THE POTENTIAL OF CHEMICAL COMPOUNDS COMPARED WITH GRAPEVINE BERRIES COLOR AND DEGREE OF DISTANCING FROM THE INITIAL SPECIES (SPONTANEOUS)

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Abstract. The color of berries in the grapevine represents a very stable morphological character and some varieties can only be determined the basis of that indicator. The diversity of nuances vine berries is due to the biochemical characteristics of the juice berries. The concentration of resveratrol in juice berries interspecific hybrids of vines (Vitis vinifera L. x Muscadinia rotundifolia Michx.) Is consistent with the color of berries. The berries of green-yellow color contain the 6.68 mg/l, berries pink color - 9.3 mg/l and blue-violet berries - 14 mg/l of resveratrol. As a result of studies it was found that hybrids third generation (BC2) is characteristic of a higher concentration of diglucozid-3,5-malvidol and methyl anthranilate than the fourth generation hybrids (BC3). So it, once the removal from parental forms, the concentration of chemical compounds, such as: resveratrol, diglucozid-3.5-malvidol, methyl anthranilate, heavy metals, etc., the juice of berries of interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) is decreasing.

Keywords: chamical compounds, berries, color, interspecific hybrids.

INTRODUCTION

During the development of the culture of the vine were applied multiple breeding methods, such as the natural selection or directed (intraspecific, interspecific, clonal, genetic engineering etc.). An desideratum of world science and practice of the wine remains the obtaining new varieties of vines: quality, absolutely resistant to impact of phylloxera (root and leaf) etc. In the process of creating new varieties of vines are attested changes in the spectrum of chemical and biochemical compounds responsible for flavor, color and taste of berries, juice and of the wine obtained. The color of berries of the vines is very stable morphological character. This indicator has practical significance not only for winemaking but is being used and for determining and classification of species and varieties of vines, some of which are only distinguished by the color of berries.

The varieties of vines culture berries color is very varied and rich in nuances. The diversity of nuances of vines berries is due to the biochemical characteristics of the juice berries. Berries because of the chemical composition represents a food product very valuable sanogenous. They shall contain many nutrients necessary for human body, such as sugars (glucose, fructose) - 12-25%, organic acids (tartaric, citric, malic) - 1-2% mineral salts (Ca, Fe, K, P, etc.) - about 1%, nitrogenous compounds - 0.15-0.2%, vitamins (C, B1, B2, PP, A, E), enzymes, polyphenols (anthocyanins, resveratrol, flavonoids), etc.

The plants of vines in response to the attack of pathogenic agents (fungi, bacteria, etc.), secrete biologically active substances from the group of polyphenols, such as resveratrol, which exercises the protection function. Today, on the basis studies and researches were identified over 4,000 polyphenols. They represents powerful antioxidant substances that protect cells and neutralize action of free radicals, which are formed as a

result of physiological processes, thus helping to slowing the aging of the body. (Țîrdea, 2007; Țîrdea, Sîrbu, Țîrdea, 2010; Gaina, Alexandrov, 2015)

The amount of resveratrol in plants varies according to the species of vines, the soil and climate conditions in the which increases and cultivation methods of plant (eg in vineyards sprinkled the purpose of protecting maximum the amount of polyphenols is more low). This polyphenolic compound is found in nature in four different forms of trans-resveratrol which seems to be the best a biological perspective active.

The resveratrol interest from three different points of view:

- oenological, phenolic compound participating in determination of color, taste and maturing of the wine, participates in oxidation-reduction reactions etc.;
- phytopatological, proprietary of defense against of phytopathogenic organisms;
- pharmacological, being a substance with properties antioxidant/radical scavengers in the body with properties to prevent and treat different diseases: cardiovascular, cancer etc. (Heroiu Elena, Savulescu Georgeta, Racota Rodica, 2005; Gaina, Alexandrov, 2015).

Although the "*grapevines*" has been thoroughly studied and multilateral, however some aspects the interdependence between the various factors specific to this plant, are to be investigated and analyzed further. (Codrean, 1976).

MATERIAL AND METHODS

As a object of study have served the species of vines: *Muscadinia rotundifolia* Michx., *Vitis vinifera* L. ssp. *sylvestris* C.C.Gmel.; varieties of vines: *Vitis vinifera* L. ssp. *sativa* D.C. (Cabernet-Sauvignon, Merlot and Pinot Noir etc.); interspecific hybrids of the vines: *Vitis vinifera* L. ssp. *sativa* D.C. x *Muscadinia rotundifolia* Michx. (DRX-M4-502; -510; -515; -515; -520; -537; -541; -542; -545; -660; -678; -M3-3-1 etc.) (Alexandrov, 2010; 2012; 2015; Gaina, Alexandrov, 2015).

