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central institute of fisheries technology
cochin-682029
india

ICAR

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INDIAN COUNCIL OF AGRICULTURAL RESEARCH

ANNUAL REPORT

1976

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY
COCHIN - 682029 - INDIA

Indian Council of Agricultural Research

Dr. Jagjivan Ram, Hon. Minister for Agriculture and Irrigation, Govt. of India and President of the ICAR inaugurating the permanent building of the Institute in Willingdon Island on 2nd June, 1976.

CONTENTS

Permanent Building of CIFT in Willingdon Island

1. DIRECTOR'S INTRODUCTION

The year 1976 was an eventful one as the Institute was able to move into its permanent campus in Willingdon Island. In a colourful ceremony, the building was formally inaugurated on 2nd June, 1976 by the Union Minister for Agriculture & Irrigation, Dr. Jagajivan Ram. The Chief Minister, Home Minister and Minister for Fisheries of Kerala participated in the function. During the year, it was also possible for the Institute to complete the first stage of construction of the Staff Quarters Complex and allot them to the staff particularly of the lower income groups.

As reported last year, emphasis was still on the production of processed fish products for internal consumption and effective utilisation of fishery wastes. Details of dehydration plant of one tonne capacity were worked out and furnished to the Kerala Fisheries Corporation Ltd. (A Govt. of Kerala Undertaking). Similarly, the Gujarat Fisheries Central Co-operative Association Ltd. was provided with a project report for erecting a dehydration plant of 2 tonnes capacity. Proposals are also under way for installation of a few more such plants in different parts of the country. In some of them the main source of heat would be solar energy.

Studies on smoke curing of the by-catch were intensified in order to cater to the needs of the rural poor. Methods were worked out for preparation of smoked products from dhoma, ribbon fish, cat fish, sharks and rays. A smoke kiln was also designed for production of good quality smoked fish.

Technological aspects of production of frozen fish in whole, gutted and filleted forms were studied with a view to promoting them in the internal markets. The Pondicherry Industrial Promotion and Investment Corporation Ltd. was provided with a project report for utilisation of the fish|shell fish resources in that Union Territory and the first freezing plant is to go into production shortly.

Canning had hitherto been an industry based entirely on prawns. Diversification in canned products is the most urgent need facing that industry. Realising the scope for extending this processing technique on potentially abundant other species of fish|shell fish, intensive investigations were undertaken. Procedure for canning mackerel in 'natural style' was perfected. Method of canning sardine earlier developed was suitably modified and the methodology was accepted by Marine Products Export Development Authority and recommended for processing sardine for export by the Sardine Export Society under a common brand. A cooking chamber for cooking sardines, designed by the Institute was installed at Integrated Fisheries Project, Cochin. Investigations showed that citric acid treatment extended the shelf life of canned squid for nearly one year. Based on a scheme and technical assistance rendered by this Institute, a private firm in Veraval established a canning plant.

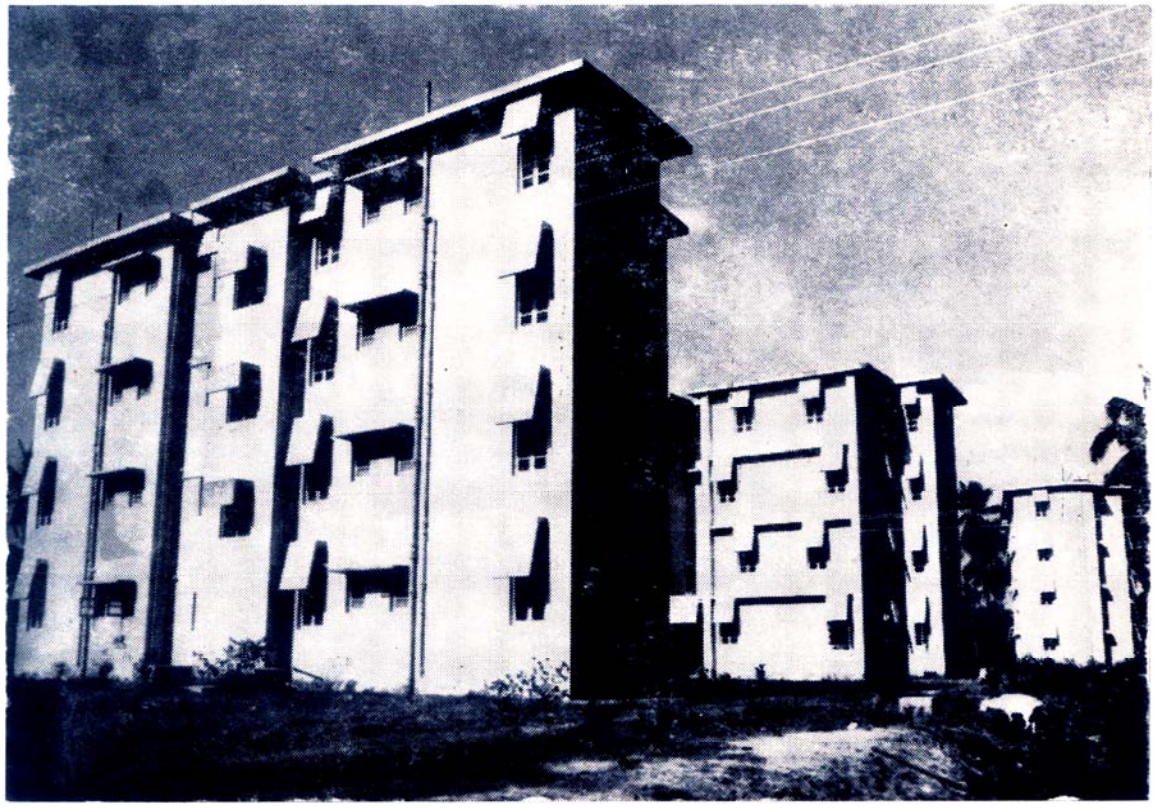
Schemes were finalised with a few entrepreneurs for the manufacture and marketing of certain products developed in the Institute like edible fish powder, fish wafers and fish soup powder. An instant deodorant developed in the Institute has become extremely popular in the processing establishments and some manufactures have started production of this item based on the Institute's know-how.

