CHAPTER II
LITERATURE SURVEY

2.1 Applications of Sericin in Biomaterials

Numerous researchers have studied activities of sericin and applied its advantages in various fields.

Hoppe and Engel (1989) invented water-based cosmetic agent for hair, which in addition to customary constituents, contains sericin and pelargonic acid as active ingredients. Sericin gives a powerful smoothing effect on the skin and reduces damage to the cuticle on the surface of the hair. They found that pelargonic acid (nonanoic acid) in conjunction with sericin (possibly with the formation of a complex) could also be used as an aqueous formulation. When a water-based cosmetic agent for hair of this type is used, the pH is stabilized in the physiological range (pH 5.7-5.9). At the same time, even on lengthy use, no scale formation is induced; on the contrary there is even a reduction in some types of dandruff.

Ishikawa *et al.* (1987) investigated the fine structure and the physical properties of blended films made of sericin and polyvinyl alcohol (PVA). The high-molecular weight sericin was extracted by boiling the cocoon shells in water for 30 min. The extracted sericin was mixed with PVA (91 kDa) and the mixture was casted on a plastic plate and dried at room temperature for 24 hours. Thermal analysis, X-ray diffraction, and electronic microscopy showed that the membrane (50 μm thickness) formed had a microphase-separated structure. The interfacial region between the two phases consisted of PVA-sericin complex. The membrane had good fracture strain and showed little elongation at elevated temperature. The film with 10-30% sericin had good thermal and mechanical properties.

According to Yamada and Nomura (1998), sericin-coated fibers can prevent abrasive skin injuries and the development of rashes. In one study, synthetic and other fibers were coated by sericin by immersing in a 3% aqueous solution of sericin for a given time and drying at 100 °C for 3 min. The fabrics woven from the sericin-coated fibers were tested in products such as diapers, diaper liners, and wound dressing.

Ahn *et al.* (2001) prepared a novel mucoadhesive polymer by template polymerization of acrylic acid in the presence of sericin for a transmucosal drug-delivery (TMD) system. FTIR results indicated that a polymer complex was formed between poly (acrylic acid)(PAA) and sericin through hydrogen bonding. The glass transition temperatures of sericin and PAA in the PAA/sericin polymer complex were inner-shifted compared with the Tg of sericin and PAA them selves. This may be due to the increased miscibility of PAA with sericin through hydrogen bonding. The dissolution rate of the PAA/sericin interpolymer complex was dependent on the pH. The mucoadhesive force of PAA/sericin polymer complex was similar to that of a commercial product.

Tsujimoto *et al.* (2001) showed the cryoprotective activity of the recombinant sericin peptide in E.coli. They focused on the sericin-rich sericin peptide consisting of 38 amino acids, which is a highly conserved and internally repetitive sequence of a sericin protein. When the dimers of sericin peptides were overexposed in Escherichia coli, the transformants showed a prominent increase in cell viability after freezing in medium. Further, the purified dimeric sericin peptide from E.coli was found to be effective in protecting lactate dehydrogenate from denaturation caused by freeze-thaw. Both of these protective effects against freezing stress in cells and proteins were also observed with sericin hydrolysate.

Zhang (2002) reviewed details of many applications of sericin. Sericin protein can be cross-linked, copolymerized, and blended with other macromolecular materials, especially synthetic polymers, to produce materials with improved properties. The protein is also used as an improving reagent or a coating material for natural and artificial fibers, fabrics, and articles. The materials modified with sericin and sericin composites are useful as degradable biomaterials, biomedical materials, polymers for forming articles, functional membranes, fibers, and fabrics. Sericin resists oxidation, is antibacterial, UV resistant, and absorbs and releases moisture easily.

2.2 Antioxidant Properties

Yamada *et al.* (1998) studied the antioxidant ability of sericin to determine a composition of high antioxidizing activity and high inhibiting action on tyrosinase activity. This composition with a sufficient amount of sericin is applicable as an antioxidant in the field of medicines, cosmetics, foods, and food additives. The inhibitory test of in vivo lipid peroxide was determined according to the TBA (thiobabituric acid) method. The result showed that sericin possessed antioxidant ability, i.e lipid peroxide did not form. The level of antioxidant ability of sericin is comparable to that of Vitamin C, which has been said to have potent antioxidizing ability. Moreover, in the case of Vitamin C oxidation may be accelerated in a low concentration range of 0.01% whereas such a phenomenon was not observed for sericin. Another test showed that sericin had permanent characteristics; i.e. its activity was not inactivated even by heating.

Hersh *et al.* (2000) presented cigarette filters having antioxidants to reduce amount of free radical damage incurred by a smoker. Treating smoke with Thione Antioxidant Complex (TM), which is comprised of L-glutathione, N-acetyl-L-cysteine and L-selenomethionine microencapsulated in liposomes, might reduce cell death and reduce the amount of damage done to human salivary proteins, which may be responsible for oral cancer.

Jianfang (2001) reviewed the generation, detection, and reactions of hydroxyl radical. Hydroxyl radical is generated in various conditions including physiological and pathological processes. This radical is highly reactive and a powerful oxidant. It reacts with most molecules in a nearly diffusion limiting rate and formed through one-electron reduction of hydrogen peroxide. Once hydroxyl radical is formed, it will react with various biomolecules. This reaction causes biological damage, which may eventually cause damage to an individual's health.

2.3 Antibacterial Activity

Kunya *et al.* (2001) determined the minimum concentration level of irradiated silk protein powder, which inhibited bacterial activity. The concentration of 100 kGy irradiated silk protein powder solution (ISP) ranged from 5 to 15% in distilled water. The activities of three types of bacteria, Escherichia coli B/r, Bacillus subtilis M3-1 and Staphylococcus aureus K, were tested by using minimum inhibition concentration method (MIC). The results indicated that the minimum concentration level that inhibited growth of E.coli B/r and S. aureus K was 5% ISP and all concentration levels studied could not inhibit Bacilus subtilis M3-1 activity.