Nutraceutical Compound Concentrations of Muscadine (*Vitis rotundifolia* Michx.) Grape Cultivars and Breeding Lines

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Abstract

Consumption of fresh fruits and vegetables has been linked both anecdotally and clinically to the prevention or alleviation of chronic diseases and provides essential nourishment to mankind. The muscadine grape, a fruit indigenous to the southeastern U.S., contains several phenolic compounds that act as antioxidants and also other compounds, such as resveratrol, that can perform as a chemopreventative. The concentrations of these compounds present in the muscadine grape equal or exceed that known for other small fruit. Fruit of selected muscadine grape genotypes, including breeding lines and cultivars, were evaluated over a 2-year period to assess the existing genetic base for these nutraceutical compounds. Results demonstrated that concentrations of anthocyanins, total phenolics, ellagic acid, and resveratrol differ significantly among cultivars and breeding lines. These results suggest a possibility to breed for increased concentrations of the health-promoting compounds in muscadine grapes. The objective of this study is to determine measurable variations between breeding lines of cultivated muscadine grapes. If there are differences among breeding lines, plant geneticists can breed cultivars with higher nutraceutical value.

INTRODUCTION

Muscadine grapes (*Vitis rotundifolia* Michx) are native to the warm humid climates of the southeastern United States. Muscadines grow wild from Delaware to the Gulf of Mexico and as far west as Missouri to Texas. Phytochemical composition of whole muscadine grapes differ from *Vitis vinifera* in that muscadines have a higher total phenolic content distinguished by high ellagic, gallic, and flavonoid glycoside concentrations. Another unique feature of the anthocyanin chemistry observed in muscadines is the presence of 3,5-diglucosides of delphinidin, cyanidin, petunidin, peonidin, and malvidin in non-acylated forms. Resveratrol (3,5,4’-trihydroxy-trans-stilbene) is a natural compound found in large quantities in grapes and red wine. Resveratrol has been shown to have anti-inflammatory, chemopreventive, and anti-angiogenic effects. A study team from Korea showed that resveratrol inhibits cell growth and induces apoptosis in PA-1 human ovarian cancer cells. Yet with 70-90% of the total phenolics of the muscadine in the skin and seed, these components are usually discarded as waste.

MATERIALS AND METHODS

Four muscadine cultivars Carlos (bronze), Magnolia (bronze), Albermarle (purple), and Noble (purple) were evaluated along with 8 selections from the breeding program (one bronze, and 7 purple). Fruit was harvested at full ripe stage from the USDA-ARS vineyard in McNeil, MS. The plants were 11-year-old mature vines managed using standard cultural procedures. Muscadines were frozen after harvest and held for analysis. Fruit was thawed and juiced for analysis. Total anthocyanin and total soluble phenolics were extracted from juice samples using acetone/methanol/formic acid solution. The total anthocyanin content of the fruit extract was determined using a modified pH differential method. A UV-visible spectrophotometer was used to measure absorbance at
510 and 700 nm in buffers at pH 1.0 and 4.5. Total phenolic content was measured by the Folin-Ciocalteu method at 700 nm, using gallic acid as a standard (Singleton and Rossi, 1965).

The ellagic acid was isolated with pure methanol extraction from pureed whole muscadines and subjected to liquid chromatographic UV-Vis detection analysis at 255 nm. Resveratrol was also extracted with methanol from pureed muscadines and subjected to HPLC analysis detected with a UV-Vis at 310 nm.

RESULTS AND DISCUSSION

Total phenolics, which correlates highly with the antioxidant activity (Wang and Jiao, 2000), is found to be high in all varieties with the exception of Magnolia, a bronze berry (Fig. 1). Yet, the other bronze fruited Carlos and NC76A0003-102 were equivalent to the purple fruit. Anthocyanin content, which is also correlated highly with antioxidant activity (Wang and Jiao, 2000), shows a definite distinction between bronze and dark fruit (Fig. 2). The fruit of the bronze cultivars Magnolia, Carlos, NC76A0003-102 show significantly less anthocyanin, this would be expected since the anthocyanin content develops the color of the fruit. The muscadine selection CD8-67 exhibits the least amount of resveratrol content with 2.48 mg/kg with the highest concentration being found in NC71A006-5, another selection (Fig. 3). Ellagic acid, which is not commonly found in other grape species (Olien, 1990), content ranged from 11.46 mg/kg in Carlos to 49.00 mg/kg found in CD8-67 (Fig. 4). This is a large range in ellagic acid content. With ranges of phytonutrient contents in both cultivated varieties as well as breeding lines, it should be possible to breed for increased concentrations of the health-promoting compounds in muscadine grapes.

Literature Cited

Figures

Fig. 1. Total phenolic content of Muscadine grape cultivars and select breeding lines.

Fig. 2. Anthocyanin content of Muscadine grape cultivars and select breeding lines.
Fig. 3. Resveratrol content of Muscadine grape cultivars and select breeding lines.

Fig. 4. Ellagic acid content of Muscadine grape cultivars and select breeding lines.