

STUDIES ON SHRIMPS OF KARACHI WATERS

Part I. Determination of Food Value and Physicochemical Constants of Fat and Protein

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Abstract. Eleven varieties of shrimps available at the Karachi Fish Harbour, have been analysed for the determination of physicochemical constants of fats and proteins. No significant differences were noted in the fat content. High acid value has been found in all the varieties. The fat of all the varieties of shrimps seems to be rich in saturated acids. Significant variations were, however, noted in saponification value and also in the nonsaponifiable matters. The muscles of shrimp have practically almost all the amino acids with the exception of cystine and cysteine which have been found in insignificant amounts or traces. However, high amounts of glycine have been estimated.

Shrimps belonging to the family penaeidae, are abundantly found along the West Pakistan coast. In spite of the fact that in recent years Pakistan has earned substantial amounts of foreign exchange through development of export trade in shrimp canning and freezing and thus contributed considerably to the national economy, no systematic survey has been conducted in order to assess the food values of different varieties of prawn or shrimps found around Karachi coast. According to the figures available, the total landing of marine prawns in 1967 was 25029.56 metric tons.¹ But perhaps due to lack of adequate scientific information only 1262.97 tons were used for canning in the year under review and about 8583.65 tons were used for freezing.² It is reported that in 1967 more than 90% of the installed capacity of canning plant remained unutilised and in the freezing sector 87% of the capacity installed remained idle.

In view of the above-mentioned facts the present work was started in collaboration with the Marine Fisheries Department, Government of Pakistan, Karachi. The present paper deals with the food values and physicochemical constants of fats and proteins of 11 varieties of shrimps available at the Karachi Fish Harbour.

There are altogether 16 varieties of shrimps belonging to 5 different genera namely *Penaeus*, *Metapenaeus*, *Parapenaeopsis*, *Solenocera* and *Metapenaeopsis*. The local fishermen have divided the shrimps into three categories according to their size, colour and texture, i.e. (1) Jiara, (2) Kalri, and (3) Kiddi.

Commercially Jiara is the most important shrimp, its size usually varies from 4 to 9 in. Kalri varies from 4 to 6 in. Kiddi consists of smallest shrimps including juveniles of Jiara and Kalri. Its size varies from 2 to 4 in.

Scientifically the three commercially important varieties of shrimps are subdivided as shown in Table 1.

Penaeus merguensis is the predominant species and forms about 80% of the total catch of Jiara. Similarly *Metapenaeus monoceros* is the predominant species and forms about 80% of the total catch of Kalri.

Besides this, there are four other species of shrimps which are found in deep waters and not landed in commercial quantity, they are *Solenocera subnuda*, *Solenocera alticarinata*, *Solenocera spinojungo*, and *Metapenaeopsis barbatus*.

Among the commercially important crustaceans, shrimps occupy the first place in the virtue of the magnitude and value of the fishery they support. Amongst the marine prawns the more important are, *Penaeus indicus*, *Penaeus merguensis*, *Penaeus semi-sulcatus*, *Metapenaeus monoceros*, *Metapenaeus affinis* and *Parapenaeopsis stylifera*.³

Experimental

The experimental work has been done in two phases. In the first phase the shrimps procured from Karachi Fish Harbour and supplied to Marine Fisheries Department, where the identification work was undertaken. In second phase the shrimps were brought to these Laboratories where biochemical studies were carried out.

Material and Methods. Each variety of shrimp was washed, weighed, deshelled and dried at 75°C in an oven, and then ground to 60 mesh in ball-grinder. The yield of dried powder was noted and this shrimp was used as a starting material in the present studies.

Chemical Analysis. Deshelled shrimp powder (60 mesh) of each variety was used for the determination of moisture, fat, protein and ash by the standard techniques of A.O.A.C.⁴ The results are given in Table 1.

Physicochemical Constants of Fat. The fat was extracted from each variety of shrimp by diethyl ether, in a soxhlet apparatus. After filtering off the extract through anhydrous sodium sulphate, ether was removed by distillation and the traces were removed in a vacuum-oven at 60°C under reduced pressure. The oil thus obtained was used for the determination of acid value, saponification value, nonsaponifiable matter, iodine value and refractive index, according to the standard techniques.⁵ The ether extract contains primarily triglycerides as distinct from phospholipids, but the latter represent a small proportion of the total lipids. The results are given in Table 2.