Uvologice and biochemical studies were conducted at the Agricultural High School Montpelie, France and the Institute of Scientific and Practical Horticulture and Food Technology from Republic of Moldova (Țîrdea, 2007; Cotea, 1985; Antoce, 2007; Țîrdea, Sîrbu, Țîrdea, 2010; (Gaina B., Jean-Louis Puech, Perstnev N. et al., 2006).

The biochemical and uvological analyzes were used the methods disclosed in the Reports Methodes des vins de l'Office des analyzes International Vigne et du Vin (Paris 2014), technical regulations "Analytical methods in the manufacture of wines".

The determination of quantitative and qualitative diglucozid-3.5-malvidol was performed according to qualitative and quantitative fluorimetric method. Determination of methyl anthranilate was carried out according to the gas phase chromatographic method. Heavy metals were determined by atomic spectroscopy method.

RESULTS AND DISCUSSIONS

The creation of new varieties of vines resistant to phylloxera root and foliar in mildium powdery mildew, gray mold and other biotic and a high resistance to low temperatures in winter and drought, will enable truly solving the problem the production of table grapes and for industrial processing, being a high quality ecological product.

The resveratrol represents a fitoalexin which determines the resistance of the vine *Botrytis cinerea* Pers. (1794), *Daktulosphaira vitifoliae* (Fitch 1855) etc.

It is significant that the wild vine species *Muscadinia rotundifolia* Michx. it contains on average 35 mg/l of resveratrol (fig.1.). Trans-resveratrol which vary from 4.9 mg/l to 13.4 mg/l and cis-resveratrol varies in the range of 9.2 mg/l to 35 mg/l. (fig. 3). Analyzing the juice of berries vine forest (*Vitis vinifera* L. ssp. *sylvestris* CCGmel.) with berries of blue-violet color it was found that the concentration of resveratrol is the limit of 16.0 mg/l. (Fig. 1).

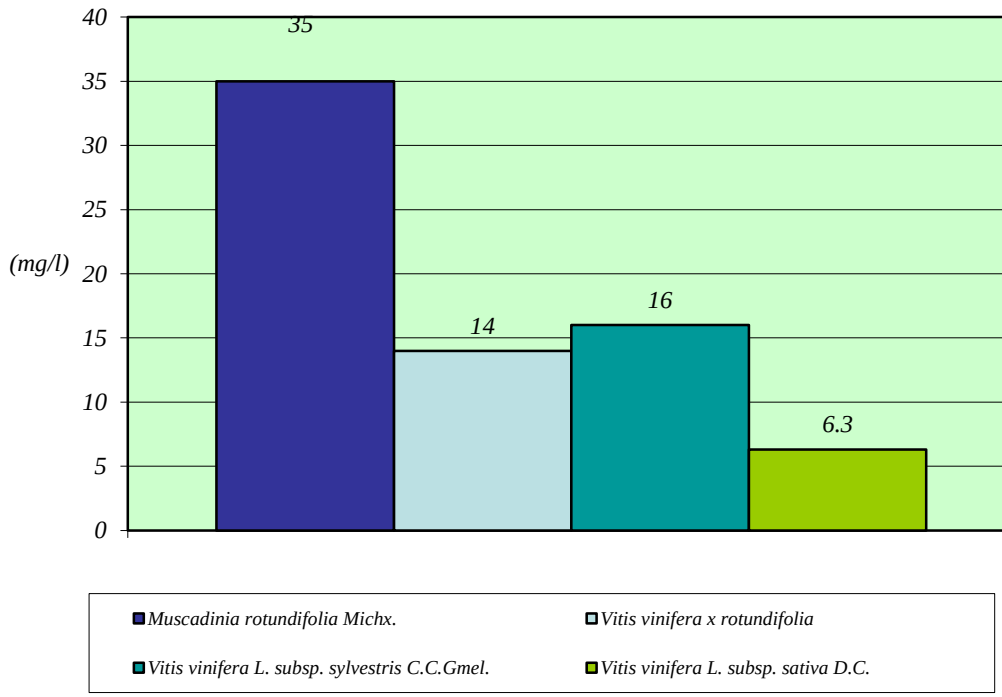

Fig. 1. The outstanding amount of resveratrol in juice of berries vines varieties

By determining the concentration of resveratrol from the juice of berries of the vines varieties *Vitis vinifera* L. ssp. *sativa* D.C. it was found that the cis-resveratrol concentration ranges between 0.8 mg/l to 3.9 mg/l, and the concentration of trans-resveratrol varies over a range from 1.2 mg/l to 6.4 mg/l. (fig. 5). As a result of interbreeding *Vitis vinifera* L. ssp. *sativa* D.C. with *Muscadinia rotundifolia* Michx. were created interspecific hybrids by vines.

