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The use of different packing medium in the cold anaesthetization of blue swimmer crab (*Portunus pelagicus*) on the survival and sensory quality under live storage

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Key words: Survival rate, Sensory evaluation, Acceptability, Packing medium, Blue swimmer crab

Abstract

Blue swimmer crab (*Portunus pelagicus*) is considered as high priced crustacean in Southeast Asia, valued and in demand in the market for its delicate and flavorful meat. The present work was carried out with a view of determining the survival rate for live storage of blue swimmer crab in chilled sawdust, rice hull and wet cloth. Randomized Complete Block Design (RCBD) was used to set up the study in three (3) corresponding replications. This study also aimed to determine the acceptability of the meat quality of blue swimmer crab in terms of appearance, aroma, mouthfeel with texture and taste. Sensory evaluation utilized the mixed method particularly descriptive and experimental research design with four (4) different treatments; T_0 - Untreated (fresh caught), T_1- sawdust, T_2 - rice hull and T_3 - wet cloth. The study was conducted at Busalian Island, Talibon, Bohol, Philippines. Self-constructed questionnaire was used as a tool for gathering the data needed for the study. Results showed that the blue swimmer crab in Treatment 3 got the highest survival rate of 95.83% while Treatment 2 got the lowest survival rate of 87.5%. In terms of sensory evaluation, Treatment 1 got the highest mean score of 8.95, 8.89 and 8.91 in terms of appearance, aroma and mouthfeel, respectively, while the Treatment 3 got the highest mean score of 8.98 in terms taste. This implies that wet cloth is the best packing medium for live storage of blue swimmer crab and sawdust is recommended for better sensory quality.

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Introduction

Blue swimmer crab (*Portunus pelagicus)* is considered as one of the most commercially important and well traded seafood commodity. It is one good source of nutritious food and one of the most favorite of Filipinos and foreign people (Yap *et al., 2*020). It is a source of highly calories fat and cholesterol, protein and carbohydrates and vitamins of Filipino even of people of foreign countries. It is used as a raw material in the processing industries. Because of its high commercial value, most fisherman regarded Blue Swimming Crab cultivation as one of the best option.

One of the most important activities in the crustacean industry that always looks ways to raise the value of the finished product is live storage. The current methods of transport utilize water which is messy and costly. This new technique will provide tremendous savings as well as increase the survival of commodities during transport (Comandante, 2004). Many studies have been conducted on how to make culture and wild caught crustaceans more marketable and how to transport them alive while maintaining the highest level of freshness (Salin and Jayasree, 2001). Transporting live shrimp has emerged as a key practice within the shrimp industry, which continually seeks to improve the quality of the end product. This is used as a means to enhance the unit value of the marketed shrimp. Researches has been dedicated to enhancing the marketability of both cultured and wild-caught shrimp, focusing on transporting them live to maintain optimal freshness.

Currently, Kuruma shrimp *P. japonicus* (Bate) stands as the sole shrimp commercially transported live, undergoing cold-induced hibernation within chilled sawdust. This unique process renders it the priciest shrimp in Japan, as noted by Salin and Vadhyar (2001). A study on the same year was conducted with Black Tiger Prawn (*Penaeus monodon*) applying moderate chilling rate for four (4) hours and was found to be optimum. In 2005, trials on Giant Freshwater Prawn (*Macrobrachium rosenbergii*) was carried out and found out that there were no significant difference in the larval hatch fecundity, survival rate and the production of post larvae between the treatment and control, indicating that the method of cold anaesthetization and live storage of berried prawns could be used for successful transportation of broodstock.

Sawdust such as coconut sawdust is a by- product or waste product of wood working operations such as sawing, sanding, milling, planning and routing. Coconut sawdust is a versatile material that can be used as a chilling medium. It is a good insulator and has a high water- holding capacity, which makes it ideal for keeping food and other items cold (Castro, 2012). Rice hull, on the other hand, have been investigated as a potential chilling medium for a variety of applications, including food preservation, transportation and cold storage. According to Wah Loy (2020), rice husk has been used as composite fillers and thermal insulators in the modern industry and it is available locally. Rice husk is usually used for wall and roof insulation. A wet cotton cloth is another good insulator and can also help to keep crabs moist. Due to cotton fabric high tensile strength, the fabric is strong and durable and is more durable when wet. This result with better insulation and higher comfort.

Much research has already been conducted to optimize the survival and high quality meat products of shrimps but very limited attempts was carried out for crabs. Hence, this study was carried out in order to determine the survival rate of blue swimmer crab using different packing medium in live storage as well as the sensory meat quality of the revitalized crabs.

