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SOME ASPECTS OF PRESERVATION OF PRAWNS IN MADRAS

by

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Prawns form one of the major fisheries of the West Coast of Madras, ranking sixth in order by quantity landed and by value. Large quantities of marine and estuarine prawns are also available in and around Pulicat Lake, Muthupet, Point Calimere and Pamban in the East Coast of the State. The freshwater prawn fishery of Collair Lake and Upputeru River, and the estuarine prawn fishery of Chinnagollapalem and Bantumilli in the Circars Coast also yield substantial catches of commercial importance. The importance of landings of the prawns on the West Coast can be inferred from the statistics collected by the Fisheries Department for the years 1943-50, which show an average of 200,000 maund* valued at 2½ million rupees. The catches comprise mostly *Penaeus indicus*, *P. monodon*, *Metapenaeus monoceros*, and to a lesser extent, *Penaeopsis* spp. etc.

Methods of Curing

1. *Beach drying :* This is one of the most primitive methods in vogue for preserving the large catches of prawns on the West Coast. The prawns are simply strewn on the sand and allowed to dry by solar heat without any preliminary cleaning or treatment. Although this product is still marketed for human consumption, the methods used not only make it unhygienic and insanitary, but it is also contaminated with extraneous materials and admixed with sand. During the monsoons, when drying is impossible, large quantities of this type of prawn are spoiled and are utilized as manure.

2. *Smoking :* Smoke-curing of prawns is practised on a cottage industry scale in the Circars. The prawn catches of the fisher-folk are blanched either in plain boiling water or weak brine and then spread on bamboo trays erected over a smoky smouldering fire. Preservation is achieved by the preliminary blanching, then by the loss of moisture and by the heat of the smoke and the deposition of smoke constituents. Here the prawns are in shell and hence perfect drying does not take place. The product is sold in weekly *shandies* (trade fairs) where they are purchased by wholesalers for export.

3. *'Prawn pulp' making :* This is one of the most universally adopted methods both on the West and the East Coasts. The prawns are boiled in sea water or weak brine and sun-dried in the shell on bamboo trays or mats. After the product is hard dried, it is packed in jute bags and beaten with clubs, when the shells separate out from meat or 'pulp' for subsequent winnowing. In this process there is some loss as some of the flesh is removed along with the shells. The 'pulp' so obtained is exported, mainly to Burma and Malaya. There is a flourishing trade in this commodity in Cochin and to a lesser extent in the Circars.

4. *Semi-drying :* This is the most scientific method of preserving prawns in India, which has been initiated by the Madras Fisheries Department at its Tanur Experimental Station. Chopra (1943), in his Presidential address to the 30th Indian Science Congress, commented on the progress made at Tanur, on prawn processing. Manufacture of semi-dried prawns was later continued on a commercial scale in the prawn processing station at Pulicat and at the Fisheries Technological Station at Kozhikode (Calicut). Chari and Pai (1946) and Venkataraman and Sreenivasan (1954) here described the process in detail. It consists of 'blanching' cleaned prawns in 4-6% brine in a tinned copper vat for 2 to 3 minutes, removing the shells by hand, followed by bringing in 25° Be brine and drying. Normally, drying was by solar heat but during inclement weather an artificial drier was also used. Infra-red drying of the prawns has also met with some success at this station. Raised bamboo thaties on scaffolds were used for drying prawns. It has been found that for every 100 pounds of raw prawns, 16 to 20 pounds of semi-dried prawns and 10 to 12 pounds of dried prawn shells are obtained. Table I below shows the chemical composition of both the fresh prawns and the dried products.

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* (1 maund=82 2/7 lbs.)

