REFERENCES

Achouri, A. and Zhang, W. 2001. Effect of succinylation on the physicochemical properties of soy protein hydrolysate. Food Research International. 34(6): 507-514.

Achouri, A., Zhang, W. and Shiying, X. 1999. Enzymatic hydrolysis of soy protein isolate and effect of succinylation on the functional properties of resulting protein hydrolysates. Food Research International. 31(9): 617-623.

Adebowale, K.O. and Lawal, O.S. 2003. Foaming, gelation and electrophoretic characteristics of mucuna bean (*Mucuna pruriens*) protein concentrates. Food Chemistry. 83: 237-246.

Adler-Nissen, J. 1979. Determination of the degree of hydrolysis of food protein hydrolysates by trinitrobenzenesulfonic acid. Journal of Agricultural and Food Chemistry. 27: 1256-1262.

Akahane, T., Chihara, S., Niki, T.P., Sano, T., Tsuchiya, T., Noguchi, S.F., Ookami, H. and Matsumoto, J.J. 1985. Differential scanning calorimetric studies on thermal behavior of myofibrillar proteins. Bulletin of the Japanese Society of Scientific Fisheries. 51: 1841-1846.

Aletor, O., Oshodi, A.A. and Ipinmoroti, K. 2002. Chemical composition of common leaf protein concentrates. Food Chemistry. 78(1): 63-68.

Alizadeh-Pasdar, N. and Li-Chan, E.C.Y. 2000. Comparison of protein surface hydrophobicity measured at various pH values using three different fluorescent probes. Journal of Agricultural and Food Chemistry. 48: 328-334.

Althouse, P.J., Dinakar, P. and Kilara, A. 1995. Screening of proteolytic enzymes to enhance foaming of whey protein isolates. Journal of Food Science. 60(5): 1110-1112.

Aluko, R.E. and Yada, R.Y. 1995. Structure, function relationships of cowpea (*Vigna unguiculata*) globulin isolate: Influence of pH and NaCl on physicochemical and functional properties. Food Chemistry. 53: 259-265.

Amersham Pharmacia Biotech. 1999. Polyacrylamide gel electrophoresis. In Protein electrophoresis: technical manual. (80-6013-88/Rev. BO/12-99). pp. 13-41.

An, H., Peters, M.Y. and Seymour, T.A. 1996. Roles of endogenous enzymes in surimi gelation. Trends in Food Science and Technology. 7: 321-327.

An, H., Weerasinghe, B., Seymour, T.A. and Morrissey, M.T. 1994. Cathepsin degradation of Pacific whiting surimi proteins. Journal of Food Science. 59(5): 1013-1017, 1033.

An, H., Wei, C.I., Zhao, J., Marshall, M.R. and Lee, C.M. 1989. Electrophoretic identification of fish species used in surimi products. Journal of Food Science. 54(2): 253-257.

AOAC. 1997. Official methods of analysis. 16th ed. Arlington: Association of Official Analytical Chemists.

Aoki, T., Yamashita, T. and Ueno, R. 2000. Distribution of cathepsins in red and white muscles among fish species. Fisheries Science. 66: 776-782.

Baek, H.H. and Cadwallader, K.R. 1995. Enzymatic hydrolysis of crayfish processing by-products. Journal of Food Science. 60(5): 929-935.

Bandyopadhyay, K. and Ghosh, S. 2002. Preparation and characterization of papain-modified sesame (*Sesamum indicul* L.) protein isolates. Journal of Agricultural and Food Chemistry. 50: 6854-6857.

Barbut, S. 1996. Determining water and fat holding. In G.M. Hall (ed.), Methods of testing protein functionality, pp. 186-225. London: Blackie Academic & Professional.

Beas, V.E., Wagner, J.R., Crupkin, M. and Anon, M.C. 1990. Thermal denaturation of hake (*Merluccius hubbsi*) myofibrillar proteins. A differential scanning calorimetric and electrophoretic study. Journal of Food Science. 55(3): 683-687,696.

Beirao, L.H., Mackie, I.M., Teixeira, E. and Damian, C. 2001. Purification and characterization of trypsin-like enzyme from the pyloric caeca of cod (*Gadus morhua*) II. Brazilian Archives of Biology and Technology. 44(1): 33-40.

Benjakul, S., Seymour, T.A., Morrissey, M.T. and An, H. 1996. Proteinase in Pacific whiting surimi wash water: Identification and characterization. Journal of Food Science. 61(6): 1165-1170.

Benjakul, S., Seymour, T.A., Morrissey, M.T. and An, H. 1998. Characterization of proteinase recovered from Pacific whiting surimi wash water. Journal of Food Biochemistry. 22: 1-16.

Benjakul, S., Visessanguan, W. and Leelapongwattana, K. 2003. Purification and characterization of heat-stable alkaline proteinase from bigeye snapper (*Priacanthus macracanthus*) muscle. Comparative Biochemistry and Physiology. 134B: 579-591.

Benjakul, S., Visessanguan, W., Tueksuban, J. and Tanaka, M. 2004. Effect of some protein additives on proteolysis and gel-forming ability of lizardfish (Saurida tumbil). Food Hydrocolloid. 18(3): 395-401.

Beynon, R.J. and Salvesen, G. 1989. Commercially available protease inhibitors. In R.J. Beynon and J.S. Bond (eds.), Proteolytic enzymes: A practical approach, pp.241-249. Oxford: IRL Press.

Biliaderis, C.G. 1983. Differential scanning calorimetry in food research - A review. Food Chemistry. 10: 239-265.

Bora, P.S. 2002. Functional properties of native and succinylate lentil (*Lens culinaris*) globulins. Food Chemistry. 77: 171-176.

Bora, P.S. and Neto, V.Q. 2005. Functionality of native and denatured cashew nut kernel protein isolates at isoelectric pH as a function of salt concentration. Journal of the Science of Food and Agriculture. 84(15): 2022-2027.

Bourtoom, T., Chinnan, M.S., Jantawat, P. and Sanguandeekul, R. 2006. Effect of select parameters on the properties of edible film from water-soluble fish proteins in surimi wash-water. Lebensmittel Wissenschaft und Technology. 39: 405-418.

Brown, W.D. 1986. Fish muscle as food. In P.J. Bechtel (ed.), Muscle as food, pp. 406-452. Florida: Academic Press, Inc.

Cao, M.J., Osatomi, K., Suzuki, M., Hara, K., Tachibana, K. and Ishihara, T. 2000. Purification and characterization of two anionic trypsins from the hepatopancreas of carp. Fisheries Science. 66: 1177-1179.

Chan, M.W. and Ma, C.Y. 1999. Modification of proteins from soymilk residue (okara) by trypsin. Journal of Food Science. 64(5): 781-786.

Chawla, S.P., Venugopal, V. and Nair, P.M. 1996. Gelation of proteins from washed muscle of threadfin bream (*Nemipterus japonicus*) under mild acidic conditions. Journal of Food Science. 61(2): 362-367.

Chen, I.C., Chapman, F.A., Wei, C.I. and O'Keefe, S.F. 1996. Preliminary studies on SDS-PAGE and isoelectric focusing identification of sturgeon sources of caviar. Journal of Food Science. 61(3): 533-535, 539.

Chen, L.F., Richardson, T. and Amundson, C.H. 1975. Some functional properties of succinylated proteins from fish protein concentrate. Journal of Milk and Food Technology. 38(2): 89-93.

Chen, S.X., Swaisgood, H.E., and Foegeding, E.A. 1994. Gelation of β-lactoglobulin treated with limited proteolysis by immobilized trypsin. Journal of Agricultural and Food Chemistry. 42: 234-239.

Chen, T.Y. and Hwang, D.F. 2002. Electrophoretic identification of muscle proteins in 7 puffer species. Journal of Food Science. 67(3): 936-942.

Chobert, J.M., Bertrand-Harb, C. And Nicolas, M.G. 1988. Solubility and emulsifying properties of caseins and whey proteins modified enzymatic by trypsin. Journal of Agricultural and Food Chemistry. 36: 883-892.

Chobert, J.M., Sitohy, M.Z. and Whitaker, J.R. 1988. Solubility and emulsifying properties of caseins modified enzymatically by *Staphylococcus aureus* V8 protease. Journal of Agricultural and Food Chemistry. 36:220-224.

Choi, Y.J., Cho, Y.J. and Lanier, T.C. 1999. Purification and characterization of proteinase from Atlantic menhaden muscle. Journal of Food Science. 64(5): 772-775.

Choi, Y.J. and Park J.W. 2002. Acid-aided protein recovery from enzyme-rich Pacific whiting. Journal of Food Science. 67(8): 2962-2967.

Choi, Y.J., Lanier, T.C., Lee, H.G., and Cho, Y.J. 1999. Purification and characterization of alkaline proteinase from Atlantic menhaden muscle. Journal of Food Science. 64(5): 768-771.

Clark A.H. and Lee-Tuffnell, C.D. 1986. Water and fat holding, In J.R. Mitchell and D.A. Ledward (eds.), Functional properties of food macromolecules, pp. 203-272. London: Elsevier Applied Science.

Closs, B., Courthaudon, J.L. and Lorient, D. 1990. Effect of chemical glycosylation on the surface properties of the soluble fraction of casein. Journal of Food Science. 55(2): 437-439, 461.

Copeland, R.A. 1994. Methods for protein analysis: a practical guide to laboratory protocols. New York: Chapman & Hall. 228 p.

Copeland, R.A. 2000. Enzymes: A practical introduction to structure, mechanism, and data analysis. 2nd ed. New York: John Wiley & Son. 397 p.

Damodaran, S. 1994. Structure-function relationship of food proteins. In N.S. Hettiarachchy and G.R. Ziegler (eds.), Protein functionality in food systems, pp. 1-37. New York: Marcel Dekker.

Damodaran, S. 1996a. Amino acids, peptides, and proteins. In O.R. Fennema (ed), Food chemistry. 3rd ed., pp. 321-429. New York: Marcel Dekker.

Damodaran, S. 1996b. Functional properties. In S. Nakai and W. Modler (eds.), Food proteins: Properties and characterization, pp. 167-234. New York: VCH Publishers.

Damodaran, S. 1997. Protein-stabilized foams and emulsions. In S. Damodaran and A. Paraf (eds.) Food proteins and their applications, pp.57-110. New York: Marcel Dekker.

