ANNUAL REPORT 1971

CENTRAL INSTITUTE OF
FISHERIES TECHNOLOGY
ERNAKULAM — COCHIN-11 — INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

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INTRODUCTION

Most of the investigations undertaken at the Institute including its Substations and Units during 1971 were aimed at solving the technical problems of the industry and evolving better and new methods and equipments to ensure its sustained growth and expansion. A clear insight into the problems of future development of the industry has enabled the Institute to take up more new projects for investigation during the period.

The technical programmes under the two All India Co-ordinated Research Projects on Transportation of Fresh Fish and Utilisation of Trash Fish sponsored by the Indian Council of Agricultural Research and in respect of which the Co-ordinating centre is attached to the Institute, were initiated in the beginning of the year.

Applications finalised during the period for patents in respect of the following inventions of the Institute also need mention.

1. A process for preparation of bacteriological peptone from miscellaneous fish.

2. A process for preparation of chitosan from prawn shell and head waste.

3. An automatic brine dispenser.

This report is a concise statement of the advances made by the Institute in the various research projects and its extension activity. The information is furnished section-wise and project-wise.

ADMINISTRATION

The schemes submitted for expansion of the activities of the Institute and for the construction of the office and laboratory buildings at Cochin and Veraval and staff quarters at Cochin at the total estimated expenditure of Rs. 120/- lakhs during the Fourth Five Year Plan were approved. Consequent on this, sanctions for creation of the various scientific, technical and administrative posts required for the expansion and development of the various Sections of the Institute at the Headquarters and different Substations and Units were received. The additional posts created include 37 scientific and technical posts, 29 supporting technical posts, 23 administrative posts and 7 class IV posts. With these sanctions the total posts in the Institute now come to 428.

Out of the posts created, those of Senior Fishery Scientist-cum-Head of Division (Craft & Gear), Fishery Scientist (Mechanical Engineering), Fishery Scientist (Processing), Senior Research Assistants (Craft and Gear), Senior Research Assistants, (Processing), Senior Laboratory Assistants, Senior Field Assistants, Laboratory Attendents, Senior Carpenter, Accountant-cum-Head Clerk, Senior Clerks, Cashier, Junior Clerks, Lascars, Peons and Watchmen were filled up and action was taken for filling up the remaining sanctioned posts. The Processing Sections proposed for the Substations at Burla and Kakinada will be set up when the new posts sanctioned for these Sections are filled up and suitable additional accommodation is secured.

A plot for housing the Institute's Substation at Veraval was also taken on lease from the Government of Gujarat during the period.

FINANCE

Details of the budget provision and the actual expenditure during the financial year 1971-'72 are given below.

	Sanctioned Budget Grant		Actual Expenditure	
	Rs.	Ps.	Rs.	Ps.
Non-Plan				
Pay of Officers	3,48,000		2,95,173	16
Pay of Establishment	4,43,000		3,74,560	65
Dearness pay and allowances	3,29,000		3,16,399	76
Interim relief	87,000		89,712	72
Overtime allowance	3,500		1,096	70
Other allowances and Honorarium	80,000		77,324	35
Travelling expenses	35,000		34,981	80
Leave salary, Pension and Provident Fund contributions	1,500		3,038	00
Other charges	4,23,000		4,36,579	47
Total	17,50,000		16,28,866	61
Plan				
Pay of Officers	1,00,000		17,389	04
Pay of Establishment	1,50,000		48,095	86
Dearness pay and allowances	1,50,000		26,559	41
Interim relief	34,000		9,177	93
Overtime allowance	—		28	05
Other allowances and Honorarium	28,000		9,255	38
Travelling expenses	3,000		14,913	40
Other charges	15,35,000		9,02,972	31
Total	20,00,000		10,28,391	38
Grand total	37,50,000		26,57,257	99

SCIENTIFIC AND ALLIED BODIES REPRESENTED BY THE INSTITUTE

Dr. V. K. Pillai, Director, continued to serve on the following scientific and allied bodies.

1. *Member* – Advisory Board, Indian Council of Agricultural Research.

2. *Member* – Scientific Panel for Fisheries Research, Indian Council of Agricultural Research.

3. *Chairman* – Fish and Fish Products Sectional Committee, AFDC:27, Indian Standards Institution.

4. *Convener* – Frozen Fish Products Subcommittee, AFDC 27:3, Indian Standards Institution.

5. *Convener* – Committee to ensure proper co-ordination between Gear Research and Fishing Organisations.

6. *Ex-Officio Member* – Panel of Experts for the purpose of hearing appeals – Export Inspection Agency, Madras and Cochin.

7. *Member* – State Fishery Advisory Board, Kerala.

8. *Member* – Advisory Boards, Export Inspection Agency Cochin.

9. *Member* – Scientific Research Committee, Fisheries Technological Station, Kozhikode.

10. *Member* – Central Advisory Committee on Exploratory Survey of Marine Fisheries.

In addition he served on the following committees constituted during the year.

11. Member – State Fisheries Research Council, Government of Tamil Nadu.

12. Member – Working Group on Prawn Fishing – National Commission on Agriculture.

13. Member – Subcommittee on Food Additives, Central Committee for Food Standards.

The following are the other committees in which the Institute was represented.

(i) Continuing Committees

1. Textile Materials for Fishing Purposes Sectional Committee, TDC : 42 of the Indian Standards Institution.
(Shri G. K. Kuriyan, Senior Fishery Scientist, as Chairman, and Shri S. Gopalan Nayar, Junior Fishery Scientist, as Alternate Member)

2. Subcommittee on work of the International Standards Organisation on Textile Materials for Fishing Purposes, TDC 42 : 1 of the Indian Standards Institution.
(Shri G. K. Kuriyan, Senior Fishery Scientist, as Convener)

3. Tender Committee for purchase of marine diesel engines, Development Department of the Government of Kerala.
(Shri G. K. Kuriyan, Senior Fishery Scientist, as Member)

4. Board of Studies and Faculty of Fisheries of the University of Calicut.
(Shri G. K. Kuriyan, Senior Fishery Scientist, as Member)

5. Marine Corrosion Subcommittee of the Metals Committee of the Council of Scientific and Industrial Research.
(Shri Balasubramanyan, Junior Fishery Scientist, as Member)

6. Marine Engineering and Ship Building Sectional Committee of the Indian Standards Institution.
(Shri M. Velu, Fishery Scientist, as Member)

(ii) **Committees constituted during the year**

7. Inland Harbour Craft and Fishing Vessel Sectional Committee, MCPD : 2 of the Indian Standards Institution.
(Shri G. K. Kuriyan, Senior Fishery Scientist, as Member and Shri R. Balasubramanyan, Junior Fishery Scientist, as Alternate Member)

8. Subcommittee on Fishing Vessels, MCPD : 2 : 2 of the Indian Standards Institution.
(Shri G. K. Kuriyan, Senior Fishery Scientist, as Convener)

9. Technical Committee on Marine Fisheries to check on designs, materials and components of marine engines, Central Board of Fisheries.
(Shri M. Velu, Fishery Scientist, as Member)

10. Regional Advisory Committee of Central Leather Research Institute, Extension Unit, Rajkot.
(Shri R. Venkataraman, Fishery Scientist, as Member)

SYMPOSIA, SEMINARS AND WORKSHOPS

The following Symposia, Seminars and Workshops were attended by the scientists of the Institute during the period.

(1) Symposium on 'Indian Ocean and Adjacent Seas' organised by the Marine Biological Association of India at Cochin during January 1971. ***A few scientists of the Institute participated in the symposium. Two technical papers, viz. (i) 'Microbiological investigations in Indian Coastal Waters and the Indian Ocean' by Dr. V. K Pillai and Shri K. Mahadeva Iyer and (ii) 'The bacterial flora of certain marine fishes and prawns caught in Cochin waters in relation to their environs' by Shri K. Mahadeva Iyer and Smt. T. C. Karthiayani, were also presented at the symposium.***

(2) The first and second meetings of National Committee of International Institute of Refrigeration held at the Council of Scientific and Industrial Research, New Delhi and the Central Food Technological Research Institute, Mysore, on the 12th April and 27th July, 1971, respectively. ***Shri C. V. N. Rao, Assistant Fishery Scientist (Processing), attended the meetings.***

(3) 'Workshop' on 'Sensory Evaluation of Foods' organised by the Indian Standards Institution in collaboration with the Central Food Technological Research Institute, Mysore and held at the latter Institute in July, 1971. ***Shri H. Krishna Iyer, Assistant Statistician, presented a paper 'Sensory evaluation of quality with special reference to fishery products' by himself and Dr. V. K. Pillai.***

(4) Seminar on 'Uses of the Sea' organised at Cochin by the U. S. Information and Cultural Centre, Madras on the 13th and 14th of September, 1971. ***Dr. V. K. Pillai, Director, Shri G. K. Kuriyan, Senior Fishery Scientist-cum-Head of Division (Craft and Gear) and Shri M. R. Nair, Fishery Scientist (processing), attended the Seminar.***

(5) 'Workshop' on the All India Co-ordinated Research Project on Ecology and Fisheries of Fresh Water Reservoirs conducted at the Central Inland Fisheries Research Institute, Barrackpore, in September, 1971. ***Shri G. K. Kuriyan presented a Paper, 'Fishing methods in the fresh water reservoirs of India' at the workshop.***

(6) Symposium on "Current Trends in Research" organised in connection with the All India Chemists' Convention, 1971, at the Institute of Sciences at Bombay on 29th October, 1971.

Shri M. R. Nair presented a paper 'Certain technological problems involved in preservation and processing of fish.'

HONOURS, AWARDS

Shri T. K. Sivadas, Assistant Fishery Scientist (Instrumentation) of the Institute was awarded a cash prize of Rs. 1000/- by the Invention Promotion Board for developing an electronic telemetering instrument for measuring the depth of operation of fishing gear. The award was announced by the Board as a part of the 1971 Republic Day awards to inventors.

TRAINING ABROAD

Shri M. R. Nair, Fishery Scientist (Processing) of the Institute was deputed to U. K. under the Colombo Plan for specialized training for a period of six months from 6-1-1971 in the field of fish proteins and enzymes chemistry at the Torry Research Station, Aberdeen.

VISITORS TO THE INSTITUTE

Officials of Government Departments, scientists from research institutions, trainees from State Fishery Departments and other organisations, students from colleges and persons connected with the fishery industry visited the Institute during the period. The visitors included:

1. Dr. Gerhard Rheinheimer, Institut fur Meereskunde, Niemannseweg, Kiel, Germany

2. Mr. Ben Fukuzaki, Manager, Resource Development and Mr. Raymond G. Rosa, Manager, San Diego Operations, Vancamp Seafood Co., 772 Tuna St., Terminal Island, California 90731

3. Mr. A. J. P. Mzumara, Principal, Fisheries Training Centre, Mangochi, Malavi

4. Dr. W. Klatt, O. B. E., Adou Mount, Overhill Road, Dulwich, London, S. E. 22.

PROCESSING DIVISION

CHEMISTRY SECTION

Chief findings

Investigation on the prawn P. stylifera revealed that inosine ribohydrolase or 5'-nucleotidase which causes rapid accumulation of hypoxanthine in the muscle was quite active when held in ice and in frozen storage. The maximum proteolytic activity of enzymes in the muscle of mackerel, sole, jew fish, ribbon fish and anchovies was found to be at pH 3-5. Study on the fatty acid composition of marine and fresh water fishes showed presence of higher amounts of C_{18} *acids and lower amounts of long chain polyenes (*C_{22} *and* C_{20}*) in the latter.*

Researches in hand

I. Biochemical changes associated with fresh fish preservation

[Project code no. P-I/C(1)/69(5)]

i) Investigation on nucleotide changes in fish and shell-fish

The rates of nucleotide dephosphorylation occurring in prawns of the species *Parapenaeopsis stylifera* were determined during storage in ice and frozen state. It was seen that inosine ribohydrolase or 5'-nucleotidase was sufficiently active to cause rapid accumulation of hypoxanthine in the muscle. During ice storage, hypoxanthine was formed within a day and rose to a value of 5.2 μ moles / g. amounting to about 60% of total purine compounds in the muscle and remained high upto 12 days.

ii) Investigation on proteolytic enzymes

Proteolytic activity of enzymes in muscle was determined in the case of a few species of fish and prawns using casein, haemoglobin and egg albumin as substrates. Mackerel, jew fish, sole, ribbon fish and anchovies recorded higher levels of activity at pH 3-5. The muscle of prawns of the species *P.stylifera* and *M.monoceros* indicated only feeble activity though their head juice showed intense

activity. The enzyme from *P.stylifera* was concentrated and the mode of cleavage of different peptides by the purified preparation was established. Peptides containing aromatic amino acid residues were found to be preferentially hydrolysed.

iii) Investigation on fish proteins

Electrophoretic analysis on polyacrylamide gel showed that sarcoplasmic proteins in lactarius, mackerel and prawns underwent very little change during ice storage. But myofibrillar proteins rapidly became inextractable.

