard management resulting in increased yield (per ha), raise questions regarding the quality of wine products, as well as regarding the overall future of viticulture in the region.

In view of climate change and the depletion of natural resources due to the intensification of vine growing, it is imperative that inputs be reduced. The above-mentioned issues are intensified by the significant increase in demand for these wine products.

'Mavrodafni' is a precious red grape cultivar with the Peloponnese and the Ionian Islands being its cultivation centers. It has been described as 'Mavrodaphne' (Guillon, 1896; Viala and Vermorel, 1909) and as 'Mavrodaphni noir' (Rovassenda, 1887). It is a very vigorous grape cultivar of medium yield capacity. However, it is characterized by intense poor fruit set, and this demands the use of specific cultivation techniques that increase cultivation cost (Stavarakaki, 2010).

'Renio' is considered either a variant of 'Mavrodafni' or an altogether different cultivar. A study that employed molecular markers showed that they are different cultivars (Stavarakaki and Biniari, 2009). 'Renio' is less vigorous, less qualitative but more productive compared to 'Mavrodafni' and does not require specific cultivation techniques. For this reason, it has gradually replaced 'Mavrodafni' from cultivation over the course of time or in some cases it is co-cultivated with 'Mavrodafni', with adverse effects on the quality of the wine products.

The aim of the present study was to assay the mechanical properties, the polyphenolic content and the antioxidant capacity of skin extracts and must of berries coming from 'Mavrodafni' and 'Renio', cultivated in the same vineyard as well as in the different regions of cultivation of the PDO 'Mavrodafni Patras'.

Results and Discussion

'Mavrodafni' recorded the highest concentrations in skin total phenolics, skin total anthocyanins, skin total tannins in all studied regions, with a statistically significant difference compared to 'Renio' (Tables 2, 3, 4). In general, 'Mavrodafni' and 'Renio' exhibited different polyphenolic profile, but both cultivars contained appreciable amounts of quality characters of grape and must, depending on the different regions where they are cultivated, and they would be worthy of further study and use for the production of different types of wines.

Table 4. Total polyphenol content and antioxidant capacity in berry skins

	Skin total phenolics (mg catechin/g f.w.)	Skin total anthocyanins (mg malvidin/g f.w.)	Skin total flavanols (mg catechin/g f.w.)	Skin total tannins (mg catechin/g f.w.)	Skin total flavonoids (mg catechin/g f.w.)	Skin total flavones (mg rutin/g f.w.)	Antioxidant capacity (mg trolox/mg f.w.)
Mavrodafni_Aria	52.20 ± 3.44d	12.60 ± 0.48b	3.79 ± 0.06b	61.63 ± 2.50b	8.96 ± 0.70d	1.89 ± 0.08abc	63.25 ± 0.98cd
Renio_Aria	54.40 ± 0.57d	9.76 ± 0.20f	4.06 ± 0.04a	63.48 ± 1.18ab	9.10 ± 0.61cd	1.95 ± 0.10cd	65.07 ± 0.49c
Mavrodafni_Fostaina	61.92 ± 3.16cd	11.20 ± 0.31bcd	3.56 ± 0.03cd	68.07 ± 1.34ab	5.95 ± 0.35e	1.60 ± 0.10bcd	64.89 ± 0.73c
Mavrodafni_Karantzas	60.40 ± 1.92cd	13.00 ± 0.24b	3.14 ± 0.02e	68.87 ± 0.85a	5.70 ± 0.23e	1.72 ± 0.18abcd	57.80 ± 0.82d
Renio_Karantzas	91.36 ± 1.45a	8.20 ± 0.42ef	3.79 ± 0.01b	31.89 ± 1.45cd	11.90 ± 0.22ab	2.13 ± 0.06ab	64.49 ± 0.34c
Mavrodafni_Karyes	64.40 ± 1.31c	11.88 ± 0.60bc	3.19 ± 0.05de	70.54 ± 1.24a	5.63 ± 0.35e	1.31 ± 0.04cd	76.88 ± 0.52b
Renio_Karyes	73.92 ± 0.24b	9.60 ± 0.34cde	3.88 ± 0.03b	21.56 ± 0.99e	10.36 ± 0.26abcd	1.15 ± 0.05d	76.63 ± 1.95b
Mavrodafni_KatwMylos	81.02 ± 0.91b	16.92 ± 0.30a	3.34 ± 0.02c	19.38 ± 0.85e	9.96 ± 0.03bcd	1.90 ± 0.11abc	80.49 ± 0.45b
Renio_KatwMylos	97.44 ± 1.32a	8.88 ± 0.27de	3.34 ± 0.01cd	38.90 ± 0.89c	12.08 ± 0.14a	2.31 ± 0.20a	65.44 ± 0.63c
Mavrodafni_Linos	80.16 ± 0.95b	18.16 ± 0.52a	3.28 ± 0.03cde	22.58 ± 2.60e	11.65 ± 0.44ab	2.11 ± 0.04ab	89.01 ± 0.43a

