



# Effect of low temperature on the survival of edible oyster *Crassostrea madrasensis* during transportation and storage

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Short Communication

## Abstract

The survival of the tropical edible oyster (*Crassostrea madrasensis*) was examined under the condition of ice-storage in a rectangular thermocol-transport box for a period of 48 h. A total of 100 two-year old farmed oysters were used for the experimental transportation. Inside the box, all oysters were arranged in four layers covered with wet-gunny bags and lined on the top and bottom with ice. Surface and bottom temperature of the transport box varied from 9.7 to 25.2° C and 9.7 to 28.4° C respectively during the 48 h exposure. The patterns of changing temperature at both surface and bottom were found to be different. Recoveries of the oysters at every two hours till 48h were monitored by taking random samples from the box. All the oysters recovered within 1 h of being placed back into seawater and there was close to 100% recovery within 2 hours. Survival was more than 90% after 8 days of the experiment.

**Keywords:** Low temperature, survival, edible oyster, transportation.

## Introduction

Oyster is very rich in protein and minerals and is generally sold with shell-on and consumed fresh throughout the world. Eating oyster in raw form is good for health because cooking reduces the quantity of amino acids. Most oysters produced in the UK are distributed live and are frequently eaten raw

or sometimes lightly cooked (Stroud, 1981). In India, edible oyster, *Crassostrea madrasensis* farming is being practiced by several farmers, especially women Self-Help Groups in central Kerala employing the rack and ren method in the estuaries and backwaters. However, farmed oysters do not find ready market acceptability and good price. After introduction of depuration system for high-end restaurants through the National Agriculture Innovative Project (Mohamed *et al.*, 2011), consumer confidence in the product has increased and thereby, rate per live oyster has increased from Rs. 1 to Rs. 7.5. Thus, the live oyster value chain has been developed in the city of Kochi and has great scope to expand to other metro cities (Mohamed and Kripa, 2013). The estimated production of farmed oysters from India in 2010 is 3200 tonnes (FAO, 2012). It is generally understood that to maintain a high survival rate and good meat quality throughout storage, one must pay careful attention to many factors including condition of the oysters, packaging, humidity and temperature. If the live value chain has to expand in other cities, there is a need for long distance transportation of live oysters and for its survival in a display unit or tank. Although few relevant studies have been carried out (Rajapandian and Muthiah, 1987; Samuel *et al.*, 1987), no information about the storage condition and survival of edible oysters in the transport box during long distance transportation are available. Therefore, the aim of the present study was

to test the effect of low temperature on the survival of the live oyster during long distance transportation and thereafter its recovery period in tank and thereby to evolve an effective live oyster transport protocol.

### Material and methods

A total of 100 two year old farmed depurated oysters were used in the present experiment. The oysters were collected from a Sathar Island oyster farm, brushed clean of all epibionts, kept moist and used for the experiment within 6 hours. Experiments were undertaken at the Edible Oyster Hatchery of Central Marine Fisheries Research Institute, at Narakkal, Kochi, India. The mean length, width, depth and weight of the oysters were 69.96 mm, 54.95 mm, 28.17 mm, and 61 g respectively. Oysters were kept in a rectangular thermocol box 50x30x35 cm, with total volume of 30 litre. 100 oysters were placed in four vertical layers (i.e., 25 oysters in each) and covered with a wet gunny (jute) bag (Fig.1) at the top and bottom. The box was packed with ice at the top and bottom at a thickness of 5 cm and perforated thermocol sheets were

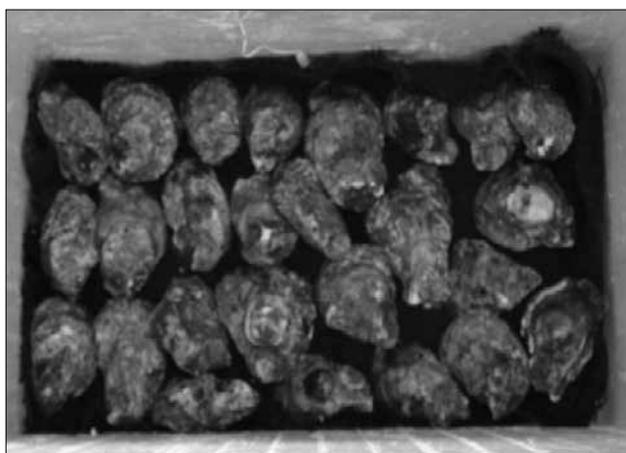


Fig 1. Oysters placed on wet gunny bag arranged in the thermocol box

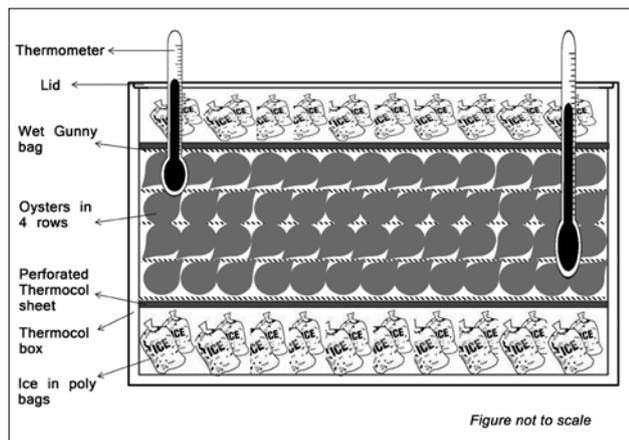


Fig 2. Cross section of rectangular thermocol-transport box with oysters

Table 1. Temperature recordings in the experimental box containing oysters and their recovery percentage.

