

## Guidelines for MAFMA Final Report

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

Project Title Development of a mathematical model to predict the distribution of calcium in cheese

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### Please complete all questions below and attached form

#### 1. Objective Summary (1-2 sentence summary)

*Ionic calcium in milk can be determined with a high degree of accuracy with a fluorescent probe and front-face fluorescence spectroscopy. This research can subsequently be applied to determine the ionic calcium content of other dairy products.*

#### 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.

1. To study the feasibility of Ca-fluorescent probes for measuring the concentration of ionic calcium in milk caused by changing milk pH, temperature, and addition of stabilizing salts (sodium citrate and sodium phosphate).

*The pH of milk and Fluo-5N probes fluorescence were directly related. For the same ionic calcium content, fluorescence was higher at a higher pH. Temperature also influenced fluorescence. Consequently a subsequent analysis was performed at room temperature. Changes in the ionic calcium content of milk caused by the addition of sodium citrate and sodium phosphate were also measure with fluorescence. However, their addition also significantly influence the background fluorescence of the skim milk.*

2. To study the influence of the presence of fat on the performance of the Ca-fluorescent probes.

*The fat content of milk also influenced fluorescence of the Fluo-5N probe and as the fat content increased the fluorescence increased*

3. To study the feasibility of mathematical modeling for predicting the concentration of ionic calcium in milk.

*PLS analysis that required use of the entire emission spectrum of Fluo-5N was able to predict the ionic calcium content of skim and whole milk*

4. To study the application of the selected Ca-fluorescent dyes for ionic calcium measurements in cheeses, as demonstrated by survey of commercially available cheeses.

*This objective was not completed because it took more extensive work than expect to develop the method to measure the ionic calcium content of skim and whole milk. However this objective will be the subject of future research*

5. To assess the feasibility of a mathematical model for predicting the distribution of calcium in commercially available cheeses.

*Again, this objective was not completed because it took more extensive work than expect to develop the method to measure the ionic calcium content of skim and whole mil. However this objective will be the subject of future research*

3. Unexpected findings, if any

*We were surprise to find that the range of ionic calcium that can be determined by the probe was larger than originally anticipated. This is important because it will allow the method to be applied to a large range of dairy products.*

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

*It is well established that the ionic calcium content of milk and other dairy products is important and influences various functional properties including renneting characteristics, heat stability, and viscosity. However, previously available methods for measuring ionic calcium required extensive analysis time and could not be utilized in dairy products that contained fat. This research developed a new fluorescence based method for measure the ionic calcium content of dairy products that is superior to the previously available methods and can potentially be applied to other dairy products.*

- b. Long Term Impacts

*This research has established that front face fluorescence spectroscopy and fluorescent probes can be used to measure the ionic calcium content of food products. Consequently, the potential exists for broadly applying this concept to numerous other food products. We expect to continue our research in this area. Additionally our industry partner has adopted this method are they are currently conduction research to determine if it can be used to analyze various products that they currently manufacture.*

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.

*A copy of a presentation given to our industry partner after completion of the project is attached.*

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.**

*One paper has been published and two additional manuscripts are being prepared. A copy of each is attached.*