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STUDY ON THE INFLUENCE OF ANESTHETIZING TEMPERATURE AND TIME ON TIGER SHRIMP (*Penaeus monodon* Fab.) SURVIVAL RATE IN DRY TRANSPORTATION SYSTEM

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ABSTRACT

The objective of this research was to find out the best temperature, time, and handling method for black tiger shrimp transportation with dry system. Anesthetizing method was applied in this research by adopting gradual cooling at the rate of 5 °C per hour. Anesthetizing was done at various temperatures (19, 17, and 15 °C) and time at critical temperature (10, 15, and 20 minutes) with package temperature of 17 °C. The result showed that the survival rate of black tiger shrimp (*Penaeus monodon* Fab.) was affected by the anesthetizing temperature, but not by the length of the cooling time at the critical temperature. The optimum temperature for anesthetizing and length of time were 15 °C and 10 minutes at critical temperature, respectively. Meanwhile, the optimum temperature for transportation was 17 °C, which gave the highest survival of the black tiger shrimp.
Key words: Anesthetizing, black tiger shrimp, dry transportation system.

INTRODUCTION

Recently, the consumer demand of fish commodity, especially live shrimp, has become more and more increasing. This causes harder and tighter trading competition in international shrimp market. It is forecasted that the competition will continue to increase in the coming years. To increase the export Appropriate technology relevant to the demand and condition of Indonesia is needed for that purpose. Unfortunately so far, the technology applied for live shrimp transportation still uses water as medium that is less safe, high risk, and less efficient (Suparno *et al.*, 1994). Research for seeking the appropriate technology is a necessity.

One of the alternative methods used for exporting live shrimp is the dry system with low temperature handling. This system works very well if the optimum condition is known. The low temperature can be obtained by lowering it gradually or directly (Wibowo, 1993; Suparno *et al.*, 1994; Nitibaskara, 1996; and Setiabudi *et al.*, 1995). With low temperature handling, the live shrimp is made in anesthetic condition before packed and transported (Berka, 1986).

competitiveness of shrimp in international market, various actions have been conducted. One of them is by changing the method from fresh frozen (dead) to fresh live. One of the important reasons for using fresh live exporting method of shrimp is that the price can reach three to four times as much as the dead frozen (Suparno *et al.*, 1994). Japan, Europe, and America are potential markets for this kind of products

Principally, in this system the shrimp is conditioned in such a way that its metabolism and respiration rates are low. With such condition, the shrimp has high survival outside its living habitat (Berka, 1986; Basyarie, 1990). From the previous research, important information on the critical temperatures for anesthetizing tiger shrimp for dry handling with low temperature was obtained. The critical anesthetizing temperatures were 19, 17, 15, 14 and 12 °C, with length of anesthetizing time ranging from 10 to 20 minutes (Wibowo, 1993; Soekarto and Wibowo, 1993; Prasetyo, 1993; Nitibaskara, 1996).

The objective of this research was to find out the best anesthetizing temperature and time and capable to keep the survival of pond tiger shrimp in non-water medium during transportation using controlled cooling system.

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Transportation test was also conducted to find out the effectiveness of the obtained method in keeping the survival rate of tiger shrimp using cold saw dust medium.

METHODOLOGY

Materials and Equipment

Materials used in this research were pond tiger shrimps (*Penaeus monodon* Fab.) taken alive, healthy, and normal with a size of 40 heads per kilograms. Packages used were made of styrofoam material, shelf-type, with saw dust as storage medium. The equipment used consisted of devices for shrimp catching and transporting, acclimatization and culturing, anesthetization box, aerator, and transportation test

Method and Procedure

Three experiments were conducted in this research, i.e., study on the effect of gradual anesthetizing temperatures, study on the effect of gradual anesthetizing time, and transportation test limited on storage (Figure 1).