Actin and myosin were prepared in pure form from prawns (*P. stylifera*) and threadfin-bream (*Nemipterus sp.*) and their molecular properties and behaviour towards various SH-active compounds and denaturants were determined. During 3 months' frozen storage at -20°C, ATP-ase activity of myosin was reduced by 33% and actin combining capacity by 57% in *Nemipterus sp.*

iv) Investigation on fish lipids

Fatty acid composition of lipids of marine fishes like lactarius, tuna, caranx, sole, mullet and seer and the fresh water fishes *Ophicephalus* and *Barbus sp.* was determined using gas-liquid chromatography. Lipids in all the species were composed mainly of saturated acids followed by poly-unsaturated and mono-unsaturated acids. Lipids of the fresh water fishes were richer in C_{18} acids and poorer in long chain polyenes of series C_{20} and C_{22}. A comparative study of the lipids of white and dark muscle of seer revealed that the former was richer in phospholipids and poly-unsaturated acids particularly docosahexa-enoic acid (C_{22} : 6 w_3). Study on the course of lipid hydrolysis occurring in prawns (*P. indicus*) during frozen storage showed that 50% of the original quantity of phosphatidyl choline and 46% of phosphatidyl ethanolamine were hydrolysed at the end of 6 months' storage at - 18°C. During hydrolysis, free fatty acids were released preferentially from phospholipids.

II. Studies on fish hormones

[P-I/C(2)/71(3)]

Phenolic steroid hormones were concentrated from gonads of the fresh water fish Tilapia. Qualitative thin layer chromatography

on silica gel using hexane - acetone solvent system (80 : 20) indicated the presence of Oestrone, Oestradiol and Oestriol in the concentrate.

Researches contemplated

All the items of work will be continued during the ensuing year. Besides. studies on development of methods for preservation of potency of active principle of pituitary extract of fish for application in induced spawning and accelerated growth will be undertaken.

Research workers associated with the projects

1. M. Rajendranathan Nair, Fishery Scientist
2. K. Gopakumar, Asst.Fishery Scientist
3. P. D. Antony, Asst.Fishery Scientist
4. K. Devadasan, Sr. Research Assistant

BACTERIOLOGY SECTION

Chief Findings

A culture medium containing peptone in 75% sea water was found to be more suitable for isolation of bacterial flora from fish. Strains of Flavobacterium lost their viability at -5°C after 3 months of storage whereas at -15°C they were viable even after 6 months. Gram positive cocci were viable upto 7 months at -5°C and -15°C. Thirty strains of Clostridium sp. were detected among the bacterial isolates collected from prawn processing factories.

Research completed

Use of antibiotics in fish preservation

The minimum concentrations of chlorotetracyclin (CTC) to cause inhibitory and destructive effect on spoilage organisms in fish and

concentration for development of CTC – tolerance by marine and pathogenic organisms were determined. In the case of marine strains, the minimum inhibitory concentration ranged between 0.25 to 2 ppm and bactericidal concentration between 0.5 to 4 ppm. In the case of *Escherichia coli* and *Staphylococcus* organisms, the minimum inhibitory concentrations were 2 and 0.125 ppm respectively. One strain of *Micrococci* developed tolerance to 10 ppm of the antibiotic, *Flavobacterium* to 4 ppm, *E. coli* to 24 ppm and one strain of *Staphylococci* to 0. 25 ppm.

Researches in hand

I. Qualitative and quantitative aspects of bacterial flora of fish [P–I/B(1)/69(5)]

i) Effect of intense cold on bacterial cultures

Different bacterial strains reacted differently at sub–zero temperatures. Strains of *Flavobacterium* lost their viability at –5ºC after 3 months of storage but at –15ºC they were viable even after 6 months. In a mixed culture of *Pseudomonas* and a gram positive *Micrococci*, the former lost viability at a faster rate.

ii) Choice of media for determination of total plate count.

The influence of calcium, magnesium and phosphate ions on the performance of sea water based medium employed for isolation of bacterial flora from fish was studied. Magnesium ions at concentration of 1.1% added to artificial sea water inhibited the growth of marine bacteria. A medium based on 75% natural sea water and containing peptone and ferric phosphate in specific proportion was found to be more suitable for the isolation of marine flora. This was evident from the higher counts obtained consistently from the medium when compared to the medium based on 100% sea water or artificial sea water.

Study on the nature of bacterial flora in oil sardines and prawns showed that obligate psychrophiles are absent in both when kept in fresh, iced or frozen form. But facultative psychrophilic organisms were detected in the samples.

Investigation on production of amino acids by marine bacteria showed that two strains of *Pseudomonas* could produce glutamic acid and alanine to the extent of 0.2μg/gm and 0.5μg/gm respectively in the culture fluid.

Yet another aspect of study was the biochemical properties of luminiscent bacteria isolated from iced fish. The cultures lost their luminiscent character when held at temperatures above 37°C as well as below 5°C, but the property was regained on subsequent storage at room temperature.

II. Microbial aspects of fish preservation methods

[P-I/B(2)/69(5)]

Bacteriology of processed products and factory environments

The survey on the occurrence of obligate anaerobes of the *Clo tridium sp.* and obligate thermophiles in processed prawn products and processing factory environments was continued in Cochin, Calicut and Mangalore regions. Of the 207 samples collected from Cochin, *Clostridium sp.* was present in 5 gut samples and 1 each of water and soil. Of the 41 samples from Mangalore and 33 from Calicut, 16 and 7 respectively showed the presence of these organisms.

In the study on the characteristics of spoilage organisms in canned prawns, mixed strains of gram positive and negative organisms were inoculated into sterile cooked prawns for assessing the nature of spoilage. The course of spoilage in some cases was different depending on whether the same gram positive spore-forming organism acted n a pure culture or in the presence of a gram negative rod.

III. Studies on isolation and rapid detection of small numbers of Salmonella and other pathogens and fungi in fish and fishery products

[P-I/B(3)/71(3)]

i) Isolation and rapid detection of small numbers of Salmonella

The performance of two enrichment broths, viz. selenite cystine broth and tetrathionate broth, was compared for their efficiency

in isolation of *Salmonella*. Both were found equally efficient. Detection of small numbers of *Salmonella* in presence of large numbers of *E. coli* was also tried. With *E.coli* and *Salmonella* in the ratios 10^5 : 10^9 and 10^5 : 10, a longer incubation period (more than 24 hours) was necessary for detection in the enrichment media. Comparison of the performance of different selective solid media for isolation of *Salmonella* showed that brilliant green agar is better than S.S. agar, Bismuth sulphite agar and Mac Conkey agar.

ii) Studies on coagulase positive staphylococci

Studies on the competitive survival of *Staphylococci* in prawn showed that the organism could not grow at temperatures of 0°C, 7°C and 28°C in competition with *E. coli* or *Streptococci*. During frozen storage of cooked prawns previously inoculated with *E. coli* and *Staphylococci*, the former disappeared after 4 months and the latter declined gradually. The chances of survival of coagulase positive *Staphylococci* during freezing and frozen storage in various substrates were also investigated. Destruction of the organisms was in the order distilled water>phosphate buffer>brain heart infusion broth>prawn extract.

Researches contemplated

Investigations on the above aspects will be continued during the ensuing year. Besides, studies on determination of generation time of bacteria during growth in different substrates and on the quantitative and qualitative changes in native flora and pathogens during pasteurisation and subsequent storage of fish are proposed to be undertaken during the coming year.

Research workers associated with the projects

1. K.Mahadeva Iyer, Jr. Fishery Scientist
2. M.Arul James, Asst. Fishery Scientist
3. T.C.Karthiayani, Asst. Fishery Scientist
4. T.S.Gopalakrishna Iyer,Asst. Fishery Scientist
5. V.Narayanan Nambiar, Sr. Research Assistant
6. P.K.Surendran, Research Assistant

PROCESSING SECTION

Chief findings

Preservation in refrigerated sea water at temperature of -1°C to 0.5°C was found beneficial in extending the storage life of eviscerated seer up to 10 days. An instrument was designed and fabricated for testing the freshness of fish making use of the changes in dielectric properties of fish muscle. Tuna frozen in the form of chunks had better storage life (at-18°C) than samples frozen as fillets. Standard conditions were worked out for canning smoked sardines and frog legs in brine, sardine in its own juice and frog legs in tomato sauce and mayonnaise sauce. A new lacquer composition developed for lacquering fish cans was found to be quite satisfactory as regards adhesiveness, flexibility and resistance towards mild acids and alkalis. Prototype of a multi-deck tunnel dryer designed earlier for dehydration of fish was fabricated and installed. The method worked out earlier for preparation of fish flakes was further improved to impart better swelling property to the product when fried.

Researches in hand

I. Preservation and transport of fish

[P-III/F(1)/69(4)]

A comparative study was made on the storage characteristics of iced fish (iced in the ratio 1:1 by weight) packed in plain bamboo baskets, plywood boxes and 2.5 cm thick thermocole insulated plywood boxes and kept in refrigerated (2-6°C) and insulated compartments, thus simulating conditions of commercial transport. Oil sardine, mackerel and jew fish were used in the study. The fish packed in plain containers and held in insulated chamber lost 80-85% of ice in 24 hours but was of acceptable quality for 48 hours. Storage life was double in the case of the material kept in insulated container. In refrigerated hold the material stored well for 4 days in plain containers and 7 days in insulated containers.

Eviscerated seer (fat content : 5% on dry weight basis) stored in refrigerated sea water at temperature of -1.5 to 0°C remained in acceptable condition even after 10 days and was free from discolouration of the flesh which was noticed in the case of sardine

and mackerel. Fish preserved in refrigerated sea water in general developed firmer texture and better appearance than those stored in ice.

Making use of the principle of thermo-electric refrigeration, a cooling chamber was fabricated for storage of fish at refrigerated temperatures. With the use of efficient insulant and aluminium with silicon oil between thermoelectric modules and heat exchangers, it is possible to maintain the desired temperature level in the chamber. A low temperature storage cabinet using liquid nitrogen as refrigerant was also designed and fabricated for preservation of fish in the temperature range of 0°C to -20°C. Made of wooden planks with 7.5 cm thick thermocole insulation, the chamber has a capacity of 4.5 cubic metre. A double walled copper vessel insulated with 10cm thick thermocole and encased in mild steel outer jacket functions as nitrogen cylinder having capacity to keep liquid nitrogen for 5-7 days.

It was noted that the capacitance value of fish tissue decreases and dielectric loss increases during progressive spoilage. A fish freshness tester was fabricated based on this principle. It consists of a capacitance measuring circuit rigged up by means of an audio - oscillator of capacity 1 KHZ. A pair of graphite electrodes is used as the sensor. Yet another instrumet developed is that for determination of thermal conductivities of porous materials. This was standardised with materials of known thermal conductivity values.

II. Freezing characteristics of tropical fish

[P–III / F (2) / 69 (5)]

Seer and tuna quick frozen in the form of chunks retained their organoleptic quality better than quick frozen chunks under identical conditions of frozen storage. Further, the frozen product packed in polythene paper had longer storage life than the unpacked product. In the case of frozen chunks of tuna, loss of characteristic colour and development of rancid flavours were the major factors limiting the storage life. In the case of crab, the claw and body meats were found to differ significantly in quality during frozen storage. Claw meat retained characteristic flavour better than the body meat under the same storage temperature of – 18°C. Study on the freezing characteristics of mussel showed that the cooked and iced meat kept better during frozen storage than the meat ice-stored and subsequently cooked, when icing was limited to 5 days in both cases. Frozen product from the cooked and iced (3 days) meat was acceptable up to 8 months of

storage at -15°C. Study was also made on the extent of weight loss due to thawing and refreezing of frozen prawns. In the case of frozen prawns (*P. stylifera*) of count 130 up, 2% loss was noted due to first freezing and thawing alone.

III. Packaging of fish and fishery products

(P–III / F (3) / 71 (5))

Investigations were conducted on the physical properties of corrugated fibre boards and waxed card boards used for commercial packaging of frozen fish. The properties studied included thermal conductivity, water vapour transmission rate and equilibrium moisture content at 92% R. H. Overall heat transfer coefficients of container materials like thermocole lined plywood and plain plywood employed for packaging have been studied at 40°C and 50–55% R. H. using panel testing method.

IV. Canning of fishery products

[P – IV/ CAN / 69 (4)]

The texture of oil sardines canned in brine as well as in its own juice could be improved by cold blanching of the meat in 20% brine containing 1% alum and 1% citric acid. This treatment worked out thus solves one of the serious problems hitherto encountered in canning of the fish. The fish canned after the treatment kept well for a year at room temperature. Smoked sardines canned in brine also gave a product with firm texture. The canning characteristics of sardine, mackerel and seer after storage in refrigerated sea water (RSW) were also studied. In general, quality of the canned product was not as good as that processed from fresh fish. However, both sardines and mackerel yielded satisfactory canned product when storage in RSW was limited to 4 days. Storage for longer periods caused development of rancidity and meat blackening in the canned product. In the case of seer, however, the optimum storage life in RSW prior to canning was 7 days. Use of the cheap brine medium for canning was tried successfully for canning froglegs also. The problem of "gelling" encountered in canned frog legs could also be solved by the technique of precooking the legs after filling in cans and incorporation of small amount of citric acid in the filling brine. Texture of the canned meat could be improved by treatment with alum and sodium tripolyphosphate. Standard conditions were also worked out for canning frog legs in tomato and mayonnaise

sauces. Blackening encountered in canned crab meat could be successfully overcome by washing the raw meat in 0.1 - 0.2% citric acid or acetic acid solution before filling in cans and incorporation of citric acid at 0.1% level in the filling brine.

