国連大学生研究成果

# Quality Improvement of Fresh Food by Thermal Preprocessing

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Heat treatments, such as use of aqua-gas (AQG), which is a mixture of micro-droplets of hot water in superheated steam (SHS), heating at 60℃ in water, and steaming are used mainly to inactivate enzymes that cause browning and to facilitate peeling of green fruit where the peel adheres firmly to the pulp, like in bananas. The characteristics of Cavendish banana (*Musa* spp.) blanched in AQG with SHS, boiling water, and steam were studied to determine the effectiveness of these treatments in prolonging the green stage of the fruit in order that the fruit could be prepared into value-added products. The work focused also on determining the characteristics of banana during the normal ripening process and on the effectiveness of these blanching techniques in delaying the ripening process. Untreated fruits stored at ambient conditions ripened after 8 days with a total soluble solids (TSS) content of 9%, which is the table ripe stage of bananas. Bananas to be used for preparing chips are required to have a maximum TSS of 5%. This level was attained in untreated bananas after 6 days of ripening. Blanching in water at 60℃ for 1, 3 and 5 minutes resulted in water soaked bananas after 5 days of blanching resulting in soft texture of the fruit. Steaming of green bananas for 30, 60 and 90 seconds resulted in ripened bananas after 4, 7 and 10 days, respectively. Blanching of mature, green bananas (Color Index, CI=2) with AQG delayed ripening time by about 7 days. Increase in TSS to 5% was attained after at least 14 days in bananas blanched for 60 seconds at 115℃ with AQG. Blanching for 90 seconds was also effective in prolonging the green stage of bananas, the 5% level was attained within 14 days of ripening or a delay of 7 days. Bananas blanched for 30 seconds delayed ripening by 4 days. Regression equations for ripening of bananas were obtained from the straight line in the graph representing the changes in total soluble solids content during its ripening. These equations can be used to predict the number of days before reaching the 5% TSS. Above results will be useful for producers of banana chips, flour and powder utilizing green bananas as raw material. The producers will have extended time to prepare these products and not worry about the early ripening of the raw material especially at times when there is abundant supply of green bananas.

# Development of agro-resource and spice-based renewable eco-bio-product and properties

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Renewable bio-products are biodegradable products developed keeping environmental concerns in mind. An integrated research and scientific on renewable bio-products / materials with insect attack protection property is an urgent need as agro/cereal grain based bio-products are usually attacked on shelf by insect pests making them defective. The aim of the study was to develop and understand the properties of biodegradable material with spice (turmeric) inclusion for protection against attack from harmful insect pests. Keeping the above objectives processing, properties and development of agro-resource and spice-based renewable eco-bio-product (eco-pots) was carried out using twin extrusion technology for pelleting and injection molding for bio-product casting. This followed studies on pellets and pots (RP 820/RPT 821) from rice, potato pulp waste with and without turmeric. Maize weevil (*Sitophilus zeamais Motschulsky*) was used as the stored product insect pest and its food preference was studied in prepared pellets and eco-pots. It was RP 820 pots which were highly preferred as food by maize weevil, as absence of turmeric resulted in cracks and crevices in pots making easy access for insect attack. Whereas pots from RPT 821 (with turmeric inclusion) were not at all preferred as food by the insect pest as the pots were free from cracks and crevices and pots had enough integrity to allow any bite. Turmeric inclusion afforded the compatibility effect on pots making it inaccessible to insect attack besides natural color.

# Effects of Sugar Components on the Properties of Enzymatically-induced Soy Protein Coagulum

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To elucidate the role of soybean proteins in enzymatic coagulation, and to analyze the effect of glycan moiety of β-conglycinin (7S) on the coagulation, dynamic rheological properties during the enzymatic coagulation as well as other physicochemical properties of soybean proteins were studied.

The coagulation of commercial soybean protein isolate (SPI) by papain and alcalase at different temperatures were studied. The results showed that papain had higher thermal stability than alcalase. The results of Arrhenius plot suggested that the coagulation by both alcalase and papain at different temperatures was single process and that the coagulation induced by papain depended more on temperature than that by alcalase.

The coagualtion of commercial SPI and 7S dispersions with presence of papain were studied at 40℃. Dynamic viscoelasticity of 7S dispersion developed faster than that of SPI, indicating that commercial 7S was easier to coagulate and formed firmer coagulum than SPI.

The observed clotting time and dynamic rheological properties of extracted 11S (E11S) , 7S (E7S) and SPI (ESPI) with presence of papain were compared. The E11S dispersion coagualted much faster than ESPI and E7S, and the E7S was the slowest. The saturated modulus values were ordered as E11S > E7S > ESPI, indicating that 11S played a key role in the papain induced coagulation.