Treatments used for the study on the effect of gradual anesthetizing temperatures comprised: gradual anesthetizing method, anesthetizing temperatures (15, 17, and 19 °C), length of anesthetizing time of 10 minutes after two hour gradual temperature lowering, room temperature of package of 17 °C, and time for transportation test of 15 hours. The treatments used for anesthetizing time experiment were gradual anesthetizing method, anesthetizing temperature (result of experiment 1), anesthetizing time for 10, 15, and 20 minutes after two hour gradual temperature lowering, package room temperature (17 °C), and time for transportation test of 15 hours. As for the transportation test, the results of the experiments 1 and 2 were used for treatments, consisting of gradual anesthetizing method, anesthetizing temperature (the best temperature resulted from the experiment 1), anesthetizing time (the best time resulted from the experiment 2), package room temperature (17 °C), time of transportation test (18, 21, and 24 hours).

The anesthetizing procedure used in the three experiments was conducted as follows: the shrimp was placed in the anesthetizing box. And then, the temperature of the water inside the box was gradually lowered with a rate of 5 °C/hour until the desired temperature was reached, and kept at a length of time already set up before. Moist saw dust at 17 °C was provided and placed inside the shelf-type styrofoam package. The anesthetized shrimp (fainted) was put inside the package filled with cold saw dust as medium. The package was then put inside a room with a temperature of 17 °C and transported during a given period of time. After transportation, unloading and recovering process were conducted by placing the shrimps inside normal seawater having temperature ranging from 27 to 27.5 °C with high aeration.

Observation

Observation was conducted on the activity of the shrimps during the processes of anesthetizing, packaging, unpacking, number of survived and dead shrimps, and time required for recovery. Temperature inside the package was also observed during transportation.

Determination of the Optimum Anesthetizing Temperature and Time

The determination of anesthetizing temperature and time was done based on the activity and condition of the shrimps during anesthetizing, packaging, unpacking, and recovering as well as the highest survival rate.

RESULTS AND DISCUSSION

Effect of Anesthetizing Temperature

Results of the experiment on the effect of anesthetizing temperature indicated that the anesthetizing at 19 °C dan 17 °C for 10 minutes gave relatively no difference. The condition of the shrimp after anesthetizing still showed strong wiggling, the panic phase had not been through, not collapsed, and not stayed still. This condition gave some difficulties in the packaging process. Besides, the shrimps were still alive and moving during transportation. It was apprehended that the shrimps were still had high metabolism rate which in turn would affect their survival rate (Basyarie, 1990). Whilst, the anesthetizing at 15 °C for 10 minutes resulted in the condition that the shrimps were not moving, already collapsed, and the panic phase had been through (at 15,8 °C), and showing no response. This condition made the packaging process easier and the shrimps was already in the condition of low level of metabolism rate (Berka, 1986).

The condition of the shrimp during unpacking after 19 °C and 17 °C anesthetizing also relatively showed no difference. The position of the shrimps had changed, showing movement and wiggling. When put inside water for 0 to 5 minutes for recovering, only a few was directly vigorous and actively swam, while the others were still collapsed. At the 10^{th} to 15^{th} minutes most of the shrimps began to be vigorous, active, responsive, and agile. In general, the shrimps were in normal condition after 30 minutes. Anesthetizing at 15 °C resulted in such condition where during unpacking the shrimps were still calm, no sign of position changing and wiggling. When put inside water, most of the shrimps were directly recovered and actively moved at the 2^{nd} and 3^{rd} minutes. At the 10^{th} minutes, most of the

shrimps were vigorous, active, responsive, and agile. In general the normal condition was reached at the 25th to 30th minutes.
at 15 °C resulted in the highest survival rates, i.e., 95.0 % at 15 °C, 88.3 % at 17 °C, and 86.7 % at 19 °C, consecutively.

Effect of Anesthetizing Time

Results of the experiment indicated that the time at critical anesthetizing temperature for 10, 15, and 20 minutes relatively gave no differences in the activities and conditions of the shrimps after anesthetized. The shrimps had collapsed, gave no wiggling and responses. The panic phase occurred at the range from 15.7 to 15.9 °C either for 10, 15, or 20 minutes of time used at critical anesthetizing temperature. For the survival rate during 15 hour transportation, there were also no significant differences, i.e., 95.0%, 93.3%, and 90.0% for 10, 15, and 20 minutes of anesthetizing time, respectively.