Materials and methods

Experimental crabs

Wild-caught blue swimmer crabs (*Portunus pelagicus*) of medium sizes were used in the present study. The initial water temperature of the condition tank is 28± ℃. A total of 72 healthy crabs were used for the experiment and only those without injury were conditioned in a 1000L circular fibertank, half-filled with clean seawater for 12 hours before transferring them to a chilling tank.

Preparation of the packing media

Sawdust, rice hull and cloth were cleaned with clean potable water before sun-dried. These were slightly moisten, packed using plastic bags, sealed and kept in cold storage for 3-5 hours to lower temperature until 10℃. The choice of wet cloth as chilling medium is clean cotton cloth, properly washed, packed and chilled.

Cold-anaesthetization, packing, live storage and revitalization

The conditioned crabs were weighed and placed inside a plastic chilling tank with aerated seawater. The water with initial temperature of 25±℃ was gradually cooled down to a temperature of 10°C over the course of at least two (2) hours. A portable thermocouple was used to monitor the water temperature in the chilling tank. After then, crabs became immobilized and could be easily handled. The changes of the experimental crabs were closely monitored and observed during the entire cold anaesthetization process.

The well-behaved and manageable cold-anaesthetized crabs were carefully stored in polystyrene box at a density of eight (8) crabs per cubic meter. These crabs were arranged carefully in two) (2) layers between three (3) layers of chilled packing medium with 5cm thickness. A pack of 500 grams crushed ice was placed at the top of the layers to maintain temperature during cold storage.

The cold anaesthetized crabs were live stored for six (6) hours and revitalized by transferring them into revitalization tanks containing aerated seawater with an initial temperature of 15°C which was gradually increased to 28± ℃ over a period of 3 hours. The crabs which regained activity and showed active movement for over 12 hours were regarded as revitalized and their survival rate was recorded.

Determination of weight loss

A calibrated 0.1g precision digital weighing scale was used for weight measurements. The crabs were weighed before cold anaesthetization and within 6 hours of revitalization after live storage.

Sensory evaluation

The sensory evaluation of the revitalized crabs after live storage and the untreated crabs (freshly caught) as control treatment was carried out in cooked form. Crab pickers from Busalian Island Crab Station was considered as panel of quality evaluators. For each packing medium, samples of revitalized crabs which survived were drawn separately from the respective boxes. For cooking, samples were steamed for 10-15 minutes and presented to the respondents for sensory evaluation of the meat. A self- constructed rating sheet was used to determine the respondent's sensory perception in terms of its appearance, aroma, mouthfeel with texture and taste adopting the 9-point hedonic scale described as follows: 9.0- 8.2 Like Extremely (LE), 8.1- 7.3 Like Very Much (LVM), 7.2- 6.4 Like Moderately (LM), 6.3- 5.5 Like Slightly (LS), 5.4- 4.6 Neither Like nor Dislike (NLND), 4.5- 3.7 Dislike Slightly (DS), 3.6- 2.8 Dislike Moderately (DM), 2.7- 1.9 Dislike Very Much (DVM), 1.8- 1.0 Dislike Extremely (DE).

Statistics

The experiment was conducted using a randomized complete block design (RCBD) in three (3) corresponding replications in each treatment. Results were subjected to One-Way Analysis of Variance (ANOVA) at <0.05 level of significance. For significant results, Post-Hoc analysis was carried out.

Results and discussion

During cold anaesthetization, crabs were observed to have gradually decreased its chelae and walking legs movements and twitching its eyestalk. As the temperature were adjusted back to normal at revitalization process, crabs manifested branchial and eyestalk movements and started to walk on the sides. Aeration in the water was found to have a strong influence on the recovery of the cold-anaesthetized crabs. The optimum temperature control from anaesthetization up to revitalization plays a crucial role on the entire process. Temperature is one of the most important factors influencing crustacean survival during water transport (Barrento *et al.*, 2011; Dong *et al.,* 2019).

Table 1. Percentage survival of blue swimmer crab (*Portunus pelagicus)* at different packing medium

Treatment	Replication			Total	Mean (%)
	I	II	III		
T_1 (sawdust)	87.50	100	87.50	275	91.67
T_2 (rice hull)	100	87.50	75	262.50	87.50
T_3 (wet cloth)	100	100	87.50	287.50	95.83

Table 2. Percentage weight loss of blue swimmer crab (*Portunus pelagicus)* revitalized after live storage at 10°C at different packing medium and after cold anaesthetization from 25 °C

