2003 MAFMA Final Report

Project Title	**Factors Affecting Astringency/Bitterness in Soy Flakes and Soy Protein Isolates**
PI	**Soo-Yeun Lee**
Co-PI (s)	**Keith Cadwallader**
Academic Institution	**University of Illinois, Urbana-Champaign**
Award Date	**September 1, 2004 – August 31, 2005**

1. Objective Summary

The long term goal of this study is to identify the major compounds responsible for the off-flavors in soy. This study will enable us to quantitatively determine the compounds which give off-flavors in soy and the methods to reduce them, which in turn will aid in developing new soy-based food products with minimal astringent/bitter off-flavors.

Our ***specific objectives*** are as follows:

1. Identify the factors (i.e., storage conditions and processing methods) responsible for variability in astringency/bitterness in SPIs.
2. Determine the efficacy and efficiency of reducing astringency/bitterness in SPIs made from soy flakes through various processing techniques.
3. Identify and characterize the major chemical compounds responsible for astringency/bitterness in soy flakes and SPIs.

2. Objective Accomplishments

Descriptive analysis was conducted on SPIs produced by different processing methods from Cargill, ADM and Solae Corporations (Muether and Lee, *in preparation*). The objectives of this descriptive panel were to 1) quantify bitter and astringent intensities from various SPIs processed from major commercial manufacturers using different processing methods, in order to preliminarily identify the processing method which results in the least bitter and astringent SPI sample, 2) determine the effect of storage temperature conditions on sensory properties of SPIs and 3) establish the effect of off-aromas/flavors on bitterness and astringency (sensory halo effect) by evaluating SPI samples with and without nose plugs.

The descriptive panel of 11 judges evaluated 7 different SPI samples on specifically the bitter and astringent perceptions and other SPI sensory properties with reference to the soymilk lexicon study (N'Kouka and others 2004). Three weeks were devoted to training the panelists and one week for actual sample assessment. An 11-point category scale (0 to 10) was used by the panelists to measure the intensity of the samples. Each sample of SPI solutions were made in a 1g/40mL SPI/water ratio. The samples were placed in 2 Oz plastic cups with lids and coded with random 3-digit numbers. Each sample was tested by the panelists with and without nose

plugs for bitter and astringent attributes, in order to determine the influence of olfactory perception on bitterness and astringency. Bitterness and astringency ratings were significantly different between with and without nose plug conditions, indicating that there is a significant halo effect with the two non-olfactory perceptions (astringency and bitterness) with other off-flavors.

One commercial brand of SPI samples was stored at 40°C, 25°C and -15°C, in four and two week intervals to simulate product storage at different temperatures to investigate the effect of storage temperatures on the sensory properties of SPIs. The stored samples were tested with other SPI samples during the sample assessment period of the descriptive analysis panel. Different storage temperatures did not show a significant trend on bitterness and astringency. This may have been due to the short storage period, thus further prolonged shelf life study with different storage temperatures may provide valuable supplementary information.

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 objectives for the second year threshold study were to 1) determine the astringency/bitterness threshold values of daidzin, genistin and saponin B group in model solutions and 2) compare the thresholds to the concentration of isoflavones normally found in food. By doing this, we can ascertain if the amount of daidzin, genistin and saponin B present in soy foods is sufficient to elicit bitter or astringent perceptions. Twenty subjects participated in the threshold study using the R-Index measure by the signal detection rating method. From our preliminary analysis of the data, the thresholds for the glycosidic isoflavones and saponins B are also significantly greater than the amount normally present in soy foods, indicating that the isoflavones (daidzin, genistin, daidzein and genistein) and saponins B group individually do not contribute to the bitterness and astringency. Thus, further study on the combined synergistic effect of the isoflavone mixtures and isoflavones-saponin mixtures is proposed for the third year renewal funding which was awarded for 2005-2006 period.

3. Practical impacts of research efforts.

a. Short Term Impacts

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.

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.

4. Publications resulting from this research.

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.

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