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Resveratrol Contents Found in Grape Juice Extracted from *Vitis* sp. Varieties and Produced Through Organic and Conventional Cultivation Systems

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Abstract: The present study was carried out to evaluate the contents of trans-resveratrol and some chemical characteristics in samples of colored grape juice (red grapes), produced in organic and conventional systems. The juice was obtained by healthy ripe grapes. Grape juice obtained from varieties, such as Isabel 572, Bordô 572, Concord 766 and Rubea 766 produced under organic and conventional system showed a concentration of resveratrol around 32.4, 30.0, 25.9 and 27.2 mg L^{-1} and for the grapes from the same cultivars produced under conventional system showed the following concentration 34.3, 31.8, 32.5 and 32.9 mg L^{-1}, respectively. The difference found, may result from the juice elaboration process, which extracts nutrients from both, the pulp and the peel, making the juice an alternative source to wine production and to the ingestion of drinks that contain bioactive substances. Due to the high contents of this molecule, grape juice may be considered as functional drink.

Key words: Trans-resveratrol, grapes, organic and conventional cultivation systems, *Vitis* sp.

INTRODUCTION

Due to the importance of having a healthy diet, there has been a search for food, or *victuals*, with other properties, beyond nurturing, to protect the body against illnesses. In this study, researches have shown that the resveratrol present in wines (red wine) and in juices of colored grapes have an important function in the prevention of diseases, mainly in those linked to the cardiovascular system.

The resveratrol molecule (trans-3,5,4-trihydroxys tilbene) is a polyphenol, antioxidant, synthesized by superior plants and it was firstly found in grape, accumulated in tissues of l eaves. Resveratrol molecule acts in the plant as a protecting agent against ultraviolet rays, mechanical injuries and attacks by fungi such as *Botrytis cinerea* and *Plasmospora viticola* (Nikfardjam *et al*., 2006a, b; Kolouchová-Hanzliková *et al*., 2004; Wang *et al*., 2002).

In the human organism, this molecule promotes benefits associated to the heart health, such as hypo-aggregation of plaques, inhibition of Low-Density Lipoprotein (LDL) peroxidation (Possier *et al*., 2005; Kolouchová-Hanzliková *et al*., 2004). Other important benefits have been under investigation and have been proving the anticarcinogenic power of resveratrol once it increases apoptosis, detaining cellular multiplication, inhibiting the proliferation of several lineages of human epithelia's malign and non-malign cells of the mamma, human cells of prostate cancer, colon tumor, inhibiting the proliferation of vascular smooth muscle cell that induces apoptosis; besides acting as antioxidant through the inhibition of the dioxigenase activity of lypoxigenase (Sauter *et al*., 2005).

Resveratrol effects were observed in countries with high consumption of red wine and also in scientific experiments (Possier *et al*., 2005).

Moreover, the consumption of organic products has been increasing because consumers have been showing preference to products free from pesticides and such behavior induces to changes in production, storage, distribution and commercialization of food (Floers-Cantillano *et al*., 2001).

The organic system of agricultural production and industrial food-processing are systems that adopts technologies with the purpose of optimizing the use of natural and socioeconomic resources and also search for self-sustainability thus, respecting cultural integrity. One

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of the fundamental items of this system refers to the elimination of pesticides and other artificial fertilizers, in an attempt of maintaining nutritional and sensorial properties of products, which makes the processing of organic food a challenge for the food processing provision industry (Sauter *et al*., 2005). Many aspects should be elucidated in relation to organic food, including the presence and amount of secondary compounds of plants that represent an edible part of a plant, so that the food component may be considered as functional food.

The present study was carried out aiming at assessing the chemical characteristics and the resveratrol contents in juices, obtained from colored grapes from different cultivars and produced by following both, the organic and the conventional systems.

MATERIALS AND METHODS

Juices extracted from different varieties of grapes were used; among them Isabel and Bordô grafted on Jales_IAC 572 rootstock, Concorde and Rubea on Campinas IAC 766 rootstock, under the same cultivation conditions in organic system and conventional system, produced in the experimental farm of the State University of Maringá in Iguatemi.

Ripe grapes, exempt from the action of pathogens and with Total Soluble Solid (TSS) contents of 14° Brix were selected in the different varieties cultivated, by using organic and conventional systems. Grapes were taken to the Laboratory of Food Biochemistry of the State University of Maringá (UEM) and were submitted to the cooking method so as to obtain the juice.

Determining chemical characteristics: Samples were homogenized and filtered in gauze. After determining the values of Total Soluble Solids (TSS) expressed in °Brix; pH, Total Titratable Acidity (TTA) expressed in grams of tartaric acid/100 mL of juice and ratio Brix/acidity, all analyses were performed according to the Instituto Adolfo Lutz analytical methodology (IAL, 2008).

Determination of resveratrol: Samples were diluted and filtered in paper -0.22 μm porosity and afterwards, they were sent to the Laboratory of Food Biochemistry of the State University of Maringá (UEM) for the analyses of resveratrol contents by scanning spectrophotometry (Cary Varian UV/VIS), so as to obtain the spectra of resveratrol electromagnetic radiation. The varian modular proStar liquid chromatograph was used to obtain chromatograms. The device contained a model 240 series 00752 piston pump, a Varian (Auto sample proStar 410) automatic injector, with loop of sampling of 20 μL, RP-18 chromatographic column and a model ProStar 350 spectrophotometric detector with a photodiode, arranged with a Polyview program of data collection. The movable phase used was the acetonitrile 75:25 in 1.5 mL min^{-1}. The wavelength used for the reading was 306 nm (Souto *et al*., 2001).