The designs and technology of the power-take-off clutch and the weed-harvester developed by the Institute were passed on through NRDC to a manufacturer for commercial production. The prototype of the weed-harvester was demonstrated at Bhubaneswar, Kalyani and Gauhati for removal of water hyacinth.

A 'Summer Institute' sponsored by ICAR on 'Coastal Fishing Methods' was held at this Institute from 14th June to 13th July, 1976. Lectures by experts in the respective fields with practicals, fishing trips and study tours were arranged for the participants from various State and Central Fisheries Organisations.

Analytical services rendered by the Institute for the benefit of fishing and fish processing industries were continued. Design drawings of boats and processing equipment and copies of publications of the Institute were supplied to interested parties. A refresher course of one week's duration on the processing of good quality frozen frog legs was conducted at Bombay for the benefit of the processors of that region.

The Institute put up exhibition pavilions at the 'Second International Sea Food Trade Fair' organised by Marine Products Export Deve-



A view of the CIFT Staff Quarters Complex at Thevara, Cochin-682015.
Inaugurated on 9th May, 1976.

lopment Authority at Madras, 'Open House and Fisheries Fair' of the Integrated Fisheries Project, Cochin and the Diamond Jubilee Celebrations of the Central Plantation Crops Research Institute, Kasaragode. An exhibition was also conducted at the Institute premises during the formal inauguration of the permanent campus in which all the different Central Fishery Organisations in Cochin participated.

Director of the Institute also functioned as the Member-Secretary of ICAR Regional Committee No. 8.

1.1. ORGANISATIONAL SET-UP

Besides the Headquarters at Cochin, the Institute has seven Research Centres at Veraval, Kakinada, Burla, Bombay, Goa, Calicut and Madras.

The Institute is headed by the Director in whom rests all the administrative powers regarding research and management of the Institute. He is assisted by a Senior Administrative Officer and Assistant Administrative Officer, who deal with matters of general administration, an Accounts Officer for accounts and internal audit and a Junior Technical Officer for attending to technical reports and matters connected with research projects handled at different Divisions and the Research Centres.

To strengthen research, the Institute was reorganised to have the following Divisions as approved in the Fifth Five Year Plan:

1. Processing & Packaging Division
2. Biochemistry & Microbiology Division
3. Craft Technology Division
4. Gear Technology Division
5. Engineering Division

and 6. Extension, Information & Statistics Division

The work under these Divisions were extended to the Research Centres as well to tackle the special problems facing the industry in the concerned region. Each Division and Research Centre is controlled by a Scientist-in-Charge, who carries out co-ordination, supervision and periodical assessment of the progress of work. Scientific work was also reorganised giving more accent on inter-divisional and inter-disciplinary approach.

The Institute continued to serve as a Co-ordinating Centre for All-India Co-ordinated Research Project on transportation of fresh fish and utilisation of "trash fish".

1.2. MANAGEMENT COMMITTEE

With a view to broad basing the decision making process and speeding up the implementation of the research programmes, the Management Committee met five times during the year under report.

1.3. ADMINISTRATION

The Administrative Section deals with recruitment, service, policy, discipline, vigilance, staff welfare, lands and buildings, budget, expenditure, stores and purchases.

With the completion of permanent building by the end of 1975, the Laboratory-cum-office situated in rented buildings at Cochin and Ernakulam were shifted to the new building at Willingdon Island, Cochin. The estimated cost of construction of the new building is Rs. 83,87,230|-. The Research Centres are still functioning in rented buildings. The addresses of the Institute and the Resarch Centres are given in Appendix I.

On completion of the first stage of CIFT Staff Quarters Complex at Perumanur, Cochin, 24 Nos. of Type I and 20 Nos. of Type II Quarters have been allotted to the Institute staff.

The personnel working in this Institute were classified as Scientific, Technical, Administrative and Supporting according to the nature of duties. The list of personnel in the different Category is furnished in Appendix II.

The details of the budget provision and the actual expenditure during the financial year 1976-77 are given in Appendix III.

During the year under report, the Administrative Section was under the control of Shri K. B. Kandankoran, Administrative Officer.

1.4. STAFF JOINT COUNCIL

A Staff Joint Council was constituted at the Institute for solving the day to day problems of general nature like those pertaining to service conditions, working facilities etc. Prior to the meeting of the Staff Joint

Council, the staff of each Division meet and discuss their problems and the respective proceedings are included in the agenda of the Staff Joint Council meetings, which are held every quarter. While the members on the Official side of the Staff Joint Council are nominatd by Director, those on the Staff side are elected to represent the different categories of staff. The following were the members of the Staff Joint Council during the year under review.