De Jong G.A.H. and Koppelman, S.J. 2002. Transglutaminase catalyzed reactions: impact on food applications. Journal of Food Science. 67(8): 2798-2806.

De Wit, J.N, Hontelez-Backz, E. and Adamse, M. 1988. Evaluation of functional properties of whey protein concentrates and whey protein isolates: 3. Functional properties in aqueous solution. Natherlands Milk and Dairy Journal. 42: 155-172. Cited in Damodaran, S. Functional properties. In S. Nakai and W. Modler (eds.), Food proteins: Properties and characterization, pp. 167-234. New York: VCH Publishers, 1996.

Dickinson, E, Owusu, R.K., Tan, S. and Williams, A. 1993. Oil-soluble surfactants have little effect on competitive adsorption of α-lactalbumin and β-lactoglobulin in emulsions. Journal of Food Science. 58(2): 295-298.

Dickinson, E. 1997. Properties of emulsions stabilized with milk proteins: Overview of some recent developments. Journal of Dairy Science. 80(10): 2607-2619.

Diniz, F.M. and Martin, A.M. 1997. Fish protein hydrolysates by enzymatic processing. Agro Food Industry Hi Tech. 8(3): 9-13.

El-Adawy, T.A. 2000. Functional properties and nutritional quality of acetylated and succinylated mung bean protein isolate. Food Chemistry. 70: 83-91.

FAO, Fisheries Department. 2004. World review of fisheries and aquaculture 2004 [Online].Available from: http://www.fao.org/docrep/007/y5600e/y5600e00.htm[2006, August 10]

Feng, Y. and Hultin, H.O. 1997. Solubility of the proteins of mackerel light muscle at low ionic strength. Journal of Food Biochemistry. 21: 479–496.

Feng, Y. and Hultin, H.O. 2001. Effect of pH on the rheological and structural properties of gel of water-washed chicken-breast muscle at physiological ionic strength. Journal of Agricultural and Food Chemistry. 49: 3927-3935.

Fennema, O.R. 1996. Water and ice. In O.R. Fennema (ed), Food chemistry. 3rd ed., pp. 17-94. New York: Marcel Dekker.

Foegeding, E.A., Davis, J.P., Doucet, D. and McGuffey, M.K. 2002. Advances in modifying and understanding whey protein functionality. Trends in Food Science and Technology. 13: 151-159.

Folk, J.E. and Cole, P.W. 1966. Transglutaminase: Mechanistic features of the active site as determined by kinetic and inhibitor studies. Biochimica et Biophysica Acta. 122: 244-252.

Franzen, K.L. and Kinsella, J.E. 1976a. Functional properties of succinylated and acetylated leaf protein. Journal of Agricultural and Food Chemistry. 24(5): 914-919.

Franzen, K.L. and Kinsella, J.E. 1976b. Functional properties of succinylated and acetylated soy protein. Journal of Agricultural and Food Chemistry. 24(4): 788-795.

Garcia-Carreno, F.L. 1996. Proteinase inhibitors. Trends in Food Science and Technology. 7: 197-204.

Gauthier, S.F., Paquin, P., Pouliot, Y. And Turgeon, S. 1993. Surface activity and related functional properties of peptides obtained from whey proteins. Journal of Dairy Science. 76(1): 321-328.

Gensheng, Z., Dirui, M., Ming, M. and Jiguang, L. 2005. Study on the properties of soy protein isolate. Food Science and Technology. 20: 18-21.

German, J.B. and Phillips, L. 1994. Protein interactions in foams: Protein-gas phase interactions. In N.S. Hettiarachchy and G.R. Ziegler (eds.), Protein functionality in food systems, pp.181-208. New York: Marcel Dekker.

Giardina, C, Pelizzola, V., Avalli, A., Iametti, S. And Cattaneo, T.M.P. 2004. Functional properties of milk protein hydrolysates obtained by controlled enzymatic hydrolysis. Milchwissenschaft. 59(9-10): 476-479.

Gomez-Guillen, M.C., De Castro, M.A.M. and Montero, P. 1997. Rheological and microstructural changes in gels made from high and low quality sardine mince with added egg white during frozen storage. Zeitschrift fuer Lebensmittel-Untersuchung und-Forschung A. 205: 419-428.

Gomez-Guillen, M.C., Javier-Borderias, A. and Montero, P. 1996. Rheological properties of gels made from high- and low-quality sardine (*Sardina pilchardus*) mince with added nonmuscle proteins. Journal of Agricultural and Food Chemistry. 44: 746-750.

Grabowska, J. and Sikorski, Z.E. 1976. The gel-forming capacity of fish myofibrillar proteins. Lebensmittel Wissenschaft und Technology. 9: 33-35.

Gruener, L. and Ismond, M.A.H. 1997a. Effects of acetylation and succinylation on the physicochemical properties of the canola 12S globulin: Part I. Food Chemistry. 60(3): 357-363.

Gruener, L. and Ismond, M.A.H. 1997b. Effects of acetylation and succinylation on the functional properties of the canola 12S globulin. Food Chemistry. 60(4): 513-520.

Gudmundsdottir, A. and Palsdottir, H.M. 2005. Atlantic cod trypsins: from basic research to practical applications. Marine Biotechnology. 7: 77-88.

Guo, M.R., Fox, P.F., Flynn, A. and Kindstedt, P.S. 1997. Heat-induced modifications of the functional properties of sodium caseinate. International Dairy Journal. 6(5): 473-483.

Guthrie, H.A. and Picciano, M.F. 1995. Human nutrition. St. Louis: Mosby. 806 p.

Haard, N.F. 1994. Protein hydrolysis in seafoods. In F. Shahidi and R. Botta (eds.), Seafoods: Chemistry, processing technology and quality, pp. 10-33. London: Chapman & Hall.

Haard, N.F. 1995. Composition and nutritive value of fish proteins and other nitrogen compounds. In A. Ruiter (ed.), Fish and fishery products: Composition, nutritive properties and stability, pp. 77-115. Oxon: Cab International.

Hall, G.M. (editor). 1996. Methods of testing protein functionality. London: Blackie Academic & Professional. 265 p.

Hall, G.M. and Ahmad, N.H. 1992. Functional properties of fish-protein hydrolysates. In G.M. Hall (ed.), Fish processing technology, pp. 249-274. New York: VCH Publishers.

Hamada, J.S. 1992. Modification of food proteins by enzymatic methods. In B.J.F. Hudson (ed.), Biochemistry of food proteins, pp. 249-270. London: Elsevier Science Publishers.

Hamada, J.S. and Marshall, W.E. 1992. Enzymatic deamidation of food proteins for improved food use. U.S. Patent 5,082,672.

Hashimoto K, Watabe S, Kono M, Shiro K. 1979. Muscle protein composition of sardine and mackerel. Bulletin of the Japanese Society of Scientific Fisheries. 45:1435-1441.

Hashimoto, K., Watabe, S., Nakagawa, T. and Sorita, K. 1984. Electrophoretic identification of three subspecies of the genus *Lagocephalus* pufferfish. Bulletin of the Japanese Society of Scientific Fisheries. 50(1): 115-118.

Hermansson, A.M. 1986. Water and fat holding, In J.R. Mitchell and D.A. Ledward (eds.), Functional properties of food macromolecules, pp. 273-314. London: Elsevier Applied Science.

Hermansson, A.M. 1994. Microstructure of protein gels related to functionality. In R.Y. Yada, R.L. Jackman and J.L. Smith (eds.), Protein structure-function relationships in foods, pp. 22-42. London: Blackie Academic and Professional.

Hettiarachchy, N.S. and G.R. Ziegler, G.R. (editors). 1994. Protein functionality in food systems. New York: Marcel Dekker. 519 p.

Hill, S.E. 1996. Emulsions. In G.M. Hall (ed.), Methods of testing protein functionality, pp. 153-185. London: Blackie Academic & Professional.

Hohne, G., Hemminger, W. and Flammersheim, H.J. 1996. Differential scanning calorimetry. New York: Springer. 222 p.

Huang, T.S., Marshall, M.R. and Wei, C.I. 1995. Identification of red snapper (*Lutjanus campechanus*) using electrophoretic techniques. Journal of Food Science. 60(2): 279-283.

Huidobro, A., Alvarez, C. and Tejada, M. 1998. Hake muscle altered by frozen storage as affected by added ingredients. Journal of Food Science. 63(4): 638-643.

Hultin H.O. and Kellerher S.D. 1999. Process for isolating a protein composition from a muscle source and protein composition. U.S. Patent 6, 005, 073.

Hultin H.O. and Kelleher S.D. 2000. Surimi processing from dark muscle fish. In J.W. Park (ed.), Surimi and surimi seafood, pp. 59-77. New York: Marcel Dekker.

Hurtado, J.L., Borderias, J., Montero, P. and An, H. 1999. Characterization of proteolytic activity in octopus (*Octopus vulgaris*) arm muscle. Journal of Food Biochemistry. 23: 469-483.

Huss, H. H. (1995). Quality and changes in fresh fish. FAO Fisheries Technical paper-T348, 195 pp. Accessed at www.fao.org.

Jeon, Y.J., Byun, H.G. and Kim, S.K. 1999. Improvement of functional properties of cod frame protein hydrolysates using ultrafiltration membranes. Process Biochemistry. 35: 471-478.

Jiang, S.T., Lee, J.J. and Chen, H.C. 1994. Purification and characterization of a novel cysteine proteinase from mackerel (*Scomber australasicus*). Journal of Agricultural and Food Chemistry. 42: 1639-1646.

Joseph, D., Lanier, T.C. and Hamann, D.D. 1994. Temperature and pH affect transglutaminase-catalyzed "setting" of crude fish actomyosin. Journal of Food Science. 59(5): 1018-1023, 1036.

Ju, S.Y., Otte, J. and Madsen, J.S. 1995. Effects of limited proteolysis on gelation and gel properties of whey protein isolate. Journal of Dairy Science. 78: 2119-2128.

Jung, S., Murphy, P.A. and Johnson, L.A. 2005. Physicochemical and functional properties of soy protein substrates modified by low levels of protease hydrolysis. Journal of Food Science. 70(2): C180-C187.

