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Imaging and Characterization of Metallic Antioxidants in Plant Based Food Using Energy Dispersive Spectroscopy

Tara L. Nylese[1]

[1.] EDAX, A Division of Ametek, Materials Analysis Division, Mahwah NJ USA

Nutritionally dense foods provide a number of health benefits for active and aging individuals. A growing number of studies show that antioxidants play a significant role in slowing and reversing damage at the cellular and tissue levels [1]. One potential mechanism for this cellular damage is caused by an increase in free radicals which lead to oxidation within the tissue and then to cellular breakdown. Free radicals lead to progressive oxidative stress which is particularly toxic to fatty acid-rich cell membranes and DNA, yet on a positive note, epidemiological data suggests that antioxidants play a role in slowing these processes down, benefiting many age related, degenerative diseases and enhancing the quality of life [2].

Further studies on antioxidants measure the amount and type of antioxidants in natural food sources, and in 2010, a team of nutritional and health management scientists created a comprehensive food database which consists of the total antioxidant content of typical foods, plants, herbs, spices and supplements [3]. These studies used a simple, fast, inexpensive, yet low specificity ferric-reducing ability of plasma (FRAP) assay to quantify the total amount of antioxidants in a wide number of plant based foods. In this type of analysis, however, there is little information about the physical and morphological presence of these compounds in the plant tissue.

In this work, Scanning Electron Microscopy and Energy Dispersive Spectroscopy will be used to detect the presence of metallic compounds in grape seeds, which are known for their antioxidant qualities. Imaging and x-ray mapping of these metals will show the distribution and location of these compounds. BSE imaging at relatively higher kV while in Variable Pressure mode creates contrast of the metal and salt compounds compared to the seed shell and tissue, which makes the analytical areas easier to identify. Next EDS, spectra collection detects and confirms the type of metal present (Figure 1). Figure 2 shows a spectrum which confirms Manganese (Mn), which is an actual component of the manganese super oxide dismutase enzyme, which is a demonstrated powerful antioxidant. With an understanding the locations of the antioxidants with EDS spectra collection and elemental mapping, future studies can correlate the mechanisms and effectiveness for antioxidant transference into food product, and subsequent release and benefit in the body.

In order to maximize the effectiveness of detection in plant tissue, which can be challenging due to the biological soft tissue, special analytical conditions including VP SEM and thin window technology are used to increase signal detection and analysis speed.

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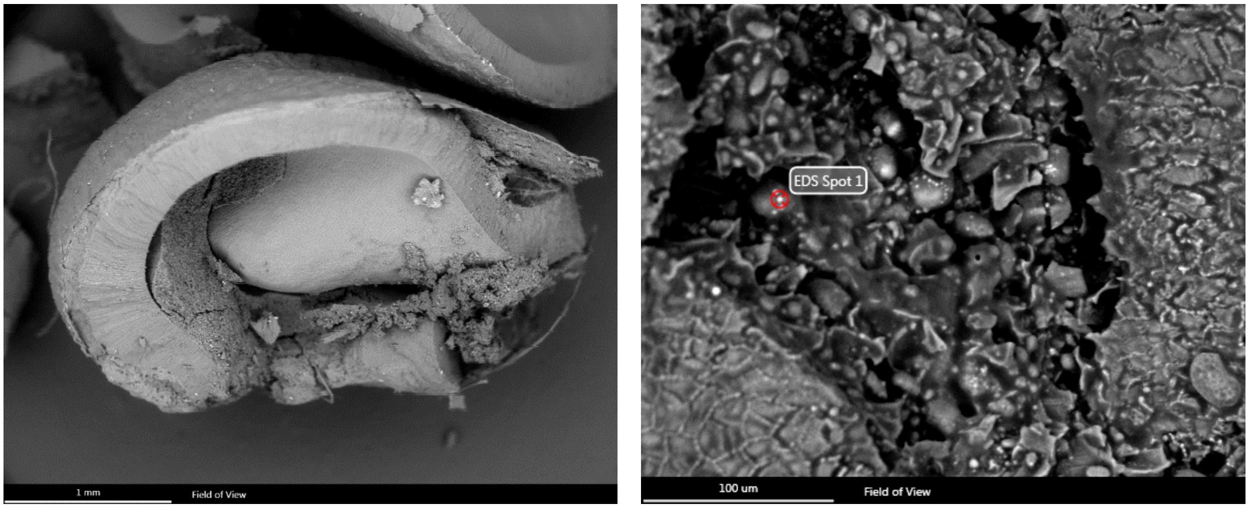

Figure 1. Low magnification, 35 X, SEM image of a cross section of Chancellor grape sees, left, at 15 kV and 60 Pa pressure with BSE; increased magnification of 400 X shows details and bright particulate, including the area of microanalysis on EDS Spot 1.

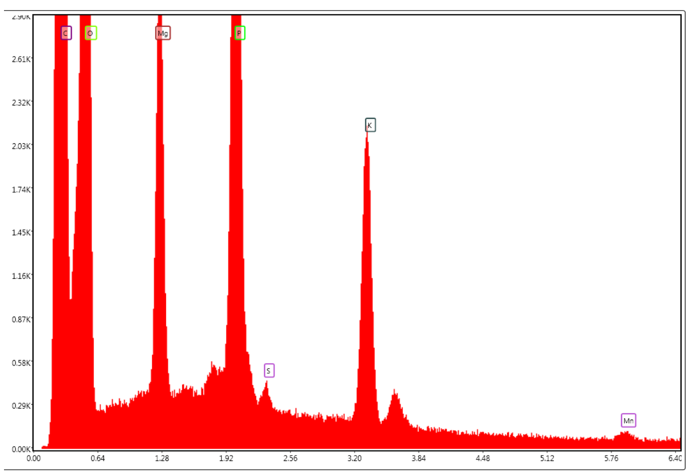

Figure 2. EDS spectrum from bright particulate of Figure 1, indicating the presence of Manganese (Mn).

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