1.	Shri G. K. Kuriyan	.. Chairman
2.	Shri M. Rajendranathan Nair	Members - Official side
3.	Shri A. Chakrapany	
4.	Shri M. Velu	
5.	Shri K. B. Kandankoran	
6.	Shri P. N. R. Kaimal	
7.	Shri M. V. Rangan	
8.	Shri K. Mahadeva Iyer	.. Secretary, Official side
9.	Shri P. K. Surendran	Members - Staff side
10.	Shri A. G. Gopalakrishna Pillai	
11.	Shri Varghese Paul	
12.	Shri M. P. Chandrasekharan	
13.	Shri R. Gopalakrishnan Nair	
14.	Shri O. C. Lonan	
15.	Shri T. T. Das	
16.	Shri V. N. Rajasekharan Nair	.. Secretary, Staff side

The Staff Joint Council met 4 times during the year under report and there was an additional extra ordinary meeting. The facility to present problems is extended to the Research Centres as well.

Shri Varghese Paul, represented the Institute's Staff Joint Council, in the Central Joint Council.

1.5. GRIEVANCE CELL

The Cell met 9 times and 8 individual cases came up for consideration in the matter of service affairs during the period under report.

1.6. PROJECT ADVISORY COMMITTEE

New projects for investigation are selected from the field or with reference to the future needs of the industry. They go through various stages from the Project Leader to Scientist-in-Charge of the Division and then to Project Advisory Committee. As per recommendation of Project Advisory Committee, the final approval is given by the Director for initiation of the project. Project Co-ordinator is the Chairman of the Project Advisory Committee and the members are the Scientists-in-Charge of the different Divisions.

The scrutiny of the progress of work covered under the technical programme for the year is also done by the Project Advisory Committee with particular reference to modification in programme of action, completion of project programmes in scheduled time, extension of time limit for the successful completion of the project and tracing of difficulties such as procurement of stores items, equipments etc. for carrying out the programme as per schedule.

Matters discussed and action if any to be taken at intra-institutional or inter-institutional levels are taken up for speedy implementation and steady progress.

The Project Advisory Committee met ten times during the year.

1.7. *STAFF RESEARCH COUNCIL*

The Staff Research Council met 3 times during the year under report to discuss the progress of research schemes. Twenty one research and technical papers presented were discussed in detail and 18 of them were approved for publication.

1.8. HIGHER STUDIES AND TRAINING

The undermentioned personnel have registered for higher studies during the year under report.

Sl. No. (1)	Name (2)	Degree (3)	Title (4)	Name of Guide (5)	Name of University (6)
1.	K. Radhalakshmy	M.Sc.	Weathering of synthetic netting twine under marine conditions.	G. K. Kuriyan	Cochin University
2.	N. A George	M.Sc.	Netting materials for trawls.	G. K. Kuriyan	Cochin University
3.	A. P. Valsan	M.Sc.	Some aspects of spoilage in cured fish and the methods to control them.	N. K. Velankar	Bombay University
4.	Cyriac Mathen	Ph.D.	Faecal and pathogenic microorganisms in seafoods - detection enumeration and destruction.	G. K. Kuriyan	Cochin University
5.	M. K. Mukundan	Ph.D.	Studies on fish lipases	K. Gopakumar	Cochin University
6.	P. D. Antony	Ph.D.	Studies on peptidases and related enzymes in fish.	K. Gopakumar	Cochin University
7.	A.Lekshmy Nair	Ph.D.	Biochemical investigations on marine lipids.	K. Gopakumar	Cochin University

Shri R. Balasubramanyan, Junior Fishery Scientist and Smt. P. J. Cecily, Junior Technical Officer who had registered for M.Sc. (by research) at Cochin University under the guidance of Shri G. K. Kuriyan, Director of the Institute, have completed their courses and submitted the thesis for evaluation.

Shri T. S. Gopalakrishna Iyer, Scientist — S1 was deputed to England for six months for training in the field of quality control of processed prawns with special emphasis on Microbiology. He completed his training in the Grimsby College of Technology and Tropical Products Institute, London. Sarvashri M. Arul James, Scientist — S1 and V. Narayanan Nambiar, Scientist — S1 have been deputed to England for similar training from 29-12-1976.

1.9. LIBRARY

The Library functioning previously in two places viz. at Ernakulam and Cochin was brought together and housed in the new building. Reading and reference facilities have been provided to Scientists. Reference facilities were extended to Fishing and Fish Processing Industries, Research Scholars etc. of the locality. Inter library loan facilities were maintained with other libraries. Reprints of the articles by the Scientists of this Institute were sent to Institutions within the country and abroad on request.

During the year 288 books were added to the collection bringing the total to 3047. About 70 Indian and Foreign journals were subscribed during the year under report. In addition to this, about 50 journals were received regularly on exchange or gratis basis. 172 volumes of journals were got bound bringing the total collection to 1610. A catalogue of serials collection of the library has been brought out. The bibliographic and document reproduction services were continued.

Under the supervision of Shri K. G. Ramachandran Nair, Scientist — S1, the Library was looked after by a Senior and a Junior Library Assistant.

