Development and Characterization of Nano Laminated Fish Oil Emulsions Using Chitosan Nanoparticles

M.A.T.M. Marasinghe[a], A.L.C.J. Liyanage[a] and S. Thiruchenduran[b]

[a] *Department of Food Science and Technology, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka*

[b] *National Aquatic Resources Research and Development Agency, Crow Island, Colombo15, Sri Lanka*

Fish oil is the main commercial source of omega-3 fatty acids. Application of fish oil in food formulations is limited due to its rapid oxidation and ensuing organoleptic changes. Encapsulation of fish oil using emulsification technique and creating layers around the lipid droplets using layer-by-layer (Lbl) electrostatic deposition technique can effectively solve these problems. Chitosan, obtained by the N-deacetylation of chitin, is a suitable bioencapsulation agent. In this study three emulsions were prepared using high speed homogenization of fish oil extracted from Indian oil sardine (*Sardinella longiceps*), sodium caseinate, chitosan extracted from shrimp (*Penaeus monodon*) shell waste and pectin at pH 5. Sodium caseinate was selected to stabilize the primary emulsion. In secondary and tertiary emulsions, chitosan and pectin were evaluated as the secondary and tertiary layers for emulsions. Zeta potential and particle size of emulsions and chitosan nanoparticles were measured. Scanning electron microscopy (SEM) and Fourier-Transform infrared spectroscopy (FTIR) were done for the emulsions and creaming stability and peroxide value of emulsions were compared. Extracted chitosan was analyzed for its physicochemical parameters. The results revealed a 20% chitosan yield with 3% of moisture, 4% of nitrogen, 52% of crystallinity index, 542% of water binding capacity, 419% of fat binding capacity, 79% of degree of deacetylation and 95% solubility of extracted chitosan. FTIR spectra confirmed the structure of chitosan compared with commercial chitosan. Average particle size of three emulsions and chitosan nanoparticles were 0.727, 1.230, 0.813 and 0.830 μm respectively. The zeta potential of emulsions and chitosan nanoparticles were -13, -5.46, -29 and + 48 mV respectively. SEM images revealed the structural arrangement of powdered emulsion with a rough surface and pores on the walls of capsules. Bonds between wall material of nanocapsules and functional groups were also confirmed by the FTIR spectra. There was a significant difference ($p<0.05$) between the peroxide value and creaming index of all three emulsions. This study revealed that three-layered fish oil droplets could be produced by Lbl deposition, incorporating caseinate, chitosan and pectin with stability against particle aggregation, creaming and oxidation. It can also be suggested that chemically extracted chitosan can be used with protein to encapsulate and stabilize the fish oil.

Keywords: Chitosan, encapsulation, emulsification, fish oil, oxidation