

Final Report

Quantitative analysis of allergens in peanut varieties and assessment of effects of food processing on peanut allergens

Jiaxu Li

Sam Chang

Objectives

The goal of this proposal was to assess the levels of allergens in different peanut varieties and effects of food processing on peanut allergens. The specific objectives of this project included:

- 1) to profile the levels of abundant allergens in peanut varieties using one-dimensional gel electrophoresis;
- 2) to profile the levels of low abundant allergens in peanut varieties using two-dimensional gel electrophoresis;
- 3) to assess the effects of protease digestions and various processing technologies on peanut allergen levels and allergenic properties.

Summary of Progress

One hundred and twenty-two peanut varieties (97 lines from USDA Core Collection and 25 lines from experimental lines or checks) obtained from New Mexico State University and one commercial cultivar (Virginia) purchased from local market have been screened for lower allergens using sodium dodecyl sulfate-polyacrylamide gel electrophoresis analysis (SDS-PAGE). Ten lines shown lower allergens determined by SDS-PAGE were further analyzed by two-dimensional gel electrophoresis for quantifying allergen levels and immunoblotting analysis for peanut-specific immunoglobulin E (IgE) binding activities. The effects of seven thermal processing treatments on peanut allergens were evaluated. Frying peanut seeds for 8 minutes was found to be the only one that could reduce soluble and insoluble allergen h 2 IgE binding properties among the seven processing methods.

I. Analysis of the levels of abundant allergens in peanut varieties using one-dimensional gel electrophoresis

One hundred and twenty-three peanut varieties from New Mexico State University have been screened for lower allergens using SDS-PAGE. Among the 123 varieties analyzed, three varieties were found to have less Ara h1 allergens, two varieties having less Ara h2 allergens, five varieties having less Ara h3 allergens. No single line that is completely lack of a major peanut allergen was identified from these 123 peanut varieties, nor was a peanut variety with reduced all three major allergens. These results suggest that the three major allergens may be essential proteins for seed formation and development.

II. Analysis of the levels of abundant allergens in peanut varieties using one-dimensional gel electrophoresis

These 10 peanut lines having lower levels of major allergens were analyzed using two-dimensional gel electrophoresis and found to exhibit reduced major allergen isoforms. Furthermore, these 11 lines were found to have reduced peanut-specific IgE binding activities. With these findings, we have completed the objectives 1 and 2 of the project.

III. The effects of protease digestions and various processing technologies on peanut allergen levels

Seven thermal processing treatments including wet processing (boiling with/without high pressure, steaming with/ without pressure), deep frying and dry processing (microwaving and roasting) were conducted for five time intervals, respectively. The commercial peanut Virginia was selected for the thermal processing analysis due to large amount availability for multiple processing treatments. Among all the seven thermal processing treatments, the protein contents of allergens were found to remain unchanged. Frying peanut seeds for 8 minutes could effectively reduce soluble and insoluble allergen h 2 IgE binding properties, suggesting that frying can serve as a key method to reduce allergic reaction to the major peanut allergen Ara h2. With these findings, we have completed the thermal processing part for objective 3. Study of protease digestions on peanut allergen properties and reactivities is currently underway.

Conference Presentations

Yan Liu, Udhghatri Kolli, Hamsini Balaji, Sam Chang, and Jiaxu Li (2016). Quantitative analysis of major allergens in peanut varieties grown in Mississippi. The Mississippi Academy of Sciences 80th Annual Meeting, Hattiesburg, MS, February 18-19, 2016.

Shi Meng, Sam Chang, Jiang Li, Jiaxu Li, Naveen Puppala, and Si-Yin Chung (2016). Quantitative analysis of allergens in peanut varieties from USDA Core Collection and other resources and assessment of food processing effects on peanut allergens. The 252nd American Chemical Society National Meeting, Philadelphia, PA, August 21-25, 2016.

Manuscript for Publication

Shi Meng, Jiaxu Li, Sam Chang, Soheila Maleki. Quantitative and kinetic analyses of peanut allergens as affected by food processing. To be submitted for publication.