

Guidelines for MAFMA Final Report

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

Project Title Factors Affecting Astringency/Bitterness in Soy Flakes and Soy Protein Isolates

PI (s) Soo-Yeun Lee

Co-PI (s) Youngsoo Lee and Keith Cadwallader

Academic Institution University of Illinois, Urbana-Champaign

Award Date September 1, 2005 – August 31, 2006

Please complete all questions below and attached form

1. Objective Summary (1-2 sentence summary)

The *long term goal* of this study was to identify the major compounds responsible for astringent/bitter perceptions in soy-related foods. Our *specific objectives* of 2005 MAFMA funding were as follows:

1. Identify the storage conditions responsible for variability in astringency and bitterness in SPIs.
2. Compare two major SPI processing methods in reduction of astringency and bitterness.
3. Determine halo effect of the aroma-related attributes on astringency and bitterness in SPI model dispersions.

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.

For the first and second objectives of the proposal, particle size and processing methods of soy protein isolates (SPI) were investigated for their effect on the sensory properties of SPI model solutions.

Four types of SPI from three manufacturers were separated into three sizes by a Ro-Tap sieve shaker. These sizes were $>45\mu\text{m}$, $<45\mu\text{m} >38\mu\text{m}$, and $<38\mu\text{m}$. The three treatments along with two controls from each of the SPIs were analyzed using a modified form of Quantitative Descriptive Analysis. Eleven panelists were trained to evaluate the aroma, aroma-by-mouth, taste, chemical sense and texture of the 20 samples. Soy protein isolate was dispersed in water in the amount of 2.5% (w/v).

The control SPIs were found to be significantly different from each other in eleven out of seventeen attributes. Processing method was found to have a significant effect on aroma and aroma-by-mouth attributes. Particle size range also showed a significant effect on sensory attributes, and it was specific to each manufacturer.

For the third objective of the proposal, bitterness and astringency perceptions were evaluated with and without noseclips.

Seven types of SPI from three manufacturers were analyzed with a modified form of Quantitative Descriptive Analysis. Eleven panelists were trained to evaluate aroma, aroma-by-mouth, taste, chemical sense and texture of the samples. Soy protein isolate was dispersed in water in the amount of 2.5% (w/v). References were determined for each attribute. Panelists evaluated bitter and astringency with and without nose plugs. Analysis of variance (ANOVA), Fisher's least significant difference test (LSD), correlation analysis and principal component analysis (PCA) were conducted to analyze the data.

Significant differences were found in the scores of bitterness and astringency when panelists used nose plugs and when panelists did not use nose plugs. This demonstrates that the aroma and aroma-by-mouth attributes affect the rating of bitterness and astringency in SPI model dispersions tested.

From the previous year's proposal, threshold measurement of glycosidic forms of soy isoflavones and saponin B group has been accomplished, and this study is in the data analysis and reporting phase (Almeida and Lee, *in preparation*). Based on the results of previous study conducted by our research group (Robinson and others 2004), the aglycone isoflavones' thresholds were much higher than the concentrations typically found in soymilks indicating that those compounds were unlikely to contribute to the bitterness/astringency in soy foods. Additional studies were needed to determine the thresholds of the glycosides of the soy isoflavones (daidzin and genistin) and saponins. The objective of this study was to determine the detection thresholds of two glycosidic isoflavones (genistin and daidzin) and saponin B group with PROP tasters and PROP non-tasters, using the R-index measure by the signal detection rating method. The thresholds obtained were compared to the concentrations of these compounds normally observed in food. The first threshold experiment was conducted with 20 subjects on 10 genistin model solutions in 3-fold increments ranging from 2.37×10^{-8} M to 4.67×10^{-4} M and 7 saponin B model solutions in 3-fold increments ranging from 1.2×10^{-4} g/L to 8.7×10^{-2} g/L. Since the concentration range tested did not encompass the thresholds of the majority of the subjects, a second threshold experiment was conducted with three higher concentrations of genistin and saponin B group. Daidzin was tested on 6 model solutions in 3-fold increments ranging from 6.67×10^{-6} M to 5.40×10^{-4} M. The genistin threshold level for the whole group, PROP taster subgroup and PROP non-taster subgroup were 1.74×10^{-3} M, 1.17×10^{-3} M and 3.45×10^{-3} M, respectively. For daidzin, the average threshold levels for the whole group, PROP tasters and PROP non-tasters were 3.46×10^{-4} M, 3.51×10^{-4} M and 3.40×10^{-4} M, respectively. The average threshold levels for saponin B group, for PROP tasters and PROP non-tasters were 7.56×10^{-2} g/L and 9.66×10^{-2} g/L, respectively. The average group threshold found for saponin B group was 8.96×10^{-2} g/L, which is 17-folds lower than the concentrations of this compound group normally found in soy foods. This suggests that saponin B group has a high potential of being one of the groups of compounds contributing to bitterness/astringency in soy foods.

