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Nano-chitosan Utilization for Fresh Yellowfin Tuna Preservation

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Abstract

Chitosan utilization as a preservative agent for freshly caught fish has been studied intensively during the last ten years in Indonesia, but the effort was concentrated more on ponds-raised fresh water fish. In this paper we report our preliminary results of a study on using chitosan in the form of nanoparticle (nano-chitosan) to improve the shelf life of freshly caught wild young yellowfin tuna (YFT- *Thunnus albacares*, Bonnaterre 1788). Pharmaceutical grade chitosan was dissolved in 0.2 mM aqueous acetic acid and aqueous ammonium hydroxide was added to reach a certain value of pH at which 1 % concentration of nano-chitosan particles was obtained. The YFT samples were immersed for 30 min in aqueous dispersion of nano-chitosan, and incubated afterwards at two different temperature settings (4 ℃ and 28 ℃). The fish deterioration was measured in terms of Total Volatile Base (TVB) and bacterial Total Plate Count (TPC), with supporting data taken including organoleptic assessment, pH and water content. The nano-chitosan did not seem to decrease the number of bacteria. However, the TVB data indicated that nano-chitosan treatment significantly suppressed the bacteria activity and the effect was more pronounced at 28 ℃.

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Keywords: Food preservative agent; fresh catch; nano-chitosan; Yellowfin tuna (*Thunnus albacares*, Bonnaterre 1788)

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Nomenclature

Chitosan	cationic polymer produced by deacetylation of chitin
Nano-chitosan	chitosan in the form of nano-sized particles dispersed in water
TPC	Total Plate Count
TVB	Total Volatile Base
YFT	Yellowfin Tuna
A0B0	Experimental code for no nano-chitosan addition at 4 °C
A0B1	Experimental code for no nano-chitosan addition at 28 °C
A1B0	Experimental code for distilled-water-based nano-chitosan addition at 4 °C
A1B1	Experimental code for distilled-water-based nano-chitosan addition at 28 °C
A2B0	Experimental code for well-water-based nano-chitosan addition at 4 °C
A2B1	Experimental code for well-water-based nano-chitosan addition at 28 °C

1. Introduction

Chitosan [$(C_6H_{11}NO_4)n$] is a deacetylated product of chitin [$(C_8H_{13}NO_5)n$], with the molecular weight of around 800 kDa. It is a cationic polymer with (2 000 to 3 000) monomers, and known to have the following important properties: biodegradable, non-toxic and edible (Kerry, 2012). More importantly, chitosan acts as an antimicrobial agent due to its positively charged polycation (El Ghaouth et al. 1994). Its nano particle form (nano-chitosan) was proven to be more compact and more potent antibacterial agent, as reported by Ramezani et al. (2015), when comparing the effectiveness of chitosan and nano-chitosan coatings on silver carp fillets (*Hypophthalmicthys molitrix*) in refrigerated storage at 4 °C.

Utilization of chitosan as a preservative agent for freshly caught fish has been studied intensively during the last 10 yr in Indonesia, but the effort was concentrated more on ponds-raised groups, such as Nile Tilapia (*Oreochromis* sp.) (Mahatmanti et al. 2010) and Catfish (*Pangasius hypopthalmus*) (Suptijah et al. 2008). On the other hand, previous studies on chitosan utilization on tropical marine fishes are rare and mostly applied to pre-treated products, such as salted Indian Scad (*Decapterus* sp.) (Swastawati et al. 2008). There was also one very preliminary microbial test of its application on smoked Skipjack (*Katsuwonus pelamis*) (Killay, 2014).

Yellowfin Tuna (YFT, *Thunnus albacares*) is a major component of the central and western Pacific (CWPO) tuna landings. A combination of small and medium scale fisheries in the Philippines and eastern Indonesia land contributes to approximately 20 % of the annual yellowfin catch globally in 1994 to 1995 (Itano, 2000). Tuna fisheries provide vital support to coastal economic development in Indonesia, creating employment in the catching sector and in onshore processing, as well as many thousands of indirect jobs. It is included in the commercially important big-pelagic fish groups caught in Maluku Province waters. Indonesian Ministry of Marine Affairs and Fisheries Division of Fishing data mentioned that there are about 371 units of tuna fishing boats licensed in Fishing Ground Zone 714 (Banda Sea and Tolo Bay) alone, with approximately 10 700 t YFT produced in 2010 (Besewni et al. 2011).

Freshly caught wild marine fishes such as this group are highly perishable that strong preservation methods are required. The warm tropical climate and the geographic hindrance as an archipelago make the preservation efforts more intriguing. The conventional preservation method (cold storage) is usually energy intensive and not affordable for low-income fishermen. Other existing preservation agents were proven either expensive (eg. Lactic acid), or potentially hazardous for public health (eg. formaldehyde). An innovation to the preservation method is thus deemed necessary, in particular in a condition where fishing period has to be prolonged due to the long distance between the fishing ground location and the unloading site.

To date, no information available on the possibility of innovating the cold storage method to preserve YFT. The objective of this paper was to describe the preliminary result of a study carried out to observe the effect of utilizing nano-chitosan to preserve the quality of freshly caught wild young YFT at 4 °C (standard cold storage temperature