

Biochemical and Nutritional Evaluation of Yellow Clams

Chinnamma George and P.T. Mathew

Fish Processing Division

Central Institute of Fisheries Technology

Cochin-682 029, India

Clams of different species such as *Katelysia* sp., *Tapes* sp., *Paphia* sp. and *Meretrix* sp. available in the Ashtamudi lake of Kerala were subjected to biochemical analysis and nutritional studies (two species). Clam muscle contained more amount of sarcoplasmic than myofibrillar protein. Glycogen, reserve increased relative to the age (size) of the animal but this was less in *Paphia* sp. Very slight variation in free amino nitrogen, pentose sugar or phosphorous content was observed among species. Meat from *Katelysia* or *Tapes* sp. was better in sensory qualities than that from *Meretrix* sp. Protein Efficiency Ratio of clam muscle was higher than the standard casein diet.

Key words : Yellow clams, biochemical and nutritional evaluation

Shellfish play a vital role in India's economy and their popularity is increasing due to their delicacy and food value. Bivalves such as clams, mussels and oysters have been serving the nutritional needs of segment of the coastal population. Most of them are good sources of protein, glycogen and minerals and are easily digestible and comparing favourably with other animal foods.

In India nine species contribute to commercial clam fisheries. Yellow clams comprising of 4 genera - *Katelysia*, *Tapes*, *Paphia* and *Meretrix* are available in plenty in Ashtamudi lake in Kerala. Clams occur in large quantities on the east and west coasts of India (Alagarswami & Narasimham, 1973). The length-height relationship of clams - *Villorita* sp. so has been worked out (Chinnamma *et al.*, 1986) and the spoilage pattern of clam meat - *Villorita* sp. during ice storage have also been reported (Chinnamma *et al.*, 1970). The suitability of ice stored clams (*Villorita* sp.) for canning, nutritional loss at different stages of processing and standardisation of processing conditions to get a good quality canned product have been studied (Chinnamma & Gopakumar, 1987).

The export industry has exploited clams since 1908s for frozen dehydrated and pickled products (Statistics of Marine Products Exports, 1993). Information regarding the biochemical and nutritional quality of yellow clam (different genera) are scanty and the present communication deals with chemical composition of 4 genera of clams viz., *Katelysia* sp., *Tapes* sp., *Paphia* sp. and *Meretrix* sp. and nutritional evaluation of two of these species (*Katelysia* and *Tapes* sp.).

Materials and Methods

Clams of four different genera collected from Ashtamudi lake near Neendakara bar mouth in the month of May 1993 were brought to laboratory in live condition, washed free of mud and sorted species wise. The height of 10 clams were measured in each lot.

After thorough washing the shell was opened with a stainless steel scalpel and meat from each lot used for biochemical and organoleptic studies.

For nutritional studies material was cooked in boiling water for 5 min, drained and cooled, meat picked and dried in an air oven (50-60°C for 10 h) and powdered.

Nutritional studies were conducted with *Katelsysia* and *Tapes* sp. only, as sufficient material was not available in the case of *Paphia* and *Meretrix* sp.

Moisture, protein, ash and lipids were estimated according to A.O.A.C. Procedure (1990). Protein fractionation was carried out by preferential solubility technique as described by Chinnamma & Gopakumar (1987). Non-protein nitrogen was estimated by the method described by Chinnamma & Gopakumar (1987) and free alpha amino nitrogen by the Pope & Stevens (1939) method. Carbohydrate and glycogen were estimated by the anthrone (Anon, 1959) and Van de Kleij (1951) methods respectively; Pentose by the method of Meijbaum (1939). Fructose as per Roe (1934), Phosphorus by the procedure of Fiske & Subbarow (1925). Calcium, sodium and potassium were estimated by flame photometry (Vogel, 1961).

Sensory evaluation was made on the material after cooking in 2% sodium chloride solution for 10 min by a trained taste panel of 6 members according to the official methods of ASTM (1968) on a 10 point hedonic scale.

Table 1. Percentage composition of diet

Ingredients	Control	Clam <i>Katelsysia</i> sp.	Clam <i>Tapes</i> sp.
Casein	12.6	-	-
Clam meat powder	-	18.2	18.2
Refined ground nut oil	7.0	7.0	7.0
Vitamin mixture++	1.0	1.0	1.0
Salt mixture+	2.0	2.0	2.0
Dextrose	25.0	25.0	25.0
Corn starch	52.4	46.8	46.8

+ as per Hubbell *et al.* (1937) ++ as per Chapman *et al.* (1959)

Protein Efficiency Ratio (PER) of clam meat (*Katelsysia* sp. and *Tapes* sp.) was

measured in weanling albino rats of Wistar strain and growth rate was also studied. Casein (Sisco Laboratories Bombay) was used as control. The amount of protein was kept at about 10% level in the diets and composition of diets are shown in Table 1.