Estimation of Amino Acids. Defatted shrimp powder of each variety obtained after the fat extraction was used for the quantitative estimation of amino acids by two-dimensional paper chromatography in the following manner:

One g defatted shrimp powder of each variety was transferred to a glass tube and 3 ml of 6N HCl was added and the hydrolysis was allowed to continue for 24 hr at 105°C. The hydrolyzate after removing acid on water bath and subsequently in a dessicator over NaOH was used for estimation of amino acids by two-dimensional paper chromatography using butanol-

acetic acid-water (100:22:50) in one direction and phenol-water (80:20) in the other. The spots were developed by 0.2% ninhydrin solution in ethanol. The spots were cut and transferred to 50 ml tubes, 1 ml of 0.2% ninhydrin, 2 ml of 0.1% solution of cadmium chloride and 20 ml of 60% methanol. After heating for 5 min in water-bath the eluate was transferred to a 25-ml volumetric flask, the volume was adjusted with 60% methanol. The colour intensity was measured in a Hilger colorimeter at 520 nm. Similar estimations using standard amino acids were conducted and amounts and amino acids in the shrimp muscles were calculated. The results are given in the Table 3.

Discussion

Out of the three varieties of Kiddi only two varieties (*Parapenaeopsis stylifera* and *Parapenaeopsis sculptilis*) found in shallow waters, were procured for the present study. Table 1 shows that Kiddi (*Parapenaeopsis stylifera*, *P. sculptilis* and *Solenocira subnuda*) and Kalri (*Metapenaeus affinis*, *M. monoceros* and *Penaeus semisulcatus*) give low yields of edible portion whereas Jiara (*Penaeus indicus*, *P. merguensis* and *P. penicillatus*) give high yields.

TABLE 1. ANALYSIS OF 11 VARIETIES OF SHRIMPS FOUND IN KARACHI WATERS.

Variety	Local name	Dehydrated material as % of wet wt	g/100 g dehydrated material				
			Moisture (%)	Fat (%)	Nitrogen (%)	Protein (%) (N×6.25)	Ash (%)
<i>Penaeus indicus</i>	Jiara	14.6	8.32	2.38	13.88	86.95	6.74
<i>Penaeus merguensis</i>	"	15.2	6.27	3.33	12.45	77.81	7.84
<i>Penaeus penicillatus</i>	"	15.4	6.60	2.09	12.51	78.18	7.42
<i>Metapenaeus affinis</i>	Kalri	11.7	8.55	2.53	13.36	83.35	6.98
<i>Penaeus monodon</i>	"	12.7	7.7	3.11	12.13	75.81	7.71
<i>Metapenaeus stebbingie</i>	"	12.8	6.56	2.62	12.58	78.62	7.98
<i>Metapenaeus monoceros</i>	"	11.6	6.07	2.93	12.12	75.75	7.81
<i>Penaeus semisulcatus</i>	"	11.01	11.35	2.68	13.49	84.31	6.38
<i>Parapenaeopsis stylifera</i>	Kiddi	9.6	5.99	3.23	13.60	84.00	7.62
<i>Parapenaeopsis sculptilis</i>	"	11.00	6.05	2.67	13.00	81.25	7.37
<i>Solenocira subnuda</i>	"	11.35	8.29	2.57	13.33	83.31	9.37

TABLE 2. FAT ANALYSIS OF 11 VARIETIES OF SHRIMPS FOUND IN KARACHI WATERS.

Variety	Acid value (%)	Saponification value	Non-saponifiable matter (%)	Iodine value	Refractive index
<i>Penaeus indicus</i>	28.2	148	13.20	103	1.4957
<i>Penaeus merguensis</i>	33.2	104	27.44	100	1.4816
<i>Penaeus penicillatus</i>	31.1	—	6.05	101	1.4815
<i>Metapenaeus affinis</i>	27.9	124	9.94	106	1.4924
<i>Penaeus monodon</i>	28.62	226	25.24	105	1.4816
<i>Metapenaeus stebbingie</i>	32.9	125	19.75	101	1.4851
<i>Metapenaeus monoceros</i>	29.5	89	16.18	106	1.4949
<i>Penaeus semisulcatus</i>	28.4	132	—	95	1.4914
<i>Parapenaeopsis stylifera</i>	28.6	168	14.87	109	1.4913
<i>Parapenaeopsis sculptilis</i>	35.5	131	37.14	105	1.4818
<i>Solenocira subnuda</i>	27.4	197	—	102	1.4943

TABLE 3. QUANTITATIVE ESTIMATION OF AMINO ACIDS OF 11 VARIETIES OF SHRIMPS FOUND IN KARACHI WATERS BY TWO-DIMENSIONAL PAPER CHROMATOGRAPHY.

