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Effect of Temperature, Heating Time and Chemicals on Shucking Edible Oyster *Crassostrea madrasensis* (Preston)

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The effects of temperature and heating time and the influence of chemicals such as sodium bicarbonate, citric acid and dilute hydrochloric acid in conjunction with heat treatment on shell gaping and meat yield of *Crassostrea madrasensis* (Preston) were investigated. The meat yield decreased with increase in heating period. There existed significant difference in meat yield between the chemical treatments. Loss in meat yield differed significantly between the concentrations of chemicals tested except for bicarbonate treatment.

Key words : Oyster shucking, meat yield, edible oyster, *Crassostrea madrasensis*.

The opening of shells of live oyster to remove meat is a difficult process. Hand shucking of oysters on a commercial scale is a laborius job needing considerable time and skill. A wide range of treatments have been tried to make this work easier. These include heat treatment (Saralaya & Nagaraj, 1978), carbon dioxide laser (Singh, 1972), microwave energy (Learson, 1974), freezing (Stroud, 1980) and chemicals (Whyte & Craswell, 1983); Srikar & Mishra, 1989). Of these, heating is the most common method. In the present study effects of temperature and duration of heating time on shucking edible oyster was evaluated and the influence of chemicals such as dilute hyrochloric acid, citric acid and sodium bicarbonate in conjunctions with heating on shucking oyster was assessed.

Materials and Methods

Live farmed edible oyster, *Crassostrea madrasensis*, length 8.84±1.22 cm and breadth 5.72±0.72 cm were collected from the Regional Centre of Central Marine Fisheries Research Institute, Tuticorin. The oysters were washed and divided into different lots of 25 numbers each. The proximate composition (AOAC, 1975), glycogen (Carroll *et al.*, 1956) and bacteriological parameters (APHA, 1976) of the fresh oysters were assessed. Meat yield was calculated by hand shucking representative samples from preweighed fresh oysters. The pH of meat was measured directly using a combined electrode pH meter after blending 10 g meat in a mortar with 50 ml distilled water.

Preweighed oyster lots were subjected to heat treatment in water at 75 and 100°C for 2.5, 5, 7.5, 10 and 15 min. In the second set of experiments they were subjected to heat treatment for 7.5 min in boiling water containing (i) citric acid (at 0.02% and 0.05% w/v;) (ii) hydrochloric acid (at 0.01%, 0.02% and 0.03% v/v); and (iii) sodium bicarbonate (at 0.5% and 1.0% w/v). Four trials were conducted for each treatment. The number of gaped oysters from each lot was noted. The meat was then separated manually, weighed and the meat yield determined. Loss in meat yield was calculated taking the meat yield

determined by hand shucking as 100% yield. The data obtained were statistically testd by the ANOVA technique (Snedecor & Cochran, 1962).

Results and Discussion

The characteristics of fresh edible oyster meat are presented in Table 1. The pH of meat varied between 6.19-6.28 and the meat yield was in the range of 5.38 to 6.77%. The levels of total and faecal coliforms in oyster meat were above the recommended levels of APHA (1976).

Table 1. Characteristics of fresh edible oyster

Parameters	Values
Moisture, %	77.96±0.65
Protein, %	9.98±0.26
Fat, %	2.42±0.03
Ash, %	1.54±0.04
Glycogen, %	7.13±0.75
Acid insoluble ash, %	0.51±0.03
Meat yield, %	6.23±0.61
pH	6.22±0.04
Total viable count g^{-1}	1.29×10^4
MPN total caliform g^{-1}	17.5
MPN faecal coliform g^{-1}	8.0
Enterococcus faecalis count g^{-1}	8.50×10^1

The effect of heating at 75 and 100°C on gaping and meat yield are presented in Tables 2 and 3 respectively. Though the number of gaped shells increased with increase in heating period, the gaping was low and never reached 50% even after heating for 10 min at 75°C. But at 100°C, all oysters gaped on heating for a period of 10 min. There were highly significant differences ($p<0.001$) in the gaping ($F_{4,12}=122.22$), meat yield ($F_{4,12} = 12.249$) and pH ($F_{4,12} = 22.93$) in oysters exposed to different periods of heating time. The loss in meat yield and increase in glycogen content may be due to the loss of moisture on heating. With respect to meat yield, a significant difference ($p<0.05$) was observed between 7.5 and 5 min heat treatments. No differences were observed in treatments for 7.5 min and above and 5 min and below. It appeared from these results that heat treatment in boiling water for 5 min was the best. However, with gaping as the criterion, 7.5 min exposure in boiling water seems to be the best (Table 3).