Analyzing the physico-chemical characteristics of the berries of interspecific hybrids of vines (*Vitis vinifera* L. ssp. *sativa* D.C. x *Muscadinia rotundifolia* Michx.) it has been found that concentrations of chemical substances: phenolic substances, resveratrol, pectins, methyl anthranilate, diglucozid-3,5-malvidol etc. varies depending on the color of berries.

The concentration of the phenolic substances in berries interspecific hybrids of vines varies depending on to their respective colors: hybrids interspecific with berries green-yellow contain the phenolic substances within the limit of 268 mg/l, hybrids interspecific with berries colored pink contain the 597 mg/l and interspecific hybrids with blue-violet berries contain the 1970 mg/l.

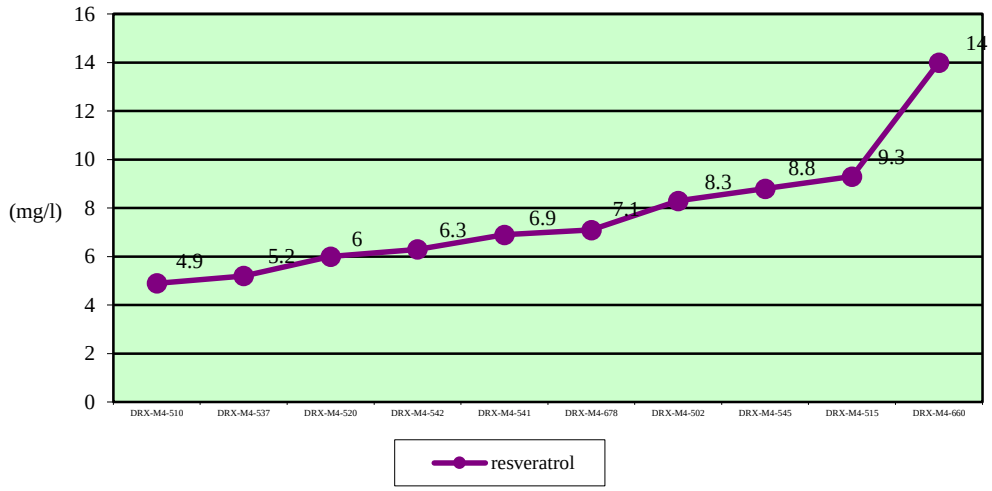

Fig. 2. The amount of resveratrol in juice of berries varieties of interspecific hybrids of vines *Vitis vinifera* L. ssp. *sativa* D.C. x *Muscadinia rotundifolia* Michx.

The concentration of resveratrol, also varies in the limit of 6.68 mg/l of berries green-yellow color, 9.3 mg/l berries of pink color and 14 mg/l berries of blue-violet (fig. 3.).

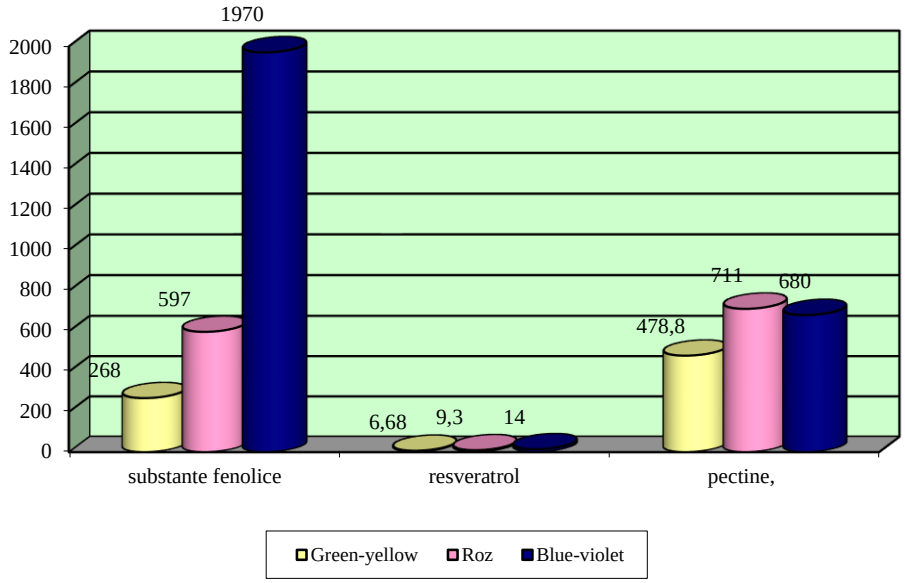

Fig. 3. Physico-chemical peculiarities depending of the color of berries of interspecific hybrids of vinee (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.), mg/l

Analyzing the results of the biochemical study of berries grapevine it was found that the juice of wild berries vine varieties resveratrol concentration is much higher than the varieties of vine cultivation. The wild vine of American origin *Muscadinia rotundifolia* Michx. containing about 35 mg/l resveratrol, and the variety obtained as a result of interspecific hybridization with this species, it contains about 11-14 mg/l. (fig. 1).