Name	g/100 g of dehydrated material											
	Aspar- tic acid(%)	Glu- tamic acid(%)	Gly- cine (%)	Ly- sine (%)	His- tidine (%)	Argi- nine (%)	Tyro- sine (%)	Phenyl- alanine (%)	Leucine & isoleu- cine (%)	Cys- tine (%)	Ala- nine (%)	Threo- nine(%)
<i>Penaeus indicus</i>	6.76	3.90	30.47	6.93	4.33	9.82	8.67	10.00	2.94	0.40	3.46	6.93
<i>Penaeus merguensis</i>	9.01	3.43	19.30	4.39	4.29	16.09	8.58	22.53	2.46	—	4.60	5.47
<i>Penaeus penicillatus</i>	4.77	3.67	17.95	6.55	4.90	17.37	9.93	22.26	7.45	2.16	0.81	2.10
<i>Metapenaeus affinis</i>	9.90	6.88	27.72	5.14	1.98	25.60	10.00	10.44	1.78	(traces)	—	(traces)
<i>Penaeus monodon</i>	7.95	10.00	22.09	3.53	5.00	25.30	7.20	8.28	4.32	0.31	3.64	2.76
<i>Metapenaeus stebbingie</i>	8.00	5.96	17.09	3.15	3.22	29.00	6.41	19.35	1.93	(traces)	—	5.48
<i>Metapenaeus monoceros</i>	9.01	3.21	19.31	4.39	4.29	16.09	8.58	22.53	2.46	(traces)	4.61	5.47
<i>Penaeus semisulcatus</i>	8.50	3.64	23.08	2.43	6.07	15.79	12.15	10.93	2.79	3.64	3.64	7.29
<i>Parapenaeopsis stylifera</i>	6.36	6.92	19.85	2.94	(traces)	28.08	7.49	16.85	3.37	(traces)	4.86	3.18
<i>Parapenaeopsis sculptilis</i>	4.89	5.10	9.18	2.44	3.57	39.81	8.16	9.18	1.22	3.18	6.73	3.47
<i>Solenoc ira subnud</i>	8.24	6.86	16.48	5.76	4.67	16.48	6.04	16.48	2.74	3.04	5.49	4.67

The percentage of fat varied between 2.38 in *Penaeus indicus* to 3.33 in *Penaeus merguensis*. The fat of all the varieties of shrimps seems to be rich in saturated fatty acids (iodine value 95–109). Significant variations were, however, noted in the saponification value (89–226) and the percentage of nonsaponifiable matter (6.05–37.14%). Lowest saponification value (89) was noted in *Metapenaeus monoceros* and the highest(226) in *Penaeus monodon*. The percentage of nonsaponifiable matter in *Penaeus penicillatus* was 6.05 while in *Parapenaeopsis sculptilis*, it was as high as 37.14. Although the oil of shrimps has quite high acid value, the oil of *Parapenaeopsis sculptilis* was very significant in having an acid value of 35.5%. The high acidity in all the eleven varieties of shrimps might be due to the fact that shrimps die very soon after catching and thus differ basically in this respect from other crustaceans e.g. lobsters, crabs, cray-fish etc.⁶

Except tryptophane and methionine which were destroyed during hydrolysis, the muscles of shrimps have practically almost all the amino acids. The amounts of some of the amino acids are, however, different from those of teleosteans and elasmobranchii fishes.^{7–10} As against fish, the shrimps possess very low amounts of glutamic acid (3.21–10%) lysine (2.43–6.93%) and leucine-isoleucine (1.22–7.45%) respectively. While they are very rich in glycine (16.48–30.47%), arginine (9.82–39.81%) and phenylalanine (8.28–22.53%). Histidine and tyrosine are present in slightly higher amounts than that in fish.

High amounts of glycine in the shrimp muscles have been estimated, which has also been reported by Simidu and Hujita¹¹ and the peculiar taste of shrimp has been attributed to the abundance of this amino acid. They have also disclosed possible relationships between the flavour and such constituents.¹² Shrimp muscles are reported to be deficient in cysteine and cystine.⁶ We have also found very little amount or traces of cystine and no cysteine could be detected during the present study. However, appreciable amounts of proline have been detected but could not

be determined quantitatively.

Penaeus japonicus and *Metapenaeus brevicornis* are also available in these waters in appreciable amounts but their fishing season is of very short duration, therefore, they could not be included in this report.

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