In the case of canned prawns, the effect of acidity of the filled brine on the can lacquer was investigated. Brine containing 0.15% residual acid formed blisters on the lacquer in 28 days' storage at 55°C. Increase in acidity also imparted bitter taste to the canned meat. This is attributable to dissolution of the lacquer under increased acid concentration. The problem can be overcome by maintaining correct concentration of acid in the filled brine and by the use of satisfactory can lacquer. A formula developed for a good can lacquer assumes greater significance in this respect. Prepared by compounding different resins in a worked out proportion, the new lacquer overcomes many of the drawbacks of the lacquer now used in commercial cans. It has very good adhesive strength, hardness, flexibility and resistance towards mild alkalis and acids. Large scale trials are underway.

The automatic brine dispensing machine developed and fabricated earlier for use in canning line was further improved by providing a device to deliver brine only when the can on the moving belt in the equipment positions itself correctly below the brine delivery end. This modification makes the equipment a completely self-controlled unit filling cans with desired volumes of brine in desired time. The equipment is thus of great promise to the industry. The brineometer developed for direct measurement of concentration of blanching brine was calibrated after extensive field trials. The instrument can read the concentration of brine containing 0.1% citric acid at its boiling point with an accuracy of ± 0.6%.

V. Dehydration of fishery products

[P-V/D/69 (4)]

The solar dryer fabricated earlier was put to large scale trials in dehydration of fish products. Standard conditions were worked out for drying mackerel as such and after salting, salted thread fin-bream, shark fillets, sprats and cooked prawns. The dried products were of good quality comparable to tunnel dried products. Though the dryer recorded the maximum temperature of 52°C, corresponding to the atmospheric temperature of 32°C, satisfactory

temperature for drying was found to be between 45 and 50°C. Air velocity was maintained at 120m/min. during the drying period.

A prototype of the multideck tunnel dryer designed earlier for dehydration of fish was fabricated and installed. Capacity is 250 kg fish per batch spread over 45 trays of size 120 cmx30 cm x 2.5 cm. each provided inside the three decks of the dryer. The dryer is equipped with automatic control system and essential measuring instruments required for dehydration experiments. Control of humidity inside the dryer is achieved by recirculation of a part of wet air from the dryer.

A few testing and measuring instruments were also developed. An electronic balance developed is of use in following the changes in weight of fish during tunnel drying. A moisture meter developed is of advantage in quick measurements of moisture levels in the range of 10 to 33% in dry fish products. It is a portable transistorized unit based on measurement of A. C. resistance at various moisture levels as different from the instrument earlier constructed for the same purpose based on measurement of thermal conductivity values. A thermocouple amplifier was also designed and constructed for direct measurement of wet and dry bulb temperatures inside artificial dryers avoiding the delicate galvanometric mechanism presently in use for the purpose.

VI. Development of speciality products

[P-VII/SP/69 (5)]

The method worked out earlier for preparation of fish flakes (wafers) was further modified to process the product from prawn meat and minced fish meat incorporating potato or tapioca starch (meat and starch in the ratio 2:3) and spices. The samples prepared had good swelling property and flavour and had a protein content of about 15%. Several samples of this product and the high energy protein food prepared out of fish hydrolysate were prepared and distributed for consumer acceptance trials and were reported to be good. The yield of hydrolysate from trash fish was found to vary between 7 and 9% and the product was rich in peptones, sub-peptones and amino acids. A method was also worked out for preparing malt enriched fish hydrolysate from thread fin-bream (locally called kilimeen and constituting a major portion of the fish catch from trawlers in Cochin area) having protein content of nearly 20%. The

product was free from any bitter taste as is common in pure fish hydrolysate from trash fish and could be freely mixed with milk for drinking. The preparation was free from residual enzyme activity and was also bacteriologically good.

Researches contemplated

All the above items of work will be continued during the ensuing year. Besides, investigations on physical properties of fish in relation to quality assessment and equipment design, and preparation of alkali solubilised fish proteins from miscellaneous fish are proposed for the coming year.

Research workers associated with the projects

1) Dr. V. K. Pillai, Director
2) T. K. Govindan, Jr. Fishery Scientist
3) C. V. N. Rao, Asst. Fishery Scientist
4) S. Ayyappan Pillai, Asst. Fishery Scientist
5) P. K. Chakraborty, Asst. Fishery Scientist
6) P. A. Perigreen, Asst. Fishery Scientist
7) Chinnamma George, Sr. Research Assistant
8) A. Vasantha Shenoy, Sr. Research Assistant
9) P. R. Girija Varma, Sr. Research Assistant
10) T. T. Annamma, Research Assistant

BY-PRODUCTS SECTION

Chief findings

Preliminary tests made with Chitosan prepared from prawn shells showed that it may be useful in giving a fine finish to cotton fabrics. Storage life of shrimp extract frozen in the form of

blocks was found to be 8 months at – 10°C. A highly unsaturated portion of fatty acid with iodine value about 300 was isolated from sardine oil. A semi-pilot plant as per the design prepared by the Institute was fabricated and installed for preparation of bacteriological peptone and the laboratory method worked out earlier was tried satisfactorily for production of the product in the plant.

Researches in hand

I. Utilisation of prawn shell waste

[P-VI/BP (1)/69 (4)]

The storage characteristics of shrimp extract prepared from prawn shells were under study. The product frozen in blocks and stored at – 10°C kept in good conditon for 8 months retaining the characteristic colour, odour and appearance. Preservation with sodium benzoate, sodium propionate or potassium sorbate at 0.3% level was beneficial in storage of the product at room temperature in containers like polythene bags, glass jars and aluminium foils for a period of 6 weeks.

Preliminary tests on the use of Chitosan prepared from prawn shells as per the method worked out earlier were conducted in collaboration with the Cotton Technological Research Institute, Bombay. The product was reported to be good as a permanent sizing material in textile industry since it imparted a permanent organdie type finish to cotton fabrics. Tests conducted in the Institute's laboratory with Chitosan as a wine clarifying agent and as a binding material for paper, hard board and glass sheets also gave encouraging results. The product is freely soluble in dilute acids yielding viscous solutions. Yield of Chitosan from prawn shells is about 10%.

II. Industrial utilisation of sardine oil

[P – VI / BP (2) 69 (4)]

Preparation of fatty acid amide as an intermediate product in the production of quaternary ammonium compound from sardine oil was

tried. A product corresponding to the amide could be prepared in the form of a white waxy material which could be recrystallised from acetone. A highly unsaturated fraction of fatty acid could also be prepared from sardine oil. The yield was about 20% of the stearin separated oil. The fraction had iodine value of about 300, was unstable and polymerized into viscous liquid under normal atmospheric conditions. The product could however be stored in a stable condition at low temperature (15°C) and in an atmosphere of nitrogen.

III. Pilot plant study on bacteriological peptone

[P - VI / BP (3) / 69 (4)]

A semi-pilot plant as per the design finalized by the Institute was fabricated and installed for production of bacteriological peptone based on the laboratory method worked out. The laboratory method was found quite satisfactory for preparation of the product in the plant and a few samples were prepared for further investigation.

Researches contemplated

Investigations on all the above aspects will be continued in the ensuing year.

Research workers associated with the projects

1. P. Vasudeva Prabhu, Asst. Fishery Scientist
2. P. Madhavan, Asst. Fishery Scientist
3. P. K. Chakraborty, Asst. Fishery Scientist
4. T. S. Unnikrishnan Nair, Sr. Research Assistant
5. A. G. Radhakrishnan, Research Asistant
   (Transferred to CIFT Substation, Veraval, from 4-5-1971)
6. K. G. Ramachandran Nair, Research Assistant

QUALITY CONTROL SECTION

Chief findings

Survey continued on the bacteriological quality of processed prawn products in Cochin area showed that 16.4% of the headless shell-on type product, 21.9% of the peeled and deveined type and 22.6% of the peeled undeveined type were of substandard quality. Similar survey on the sanitary conditions in primary process centres and processing establishments in the area revealed standard plate count above the specified levels in more than 80% of the samples of ice, water and utensils. The method worked out earlier for prevention of "drip loss" in frozen prawns was successfully employed in increasing the cooked yield of prawns by a simple modification involving incorporation of 16% sodium chloride in the phosphate mixture used for treating prawns. The method is of much economic benefit to the industry since the yield is increased to 90% from the normal yield of 75%. A method worked out for improving the colour of peeled and cooked frozen prawns as desired by the importing countries is also of much significance.

Research completed

i) Influence of chemical quality of water on the quality of processed prawn products

Studies with peeled and deveined prawns showed that presence of carbonates and bicarbonates beyond 200 ppm level in the water used for processing impart a slight bleaching effect on the frozen product. Sulphates up to the level of 300 ppm, calcium up to 500 ppm and magnesium up to 200 ppm in the water did not affect the quality of the frozen product adversely.

ii) Use of phosphates in improving cooked yield of prawns

The method of phosphate treatment worked out earlier for prevention of "thaw-drip-loss" in frozen prawns was modified and applied successfully in increasing the cooked yield of peeled and deveined prawns. By treating peeled and deveined prawns in the solution of phosphate mixture containing 16% sodium chloride and subsequent cooking in

boiling brine for a minute, the yield was increased to 90% from the normal yield of 75% (without addition of salt). The method was tried extensively in processing factories in Cochin area and found quite simple and highly beneficial for commercial adoption. During the period of trials itself it is estimated that the factories could make an additional saving of Rs. 7.4 lakhs on the finished product of 210 tonnes of cooked frozen prawns as a result of the increase in yield.

Researches in hand

I. Improvement of the quality of raw and processed fishery products

[P – II / QC (1) / 69 (5)]

A simple method was worked out for imparting an attractive reddish colour to peeled and deveined cooked frozen prawns as desired by the importing countries. The method which involves pre-treatment of peeled and deveined prawns in a solution of permitted food colours of specific concentration, can be commercially applied at an extra cost of about 12 ps per 100 kg. material. The suitability of prawns of the species *Metapenaeus affinis, M. dobsoni and Parapenaeopsis stylifera* for processing into whole cooked frozen products was also studied. Quality products could be processed if the ice-storage of the raw meterial was limited to 12 hrs.

II. Bacterial quality of processed fishery products

[P – II / QC (2) / 69 (5)]

Factory sanitation

The survey of sanitary conditions in primary process centres and processing factories and of bacteriological quality of frozen prawn products was continued. Samples of utensils, water, ice, frozen prawns and raw and cooked prawns collected from various processing establishments in Cochin area were analysed for bacteriological quality. On an average, about 80% of the samples from primary process centres and processing factories showed standard plate count above the specified level. Faecal and pathogenic organisms were present in 31% of the samples from primary process centres and 45% of the samples from processing factories. Further, 16.4% of the samples of headless shell-on

frozen prawns analysed, 21.9% of the peeled and deveined type and 22.6% of the peeled and undeveined type were of substandard bacteriological quality. *Salmonella* organisms were not detected in any of the samples collected.

The section also imparted short-term training of 1–2 months duration in bacteriological examination and quality control of processed fish products to 9 candidates from processsing factories on request. Technical assistance was also given to the processing establishments through demonstration of specific methods on request. These include methods for processing cooked frozen crab meat and cooked frozen prawns of sound bacteriological quality.

Researches contemplated

Work on all the above aspects will be continued during the ensuing year.

Research workers associated with the projects

1. Cyriac Mathen, Quality Control Officer (on study leave abroad from August 1971)
2. T. S. Gopalakrishna Iyer, Asst. Fishery Scientist
3. Chinnamma George, Sr. Research Assistant
4. Francis Thomas, Research Assistant
5. A. C. Joseph, Research Assistant
6. Annamma Mathew, Analyst

SUBSTATION, VERAVAL

(Processing section)

Chief findings

Irradiation at 100 K rad level was found beneficial in extending the storage life of fresh whole, laminated and filleted Bombay duck upto 14 days in ice. Methods were worked out for preparation of smoked catfish fillets, canned product from smoked Hilsa fillets, soup powder from Bombay duck paste, flakes from shark fillets and protein concentrate from eel, squid, Bombay duck and shark meat.

Researches in hand

I. Improvement in the methods of handling and preservation of major types of commercial fishes of Saurashtra coast

[P-VR/I/69(4)]

Study on irradiation preservation of fresh Bombay duck in whole, laminated and fillet forms showed that the ice-storage life of the fish is enhanced up to 14 days by the method. The fish was irradiated at 100 K rad level from Cobalt source. Semi-drying to a moisture level of 70% followed by freezing and frozen storage was seen to be a satisfactory method of long-term preservation of laminated Bombay duck. The product retained the characteristic odour and flavour of fresh Bombay duck and stored for more than 3 months at - 18°C in polythene packets.

II. Standardisation of processing techniques for commercially important fishes

[P-VR/II/69(4)]

Canning of smoked Hilsa fillets yielded a product of good texture, colour and odour. Standard conditions were also worked out for canning of chaksi *(Hilsa ilisha)* in oil.