Kang, I.S. and Lanier, T.C. 2000. Heat-induced softening of surimi gels by proteinases. In J.W. Park (ed.), Surimi and surimi seafood, pp. 445-474. New York: Marcel Dekker.

Kanoh, S., Suzuki, T., Maeyama, K., Takewa, T., Watabe, S. and Hashimoto K. 1986. Comparative studies on ordinary and dark muscles of tuna fish. Bulletin of the Japanese Society of Scientific Fisheries. 52: 1807-1816.

Karthikeyan, M., Mathew, S., Shamasundar, B.A. and Prakash V. 2004. Fractionation and properties of sarcoplasmic proteins from oil sardine (*Sardinella longiceps*): Influence on the thermal gelation behavior of washed meat. Journal of Food Science. 69(3): FEP79-FEP84.

Kato, A. and Nakai, S. 1980. Hydrophobicity determined by a fluorescence probe method and its correlation with surface properties of proteins. Biochimica et Biophysica Acta. 624: 13-20.

Kester, J.J. and Richardson , T. 1984. Modification of whey proteins to improve functionality. Journal of Dairy Science. 67: 2757-2774.

Kim, S.H. and Kinsella, J.E. 1985. Surface activity of food proteins: Relationships between surface pressure development, viscoelasticity of interfacial films and foam stability of bovine serum albumin. Journal of Food Science. 50: 1526-1530.

Kim, B.Y. and Park, J.W. 2000. Rheology and texture properties of surimi gels. In J.W. Park (ed.), Surimi and surimi seafood, pp. 267-324. New York: Marcel Dekker.

Kinoshita, M., Toyohara, H. and Shimizu, Y. 1990. Purification and properties of a novel latent proteinase showing myosin heavy chain-degrading activity from threadfin-bream muscle. Journal of Biochemistry. 107(4): 587-591.

Kinoshita, M, Toyohara, H, Simizu, Y and Sakaguchi, M. 1991. Induction of modori-phenomenon (thermal gel degradation) by a latent serine proteinase. Nippon Suisan Gakkaishi. 57(10): 1935-1938.

Kinoshita, M, Toyohara, H, Simizu, Y and Sakaguchi, M. 1992. Modori-inducing proteinase active at 50°C in threadfin bream muscle. Nippon Suisan Gakkaishi. 58(4): 715-720.

Kinsella, J.E. 1976. Functional properties of proteins in foods: a survey. Critical Reviews in Food Science and Nutrition. 8: 219-280. Cited in J.F. Zayas. Functionality of proteins in food. New York: Springer. 373 p., 1997.

Kinsella, J.E. 1979. Functional properties of soy proteins. Journal of the American Oil Chemists' Society. 56: 242-258.

Kinsella, J.E. 1981. Functional properties of proteins: Possible relationships between structure and function in foams. Food Chemistry. 7: 273–288.

Kinsella, J.E. 1982. Relationships between structure and functional properties of food proteins. In P.F. Fox and J.J. Condon (eds.), Food proteins, pp. 51-103. Essex: Applied Science Publishers.

Kinsella, J.E. and Whitehead, D.M. 1989. Proteins in whey: chemical, physical, and functional properties. Advances in Food and Nutrition Research. 33: 343-438.

Kishi, H., Nozawa, H. and Seki, N. 1991. Reactivity of muscle transglutaminase on carp myofibrils and myosin B. Nippon Suisan Gakkaishi. 57(6): 1203-1210.

Kneifel, W., Paquin, P., Albert, T. and Richard, J.P. 1991. Water-holding capacity of proteins with special regard to milk proteins and methodological aspects – A review. Journal of Dairy Science. 74: 2027-2041.

Koka, M., Milolajcik, E.M. and Grould, I.A. 1968. Spectrophotometric method for determination of heat-activated sulfhydryl groups of skim milk. Journal of Dairy Science. 51: 217-219.

Kolodziejska, I. and Sikorski, K.E. 1996. Neutral and alkaline muscle proteases of marine fish and aquatic invertebrates: A review. Journal of Food Biochemistry. 20: 349-363.

Kristinsson, H.G. and Hultin, H.O. 2003. Effect of low and high pH treatment on the functional properties of cod muscle proteins. Journal of Agricultural and Food Chemistry. 51: 5103-5110.

Kristinsson, H.G. and Rasco, B.A. 2000a. Biochemical and functional properties of Atlantic salmon (*Salmo salar*) muscle proteins hydrolyzed with various alkaline proteases. Journal of Agricultural and Food Chemistry. 48: 657-666.

Kristinsson, H.G. and Rasco, B.A. 2000b. Kinetics of the hydrolysis of Atlantic salmon (*Salmo salar*) muscle proteins by alkaline proteases and a visceral serine protease mixture. Process Biochemistry. 36: 131-139.

Kristinsson, H.G., Rasco, BA. 2000c. Fish protein hydrolysates: Production, biochemical, and functional properties. Critical Reviews in Food Science and Nutrition., 40(1): 43-81.

Kuraishi, C., Yamazaki, K. and Susa, Y. 2001. Transglutaminase: Its utilization in the food industry. Food Reviews International. 17(2): 221-246.

Laemmli, U.K. 1970. Cleavage of structural proteins during the assembly of the head of bacteriophage T4. Nature. 227: 680-685.

Lanier, T.C. 2000. Surimi gelation chemistry. In J.W. Park (ed.), Surimi and surimi seafood, pp. 237-265. New York: Marcel Dekker.

Lawal, O.S. 2005. Functionality of native and succinylated lablab bean (*Lablab purpureus*) protein concentrate. Food Hydrocolloid. 19: 63-72.

Liceaga-Gesualdo and Li-Chan, E.C.Y. 1999. Functional properties of fish protein hydrolysate from herring (*Clupea harengus*). Journal of Food Science. 64(6): 1000-1004.

Li-Chan, E., Nakai, S. and Wood, D.F. 1984. Hydrophobicity and solubility of meat proteins and their relationship to emulsifying properties. Journal of Food Science. 49: 345-350.

Lin T.M. and Park, J.W. 1998. Solubility of salmon myosin as affected by conformational changes at various ionic strengths and pH. Journal of Food Science. 63: 215-218.

Lin T.M. and Park, J.W. and Morrissey, M.T. 1995. Recovered protein and reconditioned water from surimi processing waste. Journal of Food Science. 60(1): 4-9.

Linden, G. and Lorient, D. 1999. New ingredients in food processing. Fambridge: Woodhead Publishing. 366 p.

Love, R.M. 1992. Biochemical dynamics and the quality of fresh and frozen fish. In G.M. Hall (ed.), Fish processing technology, pp. 1-30. New York: VCH Publishers.

Ma, C.Y. 1984. Functional properties of acylated oat protein. Journal of Food Science. 49(4): 1128-1131.

Mackie, I.M. 1990. Identifying species of fish. Analytical Proceedings. 27: 89-92.

Mackie, I.M. 1996. Authenticity of fish. In P.R. Ashurst and M.J. Dennis (eds.), Food authentication, pp. 140-170. London: Blackie Academic & Professional.

Mackie, I.M. 1997. Methods of identifying species of raw and processed fish. In G.M. Hall (ed.), Fish processing technology, 2nd ed., pp. 160-199. London: Blackie Academic & Professional.

MacRitchie, F. and Lafiandra, D. 1997. Structure-function relationships of wheat proteins. In S. Damodaran and A. Paraf (eds.) Food proteins and their applications, pp.293-324. New York: Marcel Dekker.

Mahajan, A. and Dua, S. 2002. Salts and pH induced changes in functional properties of amaranth (*Amaranthus tricolor* L.) seed meal. Cereal Chemistry. 79(6): 834-837.

Mahmoud, M.I. 1994. Physicochemical and functional properties of protein hydrolysates in nutritional products. Food Technology. 48(10): 89-95.

Marti, C., Roeckel, M., Aspe, E. and Kanda, H. 1994. Recovery of proteins from fishmeal factory wastewaters. Process Biochemistry. 29: 39-46.

Mathewson, P.R. 1998. Enzymes: Practical guides for the food industry. Minnesota: Eagan Press. 109 p.

Matsumura, Y. and Mori, T. 1996. Gelation. In G.M. Hall (ed.), Methods of Testing Protein Functionality, pp. 76-109. London: Blackie Academic & Professional.

Miller, R. and Groninger, H.S. 1976. Functional properties of enzyme modified acylated fish protein derivatives. Journal of Food Science. 41: 268-866.

Miyaguchi, Y., Nagayama, K. and Tsutsumi, M. 2000. Thermal and functional properties of porcine sarcoplasmic proteins: A comparison with some water-soluble animal proteins. Animal Science Journal. 71(4): 416-424.

Modler, H.W. and Jones, J.D. 1987. Selected processes to improve the functionality of dairy ingredients. Food Technology. 41(10): 114-117, 129.

Montero, P. and Gomez-Guillen, M.C. 1998. Recovery and functionality of wash water protein from krill processing. Journal of Agricultural and Food Chemistry. 46(8): 3300-3304.

Morioka, K. and Shimizu, Y. 1993. Relationship between the heat-gelling property and composition of fish sarcoplasmic proteins. Nippon Suisan Gakkaishi. 59(9): 1631.

Morioka, K., Kurashima, K. and Shimizu, Y. 1992. Heat-gelling properties of fish sarcoplasmic protein. Nippon Suisan Gakkaishi. 58(4): 767-772.

Morioka, L., Nishimura, T., Obatake, A. and Shimizu, Y. 1997. Relationship between the myofibrillar protein gel strengthening effect and the composition of sarcoplasmic proteins from Pacific mackerel. Fisheries Science. 63(1): 111-114.

Morrissey, M.T. and Tan, S.M. 2000. World resources for surimi. In J.W. Park (ed.), Surimi and surimi seafood, pp. 1-21. New York: Marcel Dekker.

Morrissey, P.A., Mulvihill, D.M. and O'Riordan, D. 1991. In B.J.F. Hudson (ed.), Functional properties of blood proteins, pp. 125-166. London: Elsevier Applied Science Publishers.

Mulvihill, D. and Kinsella, J. 1987. Gelation characteristics of whey proteins and β-lactoglobulin. Food Technology. 41(9): 102-111.

