Studies on the Ice Storage Characteristics of Blood Clam *Anadara Granosa* meat

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Ice-storage study of blood clam *(Anadara granosa)* meat in direct contact and out of contact (in 200 gauge polyethylene bag) with ice was taken up to assess the amenability of the meat to icing. Changes in moisture, total protein, non-protein nitrogen, ∝ amino nitrogen, total volatile base nitrogen, glycogen, free fatty acid, peroxide value, total bacterial count and coliform count were followed every day. The raw and cooked meat were also subjected to organoleptic evaluation. The study showed that the clam meat can be ice-stored in very good condition out of contact with ice in polyethylene packets for 4 days and in direct contact with ice for 2 days.

Anadara granosa occur in large quantities along the Indian coast and forms an important fishery in the Kakinada Bay where approximately 1000 t are landed annually (Narasimham, 1973). The cockle shells are mainly used for lime burning together with the intact meat thereby destroying much of the valuable protein. The cooked cockle meat has good texture, flavour and attractive pink colour. The canned meat can have good export market and will generate additional income to the fishermen. The cockles can be shucked at the sea shore leaving the shells there and the meat can be transported to the canning centres 5–10 km interior which necessitates development of suitable transportation techniques. The present paper reports the attempts of the authors on the ice-storage studies on *Anadara granosa* meat.

Materials and Methods

Live cockle shells were collected from a local landing centre and stored in clean seawater for 16–24 h to empty the gut (Nowak, 1970). Then the shells were thoroughly washed thrice with 10 p.p.m. chlorinated tapwater. The cockles were shucked and the meat collected. Intestine was removed, meat washed thrice with potable water and was ice-stored in two different ways. Half the meat was stored in direct contact with ice (unpacked) layer by layer in a thermocole (5 cm thick) insulated plywood second hand tea-chest. The remaining half was packed in small sealed polyethylene bags (200 gauge) and stored in ice (without contact with ice) layer by layer. In each layer half of the cockle meat was in direct contact with ice and half without contact with ice. Sufficient ice was added to maintain the temperature between 0°C and 1°C. Cockle meat so iced was subjected to biochemical, bacteriological and organoleptic tests.

Moisture, ash and total nitrogen (TN) were determined by AOAC methods (1975). The non-protein nitrogen (NPN), total volatile bases (TVB) and ∝ amino nitrogen were determined from trichloro acetic acid extract of the muscle. Non-protein nitrogen determination was done by Kjeldahl method, TVB nitrogen by Conway diffusion method and ∝ amino-N was estimated by the method of Pope & Stevens (1939). Total fat was estimated by extracting the moisture free sample with petroleum ether (40–60°C) for about 5 h using Soxhlet extractors. For peroxide value estimation, the cockle meat was ground well with anhydrous sodium sulphate and fat was extracted with chloroform. Peroxide value and free fatty acid were estimated in the chloroform extract (AOAC, 1975), glycogen by the method of Roe & Dailey (1966), total bacterial count (TBC) by the standard pour plate method using tryptone glucose agar medium by incubating the plates at 27°C and coliform count by using desoxycholate medium.

The organoleptic quality was evaluated by a panel of 5 members both for the raw

and cooked meat. The changes in texture, colour and odour of raw meat were observed at different stages of storage. The quality characteristics considered for cooked meat were texture, colour and flavour; the sample being boiled in 2% brine for 10 min. The scores given for the above characteristics were excellent, very good, good, fair and poor.

Results and Discussion

The proximate composition of the cockle meat is presented in Table 1. The wide range

Table 1. *Proximate composition of cockle meat (edible portion)*

*Moisture, %	79.0–83.87
Protein (Total nitrogen x 6.25), %	9.6–19.0
Fat, %	1.26–2.36
Glycogen, %	5.4–13.6
Total ash, %	0.70–0.95
Acid insoluble ash, %	0.02–0.09

* Moisture shows higher value due to the entrapped moisture in the intestinal cavity which cannot be removed uniformly by any means. So the data with constant error is presented here.

in the proximate composition is quite evident from the fact that in cockle the biochemical composition shows correlation with season, sex, maturity and reproductive cycle (Ansell, 1972, 1974 a, 1974b, 1974c, 1975, Ansell *et al.* 1973; Durve & Bal, 1961; Nagabhushanam & Mane, 1978). The chemical and bacteriological quality of the meat at different stages of ice-store are presented in Table 2.