The smoke-curing characteristics of a few types of fish were also investigated Good smoked product could be prepared from cat fish fillets by brining (for 30 minutes in 15% brine) followed by rinsing in 5% brine containing 0.1% potassium sorbate, semi-drying for 30 mts, overnight smoking and final drying for 4–6 hrs. The smoked product had attractive golden yellow colour and good flavour and stored well for 3 months Fumigation under controlled conditions was tried for prevention of insect infestation in cured fish products with encouraging results. Ethylene dibromide and phosphine were used as fumigants. In the case of commercially dried Bombay duck, the level of uric acid in the product was seen to be a reliable index for assessment of external contamination.

III. Studies on economic utilisation of low grade aod miscellaneous fish

[P-VR/III/69(4)]

Fish protein concentrate was prepared from dhoma, eel, squid meat, Bombay duck and shark meat using isopropanol as solvent for removal of fat and odour-bearing compounds. The product was colourless and odourless and of protein content about 90%. Fish soup powder and flakes are the other products prepared from low grade fish, the former from Bombay duck paste after incorporating starch, onion and spices and the latter from shark fillets. The products were of good quality.

Researches contemplated

All the above items of work will be continued during the ensuing year. Further, study towards improvement of the quality of dried shark fins and fish maws is proposed for the ensuing year.

Research workers associated with the projects

1. R. Venkataraman, Fishery Scientist
2. K. K. Solanki, Asst. Fishery Scientist
4. A. G. Radhakrishnan, Sr. Research Assistant

UNIT, BOMBAY

(Processing section)

Chief findings

Dhoma stored in ice for more than 4 days was found unsuitable for freezing. Study on the quality of transported fish arriving at Bombay in different containers showed that iced silver pomfrets in thermocole - lined plywood boxes is far better preserved than the fish in uninsulated containers and could be stored in edible condition for a further period of one week.

Research in hand

Freezing and cold storage of commercially important fishes of Bombay coast

[P-BM/1/70 (5)]

Dhoma as whole, in gutted form and as fillets, held in ice was suitable for freezing if the ice storage was limited to 4 days. The fish frozen in blocks and glazed with water and agar remained in good condition for more than 3 months in frozen storage.

A regular survey was made on the quality of fish and prawns arriving at Bombay from distant areas like Ratnagiri and Malwan in trucks, trains and carrier launches and also on the quality of fish transported by train from Veraval in plain and insulated plywood boxes. The fish reaching Bombay was generally of e dible quality. Mackerel, dhoma, silver and black pomfrets, shark and eel fillets, Bombay duck and hilsa were covered by the survey. Silver pomfrets transported from Veraval with ice in 12.5 mm thick thermocole insulated plywood boxes were especially of good quality and further preservable in ice for one week in edible condition.

Research Contemplated

Studies under the project will be continued during the ensuing year.

Research workers associated with the project

1. K. K. Balachandran, Asst. Fishery Scientist
2. D. K. Garg, Research Assistant

UNIT, CALICUT

(Processing section)

Chief findings

Pre-treatment of the fish in a 3% solution of a mixed preservative containing sodium propionate before the salting stage was seen to be the most effective method of use of the chemical for preservation of dry cured products. The shelf life of wet cured fish could be enhanced by about 6 weeks by incorporation of sodium benzoate at 2% level in the salt used for curing the fish. Treatment of cooked prawns in brine containing sodium propionate was beneficial in extending the storage life of semi-dried prawns.

Research completed

Use of chemical preservatives in dry and wet cured fish

Extensive trials were undertaken on the use of the mixed preservative consisting of sodium propionate, benzoate and butylated hydroxy anisole (BHA) in preservation of wet and dry cured mackerel, sardines, catfish and shark. Pre-treatment of the fish in a 3% solution of the preservative mixture was found to be the most effective method of application in the case of dry cured fish. For preservation of wet cured fish, sodium benzoate at 2% level was better than sodium propionate and use of this preservative extended the storage life of the products upto 2 months. In the case of semi-dried prawns, pre-treatment of the blanched prawns in 15% brine containing 3% sodium propionate for 15 minutes was effective in enhancing the storage life of the product upto 5 months as against the normal storage life of 6 weeks.

Researches in hand

I. Improvement in curing techniques for obtaining better quality products

[P-CL/I/69 (3)]

Survey on the chemical and bacteriological quality of cured fish products processed in the Calicut region was continued. Most

of the samples were bacteriologically sub standard, putrified and having attack of red halophilic bacteria ("red") and fungus. The quality of different wet and dry cured products also varied enormously.

II. Improvements in smoke - curing of fish

[P - CL / III / 70 (4)]

Improvement of the quality of smoked filleted sardines was tried because of the product getting easily spoiled due to rancidity and insect infestation. Incorporation of 3% sodium propionate in the brine used for salting the fish extended storage life of the product to 3 months. For prevention of insect infestation, heat treatment at 125°C for 15 minutes was found effective. Yield of the filleted smoked sardine is 14% of the weight of fresh fish. Methods were also worked out for preparation of dehydrated and smoked clams and mussels. The product had very good flavour. With moisture content of 10% it stored in good condition for 4 months. Improvement of the quality of "masmin" processed from tuna fish was also tried. Product prepared after brining the fish followed by steam cooking was superior in quality to that obtained by the traditional method of boiling in sea water.

Researches contemplated

All the above items of work will be continued during the coming year. Besides, a new project on pickle curing of fish covering all aspects of pickling and marination is proposed for the coming year.

Research workers associated with the projects

1. A. P. Valsan, Asst. Fishery Scientist
2. T. S. Unnikrishnan Nair, Research Assistant (Transferred to Headquarters Laboratory from 9-8-1971)
3. V. Muraleedharan, Research Assistant
4. V. Narayanan Nambiar, Sr. Research Assistant (at Headquarters handling bacteriological aspects of the studies)

CRAFT & GEAR DIVISION

GEAR MATERIALS SECTION

Chief findings

Twist specifications for cotton ropes of different constructions were finalised. Studies on HDPE tapes have shown promise of a cheaper but equally efficient substitute to yarn as a net making material.

Researches in hand

I. Standardisation of twist for cotton ropes and synthetic monofilaments

[GM-1(a)/69(3)]

Cotton Ropes

The experiments initiated during the previous year to study the effect of the different constructions on the quality of ropes were completed. Twist standards were also worked out for cotton ropes of ZZS and ZSZS constructions. The value of the twist constant 'K' in the relation $To = K \frac{\sqrt{No}}{\sqrt{n}}$ was found to be 30.0 for soft twisted and 34.0 for hard twisted ropes of ZZS construction and 6.5 for medium twisted ZSZS ropes. In the case of ZZS construction, the strength per yarn ranged from 0.29 to 0.35 Kg while that for ZSZS construction it was 0.36 Kg. The extension values for the two constructions were 30-50% and 25-40% respectively. The relationship between the outer twist, To, and inner twist, Ti, for the ZZS type construction was worked out as 1 : 1.3. In the case of ZSZS type construction, the relationship between rope twist (Tr), twine twist (Tt) and strand twist (Ts) was 1 : 2.2 : 3.0. The data for the four types of constructions viz. ZSZ, ZZSZ, ZZS and ZSZS have been compiled for the preparation of the basic specifications required for cotton ropes.

Synthetic monofilaments

Study on the comparative efficiency of polypropylene and polyethylene monofilament yarns showed that the former is about 40% stronger than the latter. Polypropylene yarn of 360 den. and 0.2 mm dia. was used in the study. The yarn tenacity recorded is 4.4 g / den. The material is, however, relatively more stiff and hence is suitable only for long lines, branch lines and hand lines.

II. Synthetic tapes for fish net twines and ropes

[GM – 2 / 71 (2)]

High density polyethylene tapes

Studies relating to the properties of twines made out of HDPE tapes were initiated during the year. The tapes are at present used mainly in the sack industry and are of guage thickness 100–160 and of width 2-4 mm. Denier sizes range from 700 to 1140 with an average tenacity of 3.25 gm / den. Tapes were twisted into different specifications and the dynamic properties of the twines analysed. Preliminary quality standards were also worked out for the twisted tape twines.

III. Mercerization of cotton twines

[GM – 1 (b) / 69 (3)]

Hard twisted twines of specifications from 20/4/3 to 20/20/3 and soft twisted twines of specification 20/4/3 were slack mercerized in caustic soda solution of concentration 10–50% for 1 to 10 minutes and the properties of the mercerized samples were determined.

Researches contemplated

Investigations on all the projects except III will be continued. It is also proposed to carry out field trials with a trawl net made out of HDPE tape twisted twines as well as to study the effect of weather changes on synthetic twines.

Research workers associated with the projects

1. K. Radhalakshmy, Asst. Fishery Scientist
2. P. J. Cecily, Sr. Research Assistant
3. Verghese Paul, Research Assistant
4. G. K. Kuriyan, Sr. Fishery Scientist

FISHING METHODS SECTION

Chief findings

Investigations carried out on the effect of weight of otter boards on the horizontal spread of nets have indicated that doors with 55 kg wt. gave the maximum opening as well as catch when operated in combination with a 17m bulged belly trawl. The efficiency of coloured gill nets was observed to be more significant when operated during moon-lit nights and in waters where luminiscent organisms were predominant. Nets with 52 mm bar mesh size were effective for the exploitation of commercially significant size groups of Scomberomorus guttatus, particularly in the west coast.

Researches in hand

Trawl fishing

I. Development of suitable trawl design for medium and large trawlers

[FM-1(a)/71 (5)]

Design details of three nets following three concepts viz. long wing, four panel and bulged belly, were worked out and the nets made using polyethylene monofilament twines of 1 mm and 2 mm dia. The designs of the otter boards for operation with these nets were also prepared and the doors fabricated. Trial fishing operations were conducted with these nets in combination with 3 types of otter boards.

Efforts were also directed towards studying the availability of prawns in different depth regions off Cochin coast and to correlate

the same with factors like oxygen content of sea water and nature of sea bottom. Since only a few operations could be made, no definite conclusions could be arrived at and further experiments are in progress.

II. Effect of weight of otter boards on horizontal spread of the net.

[FM-1 (a)/69 (3) c]

The bulged belly trawl evolved earlier was operated in combination with horizontal curved otter boards of size 120x60 cms. having 50, 55 and 60 kg. weights to determine their comparative performance. During experiments it was found that the board with 60 kg. wt. was not functioning well as it had a tendency to dig into mud while the board with 50 kg. weight was found to be relatively light for bottom operation. However, with the otter door with 55 kg weight there was increase in the catch/hr. without any significant difference in the tension and the horizontal spread.

III. Determination of the flow characteristics inside the net under different operational conditions

[FM-1 (a) 70 (2) c]

The instrument developed in the Institute for measurement of water flow inside the net was calibrated at the Indian Institute of Technology, Madras. The instrument was tested under field conditions both in the backwater and in the sea. It was found suitable for measuring water flow between 0-2M/second. A few preliminary measurements of the velocity of water flow inside a 17 m bulged belly trawl were also made.

IV. Efficiency of a trawl net made with a combination of different materials

[FM-1 (c)/71 (2)]

Three 17m trawl nets, one each in cotton, polyethylene twisted monofilaments, and a combination of cotton and polyethylene i. e. upper and one side panel with polyethylene and lower and the second side

panel with cotton, required for the studies were fabricated. Fourteen cycles of operations for the evaluation of the comparative efficiency of the three nets were undertaken. The data gathered did not show any significant difference in the tension offered by the three nets as well as in the horizontal spread. No significant difference was noticed in the catch of prawns. However, as regards total catch, a higher catch rate was noticed in the net made with polyethylene twines and in the combination trawl compared to that in the cotton net. Mesh size measurements of the three nets after the period of operations also did not show any appreciable difference from the original values.

V. The effect of impulse current on the efficiency of a trawl net

[FM – 1 (a)/69 (3) j]

Trails with the electrical shrimp trawl were initiated during the year. Direct current drawn from a 24V battery was employed in these trials, the impulse current being applied to the foot rope. An increase of approximately 30% in the catch of the prawn *P. indicus* was noticed in the method.

VI. Survey of trawling gear

(Ad hoc study)

For a thorough assessment of the design aspects of trawl gear, a further survey was undertaken during the year in important centres like Madras, Cuddalore, Mandapam and Rameswaram on the East Coast, and Colachel, Neendakara, Sakthikulangara, Alleppey, Beypore and Calicut on the West Coast. The data collected from these centres along with the survey data of the previous year, were analysed for integration of the various parts of four seam type trawls. The findings do not indicate any significant changes in any of the relationships reported earlier.

Further, from the data collected during the survey, the various parameters of the integrated parts of two seam type trawl nets were also analysed. The correlation coefficients between the different integrated parts were not seen to be very significant. It appears that the relationship between the various integrated parts of this type of trawls is not linear. The non-linear empirical relationships are being worked out.

1. Investigation on Seer gill nets

[FM-2 (d) 69 (2)]

(a) Mesh selectivity

The data collected from the operation of gill nets during the fishing season indicate that the selectivity of *Scomberomorus guttatus* to 50 mm bar net is well marked and amounted to 3 and 9 times more than the catch in 60 and 70 mm bar nets. To obtain maximum sustainable yields, taking biological factors also into consideration, 52 mm. bar nets are suggested for exploitation of fishing on the west coast of India. Morphological relationships have been established between maximum girth (G) and length (L) of *S. guttatus* on the one hand and mesh size with gilled and maximum girth on the other. The regression representing the relation between the girth and length is :

$$G = 0.4685\ L - 1.9375$$

The ratio of mesh perimeter to the average measurements at gilled and maximum girth regions are 1.048 and 1.134 respectively. This holds good only to the particular twine size used in the experimental nets.