Munilla-Moran, R. and Stark, J.R. 1989. Protein digestion in early turbot larvae, *Scophthalmus maximus* (L.). Aquaculture. 81: 315-327.

Mutilangi, W.A.M., Panyam, D. and Kilara, A. 1995. Hydrolysates from proteolysis of heat-denatured whey proteins. Journal of Food Science. 60(5): 1104-1109.

Mutilangi, W.A.M., Panyam, D. and Kilara, A. 1996. Functional properties of hydrolysates from proteolysis of heat-denatured whey protein isolate. Journal of Food Science. 61(2): 270-273, 303.

Nakagawa, T., Nagayama, F., Ozaki, H., Watabe, S. and Hashimoto, K. 1989. Effect of glycolytic enzymes on the gel-forming ability of fish muscle. Nippon Suisan Gakkaishi. 55(6): 1045-1050.

Nakagawa, T., Watabe, S. and Hashimoto, K. 1988a. Electrophoretic analysis of sarcoplasmic proteins from fish muscle on polyacrylamide gels. Nippon Suisan Gakkaishi. 54(6): 993-998.

Nakagawa, T., Watabe, S. and Hashimoto, K. 1988b. Identification of three major components in fish sarcoplasmic proteins. Nippon Suisan Gakkaishi. 54(6): 999-1004.

Nakai, S., Li-Chan, E. and Arteaga, G.E. 1996. Measurement of surface hydrophobicity. In G.M. Hall (ed.), Methods of Testing Protein Functionality, pp. 226-259. London: Blackie Academic & Professional.

Neto, V.Q., Narain, N., Silva, J.B. and Bora, P.S. 2001. Functional properties of raw and heat processed cashew nut (*Anacardium occidentale*, L.) kernel protein isolate. Nahrung. 45(4): 258-262.

Neurath, H. 1989. The diversity of proteolytic enzymes. In R.J. Beynon and J.S. Bond (eds.), Proteolytic enzymes: A practical approach, pp. 1-13. Oxford: IRL Press.

Normah, I., Jamilah, B., Saari, N. and Man, Y.B.C. 2004. Chemical and taste characteristics of threadfin bream (*Nemipterus japonicus*) hydrolysate. Journal of the Science of Food and Agriculture. 84: 1290-1298.

Nowsad, A.A.K.M., Kanoh, S. and Niwa, E. 1994. Setting of transglutaminase-free actomyosin paste prepared from Alaska pollack surimi. Fisheries Science. 60(3): 295-297.

Nowsad, A.A.K.M., Kanoh, S. and Niwa, E. 1995. Contribution of transglutaminase on the setting of various actomyosin pastes. Fisheries Science. 61(1): 79-81.

Nowsad, A.A.K.M., Katoh, E., Kanoh, S. and Niwa, E. 1995. Effect of sarcoplasmic proteins on the setting of transglutaminase-free paste. Fisheries Science. 61(6): 1039-1040.

Oakenfull, D, Pearce, J. and Burley, R.W. 1997. Protein gelation. In S. Damodaran and A. Paraf (eds.) Food proteins and their applications, pp.111-142. New York: Marcel Dekker.

Okazaki, E. 1994. A study on the recovery and utilization of sarcoplasmic protein of fish meat discharged during the leaching process of surimi processing. Bulletin of the National Research Institute of Fisheries Science. 6: 79-160.

Opstvedt, J., Miller, R., Hardy, R.W. and Spinelli, J. 1984. Heat-induced changes in sulfhydryl groups and disulfide bonds in fish protein and their effect on protein and amino acid digestibility in rainbow trout (*Salmo gairdneri*). Journal of Agricultural and Food Chemistry. 32: 929-935.

Osatomi, K., Sasai, H., Cao, M., Hara, K. and Ishihara, T. 1997. Purification and characterization of myofibril-bound serine proteinase from carp *Cyprinus carpio* ordinary muscle. Comparative Biochemistry and Physiology. 116B(2): 183-190.

Oshodi, A.A. and Ojokan, E.O. 1997. Effect of salts on some of the functional properties of bovine plasma protein concentrate. Food Chemistry. 59(3): 333-338.

Owusu-Apenten, R.K. 2004. Testing protein functionality. In R.Y. Yada (ed.), Proteins in food processing, pp. 217-244. Cambridge: Woodhead Publishing.

Owusu-Apenten, R.K., Chee, C. and Hwee, O.P. 2003. Evaluation of a sulphydryl-disulphide exchange index (SEI) for whey proteins-β-lactoglobulin and bovine serum albumin. Food Chemistry. 83: 541-545.

Panyam, D. and Kilara, A. 1996. Enhancing the functionality of food proteins by enzymatic modification. Trends in Food Science and Technology. 7: 120-125.

Panyam, D. and Kilara, A. 2004. Emulsifying peptides from the tryptic hydrolysis of casein. Journal of Food Science. 69(3): C154-C163.

Park J.W. (editor). 2000. Surimi and surimi seafood. New York: Marcel Dekker. 500 p.

Paulson, A.T. and Tung, M.A. 1988. Rheology and microstructure of succinylated canola protein isolate. Journal of Food Science. 53(3): 821-825.

Pavlova, L.A., Damshkaln, L.G. and Vainerman, E.S. 1991. Effect of acetylation on rheological properties of fish protein isolates during heating. Nahrung. 35(1): 53-59.

Pearce, K.N. and Kinsella, J.E. 1978. Emulsifying properties of proteins: Evaluation of a turbidimetric technique. Journal of Agricultural and Food Chemistry. 26(3): 716-723.

Peterson, G.L. 1977. A simplification of the protein assay method of Lowry et al. which is more generally applicable. Analytical Biochemistry. 83: 346-356.

Petursson, S., Decker, E.A. and McClements, D.J. 2004. Stabilization of oil-in-water emulsions by cod protein extracts. Journal of Agricultural and Food Chemistry. 52: 3996-4001.

Phillips, L.G. 1992. The Relationship between the structural, interfacial and foaming properties of β-lactoglobulin. Ph.D. Dissertation, Cornell University, Ithaca, NY. 479 p.

Phillips, L.G. and Kinsella, J.E. 1990. Effects of Succinylation on β-lactoglobulin foaming properties. Journal of Food Science. 55(6): 1735-1739.

Phillips, L.G., German, J.B., O'Neill, T.E., Foegeding, E.A., Harwalkar, V.R., Kilara, A., Lewis, B.A., Mangino, M.E., Morr, C.V., Regenstein, J.M., Smith, D.M., and Kinsella, J.E. 1990. Standardized procedure for measuring foaming properties of three proteins, a collaborative study. Journal of Food Science. 55: 1441-1444, 1453.

Phillips, L.G., Schulman, W., and Kinsella, J.E. 1990. pH and heat treatment effects on foaming of whey protein isolate. Journal of Food Science. 55(4): 1116-1119.

Phillips, L.G., Yang, S.T. and Kinsella, J.E. 1991. Neutral salt effects on stability of whey protein isolate foams. Journal of Food Science. 56(2): 588-589.

Phillips, M.C. 1981. Protein conformation at liquid interfaces and its role in stabilizing emulsions and foams. Food Technology. 35: 50-57.

Ponnampalam, R., Goulet, G., Amiot, J., Chamberland, B. and Brisson, G.J. 1988. Some functional properties of acetylated and succinylated oat protein concentrates and a blend of succinylated oat protein and whey protein concentrates. Food Chemistry. 29(2): 109-118.

Poulter, R.G., Ledward, D.A., Godber, S., Hall, G. and Rowlands, B. 1985. Heat stability of fish muscle proteins. Journal of Food Technology. 20: 203-217.

Qi, M., Hettiarachchy, N.S. and Kalapathy, U. 1997. Solubility and emulsifying properties of soy protein isolates modified by pancreatin. Journal of Food Science. 62 (6): 1110-1115.

Rao, M.A. 1999. Measurement of flow and viscoelastic properties. In M.A. Rao (ed.), Rheology of fluid and semisolid foods, pp. 59-151. Maryland: Aspen Publisher.

Rawdkuen, S., Benjakul S., Visessanguan, W. and Lanier, T.C. 2004. Chicken plasma protein affects gelation of surimi from bigeye snapper (*Priacanthus tayenus*). Food Hydrocolloid. 18(2): 259-270.

Rehbein, H., Etienne, M., Jerome, M., Hattula, T., Knudsen, L.B., Jessen, F., Luten, J.B., Bouquet, W., Mackie, I.M., Ritchie, A.H., Martin, R. and Mendes, R. 1995. Influence of variation in methodology on the reliability of the isoelectric focusing method of fish species identification. Food Chemistry. 52: 193-197.

Roe, S. (editor). 2001. Protein purification techniques: A practical approach. 2nd ed. Oxford: Oxford University press. 262 p.

Ross, C., Tilghman, R.W., Hartmann, J.X. and Mari, F. 1997. Distribution of parvalbumin isotypes in adult snook and their potential applications as species-specific biomarkers. Journal of Fish Biology. 51: 561-572.

Saeed, S. and Howell, N.K. 2004. Rheological and differential scanning calorimetry studies on structural and textural changes in frozen Atlantic mackerel (*Scomber scombrus*). Journal of the Science of Food and Agriculture. 84: 1216-1222.

Sarath, G., De La Motte, R.S. and Wagner, F.W. 1989. Protease assay methods. In R.J. Beynon and J.S. Bond (eds.), Proteolytic enzymes: A practical approach, pp. 25-55. Oxford: IRL Press.

SAS. 2000. Statistical analysis system software. Version 8.01. North Carolina: SAS Institute Inc.

Sathe, S.K. and Salunkhe, D.K. 1981. Functioanl properties of the Great Northern Bean (*Phaseolus vulgaris* L.) proteins: emulsion, foaming, viscosity and gelation properties. Journal of Food Science. 46: 71-74.

Sathivel S. and Bechtel, P.J. 2006. Properties of soluble protein powders from Alaska pollock (*Theragra chalcogramma*). International Journal of Food Science and Technology. 41: 520-529.

Sathivel S., Bechtel, P.J., Babbitt, J., Prinyawiwatkul, W., Negulescu I.I. and Reppond, K.D. 2004. Properties of protein powders from arrowtooth flounder (*Atheresthes stomias*) and herring (*Clupea harengus*) byproduct. Journal of Agricultural and Food Chemistry. 52: 5040-5046.