Moisture content of the unpacked cockle meat increased upto 4 days of storage owing to absorption of moisture from the ice and ice-melt water while there was no increase in moisture content in polyetheylene packed meat upto the 5th day. In the case of unpacked meat appreciable shrinkage was observed on the 5th day which is also evident from the low moisture value, whereas the shrinkage was observed on the 6th day in packed meat with good amount of drip accumulating in the polyethylene bag which is also evident from the sudden drop in moisture value on 6th day. The effect of shrinkage on unpacked meat was considerable as almost all the freely absorbed water was released. Both for packed and unpacked meat the moisture values are well reflected in the protein values. The α amino-N values for unpacked meat showed a decrease while for packed meat it showed slight increase upto the 5th day, after which there was decrease accounting shrinkage. Slight increase in packed meat compared to decrease in unpacked meat indicates absence of leaching in packed meat and reduced enzymatic activity and bacterial multiplication at low temperature of storage. The reduced bacterial multiplication is evident from total count data which shows very slight increase. The decreasing trend of α amino-N values for unpacked meat is due to the effect of leaching by ice-melt water. While the TVB nitrogen values for unpacked meat showed slight increasing trend with characteristic drop on the 5th and 6th days for unpacked and packed meat respectively accounting shrinkage. The TVB nitrogen values followed the same trend owing to leaching in unpacked sample and sharp increasing trend due to absence of leaching in packed sample. NPN values also showed almost the same trend as that of α amino-N, once again confirming the previous inference. The last high values of NPN and α amino-N for packed meat are due to the increased enzymatic and bacterial degradation. The irregularity of values may be due to individual variation in the same species. About 17 per cent of non-protein nitrogen in cockle meat is constituted of free amino acid. The characteristic attractive flavour and sweet taste of cockle meat is probably due to the high amino acid and high glycogen content. The free fatty acid and peroxide values were negligible in both cases throughout the storage period. There was no coliforms in raw and ice-stored samples. There was definite decrease of glycogen in packed sample from beginning to end which is due to the gradual breakdown of glycogen in post-mortem muscle. The sharp decrease in glycogen of unpacked meat is due to leaching effect of ice-melt water.

Organoleptic characteristics of ice-stored raw cockle meat are furnished in Table 3. The changes in all the parameters were considerably slow in packed meat compared

Table 2. *Biochemical and bacteriological changes in ice stored cockle meat*

No. of days of storage		0	1	2	3	4	5	6	7	8
Moisture,%	P	83.87	84.43	83.99	83.59	83.07	84.12	82.27	82.10	83.27
	UP	83.87	85.71	87.79	88.90	89.81	84.14			
Total protein, g/100g muscle (Total N x 6.25)	P	13.463	13.031	13.252	13.338	13.438	13.018	15.500	15.625	13.375
	UP	13.463	10.600	9.668	8.881	7.990	10.906			
NPN, mg/100g	P	222.33	226.66	244.98	259.25	267.67	270.29	225.28	214.63	374.82
	UP	222.33	124.41	169.83	149.53	125.24	103.19			
α-amino N, mg/100g	P	42.93	43.43	51.81	60.61	59.83	60.85	52.30	54.91	70.77
	UP	42.93	41.57	37.89	22.96	18.85	17.47			
Total volatile base nitrogen, mg/100 g	P	5.01	5.12	6.55	10.02	15.21	17.43	10.89	12.02	16.19
	UP	5.01	5.41	6.62	7.71	7.18	6.66			
Glycogen, g/100g	P	6.972	6.983	6.940	—	6.979	—	6.196	4.052	4.367
	UP	6.972	4.545	2.452	2.449	1.927	—			
Total count/g	P	5.3×10^3	2.1×10^3	2.5×10^3	9.1×10^3	3.2×10^3	2.1×10^4	3.2×10^4	3.2×10^4	4.3×10^4
	UP	5.3×10^3	1.57×10^3	2.1×10^3	8.2×10^3	9.5×10^3	3.4×10^4			

P = Packed; UP = unpacked

Table 3. *Organoleptic charactistics of ice-stored raw cockle meat*

Days of storage	Texture		Colour		Flavour	
	P	UP	P	UP	P	UP
1	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
2	,,	Very good	,,	Very good	,,	Very good
3	Very good	Good	Very good	Good	Very good	Good
4	Good	Fair	,,	Poor	,,	Fair
5	Fair	Poor	Good	Poor	Good	,,
6	,,	—	,,	—	,,	—
7	,,	—	Fair	—	Fair	—
8	Poor	—	,,	—	Poor	—

P – Packed; UP – Unpacked

Table 4. *Organoleptic characteristics of cooked samples of ice-stored cockle meat*

Days of storage	Texture		Colour		Flavour	
	P	UP	P	UP	P	UP
1	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
2	,,	Very good	,,	Very good	,,	Very good
3	,,	,,	,,	,,	,,	Good
4	Very good	Good	Very good	Poor	Very good	Fair
5	,,	Fair	,,	,,	,,	,,
6	Good	—	Good	—	Good	—
7	Fair	—	Fair	—	Poor	—
8	Poor	—	Poor	—	Poor	—

P – packed; UP – unpacked

to unpacked meat, the difference in colour and texture between the samples being more distinct. Organoleptic characteristics of ice-stored cooked cockle meat is presented in Table 4. The organoleptic scores of the cooked meat also showed the same trend as that of the raw meat.

Two trials reveal that cockle meat can be preserved for 4 days in direct contact with ice and 7 days out of contact with ice in polyethylene packets in acceptable condition. But the change in colour and texture is appreciable after 2 and 4 days of storage respectively. Again changes are very rapid in the meat in direct contact with ice. So we conclude that cockle meat can be ice-stored in very good condition out of contact with ice in polyethylene packets for 4 days and in direct contact with ice for 2 days.

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