Five male weanling albino rats having similar mean weights, housed individually in cages having wire mesh bottoms were assigned to each diet. The initial weight of the animals were 39-54 g. Feed and water were supplied *ad libitum*. The daily food intake and weekly increase in body weight were recorded for 28 days.

Table 2. Chemical composition of clam muscle (on wet weight basis)

Parameters	<i>Katelsysia</i> sp.	<i>Tapes</i> sp.	<i>Paphia</i> sp.	<i>Meretrix</i> sp.
Moisture g%	82.93	81.79	80.30	82.75
Crude protein (TN x 6.25) g%	9.38	9.38	9.47	9.70
Non-protein nitrogen, mg%	163.20	132.70	139.70	117.30
TN in shell liquor, mg%	142.60	152.50	154.1	159.60
Alpha amino nitrogen, mg%	126.0	131.6	131.6	115.5
Lipids, %	0.72	0.74	0.78	0.88
Ash, %	1.72	1.77	1.84	3.01
Acid insoluble ash, g%	0.032	0.034	0.009	0.039
Carbohydrate, g%	4.20	4.80	5.65	3.92
Glycogen, g%	3.67	4.30	5.10	2.65
Fructose, mg%	54.00	94.00	91.40	100.00
Ribose, mg%	100.20	114.60	105.30	106.50
Phosphorus inorganic, mg%	40.80	47.80	48.00	46.64
Calcium, mg%	16.90	27.4	66.60	61.57
Sodium, mg%	320.00	293.00	320.00	476.76
Potassium, mg%	2.53	2.66	3.33	2.69

Results and Discussion

The height of shells varied from 4.0 to 6.0 cms in *Katelysia* sp. (Mean 4.78 cm) 4.0 to 4.8 cms in *Tapes* (Mean 4.33 cm) 4.2 to 6.2 cm in *Paphia* sp. (Mean 4.92 cm) and 3.1 to 5.0 cms in *Meretrix* sp. (Mean 4.1 cm)

Table 3. Protein fractions in clam muscle

Protein fractions	<i>Katelysia</i> sp.	<i>Tapes</i> sp.	<i>Paphia</i> sp.	<i>Meretrix</i> sp.
Total protein, g%	8.36	8.55	8.59	8.97
Sarcoplasmic, % of total protein	33.01	44.04	41.42	33.37
Myofibrillar, % of total protein	37.47	24.45	26.90	45.83
Denatured, % of total protein	28.67	30.36	30.42	19.88
Stroma, % of total protein	0.85	1.132	1.25	0.92

Chemical composition of the 4 species of clams is presented in Table 2. Water, protein and carbohydrate were the main constituents in clam meat with fat, non-protein nitrogen and salt in small amounts. A small amount of sand was retained in the gut portion. Moisture content was lowest in *Paphia* sp. (80.3%). Crude protein, lipid and ash were maximum in *Meretrix* sp., while non-protein nitrogen and free alpha amino nitrogen contents were lowest. Carbohydrate, glycogen, inorganic phosphorus, calcium and potassium were greater in *Paphia* sp. than other clams. Clam meat was high in sodium (293-476.76 mg%) and low in potassium (2.53 to 3.33 mg%). Moderate quantity of fructose and ribose were also observed in clam meat.

Table 4. Protein Efficiency Ratio of different diets

Assay group	Average weight initial	Average weight gain	Average food intake	Average protein consumed	PER
	g	g	g	g	
Casein	46.8	88.6	327	32.70	2.70
Clam <i>Katelysia</i> sp.	45.6	116.9	335	33.50	3.48
Clam <i>Tapes</i> sp.	46.8	114.2	334.5	33.45	3.41

Table 3 represents the protein fractions in the four species of clam meat. Sarcoplasmic protein was less in *Katelysia* and *Meretrix* sp. while *Tapes* and *Paphia* sp. had lower myofibrillar protein. Denatured protein content were similar in *Katelysia*, *Tapes* and *Paphia* sp. (28.67-30.42%) but lower in *Meretrix* sp. Stroma protein content was less in *Katelysia* and *Meretrix* sp. Higher percentage of sarcoplasmic and lower amount of stroma protein were observed in the case of black clam *Villorita* sp. (Chinnamma, 1984)

Table 5. Chemical analysis of organs of rats fed on different diets

		Moisture g%	Protein (TN x 6.25) g%
Control	Muscle	59.40	22.86
	Liver	62.94	18.08
	Kidney	74.95	26.36
	Heart	70.50	21.82
Clam <i>Katelysia</i> sp.	Muscle	59.89	21.22
	Liver	60.36	19.51
	Kidney	74.50	19.62
	Heart	69.85	22.51
Clam <i>Tapes</i> sp.	Muscle	58.14	21.68
	Liver	67.35	20.91
	Kidney	68.90	22.42
	Heart	67.25	20.52

Sensory evaluation of the cooked material indicated that *Katelysia*, *Tapes* and *Paphia* sp. were slightly superior to *Meretrix*.

