1. Name

Andrew Caffrey

2. Chemistry Faculty Research Director

Dr. Dobberpuhl

3. Research proposed (not to exceed 500 words and not to exceed 2 pages; include work already completed, if appropriate)

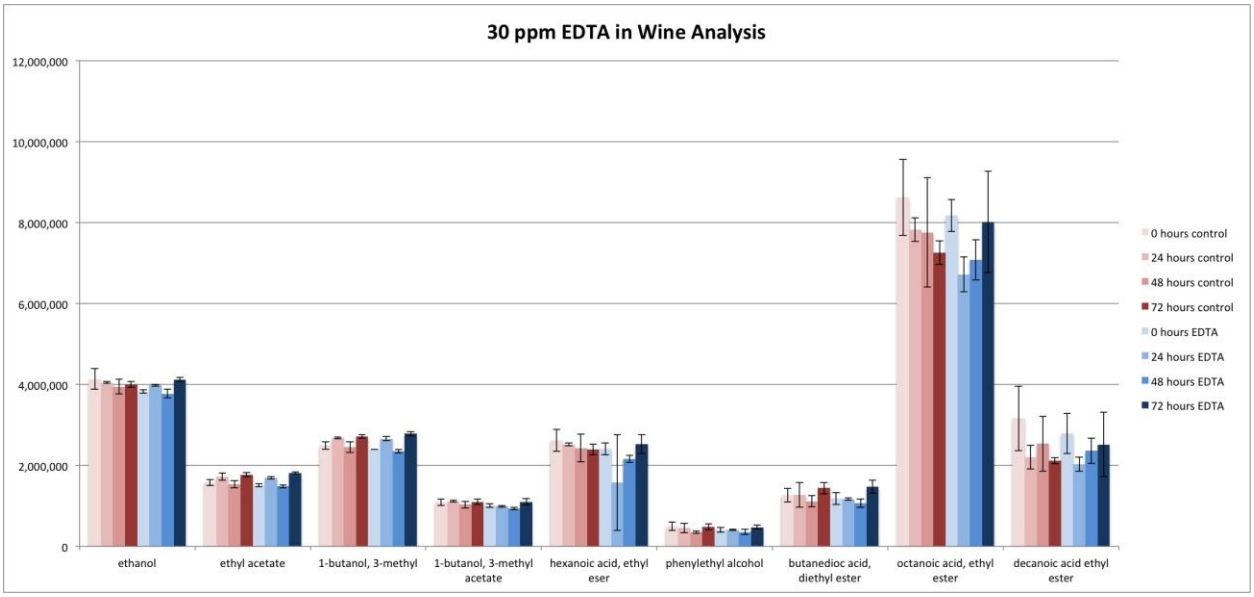
The deterioration of wines upon opening is a surprisingly poorly-understood process. Previous work in other groups has been inconclusive, largely because the wine sample matrix includes hundreds, if not thousands, of compounds.[1] The proposed research hopes to elucidate the mechanism by which flavor compounds in wine are oxidized, with the intent of eventually identifying potential strategies for retarding spoilage.

To study wine deterioration, solid-phase-micro-extraction with gas-chromatography/mass-spectrometry (SPME-GC/MS) is used to quantify and identify various volatile flavor compounds. Using this technique, over 60 of the hundreds of compounds apparent in red, white, and sweet wines have been identified. Prior efforts have focused on method development, specifically to create a technique that maximizes signal size (peak area) and reproducibility.

One theory for wine degradation is based upon introduced oxygen reacting with iron and copper in the wine, producing hydrogen peroxide. Hydrogen peroxide is then believed to react with ferrous iron in the Fenton reaction to produce hydroxyl radicals that react with other compounds in wines.[2] The loss of flavor molecules like fruity ethyl esters comes with a concomitant increase in oxidative products, largely organic acids, associated with “off” flavors. As shown in Figure 1, the concentrations of various compounds do change over time once a bottle is opened.

Removing oxygen by purging the headspace with nitrogen is effective in preventing the wine spoilage, but is somewhat impractical for everyday use. As such, work proposed here focuses on metal-ion chelators known to limit radical formation in model wines,[3] with earlier work in our lab suggesting that food-grade EDTA has promise. The EDTA is believed to chelate ferric iron at typical wine pH, thus retarding the Fenton reaction. However, since ferrous iron and copper ions are not chelated at the pH, these metal ions are still able to react with hydrogen peroxide. The work proposed here is designed to increase understanding of wine deterioration mechanisms while also investigating preservation strategies.

Figure 1. Time-Dependent Signal of Representative Flavor Compounds in a Red Wine



Red bars show relative signal for unadulterated control; Blue bars for wine adulterated with 30 ppm EDTA.

Works Cited

1. Lee, Dong-Hyun, Bo-Sik Kang, and Hyun-Jin Park. "Effect of Oxygen on Volatile and Sensory Characteristics of Cabernet Sauvignon during Secondary Shelf Life." *J. Agric. Food Chem. Journal of Agricultural and Food Chemistry* 59.21 (2011): 11657-1666. Web.

2. Oliveira, Carla Maria, António César Silva Ferreira, Victor De Freitas, and Artur M.s. Silva. "Oxidation Mechanisms Occurring in Wines." *Food Research International* 44.5 (2011): 1115-126. Web.

3. Waterhouse, Andrew L. "Oxidation of Wine Phenolics: A Critical Evaluation and Hypothesis." *ASEV 2005 Phenolics Symposium* (2006): n. pag. Web.

4. Plans for presentation of research results (conference, publication, seminar, etc.)

I am interested in presenting for both St. Albert's Day and the Nebraska Academy of Science Meeting. If the work is satisfactory, a publication will be sought after.

5. Post-graduate plans (job market, graduate school, medical school, etc.)

I plan on applying to graduate schools for fall of 2016

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6. Social security number

7. Applicant signature

8. Chemistry research director's signature