



Antioxidant and cryoprotective effects of Amur sturgeon skin gelatin hydrolysate in unwashed fish mince



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ABSTRACT

Antioxidant and cryoprotective effects of Amur sturgeon skin gelatin hydrolysates prepared using different commercial proteases in unwashed fish mince were investigated. Gelatin hydrolysates prepared using either Alcalase or Flavourzyme, were effective in preventing lipid oxidation as evidenced by the lower thiobarbituric acid-reactive substances formation. Gelatin hydrolysates were able to retard protein oxidation as indicated by the retarded protein carbonyl formation and lower loss in sulfhydryl content. In the presence of gelatin hydrolysates, unwashed mince had higher transition temperature of myosin and higher enthalpy of myosin and actin as determined by differential scanning calorimetry. Based on low field proton nuclear magnetic resonance analysis, gelatin hydrolysates prevented the displacement of water molecules between the different compartments, thus stabilizing the water associated with myofibrils in unwashed mince induced by repeated freeze–thawing. Oligopeptides in gelatin hydrolysates more likely contributed to the cryoprotective effect. Thus, gelatin hydrolysate could act as both antioxidant and cryoprotectant in unwashed fish mince.

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1. Introduction

In recent years there has been an increasing interest in utilizing waste from seafood industry as functional ingredients to reduce quality deterioration of fish and fish products, especially during frozen storage (Samaranayaka & Li-Chan, 2011). Although freezing is the most widely method used for preservation of seafood, protein denaturation still occurs and is associated with quality loss (Benjakul & Visessanguan, 2011). The formation of ice crystals and the destruction of the hydrate layers surrounding polar residues followed by hydrophobic interactions are considered to be the prime causes of freeze-induced denaturation of fish protein (Hanafusa, 1973; Némethy & Scheraga, 1962). Physical and biochemical changes occurring in seafood during frozen storage or temperature fluctuation determine the distribution and binding of the water in the muscle (Shenouda, 1980). Changes in muscle water distribution are mainly a result of damage to proteins leading to denaturation and aggregation. This results in a decreased protein solubility and loss of functional properties such as water binding capacity (Andersen & Jørgensen, 2004).

Carbohydrate-based cryoprotectants such as sucrose and sorbitol are commonly used to maintain the quality of seafood during frozen storage but impart undesirable sweet taste (Cheung, Liceaga, & Li-Chan, 2009). Several studies have shown that fish protein hydrolysate and peptides could be used as alternative antioxidants and cryoprotectants in seafoods (Harnedy & FitzGerald, 2012; Karnjanapratum & Benjakul, 2015; Nikoo et al., 2014). Hossain et al. (2004) and Damodaran (2007) suggested that peptides in protein hydrolysate with high proportion of hydrophilic amino acids could bind water, thereby lowering the migration of water to form ice crystals. This leads to structural stabilization of proteins during frozen storage. The tetrapeptide isolated from Amur sturgeon skin gelatin could decrease the loss of intra-myofibrillar water and prevent the denaturation of myosin and actin induced by repeated freeze–thawing (Nikoo et al., 2015).

Lipid oxidation is another chemical reaction, which contributes to the deterioration of frozen seafoods. Due to high content of PUFA, iron and haemoglobin, unwashed fish mince is generally susceptible to oxidation, especially during the extended frozen storage (Jacobsen et al., 2008). To minimize the deteriorative reaction, antioxidants have been widely used. Several protein hydrolysates have been demonstrated to exhibit the antioxidant activity. Gelatin hydrolysate from blacktip shark skin and unicorn leather-jacket skin exhibited antioxidant and cryoprotective effects in washed fish mince (Karnjanapratum & Benjakul, 2015;

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