Subsequent research in interspecific hybrids with interspecific varieties involvement will inevitably demonstrate fact that the concentration of this chemical compound will be steadily decreasing. This trend can be observed when creating of vines varieties within species *Vitis vinifera* L. The concentration of resveratrol in juice berries subspecies of forest vines *Vitis vinifera* L. ssp. *sylvestris* C.C.Gmel. constitutes approx. 16 mg/l. While the varieties of culture grapevine of the subspecies *Vitis vinifera* L. ssp. *sativa* D.C. the concentration of resveratrol varies between average of 4-6 mg/l.

To the extent obtaining new varieties of vines and removal of the initial species (spontaneous) concentration of chemical compounds (particularly resveratrol) are decreasing.

It is very important that when creating new grapevine varieties, both the interspecific hybridization method, and the intraspecific emphasis is placed on the concentration of chemical compounds in berries that provide plant resistance to noxious environmental factors.

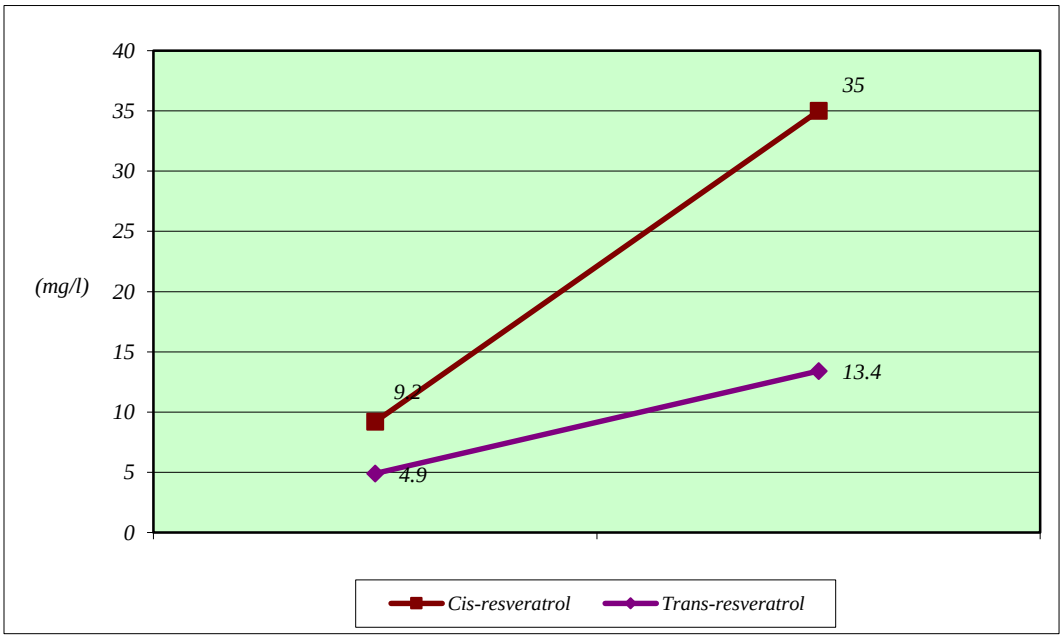

Fig. 4. The concentration of the resveratrol in the juice of berries of the *Muscadinia rotundifolia* Michx.

The berries color of the grapevine is a very stable morphological character. This indicator has practical significance not only for winemaking but is also used for determining and classification of species and varieties of vines. Some varieties of grapevine can be distinguished only by the color of berries.

By analyzing the physicochemical characteristics of interspecific hybrids berries of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) it was found that concentrations of chemicals: phenolic substances, resveratrol, pectins etc. varies depending color of berries.

The concentration of resveratrol in the berries of interspecific hybrids of vines, varies from 6.68 mg/l in green-yellow berries, 9.3 mg/l in the color rose berries and 14 mg/l in blue-violet berries (fig. 6).

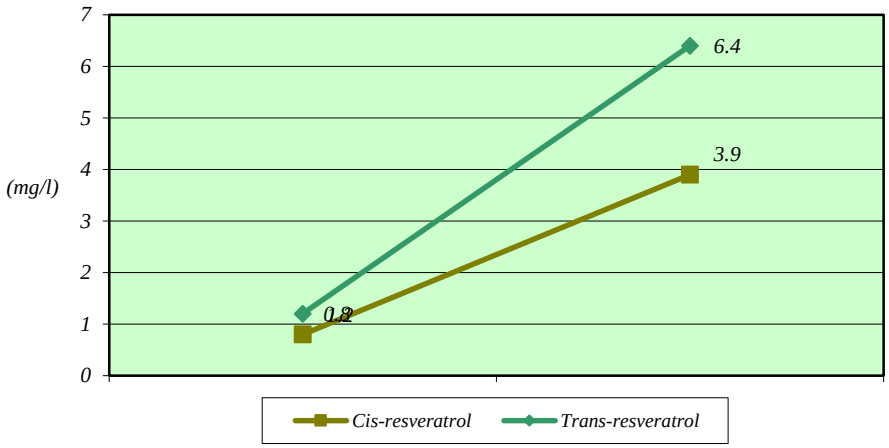

Fig. 5. The concentration of resveratrol in the juice of berries of the *Vitis vinifera* L. subsp. *sativa* D.C.