Sathivel, S., Bechtel P.J., Babbitt, J., Prinyawiwatkul and Patterson, M. 2005. Functional, Nutritional, and rheological properties of protein powders form arrowtooth flounder and their application in mayonnaise. Journal of Food Science. 70(2): 57-63.

Sathivel, S., Bechtel, P.J., Babbitt, J., Smiley, S,. Crapo, C., Reppond, K.D. and Prinyawiwatkul, W. 2003. Biochemical and functional properties of herring (*Clupea harengus*) byproduct hydrolysates. Journal of Food Science. 68: 2196-2200.

Sathivel, S., Smiley, S., Prinyawiwatkul, W. and Bechtel, P.J. 2005. Functional and nutritional properties of red salmon (*Oncorhynchus nerka*) enzymatic hydrolysates. Journal of Food Science. 70(6): C401-C406.

Schwenke, K.D. 1997. Enzyme and chemical modification of proteins. In S. Damodaran and A. Paraf (eds.) Food proteins and their applications, pp.393-423. New York: Marcel Dekker.

Scobbie, A.E. and Mackie, I.M. 1988. The use of sodium dodecyl sulphate polyacrylamide gel electrophoresis in fish species identification – A procedure suitable for cooked and raw fish. Journal of the Science of Food and Agriculture. 44: 343-351.

Seifert, A. and Schwenke, K.D. 1995. Improve approach for characterizing the coalescence stability of legumin stabilized O/W emulsions by analytical ultracentrifugation. Progress in Colloid and Polymer Science. 9: 31-38.

Seki N., Nozawa H. and Ni, S. 1998. Effect of transglutaminase on the gelation of heat-denatured surimi. Fisheries Science. 64: 959–963.

Seki, N., Uno, H.M., Lee, N.H., Kimura, I., Toyada, K., Fujita, T. and Arai, K. 1990. Transglutaminase activity in Alaska pollack muscle and surimi, and its reaction with myosin B. Nippon Suisan Gakkaishi. 56(1): 125-132.

Severin, S. and Xia, W.S. 2006. Enzymatic hydrolysis of whey proteins by two different proteases and their effect on the functional properties of resulting protein hydrolysates. Journal of Food Biochemistry. 30: 77-79.

Seymour, T.A., Morrissey, M.T., Peters, M.Y. and An, H. 1994. Purification and characterization of Pacific whiting proteases. Journal of Agricultural and Food Chemistry. 42: 2421-2427.

Shahidi, F., Han, X.Q. and Synowiecki, J. 1995. Production and characteristics of protein hydrolysates from capelin (*Mollotus villosus*). Food Chemistry. 53: 285-293.

Shih, F.F. 1992. Modification of food proteins by non-enzymatic methods. In B.J.F. Hudson (ed.) Biochemistry of food proteins, pp. 1-33. London: Elsevier Applied Science.

Shimizu, M., Saito, M. and Yamauchi, K. 1985. Emulsifying and structural properties of β-lactoglobulin at different pHs. Agricultural and Biological Chemistry. 49: 189-194.

Shimizu, M., Saito, M. and Yamauchi, K. 1986. Hydrophobicity and emulsifying activity of milk proteins. Agricultural and Biological Chemistry. 50: 791-792.

Sikorski, Z.E. 1981. Modification and technological properties of fish protein concentrates. CRC Critical Reviews in Food Science and Nutrition. 14(3): 201-230.

Siu, M. and Thompson, L.U. 1982. In vitro and in vivo digestibilities of succinylated cheese whey protein concentrates. Journal of Agricultural and Food Chemistry. 30: 743-747.

Slizyte, R. Van Nguyen, J. Rustad, T. and Storro. I. 2004. Hydrolysis of cod (*Gadus morhua*) by-products: Influence of initial heat inactivation, concentration and separation conditions. Journal of Aquatic Food Product Technology. 13(2): 31-48.

Sotelo, C.G., Pineiro, C., Gallardo, J.M. and Perez-Martin, R.I. 1993. Fish species identification in seafood products. Trends in Food Science and Technology. 4: 395-401.

Spinelli, J. and Dassow, J.A. 1982. Fish proteins: Their modification and potential uses in the food industry. In R.E. Martin, G.J. Flick, C.E. Hebard and E.R. Ward (eds.), Chemistry and biochemistry of marine food products, pp. 13-25. Connecticut: AVI Publishing.

Stanley, D.W., Stone, A.P. and Hultin, H.O. 1994. Solubility of beef and chicken myofibrillar proteins in low ionic strength media. Journal of Agricultural and Food Chemistry. 42: 863-867.

Stefansson, G, and Hultin, H.O. 1994. On the solubility of cod muscle protein in water. Journal of Agricultural and Food Chemistry. 42: 2656-2664.

Stoknes, I., Rustad, T. an Mohr, V. 1993. Comparative studies of the proteolytic activity of tissue extracts from cod (*Gadus morhua*) and herring (*Clupea harengus*). Comparative Biochemistry and Physiology. 106B(3): 613-619.

Stoknes, I.S., Walde, P.M. and Synnes, M. 2005. Proteolytic activity in cod (*Gadus morhua*) muscle during salt curing. Food Research International. 38: 693-699.

Suzuki, T. 1981. Fish and krill protein: Processing technology. London: Applied Science Publishers. 260 p.

Swaisgood, H.E. 1996. Characteristics of milk. In O.R. Fennema (ed), Food chemistry. 3rd ed., pp. 841-878. New York: Marcel Dekker.

Townsend, A.M. and Nakai, S. 1983. Relationships between hydrophobicity and foaming characteristics of food proteins. Journal of Food Science. 48: 588-594.

Truong, V.D., Clare, D.A., Catignani, G.L. and Swaisgood, H.E. 2004. Cross-linking and rheological changes of whey proteins treated with microbial transglutaminase. Journal of Agricultural and Food Chemistry. 52: 1170-1176.

Utsumi, S., Matsumura, Y. and Mori, T. 1997. Structure-functional relationships of soy proteins. In S. Damodaran and A. Paraf (eds.) Food proteins and their applications, pp.257-291. New York: Marcel Dekker.

Van Kleef, F. 1986. Thermally induced protein gelation: Gelation and rheological characterization of highly concentrated ovalbumin and soybean protein gel. Biopolymers. 25: 31-59.

Venugopal, V. and Shahidi, F. 1994. Thermostable water dispersions of myofibrillar proteins from Atlantic mackerel (*Scomber scombrus*). Journal of Food Science. 59(2): 265-268, 276.

Venugopal, V. and Shahidi, F. 1996. Structure and composition of fish muscle. Food Reviews International. 12(2): 175-197.

Visessanguan, W., Menino, A.R., Kim, S.M. and An, H. 2001. Cathepsin L: A predominant heat-activated proteinase in arrowtooth flounder muscle. Journal of Agricultural and Food Chemistry. 49: 2633-2640.

Vojdani, F. 1996. Solubility. In G.M. Hall (ed.), Methods of testing protein functionality, pp. 11-60. London: Blackie Academic & Professional.

Voutsinas, L.P. and Nakai, S. 1983. A simple turbidimetric method for determining the fat binding capacity of proteins. Journal of Agricultural and Food Chemistry. 31:58-63.

Voutsinas, L.P. Cheung, E. and Nakai, S. 1983. Relationship of hydrophobicity to emulsifying properties of heat denatured proteins. Journal of Food Science. 48: 26-32.

Wagner, J.R. and Anon, M.C. 1986. Effect of frozen storage on protein denaturation in bovine muscle I. Myofibrillar ATPase activity and differential scanning calorimetric studies. Journal of Food Technology. 21: 9-14.

Wahyuni, M., Ishizaki, S. and Tanaka, M. 1999. Improvement of functional properties of fish water soluble proteins with glucose-6-phosphate through the Maillard reaction. Fisheries Science. 65(4): 618-622.

Wanasundara, P.K.J.P.D. and Shahidi, F. 1997. Functional properties of acylated flax protein isolates. Journal of Agricultural and Food Chemistry. 45(7): 2431-2441.

Wang, J.H., Ma, W.C., Su, J.C., Chen, C.S. and Jiang, S.T. 1993. Comparison of the properties of m-calpain from tilapia and grass shrimp muscles. Journal of Agricultural and Food Chemistry. 41: 1379-1384.

Wang, J.H., Su, J.C., Jiang, S.T. 1992. Stability of calcium-autolyzed calpain II from tilapia muscle (*Tilapai nilotica x Tilapia aurea*). Journal of Agricultural and Food Chemistry. 40: 535-539.

Watabe S, Ochiai Y, Kanoh S, Hashimoto K. 1983. Proximate and protein compositions of requiem shark muscle. Nippon Suisan Gakkaishi. 49: 265–268.

Were, L., Hettiarachchy, N.S. and Kalapathy, U. 1997. Modified soy proteins with improved foaming and water hydration properties. Journal of Food Science. 62: 821-823.

Wicker, L., Lanier, T.C., Hamann, D.D. and Akahane, T. 1986. Thermal transitions in myosin-ANS fluorescence and gel rigidity. Journal of Food Science. 51(6): 1540-1543, 1562.

Wilde, P.J. and Clark, D.C. 1996. Foam formation and stability. In G.M. Hall (ed.), Methods of testing protein functionality, pp. 110-152. London: Chapman & Hall.

Wright, D.J. and Wilding, P. 1984. Differential scanning calorimetric study of muscle and its proteins: Myosin and its subfragments. Journal of the Science of Food and Agriculture. 35: 357-372.

Wright, D.J., Leach, I.B. and Wilding, P. 1977. Differential scanning calorimetric studies of muscle and its constituent proteins. Journal of the Science of Food and Agriculture. 28: 557-564.

Wu, W.U., Hettiarachchy, N.S. and Qi, M. 1998. Hydrophobicity, solubility and emulsifying properties of soy protein peptides prepared by papain modification and ultrafiltration. Journal of the American Oil Chemists' Society. 75(7): 845-850.

Xiong, Y.L., Brekke, C.J., and Leung, H.K. 1987. Thermal denaturation of muscle types as studied by differential scanning calorimetry. Canadian Institute of Food Science and Technology Journal 20: 357-362.