TABLE I

Chemical composition of fresh and processed prawns (*Penaeus monodon*)

Particulars	Water %	% composition on moisture free basis							Insol-ubles	NaCl
		Pro-tein	Ash	Fat	Carbo-hydrates	P	Ca	Fe mgm%s		
1. Fresh prawns	78.46	81.91	7.15	1.90	9.04	1.59	1.01	21.36	..	1.39
2. Semi-dried prawns	40.60	62.59	24.33	1.65	11.43	1.05	1.05	17.82	0.40	17.18
3. Beach-dried prawns	22.65	59.91	30.17	0.93	8.99	1.66	0.54	8.68	19.86	2.43

Venkataraman *et al* (1953) have worked out the rationale of this process. Besides inactivating the autolytic enzymes, blanching in weak brine reduced the bacterial load by 98.4% and moisture by 11%. As a result of brining they found the bacterial load to be reduced still further by 99.45% and moisture content by 17.3%. Table II shows the effect of blanching and brining in the semi-drying process as standardised in this laboratory.

TABLE II

Effect of blanching and brining in the semi-drying process of prawns

	Bacterial count per gm.	Reduction in Bacterial count % of fresh prawns	Total volatile bases mg per 100 gm.	Moisture %	NaCl %
Fresh prawns	5,650,000	..	21.00	80.97	0.33
Blanched prawns	90,000	98.42	15.40	69.95	1.56
Brined prawns	23,500	99.45	10.20	63.67	9.97

Composition and Nutritive Value

Tables I and III give the chemical composition of the raw prawns, semi-dried prawns and beach dried prawns, as worked out by Chari and Pai (1946) and Chari (1948).

It can be seen that fresh prawns contain 78.5% of water and on a moisture-free basis, 81.9% protein, 1.59% phosphorus, 1.0% calcium and 21.36 mgm.% of iron. Except for a very slight loss of soluble proteins as a result of semi-drying, the nutritive

TABLE III

Percentage chemical composition of the various species of prawns

Scientific Name	H_2O	Protein	Fat	Ash	Carbo-hydrates	P	Ca	Fe mgm.%
Penaeus monodon	78.46	17.64	0.41	1.54	0.79	0.35	0.28	4.66
Penaeopsis dobsonii	78.87	18.01	0.42	1.68	1.02	0.34	0.15	9.42
Penaeus semisulcatus	76.70	20.76	0.69	1.49	0.36	0.33	0.28	6.92
Trachypenaeus asper	78.59	18.74	0.85	1.23	0.59	0.26	0.18	1.80

value remains intact. In the crude 'beach dried prawns' analysed by them, insolubles alone account for 19.86%, which is no doubt largely due to admixture of sand, while the mineral content is also lowered. In Table III it is shown that *Penaeus monodon*, *P. semisulcatus* and *Penaeopsis dobsonii* have identical chemical composition but that *Trachypenaeus asper* has a slightly lower nutritive value, and in particular a rather low content of iron, calcium and phosphorus. Airan *et al* (1953) have shown by chromatography that the Bombay lobster, *Palinurus polyphagus* contained the following amino-acids: Leucines, Phenylalanine, Valine, Methionine, Tyrosine, Lysine, Histidine, Cystine, Glutamic acid, Arginine, Alanine and Proline.

Pickling

Experiments on the pickling of prawns were tried at the Tanur Experimental Station. Prawns were pickled in brine in glass jars and heat processed at 105°C under a pressure of 10 lbs. Preservation was found to be effective up to one year (Administration Reports 1928-40). But instead of fresh prawns, 'semi-dried' prawns were used and so the product was not relished in the U.K. Later, at Madras, prawns were pickled in vinegar, oil and spices and this product was very much appreciated in the various exhibitions. Since the Indian consumers have a preference for salt-spiced products, pickled prawns are bound to have a good consumer appeal.

Other methods of preservation

Freezing of prawns (frozen shrimp or lobster tails) is a promising possibility which can be tried out when the ice plant and cold storage at Calicut is in operation. Successful experiments in freezing prawns in the shell into blocks were carried out.

Packing, storage and keeping qualities

The beach-dried prawns and prawns cured by primitive methods on the East Coast have a very short storage life. The 'semi-dried' prawns have a maximum life of two months when stored normally in tea-chests. On the West Coast, owing to high humidity, fungal attack occurs after two months, while on the East Coast this is less frequent, 'salt excrescene' being more commonly met with.

Various types of paper and indigenous substances were tried as packing materials, e.g. newspaper, brown cartridge paper, butter paper, dried lotus leaves, dried plantain leaves, paper treated with benzoic acid, boric acid etc., cardboard cartons, bamboo woven baskets etc.