The ability of clams to retain liquor in the shell cavity with its shell tightly closed is an adaptation to life in unfavourable circumstances. Total nitrogen in the shell liquor varied from 142-159 mg%. Clams being bottom feeders, can accumulate mud and harmful organisms in their alimentary canal and hence a period of depuration is necessary before consumption.

Growth rates of rats fed with 3 diets are shown in Fig. 1. Diets containing clam meat induced marginally higher growth rates than the standard casein diet.

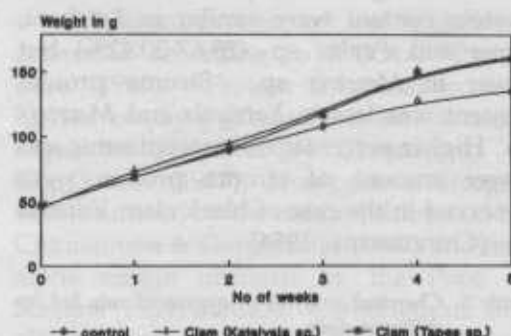


Fig. 1. Growth rates of albino rats fed with clam based diets and casein control

Table 4 gives an account of weight gain, average food intake and Protein efficiency ratio of 3 sets of rats fed on casein and clam muscle protein. PER in control rats was only 2.70 and in clam fed rats 0 katalsysia and Tapes sp. the ratios were 3.48 and 3.41 respectively.

The analytical results of organs such as muscle, liver, kidney and heart collected from rats in three groups are presented in Table 5. Major differences were not noticed between protein compositions of control and clam meat fed rats. The foregoing studies gave clear indication about the high quality of clam muscle proteins.

The authors are grateful to the Director, Central Institute of Fisheries Technology, Cochin for the facilities provided for carrying out this work. Our sincere thanks are due to Shri Alloysius of Samaron Company, Quilon for supplying live clams. We are indebted to the staff of Byproducts Section for the sincere help rendered for carrying out this work.

References

Alagarsamy, K. & Narasimham, K.A. (1973) in Proceedings of the symposium on

"Living Resources of the Seas Around India", p. 648, CMFRI, Cochin

AOAC (1990) *Official Methods of Analysis*, Association of Official Analytical Chemists, Washington D.C., USA

ASTM (1968) *Manual on Sensory Testing Methods*. ASTM-E-10 of the American Society of Testing Materials, STP, 434

Chapman, D.G., Castello, R. & Campbell, J.A. (1959) *Can. J. Biochem. Physiol.* 37, 679

Fiske, C.H. & Subbarow, Y. (1925) *J. Biol. Chem.* 66, 375

Chinnamma, P.L., Choudhury, D.R. & Pillai, V.K. (1970) *Fish. Technol.* 7, 137

George Chinnamma (1984) *Biochemical changes associated with processing of shellfishes and flavour constituents of body meat and claw meat of crab*, Ph.D. Thesis, Cochin University of Science and Technology, Cochin, India

George Chinnamma, Rajagopalan Unnithan, G. & Gopakumar, K. (1986) *Fish. Technol.* 23, 178

George Chinnamma, & Gopakumar K. (1987) *Fish Technol.* 24, 57

Hubbell, R.B., Mendel, L.B. & Waleman, A.J. (1937) *J. Nutr.* 14, 273

Mathew, P.T., Lakshmy Nair, A. & Prabhu, P.V. (1982) *Fish. Technol.* 19, 97

Mejbaum, W.Z. (1939) *Z. Physiol. Chem.* 258, 117 cited in *Manometric techniques*, (W.W. Umbreit, R.H. Burries and J.F. Stauffer, 1959). p. 274, Burgess Pub. Co. Minneapolis 15, Min. USA

- Pope, C.G. & Stevens, M.F. (1939) *Biochem. J.* **33**, 1070
- Roe, J.H. (1934) *J. Biol. Chem.* **107**, 15. Cited in Manometric techniques (Umbreit, Burris and Stauffer, 1959). p. 274. Burgess Pub. Co. Minneapolis, 15, Minn. USA
- Statistics of Marine Products Exports (1993) Marine Products Export Development Authority, Cochín
- Umbreit, W.W., Burris R.H. & Stauffer, J.F. (1959) *Manometric techniques* Burgess Pub. Co., Minneapolis, Minn. USA
- Van de Kleij, B.J. (1951) *Biochem. et. Biophys. Acta.* **481**, 2
- Vogel, A.I. (1961) *Quantitative Inorganic Analysis 3rd Edn.* p. 884, Longmans Green & Co. Ltd., London