Xiong, Y.L. 1997. Structure-function relationships of muscle proteins. In S. Damodaran and A. Paraf (eds.) Food proteins and their applications, pp.341-392. New York: Marcel Dekker.

Yada, R.Y. 2004. Proteins in food processing. Cambridge: Woodhead Publishing. 686 p.

Yamauchi, T., Ono, H., Kamata, Y. and Shibasaki, K. 1979. Acetylation of amino groups and its effect on the structure of soybean glycinin. Agricultural and Biological Chemistry. 43: 1309-1315.

Yongsawatdigul, J. and Park, J.W. 2003. Thermal denaturation and aggregation of threadfin bream actomyosin. Food Chemistry. 83: 409-416.

Yongsawatdigul, J. and Park, J.W. 2004. Effects of alkali and acid solubilization on gelation characteristics of rockfish muscle proteins. Journal of Food Science. 69: C499-C505.

Zayas, J.F. 1997. Functionality of proteins in food. New York: Springer. 373 p.

Ziegler, G.R. and Acton, J.C. 1984. Mechanisms of gel formation by proteins of muscle tissue. Food Technology. 38(5): 77-80, 82.

APPENDICES

APPENDIX A

ENZYMATIC ASSAY OF TRANSGLUTAMINASE

PRINCIPLE:

$$\text{CBZ-Gln-Gly} + \text{Hydroxylamine} \xrightarrow{\text{Transglutaminase}} \text{CBZ-Gln-Gly-Hydroxamate}$$

Abbreviations used: CBZ = N-Carbobenzoxy

CONDITIONS: T = 37°C, pH = 6.0, A525 nm, Light path = 1 cm

REAGENTS: (Sigma)

A 1000 mM Tris Buffer, pH 6.0 at 37°C

B CBZ-Glutaminylglycine (CBZ-Gln-Gly) (Sigma Prod. No. C-6154)

C 200mM Hydroxylamine with 20 mM Glutathione Reduced Form Solution (HA/Glut) were prepared fresh using Hydroxylamine Hydrochloride (Sigma Prod. No. H-9876, and Glutathione, Reduced Form, Sigma Prod. No. G-4251)

D 1000 mM Calcium Chloride Solution ($CaCl_2$)

E 10 mM L-Glutamic Acid γ-Monohydroxamate Solution (std)

F 12% (v/v) Trichloroacetic Acid Solution

G 5% (w/v) Ferric Chloride Solution

H 100 m M Hydrochloric Acid

I Transglutaminase Enzyme Solution
(Immediately before use, prepare a solution containing 2 units/mL of Transglutaminase in cold deionized water.)

PROCEDURE:

The reaction cocktail was prepared by combining the following reagents into a suitable container:

Reagent B (CBZ-Gln-Gly)	120 mg
Reagent A (Buffer)	2.00 mL
Reagent C (HA/Glut)	5.00 mL

Then reagent D ($CaCl_2$, 0.05 mL) was added and the solution was mixed by inversion, and adjusted to pH 6.0 at 37°C with 100 mM NaOH. Then deionized water was added to make a final volume of 10.0 mL. The assay was performed by pipetting the following reagents in to suitable containers:

	Test	Test Blank	Std.	Std. Blank
Reaction Cocktail	0.20	-	-	-
Equilibrate to 37°C. Then add:				
Reagent I (Enzyme Solution)	0.03	-	-	-
Mix by inversion and incubate at 37°C for exactly 10 minutes. Then add:				
Deionized Water	-	-	-	0.10
Reaction Cocktail	-	0.20	-	-
Reagent E (Std)	-	-	0.10	-
Reagent F (TCA)	0.50	0.50	0.05	0.50
Reagent I (Enzyme Solution)	-	0.03	-	-
Mix by inversion. Then add:				
Reagent G ($FeCl_3$)	0.50	0.50	0.50	0.50

The resulting solutions were mixed by inversion, centrifuged for 5 minutes, and the solutions were transferred to suitable cuvettes. Then A_{525nm} was recorded for the Standard, Test and Blank samples. The activity of TGase was calculated as shown below,

$$E_{mM}^{1} = (A_{525nm}\ \text{Std.} - A_{525nm}\ \text{Std. Blank})\ (1.1)$$

$$\text{Units/mg enzyme} = \frac{(A_{525nm}\ \text{Test} - A_{525nm}\ \text{Test Blank})\ (1.23)}{(E_{mM})\ (\text{mg enzyme/RM})\ (10)}$$

1.1 = Volume of Standard (in milliliters)

1.23 = Volume of Color Mix

RM = Reaction Mix (Volume = 0.23 mL)

10 = Time of reaction in minutes

Unit Definition:

One unit is defined as the amount of enzyme which will catalyze the formation of 1.0 μmole of hydroxamate per minute from Nα-CBZ-Glutaminylglycine and hydroxylamine at pH 6.0 at 37°C. (L-Glutamic acid γ-monohydoxamate is the standard.)

In a 0.23 mL reaction mix, the final concentrations are 174 mM Tris, 31 mM CBZ-glutaminylglycine, 87 mM hydroxylamine, 8.7 mM glutathione, reduced form, 4 mM calcium chloride and 0.06 unit transglutaminase.

APPENDIX B

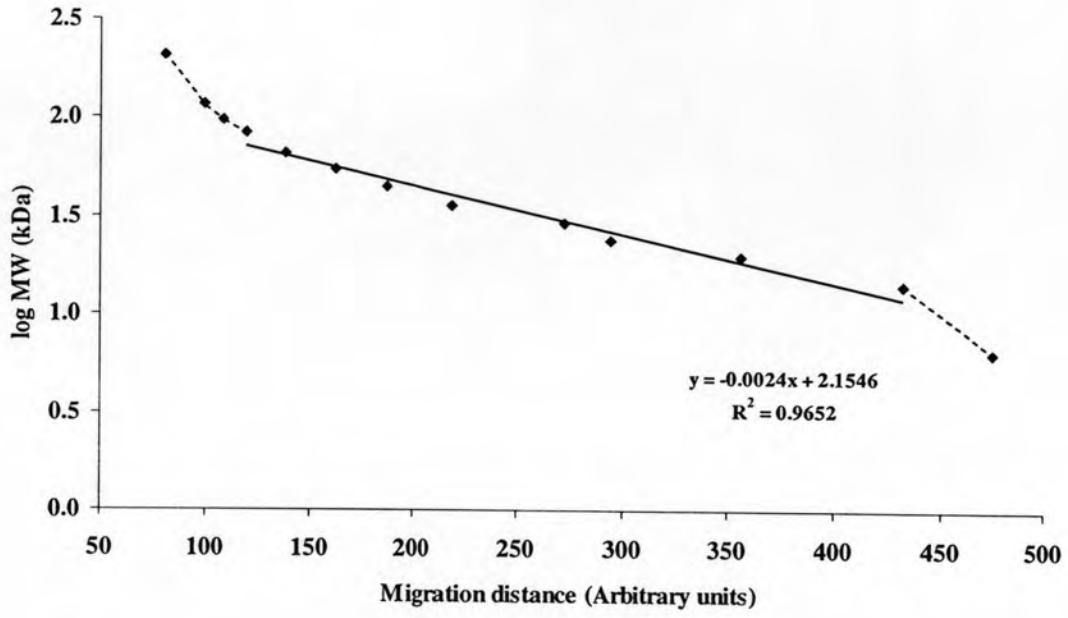

Figure B1 Calibration curve of standard marker proteins on SDS-PAGE at 12.5% gel. Data was taken from the gel in Figure 4.1.

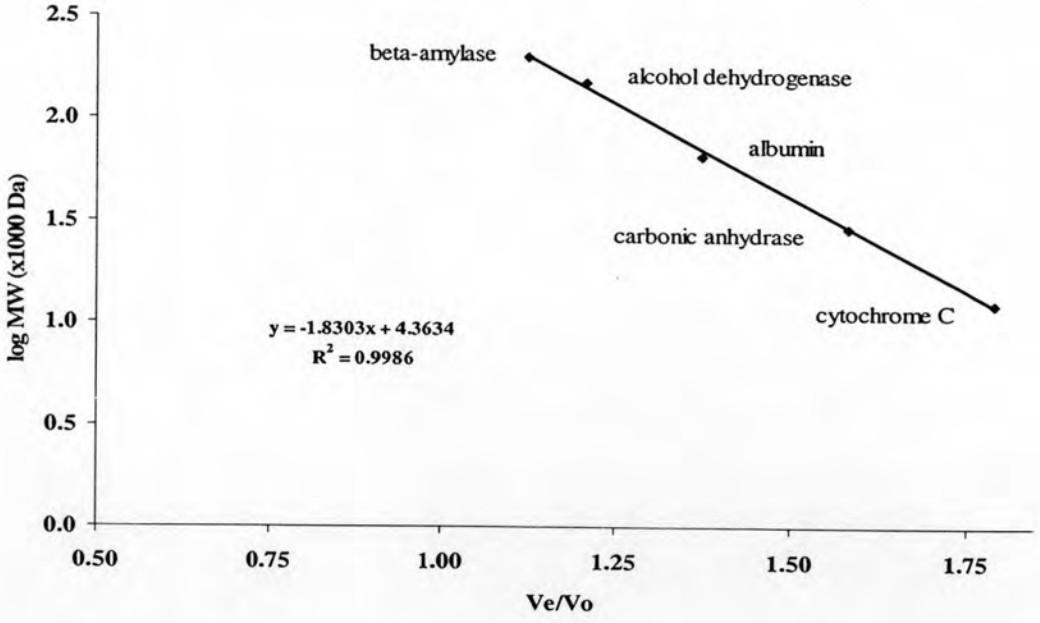

Figure B2 Gel filtration calibration curve from a column (16/70 cm) of Sephacryl S-200 HR, flow rate 0.5 mL/min, fraction volume 2.5 mL. The elution was performed by 0.05 M phosphate buffer, pH 7.0, containing 0.15 M NaCl in refrigerator (4°C).