1.10. TECHNICAL SECTION

A new Technical Section was formed to assist the Director in technical matters. This section collected requisite materials from the different Divisions of the Institute and prepared technical notes and reports. The project programmes received from the Project Leaders were compiled in the form of Research Project Proposal and presented before the Staff Research Council and Management Committee for discussion and approval

of the projects. During the year under report, the Section was under the charge of Smt. P. J. Cecily, Junior Technical Officer.

1.11. AGRICULTURAL RESEARCH SERVICE

The Agricultural Research Service was introduced by ICAR during the year. 81 Scientists possessing the requisite qualification in the different fields were inducted into the various grades of the Agricultural Research Service on a point to point basis. However, those qualified Scientists and Technicians holding the posts of Research Assistants (Rs. 425-700) and those in the posts of Assistant Fishery Scientist (Rs. 650-1250) were inducted to Grades 'A' and 'S1' respectively.

14 candidates. who got selection on the basis of ARS competitive examination conducted by the Agricultural Scientists Recruitment Board, were allotted to this Institute and they are undergoing training in different fields. Of these ten are in the discipline of Fish Processing Technology, two in Chemical Engineering and two in Farm Machinery and Power.

1.12. COMMITTEES REPRESENTED BY THE INSTITUTE

The Director of the Institute served on the following scientific and allied bodies:

1.	*Member*	..	Scientific Panel for Fisheries Research, ICAR.
2.	*Ex-Officio Member*	..	Panel of Experts for the purpose of hearing appeals — Export Inspection Agency, Karnataka and Cochin.
3.	*Member*	..	State Fishery Advisory Board, Kerala.
4.	*Member*	..	Scientific Research Committee, Fisheries Technological Research Station, Kozhikode, Kerala.
5.	*Member*	..	Central Advisory Committee on Exploratory Survey of Marine Fisheries.
6.	*Member*	..	State Fisheries Research Council, Government of Tamil Nadu.
7.	*Member*	..	Marine Products Export Development Authority.
8.	*Member*	..	Technical Committee of Marine Products Export Development Authority.

9. *Member* .. Board of Studies in Marine Sciences, University of Cochin.

10. *Chairman* .. TDC-42 — Textile materials for fishing purposes — Sectional Committee, Indian Standards Institution.

11. *Chairman* .. MCPD-21 — Fishing Vessels Sectional Committee, Indian Standards Institution.

12. *Member* .. Board of Examiners, Central Institute of Fisheries Education, Bombay.

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

1. *Dr. C. C. Panduranga Rao,* Senior Bacteriologist as Principal Member, ISI, AFDC-27, Fish and Fisheries Products Sectional Committee.

2. *Shri M. Rajendranathan Nair,* Project Co-ordinator as Alternate Member, ISI, AFDC-21, Fish and Fishery Products Sectional Committee.

3. *Shri M. Rajendranathan Nair,* Project Co-ordinator as Member, ISI, AFDC-27:2 — Frozen Fish Products Sub Committee.

4. *Shri Cyriac Mathen,* Scientist — S2 as Alternate Member, ISI, AFDC-27:2 — Frozen Fish Products Sub Committee.

5. *Shri R. Balasubramanyan,* Junior Fishery Scientist as Member, — Marine Corrosion Sub Committee of the C.S.I.R.

6. *Shri R. Venkataraman,* Senior Bacteriologist as Member, ISI, AFDC-27:1, Canned Fish Products Sub Committee.

7. *Shri K. K. Balachandran,* Scientist — S1, as Alternate Member, Canned Fish Products Sub Committee, AFDC-27:1, Indian Standards Institution, New Delhi.

8. *Smt. K. Radhalakshmy,* Assistant Fishery Scientist as Alternate Member, ISI, TDC-42, Textile Materials for fishing purposes.

9. *Shri S. Ayyappan Pillai,* Scientist — S2, as CIFT Nominee, National Committee for International Institute of Refrigeration.

10. *Shri S. Ayyappan Pillai,* Scientist — S2 as Executive Committee Member, Indian Cryogenic Council — South Zone.

11. *Shri P. K. Chakraborty,* Scientist — S1, as Member, Indian Cryogenic Council Sub Committee II.

12. *Shri A. P. Valsan,* Junior Scientist as Member, ISI, AFDC-27:3 — Dried Fish Products Sub Committee.

13. *Shri T. S. Unnikrishnan Nair,* Scientist — S1 as Alternate Member, ISI, AFDC-27:3, Dried Fish Products Sub Committee.

1.13. SYMPOSIA, SEMINARS AND MEETINGS

Director of the Institute and Shri T. S. Gopalakrishna Iyer, Scientist — S1 attended the 'International Conference on Handling, Processing and Marketing of Tropical Fish', London from 5th to 9th July, 1976. Director apart from chairing the Session on 'Shell fish' and presenting a paper on 'Fish Product Development in India', participated in the post conference tour visiting some of the places of fishery interest in United Kingdom.

Sarvashri P. K. Chakraborty, Scientist — S1 and S. Ayyappan Pillai, Scientist — S2 attended the Fifth National Symposium on Refrigeration and Air-conditioning organised by National Committee for International Institute of Refrigeration and Indian Institute of Technology held at IIT, Madras on December 6th and 7th, 1976. They also attended the Second National Symposium on Cryogenics organised by Indian Cryogenic Council and IIT at IIT, Madras on December 8th to 10th, 1976.

The Institute hosted the meetings of the Standing Finance Committee and Governing Body of ICAR on 1st and 2nd June, 1976 respectively. Later in the year, in collaboration with the three other ICAR Institutes in Kerala, the Institute also hosted the ICAR Directors' Conference held from 3rd to 5th November, 1976.