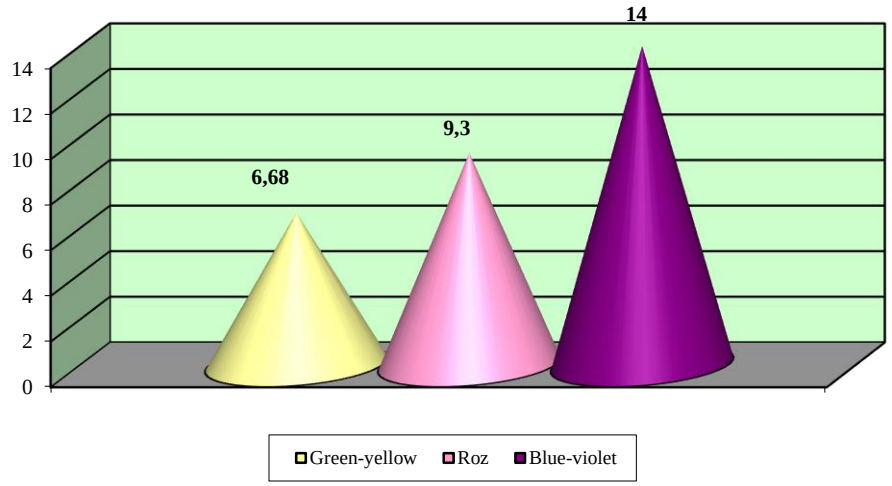

Fig. 6. The concentration of resveratrol dependeng of the color of berries of the interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.), mg/l

The total concentration of resveratrol in berries of vines is in accordance with the color of berries, so, according to a conventional system of 10 units, berries of bleu-violet color possess 10 units of resveratrol, berry rose color possess 2-3 units ang berries of green-yellow - 0.5-1 units. (Waterhouse, 2002; Lamuela-Raventos, Romero-Perez, Waterhouse, Carmen de la Torre-Boronat, 1995; Okuda, Yokotsuka, 1996). The concentratgion of pectines in the berries varies in the limit of 478,8 mg/l in the berries o green-yellow color, 711 mg/l in the berries of pink colored and 680 mg/l in the berries of bleu-violet. (fig. 3.).

According to the European Union requirements, the production of wine products, the chemical composition of the starting material must correspond to the strict requirements, for example diglucozid-3,5-malvidol shall not exceed the limit of 15 mg/l. Recently the World Organisation of Vine and Wine has raised the issue of reducing this indicator to wine at the limit of 5 mg/l, fact which imposes the monitoring of interspecific hybridization severe with selection to homologate just varieties with low diglucozid-3,5-malvidol. A further important

component of the juice berries of vines hybrids of any order, including the interspecific it is methyl anthranilate (3,4-benzoxazole), to whom the has the main role in determining taste and smell (aroma) of foxat (the naphthalene and/or phenol) (Gaina, Jean-Louis Puech, Perstnev et al., 2006).

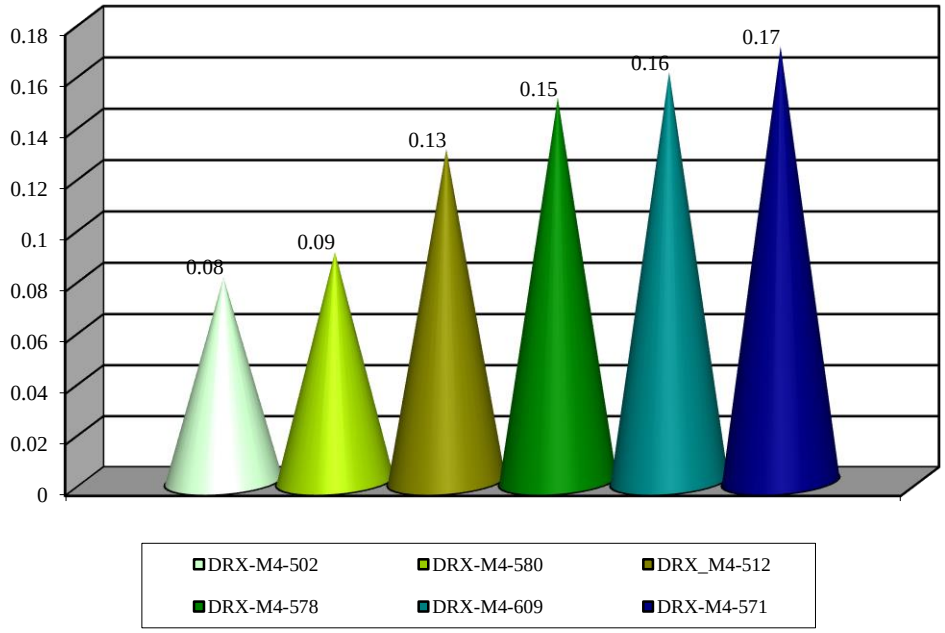

Fig. 7. The concentration of the methyl anthranilate in the berries of green-yellow color of the interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.), mg/l