It was found that one of the cheapest and most efficient combinations was the bamboo basket lined with butter paper. These were found to be quite convenient for storage and transport by rail or bus, added very little weight to the product, could be used over again, and because of flexibility were the least damaged in transit. Clean kerosene tins have also been used for transport, but these are liable to rust.

Laboratory scale experiments were carried out with semi-dried freshwater prawns stored in sealed tins in an atmosphere of carbon dioxide. This system maintained the product in fresh condition for eight months, both the colour and flavour remaining unaltered and the prawns in prime condition. Large scale preservation of prawns in CO_2 gas was also carried out at Tanur Experimental Station and later at Akividu. Semi-dried prawns were kept in anaerobic jars into which CO_2 was passed and observations were made periodically in this laboratory in 1952. Because of the transparency of the container, observations could be made without opening the container.

Evidence was available that for the 6½ months that observations were continued, the semi-dried prawns retained their pink colour and good condition, while the control prawns were spoiled, becoming sticky and black in two months, with production of ammoniacal off-odours. No fungal growth was noted. The bacteriological quality of the CO_2 preserved product was satisfactory, the original bacterial content of 7900 per gm having risen after 6½ months, storage, under CO_2 gas, to only 9600 per gm.

For retailing, butter paper and cellophane packets were being used in this Station, but these have now been superseded by 'Alkathene' bags (Venkataraman and Vasavan 1953), a polyethylene plastic of Imperial Chemical Industries. Storage in Alkathene bags was found to be very convenient, since they had an eye appeal, prevented excess loss of moisture and were vapour and vermin proof. This method is now being used for large scale transportation and half pound and one pound packets are made in Alkathene, which are heat sealed and packed in plywood chests for transportation over long distances to such places as Calcutta, Shillong and Darjeeling, where they have arrived in good condition.

Chemical preservation

Incorporation of various harmless chemicals in the brine for preserving semi-dried prawns over longer periods was tried at this Station. Benzoic acid, salicylic acid, sodium nitrite, acetic acid, boric acid and hexamine were used. Preliminary experiments have shown that sodium nitrite, hexamine and 0.1% acetic acid can extend the shelf life of semi-dried prawns. Further work on these lines is however desirable. The addition of ascorbic acid was found to encourage fungal growth (Venkataraman

and others, *loc. cit.*), though it reduced the bacterial load quite effectively.

By-products

The prawns consist mainly of the chitinous shell and the muscle (meat), the two together forming nearly 95% of the weight. The hepatopancreas as well as the 'berries' or eggs of the freshwater Palaemonids are also often eaten. The meat and shell each constitute nearly half the wet weight of prawns. When prawns are shelled for semi-drying, the shells are not discarded but are dried, powdered, sieved and converted to meal which is found to contain about 41.0% of protein and fairly high amounts of calcium (13.2%) as CaO and phosphorus (4.98% as P_2O_5) and it has therefore been recommended as poultry feed (Chari and Pai 1948). When mixed with shark meal or any lean, high protein fish meal, it can be used as cattle fodder and is especially useful for fattening pigs; in fact, all veterinary institutes in Madras State now use fish meal for feeding cattle. Since the chitinous shell contains a polymer of acetyl glucosamine, experiments are under way to see if this chemical, much used in intravenous preparations, could be prepared economically from shells.

Microbiology

The bacterial flora of fresh prawns has not been studied here. Venkataraman and Sreenivasan (unpublished 1951) noted that the semi-dried prawns had a flora of predominantly aerobic spore-forming *Bacillus* and *Micrococcus* and this agrees with their finding that salted products invariably retain these forms (ibid., 1954).

Utilization

Semi-dried prawns can be utilized in almost the same manner as fresh prawns. After a preliminary de-salting in warm water, they could be deep-fried in fats with condiments, used in gravies and sauces, or made into pastes or cutlets. The shells also are made into pastes by poorer people.

Methods of capture and transportation of prawns

On the West Coast of India, especially in Cochin, prawns are caught in the backwaters by the use of Chinese dip nets, using powerful lights to attract the prawns. In the sea, shoals of prawns are captured in a sort of bag net, the '*Paithu vala*'. A very detailed account of the craft and tackle of the East and West Coasts is given by James Hornell (1927 and 1941). Stake nets are used to catch migratory prawns in the West Coast rivers.