1.14. VISITORS

State and Central Government Officials, foreign dignitaries and students from educational departments visited the Institute. The visitors include:

1. *Shri T. Narayanan,* Director (Animal Husbandry), Planning Commission, New Delhi.

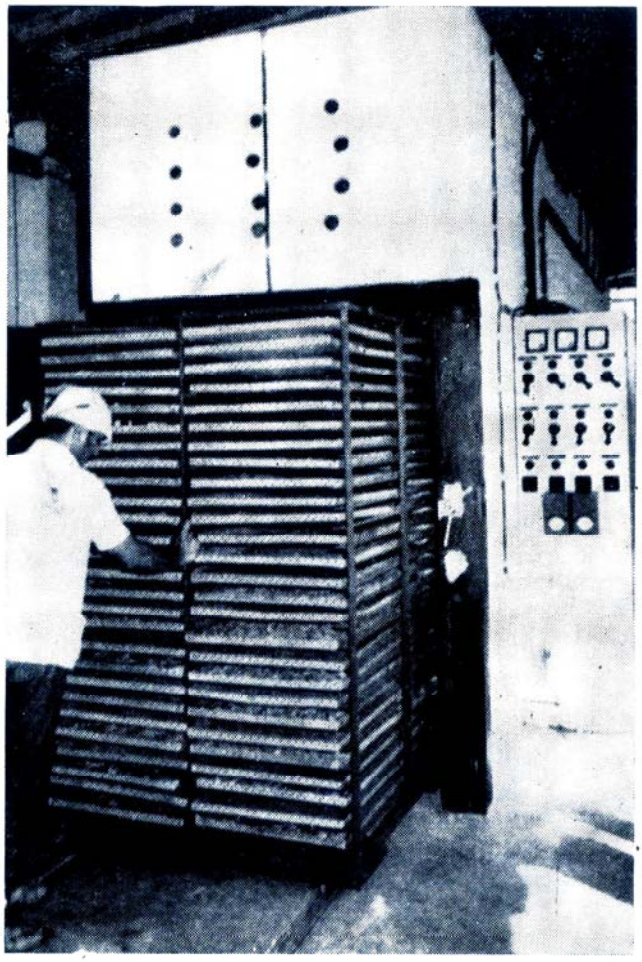
2. *Dr. B. Natarajan,* Chairman, Institute for Techno-Economic Studies, Madras.

3. *Shri T. T. Joseph,* Secretary to Govt. of Pondicherry.

4. *Shri A. K. Kawarta,* Joint Director and Warden of Fisheries, Punjab.
5. *Dr. Jagajivan Ram,* Union Minister for Agriculture & Irrigation.
6. *Dr. T. M. Burley,* Manager, Market Research Division, The Economist Intelligence Unit, London. (Consultant for MPEDA).
7. *Dr. Andrew H. Jones,* Tropical Products Institute, London.
8. *Mr. G. Lovold* and *Mr. V. Perovic* of the UNDP|FAO.
9. *Dr. Y. Scharfe* of the Headquarters of FAO at Rome.
10. *Mr. Brian Chatterton,* Minister of Fisheries, Australia.
11. *Dr. N. F. Hall, Dr. N. R. Jones* and *Mr. John Disney* of the Ministry of Overseas Development, U.K.
12. *Shri A. A. Joshi,* Indian Institute of Packaging, Bombay.
13. *Dr. G. B. Debling* of the Grimsby College of Technology, Grimsby.

1.15. OBITUARIES

In July, 1976, the Institute was bereaved by the sudden demise of Shri P. P. Thomas who joined this Institute in 1958 and was working as Bosun at Kakinada Research Centre. In October of the year, the Institute had also to part with Shri Boppuri Victor, Senior Mechanic who joined the Kakinada Research Centre in 1963.



A one tonne tunnel dryer installed at the Integrated Fisheries Project, Cochin-16 as per C.I.F.T. design for dehydration of fish products. (Report published last year)

2. PROGRESS OF RESEARCH

2.1. DEHYDRATION AND SMOKING

CHIEF FINDINGS

During the year under report more emphasis was paid for the production of fish products for internal consumption. Due to inadequate facilities for transportation of fresh fish, the consumers in the interior parts of the country still depend on dried and cured products. Sardine, cat fish, shark and soles are the major items, which have been processed as cured products. Studies conducted at this Institute have shown that depending on the method of processing, a variety of products can be made such as 'hard cured', 'mild cured', 'cold smoked' or 'hot smoked'. Studies on smoke curing of low priced fishes have been carried out in detail and some of the processes standardised. The technology developed on the above lines enables the average fish processor to undertake commercial production of dehydrated and smoked products as against frozen and canned ones, the production of the latter call for sophisticated machineries and plants.

Efforts have also been made for the fabrication of a solar fish dryer-cum-demonstration model and popularisation of that dryer through NRDC and other Institutions.

RESEARCH IN HAND

Experiments on processing and preservation of different fish were continued with a view to developing suitable methods for proper and economic utilisation of less popular fish, which do not have a ready market as fresh or frozen. Processes were developed for preparing smoked jew fish, mackerel, cat fish and shark. In the case of cat fish and shark, the initial brining was substituted with dry salting overnight. Smoked products were dried to a moisture level of about 35%. The products were good in all respects and free from unpleasant flavour. The process of smoke curing of sole fish was standardized.