The difference was only seen in the speed of recovery. When put inside water for recovering, most of the shrimps treated with 10 minute anesthetizing time at critical temperature were directly recovered and actively swam at the 2nd and 3rd minutes. In general, the shrimps began to become normal after 30 minutes of recovering process. For the 15 minutes anesthetizing time, around 50 % of the shrimps directly became vigorous and actively swam at the 5th minutes after recovering process. In general, most of the shrimps had already been vigorous, responsive, and actively swam at the 30th to 35th minutes after recovering process. Only a few of the shrimps with 20-minute anesthetizing time became stable and normal, and moved actively at the 5th and 7th minutes after recovery. At the 35th and 40th minutes most of the shrimps became vigorous, active, responsive, and actively swam.

It was obvious from the experiment results that the faster the anesthetizing process, the sooner the shrimps became recovered and the lesser the energy was required. Consequently, it was found that the 10-minute anesthetizing time was the best or optimum. Furthermore, the package temperature was relatively stable and able to retain so during the 15-hour transportation, i.e., ranging from 16.7 °C to 17.3 °C.

For the survival rate experiment after 15 hours storage, , the anesthetizing

Transportation Test

Result of the transportation test on the pond black tiger shrimp was found to be satisfying. The gradual anesthetizing at 15 °C for 10 minutes and package room temperature of 17 °C using shelf-type packaging was capable of making the shrimps strong enough during the transportation with survival rates up to 91.7 % for 18 hours, 84.4 % for 20 hours, and 72.9 % for 24 hours. The results seemed to be highly prospective considering that the previous research conducted (Wibowo, 1993; Soekarto and Wibowo, 1993; Prasetyo 1993) resulted in a survival rate of only 60 % for 19-hour transportation. The direct anesthetizing method used in the research conducted by Wibowo and Setiabudi (1995), at 18 °C for 15 minutes, indicated that around 55% of the black tiger shrimps could survive for 16 hours, and 40 % for 19 and 22 hours.

The research results also indicated that the change in temperature of the packages stored in cold room with controlled temperature at 17 °C was very small. This condition made the shrimps remain calm, slightly move, with less activities of metabolism and respiration, so that the survival was expected to be high (Berka, 1986). Considerable change in temperature is assumed to have bad effect on the survival of shrimps. High temperature would cause shrimps to recover sooner and have high activity. The higher the activities are, either physically or metabolically, the higher the oxygen supply needed. Since the supply of oxygen in the package with dry medium was limited, the shrimps will suffer from lack of oxygen which in turn caused mortality (Setiabudi *et al.*, 1995).
If the temperature inside the package could be kept stable, then the survival of the shrimps inside the dry medium would also increase. With the stable temperature, the physical as well as metabolic activities of the shrimps were low, so that the oxygen consumption was also low (Berka, 1986).

It was seen from the result of the experiment that after 24 hours, the package room temperature was relatively stable and could be retain as so during the transportation, i.e., kept at approximately range of temperature from 16.8 to 17.3 °C (Figure 2).

CONCLUSSION

Anesthetizing with low temperature conducted gradually (5 °C/hour) affected the survival rate of pond tiger shrimps in dry medium of transportation. The best or optimum temperature was 15 °C.

Anesthetizing time with low temperature gradually conducted (5 °C/hour) relatively had no effect on the survival rate of the pond tiger shrimps in dry medium of transportation. But anesthetizing time at critical temperature resulting in the best condition of the shrimps for transportation was 10 minutes at critical

temperature. Anesthetizing technique with gradual lowering of temperature (5 °C/hour) up to package room temperature of 17 °C resulted in survival rates of 91.7% for 18 hours, 84.4 % for 15 °C and retained for 10 minutes 21 hours, and 72.9 % for 24 hours. The survival rate in a perfect condition could reach 100 %.

