

## 2005 MAFMA Final Report

Project Title        **Improved coating: Polarity effects on adhesion, reproducibility, efficiency and dustiness of electrostatic coating**

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### 1. Objective Summary

The goals of this project are to test the effect of positive versus negative corona for electrostatic coating, determine the importance of electrostatics to adhesion in food products, and determine effective ways to apply the industrial partner's browning agents.

### 2. Objective Accomplishments

#### **Positive vs negative corona for electrostatic coating**

Previous studies on electrostatic coating of food powders using negative corona showed benefits such as an increase in coating deposition and a more even coating. However, no work had been done on the advantages of positive corona. Thus, this study was aimed to determine whether positive or negative corona produced better coating for different food powders. Twenty-three powders were coated using an electrostatic powder applicator. Transfer efficiency, adhesion and dustiness were measured and correlated to particle size, flowability and tribocharging value. For most proteins, positive corona produced higher transfer efficiency than negative corona. Most carbohydrates produced a higher transfer efficiency with negative corona than positive corona. Salts showed no difference between the transfer efficiency of positive and negative corona. No significant difference was observed between positive and negative corona for adhesion and dustiness.

#### **Importance of electrostatic adhesion**

A range of food powders were coated onto food samples electrostatically and non-electrostatically and the adhesion measured. Electrostatic powder coating increased the adhesion of most food powders onto most food targets. The lower the resistivity of the target, the more likely electrostatic adhesion was to be significant. The higher the resistivity of the powder, the more likely electrostatic adhesion was to be significant. Powders containing protein had significant electrostatic adhesion, possibly because the protein increases the resistivity. Electrostatic adhesion was significant for sugar particles 20-200  $\mu\text{m}$ . Larger particles showed no significant electrostatic adhesion. The higher the humidity of storage (12-96%), the less time electrostatic adhesion lasted because higher humidity decreases resistivity and increases the rate of charge decay. Electrostatic powder coating improves the adhesion of high resistivity, small size powders onto low resistivity targets stored at low relative humidity.

#### **Application of a commercial browning agent**

A comparison of color development after the addition of wood pyrolysis-derived carbonyls to par-fried French fries and potato rounds processed by deep fat frying, microwaving and baking

was performed. The processing method had a significant effect on the relationship between color development and processing time. Frying produced the highest color values on the control samples and microwave produced the highest color for the coated samples. The addition of wood-pyrolysis derived carbonyls, or dextrose-derived additives led to a significant increase in color production over the control. The kinetics of color development indicated that the processing method and the addition of additives had no effect on the reaction order which remained a zero-order reaction. The restructuring process has a significant effect on the rate of the color generation reaction with non-restructured products displaying faster color development during frying and microwaving and non-restructured products displaying faster color development during baking. The study produced prediction models for color generation in potato products processed by different methods.

### **3. Unexpected findings, if any**

It was expected that the whether a food powder would respond better to positive or negative corona could be predicted by its physical properties. Instead, there appears to be a strong composition affect that determines which polarity produces better results.

### **4. Practical impacts of research efforts.**

#### **a. Short Term Impacts**

This project showed that Red Arrow's browning agents can very effectively increase browning in potato products. Red Arrow demonstrated the process at the annual IFT meeting and is using the demonstration for potential clients during sales calls. They have already made several sales as a result of these demonstrations.

The ability to determine which polarity will produce the best electrostatic coating by knowing the composition allowed the PI to solve one problem over the phone, when a company called to ask advice on why their preliminary tests with electrostatic coating was producing poor results.

#### **b. Long Term Impacts**

Red Arrow will continue to use the information we gave them to sell their product across the country, increasing their profitability and solving their customers' browning problems.

Knowing the advantages of positive vs. negative corona will allow electrostatic coating to be used to improve the coating of powders that did not produce good results when negative corona alone was used, expanding the usefulness of this technology.

### **5. Publications resulting from this research.**

**Bebko M, Abu-Ali J, SA Barringer. 2005.** Kinetics of potato color and texture development during baking, frying and microwaving with the addition of liquid smoke. In preparation.

**Sumawi H, Barringer SA. 2005.** Positive vs. Negative electrostatic coating using food powders. J Electrostat 63(6-10): 815-821.

**Halim F and Barringer SA.** Importance of food powder and target characteristics, and relative humidity on electrostatic adhesion. Innov Food Sci Emerg Technol submitted.