Smoked sardine with very good appearance, palatability and shelf life could be prepared by modifying the method developed earlier. The shelf life of the product was found to be six months. 'Hard smoked' ray gave a product similar to 'masmin'. Experiments were carried out to prepare 'light salted' products from jew fish, mackerel, cat fish and shark. Treatment

with certain preservatives in appropriate quantity and drying to a moisture level of about 35% gave good shelf life. Scaling improved the appearance of smoked jew fish. In commercially dried ribbon fish, the main factor causing its dull appearance is the shining substance on skin. Once this substance is removed, the fish can be made into appealing dried and smoked products. The substance thus removed could be profitably used by a simple process to yield good pearl essence. About 0.3% yield of pearl essence of the fresh weight of fish can be expected and the process can be taken up on a cottage industry basis. Mussel meat was dried and smoke-cured following different methods. Meat pickled with salt, turmeric, tamarind and garlic gave a satisfactory product.

A laboratory model tunnel dryer was installed at Calicut Research Centre of the Institute for undertaking dehydration studies on important commercial varieties of fish available in that area. A design of a smoke kiln was prepared for the production of smoked fish. A complete project report was prepared for fish smoking plant to undertake studies on smoking of fish and supplied to M|s. Dolphin Industries Pvt. Ltd., Gujarat. A similar project report for a two tonne capacity dehydration plant for laminated Bombay duck for M|s. G.F.C.C.A., Gujarat and one tonne capacity plant for M|s. Kerala Fisheries Corporation were prepared and supplied together with detailed design drawings for the dryer, layout and other accessories. Technical guidanc for starting fish based industrial units was furnished to those interested.

RESEARCH CONTEMPLATED

1. Development of smoke-cured products from less important fish and shell fish.
2. Preparation of light salted products of improved shelf life from commercially important fishes.
3. Dehydration of mussel meat and development of products based on the dehydrated meat.
4. Incidence of halophilic bacteria in cured fishery products.
5. Fabrication of smoke kiln and designing of semi-commercial fish oil extraction plants based on processes developed in this Institute.
6. Design and development of descaling and fish cutting machines.

SCIENTISTS ASSOCIATED WITH THE PROJECT

CALICUT: T. S. Unnikrishnan Nair, V. Muraleedharan, K. George

VERAVAL: K. Devadasan, K. K. Solanki, T. K. Thankappan.

COCHIN: P.K. Chakraborty, P.N.R. Kaimal, P.N. Joshi, Korah Eapen.

2.2. FREEZING

CHIEF FINDINGS

In Cochin Centre, technological aspects of production of frozen fish fillets from different varieties of fish like cat fish (Tachysurus *sp.*), leopard *coral trout* (Plectoropomus leopardus), *threadfin bream* (Nemipterus japonicus), *Indian halibut* (Psettodes erumei), *reef cod* (Epinephelus *sp.*) *were studied in detail. Method of filletting these fishes, yield of fillets and frozen storage characteristics were the important aspects investigated. Frozen cat fish fillets packed in polythene lined waxed cartons were found to be in acceptable condition even after* 5 *months of storage at* -15°C. *Drip loss occurring during thawing of frozen fillets can be reduced to a minimum by employing polyphosphate treatment.*

Detailed investigations were carried out on the freezing and cold storage characteristics of commercially important fishes of Gujarat coast like hilsa (Hilsa toli, Hilsa ilisha), *pomfrets* (Pampus argentieus), *ghol* (Pseudosciaena diacanthus) *and squid* (Loligo *sp.*). *Treatment with antioxidants before freezing was found to be beneficial in preventing rancidity in the case of fatty fishes. Frozen squid was found to keep well for* 20 *weeks at* -18°C. *Indian salmon* (Polynemus *spp.*) *frozen and stored at* -18°C *to* -20°C *remained in prime condition after* 6 *month's storage.*

Ice storage studies carried out at Bombay Centre on Indian shad (Chirocentrus *spp. and* Pellona *spp.*) *revealed that these fishes could be safely stored in ice for a period of* 10 *days without themselves undergoing any appreciable loss in quality.*

The survey to assess the extent of wastage due to spoilage in the raw material used in prawn processing industry in Cochin area showed a decrease in the extent of wastage during the year under report. This decrease was caused mainly due to the vigilance on the part of processors. Studies on the recovery of size grades of meat from whole prawns of a given count was found to be more in 'Karikkadi' (P. stylifera) *than in 'Poovalan'* (M. dobsoni).

RESEARCH IN HAND

Methods of filletting of fishes like cat fish, leopard coral trout, reef cod, thread fin bream and Indian halibut, yield of fillets, frozen stor-

age characteristics, packagings to be used and treatment, if any, for improving the quality were studied in detail. Cat fish yielded 25-35% skinless fillets, leopard coral trout 41-43% and reef cod 30-32% on the basis of whole gutted fish. Maximum yield of fillets (45-48%) was obtained from Indian halibut (flat fish). Frozen fillets of reef cod and cat fish packed in polythene lined waxed cartons were found to be in acceptable condition even after 5 months of storage at -15°C.