Time (h)	Temperature(°C)		Recovery (%)	Time taken for recovery (mins)
	Surface	Bottom		
00	15.8	28.4	-	-
02	15.5	28.0	100	2
04	14.7	21.3	100	2
06	13.5	16.7	100	2
08	11.1	13.5	100	2
10	09.7	10.9	100	2
12	13.4	09.9	100	3
14	13.9	09.7	100	3
16	14.0	10.0	100	3
18	15.6	10.8	100	3
20	17.0	12.1	100	3
22	17.8	13.7	100	5
24	19.2	16.1	100	5
26	19.4	17.9	100	5
28	20.8	19.3	100	5
30	21.3	19.6	100	5
32	21.9	20.1	100	5
34	22.7	21.7	100	6
36	23.0	23.2	100	6
38	23.6	24.0	100	8
40	23.6	24.8	100	8
42	23.9	25.1	100	8
44	24.0	25.3	100	9
46	24.6	25.5	100	11
48	25.2	25.7	100	11

placed at both ends in order to avoid direct contact of oysters with ice (Fig.2).

The ice packs used in the experiment were prepared by using freshwater, which was packed in polythene zip-lock covers and placed in deep freezer. The polythene cover was used to curtail the leaking of melted water. Two thermometers were placed at both ends of the box for measuring temperature at the surface and bottom of the oyster layers respectively at an interval of two hours. Two oysters were taken from the box at every two hours and placed in a tank containing filtered seawater for monitoring continually their recovery. Recovery in oyster was defined as the length of time between release and the closure of animal shells in response to touching of their mantle tissue (Norton *et al.*, 1996). This experiment was continued up to 48 hours after which all the oysters were

returned to a tank with filtered seawater, and provided with cultured diatom as feed and monitored daily (upto 8 days) for survival.

## Results and discussion

Table 1 shows the surface and bottom temperature of the experimental box containing oysters and their recovery (at every two hours) and the time taken for it. The patterns of temperature at surface and bottom of the box containing oysters were different. Surface temperature gradually decreased from the inception (15.8°C; 00 h) onwards and reached the minimum at 10h (9.7°C). Thereafter, it increased steadily and reached the maximum at the conclusion of experiment (25.2°C; 48 h). Bottom temperature of the box ranged between 9.7 to 28.4°C with the minimum seen in 14h and maximum observed at the beginning of the experiment. Bottom temperature decreased steadily from 28.4°C at the beginning and reached the minimum at 14 h (9.7°C). Thereafter, it increased gradually to the termination of the experiment (25.7°C; 48 h). The temperature fluctuations were within the optimal range and sufficient for the survival of oysters with a minimal stress.

Different storage temperature and conditions are required for the different species and the protocol of one species of oyster may not apply to another. For instance, Pacific oysters are transported and stored under refrigeration (5°C) for maximum shelf life, while Sydney rock oysters are stored at temperatures below about 8°C (Bird *et al.*, 1995). In the present study, animals were allowed to recover at every two hours (Table 1) during the entire course of the experiment. Surprisingly, all animals were found to recover well even after 48 h. the time taken for recovery of oyster ranged from 2 minutes at the start of the experiment to 11 minutes after 48 h. Keeping oysters in moist and cool conditions has probably aided their recovery as also observed by Stroud (1981) in European oyster *Ostrea edulis* and Pacific oyster *Crassostrea gigas*. Stroud, (1981) based on his studies in the handling and processing oysters in Aberdeen, Scotland stated that oysters can survive out of water for weeks, if carefully handled and kept cool and moist by covering with a damp cloth. He further stated that oysters should be carried with the cupped half of the shell downwards and the edge of the shells should not be damaged since they will rapidly lose liquid from within.

Oyster can survive at water temperatures as low as -2°C and as high as 49°C; Survival at either temperature extreme increases when the oysters are covered with waters (Harding *et al.*, 1999). Temperature is the most important exogenous factor regulating the metabolism of exothermic organisms and its influence on the rates of oxygen consumption, feeding

Table 2. Survival of the oysters after the experimentation

Number of days	Number of oysters	Mortality (%)
1	52	Nil
2	52	Nil
3	52	Nil
4	52	Nil
5	50	3.8
6	47	6.0
7	47	Nil
8	47	Nil

and nitrogen excretion in temperate species of bivalves has been studied extensively (Newell and Bayne, 1980; Bayne and Newell, 1983). Because oyster metabolism is directly correlated with water temperatures, temperatures affect every aspect of oyster biology including reproduction, larval success, settlement, feeding, growth and development. At very low and very high temperatures, oyster metabolic rates decrease to maintenance levels. At intermediate or "normal" temperatures, oyster metabolic rates increase seasonally enabling growth and reproduction.

Survival of the oysters of the box was monitored visually in a tank after the experiment for 8 days (Table 2). No mortality was observed in animals (52 numbers) upto 4 days. Thereafter, 5 animals were found dead during 5th and 6th days (nearly 10% mortality). It can be concluded that live oysters can be safely transported for a period of 48 h with 90% survival. Pacific oysters (*Crassostrea gigas*) stored in air with water sprinkling at 7°C had 52-80% of survival after 20 weeks storage (Seaman, 1991). Samuel *et al.* (1987) have reported a mortality rate of 0.45% when live oysters were transported and stored without seawater upto 24 h at ambient temperature. Similar observations were made by Rajapandian and Muthiah (1987) when live oysters were transported from Tuticorin. The percentage of mortality (10%) observed in the present study is more compared to that observed earlier. This may be because the earlier observations were limited to recovery of oysters after transportation not the survival upto 8 days as observed in the present study and also the duration of transportation is half compared to the present experiment. They had also moistened the gunny bag containing oysters with seawater frequently throughout the journey by road and also drained the excess water at frequent intervals. However, the present protocol is recommended since the oysters have high survival even after 8 days. These oysters can also be used in high-end restaurants where depuration facilities are available.

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