Studies on the Transportation of Live Clams*

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Live clams *(Villorita cyprinoides)* collected from their natural beds were packed in different ways like dry pack, tray pack, in oxygenated water (wet pack) and depurated samples in wet pack. It was found that the packaging in 1 kg lots in 200 gauge polythene bags with oxygen at a temperature of 20°C could keep them live for 4 days. In tray pack without oxygen and water they can be kept alive for 3 days at 20°C. Temperature seems to be the critical factor in the transportation of live clams. At room temperature both dry and wet pack can be kept for 24 h only. Depuration technique does not appear to be useful in prolonging the storage life of clams in live condition as percentage mortality is more at 48 h both at 20°C and room temperature compared to the non-depurated samples.

Clams occur in appreciable quantities in different parts of the Indian coast, backwaters and estuaries. As per an estimate made by Sebastian (1970) about 2400 t of clam meat is available annually from the Vembanad Lake. Clam meat is rich in cogen (Chinnamma *et al.*, 1970). The poorer protein and glyclasses of the coastal population only use them as food. Of late, there is demand for frozen clam meatp articularly in Japan (Anon, 1983) and also for live clams from Japan and Italy. The present paper reports a method developed by the authors for transporting live clams.

Materials and Methods

Clams *(Villorita cyprinoides)* were collected from Perumpadapu, in the Vembanad Lake. After washing, they were graded. In all the experiments the size grade of 46–48 nos/kg was used. 1 kg of clam was packed in a polythene bag (200 gauge, 30 x 28 cm) and put inside another polythene bag. 500 ml water collected from the same environment was added to the bag and oxygen was bubbled through it for one min. from an oxygen cylinder. The bags were then fastened with rubber band and placed inside a waxed duplex carton of 34 x 17 x 4.5 cm in the horizontal position. Eighteen such duplex cartons were packed inside a master carton (5 ply corrugated fibre board) of the size 53 x 35 x 30 cm conforming to OAA packaging standards for wet shipments of live fish (Anon, 1980). The master carton should be of full overlap slotted container (FOL) where all the flaps are of same length. The master cartons were reinforced with two synthetic straps girthwise. In the tray pack, individual clams were put in moulded pulp trays in such a way that the clams were held flat with the shell opening horizontal. This helps the clam for holding the shell fluid while it breathes (Nicholas, 1978). After packing in trays of 50 x 30 cm, each tray was packed in a polythene bag with aeration holes and secured with a rubber band so that the clams were not displaced from their moulds. Six pulp tray packs were placed inside a 3 ply regular slotted master carton (53 x 35 x 30 cm). In dry pack the method followed is identical to that of wet-pack but without water in it. Depuration was carried out by keeping the clams in water from the habitat for 24 h before they were transported. All the master cartons were reinforced with two synthetic straps girthwise, provided two openings on the sides of the cartons upwards and kept in air conditioned room at 18–20°C. For finding out the mortality at various temperatures, a humidity oven with adjustable temperature was used. Twenty clams

*Paper presented at the National Syposium on Food Packaging jointly organised by Association of Food Scientists and Technologists, CFTRI, Mysore, 17–18th January, 1985

were removed periodically from the pack and the tip of a sharp scalpel introduced gently in between the shells at the free end opposite to the hinge to a few millimeters taking care not to damage the internal organs. Live clams would firmly close the shells thereby gripping the scalpel. The shell would remain agape in dead clams even on touching with a scalpel. The finished packs were subjected to a free drop from a height of 1 m allowing the impact on sides, edges and corners as per IS: 7028 (1973). To find out the yield of meat after every 24 h, about 1 kg of clam was boiled in 500 ml water for about 30 min and after cooling the meat was shucked and weighed. Acceptability studies were carried out with cooked meat at various intervals of storage.

Results and Discussion

Table 1 indicates the effect of temperature on the mortality of clams in water (wet pack) flushed with oxygen. Temperature seems to be the critical factor for keeping the clams alive. At room temperature they were alive for 24 h only but at 18–20°C they remained alive for 96 h. However further lowering of temperature was detrimental and 100% mortality was observed after 24 h at 12.5 to 14°C.

Table 2 shows the effect of depuration on the mortality of clams. Mortality was 50% in depurated samples after 48 h in wet pack kept at 18–20°C and it is desirable to transport them immediately after catch in wet or dry pack.