Frozen storage characteristics of fishes like hilsa, silver pomfret, black pomfret, ghol and squid were studied in detail at Veraval Centre. *Hilsa toli,* frozen as whole, had a storage life of 18 weeks at -18°C. Frozen *Hilsa ilisha* could be stored at -18°C for 24 weeks in edible condition. In the case of silver pomfret, after 16 weeks storage, bigger specimens showed slight yellow discolouration and it was found that this phenomenon could be prevented by giving a treatment with BHA prior to freezing.

Ghol, frozen in fillet form, was found to spoil at a faster rate compared to samples of the same frozen in chunk-form. Indian salmon was dressed and frozen in (1) fillets — individually wrapped in polythene and (2) fillets — treated with polyphosphate and then individually wrapped in polythene and stored at -18 to -20°C. Similarly Wolf herring and Indian shad were frozen in round form, individually wrapped in polythene and stored at -18 to -20°C. Frozen samples were periodically drawn for physico-chemical, bacteriological and organoleptic assessment. It was observed that colour and appearance of any of the frozen material did not undergo significant deterioration even after six months' storage. Texture remained firm in case of Indian shad and ghol, while in the case of Indian salmon (untreated) and Wolf herring, it was slightly rubbery. Drip losses were not appreciable in the case of Wolf herring, Indian shad and phosphate treated ghol and Indian salmon fillets.

Studies on the wastage of raw material used in prawn processing industry were continued during the year. About 50 collections (from 11 factories, 5 peeling sheds and 2 landing centres) were analysed. For *M. dobsoni* and *P. stylifera,* the wastage at the landing centre ranged from 0-9% and from 0-6% at the peeling sheds. In the material brought to the factory, the wastage was found to be between 0 and 11% during January-March and between 0 and 3% for the rest of the period.

Data on recovery of different size grades of meat from whole prawns of different counts were also collected during the year. The counts of the

raw materials and the important size grades of meat recovered are as follows:

Species	Count of whole prawans per kg.	Main size grades of meat recovered	Types for processing
M. dobsoni	200-300	100|200 & 200|300	PD & PUD
-do-	300-400	200|300 & 300|500	-do-
-do-	300-400	130|300, 300|500 & 400|600	CP
-do-	400-500	300|500 & 400|600	-do-
P. stylifera	300-400	130|200, 200|300 & 300|500	PD & PUD
-do-	200-350	130|300 & 300|500	CP
-do-	350|500	300|500 & 500 UP	-do-
P. indicus	80-120	51|60, 61|70 & 71|90	HL

Variation in the size grades of meat recovered from whole prawns of a given count is found to be more in *P. stylifera* than in *M. dobsoni.*

Studies on phosphate treatment on small sized shrimp meat showed that counts of 200|300, 300|500 and broken grades when treated with phosphates as recommended earlier lost its appearance by becoming highly soapy. Reduced volumes (60 ml|kg) was found to be sufficient in these cases. Treatment was also modified to suit headless shellon prawns. A questionnaire was prepared to assess the impact of phosphate treatment on the shrimp freezing industry and copies were sent to all processors. Only 20% of these were so far received back.

Ice storage studies of Wolf herring and Indian shad have shown that these fishes could stand in ice in acceptable condition for a period of 10 days.

Physical properties like water-vapour transmission rate, bursting strength, puncture resistance etc. of packaging materials used in fish processing industry were studied. Comparative study of the physical properties of chitosan coated paper and uncoated paper was also made. An air permeability testing device was fabricated as per the design developed by the Institute.

A fish processing table suitable for 6 workers at a time was designed. A deodorant developed by the Institute for use in fish processing establishments was popularised resulting in commercial production of the product by more than a dozen units. The schemes on fish freezing units prepared and supplied to different parties during the period have also been instrumental in the establishment of a few more processing units in different parts of the country. Visits to the fish processing units in Bombay, Thana, Veraval, Dwaraka, Okha, Jamnagar and Porbander enabled to detect technical problems faced by the industry. The project report prepared and furnished earlier to the Pondicherry Industrial Promotion and Investment Corporation Ltd. towards utilisation of the fish|shell fish resources of this Union Territory was effectively implemented.

RESEARCH CONTEMPLATED

1. Development of technology for preparation of frozen fish fillets will be continued.

2. Further studies on the freezing of ghol, black pomfret and squid will be carried out.

3. Studies on the ice storage and frozen storage characteristics of fresh water fishes of Gujarat.

4. Survey will be conducted on the use of different types of packaging materials in frozen fish industry. Studies on the properties of packaging materials used in fish processing industry will be continued.

5. Bulk freezing of oil sardine, suitablity of the frozen material for further processing into canned products and ways and means of extending the shelf life of frozen oil sardine will be investigated.

SCIENTISTS ASSOCIATED WITH THE PROJECT

COCHIN: P. A. Perigreen, Cyriac Mathen, Chinnamma George, A. C. Joseph, K. Vijayabharathy, K. Ramakrishnan, S. Ayyappan Pillai, P. N. Joshi, P. N. R. Kaimal, A. K. Kesavan Nair, P. Srinivasa Rao.

VERAVAL: K. Devadasan, P. R. Girija Varma, Jose Joseph.

BOMBAY: Jose Stephen, D. K. Garg.

2.3. CANNING

CHIEF FINDINGS

Studies on the discolouration of canned crab meat showed that the critical levels of copper and iron above which their presence causes this phenomenon are 9-12 and 30-36 ppm. respectively. Lean mackerel was found to be amenable to canning in 'natural style'. Good quality canned products could be prepared out of sail fish. Light smoked dhoma and cat fish yielded canned products of good storage life.

