

Guidelines for MAFMA Final Report

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

Project Title: Cholesterol-lowering properties of phytosterol esters made with beef tallow fatty acids

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Co-PI (s) _____

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Award Date 07/15/2006 to 06/14/2007

Please complete all questions below and attached form

1. Objective Summary (1-2 sentence summary)

Our goal is to develop cholesterol-lowering food ingredients (i.e., phytosterol esters) made from components of soybeans and beef tallow. Efficacy of our food ingredient was tested in human subjects by measuring plasma LDL and HDL cholesterol concentration, LDL size and composition, and phytosterol concentration.

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.

The experimental design was a randomized, double-blind, two group parallel, placebo-controlled study lasting 4 weeks. Subjects were selected based on the following criteria: Age 19-70 years, body mass index 18.5-30.0 kg/m², plasma LDL cholesterol 100-190 mg/dL, avoidance of lipid lowering medication, and absence of chronic diseases. Thirty-two subjects participated in the study; 16 per group with equal number of males and females in each group. Subjects consumed 3 grams per day of either phytosterol ester (PSE) or placebo (1 gram, 3 times per day with meals) delivered in capsules. Subjects were instructed to "check in" to the clinic each week to have blood drawn and to receive their weekly allotment of capsules. Blood samples were collected on Day 1, 8, 15, 22 and 29 for analysis of several biomarkers of metabolic function. Plasma lipids were analyzed in samples collected on Day 1 and 29 to document the effect of PSE treatment.

A statistically significant reduction of 11.0% in plasma LDL cholesterol concentration was observed in the PSE group, whereas LDL cholesterol remained relatively unchanged in the Placebo group during the 4 week study. At Day 1, the PSE group had higher starting levels of LDL cholesterol, suggesting that PSE treatment might be more effective in mildly hypercholesterolemic subjects. Reanalysis of the data from subjects in the PSE group having baseline LDL cholesterol of 130-160 mg/dL indicated a reduction in LDL cholesterol of 14.2%. Although statistically significant, reanalysis of the

data in this way should be viewed with caution because of the small number of subjects in the PSE group with LDL cholesterol in the range of 130-160 mg/dL (n = 6).

The LDL/HDL ratio was also significantly reduced in the PSE group during the 4 week study, further emphasizing that PSE treatment specifically affected LDL rather than HDL cholesterol metabolism. Plasma HDL cholesterol, triglyceride, and glucose concentration did not change during the 4 week study in either the Placebo or PSE group.

Plasma LDL size and composition was not altered by dietary PSE, indicating that PSE specifically affects LDL particle concentration but not its chemical composition. Because phytosterols elicit their cholesterol-lowering response by blocking intestinal cholesterol absorption, we speculate that reduced cholesterol flux to the liver causes increased LDL receptor activity and hence plasma LDL clearance. While we were unable to explore this possibility in humans, numerous animal studies support this conclusion.

Plasma markers of cholesterol synthesis (desmosterol and lathosterol) did not change during the study in either the Placebo or PSE group, indicating that neither treatment altered cholesterol synthesis. Desmosterol and lathosterol are cholesterol precursors in the synthetic pathway and their concentration in plasma is directly related to the rate of cholesterol synthesis. In contrast, plasma campesterol and sitosterol are plant sterols and are not synthesized in the body; therefore, their presence in plasma reflects exclusively dietary intake. A significant increase in plasma campesterol was observed in the PSE group, confirming that the PSE group complied with the study protocol and indeed consumed greater amounts of plant sterols. The campesterol:lathosterol molar ratio was also significantly increased in the PSE group.

3. Unexpected findings, if any

There were no unexpected findings.

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

Producing a cholesterol-lowering compound by combining soybean sterols with beef tallow fatty acids will demonstrate a “healthful” application for beef tallow, thus adding value to the tallow surplus. Our industry partner, Beef Products Inc., is the world's leading manufacturer of boneless lean beef and major producer of tallow by-products. Beef Products Inc. is also an innovator of food processing equipment and is well positioned to produce and commercialize our phytosterol ester compound.

b. Long Term Impacts

Heart disease is the primary cause of death in the U.S. Lowering cholesterol with drugs is effective, but drug therapy is also associated with severe side effects. Our phytosterol ester compound significantly lowers cholesterol without adverse effects. We envision a great potential for functional foods and supplements that offer an alternative to drug therapy. In 2005, global sales of functional foods and supplements were \$72 billion and

\$63 billion, respectively. Consumers have clearly increased their desire for healthful food choices that optimize their diets while maintaining busy lifestyles. In view of the link between heart disease and elevated cholesterol, functional foods and supplements that lower cholesterol will represent a significant market share of this growing industry.

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.

None.

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.**

No publications at this time. However, we plan to publish in the near future and will include the required acknowledgment.