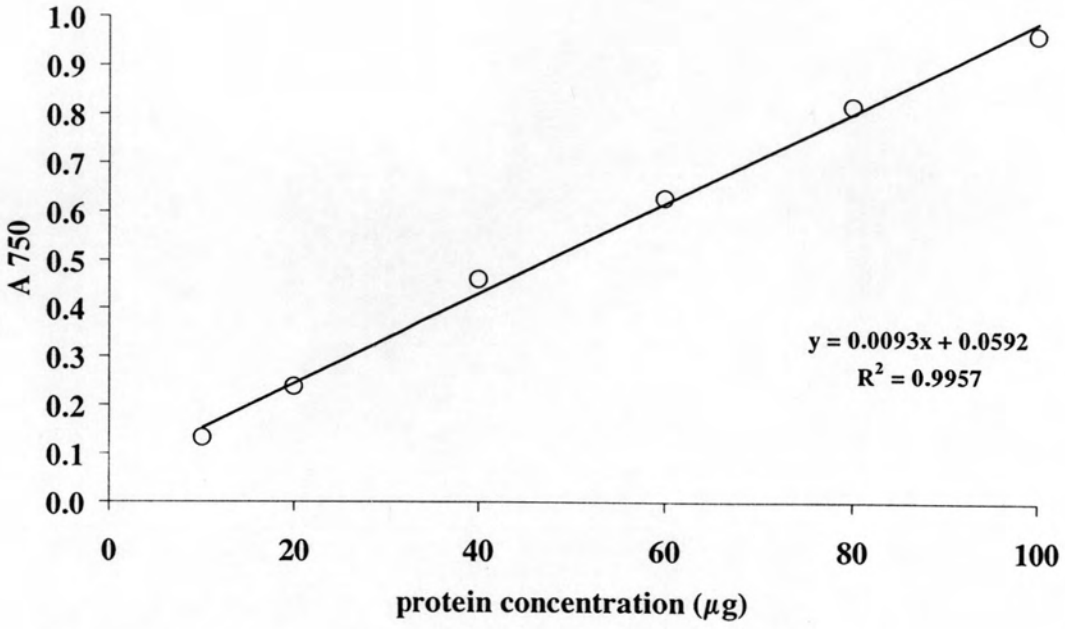

Figure B3 The Lowry calibration graph using bovine serum albumin as reference protein.

APPENDIX C

Table C1 Fraction of TBSP on gel filtration

Peak No.	Fraction No.	V_e	V_e/V_o	log MW (kDa)	MW (kDa)
1	25	62.5	1.04	2.4568	286
Molecular weight and peak data for standards					
Blue dextran	24	60.0(V_o)	-	-	2000
Beta-amylase	27	67.5	1.1250	2.3010	200
Alcohol dehydrogenase	29	72.5	1.2083	2.1461	150
Albumin	33	82.5	1.3750	1.8195	66
Carbonic anhydrase	38	95.0	1.5833	1.4624	29
Cytochrome C	43	107.5	1.7917	1.0934	12.4

Note: Gel filtration was performed on a Sephacryl S-200 HR (16/70) flow rate 0.5 ml/min, fraction volume = 2.5 ml/tube. The column 16/70, V_o = 60. The elution was performed by 0.05 M phosphate buffer, pH 7.0, containing 0.15 M NaCl in refrigerator (4°C). See section 3.1.8 for further details.

Table C2 pH profiles of solubility of TBSP and trypsin modified TBSP

pH	Sample solubility (Relative Scale)		
	No trypsin	+trypsin (1h)	+trypsin (24h)
2	0.8	2.1	0.6
3	0.5	0.8	0.1
4	0.3	0.6	0.1
5	0.5	0.8	0.2
6	0.6	1.1	0.5
7*	1.0*	1.3	0.6
8	0.9	1.5	0.6
9	0.8	1.8	0.6

Note: * reference sample relative solubility value = 1.0 (pH 7). All samples were incubated at 55°C.

APPENDIX D

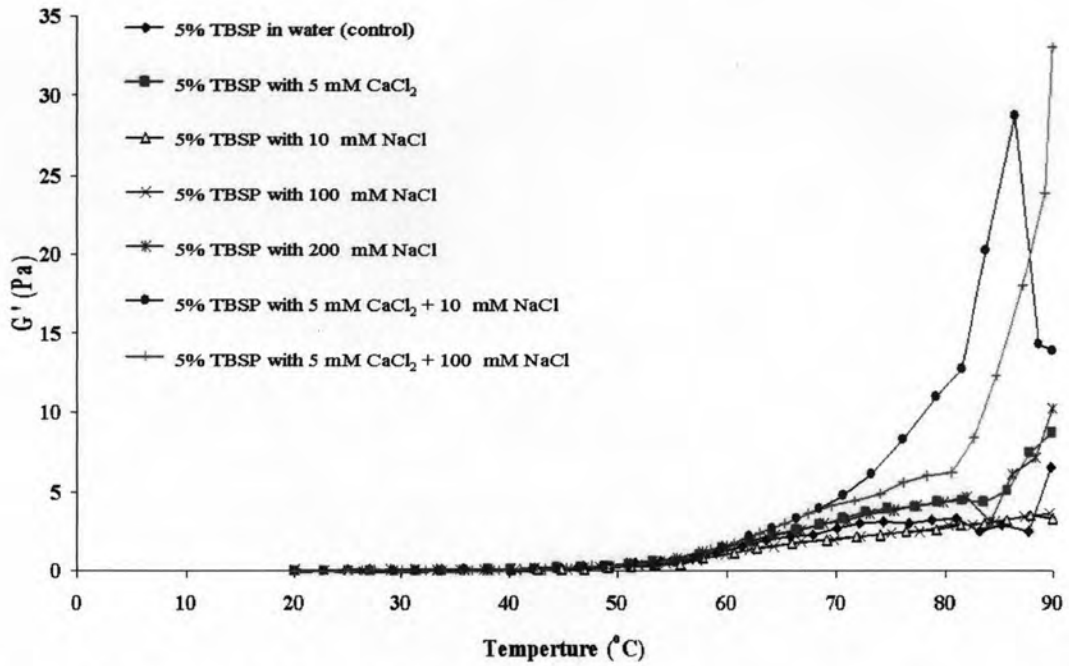

Figure D1 Effect of $CaCl_2$ and NaCl on G' of 5% TBSP.

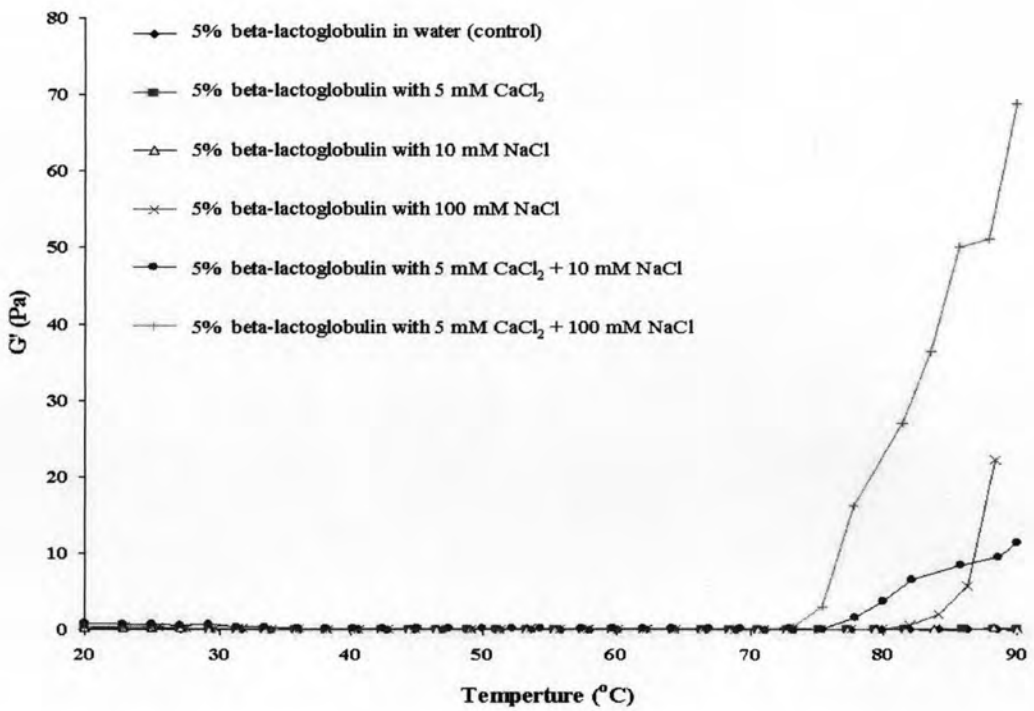

Figure D2 Effect of $CaCl_2$ and NaCl on G' of 5% beta-lactoglobulin.

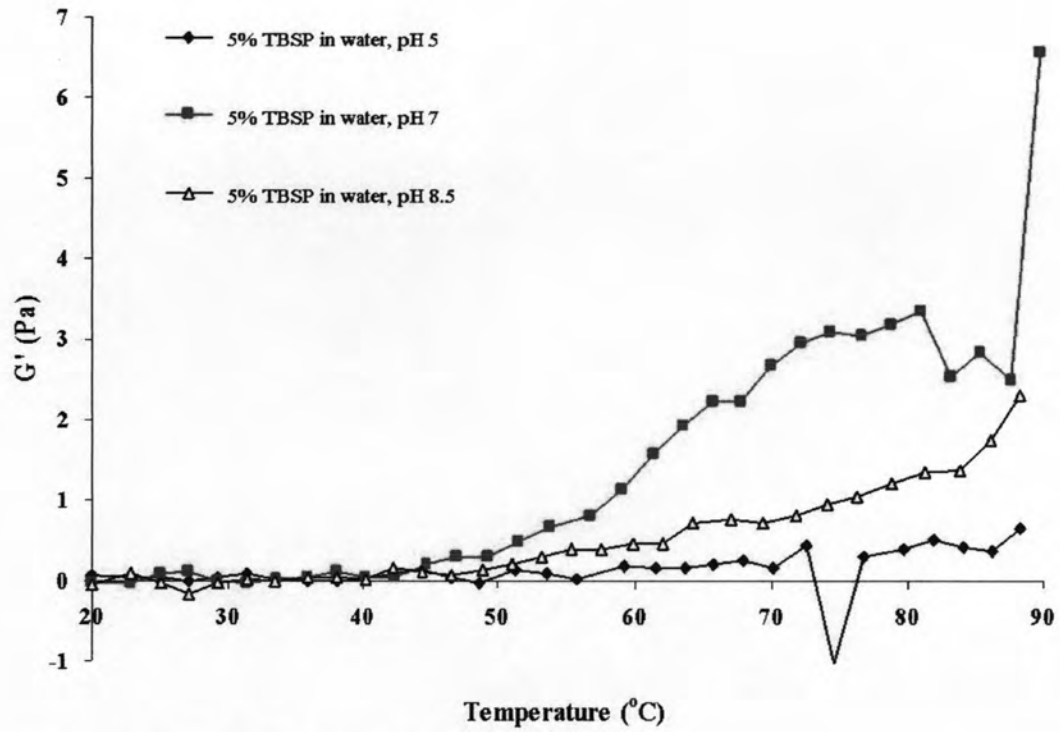

Figure D3 Effect of pH on G' of 5% TBSP.