(b) Effect of coloured nets on catch

Nets of identical design dyed in brown, blue, orange and green colours operated along with a control net have indicated the superiority of those dyed in brown colour followed by blue, orange and green in the order of preference. It has also been observed that the effect of colour of the net on the catch is more pronounced during moonlit nights and in waters where luminiscent organisms are predominant.

(c) Spatial distribution of seer

The spatial distribution of seer in surface drift nets and bottom drift nets was studied. Of the total of 163 fish caught in the surface drift nets, 95 5% was gilled in the area between 0 to 7.5 m depth in the nets having a total fishing height of 10m. Similarly, in the bottom operations, 72.8% of the catch was obtained in the area between 2.6 to 10.0 m. These observations are suggestive of the fact that the fishing height of the gear can be reduced, effecting a great economy in the total cost of the gear.

(d) Gill net hauler

A gill net hauler for small boats in the size range of 9-11m was designed, fabricated and tested.

II. Mechanised hand lining for kalava

[FM - 3 (b) / 70 (2)]

A hand operated portable Kalava hand line reel was designed and prototype fabricated. Preliminary trials carried out were successful.

Researches contemplated

Investigations on the above aspects will be continued during the ensuing year. In addition the following programmes are also proposed.

1. Studies on six panel trawl net.
2. Studies on a dual purpose trawl.

Research workers associated with the projects

1. G. K. Kuriyan, Sr. Fishery Scientist
2. S. Gopalan Nayar, Jr. Fishery Scientist
3. P. Sulochanan, Asst. Fishery Scientist
4. R. S. Nair, Asst. Fishery Scientist
5. V. C. George, Asst. Fishery Scientist
6. K. Radhalakshmi, Asst. Fishery Scientist
7. K. N. Kartha, Research Assistant
8. N Subramonia Pillai, Research Assistant
9. V. Vijayan, Research Assistant
10. M. Syed Abbas, Research Assistant
11. C. Hridayanathan, Research Assistant
12. M. Velu, Fishery Scientist
13. K. Sreedharan Namboodiri, Asst. Fishery Scientist
14. T. K. Sivadas, Asst. Fishery Scientist

CRAFT SECTION

Chief findings

It has been possible to standardise a suitable toxic wood preservative and method of treatment against biological attack on timber structures like those of Mango (Mangifera indica) and Haldu (Adina cordifolia) with a minimum dose of 0.2% arsenical creosote. This chemical preservative did not corrode metal fastenings even when in direct contact. Al minised iron fastenings showed longer service life in comparison with galvanised iron fastenings under coastal atmospheric conditions in and around Cochin. A new seaming compound which will go well with FRP sheathing was also developed.

Research completed

Studies on arsenical creosote

[C – 5 / 71 (1)]

The efficiency of arsenical creosote as a wood preservative was significantly improved by working out the proper methods of preparation and application. Different compositions were experimented at different temperatures of application ranging from 40 – 90°C. A composition containing 0.2% arsenic in plain creosote at temperature between 80° – 90°C gave the best result. Fastenings and hardwares in contact with the composition have been free from corrosion. Treated panels of timbers like Mango (*Mangifera indica)* and Haldu (*Adina cordifolia)* with necessary untreated samples were exposed at different locations in Cochin, Goa, Veraval and Kakinada. Under 120 days of continuous immersion the treated panels were free from the common deterioration, while the controls were damaged in varying degrees. The cheaper secondary species of timbers like Mango and Haldu have thus been found to last under marine use as long and as good as the untreated conventional types of boat building timbers. The finding holds scope for utilisation of the cheaper timbers for construction of fishing boats, thus bringing down the cost of construction and easing the problem of scarcity of the conventional types of timbers like Teak and Aini.

Researches in hand

I. Fibreglass reinforced plastic sheathing

[C–6/71 (1)]

White putty, the conventional seaming compound, which was going well with metallic hull sheathings, was not found compatible

with FRP. A composition of polyester resin mixed in suitable proportion with dry saw dust or titanium dioxide or slaked lime powder was found suitable for filling up seams of wooden boat hulls prior to FRP sheathing. However, once the new compund was fully cured and dried, it became very rigid without any resilience. The quality was improved by partial caulking with cotton threads and by binding the seam by superficial application of the new compound. Cashew-nut shell liquid (CNSL) resin as such was found to be unsuitable for use with fibreglass and it required further improvement. Attempt was therefore made to modify the CNSL resin as CNSL epoxy resin for imparting the desired property.

The commercially available epoxy resin *"ARALDITE LY 553"*, which was found suitable for FRP sheathing is 2½ times costlier than the conventional polyester. Thus, cost reduction in the present standard FRP sheathing appears possible with the commercially available epoxy resins. The possibility of epoxy CNSL resin in reducing the present cost has to be explored.

The method of sheathing wooden fishing boats with FRP as recommended by the Institute is put to wide commercial application. More than 100 FRP sheathed mechanised fiishing boats are in operation in Kerala and Mysore at present.

II. Bacterial destruction of underwater structures

[C-3 (a)/70 (3)]

A number of boat-building timbers (Teak, Aini, Venteak, Mango, Haldu & Marudu) in the form of test coupons as well as metal coupons of copper and its alloys, steel and its alloys, G. I., tin and zinc were all immersed in sea water under field conditions and indoor laboratory conditions The primary film of slime deposited on all types of test coupons was collected periodically and qualitative and quantative analysis made. The bacterial flora was predominated by gram negative spore forming rods. Nitrate, Sulphate and cellulose reducing organisms were found on an average to the extent of 60, 18 and 12% in the sea water at the test site and 61, 15.5 and 18.5 in the bacterial deposit on the different test coupons.

III. Irradiation preservation of wood

[Ad hoc Study]

Five different species of boat building timbers were got irradiated at the BARC, Bombay after initial polymer loading varying from 1% to 98%. Radiation dosage was maintained between 2.5 and

6 M rad. Irradiated panels have been exposed to marine organisms under immersion in sea water in the port of Cochin. Periodical observations are being made.

Researches contemplated

1. Studies on bacterial destruction of marine underwater structures will be intensified with special reference to the primary film of slime deposit and accompanying biochemical changes.

2. Stability studies of "Ferrocement" mock-up panels both above and below sea water.

3. Observations on the irradiated timber test blocks will be continued for a preliminary assessment.

Research workers associated with the projects

1. R. Balasubramanyan, Jr. Fishery Scientist
2. N. Unnikrishnan Nair, Research Assistant
3. A. G. Gopalakrishna Pillai, Research Assistant

MECHANICAL ENGINEERING SECTION

Chief findings

Studies on power requirement of trawl winches in 9.8m class boats indicate that the maximum power required is of the order of 10 H. P. A full scale equipment as per the design finalized earlier was fabricated for eradication of submerged weeds from inland water areas. A gill net hauler suitable for operation from 9–11m class vessels was fabricated and tried successfully. An instrument was developed for monitoring more than one operational parameter of a trawl net through a single cable. Another electronic instrument to measure the tension of cod-end alone was fabricated.

Researches in hand

I. Mechanical equipment for weeding of lakes and bheels

[ME - 1 / 69 (2)]

Fabrication of the full scale machine for removal of submerged weeds from inland water areas like bheels and tanks was completed as per the design finalized earlier. The equipment will be put to large scale field trials.

II. Refrigeration of fishholds

[ME - 4 / 70 (3)]

Temperature measurements were made with and without ice but without fish at different points of the fish hold. It is found that the melting of ice without fish works out at the rate of about 250kg/day of 24 hours out of port. Further work is in progress to work out the melting rate of ice with fish.

III. Measurement of the power required by a trawl winch

[ME - 5 / 70 (2)]

Studies indicated that the maximum power requirement of trawl winch for 9.8m (32') class of boats was of the order of 10 h. p. Details of power requirements for 11 m (36') class trawlers have been collected and the results are under analysis.

IV. Development of underwater gear testing instruments

[ME - 3 / 69 (3)]

i) Portable electronic tension meter

This instrument which is an improvement over the existing mechanical types, was fabricated, tested and found suitable for measuring tensions upto 200 kg.

ii) Rudder position indicator

Fabrication of this unit was completed and the instrument is ready for field trials. Range of the instrument is from $-45°$ to $+45°$.

iii) Electronic impulse generator

The limitations in mechanical type of impulse generators showed the need to develop an electronic type equipment for producing high power D. C. pulses of sharp rise and slow decline, required for attracting fishes. Construction of pulse circuits required for the equipment was completed.

iv) Multisignal telemetering link between net and boat

Fabrication of this instrument intended for acquisition of data on hydro-dynamic characteristics and operational parameters of a trawl net using a single cable and meter but with independent transducers was completed. The instrument was operated under field conditions and was found satisfactory except for a slight leakage in its switch. The switch is being suitably modified.

Other items of work

i) Testing of Kirloskar RVM4 engine

Performance evaluation of Kirloskar RVM4 engine undertaken at the request of the manufacturers was completed and a report incorporating the findings and suggestions for overcoming the defects observed was prepared and furnished to the manufacturers.

ii) Cable for electrical installations in fishing boats

Studies carried out have shown that aluminium cables are suitable for various electrical installations in fishing boats.

Researches contemplated

i) Fish meat picking machines are not manufactured in India. Work was initiated to develop a meat picking machine which can be produced with indigenous raw material, machinery and know-how, and will be continued in the ensuing year.

2) Development of a telemetering instrument for the measurement of warp declination of otter trawls during operation so as to determine the configuration of the warps.

Research workers associated with the projects

1. M. Velu, Fishery Scientist
2. K. Sreedharan Namboodiri, Asst. Fishery Scientist
3. T. K.Sivadas, Asst. Fishery Scientist
4. R. Krishnaswamy, Research Assistant
5. P Sulochanan, Asst. Fishery Scientist
6. V. Vijayan, Research Assistant
7. C. Hridayanathan, Research Assistant

SUBSTATION, VERAVAL

(Gear Section)

Chief findings

Preliminary catch data collected on a double - rig trawl reveal immense potentialities of this method of fishing for shrimps.

Researches in hand

Trawls

I. Studies on shrimp trawl

[FM-1 (VR)/69 (4)]

In the studies on the comparative efficiency of the long wing and six-seam trawls of size 29.26 m and 15.8m respectively, a total of 27 hauls were made. Preliminary analysis of the catch data, both of prawns and total catch, showed the superiority of the six-seam trawl for operation along the coast.

II. Double-rig trawling

[FM-2 (VR)/71 (3)]

Study on the method of double-rig trawling was initiated to find out commercial feasibility of the method in increasing prawn catch. In the double-rig trawl, the combined catch of prawns in the two smaller nets was more than that of a single net of double size.

The percentage of prawn in the total catch was 23.7 for the single big net and 36.5 for the two smaller nets.

III. Mid water trawling for fishes

[FM-3 (VR)/71 (3)]

A beginning was made in the experiments with mid water trawl aimed at evolving suitable gear. A 10.5 m net of 4 equal panels was initially operated and 28 hauls made. The total landing of fish was 520 kgs. Subsequently the catch of the 4 equal panel net was compared with a net having unequal panels (both nets having identical head rope length). The catch by the four-equal-panel net was found to be nearly 7 times more than that of the other net.

Gill nets

Gill nets for Pomfrets/Hilsa

[FM-2 (VR)/70 (2)]

Nine combinations (27 Nos.) of Hilsa gill nets made with three twine sizes, viz. 210/2/3, 210/3/3 and 210/4/3, and of three different mesh sizes, viz. 50.8 mm, 57.1 mm and 63.5 mm bar, were mounted on head and foot ropes with 30%, 40% and 50% take-up. A total of 53 trips were made and data on landings from each unit were collected. The total catch was 1024.5 kg. which was constituted by 654 nos. of Hilsa weighing 539.5 kg. The rest (485 kg) was constituted by miscellaneous types.

Researches contemplated

Studies on all the above aspects are to be continued. In addition, experiments with the bulged belly trawl will also be initiated.

Research workers associated with the projects

1. P. Appukutta Panicker, Jr. Fishery Scientist
2. T. M. Sivan, Asst. Fishery Scientist
3. H. N. Mhalathkar, Asst. Fishery Scientist
4. S. V. S. Rama Rao, Sr. Research Assistant
5. P. George Mathai, Research Assistant
6. T. P. George, Research Assistant

SUBSTATION, KAKINADA

(Gear Section)

Chief findings

The V-shaped and horizontal curved otter boards were found to be of almost equal efficiency in bottom trawling. But the V-shaped boards are preferable in view of the advantages in operation and maintenance. Assessment of performance of the vertical otter boards indicated their better utility in midwater trawling.

Research completed

Studies on different shaped otter boards

[FM-2 (K)/69 (2)]

Horizontal curved and V-shaped steel otter boards, found comparatively effective, were subjected to further experimentation to study their individual behaviour at different depth/warp ratios and at different depths. Thus, fishing experiments with these boards separately were conducted at 15, 25 and 35 m. depths with 1:4, 1:5 and 1:6 scope ratios. An 18.26m (60^1) two-seam net with 20m. single sweep system was used along with the boards. The V-shaped steel otter board worked better with high catch rate at the scope ratio of 1:5, whereas the horizontal curved otter board gave good catch rate at the scope ratio of 1:6 at all the depth ranges experimented. The results of both the comparative fishing experiments and scope ratio studies can be exploited on pilot scale along the coast, to make this newly experimented V-shaped otter board more popular in view of the advantages in operation as well as maintenance. Vertical otter boards were found to be better suited for midwater trawling operations.