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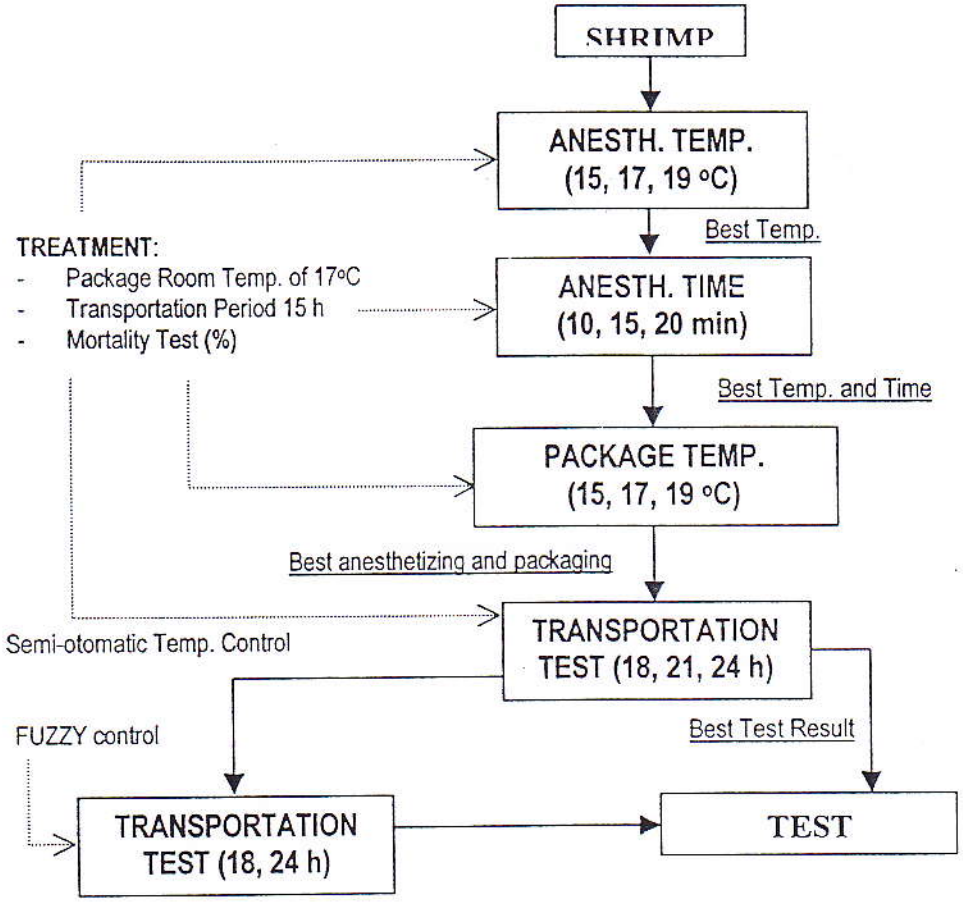

Figure 1. Research procedure for finding the best value

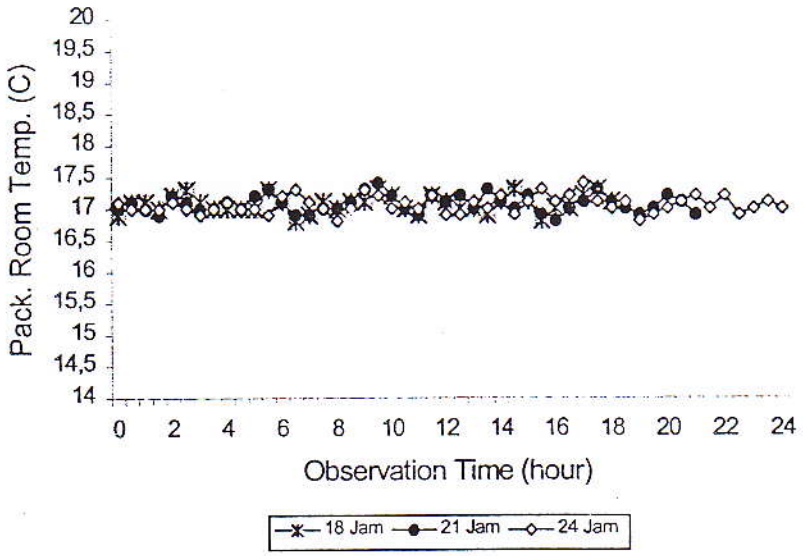

Figure 2. Pattern of change in room temperature during the transportation test