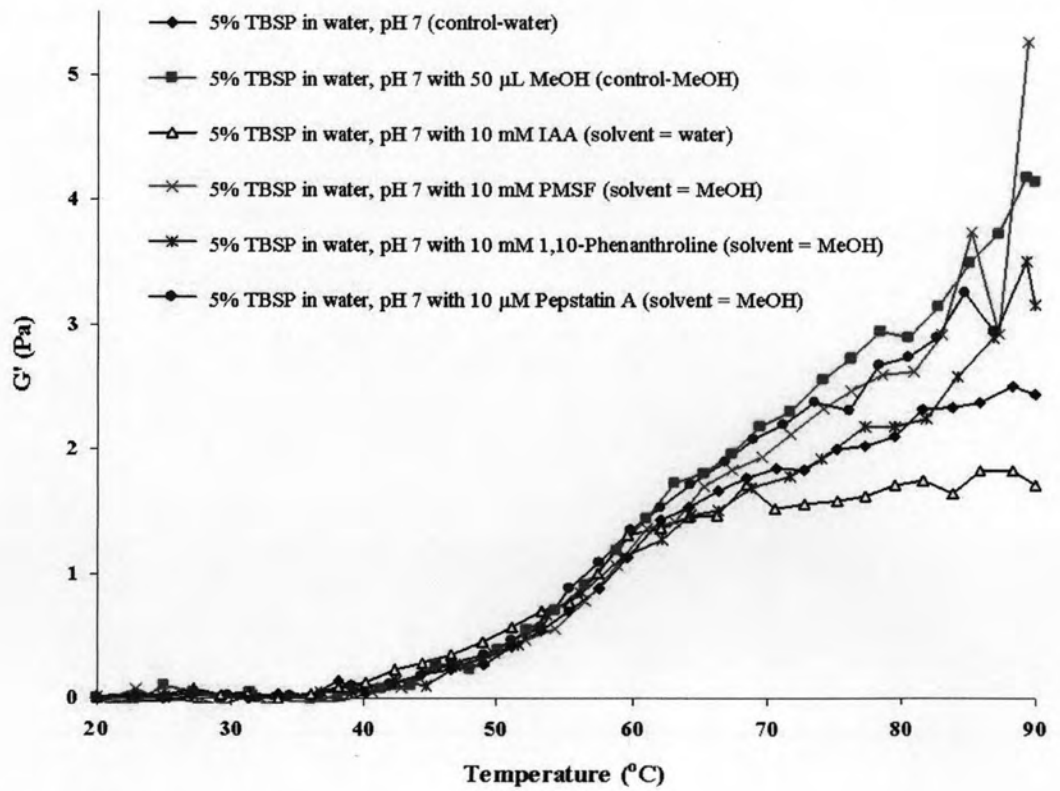

Figure D4 Effect of inhibitors on G' of 5% TBSP.

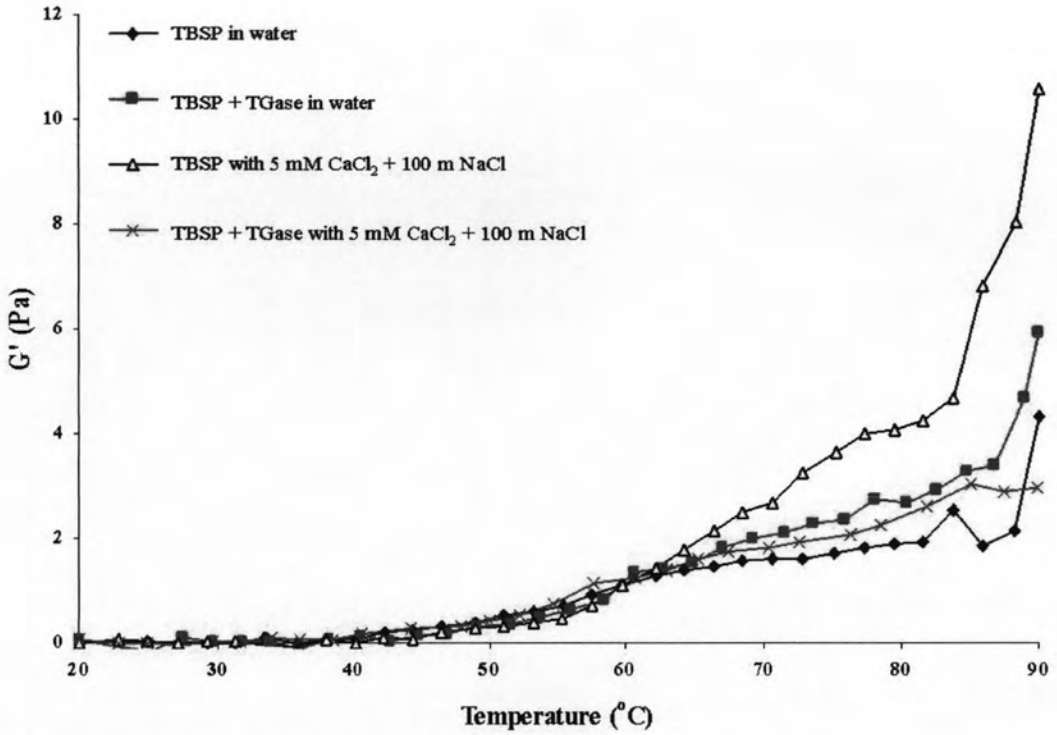

Figure D5 Effect of TGase on G' of 5% TBSP.

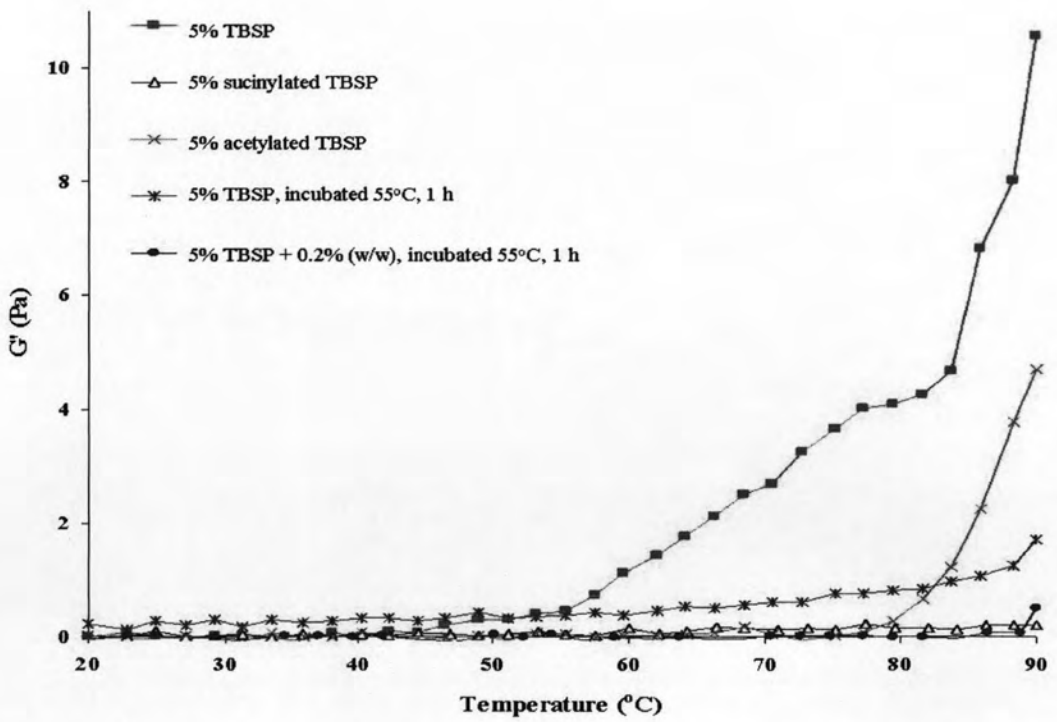

Figure D6 Effect of modification on G' of modified TBSP in 5 mM $CaCl_2$ with 100 mM NaCl solution.

VITA

Miss Nisanarth Krasaechol was born on June 29th, 1971 in Chonburi, Thailand. She obtained a B.Sc. degree in Food Science and Nutrition from Burapha University in 1994 and a M.Sc. degree in Food Technology from Chulalongkorn University in 1998. After graduating in 1998 she worked as an instructor for Department of Food Science, Faculty of Science, Burapha University, Chonburi, Thailand. In 2001, she received a scholarship from Ministry of Royal Thai government to extend her Ph.D. at the Department of Food Technology, Faculty of Science, Chulalongkorn University. During this time she also got a scholarship for 1 year to conduct her research at Department of Food Science, College of Agricultural Sciences, The Pennsylvania State University, University Park, Pennsylvania, USA. After her Ph.D. degree, she will join the Department of Food Science, Faculty of Science, Burapha University, Chonburi, Thailand.

Publications:

- Krasaechol, N., Sanguandeekul, R., Duangmal, K. and Owusu-Apenten, R.K. 2005. Characteristics and functional properties of sarcoplasmic proteins from threadfin bream (*Nemipterus hexodon*). Session 71-B-14. Poster. IFT Annual Meeting, July 15-20, New Orleans, Louisiana.

- Krasaechol, N., Sanguandeekul, R., Duangmal, K. and Owusu-Apenten, R.K. 2006. Characteristics and functional properties of sarcoplasmic proteins from threadfin bream (*Nemipterus hexodon*). Journal of Food Science. (submitted).