As a result of the study on the concentration of methyl anthranilate in the juice of berries of the interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) it was found that in green-yellow berries of this chemical varies from 0.08 mg/l (DRX-M4-502) to 0.17 mg/l (DRX-M4-571), (fig. 7), and the red-violet berries of methyl anthranilate concentration varies within the limits 0.20 mg/l (DRX-M4-665) to 0.24 mg/l (DRX-M3-3-1), (fig. 8).

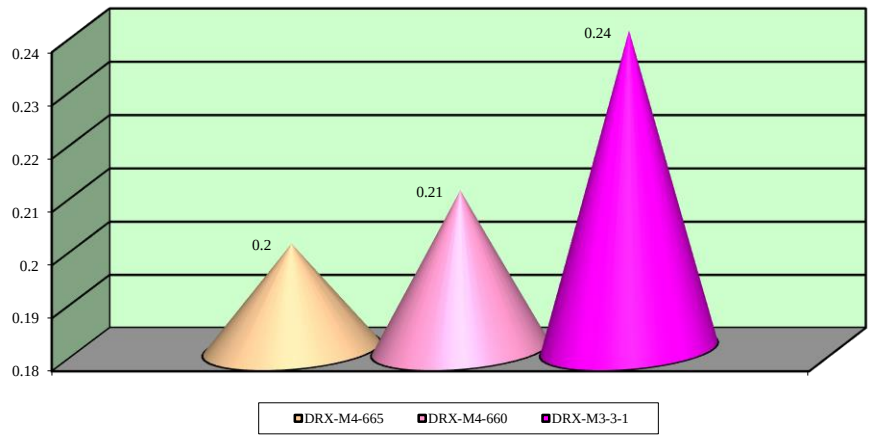

Fig. 8. The concentration of the methyl anthranilat in the berries of red-violet color of the interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.), mg/l.

Methyl anthranilate represents a nitrogen compound from the group of benzoxazoles is formed in grapes (especially the hybrid direct producers) in amounts of from 0.2 to 3.5 mg/l of must (the juice). It is reflected in the wine along with the same concentrations of volatile aromatic another chemical component - amyl acetate, importantly chemical compound that contains the juice berries of interspecific hybrids new selection, to be determined, studied and taken as a criterion preselection.

By determining the concentration of methyl anthranilate from the juice of berries of the interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) it was found that third-generation hybrids (BC2) of methyl anthranilate limit possess approximately 0.24 mg/l (DRX-M3-3-1 etc.) and fourth generation hybrids (BC3) hold approximately 0.21 mg/l (DRX-M4-660 etc.) (fig. 9).

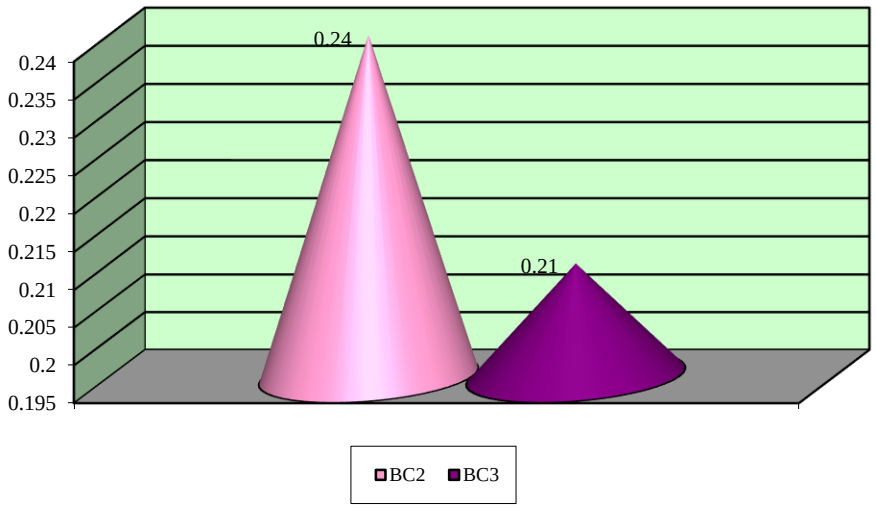

Fig. 9. The concentration of the methyl anthranilat in thejuice of berries of the interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.), mg/l

Diglucozid-3.5-malvidol also varies depending on the degree of distancing from initial species. The result of studying interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) it was found that third-generation hybrids (BC2) containing diglucozid-3,5-malvidol limit of 9.3 mg/l (DRX -M3-3-1 etc.), and the fourth generation hybrids (BC3) contains 7.7 mg/l diglucozid-3,5-malvidol (DRX-M4-660, etc.) (fig.10.).

