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## The Effects of Chitosan Hydrocolloid and Its Oligosaccharides in Comparison with Sodium Pyrophosphate on Some Quality Properties of Vannamei shrimp (*Litopenaeus vannamei*) During Frozen Storage

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### Abstract

In this study, the effects of the coating by chitosan (Cs) and its oligosaccharides (CsO) on some quality properties of peeled vannamei shrimp (*Litopenaeus vannamei*) during 3 months of frozen storage were compared with sodium pyrophosphate (SPP) (1 and 2%), Cs-SPP (1 and 2%) and CsO-SPP (1 and 2%). The moisture content, conjugated dienes (CD), thiobarbituric acid (TBA), color and texture properties of the samples were analyzed. The results showed that coating of shrimp by chitosan and its oligosaccharides, alone or in combination with SPP showed significant effects on the texture characteristics (springiness and chewiness) compared with the control and SPP-treated batches ( $P<0.05$ ). The CD and TBA indices showed an increasing trend during storage ( $P<0.05$ ). In the immersed treatments at CS 1% and in combination treatment with SPP, the TBA value was increased of 0.28 to 0.58 and 0.82 mg malondialdehyde/kg. This index was increased in the control and SPP (1 and 2%) to the 0.92 to 0.97 mg malondialdehyde/kg. According to the results, the treatments coated by chitosan and its oligosaccharide alone or in combination with sodium pyrophosphate had an effective role in inhibiting lipid oxidation and preventing its undesirable effects on frozen shrimp. In addition, color parameters ( $L^*$ ,  $a^*$ ,  $b^*$ ) in the treated samples by chitosan showed positive effects on stabilizing and improving the color of frozen shrimp during storage. Overall, the coating by chitosan and its oligosaccharides could maintain the quality of peeled frozen shrimp.

**Keywords:** Chitoooligosaccharide, Chitosan, Oxidation, Shrimp, Texture

### Introduction

Frozen storage is considering the most common method of preservation for seafood products (Ma, Zhang, Deng, & Xie, 2015). Some undesirable changes such as protein denaturation, lipid oxidation, recrystallization of ice crystals, and drip loss in muscle tissue can still occur during the freeze/thaw process; which negatively affect the product quality and consumer acceptability of shrimp products (Zhang *et al.*, 2018). In this study, the effect of coated peeled

shrimp (*Litopenaeus vannamei*) by chitosan (Cs) and its oligosaccharides (CsO) was studied during frozen storage.

**Materials and methods**

The peeled shrimp were submerged in the prepared solutions as follows: (W) fresh water; Cs and CsO (1, 2%), sodium pyrophosphate (SPP) (1, 2%), Cs+SPP (1, 2%) and CsO+SPP (1, 2%). The coating of samples was done for 1h to allow the diffusion of the cryoprotective substances on to the surface of the shrimp then the coated samples were packed and stored at -18 °C for 3 months. The treatments were subjected to the different experiments of conjugated dienes (CD) (Juntachote, Berghofer, Siebenhandl, & Bauer, 2006), thiobarbituric acid (TBA) (Buege & Aust, 1978), moisture content (AOAC, 2005), color and texture properties (Zhang *et al.*, 2018) (0, 15, 30, 45, 60, 75, and 90 day). This study was analyzed in completely randomized design by split-plot and significant differences of the means were tested by Tukey's test.

**Results and discussion**

The changes of moisture content showed that coating by chitosan and its oligosaccharide led to lower loss of moisture of shrimps during storage. At the end of storage, this content control and SPP (1%) samples was significantly less than other ones. According to the chemical tests, CD and TBA indices showed an increasing values during the storage significantly ( $P<0.05$ ); while it was lower in treated samples by Cs and CsO compared to the SPP treatments. At the first of storage, CD value was ~0.37 at all treatments and at the end of storage, increased to 1.33 to 1.74 at the different treatments ( $P<0.05$ ). The TBA value increased from 0.28 to 0.97 mg MDA/kg sample at the end of storage. Treated shrimps by Cs kept the texture characteristics (hardness, springiness, gumminess, chewiness, cohesiveness) after 12 weeks of storage, compared with the control and SPP-treated batches ( $P<0.05$ ). According to the results, significant changes at the  $L^*$  values of the coated shrimps were observed during storage. The  $L^*$  value of all treated shrimps significantly increased after 6 weeks ( $P<0.05$ ) and it was attributed to changes in light absorption and scattering that were caused by water melting in extracellular spaces.  $L^*$  value revealed that these saccharides had positive effects on color stability during storage (Fig. 1).

Extended Abstract

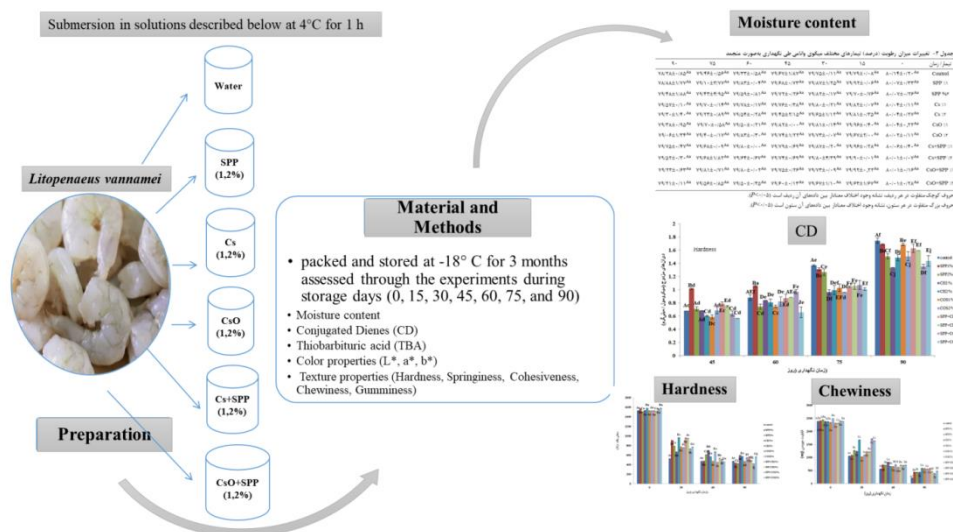


Fig. 1. Graphical abstract of the project

## Conclusion

According to the study, the cryoprotective effects of Cs and CsO on the shelf-life and quality of frozen shrimps were observed. Chitosan and its oligomers have shown great results and might be widely applicable to extend the commercialization of frozen seafood to preserve quality and safety of products.

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