Guidelines for MAFMA Final Report

Final Reports due 3 months after completion of project
(4-5 pages)

Project Title Evenness of electrostatic coating

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Co-PI (s)

Academic Institution The Ohio State University

Award Date Fall 2005

Please complete all questions below and attached form

1. Objective Summary (1-2 sentence summary)

The first objective of this project is to compare coating produced using corona, Teflon tribocharging, Nylon tribocharging and nonelectrostatic charging methods. The second objective is to determine which powder properties cause electrostatic coating to produce improved powder functionality, when the same total amount of powder is on the food product.

2. Objective Accomplishments
   (If objectives were not met, what extenuating circumstances contributed to that factor?)
   Convey all of your progress on this project including that obtained with the industry and other matching funds.

Corona vs. Tribocharging vs. Nonelectrostatic coating

The purpose of this research was to compare electrostatic and nonelectrostatic coating and determine the improvement between corona and triboelectric charging systems. Graham crackers were coated with food powder at 0, -50 or -95 kV or by tribocharging with Teflon or nylon. Five sizes of sucrose from 13 to 138 μm were coated onto the crackers to determine the effect of particle size on coating efficiency. Three proteins, three carbohydrates and one salt between 35 and 58 μm were analyzed to determine the effect of composition. Electrostatics improved transfer efficiency up to 27%, adhesion up to 40% and reduced dust up to 99% over nonelectrostatic coating. Particle size and composition significantly affected the improvement produced by each charging method. As particle size increased, nonelectrostatic transfer efficiency and adhesion increased, while dust decreased. Electrostatic transfer efficiency increased and leveled off and adhesion and dust decreased with increasing particle size. Generally, corona transfer efficiency, adhesion and dust reduction was the highest, followed by Teflon triboelectric, nylon triboelectric and nonelectrostatic coating. For proteins, Teflon produced higher charge to mass, transfer efficiency and adhesion than nylon. For carbohydrates and salt, there was no difference between Teflon and nylon in charge to mass, transfer efficiency or adhesion, with the exception of potato starch transfer efficiency. Although the corona system was most efficient, the Teflon triboelectric system produced comparable results for some powders and may be necessary to produce a thick coating while minimizing back ionization and alleviating Faraday Cage effects.

Improved powder functionality

French fries were coated with smoke extract or glucose and mozzarella cheese slices with sodium erythorbate or cellulose with natamyacin at 0kV and -25kV. For the first three samples, transfer efficiency was higher for electrostatically coated products. When the same amount of powder on each sample was compared, electrostatically coated samples showed a greater color development and less mold growth than nonelectrostatically coated samples. This improvement in color and shelf life could be explained by improvement in coating evenness due to the charging of the powder. Cellulose with natamyacin did not show an improvement in transfer efficiency, mold suppression or charge to mass ratio with electrostatic coating. This powder did not charge well because it was cohesive and of the wrong polarity. The smaller the size of the powder, the greater the charge to mass ratio and final color development.

3. Unexpected findings, if any

It was expected that certain food powder would respond best to Teflon triboelectric charging, others would respond best to nylon triboelectric charging, and that which method was best could be predicted by powder composition. Instead, nylon was never the best method, and so should never be recommended for food powder coating.

In addition, it was expected that sometimes Teflon triboelectric charging would be better and sometimes corona charging would produce better results. Instead, Teflon was always equal to or worse than corona, but never better. There are still some reasons to choose Teflon tribocharging, such as when back ionization or Faraday cage effects occur.

4. Practical impacts of research efforts. Include: implementation of accomplishments by industry partners (if any), identification of economic impacts, and any further pursuit by PI of research in area of this project whether MAFMA or not.
    a. Short Term Impacts

The fact that nylon tribocharging does not produce any advantages means that the PI will not continue that area of research. However, the advantages of Teflon tribocharging mean that in some cases more even coating can be produced than with corona charging. This area of research, to produce more even coating, is being pursued by the PI with other granting agencies.

This project demonstrated that electrostatic coating could be used to apply a more even layer of antimycotic, so that less needs to be used to produce the desired shelf life.

    b. Long Term Impacts

Knowing the advantages of different charging mechanisms will allow the correct charging mechanism to be chosen to produce the highest quality, most efficient powder coating.

As a result of the previous year's MAFMA grant, we have continued to work with Red Arrow. This year's project demonstrated that using electrostatic coating could allow their powder to be applied more evenly, producing better color. The company has used this information in their marketing to their customers.

5. If you are also making reports to other funding agencies in the course of this research work, please include a copy of that report.

6. If any publications resulted from the research, a copy must be included. Please note we were notified by the USDA/CSREES National Program Leader for the Midwest Advance Food Manufacturing Alliance (MAFMA) that all publications resulting from research that was funded by MAFMA must include the following wording **"The project was supported by the USDA Cooperative State Research, Education and Extension Service, special research grant number 200X-34328-xxxxx.**

Amefia A, Abu-Ali JM and Barringer SA. 2006. Improved functionality of food additives with electrostatic coating. Innov Food Sci Emerg Technol 7(3): 176-181.

Mayr MB, Barringer SA. 2006. Corona compared with triboelectric charging for electrostatic powder coating. J Food Sci 71(4): E171-177.

7. Budget summary of actual expenditures
   (See attached form) Include actual matching funds received and/or in-kind. Remember no more than 50% can be in-kind.