Heavy metals are toxic for all living organisms. Thus, plants accumulate heavy metals from soil, air, water. The animals, particularly herbivores consume plants for feeding. The people consume derived products from plant and animal origin, ambient air, water etc.

The presence of heavy metals in the body in concentrations inadmissible put in danger its functioning and consequently lead to destruction. For the development of a healthy society it is necessary for derived products used in food production technologies, have admissible concentrations of chemical compounds.

The World Health Organization has set maximum permitted concentrations of heavy metals in wine-derived products. An imperative of modern ecology is the presence of metals in wines, especially heavy metals. Today, great attention is given to identifying sources

which makes the presence of heavy metals in wine and reducing the content of these metals by applying treatments permitted by applicable law.

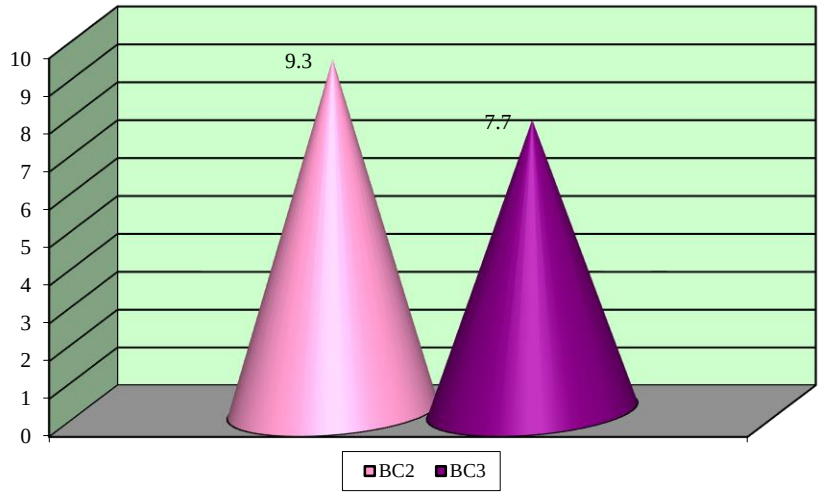

Fig. 10. The concentration of the diglucozid-3,5-malvidol in the juice of berries of the interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.), mg/l

The results obtained reveals that the juice of berries have a high degree hygienic high in all forms of interspecific hybrids of vines studied the content of heavy metals Fe, Cu, Zn, Pb, Cd, As and Hg are much smaller (lower) the permissible limits (rules), approved by the World Organisation of Vine and Wine (WOVW) (fig. 11; fig. 12.).

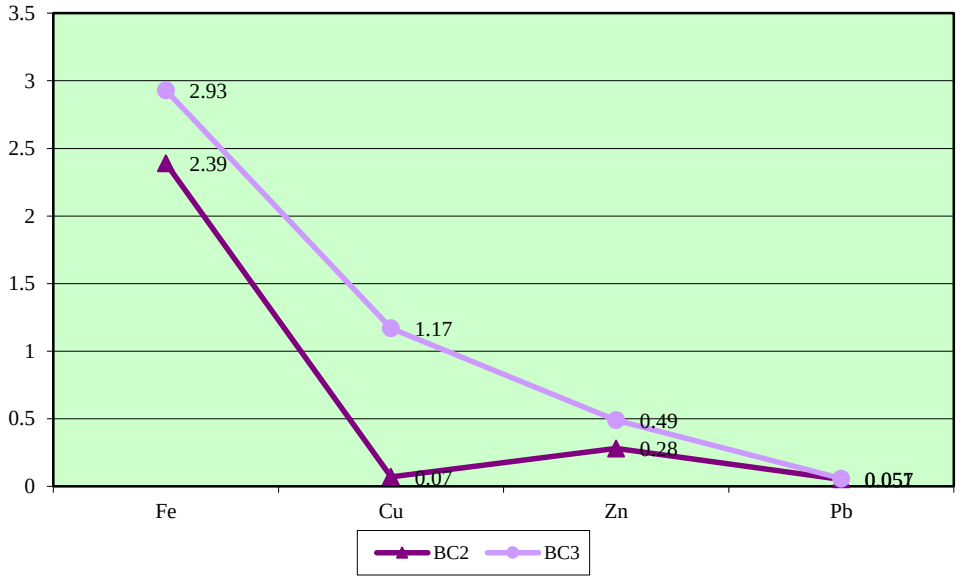

Fig. 11. The concentration of heavy metals in the berries of blue-violet color of the interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.), mg/l

