

2004 MAFMA Final Report

Project Title: **Examination of cranberry components as a source of antioxidants in food systems**

PI: **Mark P. Richards**

Co-PI: **Jess D. Reed**

Academic Institution: **University of Wisconsin-Madison**

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1. Objective Summary

The primary objective was to determine the ability of different cranberry extracts to inhibit quality deterioration in food products, with an emphasis on muscle foods.

2. Objective Accomplishments

The following results can be found in the attached manuscript:

The ability of different extracts from cranberry press cake to inhibit lipid oxidation in mechanically separated turkey (MST) was examined:

Heating press cake prior to extraction with 70% ethanol increased antioxidant efficacy compared to extracting unheated press cake.

Water extracts were least effective in inhibiting lipid oxidation. The most effective extracts were obtained by solvent extraction (SE) with 100% acetone or microwave assisted solvent extraction (MASE) with 100% ethanol.

A poor correlation was obtained between the total phenols in the extracts and their ability to inhibit formation of lipid oxidation products in mechanically MST.

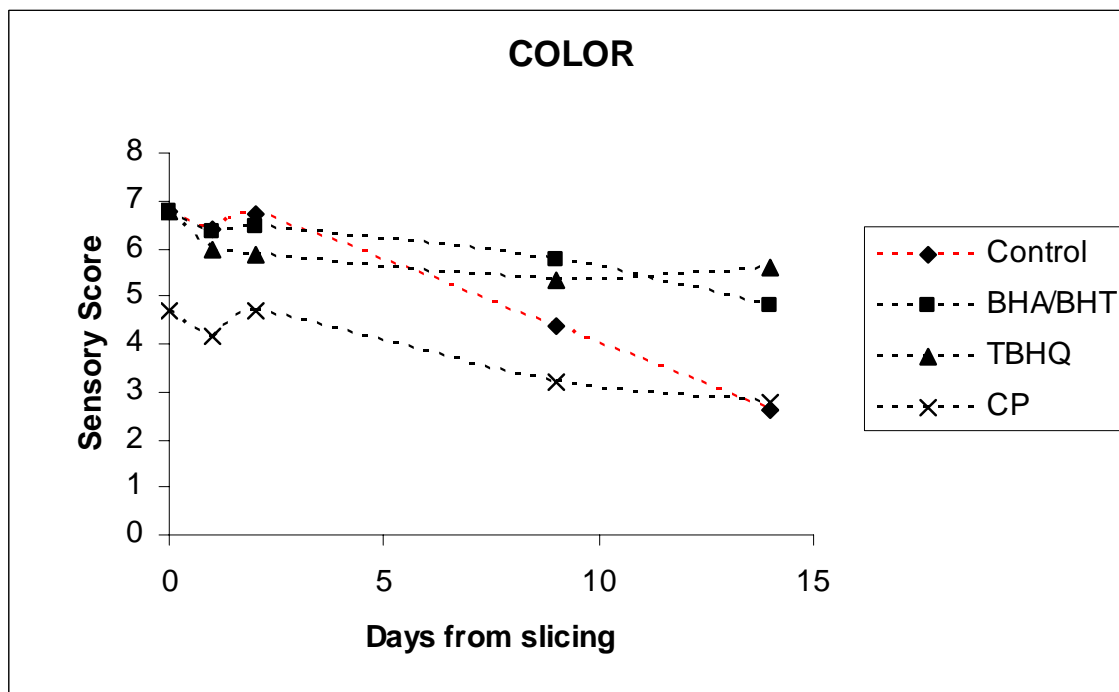
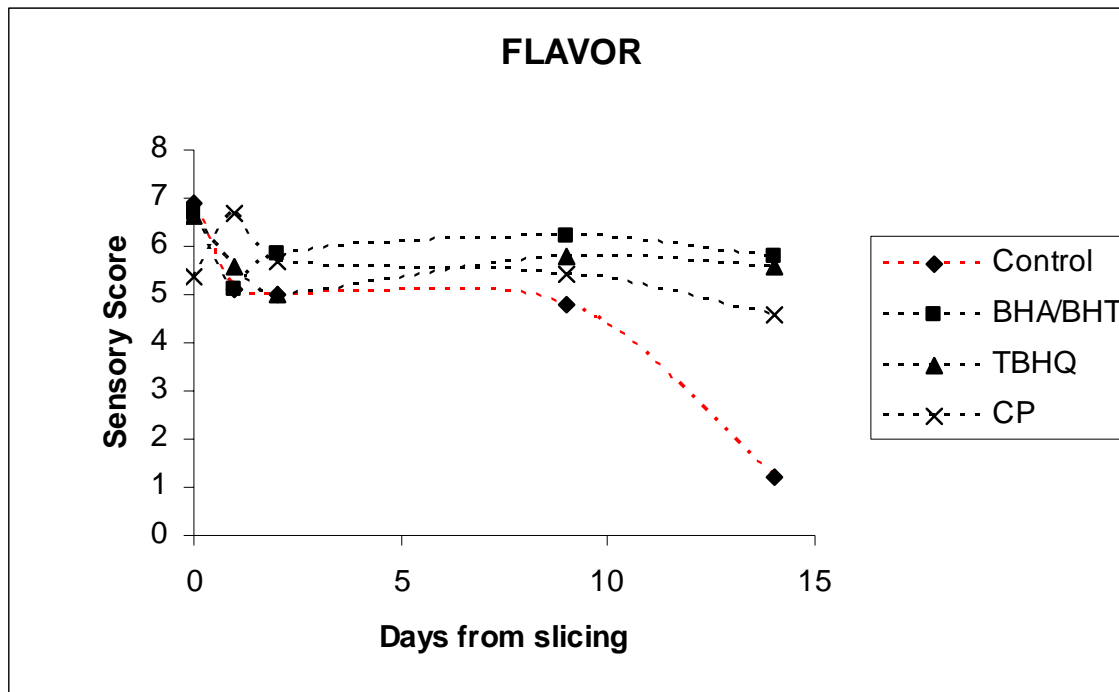
Similar yields using 100% ethanol were obtained when comparing MASE and solvent extraction. However, MASE extraction was more effective at inhibiting lipid oxidation compared to solvent extraction without microwave assistance.

