

Oil content in grapevine seeds of intra- and interspecific provenance genotypes

E. Alexandrov

The Institute of Genetics, Physiology and Plant Protection of the MSU,
Republic of Moldova

*Corresponding author e-mail: alexandrov.eugeniu@gmail.com

ABSTRACT

The aim of this study was to determine and compare the oil content in grapevine seeds from intra- and interspecific genotypes with yellow-green and blue-violet berries. Grapevine processing generates secondary products that represent about 20% of the total processed mass among which grape seeds contain 9-20% oil, rich in antioxidants and essential fatty acids with biological importance for the human body. Owing to this composition, grape seeds serve as a valuable raw material for obtaining grape seed oil. The seeds were extracted from fresh berries at the onset of must fermentation, and oil content was determined using the nuclear magnetic resonance (NMR) relaxometry method. In intraspecific genotypes with yellow-green berries, oil content ranged from 13.8-13.7% ('Fetescă regală', 'Sauvignon'), while interspecific genotypes of the same colour group contained 13.45-14.46% oil ('Alexandrina', 'Sarmis', etc.). For intraspecific genotypes of the same colour group contained 13.5% oil ('Fetească regală') and 16.6% oil ('Merlot'), were recorded, whereas interspecific blue-violet genotypes showed oil contents between 11% ('Ametist') and 15.35% (Sor). The results indicate that oil accumulation in grapevine seeds depends both on the genotype and on the climatic conditions in which the vines are cultivated. Climatic analysis of the cultivation area showed an increase of 3.23°C above the calculated long-term annual temperature norm, suggesting that arid conditions favour higher oil content compared with regions with moderate temperatures.

Keywords: genotype, seeds, oil, grapevine, relaxometry

INTRODUCTION

Every year, winemaking enterprises accumulate impressive quantities of grape pomace, which, as a result of the separation of fractions, extract the seeds for further processing for various purposes. The secondary products, as a result of the processing of the vine grapes, constitute about 20% of the total mass processed, being made up of bunches, the skin of the berries, seeds and various sediments from the must and wine. This is the raw material for the production of grape seed oil, feed products, food products, abrasive materials, oenotannin, etc. As a result of the fermentation of grape juice, to obtain derived products (wine, divin), the deposited sediments allow the production of tartaric acid, as well as alcohol, biogas and organic fertilizers (Glăman *et al*, 2018; Codreanu, 2006; Dorobanțu and Beceanu, 2007).

From an economic and technological point of view, a primary criterion for evaluating oil raw materials is the composition and quality of the oils. The oil obtained from grape seeds consists of saturated fats (palmitic and stearic) as well as unsaturated fatty acids. Grape

seeds contain three times less oil compared to traditional oil crops, such as rapeseed, sunflower, etc. (Antoce. 2007; Prichernomorya 2009).

This work aimed to quantitatively compare the oil content of seeds of intraspecific and interspecific grapevine genotypes.

MATERIALS AND METHODS

The study was carried out at the Institute of Genetics, Physiology and Plant Protection of the MSU, where all seed processing and analytical determinations were performed, in the period 2024. The biological material consisted of seeds obtained from—intraspecific grapevine genotypes ('Feteasca neagră', 'Feteasca regală', 'Merlot', "Sauvignon"), and interspecific rhizogenic grapevine genotypes ('Ametist', 'Alexandrina', 'Tethys', etc. (Alexandrov, 2019; 2023). These genotypes are part of the institutional germplasm collection described in previous studies.

Grape seeds were extracted from freshly harvested berries before the onset of must fermentation, to preserve their natural biochemical composition, particularly the oil fraction.

Through the analyses carried out, according to existing standards, the following were determined: the amount of oil (%) and the weight of the seeds.

The determination of oil content in grape seeds was carried out using the NMR (nuclear magnetic resonance) relaxometer method.

The determination of oil by nuclear magnetic resonance is carried out by comparing the amplitude of the echo signal from the seeds with that from a set of calibration standards. Grape seeds were extracted manually from freshly harvested berries before the onset of must fermentation, to preserve their natural biochemical composition, particularly the oil fraction. After extraction, the seeds were cleaned and prepared for analysis in accordance with the standard. According to existing methodological standards, two parameters were determined Seed oil content (%), and Seed weight (mg).