Researches in hand

Trawls

Development of a combination trawl

[FM - 1 (K) / 71 (4)]

Fabrication work of the two different trawls selected for the

investigations, namely 30m. long wing four seam and 30m. bulged belly trawl, was completed. Both the nets were made out of cotton twine as per the design specifications. The required cod ends for mesh selectivity studies and pockets for the escapement studies from the different parts of the net, were also made ready. Experimental fishing operations could be taken up only in the latter part of October 1971. The 30m. long wing net was initially tried to assess its working in actual fishing conditions. Eight fishing trips were made, four for trial fishing and four for escapement studies.

A new double trawl made by the introduction of a panel of webbing between the upper and lower panels of ordinary trawl and with two cod ends, was put to trials with a view to study the utility of the trawl in selective fishing. Fishing was done for a week in May. From the results, it was found that the catch per hour in lower cod end (30.8 kgs.) is more than in the upper cod end (15.5 kgs), but the catch in upper cod end consisted more of bottom forms like lactarius, caranx, moon fish and silver bellies (64.5%) while these fishes constituted only 36.1% in the lower cod end.

Gill nets

Improvement in the designs of seer gill nets

[FM - 3 (K) / 69 (2)]

Fifty six experimental operations were conducted for *S. commersoni* and *S. lineolatus* from June to November and 16 units of nets were operated on all the days. The nets were fabricated out of twines of size 210/6/3, 210/7/3, 210/8/3 and 210/9/3 and having mesh sizes of 55, 65, 75 and 85mm far. Forty observations were made by operation as bottom drifting nets and the remaining as surface drifting nets. Bottom fishing was mainly at 15 to 30m depth. Owing to continued rough seas and lean fishing season extending from June to November the general catch was poor during the period. The 85mm mesh sized units of all twines brought more catch of seers. *S. commersoni* of size group 90 to 110 cms. predominated the seer catch. Shark constituted the rest.

Researches contemplated

The programmes on hand are to be continued. Experiments with the six seam trawl will also be initiated.

Research workers associated with the projects

1. A. V. V. Satyanarayana, Jr. Fishery Scientist
2. G. Narayanappa, Sr. Research Assistant
3. G. D. Chandra Pai, Research Assistant
4. J. Sitarama Rao, Research Assistant
5. Percy Dawson, Research Assistant

SUBSTATION, BURLA

(Gear Section)

Researches in hand

Standardisation of optimum size of fishing fleet of gill nets (Trammel and Frame Nets)

i) Trammel nets

The gear required for the investigations, viz. ten trammel nets each measuring 35 m x 5.25 m with mesh size ratio of 1 : 3 made of two different twines and four combinations of horizontal and vertical hanging coefficients were fabricated and a few trial fishing operations were conducted.

ii) Frame nets

Ten frame nets with 1.75 m x1.75m frame sizes and each measuring 35m x5.25m with two different hangings and two sizes of twines were got ready and preliminary fishing operations were made.

During the course of investigations it was also observed that in gilling and entangling nets, the majority of fishes was caught in the areas of 0–2 and 3–4 metres depth of the nets having 6 metres fishing height. A reduction in the present height of gill net is therefore possible which would in turn help easy operation and less entanglement with underwater obstructions.

Researches contemplated

Studies towards standardisation of optimum size of fishing fleet of gill nets and on the effect of colour on the catches of gill nets will be undertaken during the ensuing year.

Research workers associated with the projects

1. Y. Sreekrishna, Assistant Fishery Scientist
2. R. M. Naidu, Senior Research Assistant
3. Anwar Ahmed Khan, Research Assistant
4. M. D. Varghese, Research Assistant

UNIT, GOA

(Gear Section)

Chief findings

Experimental troll line fishing operations conducted with the artificial lures of CIFT design have indicated their effectiveness as suitable substitutes for imported lures in capture of seers.

Researches in hand

I. Improvement on the design and operation of purse seines

[FM - 2 (G) / 71 (3)]

With a view to collect information regarding purse seining as praetised in the area and to suggest improvements, a detailed study of the gear was undertaken. It was found that the length and depth of the purse seines ranged fron 200 to 400 metres and 35 to 50 metres respectively. The length of a single unit of the main net ranged from 15 to 25 metres and each unit was rigged with 19 kgs. of weight on the foot rope and 125 plastic floats on the head rope. Mesh size of the main webbing and selvedge ranged from 2 to 3 cms and 5 to 14 cms respectively. Size of purse seines ranged from 12.19m (40′) - 16.7m (55′).

Regular fishing voyages were made on board private vessels to collect details of fiishing operations. Purse seining with one boat

with the aid of a skiff is the common practice. Except the winch, gallows, davit and derrick, there are no other machineries to handle the gear. The number of crew engaged by each vessel varied from 17 to 21. Fish detection is by visual aid and no electronic instrument is employed. Fishing season is from September to December. The average daily catch varied from 3–7 tons per boat.

II. Investigation on troll line lures

[FM - 3 (G) / 69 (2)]

Systematic studies with CIFT designed lures were conducted to find out their effectiveness in place of the imported lures commonly used in Goa. CIFT designed lures were found to be very effective for seer. Stainless steel spoon jigs of 14 cm. length and 75 gms in weight proved to be better than buffalo horn jigs. The study is being continued for confirmatory results.

III. Survey of trawling gear

(Ad hoc study)

As a pre-requisite for study on suitable trawl net designs for operation from different sizes of boats in the region, a detailed survey was conducted to collect basic information regarding the existing trawl nets, otter boards, their mode of rigging and operations, on board vessels stationed at Panaji. The vessels are mainly stern trawlers and most of them are provided with mechanically operated winches. The existing facilities available in the trawlers are sufficent to operate them only up to 24 metres (15 fathoms). The survey indicated the necessity of improving the gear system for effecting better catches.

Research workers associated with the projects

1. K. A. Sadanandan, Jr. Fishery Scientist
2. N. A. George, Asst. Fishery Scientist
3. K. K. Kunjipalu, Sr. Research Assistant
4. Joseph Mathai, Sr. Research Assistant
5. P. R. Senthivelan, Research Assistant

EXTENSION, INFORMATION AND STATISTICS DIVISION

STATISTICS SECTION

Chief findings

Study on variations in drained weights of canned and frozen prawns has shown the possibility of using control charts in processing factorie for regulating the drained weights of the products. The cost of processing and shipment of 22.7 kg. (50 lb. representing the weight of product in a master carton for export) of frozen prawns excluding the cost of raw material was worked out to be between Rs. 57.70 — Rs. 59.50 and Rs. 46.70 — Rs. 48.50 for shipment to U. S. A. and Japan respectively during the year. The numerical scoring scale evolved earlier for quality assessment of three species of prawns in ice storage was extended to two more commercially important species.

Researches in hand

I. Study on the fluctuations in drained weights of canned and frozen prawns

[S - 1 / 70 (2)]

The possibility of applying control chart technique based on gross weights of frozen prawns to regulate the corresponding drained weights of the product was investigated. Preliminay data collected from three processing factories in the case of peeled and deveined frozen prawns of size grade 200-300 and peeled and undeveined type of size grade 80-120 indicated the possibility of applying the technique with respect to individual factories. Gross weights of canned prawns processed from material blanched in different batches were studied to find out uniformity in gross weights indicating the variability arising from different blanching operations.

II. Development of a numerical scoring system for organoleptic characteristics of ice-stored prawn

[S - 2 / 69 (2)]

The numerical scoring scale worked out earlier for quality assessment of ice-stored prawns of the species *M. affinis*, *M. dobsoni* and

P. stylifera was extended to *P. indicus* and *M. monoceros* also. Significant changes in flavour ofthe ice-stored material (peeled and deveined form) could be detected by a difference of 0.91, 0.65, 0.67 and 0.69 in the scoring scale corresponding to 2, 5, 7 and 10 days of storage. Changes in odour were sensed by a difference of 1.33, 0.94, 0.97 and 0.99 points in the scale corresponding to 2, 5, 6 and 9 days of storage. Changes in texture were detected only on 2nd, 3rd, and 9th days of ice – storage.

III. Study on the economics of operation in prawn processing factories

[S – 3 / 70 (1)]

Based on the average rates worked out earlier of sorting, grading, peeling and deveining of different species of prawns the average cost involved in freezing and shipment of 23kg. of prawns (50 lbs. representing a master carton weight for export) was worked out. It was seen to be between Rs. 57.70 – Rs. 59.50 for shipment to U. S. A. and between Rs. 46.70 to Rs. 48.50 for shipment to Japan during the year, exclusive of raw material cost in both cases. Cost of packing materials including containers, transport, salaries, wages, accounts, administration and general overheads, depreciation and maintenance, customs and inspection charges and freight charges were taken into account in working out the above estimates

IV. Price study of frozen prawns in the U. S. market

(Ad hoc study)

Analysis of the price data during the period 1966–1970 has revealed wide fluctuations in the prices of Indian frozen prawns in the U. S. market. Attempt was made to correlate the factors which might have a bearing on these variations. The ex-vessel prices paid to two size-grades (15–20 and 51–65) of shrimp at Brownsville (Texas) were considered along with the first of month cold storage holding in U.S.A. and the monthly export of Indian products to the market. It was seen that the price of Indian frozen prawn is affected by the ex-vessel price of the nearer size grade of the Brownsville shrimp. The prices of smaller grades were affected by the first of month cold storage holdings in U. S. A.

Monthly indices of prices and associated standard deviations were also worked out for the period 1966–1970 in the case of 12 size grades of peeled and deveined frozen prawns and 8 size grades of

headless shell - on product. The standard deviations were higher for smaller size grades than for larger ones indicating higher variability in the case of the former over different seasons. The monthly indices were higher in the last quarter of a year than in the first in the case of all size grades of headless shell-on type and a few large size grades of peeled and deveined variety. The smaller size grades of peeled and deveined type did not show any such variation.

Researches contemplated

Study on the economics of operation in prawn processing factories is to be continued during the ensuing year. Besides, the following are also contemplated.

1) Thaw-drip-loss in frozen shrimps and froglegs

2) The percentage yields of finished products from raw materials with respect to canned and frozen prawns.

3) Optimum size of fishing fleet for a viable integrated fish processing factory.

Research workers associated with the projects

1. H. Krishna Iyer, Asst. Statistician
2. K. Krishna Rao, Asst. Statistician
3. N. Balraj, Senior Research Assistant
4. R. Gopalakrishnan Nair, Computor

EXTENSION AND INFORMATION SECTION

I. Technical consultancy service

1) Replies to technical enquiries

Three hundred and fifteen technical enquiries were received by the Institute during the year. Out of these 189 related to fish processing industry and 126 to fishing craft and gear. The details furnished on fish processing industry include schemes for setting up canning, freezing and dehydration plants, fishmeal and oil production units, methods for canning, freezing and drying of different types of fish

and shell fish, data on weight loss due to thawing and refreezing of different species of prawns, details of the economics of production of laminated Bombay duck, method of preventing insect infestation in dry cured fish products, different types of packaging for cured fish products, use of antioxidants for increasing storage life of frozen oil sardines, specification of plastic containers for use in the processing industry, methods of extraction of sardine and shark liver oil, processing of shark fins, fin rays and fish maws, production of meal from frog wastes, processes for preservation of fish and prawns by pickling, method for packaging and transportation of fresh and frozen fish over long distances, etc. Details furnished with respect to fishing craft and gear include specifications of nets, otterboards and winches for operation from different sizes of boats, details of electric shrimp trawl, suitable nets and boats for fishing in inland waters, details of cheaper substitute materials recommended for construction of fishing boats, approximate cost of steel trawlers for deep sea fishing, estimated fish catch from different sizes of boats, details of the method of sheathing wooden hulls of fishing boats with fibreglass reinforced plastic (FRP) and aluminium magnesium alloy, causes of corrosion and remedial measures suggested by the Institute in case of aluminium sheathing, specifications of echo-sounders and radio telephones for vessels below and above 15.25 m, list of machinery and equipments required for a slipway-cum-service station, scheme for setting up boat building yard etc. About 173 parties including industrialists and new enterpreneurs also called at the Institute for personal discussions and technical guidance during the year.

2) Testing of materials and products

Arrangements were made for testing samples of twines, floats, fish products etc. received from indigenous manufacturers and processors. Thirteen samples of nylon yarns and twines, 40 of polyethylene monofilament twines, 8 of polyethylene tape, 2 of aluminium floats, 1 each of polypropylene yarn and rope, 25 samples of prawns canned in brine, 8 of tuna canned in oil, 1 of frozen shrimp, 1 sample of sardine oil, 16 samples of fishmeal, 1 of sardine canned in oil, 4 samples of canned tuna soup, 2 each of turtle meat canned in brine and curry, 1 sample each of prawn masala, rice bran, ground nut cake, prawn powder and adult mash (a mixed protein feed), 2 samples of citric acid, 1 each of a detergent and a disinfectant and 7 samples of water were analysed on specific requests and results of analysis along with suggestions for improvement of quality, wherever required, were furnished to the parties concerned.