Table 1. *Effect of temperature on the mortality of clams in wet pack flushed with oxygen*

	Mortality %				
	24h	48 h	72 h	96 h	120 h
Room temperature (27 to 30°C)	Nil	75	100		
23 to 25°C	Nil	Nil	18 - 20	50	100
18 to 20°C	Nil	Nil	Nil	Nil	80
12.5 to 14°C	100				

Table 2. *Effect of depuration (24 h) on the mortality of clams in wet pack*

	Mortality %		
	24 h	48 h	96 h
18 to 20°C	Nil	50	100
Room temperature	80	100	

Table 3. *Effect of dry pack on the mortality of clams at different temperatures and different modes of packing*

Mode of packing and temperature of holding	Mortality %				
	24 h	48 h	72 h	96 h	120 h
Dry pack in polythene bag with air or without oxygen at room temperature (27 to 30°C)	Nil	75–79	100	–	–
Dry pack with or without oxygen in polythene bags at 23 to 24°C	Nil	Nil	90	100	–
Dry pack with or without oxygen in polythene bags at 18 to 20°C	Nil	Nil	20	80	100
Tray pack without oxygen at 18 to 20°C with free ends upwards	Nil	Nil	Nil	15	83
Tray pack with aeration holes in polythene kept at 18 to 20°C in horizontal position	Nil	Nil	Nil	7.8	60
Tray pack with clams in downward position (clams in pulp trays with their free end downwards)	Nil	Nil	27	60	100

Table 3 indicates the effect of dry pack on the mortality of clams at different temperatures and different modes of packing. Dry pack in polythene bag secured with rubber band can be kept only for a period of 48 h at 18–20°C. Clams in moulded pulp tray pack with aeration holes can be kept for 3 days in good condition without any mortality and with minimum mortality at the end of 4 days. This may be due to retention of fluid within the shell in tray pack unlike in dry pack where it is difficult to adjust the position of clams in the horizontal position enabling the clams to retain the shell fluid. This is in conformity with that of Benett & Viestans (quoted by Nicholas, 1978) who carried out the experiments by keeping the clams in horizontal position.

Results of the drop test along with the cost of packaging are presented in Table 4. The results indicate that 3 ply corrugated fibre board box (RSC) of 53 x 35 x 30 cm can safely accommodate six moulded pulp tray packs with a gross weight of 11 kg. For the wet pack, corrugated fibre board box (FOL) of the size 53 x 35 x 30 cm (5 ply) may be used. The container in wet pack should be of full overlap slotted type for export purposes to withstand the strain of transportation.

The cost of the packaging material per kg of clams is around Rs. 2.25 in wet pack and Rs. 2.40 for those in tray pack. The yields of the clam meat in all the packs were found to be 7.3 to 8%.

Table 4. *Drop test, size of the bulk packaging and cost of the packaging material*

	Gross weight	Size and style of the CFB	Result of the test	Cost / kg clams
	kg			Rs
Moulded pulp tray with aeration holes in 100 guage LDPE film	11.0	53X35X30 cm (3 ply RSC)	No damage to the clam. Pulp tray, CFB board intact	2.40
Wet pack in a polythene bag (200 gauge) with oxygen secured with rubber band. Each bag again placed in another polythene bag secured with rubber band. Each pack placed in waxed duplex carton and 18 nos. of the duplex cartons packed in a master carton	30.0	53X35X30 cm (5 ply FOL)	No leakage of water or damage to the box	2.25

Table 5. *Specification of the master cartons.*

Type of test	Requirement		
	up to 20 kg	Ypt	Upto 20-30 kg
Bursting strength, kg/cm² minimum	12		14
Water proofness (cobb/30 min)	120		120
Substance g/m²			
a) for corrugating medium	170 (3 ply) 150 (5 ply)		170 (3 ply) 150 (5 ply)
b) for combined weight of liners	400 (3 ply)) 450 (5 ply)		450 (3 ply) 500 (5 ply)
Type of flute	A, B, C or any combination of these		A, B, C or any combination of these
Puncture resistance, Beach units (minimum)	175		200
Flat crush test 3 ply, kg/cm² (minimum)	2.5		2.5

Tests indicate that the material was quite acceptable upto 4 days in wet pack kept at 18–20°C and 3 days in moulded pulp tray pack kept at the same temperature with ventillation holes.

Table 5 indicates the specification for master cartons for use in live transportation of clams. These have been suggested based on the I.S.I. specifications for master carton for export of frozen seafoods and frog legs (IS: 6715, 1972).

The authors are grateful to the Director, Central Institute of Fisheries Technology, Cochin for permission to present the paper at the symposium.

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