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Antioxidant activity of Sind sardine hydrolysates with pistachio green hull (PGH) extracts

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ABSTRACT

High rates of oxidation during hydrolysis are one the main problems with hydrolysate production from fatty fishes such as Sind sardines. The purpose of this study was to control oxidation by different pretreatments with pistachio green hull (PGH) extracts as an antioxidant. Different enzyme levels (1.3%, 2.5%, and 5%), pretreatments of fish mince (washing, defatting, fish protein isolate (FPI)), and the addition of PGH as well as nitrogen gas treatment were studied on lipid oxidation during hydrolysis of Sind sardines (*Sardinella sindensis*). The antioxidant properties of the hydrolysates were also studied. Results for thiobarbituric acid reactive substances indicated that the nitrogen gas and 5% (w/w) enzymatic treatment significantly decreased lipid oxidation along with having a higher degree of hydrolysis and higher antioxidant activity for the hydrolysate. FPI was more effective than washing in controlling oxidation while defatting using isopropanol was the most effective. PGH (260 μg/ml) effectively controlled the oxidation of mince and washed mince ($P < 0.05$) but it was not effective for FPI as seen by the higher oxidation of heme-pigments and weaker metal chelating activity of PGH. Interaction of hydrolysates from all treatments and PGH showed significant combined DPPH radical scavenging and metal chelating activity ($P < 0.05$). Therefore, defatting using isopropanol and addition of an antioxidant such as PGH can effectively be used for inhibition of lipid oxidation during hydrolysis and improvement of antioxidant activity of hydrolysates.

1. Introduction

A considerable amount of by-catch and low commercial value fish species such as sardine (*Sardina pilchardus*), horse mackerel (*Trachurus mediterraneus*), and axillary seabream (*Pagellus acarne*) are caught annually (García-Moreno et al., 2014). By-catch, and underutilized fish and shellfish are generally used for the production of fishmeal (Bozzano & Sarda, 2002; García-Moreno et al., 2013, 2014). However, there is an increasing need for better use of underutilized marine resources (Halim, Yusof, & Sarbon, 2016; Harnedy & FitzGerald, 2012; Nikoo & Benjakul, 2015). These marine species contain high quality proteins for the production of bioactive hydrolysates as potential functional food ingredients (Ghaly, Ramakrishnan, Brooks, Budge, & Dave, 2013; Nikoo, Benjakul, & Rahmanifarah, 2016; Ordóñez-Del Pazo et al., 2014).

One of the main challenges during the production of fish protein hydrolysates (FPH) is the high oxidation rate due to the presence of pro-oxidants such as phospholipids in cell membranes, myoglobin and other heme proteins in fish muscle, and undesirable lipid substrates (Khantaphant, Benjakul, & Ghomi, 2011). These constituents are involved in the undesirable organoleptic properties and oxidative instability of hydrolysates (Benjakul, Yarnpakdee, Senphan, Halldorsdottir, & Kristinsson, 2014). Primary products of lipid oxidation break down to secondary products with a bad odor and rancid taste. Also, oxidized unsaturated lipids can produce insoluble lipid-protein complexes and cause quality deterioration and loss of nutritional value in the resulting hydrolysates (Chaijan, 2008; Ladikos & Lougovois, 1990). These processes may be more significant when FPH is produced from fatty fishes such as Sardinella species as they contain more mitochondria, myoglobin, fats, glycogen, cytochromes, and dark muscle fibers than white fleshed-fish species (Chaijan, Benjakul, Visessanguan, & Faustman, 2005).

Previously, FPH were produced using different fish substrate such as fish mince (Nazeer, Kumar, & Ganesh, 2012; Zhang, Zhang, Wang, Chen, & Luo, 2017), defatted sh mince (Chi et al., 2015; Galla,

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