References

- Biniari, K., Gerogiannis, O., Daskalakis, I., Bouza, D., & Stavarakaki, M. (2018). Study of some qualitative and quantitative characters of the grapes of indigenous Greek grapevine varieties (*Vitis vinifera* L.) using HPLC and spectrophotometric analyses. *Natural Bioactive Horti Agrobotanici*, 46(1), 97–106. <http://dx.doi.org/10.15835/nbha46611008>.
- Guillon, J.M. (1896). Les cépages orientaux. G. Garne, Paris, France.
- Rovassenda, G. (1887). Saggio di una ampelografia universale, eds. E. Loescher, Torino, Italy.
- Stavarakaki, M., & Biniari, K. (2009). Genetic study of grapevine varieties using molecular markers. Proceedings of the XXXIIIrd Old World Congress, Zagreb June 28th–July 3rd 2009.
- Stavarakaki, M., Biniari, K., Daskalakis, I., & Bouza, D. (2018). Polyphenol content and antioxidant capacity of the skin extracts of berries from seven biotypes of the Greek grapevine cultivar Korinthiki Staphis (*Vitis vinifera* L.). *Australian Journal of Crop Science*, 12(12), 1927–1936. <http://dx.doi.org/10.21475/ajcs.18.12.12.p1216>.
- Stavarakaki, M.N., (2010). Ampelography. Tropi Publications, Athens, Greece.
- Viala, P., & Vermorel, V. (1909). *Traité Général d'Ampélographie* (volumes 7). Maisson éd., Paris.

Table 1. Cultivars studied and vineyards' characteristics

a/a	Cultivar	Vineyard	Training system	Age	Altitude
1	Mavrodafni	Aria	Cordon	20 years	600 m
2	Renio	Aria	Cordon	20 years	600 m
3	Mavrodafni	Fostaina	Cordon	6 years	400 m
4	Mavrodafni	Karantzas	Cordon	30 years	200 m
5	Renio	Karantzas	n/a	30 years	200 m
6	Mavrodafni	Karyes	Cordon	5 years	n/a
7	Renio	Karyes	Cordon	5 years	n/a
8	Mavrodafni	Katw Mylos	n/a	n/a	n/a
9	Renio	Katw Mylos	n/a	n/a	n/a
10	Mavrodafni	Linos	n/a	30 years	0 m

Table 2. Characters of the must

	pH	Sugars (Brk)	Total Titr. Acidity
Mavrodafni_Aria	3.17 ± 0.00g	17.16 ± 0.03f	6.75 ± 0.00ab
Renio_Aria	3.15 ± 0.00g	12.06 ± 0.06h	5.50 ± 0.25de
Mavrodafni_Fostaina	3.71 ± 0.00b	18.90 ± 0.00c	5.25 ± 0.00e
Mavrodafni_Karantzas	3.89 ± 0.00f	17.43 ± 0.03d	6.25 ± 0.12bc
Renio_Karantzas	3.56 ± 0.00d	18.50 ± 0.00e	6.00 ± 0.00cd
Mavrodafni_Karyes	3.44 ± 0.00e	12.26 ± 0.03g	6.62 ± 0.12ab
Renio_Karyes	3.39 ± 0.00h	12.36 ± 0.03g	7.00 ± 0.25a
Mavrodafni_KatwMylos	3.85 ± 0.00d	21.76 ± 0.00a	5.25 ± 0.00e
Renio_KatwMylos	3.74 ± 0.00a	21.76 ± 0.03b	4.50 ± 0.00f
Mavrodafni_Linos	3.65 ± 0.00c	21.80 ± 0.00b	5.25 ± 0.00e

Table 3. Mechanical properties of the grape

	Bunch length (cm)	Bunch width (cm)	Bunch weight (cm)
Mavrodafni_Aria	19.66 ± 1.85ab	9.66 ± 0.65abc	248.33 ± 54.63abc
Renio_Aria	18.66 ± 0.88abc	8.26 ± 0.37bc	251.66 ± 32.05abc
Mavrodafni_Fostaina	17.00 ± 1.73abcd	9.00 ± 0.57bc	300.00 ± 10.09abc
Mavrodafni_Karantzas	13.90 ± 0.10cd	9.50 ± 0.75abc	165.33 ± 6.33cd
Renio_Karantzas	15.33 ± 1.76abcd	6.00 ± 0.57c	265.00 ± 13.32bcd
Mavrodafni_Karyes	18.00 ± 0.57abcd	13.33 ± 1.65a	259.66 ± 38.80abc
Renio_Karyes	20.33 ± 0.66a	10.83 ± 0.16abc	291.33 ± 25.72abc
Mavrodafni_KatwMylos	13.66 ± 0.66cd	9.16 ± 0.92abc	223.00 ± 18.73bcd
Renio_KatwMylos	13.00 ± 0.04d	8.33 ± 0.60bc	168.00 ± 24.08bcd
Mavrodafni_Linos	14.83 ± 1.09bcd	5.50 ± 0.28c	90.66 ± 3.33d