3) Visits to fish processing factories and primary centres

Ninetyfour prawn peeling sheds in and around Cochin area were visited for assessment of the sanitary conditions and demonstration of the schedule of cleaning recommended by the Institute for maintenance of sound factory hygiene. Apart from this, regular visits were also made to fish processing establishments and discussions held with the concerned technical staff on technological problems faced by the industry.

A few factories in Mangalore were also visited by the Bacteriology Section of the Institute to assess the bacteriological quality of raw material, water, ice etc. used in the establishments. Analysis of the samples collected was made with special reference to bacteria of the *Clostridium* species. Reports of analysis and remedial measures in cases of defects observed were forwarded to the concerned parties. The Quality Control Section of the Institute also made regular visits to fish processing establishments in Cochin area for giving technical assistance in improved processing methods, as for example, production of cooked frozen prawns, frozen crab meat and frozen frog legs of sound bacteriological quality, increasing the cooked yield of prawns, prevention of thaw-drip-loss in frozen prawns, all as per the methods worked out by the Institute. Technical assistance in freezing and packing of fish fillets was also given to a processor in Mangalore on specific request received.

4) Supply of designs of nets, mechanical fishing aids, dehydration plants etc.

Twentyone sets of designs of trawl winches suitable for different sizes of boats, 5 designs of trawl nets and suitable otter boards, 1 of a gill net for fishing gid *(Labeo diplostomus)*, 1 of a try net and a suitable otter board, 2 sets of designs of the power-take-off clutch, 1 each of the jockey pulley gear and power pole arrangement for propulsion in shallow waters, 11 designs of the tunnel dryer of 1 tonne raw material capacity for dehydration of fish, 13 of the rotary drum dryer of 1/2 tonne raw material capacity for dehydration of prawns and production of fish meal and 1 of the mechanised prawn peeling table, all designed by the Institute, were supplied to interested parties on request. Besides, 4 copies of the booklet on 7.6 m. (25') open power fishing boat and 26 copies of the special bulletin, 'An Account of the Inland Fishing Gear and Methods of India' published by the Institute, were also supplied during the period.

5) Exhibition

The Institute participated in two exhibitions during the year, one organised in connection with the symposium on 'Indian Ocean and Adjacent Seas' organised by the Marine Biological Association of India during January 1971 and the other in connection with the 'Open House' conducted by the Indo-Norwegian Project in Cochin between 17th and 19th October 1971. Exhibits pertaining to the important achievements of the Institute were also sent for display in the exhibition on Agricultural Research held during the year in the lawns of the Parliament House, New Delhi.

II. Publications

A special bulletin 'An Account of the Inland Fishing Gear and Methods of India' and a leaflet 'A Mechanical Device for Eradication of Submerged Aquatic Weeds' were brought out during the period. The former publication deals with the design aspects of the various types of inland fishing gear in vogue in different parts of India and the latter illustrates the design details and operational technique of the equipment developed by the Institute for eradication of weeds from inland water areas. Besides, a leaflet on the causes of blackening in canned prawns and method worked out for prevention of the phenomenon was also brought out in cyclostyled form.

III. 'Open House Discussions' and 'Workshop'

In view of the proposal of the Government of India for implementing compulsory bacteriological inspection in respect of fresh frozen prawns for export from the country, an 'Open House Discussion' on production of the product of sound bacteriological quality was conducted at Bombay in May 1971 for the benefit of the processors in the region. The discussions attended by sixty persons representing twentynine processing factories served to educate the processors in the causes of bacterial contamination of raw materials and processed products at the different stages of processing, methods for prevention of such contamination and production of quality products for export.

A combined workshop organised by the Indian Council of Agricultural Research on All India Co-ordinated Research Projects

on Transportation of Fresh Fish and Utilisation of Trash Fish, in respect of which the Institute functions as the Co-ordinating Centre, was held on the 11th and 12th October 1971. The Workshop had three technical sessions in which the research work carried out under the projects at the different centres and subcentres was reviewed and the technical programmes for the ensuing years were finalised. The workshop was attended by officials of the ICAR, Directors of State Fisheries Departments, representatives of the Central Food Technological Research Institute and State Fisheries Technological Laboratories and representatives of processing factories and can manufacturing companies.

Technical assistance by Substations and Units

The Substations and Units of the Institute also continued to render technical assistance to the fishing and fish processing industries in the concerned regions. The Substation at Veraval helped the fishermen and fishing units in the region in proper methods of rigging of boats for trawling for prawn fishery, selection of suitable types of gear for operation from different sizes of boats, handling, icing and transportation of fresh fish and processing of dried Bombay duck of improved quality.

The Unit at Goa rendered similar assistance in rigging trawlers, selection of proper types of trawl nets for operation from different sizes of boats and proper methods of operation of trawl gear.

The Unit at Bombay rendered assistance to the processors in the region for production of frozen prawns and frog legs of standard quality, and assessing the quality of water used for processing work and improving quality wherever found necessary. The Unit at Calicut analysed samples of water, fishmeal, shrimp powder etc. received from the local processors and reports of analysis and comments for improvement of quality were furnished to the concerned parties. The unit also rendered assistance in processing frozen prawns and frog legs of standard quality.

Persons associated

1. P. N. R. Kaimal, Extension Officer
2. M. K. Kandoran, Assistant Extension Officer
3. Mary Thomas, Senior Research Assistant (E)

SUMMARY

Inosine ribohydrolase or 5'-nucleotidase, both of which can cause rapid accumulation of hypoxanthine in the muscle, was found quite active in prawns *(P. stylifera)* when held in ice and in frozen storage. Proteolysis by enzymes in the muscle of mackerel, sole, jew fish, ribbon fish and anchovies was found to be maximum at PH 3-5. Higher amounts of C_{18} acids and lower amounts of long chain polyenes (C_{22} and C_{20}) were detected in the lipids of fresh water fishes than in those of marine species. Presence of Oestrone, Oestradiol and Oestriol was detected in the phenolic steroid hormones concentrated from gonads of the fresh water fish Tilapia.

A culture medium containing peptone and ferric phosphate in 75% sea water was found to be more suitable for isolation of bacterial flora from marine fishes. Strains of *Flavobacterium* were also found to lose viability at a faster rate at - 5°C than at - 15°C. Two strains of *Pseudomonas* were found to be able to produce slight amounts of glutamic acid and alanine in the culture fluid. Thirty strains of *Clostridium sp.* were detected in processed prawn products and factory environments in Cochin, Mangalore and Calicut during a survey conducted during the year.

Oil sardine, mackerel and jew fish iced and packed in plywood boxes (uninsulated) and kept in insulated chamber lost 80-85% of ice in 24 hrs., but were of acceptable quality upto 48 hrs. Storage life was double when packed in insulatd containers and up to 7 days when the packed fish was held in refrigerated hold. Preservation in refrigerated sea water (at temperature of - 1.5 to 0°C) was found beneficial in extending the storage life of fresh eviscerated seer fish up to 10 days. Fish preserved in refrigerated sea water were of better texture and appearance than the corresponding ice-stored samples. Freezing in the form of chunks was found to be better suited to seer and tuna than fillet freezing. Standard conditions were worked out for canning smoked sardines and frog legs in brine, sardine in its own juice and frog legs in tomato and mayonnaise sauce. An effective treatment was worked out for prevention of blackening in canned crab meat. A new lacquer composition was developed for lacquering tin cans for canning fish. Prototype of a multideck tunnel dryer designed earlier for dehydration of fish was fabricated. Standard conditions were worked out for dehydration of mackerel, thread-fin-bream, shark fillets, sprats and cooked prawns in the solar dryer developed by the Institute. The automatic brine filling equipment developed earlier was further improved

to make it a completely self-controlled unit. Method for preparation of fish flakes from trash fish was further improved to impart better swelling property to the product on frying. A cooling chamber was designed and fabricated for low temperature storage of fish. An instrument was developed for testing the freshness of fish based on changes in dielectric properties of muscle. Other testing and measuring instruments designed and fabricated during the period include an electronic balance for use in following the changes in weight of fish during tunnel drying, and a moisture meter for quick measurements of moisture contents in dry fish products.

Preliminary trials with chitosan prepared from prawn shells as per the method worked out earlier showed usefulness of the product in imparting a permanent finish to cotton fabrics. Frozen storage life of shrimp extract from prawn shells was found to be 8 months at - 10°C. A highly unsaturated portion of fatty acids with iodine value of 300 was isolated from sardine oil. A semi-pilot plant fabricated as per the design finalized by the Institute was installed for pilot scale trials of the method of preparation of bacteriological peptone from trash fish

The method of treatment with polyphosphates worked out earlier for prevention of "thaw-drip-loss" in frozen prawns was modified and successfully applied for increasing the cooked yield of prawns to 90% from the normal yield of 75%. A treatment with permitted food colours was evolved for imparting attractive colour to cooked frozen prawns as required by the importing countries. The survey of the bacteriological quality of frozen prawns processed in Cochin area revealed that 16.4% of the samples of headless shell - on product analysed, 21.9% of the peeled and deveined type and 22.6% of the peeled undeveined type were of substandard quality. A similar survey of water, ice and utensils used in processing factories and primary process centres in the area showed that nearly 80% of the samples analysed were defective.

Twist specifications were worked out for cotton ropes of ZZS and ZSZS constructions. Study on high density polyethylene tape has shown the material as a cheap but equally efficient substitute for yarn as a net making material. Preliminary quality standards were also worked out for twines twisted out of the material.

For the 17m. bulged belly trawl, otter boards of wt. 55 kg. were found to give the maximum horizontal opening resulting in increased catches. Gill nets of mesh size 52 mm. bar were found to

be the most efficient for exploitation of the commercially significant size groups of seer of the species *Scomberomorus guttatus* on the west coast of India. Efficiency of coloured gill nets was observed to be more enhanced when operated on moonlit nights and in water predominated by luminiscent organisms. Following the three concepts in trawl designs, viz. long wing, four panel and bulged belly, three designs of trawl nets of size 32 m. each were finalized and the nets fabricated for comparative fishing operations from a 15.24 m. vessel.

Composition of an efficient wood preservative was evolved and the method of application standardised for treating secondary species of timbers like Mango and Haldu to make them suitable for boat construction. A new seaming compound for use in sheathing of wooden boats with fibreglass reinforced plastic was also developed. Aluminized iron fastenings showed longer service life in comparison with those of galvanized iron under coastal atmospheric conditions in Cochin.

A full scale equipment was fabricated for removal of weeds from inland water areas as per the design finalized earlier. A hand operated reel was designed and fabricated for handling lines in line fishing for perches. A gill net hauler was also designed and fabricated for use in 9–11 m. class vessels. The maximum power required by trawl winches in 9.8 m. class vessels was seen to be of the order of 10 HP. Aluminium cables were found suitable for various electrical installations in fishing boats. An instrument was developed for monitoring different operating parameters of trawl net using a single cable. An electronic instrument to measure the tension of cod end of a trawl net was also designed.

At the Institute's Substation at Veraval, irradiation at 100 K rad level was found beneficial in extending the ice storage life of fresh whole, laminated and filleted Bombay duck upto 14 days. Semi-drying (to 70% moisture level) followed by freezing was found to be a satisfactory method of long term preservation of Bombay duck. The Substation also worked out methods for preparation of smoked cat fish fillets, canned product from smoked hilsa fillets, soup powder from Bombay duck paste, flakes from shark fillets and protein concentrate from eel, squid, Bombay duck and shark meat. Gear investigations at the Substation showed the better efficiency of six seam trawls in catching more prawn and fish compared to long wing trawls. In double - rig trawling the combined catch of two small nets was more than the catch of a single net of double size.

The Institute's Unit at Bombay observed that dhoma stored in ice for more than 4 days did not yield frozen product of good quality. Study on the quality of fish transported to Bombay from different regions showed that silver pomfrets transported from Veraval in thermocole-lined plywood boxes remained in good conditon and could be further preserved in ice for 12 days.

In the Unit at Calicut, the most effective way of using sodium propionate in preservation of dry cured fish was found to be as a pre-treatment solution (3%) for the fish just before salting. Incorporation of sodium benzoate at 2% level in the salt used for curing the fish enhanced the storage life of wet cured fish by about 6 weeks. Cooking prawns in brine containing sodium propionate, potassium sorbate or sodium benzoate at specified level was beneficial in extending the storage life of semi-dried prawns. The unit also worked out a method of heat treatment for prevention of insect infestation in smoked sardine fillets.

At the Substation at Kakinada, V-shaped otter boards were found better suited than horizontal curved and vertical otter boards for bottom trawling. For mid-water trawling vertical otter board was found better than the other two types.

The Substation at Burla observed that in gilling and entangling nets operated in Hirakud reservoir, the majority of the fishes was caught in the areas of 0–2 and 3-4 metres depths of the nets having 6 metres fishing height indicating the possibility of reducing the present height of gill nets and easy operation of the gear.

Experimental troll line fishing conducted by the Unit at Goa has shown that the artificial lures developed by the Institute are efficient substitutes for imported lures for capture of seer.

