**Final Report**

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**Title of Research Project:**

Improvement of soybean protein functionality using chemical and nanotechnology as approaches

**Project Investigator:**

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**Objectives:**

Objective 1. Development of microcapsule from soy protein.

Objective 2. Physicochemical and permeability evaluation of microcapsule.

**Accomplishments – *March 1, 2017 through August 31, 2017***

As proposed in objective 1 and 2 of our research plan, we have carried out the development of and the physicochemical characterizations of CSPI.

1. Development of microcapsule from soy protein.

In this study, we have successfully fabricated the soy glycinin microcapsules based on the NaCl induced microphase separation with subsequent heating. Under vigorous stirring (700 rpm), native soy glycinin solutions (20 g/L) with pH 7.2 were mixed with equal volume of 0.1 M NaCl to a final NaCl concentration of 0.05 M and protein concentration of 10 g/L. The samples were then immediately heated in a thermostat bath at 80C for 20 min with an accuracy of ±0.2 °C. Isolation of the microcapsules formed were centrifuged at 3000 g for 3 min. The isolated microcapsules were then dispersed in pure water. We used various a group of Fluorescein isothiocyanate (FITC) labeled dextran as representative hydrophilic biomacromolecules to investigate the permeability of the microcapsules. The microstructure of the microcapsules was observed by confocal laser scanning microscopy (CLSM) and scanning electron microscopy (SEM). The permeability of soy glycinin microcapsules showed not only pH and ionic strength responsive but also an spontaneous accumulation effect for compounds carrying opposite charge which have not been found with any other protein microcapsules. The possible mechanism of the permeability change under different condition was also discussed. By tuning the permeability of the microcapsules, FITC-dextran was successfully encapsulated.

1. Physicochemical and permeability evaluation of microcapsule.

Soy glycinin microcapsules fabricated by heating salt induced microphase separated dispersion showed good stability in a wide pH range. It swelled at pH > 11 and pH < 3, caused by the strong electrostatic repulsion when pH was far away from the isoionic point. But it dissociated when pH > 11 which was supposed to be caused by the dissociation of the disulfide bonds that stabilized the microcapsule. Both increasing the ionic strength and adjusting pH away from neutral led to an increased roughness of the microcapsule surface accompanied by an increased permeability.

By adjusting ionic strength or pH, FITC-dextran was successfully encapsulated which did not leak out in salt free neutral solution. Increasing the ionic strength or pH, the encapsulated FITC-dextran could be released. The encapsulation efficiency was significantly higher by adjusting pH towards acid condition where the microcapsules showed accumulation effect for FITC-dextran which was due to the electrostatic attraction between FITC-dextran and the remaining glycinin inside the microcapsules. By using the spontaneous self-accumulation technique, the loading amounts was no longer limited by the concentration of compounds in bulk solution and hydrophilic compounds can be successfully encapsulated in large quantity by simple alteration of the pH value. Such spontaneous deposition technique greatly improves the loading efficiency and can be considered for the encapsulation of a variety of materials.

1. A manuscript is being prepared and will be submitted to a top food science journal in April 2018. The published paper will be sent to MSB.