［課程博士］
Doctoral Course

博士学位論文内容要旨
Abstract

専　攻 Major	Applied Marine Biosciences	氏　名 Name	Le Thi Minh Thuy
論文題目 Title	Characterization and utilization of fish scale as a raw material of edible film		

Marine fish species and their processed products are very important foodstuffs in Japan. During fish processing, a large amount of byproduct, including skin, scales and bone, which accounts for 50-70% of fish weight, has been discarded (Kittiphattanabawon et al., 2005). Utilization of marine waste, such as scale, by using as a raw material to extract collagen and gelatin is necessary from the viewpoints of both environmental conservation and the development of new industries.

In Chapter 2, acid-soluble collagen (ASC) was successfully extracted from the scales of lizard fish (*Saurida spp.*) and horse mackerel (*Trachurus japonicus*) from Japan and Vietnam and grey mullet (*Mugil cephalus*), flying fish (*Cypselurus melanurus*) and yellow back seabream (*Dentex tumifrons*) from Japan. ASC yields were about 0.43-1.5% (on a dry weight basis), depending on the species. The SDS–PAGE profile showed that the ASCs were type I collagens, and consisted of two different α chains, α1 and α2, as well as a β component. ASC of horse mackerel from Vietnam showed a higher imino acid level than that from Japan did. ASC denaturation temperature (T_d) ranged from 26 to 29°C, depending on fish species and imino acid contents ($p<0.01$). Maximal solubility of individual collagens was observed at pHs 1-3. Collagen solubility decreased sharply at NaCl concentrations > 0.4 M, regardless of fish type.

In chapter 3, the optimal conditions for extracting gelatin and preparing gelatin film from horse mackerel scale, such as extraction temperature and time, as well as the protein concentration of film-forming solutions (FFS) were investigated. Yields of extracted gelatin at 70, 80, and 90°C for 15 min to 3 h were 1.08-3.45%, depending on the extraction conditions. Among the various extraction times and temperatures, the film from gelatin extracted at 70°C for 1 h showed the highest tensile strength

(TS) and elongation at break (EAB). Water vapor permeability (WVP) of the gelatin film was lower than that of other fishes and mammalian species. Gelatin films showed excellent UV barrier properties at 200 nm, regardless of the preparation conditions. From the results, it is suggested that gelatin film from horse mackerel scale extracted at 70°C for 1 h can be applied to food packaging due to its lowest WVP value and excellent UV barrier property.

Properties of gelatin film incorporated with various phenolic compounds were characterized in chapter 4. TS of films increased while EAB decreased with increasing phenolic concentration. The increase in phenolic concentration lead to enhance WVP value. Gelatin films at different phenolic concentrations showed the excellent UV barrier properties. The findings of this study showed that the incorporation of phenolic compounds into gelatin films lead to higher DPPH radical scavenging activity of the film than that of the film with no additives. FTIR spectra showed that wavenumber of amide-A band of films decreased with increasing phenolic concentration. This indicates hydrogen bond between –NH group of gelatin and –OH group of phenolic compound lead the enhancement of film TS. From the results, it was elucidated that TS and the antioxidant activity of gelatin film can be improved by phenolic compounds.

Antioxidative properties of gelatin film incorporated with various phenolic compounds were characterized by using gelatin films as a packaging material to cover fresh tuna oil in chapter 5. Both peroxide value (PV) and thiobarbituric acid reactive substances (TBARS) of fish oil increased slightly during initial 2 days (sample without air) and 4 days (sample with infusion of 2 ml air) of storage at 40ºC and relative humidity of 40%, but these values decreased significantly at the later stage of storage. Fish oil covered by flexible pouches of gelatin films incorporated with phenolic compounds always showed the lower PV and TBARS values than the samples covered by gelatin film without phenolic compound during the storage period. This result indicated that gelatin film incorporated with phenolic compounds could effectively prevent the auto-oxidation of fish oil. From the results, the addition of phenolic compounds into gelatin film was demonstrated to improve the antioxidative properties of the film. Thus, it could potentially be applied as a packaging material to prevent the lipid oxidation of food products during storage.