Oil content was quantified using the nuclear magnetic resonance (NMR) relaxometry method. The determination is based on measuring and comparing the amplitude of the echo signal from the seed samples with that obtained from calibration standards selected according to the natural biochemical characteristics of grapevine seeds.

Temperature and atmospheric precipitation were collected from weather stations; the data obtained were analyzed and statistically processed, based on which the necessary graphs were developed [Atlas, 2021; www.meteo.md].

The climatic parameters (temperature and atmospheric precipitation) corresponding to the cultivation area of the analyzed grapevine genotypes were obtained from official national meteorological stations.

The recorded data, calculated as averages for the study years (2022–2024), were processed and compared with the long-term climatic norms established for the region (covering the period 1950–1985). Data were expressed as mean $\pm$ standard deviation

Statistical analysis was performed using software SPSS, R, STATISTICA.

RESULTS AND DISCUSSIONS

Grape seed oil is known to be rich in antioxidants, particularly vitamin E and contains essential fatty acids such as linoleic acid, which contribute to supporting cardiovascular, circulatory and immune functions. Literature data indicate that grape seeds contain between 9.9 – 20.6% oil on a dry mass [Dorobanțu and Beceanu D., 2007; Prichernomorya, 2009].

The quantity of oil accumulated in depends on the genotype seeds is influenced both by the genotype and the climatic conditions in which the grapevine is cultivated. In the case of grapevine cultivation in the southern wine-growing area with an arid climate, the oil content

in grapevine seeds will be higher than in the case of grapevine cultivation in areas located further north. Grape berries contain between one and four seeds; therefore, 1,000 berries yield approximately 2,000 seeds. From one kilogram of grapes, about 30 g of seeds can be obtained, with a dry matter content of roughly 72% (Codreanu, 2006; Dorobanțu and Beceanu, 2007; Vinogradarstvo, 2009). Determining the oil content in grapevine seeds of intraspecific genotypes with yellow-green berries, it was found that they contain about 13.8-13.7% oil ('Fetească regală', 'Sauvignon'), while seeds of interspecific genotypes with yellow-green berries contain about 13.45-14.46% oil ('Alexandrina', 'Sarmis', etc.) (Table 1.).

Analysis of oil content in seeds from intraspecific genotypes with blue-violet yellow-green berries showed values of 13.8–13.7% (Fetească regală, "Sauvignon"), whereas interspecific genotypes with yellow-green berries contained 13.45–14.46% oil ('Alexandrina', 'Sarmis', etc.) (Table 1).

For intraspecific genotypes with blue-violet berries, oil content reached 13.5% ('Fetească neagră') and 16.6% ('Merlot'). In comparison, interspecific genotypes with blue-violet berries contained 11% ('Ametist') and 15.35% ('Sor') (Table 1).

Considering the average seed weight intraspecific genotypes displayed an average value of 30.4 mg, with an average oil content of 14.4% while interspecific genotypes presented seeds with an average weight of 33 mg and an average oil content of 13.9% (Table 1).

When grouped according to berry colour, seeds from genotypes with yellowish-green berries contained, on average, 14.4% oil, whereas those from genotypes with blue-violet berries contained 13.54% oil.

Previous studies reported that grape seeds collected from fermented grape pomace contain only 9-12%, which is lower than values obtained from seeds extracted before must fermentation (Codreanu, 2006; Dorobanțu and Beceanu, 2007).

Regarding the climatic conditions in the cultivation area of the studied genotypes, the long-term average annual temperature norm for the region is 9.73°C (the period 1950–1985).

The average annual temperature calculated for the study period 2022–2024 was 12.96°C, indicating an increase of 3.23°C above the established climatic norm (Figure 1).

