American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)
ISSN (Print) 2313-4410, ISSN (Online) 2313-4402

http://asrjetsjournal.org/

Effect of High Pressure Processing on Sensory and Physical Attributes of Malaysian Shrimps and Mud Crabs

Wael Mohamed [a]*, Johari Endan [b], Yus-Aniza Yusof [c], Rosnah Shamsudin [d], Anvarjon Ahmedov [e]

[a,b,c,d,e] *Department of Process and Food Engineering, Faculty of Engineering, University Putra Malaysia, Serdang, Selangor, 43400, Malaysia*

[a] *Biological and Agricultural Engineering, Faculty of Engineering, University of Khartoum, Khartoum, 11111, Sudan*

[a] *wael_nesta@hotmail.com*

[b] *johari@eng.upm.edu.my*

[c] *yus.aniza@upm.edu.my*

[d] *rosnahs@upm.edu.my*

[e] *anvarjon@upm.edu.my*

Abstract

The present study has investigated the application of high pressures (345 MPa for 5 min) in Shrimps (Penaeus Merguiensis) and Mud crabs (Scylla Serrata) samples. High pressure processing (HPP) treatment would appear to be beneficial in providing freshness and cook appearance to the treated products. According to the results, HPP treatments were resulted in semi-cooked appearance of the treated meat, and have improved the meat hardness in both products. Separation of meat from the shell in the HPP processed Mud Crab was much easier than for Shrimps, which show no significant changes in this matter compared with untreated samples.

Keywords: High pressure processing; Shrimp; Mud crab; Quality; Seafood

1. Introduction

In the seafood industry, consumers always demand high quality minimally processed food that is safe, natural flavor and taste and additive-free convenient products. Besides, they look for acceptable physical appearance, texture and fresh looking food, which cannot be done by other traditional heat treatments.

---

* Corresponding author.

E-mail address: wael_nesta@hotmail.com

It is crucial to ensure that these demands are met without losing the safety of the products. Hence, an alternative non-thermal processing methods in the food industry is needed [1, 2].

On the other hand, consumers who demand fresh foods may be pleased by the refrigerated products, but the short shelf-life of these products is a problem as well [3]. Long shelf-life or shelf-stable products can grab consumer's attention and motivate them to buy [4]. All of that adds commercial opportunities for non-thermal food processing especially high-pressure products.

Malaysian locally consumed seafood products are the main target in the experimental work of this study. Marine shrimps and Mud Crabs have been known as products that are locally cultured for commercial purposes in tidal mudflats of the western coast of Malaysia. Marine shrimp are becoming the most important aquaculture species, and considered as the fastest growing sector in Malaysia [5]. Changes of physical characteristics of Shrimps and Mud Crab following the HPP treatment were studied in this experiment.

2. Materials and Method

Fresh Shrimps and Mud Crabs were purchased from a local fish market (Pazar Awam) in Serdang area at the time day a new and fresh stock was arrived. Shrimps and Mud Crabs were randomly harvested by local fishermen from the west coastal region of Malaysia. Samples were kept at approximately 10 °C during carriage to the lab. Samples were first measured (Figure 1) and packed in flexible containers, and the control samples were kept fresh in water.

Figure 1: Measuring of fresh samples, Shrimp (left) and Mud crab (right).

2.1. HPP Equipment

HPP was carried out using a 5L pilot-scale high pressure food processing unit at Food Packaging Laboratory, Department of Process and Food Engineering, University Putra Malaysia, Malaysia.

2.2. Processing

Packed foods were subjected to high-pressure treatment of 345 MPa, followed by five minutes of holding time. After the vessel was decompressed, and the containers were unloaded, the processed and untreated samples were immediately examined for the separation process and then the meat examined for physical changes. Based visual inspection, the descriptive changes between the two groups were explained.

3. Results

3.1. Effect of HPP on Physical Properties of Shrimps

Figure 2 shows the HPP-treated shrimps after being separation of meat from the shell. No significant differences were observed between the HPP-treated and untreated samples in the easiness of removing the shell. Nevertheless, there are some changes in the color and texture compositions.

Figure 2: Separation of shrimps' meat from their shells after a 345 MPa treatment

As it is clear in figure 3, following the HPP treatment, the color of extracted meat became paler than the unprocessed meat, and it was gained a semi-cook appearance. The whitening effect of HPP on the meat was clearly observed. The hardness of meat was also changed. HPP treated samples showed significantly increasing in hardness comparing to untreated samples. HPP-treated samples swelled after the treatment.

Figure 3: Changes in hardness and volume of untreated samples (left), when compared to 345 MPa processed samples (right) meat

These observations were in agreement with other research that conducted on the effect of HPP treatments on some similar species, like Black Tiger Shrimps [6, 7], and Prawns [8].

3.2. Effect of HPP on Physical Properties of Mud Crab

In the case of Mud Crab (Figure 4), the HPP-treated Crab showed a significant improvement in the separation process of meat in comparison to untreated one. It was easier to remove the shell and extract the meat. Same sensory changes that appeared in the HPP-treated shrimps had also been observed in these treated Crabs. HPP-treated samples showed significant changes in color when compared to untreated control samples. The meat also becomes harder, stiffer and gained more volume than the control.

Figure 4: Separation of meat from shell in Mud crab after 345 MPa treatment

4. Discussion

The observations of the effect of high pressure processing on the color and texture of Shrimps and Mud crab are recognized as a general effect of HPP on seafood. The results matched mash with some HPP works obtained from works that conducted on other seafood products like Salmon [9], Rainbow Trout and Mahi Mahi [10].