No significant difference was found for the clotting time by papain between the deglycosided 7S (D7S) and its intact control. The D7S coagulum was little bit firmer than the control one, but both formed very weak coagula. The deglycosidation was not effective to enhance gel structure induced by papain.

It can be concluded that deglycosidation is not very effective for increasing the gel strength of the enzymatic coagulum of soybean protein. Soybean 11S plays a key role in the coagulation of the enzymtaic coagulation, the same as reported in tofu-like gels induced by saline or acid coagulants.

# Improvement of Fish Sauce Flavor by Using Ultrafiltration Method

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Fish sauce is a condiment made from fermented fish. Some people, however, dislike fish sauce due to its some strong unpleasant flavors. In this study, a membrane separation technique for improving the flavor of fish sauce was developed.

Some polymers solutions including sodium carboxymethyl cellulose, sodium alginate, dextran, chitosan, gelatin, polyethilene glycol were mixed with trimethylamine or butyric and iso-valeric acids and then were ultrafiltrated and subsequently both the permeate and feed were assayed. At the next stage, ultrafiltration experiments of the polymer solutions with total recirculation mode were carried out, and the model of ultrafiltration of polymers solution was developed. A simple optimization technique was set up in order to find the optimum energy for filtration. Simulation of the batch-wise ultrafiltration the polymer in fish sauce solution was carried out and sensory evaluation was applied to compare the original fish sauce and the treated ones.

It was found that sodium carboxymethyl cellulose (CMC) and sodium alginate (SAG) could bind with trimethylamine while chitosan could bind with lower fatty acids. Gelatin could slightly bind with the lower fatty acids. The model based on resistance-in-series model can explain the permeate data obtained. Feed flow velocity ranging from 0.073 to 0.298 m/s has significant effect to the resistance only at higher trans-membrane pressures while temperature ranging from 25 to 45℃ has the effect at both higher and lower trans-membrane pressure. However, the temperature effect was lower than that of feed flow velocity. In the range of targeted permeate flux of 0.00003 to 0.00007 $m^3/m^2$-s, optimum inlet pressure for all solutions are occurred at similar values but the corresponding feed flow velocity of chitosan in 0.01 N HCl solution, and therefore its pressure energy, is significantly higher than those of CMC and SAG solution. At the curve $J_v$ vs $\Delta P$, the required optimum energy points do not necessarily to occur at the region where the curve deviates from linear.

The permeate flux of polymers in fish sauce is severely lower than those in aquaeous solutions, i.e. less than a quarter for all polymers. Furthermore, the CMC in fish sauce solution has permeate flux much lower than that of SAG at the same trans-membrane pressure whereas their optimum values are approximately same in the aquaeous solution. The model for batch-wise simulation was agreed with data only for SAG.

Sensory evaluation showed that ultrafiltration of CMC, SAG, chitosan and mixture of SAG and chitosan in fish sauce solution can significantly change the odor and taste of the fish sauce at 95% confidence interval. CMC, SAG and mixture of SAG and chitosan improved significantly the odor of fish sauce, while chitosan and mixture of SAG and chitosan improved significantly the taste of fish sauce.

# Development of Method to Enhance Resistant Starch Content in Rice Flour

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Rice is the main crop of Thailand, but the utilization and the value of the rice flour is limited. The digestibility of rice flour is high due to its low resistant starch (RS) content. The functions of the RS are similar to the dietary fibers. Many public health authorities and food organizations recognize RS as a beneficial carbohydrate. High and low amylose Thai rice flours (KC and ML, respectively) were used in this work, to increase the RS content in the flour. Pullalanase debranching followed by heat-moisture treatment (HMT) altered the pasting properties, which increased the shear stability to the flours. The gelatinization temperature determined by DSC was increased and the more retrogradation occurred in treated flour compared to the native flour. The SEM observation showed that the treatment did not change the morphology of the granules in both flours. The RS content of the treated KC flour was not significantly changed from 10.86% in native to 10.20 and 10.81% in both treatments, but the slowly digestible starch (SDS) content was significantly increased (from 1.07% to 3.27 and 3.25%). The treatment worked well with ML rice. The RS content in the treated ML flour was increased to 18.31% from 11.59% in native flour. This concluded that the treatment can increase the RS, while maintaining the granular structure and improve the pasting properties of the flour. Moreover the debranching and HMT process has different effect on the RS content, depends on the cultivar and the milling method of the rice flour. This can be used to improve functional properties of rice flour and also increase the value of rice flour.