Table 1. Oil content and weight of grapevine seeds

<i>Genotype</i>	<i>Oil, (%)</i>	<i>Seed weight, (mg)</i>
<i>Intraspecific genotypes (yellow-green berry)</i>		
'Feteasca regală'	13,8±0,15	27±0,15
'Sauvignon'	13,7±0,2	38,9±0,25
<i>Intraspecific genotypes (blue-purple berry)</i>		
'Feteasca neagră'	13,5±0,12	28,4±0,13
'Merlot'	16,6±0,18	27,3±0,11
<i>Interspecific genotypes (yellow-green berry)</i>		
'Alexandrina'	14±0,15	32,6±0,14
'Tethys'	13,45±0,12	29,8±0,21
'Sarmis'	13,7±0,21	38,9±0,22
'BC ₃ -536'	14,46±0,14	35,8±0,2
<i>Interspecific genotypes (blue-purple berry)</i>		
'Ametist'	11±0,11	32,85±0,24
'Sor'	15,35±0,13	28,4±0,13

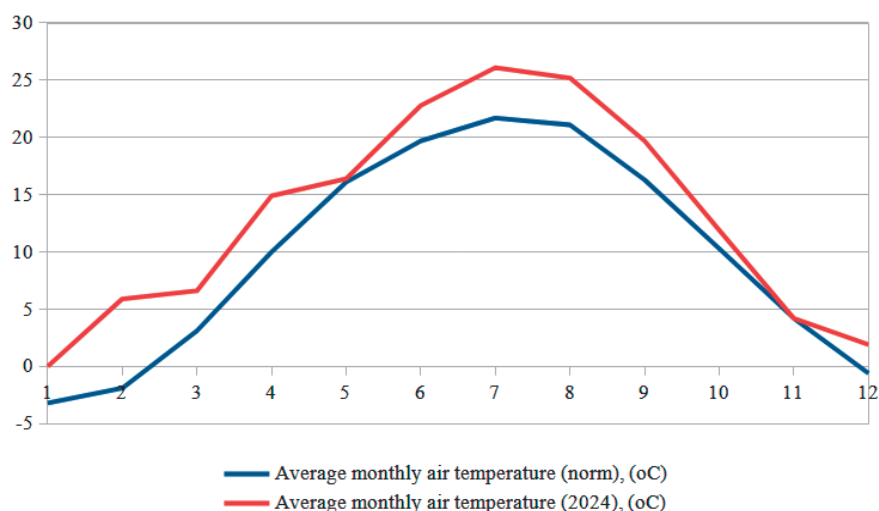


Figure 1. Average monthly temperature during 2024 compared to the monthly norm (1950-1985), Chisinau

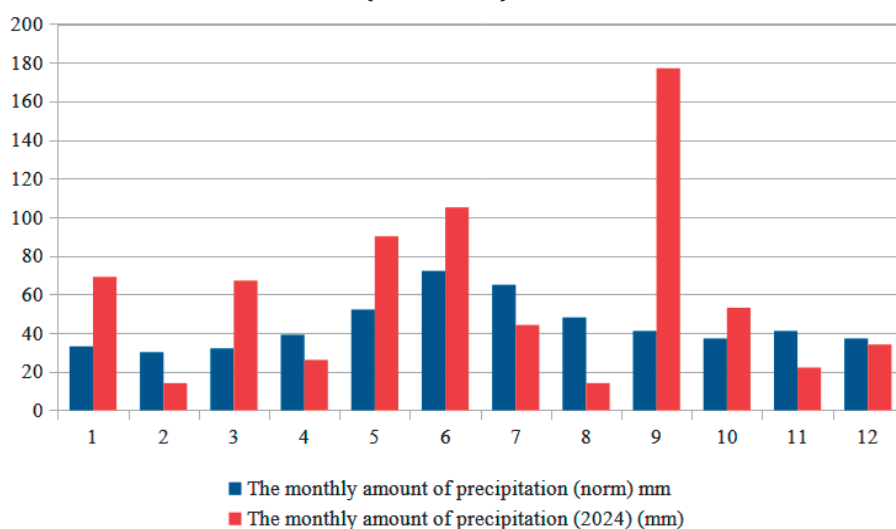


Figure 2. Amount of monthly atmospheric precipitation during 2024 compared to the norm (1950-1985), Chisinau

The annual precipitation norm for the studied area is 527 mm. In the year 2024, the total amount of atmospheric precipitation reached 715 mm. These data indicate an excess of 188 mm relative to the multiannual norm.