Table 2. The effect of heating at 75°C on gaping, yield and pH of meat of *Crassostrea madrasensis*

	Period of heat treatment, min				
	0	2.5	5	7.5	10
Gaped shell, %	0	33.33	40.00	46.67	46.67
Meat yield, %	6.56	6.20	5.84	5.68	4.73
Loss in yield, %	Nil	5.48	10.98	13.48	27.90
pH of meat	6.28	6.47	6.49	6.45	6.45

Values are average of 4 observations

As shucking by heating in boiling water for 7.5 min appeared to be the most appropriate of the treatments tried (Table 3), it was selected for further testing with chemical treatments. The results of the same are presented in Table 4. The incidence of opening increased to 100% with the increase in the concentration of chemicals except for sodium bicarbonate. There were significant differences ($p<0.001$)

Table 3. The effect of heating at 100°C on gaping, yield, pH and glycogen content of meat of *Crassostrea madrasensis*

	Period of treatment, min					
	0	2.5	5	7.5	10	15
Gaped shells, %	0	57.14	65.00	91.32	100	100
Meat yield, %	5.38	4.63	4.33	3.77	3.31	3.37
Loss in meat yield, %	Nil	13.94	19.52	29.93	38.48	37.36
pH of meat	6.19	6.56	6.67	6.70	6.69	6.79
Glycogen, %	6.08	-	6.66	6.61	6.53	-

Values are average of 4 observations

Table 4. Effect of chemicals on the gaping and meat yield of *Crassostra madrasensis*

	Fresh oyster	Hydrochloric acid			Sodium bicarbonate		Citric acid	
		0.01%	0.02%	0.03%	0.5%	1.0%	0.02%	0.05%
Gaped shells, %	Nil	95.00	95.00	100.00	95.00	95.00	95.00	100.00
Meat yield, %	6.77	5.18	5.00	5.07	5.16	5.13	5.47	5.41
Loss in meat yield, %	Nil	23.49	26.15	25.12	23.78	24.22	19.20	20.09
pH of meat	6.20	6.31	6.29	6.28	6.97	7.75	6.38	6.32
Glycogen, %	7.75	8.21	8.25	8.15	7.70	7.99	8.23	8.31

Values are average of four observations. The temperature of heat treatment and period were 100°C and 7.5 min, respectively.

in gaping ($F_{6, 18}$ = 46.87), pH ($F_{6, 18}$ = 83.99), glycogen content ($F_{6, 18}$ = 1743.9) and meat yield ($F_{6, 18}$ = 273.65) among treatments. A slight decrease in meat yield was observed at higher concentration of chemicals used. Statistically significant differences in meat yield ($p<0.05$) was observed between hydrochloric acid, sodium bicarbonate and citric acid treatments. Loss in meat yield differed significantly ($p<0.05$) between the concentration of chemicals used except for bicarbonate treatment. The loss in meat yield was lesser in 0.02% (w/v) citric acid when compared to other chemical treatments.

The results revealed that 0.02% citric acid treatment was the best of the seven treatments in meat yield. In a commercial shucking operation of pacific oyster, *C. gigas*, magnesium chloride treatment was found to be effective in gaping test oysters (Whyte & Carswell, 1983). Srikar & Mishra (1989) reported the advantageous effect of 0.5% sodium bicarbonate treatment for shucking clams. It is suggested here that citric acid (0.02% w/v) in conjunction with boiling water exposure for 7.5 min could be ideal for shucking *C. madrasensis*.

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