The concentrations used for genistin and daidzin threshold tests were much higher than the concentrations of these compounds normally found in soy foods; thus, suggesting that genistin and daidzin individually do not contribute to the objectionable sensory properties such as bitterness and astringency in soy foods.

3. Unexpected findings, if any

N/A

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 change of perception in bitterness and astringency when evaluated with and without olfaction is important in learning how to eliminate these objectionable perceptions in soy-based foods. By identifying halo effect of aroma/flavor attributes to bitterness and astringency, this research will be able to provide effective ways to mask or reduce bitterness and astringency indirectly by reducing the aroma/flavor characteristics of soy-related foods.

The threshold values of the major isoflavones and saponin B group found from the funded study will enable the soy foods manufacturers better direction of which polyphenolic compound(s) to target to reduce the astringency and bitterness perceptions.

b. Long Term Impacts

Identifying the negative flavor compounds will give soy food manufacturers the ability to reduce or eliminate these compounds from soy products. Decreasing the negative flavors in soy can ultimately increase consumer acceptance of these products. Because soybeans currently produced are under-utilized, an increase in acceptance and demand in soy-based products will add much value to the current soy market, which will in turn have a great beneficial impact on the Midwest economy.

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.

N/A

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.**

Journal publications:

Robinson K.M., Klein B.P., Lee S.-Y. (2004) Utilizing the R-Index Measure for Threshold Testing in Model Soy Isoflavone Solutions. *J. Food Sci.*, **69(1)**:SNQ1-4.

Muether, A.T., Lee, S.-Y. Halo effect on bitterness and astringency by flavor attributes in soy protein isolate (SPI) model solutions. *J. Food Sci.*, **in preparation.**

Almeida, J.K., Lee, S.-Y. Application of R-index by the rating method: Threshold determination of genistin, daidzin and saponin B group for PROP (6-n-propyl-2-thiouracil) tasters and non-tasters *J. Food Sci.*, **in preparation**.

Theses:

Almeida, J.K. 2006. Application of R-index by rating and ranking methods in food research. M.S. thesis, University of Illinois, Urbana-Champaign.

Muether, A.T. 2006. Bitterness and Astringency perceptions in soy protein isolate dispersions. M.S. thesis, University of Illinois, Urbana-Champaign.

Presentations:

Almeida, J.K., Lee, S.-Y. Threshold study of genistin, daidzin, and saponin B with PROP tasters and PROP nontasters using the R-index by rating method. IFT Annual Meeting, New Orleans, LO, July 2005

Muether, A.T., Lee, S.-Y. Halo effect on bitterness and astringency by flavor attributes in soy protein isolate (SPI) model solutions. IFT Annual Meeting, New Orleans, LO, July 2005

A.T. Muether and S.-Y. Lee. Particle size and processing method effects on the aroma and aroma-by-mouth attributes of soy protein isolate (SPI) model solutions. IFT Annual Meeting, Orlando, FL, July 2006