The Institute continued to render technical assistance and guidance to the fishing and fish processing industry, State Fisheries Departments and other fishery interests throughout the country. Technical enquiries numbering 315 received from different sources were replied apart from giving technical information and guidance to 173 parties who called at the Institute. Samples of fish net twines, floats, fish products etc. received from indigenous manufacturers and processors were tested. Regular visits were made to fish processing establishments in and around Cochin for giving technical assistance in maintenance of sound factory hygiene and production of better quality products. A few factories in

Mangalore were also visited for assessing the bacteriological quality of raw materials, water, ice etc. used in the establishments. Drawings of fishing nets, mechanical fishing aids, dehydration plants etc. designed by the Institute were supplied to interested parties on request. An 'Open House discussion' on production of bacteriologically sound prawn products was held in Bombay for the benefit of the processors in the region. A combined workshop on the All India Co-ordinated Research Projects on Transportation of Fresh Fish and Utilisation of Trash Fish organised by the Indian Council of Agricultural Research was held at Cochin in which the research work carried out under the projects at the different centres and subcentres was reviewed and future programmes finalised. The Institute also participated in two exhibitions at Cochin. Two printed publications, one a bulletin on the inland fishing gear and methods of India and another a leaflet on the weeding equipment developed by the Institute, were also issued during the period.

PUBLICATIONS

List of scientific papers published

1. ***Ayyappan Pillai, S.***

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3. ***Balasubramanyan, R.***

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4. ***Balasubramanyan, R.***

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5. ***Balasubramanyan, R.***

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6. ***Balasubramanyan, R.***

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8. ***Chakraborty, P. K. & Krishna Iyer, H.***

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14. ***Gopakumar, K. & Nair, M. R.***

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15. ***Gopalakrishna Iyer T. S. & Pillai, V. K.***

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18. **Kandoran, M. K., Solanki, K. K. & Venkataraman, R.**

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19. **Karthiayani, T. C. & Mahadeva Iyer, K.**

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20. **Karthiayani, T. C. & Mahadeva Iyer, K.**

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37. **Rao, C. V. N., Prabhu, P. V. & Venkataraman, R.**

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38. **Sivadas, T. K.**

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39. **Sreedharan Namboodiri, K.**

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44. **Vasantha Shenoy, A. & Pillai, V. K.**

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45. **Velu, M.**

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1. **Govindan, T. K.**

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2. **Govindan, T. K.**

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4. **Kuriyan, G. K.**

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5. **Kuriyan, G. K.**

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PERSONNEL

(Statement showing Division-wise staff position of the Institute as on 31-12-1971)

Director: Dr. V. K. Pillai

HEADQUARTERS (COCHIN)

PROCESSING DIVISION

Sl. No.	Name	Designation
1.	Shri M. Rajendranathan Nair	Fishery Scientist
2.	,, K. Mahadeva Iyer	Junior Fishery Scientist
3.	,, T. K. Govindan	-do-
4.	,, Cyriac Mathen	Quality Control Officer
5.	,, C. V. N. Rao	Assistant Fishery Scientist
6.	,, P. Vasudeva Prabhu	-do-
7.	,, M. Arul James	-do-
8.	,, S. Ayyappan Pillai	-do-
9.	,, P. Madhavan	-do-
10.	,, P. K. Chakraborty	-do-
11.	Smt. T. C. Karthiayani	-do-
12.	Shri. K. Gopakumar	-do-
13.	,, P. A. Perigreen	-do-
14.	,, T. S. Gopalakrishna Iyer	-do-
15.	,, P. D. Antony	-do-
16.	Smt. P. L. Chinnamma	Senior Research Assistant
17.	Shri. V. Narayanan Nambiar	-do-
18.	,, K. Devadasan	-do-
19.	,, A. Vasantha Shenoy	-do-

Sl. No.	Name	Designation
20.	,, T. S. Unnikrishnan Nair	Senior Research Assistant
21.	,, P. R. Girija Varma	-do-
22.	,, P. K. Surendran	Research Assistant
23.	,, A. C. Joseph	-do-
24.	,, K. G. Ramachandran Nair	-do-
25.	,, K. G. Francis Thomas	-do-
26.	Smt. T. T. Annamma	-do-

The above research staff are assisted by the following technical staff in the Division.

Sl. No.	Designation	Strength
1.	Analyst	1
2.	Glass Blower	1
3.	Instrument Technician	1
4.	Senior Mechanic	2
5.	Senior Field Assistant	2
6.	Senior Laboratory Assistant	4
7.	Junior Laboratory Assistant	3
8.	Metal Worker	1
9.	Boilerman	1
10.	Laboratory Attendant	8

CRAFT AND GEAR DIVISION

Sl. No.	Name	Designation
1.	Shri. G. K. Kuriyan	Senior Fishery Scientist-cum-Head of Division
2.	,, M. Velu	Fishery Scientist
3.	,, R. Balasubramanyan	Junior Fishery Scientist
4.	,, S. Gopalan Nayar	-do-

Sl. No.	Name	Designation
5.	Shri P. Sulochanan	Assistant Fishery Scientist
6.	,, R. S. Nair	-do-
7.	,, K. Sreedharan Namboodiri	-do-
8.	,, P. Ravindran (on study leave)	-do-
9.	,, V. C. George	-do-
10.	,, T. K. Sivadas	-do-
11.	Smt. K. Radhalakshmy	-do-
12.	,, P. J. Cecily	Senior Research Assistant
13.	Shri C. P. Varghese (on study leave)	-do-
14.	,, N. Unnikrishnan Nair	Research Assistant
15.	,, K. Narayanan Kartha	-do-
16.	,, A. G. Gopalakrishna Pillai	-do-
17.	,, N. Subramonia Pillai	-do-
18.	,, V. Vijayan	-do-
19.	,, M. Syed Abbas	-do-
20.	,, Om Prakash Pandey	-do-
21.	,, M. Shahul Hammeed	-do-
22.	,, R. Krishnaswami	-do-
23.	,, Verghese Paul	-do-
24.	,, C. Hridayanathan	-do-

The above research staff are assisted by the following technical staff in the Division.

Sl. No.	Designation	Strength
1.	Skipper	1
2.	Superintendent (Electrical & Mechanical)	1
3.	Engine Driver	1
4.	Draughtsman	2
5.	Fitter	1
6.	Welder-cum-Blacksmith	1

Sl. No.	Designation	Strength
7.	Machinist	1
8.	Senior Mechanic	1
9.	Junior Laboratory Assistant	4
10.	Tindal	3
11.	Driver (Launch)	1
12.	Senior Carpenter	1
13.	Deck hand	2
14.	Cook	1
15.	Laboratory Attendant	9
16.	Lascar	4
17.	Net Maker	4

EXTENSION, INFORMATION AND STATISTICS DIVISION

Sl. No.	Name	Designation
1.	Shri P. N. R. Kaimal	Extension Officer
2.	,, M. K. Kandoran	Assistant Extension Officer
3.	,, K. Krishna Rao	Assistant Statistician
4.	,, M. Krishna Iyer	-do-
5.	Smt. Mary Thomas	Senior Research Assistant
6.	Shri N. Balraj	-do-
7.	,, K. Bhaskaran	Photographer-cum-Artist
8.	,, R. Gopalakrishnan Nair	Computer

There are also a Field Assistant and a Laboratory Attendant attached to the Division.

ADMINISTRATION SECTION

Sl. No.	Name	Designation
1.	Shri Thomas Joseph	Administrative Officer
2.	,, A. Chakrapany	Superintendent (Accounts)
3.	,, Verghese Paul	Superintendent (Est.)

Besides the above, the following personnel are also attached to the section.

Sl. No.	Designation	Strength
1.	Senior Store Keeper	1
2.	Accountant-cum-Head Clerk	1
3.	Cashier	1
4.	Junior Stenographer	2
5.	Librarian	1
6.	Senior Clerk	10
7.	Junior Clerk	12
8.	Store Keeper	2
9.	Jeep Driver	3
10.	Gestetner Operator	1
11.	Daftry	1
12.	Peon	10
13.	Watchman	9
14.	Sweeper	3

AUDIT AND ACCOUNTS SECTION

Name	Designation
Shri K. Jayaraman	Accounts Officer

Other staff members in the Section are:

Sl. No.	Designation	Strength
1.	Junior Accountant	1
2.	Senior Clerk	4
3.	Junior Clerk	2
4.	Peon	1

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY SUBSTATION, VERAVAL

Processing Section

Sl. No.	Name	Designation
1.	Shri R. Venkataraman	Fishery Scientist
2.	,, K. K. Solanki	Assistant Fishery Scientist
3.	,, A. G. Radhakrishnan	Senior Research Assistant

Gear Section

Sl. No.	Name	Designation
1.	Shri P. Appukutta Panicker	Junior Fishery Scientist
2.	,, T. M. Sivan	Assistant Fishery Scientist
3.	,, H. N. Mhalathkar	-do-
4.	,, S. V. S. Rama Rao	Senior Research Assistant
5.	,, P. George Mathai	Research Assistant
6.	,, T. P. George	-do-

The above research staff are assisted by the following technical and ministerial staff.

Sl. No.	Designation	Strength
1.	Skipper	1
2.	Senior Clerk	1
3.	Senior Mechanic	1
4.	Junior Clerk	1
5.	Junior Laboratory Assistant	1
6.	Jeep Driver	1
7.	Tindal	1
8.	Driver (Launch)	1
9.	Deck hand	4
10.	Cook	1

Sl. No.	Designation	Strength
11.	Laboratory Attendant	3
12.	Net Maker	2
13.	Peon	1
14.	Watchman	1
15.	Lascar	2

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY SUBSTATION, KAKINADA

Sl. No.	Name	Designation
1.	Shri A. V. V. Satyanarayana	Junior Fishery Scientist
2.	,, G. Narayanappa	Senior Research Assistant
3.	,, J. Sitarama Rao	Research Assistant
4.	, Percy Dawson	-do-
5.	,, David Chandra Pal	-do-

The above research staff are assisted by the following technical and ministerial staff.

Sl No.	Designation	Strength
1.	Bosun	1
2.	Engine Driver	1
3.	Junior Clerk	1
4.	Jeep Driver	1
5.	Tindal	1
6.	Deck Hand	2
7.	Driver (Launch)	1
8.	Cook	1
9.	Laboratory Attendant	3
10.	Peon	1

Sl. No.	Designation	Strength
11.	Net Maker	2
12.	Lascar	3
13.	Watchman	2

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY SUBSTATION, BURLA

Sl. No.	Name	Designation
1.	Shri Y. Sreekrishna	Assistant Fishery Scientist
2.	,, R. Mangayya Naidu	Senior Research Assistant
3.	,, M. D. Varghese	Researh Assistant
4.	,, Anwar Ahmad Khan	-do-

The above research staff are assisted by the following technical and ministerial staff.

Sl. No.	Designation	Strength
1.	Senior Clerk	2
2.	Junior Clerk	1
3.	Junior Laboratory Assistant	1
4.	Jeep Driver	1
5.	Driver (Launch)	1
6.	Laboratory Attendant	3
7.	Peon	1
8.	Lascar	3
9.	Net Maker	3
10.	Watchman	3

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY UNIT, BOMBAY

Sl. No.	Name	Designation
1.	Shri K. K. Balachandran	Assistant Fishery Scientist
2.	,, Dinesh Kumar Garg	Research Assistant

The above research staff are assisted by the following technical and ministerial staff.

Sl. No.	Designation	Strength
1.	Laboratory Attendant	1
2.	Peon	1
3.	Watchman	1

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY UNIT, CALICUT

Sl. No.	Name	Designation
1.	Shri A. P. Valsan	Assistant Fishery Scientist
2.	,, V. Muraleedharan	Research Assistant

The above research staff are assisted by the following technical and ministerial staff.

Sl. No.	Designation	Strength
1.	Senior Laboratory Assistant	1
2.	Laboratory Attendant	2
3.	Junior Clerk	1
4.	Watchman	1

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY UNIT, GOA

Sl. No.	Name	Designation
1.	Shri K. A. Sadanandan	Junior Fishery Scientist
2.	,, N. A. George	Assistant Fishery Scientist
3.	,, K. K. Kunji Palu	Senior Research Assistant
4.	,, T. Joseph Mathai	-do-
5.	,, P. R. Senthivelan	Research Assistant
6.	,, G. Jagadeesan	-do- (on study leave)

The above research staff are assisted by the following technical and ministerial staff.

Sl. No.	Designation	Strength
1.	Bosun	1
2.	Engine Driver	1
3.	Laboratory Attendant	1
4.	Peon	1
5.	Lascar	2
6.	Net Maker	1
7.	Watchman	2

List of abbreviations used in the report

Abbreviation used	*Full form*
AFDC	Agricultural and Food Products Division Council
ATP	Adenosine triphosphate
BARC	Bhabha Atomic Research Centre, Bombay
den.	Denier
FRP	Fibreglass reinforced plastic
gm/den.	Grams per denier
G. I.	Galvanised iron
HDPE	High density polyethylene
H. P.	Horse Power
KHZ	Kilo cycles per second
K. rad.	Kilo rad
MCPD	Marine Cargo Movement and Packaging Division Council
M/min.	Metres per minute
M. rad	Mega rad
Ppm.	Parts per million
R. H.	Relative humidity
SH-active compounds	Sulphhydryl active compounds
S. S. agar	Salmonella – Shigella agar
TDC	Textile Division Council
μ g/gm.	Microgram per gram