HPP prompts changes in muscle enzymes, meat proteolysis, and myofibrillar proteins, as a result, the structure and texture of the meat changed during the process [2]. Denaturation of muscle proteins including myofibrillar protein in meat can explain the increasing of hardness with elevated pressure. Muscle proteins are unfolded up to a pressure of 300 MPa, above that it will result in high denaturation, gel formation and denser structure of the meat [11, 12]. Yamamoto, et al. [13] reported that the pressure enhancement in the hardness meat could be a result of the denaturation of myosin molecules at pressures that exceeding 100 MPa. Elevated hydrostatic pressure causes formation to the structures that contain hydrogen bonds.

On the other hand, the change of the color of meat as an effect of HPP is can be probably due to the denaturation of globin and/or heme displacement. According to Cheftel and Culioli [12], the whitening effect is starting between the ranges from 200 to 350 MPa. Another suggestion that the pressure is induced coagulation of myofibrillar proteins can be a reason behind the changes of the color of meat [14].

Cruz-Romero, et al. [15] has proposed that the color change is due to the release of iron ions from the muscles because of lipid oxidation that caused by the degradation of the major carotenoid pigment. Although, meat color is an important parameter in the consumer perception of meat quality. HPP treatment still has less effect on color compared to thermal treatments [9, 16, 17].

5. Conclusion

HPP pressurized Shrimp and Mud crab samples were resulted in a semi-cooked appearance of the treated meat, and have improved the meat hardness in both of them. Separation of HPP processed Mud Crab meat from the shell was much easier than for Shrimps, which show no significant changes in this matter compared with untreated samples. Besides the ability of high pressure processing to achieve a satisfactorily microbial safety to add value the treated products, this study has also shown that the HPP of Shrimps and Mud crabs can deliver a products with cook appearance and hard texture that can be marketed as a ready-to-eat food.

References

[1] J. Smelt. "Recent advances in the microbiology of high pressure processing." Trends in food science & technology, vol. 9, pp. 152-8, 1998.

[2] N. Rastogi, K. Raghavarao, V. Balasubramaniam, K. Niranjan, and D. Knorr. "Opportunities and challenges in high pressure processing of foods." Critical reviews in food science and nutrition, vol. 47, pp. 69-112, 2007.

[3] J. A. Torres and G. Velazquez, "Commercial opportunities and research challenges in the high pressure processing of foods," Journal of Food Engineering, vol. 67, pp. 95-112, 2005.

[4] R. Deliza. "The Effects of Expectation on Sensory Perception and Acceptance." Ph.D. thesis, University of Reading, 1996.

[5] M. H. B. H. Mahmud. "Shrimp seed Production in Malaysia," presented at the Proceedings of the Aquaculture Workshop for SEAFDEC/AQD Training Alumni, Iloilo, Philippines, 1993.

[6] T. Jantakoson, K. Kijroongrojana, and S. Benjakul. "Effect of high pressure and heat treatments on black tiger shrimp (Penaeus monodon Fabricius) muscle protein." International Aquatic Research, vol. 4, pp. 1-12, Dec. 2012.

[7] B. Kaur, N. Kaushik, P. S. Rao, and O. P. Chauhan. "Effect of high-pressure processing on physical, biochemical, and microbiological characteristics of black tiger shrimp (penaeus monodon)." Food and Bioprocess Technology, vol. 6, pp. 1390-400, Jun. 2013.

[8] M. E. López-Caballero, M. Pérez-Mateos, J. A. Borderías, and P. Montero. "Extension of the shelf life of prawns (penaeus japonicus) by vacuum packaging and high-pressure treatment." Journal of Food Protection, vol. 63, pp. 1381-8, 2000.

[9] Y. Yagiz, H. G. Kristinsson, M. O. Balaban, B. A. Welt, M. Ralat, and M. R. Marshall. "Effect of high pressure processing and cooking treatment on the quality of Atlantic salmon." Food Chemistry, vol. 116, pp. 828-35, Oct. 2009.

[10] Y. Yagiz, H. Kristinsson, M. Balaban, and M. Marshall. "Effect of high pressure treatment on the quality of rainbow trout (Oncorhynchus mykiss) and mahi mahi (Coryphaena hippurus)." Journal of Food Science, vol. 72, pp. C509-15, 2007.

[11] X. D. Sun and R. A. Holley. "High hydrostatic pressure effects on the texture of meat and meat products." Journal of Food Science, vol. 75, pp. R17-23, 2010.

[12] J. C. Cheftel and J. Culioli. "Effects of high pressure on meat: a review." Meat Science, vol. 46, pp. 211-36, 1997.

[13] K. Yamamoto, Y. Yoshida, J. i. Morita, and T. Yasui. "Morphological and physicochemical changes in the myosin molecules induced by hydrostatic pressure." Journal of Biochemistry, vol. 116, pp. 215-20, Jul. 1994.

[14] A. Sequeira-Munoz, D. Chevalier, A. LeBail, H. S. Ramaswamy, and B. K. Simpson. "Physicochemical changes induced in carp (Cyprinus carpio) fillets by high pressure processing at low temperature." Innovative Food Science & Emerging Technologies, vol. 7, pp. 13-8, 2006.

[15] M. Cruz-Romero, J. Kerry, and A. Kelly. "Changes in the microbiological and physicochemical quality of high-pressure-treated oysters (Crassostrea gigas) during chilled storage." Food Control, vol. 19, pp. 1139-47, 2008.

[16] M. Hendrickx, L. Ludikhuyze, I. Van den Broeck, and C. Weemaes. "Effects of high pressure on enzymes related to food quality." Trends in Food Science & Technology, vol. 9, pp. 197-203, 1998.

[17] T. Ohshima, H. Ushio, and C. Koizumi. "High-pressure processing of fish and fish products." Trends in Food Science & Technology, vol. 4, pp. 370-5, 1993.