Treatment	No. of crabs stored	Mean weight (g)		Weight Loss (%)
		Before chilling treatment	After revitalization	
T_1 (sawdust)	8	1058.9	1029.4	2.79
T_2 (rice hull)	8	1058.1	1029.2	2.73
T_3 (wet cloth)	8	1046.4	1042.7	0.35

Table 3. Sensory quality attributes of blue swimmer crab (*Portunus pelagicus)* under live storage using the 9-point Hedonic scale

Treatments	Appearance		Aroma		Mouthfeel		Taste	
	Mean	DR	Mean	DR	Mean	DR	Mean	DR
T_0 (untreated/fresh)	8.86	LE	8.87	LE	8.87	LE	8.94	LE
T_1 (sawdust)	8.95	LE	8.89	LE	8.91	LE	8.95	LE
T_2 (rice hull)	8.86	LE	8.87	LE	8.85	LE	8.94	LE
T_3 (wet cloth)	8.86	LE	8.87	LE	8.90	LE	8.98	LE

The results obtained on the percentage survival of blue swimmer crab (P*ortunus pelagicus*) cold anaesthetized at three (3) different packing medium and stored live are summarized in Table 1. The highest survival rate of 95.83% was obtained from the crabs packed in chilled wet cloth (T3) whereas, chilled rice hull in Treatment 2 got the lowest survival percentage of 87.5%. This result corroborated with the study of Shields and Smith (1995) using cotton cloth as a chilling medium for live storage of blue crabs (*Callinectes sapidus*). The results showed that the cotton cloth was an effective chilling medium for live storage of blue crabs. Cotton cloth was able to maintain a lower temperature in the water than crushed ice, and it also maintained a higher oxygen level.

In terms of weight loss, the mean weight of blue swimmer crab before cold anaesthetization and after revitalization after live storage are presented in Table 2. A decline in the mean weight of revitalized shrimps was observed in all the treatments tested. The percentage weight loss obtained was higher for Treatment 1 (chilled sawdust) and lower for Treatment 3 (wet cloth). The Analysis of Variance of the data on weight measurements, however, showed that these variations were not statistically significant. Weight loss caused by live shipment out of water has been reported to be about 7.59% in the case of *Scylla serrata* (Parvathy *et al.,* 2020).

Sensory evaluation on the meat quality of the treated crabs and untreated crabs as control treatment was carried out. The appearance, aroma, mouthfeel with texture and taste of the four (4) treatments were represented in Table 3. There were differences in the meat appearance of the cold-anaesthetized, live stored blue swimmer crab. Treatment 1 got the highest mean score of 8.95 which was described as Like Extremely. Statistically, the mean scores of Treatment 1 was significantly different ($P<0.05$) from Treatment 2. But in the case of the control treatment, results show that that appearance is not significant among the other treatments. This implies that, the quality of the treated crabs in terms of physical appearance is as good as the untreated one.

In terms of aroma and mouthfeel with texture, Treatment 1 got the highest mean score of 8.89 and 8.91, respectively, described as Like Extremely. Treatment 0, 2, and 3 also got the acceptability mean scores which were also described as Like Extremely.

Aroma and mouthfeel are somehow interconnected since according to Bordiga and Nollet (2019), up to 80% of what we feel in the mouth are actually aroma. Moreover, Treatment 3 got the highest mean score of 8.98 in terms of taste which implies that chilled wet cloth is not only ideal in terms of higher survival rate and minimal weight loss but also has good taste which competes greatly with the control treatment. Taste is the number one purchase driver for food and drink products; a superior taste is key to creating a strong product experience (Tyle, 1993). Treatment 0 and Treatment 2 on the other hand got the lowest mean score of 8.94 both described as Like Extremely. Statistically, results on aroma, mouthfeel with texture and taste are found to be not significant across all four (4) treatments.

Conclusion

In conclusion, the use of chilled wet cloth is ideal for live storage in cold-anaesthetized crabs due to its high survival percentage upon revitalization. Also, it was found to have the lowest weight loss compared to other packing medium in the experiment. In terms of its sensory quality attributes, chilled sawdust is the most preferable in terms of appearance, aroma and mouthfeel with texture. Chilled wet cloth on the other hand, is the most preferable in terms of taste.

Recommendation

This work is a preliminary study on cold anesthetization and live storage of Blue Swimming Crab in various packing medium. The findings from these investigations are intended to lay the groundwork for future research aimed at standardizing the technology for handling, packing, and transporting blue swimmer crabs, whether farm-reared or wild-caught, in live conditions out of water. Additionally, the potential application of this technology for transporting shrimp broodstock from their natural collection sites to hatcheries whether as adult broodstock for captive maturation or as ripe spawners-represents another area that warrants further exploration by aquaculture researchers.

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