On the East Coast the following types of nets are used for capturing prawns in the sea and backwaters. The *Eru valai* is a conical bag net of small mesh especially for the capture of prawns. The *Konda valai*, also meant specifically for prawns, is a sort of upright stake net fixed in a helicoidal fashion. A somewhat similar type of stakes net, the *Kattu valai*, is also used in backwaters. The *Kuzhi valai* is a type of drag net used seine fashion, with the unusual characteristic of having the mouth crossed and distended by wooden rods. Prawns are also caught along with other fishes in the *Thuri valai*, a primitive trawl (like the Italian trawl). The catches of this net are poor in keeping quality, due to the heavy pressure of the fish caught along with the prawns. The *Siru valai* and *Kal valai* are two small bag nets used for catching prawns in backwaters.

In the rivers, migratory prawns are caught in stake nets, which differ from those described above as used in backwaters. There is a profitable stake net fishery in the Upputeru river, where the nets are 105 to 120 feet long. These are tied to permanently fixed posts, 10 feet apart, the mouth of the net being distended by ropes and the head ropes tied near the surface. Slip knots are tied for the foot ropes, which are pushed down with a long pole, or by a person operating it with his foot and dragging it down. The open cod end is closed with a trap funnel made of bamboo. In the swamps of Collair and Upputeru river, basket traps are extensively used in batteries for the capture of prawns. One type, called *Gampa garre* is a telescopic two-piece bamboo funnel-like device; the other, the *Mayulu*, is a rectangular bamboo basket cage or trap. The prawns caught in traps are always better in quality as compared with those caught in nets.

The normal mode of transport from the catching place to the market or Railway Station is on foot by means of a long shoulder pole on either end of which is slung a basket, the prawns being covered with fresh green leaves or with aquatic weeds to keep them cool. In inland areas, a distance of up to about 8 to 12 miles is covered in this fashion in 3 to 4 hours. Prawns are sent to Madras from the backwaters of Pulicat, partly by country boats (16 miles in 6 to 8 hours) and partly by cart or bus (12 miles in 1 to 3 hours). They are not iced and more often than not they are not in prime condition. However, the State Government now has a van for the quick transport of these prawns in iced condition. About 60% of the catch is consumed fresh.

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MARKETING AND UTILIZATION OF SHRIMP IN THE UNITED STATES

by

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In 1954 the catch of shrimp in the United States was 265 million pounds. Shrimp used for canning amounted to 54 million pounds, or 22 per cent of the catch. The remaining 78 percent was marketed almost entirely as fresh and frozen shrimp (See tables 1 and 2). Over 95 percent of the shrimp produced in the United States is landed in the South Atlantic and Gulf States, which include North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas. The balance of shrimp caught by United States fishermen is taken along the Pacific Coast, in California and Alaska. The shrimp fishery is currently the most valuable fishery in the United States at the fisherman's level.

There are three principal varieties of shrimp : (1) white (*Penaeus setiferus*), (2) brown (*Penaeus aztecus*), and (3) pink (*Penaeus duorarum*).

Commercial quantities of a fourth species, a deep-water red shrimp (*Hymenopenaeus robustus*) were discovered by the United States Fish and Wildlife Service's exploratory vessel *Oregon* in late 1950. However, this species is not being fished commercially due to the current abundance of other varieties and the deep waters in which red shrimp are found. They are caught in depths of 200 to 275 fathoms, which require special deep-water trawl gear, used mostly experimentally so far. As the gear is improved and the demand increases it is expected that red shrimp will be fished and eventually appear on the market. However, from information now available, it is believed that the quantity landed will not be as great as other varieties. The fact that catches may be limited would place red shrimp in a specialty category. Recalling earlier consumer educational efforts required to establish brown shrimp on the market it can be expected that there will be somewhat similar problems connected with marketing red shrimp. It should be noted, however, that those persons who have had the good fortune to sample red shrimp believe they are superior in appearance and flavor.

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