RESULTS AND DISCUSSION

The amount of juice obtained was 60%. The chemical characteristics of the juices obtained may be shown in Table 1. The juice obtained from Concorde varieties (organic and conventional), Rubea (organic and conventional) presented good sensorial balance (IAL, 2008). However, only the juice from Concorde variety (conventional) showed °Brix value in agreement with the legislation. The other samples suffered dilution of soluble compounds due to the method used. All juice samples showed a minimum acidity, in accordance with patterns required by legislation.

The grape juice obtained presented contents of soluble solids between 9.46-14.23 °Brix. Brazilian legislation prescribes a minimum content of TSS around 14 °Brix, thus, the amount of juice obtained from the varieties assessed presented lower values compared to those required by legislation. Only the juice obtained from Concord variety, produced in conventional system, was in accordance with the requirements. Regarding TSS contents, results from organic varieties were similar to those reported by Rizzon and Link (2006), which were (12.2-13.1), who obtained the juice using the same extraction process. According to the researchers mentioned, this was due to the dilution of water steam, which occurs according to the type of equipment used.

The ratio (TSS/TTA) represents the balance between sweet and acid taste in grape juice. Brazilian legislation establishes the range of this ratio as 15 and 45. This ratio values were more appropriate for Concord 766 (15.18) and Rubea 766 (17.64) varieties, which were cultivated in a conventional system. Rizzón and Link (2006) obtained slightly higher contents, for juices from Bordô and Cabernet Sauvignon varieties (18.3 and 18). However, pH values found in the different types of juice extracted from all analyzed varieties were considered appropriate for the conservation of the product.

Trans-resveratrol contents may be shown in Table 2. Resveratrol values may vary according to climatic conditions, production methodology, fungi attack, cultivar and harvest methods. The Table 1 amount of trans-resveratrol extracted depends on the grape variety and on the year wine is made.

Trans-resveratrol contents found in all varieties of grape juice analyzed in different cultivars (organic and conventional cultivation systems), showed higher values

Table 1: Chemical characteristics of grape juices obtained from grapes produced under organic and conventional systems

Varieties	Cultivation system	pH	TSS	TTA	TSS/TTA
Bordô 572	Organic	2.87	9.46	1.2500	7.568
Isabel 572	Organic	3.01	10.95	0.7700	9.180
Concorde 766	Organic	3.01	10.95	0.7700	14.220
Rúbea 766	Organic	3.04	11.73	0.9140	12.640
Concorde 766	Conventional	3.05	14.23	0.9375	15.180
Rúbea 766	Conventional	3.02	13.23	0.7500	17.640
Bordo 572	Conventional	3.00	9.30	0.9000	10.330
Isabel 572	Conventional	2.73	10.63	0.9000	11.800

SST: Total Soluble Solids, expressed in °Brix; ATT: Total Tritatable Acidity (g) of tartaric acid in 100 mL^{-1} grape juice

Table 2: Contents of resveratrol obtained from grape juices cultivated under organic and conventional system (expressed in mg L^{-1})

Varieties	A	B
Concorde	25.9	32.5
Rubea	27.2	32.9
Bordô	30.0	31.8
Isabel	32.4	34.3

A: Grape juice from grapes produced under organic system; B: Grape juice from grapes produced under conventional system

than those found by Romero-Pérez *et al.* (1999) in studies with juice extracted from commercial grapes, the values found for Total Trans-Resveratrol (TTR) was around 14.47 mg L^{-1}. The resveratrol contents observed in the present study with juice obtained from the grape varieties analyzed were from 25.9-34.3 mg L^{-1}. Such contents of juice resveratrol also varied depending on the cultivar and on the cultivation system. Juice obtained from grapes produced in organic cultivation system presented smaller amounts of resveratrol, when compared to the same cultivars produced in conventional system. Kopke (2005) claims that an advantage of organic agriculture is its potential in producing healthy food, based on higher concentrations of secondary nourishing substances of the plant, when compared to the non-organic cultivars; nevertheless, this fact was not observed in the present experiment.

The high proportion of trans-resveratrol found in the amount of juice obtained (Table 2), may be related to the process used for extracting the juice. The cooking method extracts the juice, initially, through the passage of water steam through the peel and afterwards the extraction of the pulp begins. According to Cantos *et al.* (1999) the peel is the portion of grape with high incidence of resveratrol, thus, in his experiments, the researcher reports the absence of this substance in grape pulp. Romero-Pérez *et al.* (1999) extracted larger amounts of resveratrol for his experiments, by using 60°C temperature for 30 min. Further studies should be carried out in order to elucidate the behavior of plants cultivated through organic systems and to analyze their secondary compound production.

Results suggest that the cooking method, used to extract grape juice may be recommended so as to obtain a larger amount of resveratrol, however, the method should be adapted, so that it may meet the requirements of Brazilian legislation for grape juice processing, concerning TSS content.

CONCLUSION

Due to its high resveratrol contents, the juice obtained from colored grapes is indicated as source of this substance. In addition, organic grape juice contributes to a healthier diet because it does not contain pesticides or fertilizers.

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