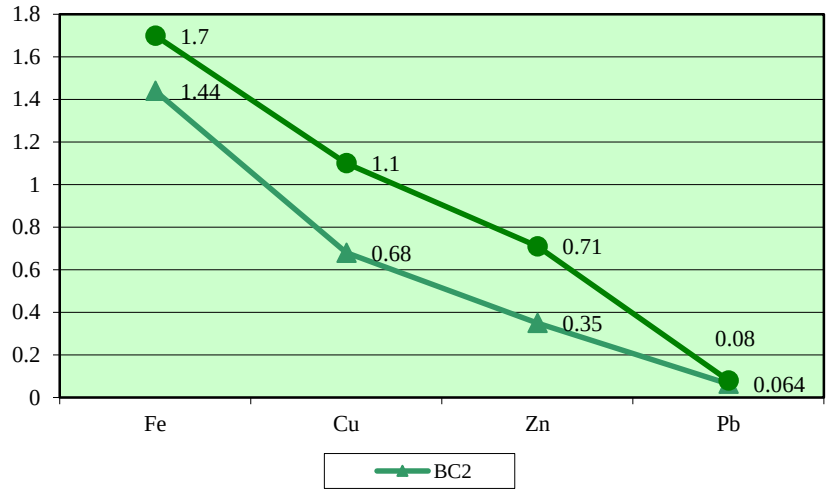

Fig. 12. The concentration of heavy metals in the berries of green-yellow color of the interspecifichybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.), (mg/l)

Analyzing the titratable acidity in berries of the interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) in comparison with their color, we find that the green-yellow berries titratable acidity is the limit of 6.26 mg/l , the color rose berries is 7.2 mg/l and blue-violet berries of 8.1 mg/l.(fig. 13.).

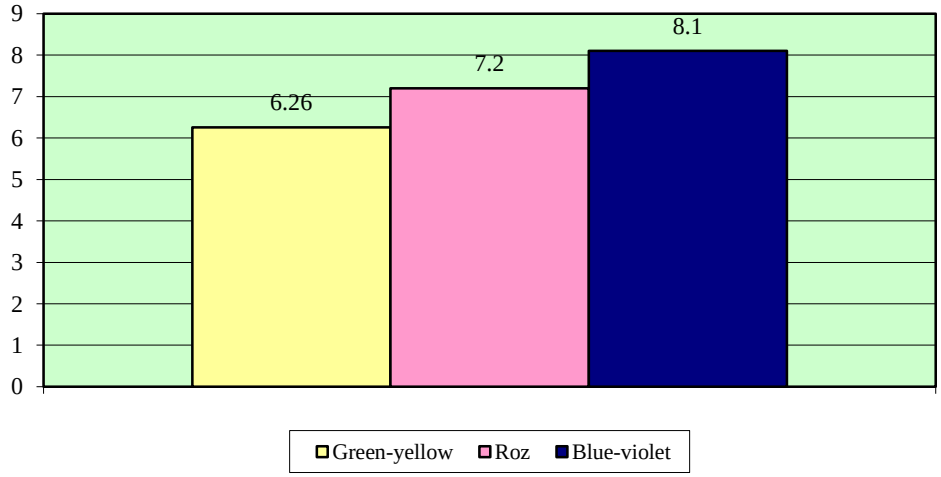

Fig. 13. The titratable acidity of the juice of berries interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) compared with berries color. (mg/l)

CONCLUSIONS

1. When creating the new varieties of vines, both through hybridization method interspecific and the intraspecific is very importantly to take into account the concentration of chemical compounds in berries such as resveratrol, which provides plant resistance to certain factors of the environment.

2. The concentration of resveratrol in of vines wild species is much larger, nearly double as compared to the descendants of these species. Once the removal of wild species, the concentration of resveratrol in of vines berries is decreasing.

3. The total concentration of resveratrol from the juice of berries of interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) is in accordance with the color of berries. Thus, if conventional blue-violet berries possess 10 units of resveratrol, then color rose berries possess 2-3 units, and the green-yellowish 0.5-1 units.

4. Depending on the degree of distancing from initial species, the concentration of diglucozid-3,5-malvidol and methyl anthranilate from the juice of berries of interspecific hybrids of grapevine (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) decreases. It was found that hybrids third generation (BC2) contain higher concentrations of diglucozid-3,5-malvidol and methyl anthranilate than hybrids fourth generation (BC3). So it once the removal from parental forms, the concentration of diglucozid-3,5-malvidol and methyl anthranilate from the juice of berries of the interspecific hybrids of vines (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) is decreasing.

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