The analysis of daily precipitation recorded throughout 2024 reveals a marked irregularity in the temporal distribution of atmospheric precipitation (Figure 2). The average annual normal temperature for the territory of the Republic of Moldova, calculated for the reference period 1950–1985, is 9.46 °C. Analysis of the average annual temperature data for the period 2002–2024 indicates a mean value of 10.88 °C. Consequently, an increase of 1.42 °C above the climatic norm is recorded for this interval across the territory of the republic (Figure 4).

Based on the analysis of monthly atmospheric precipitation for the period 2002–2024 in the territory of the Republic of Moldova, it was found that precipitation amounts were approximately half of the calculated norm for 1950–1985. Consequently, a pronounced soil moisture deficit persists throughout the region (Figure 3).

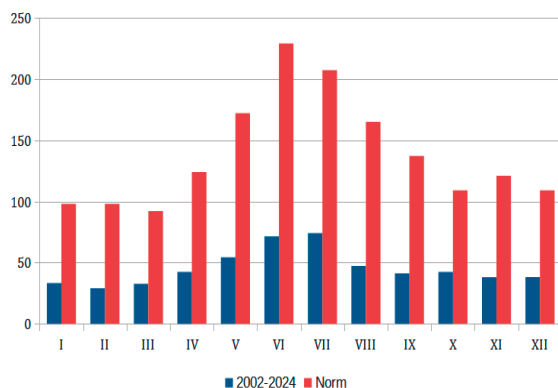


Figure 3. Monthly atmospheric precipitation for 2002–2024 compared with the calculated climatic norm for 1950–1985, Republic of Moldova.

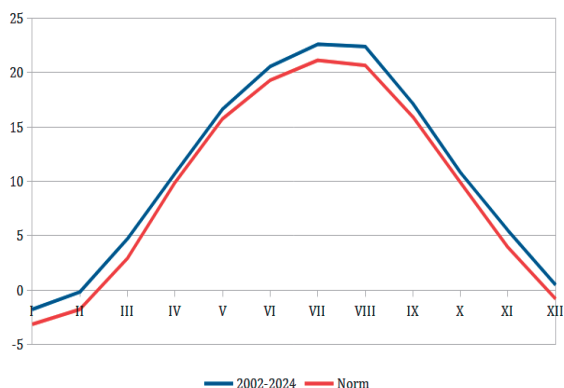


Figure 4. Average annual temperature in the Republic of Moldova (2002–2024) compared with the calculated climatic norm (1950–1985).

The annual distribution of atmospheric precipitation exhibits pronounced non-uniformity. Analysis of monthly precipitation data indicates extended periods of 2–3 months across large areas with little or no rainfall. Additionally, precipitation events are highly localized, occurring over relatively small areas (Alexandrov E. 2019; 2023; 2024).

CONCLUSIONS

Grapevine seeds, taking into account the fact that they contain valuable derivatives of oily substances, so necessary to maintain the activity of the human body, demonstrate that they can serve as raw material for obtaining and using these seed oils.

A greater amount of oil can be extracted from grape seeds extracted from the grapevine before the fermentation process begins than from seeds extracted after the grapevine fermentation process has taken place.

Grapevine seeds of intraspecific genotypes with yellow-green berries contain 13.8–13.7% oil ('Fetescă regală', 'Sauvignon'), while seeds of interspecific genotypes with yellow-green berries contain 13.45–14.46% oil ('Alexandrina', 'Sarmis', etc.).

Grapevine seeds of intraspecific genotypes with blue-violet berries contain 13.5% oil ('Feteasca regală') and 16.6% oil ('Merlot'), while seeds of interspecific genotypes with blue-violet berries contain 11% oil ('Ametist') and 15.35% oil (Sor).

Based on the color of the berries of the studied grapevine genotypes, it was found that grapevine seeds of genotypes with yellowish-green berries contain an average of 14.4% oil, and seeds of grapevine genotypes with blue-violet berries contain an average of 13.54% oil. For the period 2002–2024, an increase in the average temperature of 1.42 °C compared to the normal temperature is observed.

Atmospheric precipitation is manifested by non-uniformity, predominantly local and short-lived.

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