There was a trend that inhibitory power of the different extracts was correlated with the amount of quercetin present.

The following results have not yet been submitted for publication:

Direct addition of press cake at a level of 0.5% inhibited formation of oxidized flavors during storage of pepperoni compared to pepperoni containing no added antioxidant (below). Higher scores indicate higher acceptability. The press cake was nearly as effective as butylated hydroxyl toluene (BHT), a synthetic antioxidant typically used in the preparation of pepperoni. Although

the press cake inhibited lipid oxidation, an undesirable color was observed in pepperoni containing added press cake (below).



The ability of extracts from cranberry juice powder (CJP) and cranberry press cake to inhibit lipid oxidation in MST was examined.

The effectiveness of the extracts to inhibit lipid oxidation was, chloroform extract of CJP > ethyl acetate extract of press cake \geq ethanol extract of press cake.

The amount of quercetin in the extracts and the amount of quercetin that partitioned into the membranes followed the same order.

Regardless of the extraction method, around 78% quercetin from the extracts partitioned into the membranes.

Extenuating circumstances that impeded examining color stability in bacon

Our freeze drier became inoperable during the project which slowed preparation of extracts. Based on yields and inhibitory power from the various solvent extracts prepared from press cake, it was estimated that an exorbitant amount of time would be required to prepare enough extract to potentially stabilize bacon. Bacon is prepared from pig bellies which have considerable mass. As an alternative, direct addition of finely milled press cake to small batches of pepperoni were examined (see page 2). A new freeze drier has recently been obtained.

3. Unexpected findings

Technical problems were encountered in preparing emulsions (e.g. inconsistent particle size). Thus, this work has been delayed. We are currently collaborating with another lab with sound techniques to prepare emulsions. Planned studies are to test the ability of an ethanol extract from cranberry press cake to inhibit lipid oxidation in the emulsion system.

4. Practical impacts of research efforts

a. Short term impacts

These studies indicated that heating starting materials prior to extraction and using microwave assistance in the extraction process improved the inhibitory power of extracts from cranberry press cake.

Total phenol content in the different extracts was a poor predictor of how well the different extracts inhibited lipid oxidation. This indicated it is inappropriate to assume that elevated phenol content improves antioxidant efficacy in muscle foods.

A preponderance of evidence indicated that quercetin was a primary inhibitory components in cranberry juice powder and cranberry press cake.

b. Long term impacts

It can be concluded that increasing the amount of quercetin in the press cake extracts increases the ability of the extracts to inhibit lipid oxidation in MST. Hence, a proper choice of solvents and extraction method which increases the amount of quercetin in the press cake extracts should increase the antioxidant potential of the extracts and hence their economic value.

The primary hurdle to economic impacts and implementing accomplishments from this work in the muscle food industry is that competing natural extracts (e.g. rosemary) appear to be superior to the extracts we prepared from cranberry press cake (data not shown). Our findings suggest microwave extraction should be further explored with various starting materials including rosemary to increase antioxidant efficacy. In the cases when cranberry extracts did inhibit oxidized flavor formation, the color quality appeared to be compromised. Future studies will attempt to increase antioxidant potency of extracts as described below. The goal will be to use

less extract to protect flavor and at the same time not compromise color quality or introduce fruity odors.

Further pursuit by PI of research in area of this project whether MAFMA or not.

- i) identify components in cranberry juice powder that inhibit lipid oxidation in muscle food systems using mass spectrometry.
- ii) Examine strategies to increase the deposition of quercetin into membranes of muscle foods and determine the effect on lipid stability during storage.
- iii) Examine methods to remove the sugar unit from quercetin glycosides. This potentially could increase ability of extracts from cranberry materials to inhibit lipid oxidation.
- v) Examine antioxidant capacity of an ethanol extract from cranberry press cake in emulsion systems. Anti-microbial properties will also be examined.
- iv) Identify components in cranberry juice powder and cranberry press cake that induce a quinone reductase which is believed to be an anticarcinogenic enzyme.

5. Reports to other funding agencies in the course of this research work

Findings from the studies done with Tyson-IBP can be found in the Wisconsin Cranberry Board, Inc. Progress Report

6. Publications

Raghavan, S.; Richards, M.P. 2006. Comparison of solvent and microwave extracts of cranberry press cake on the inhibition of lipid oxidation in mechanically separated turkey. Food Chem. **In Press.**