RESEARCH IN HAND

Crabs from Jamnagar-Sikka coasts were procured fresh and their body meat and claw meat canned separately in brine. Studies on determination of the critical levels of copper and iron inasmuch as they are responsible for incidence of blue black discolouration in canned crab meat were continued. The meat collected out of thoroughly bled animal as well as the same to which known quantities of copper and iron had been introduced were analysed. No discolouration was apparent in the meat in which the content of copper and iron ranged from 9-12 and 30-36 ppm. respectively. It was observed that by using actively live crab for processing and bleeding the sections of the crab for a sufficiently long time in running water, the content of copper could be brought down to the above level. Contact of meat with iron and copper vessels and utensils at every stage of processing has to be strictly prevented.

Squid meat canned with addition of citric acid kept well for over an year whereas those canned without adding citric acid developed discolouration after 8 months of storage.

Canning of cat fish in different media other than oil viz. brine, tomato sauce, mayonnaise sauce, was attempted. Whole fish after cooking in steam under pressure was used. Brining chunks of fish before precooking as well as addition of dry salt to cooked fish packed in can were attempted. Comparison of the resultant products showed that samples packed in oil yielded good products.

Canning of mackerel in 'natural style' was undertaken. Leanfish of small size was found to be most suitable for processing by this method. It has been observed during the experiments that round tall cans are not suitable for packing mackerel in 'natural style' since the self juice produced was not sufficient to cover the fish and therefore scorching of some portion

of fish occurred. In order to avoid this defect, a modification in the process viz., addition of dilute brine to the can was employed and found to give encouraging results.

Based on a request from M.P.E.D.A., processes were developed for canning sardines employing different media for packing.

Studies on canning of smoked fish showed that light smoked dhoma and cat fish yielded satisfactory canned products with good storage life. Sail fish has been found to be suitable for preservation by canning.

A cooking chamber as per the Institute's design was constructed at Integrated Fisheries Project, Cochin.

Based on the technical assistance and scheme furnished, a canning plant for canning fish and shell fish was installed by a private firm in Veraval.

RESEARCH CONTEMPLATED

1. Evaluation of the process already developed for canning in terms of the storage life of the products.
2. Canning studies on skinless and boneless fillets of mackerel in oil, sauce and brine.
3. Methods for canning horse mackerel and canning of smoked fish.
4. Development of processes for new type of canned products similar to those popular in international markets.
5. Development of processes for canning fish in pounched bulk pack in unconventional type cans and juice cans.
6. Thermal distribution studies in different types and sizes of cans and different types of material packed.

SCIENTISTS ASSOCIATED WITH THE PROJECT

COCHIN: K. K. Balachandran, P. K. Vijayan, K. Vijayabharathi, Korah Eapen, P. N. Joshi, P. N. R. Kaimal.

VERAVAL: P. R. Girija Varma.

2.4. ENZYMES, PROTEINS AND LIPIDS

CHIEF FINDINGS

Studies were carried out on the nature and activity of the enzymes controlling the flavourous compounds in fishes like pearl spot (Etroplus suratensis) *and Waigeu snapper* (Lutianus waigiensis). *It was found that in chilled storage, the changes due to enzyme activities decreased continuously, the maximal activity being confined to the first week of storage. The distribution of myokinase involved in the break-down of muscle adenosine triphosphate recorded an average value of* 20 *units per gram of fresh tissue.*

The species differentiation by protein mapping through disc electro phorograme of both fresh and cooked meat showed that unlike other fishes and shell fishes, clams formed a class of special significance as they contain only a few protein bands. In the case of fishes which contained appreciable amount of trimethyl amine or trimethyl amine oxide, the formaldehyde released during storage could cause significant protein denaturation.

RESEARCH IN HAND

The release of flavour bearing compounds associated with enzymatic activities in tissue of pearl spot and Waigeu snapper under frozen storage was studied by periodic analysis of samples. Identification and extent of distribution of proteolytic enzymes in mackerel showed that a very active enzyme causing protein hydrolysis with haemoglobin as substrate was present in the muscle tissue which acts maximally at pH4, the activity being highly dependant on the pH. Further identification of the number of enzymes involved in protein hydrolysis has been carried out using benzoyl arginine β naphthylamide and benzoyl arginine p-nitro anilide (BANA and BAPA) respectively as substrates on disc electrophorograms, showed at least one major globulin fraction, active in protein hydrolysis. The extent of distribution of proteolytic enzymes in fishes like pearl spot and Waigeu snapper was found to be very low compared to sardine and mackerel.

Studies on nutritional evaluation of proteins and lipids were continued during the year. Incorporation of formaldehyde in muscle homogenates between 100 to 1000 ppm. showed that there was progressive protein denaturation as evidenced by solubility studies which could not be fully explained in terms of diffusion controlled denaturation by formaldehyde as the study was done with muscle homogenates where the thickness of the

particle was practically negligible. The progressive denaturation bears a direct relationship to both concentration and period of storage.

The analysis of fatty acid make-up of lipids from oil sardine both during frozen storage and ice storage recorded a rapid loss of polyunsaturated acids, the maximum affected ones being eicosa pentaenoic and docosa hexaenoic acids, the loss being 20% and 16% respectively during a period of 6 months at -18°C, the degree of loss being greater in fish with higher fat content. The pattern of fatty acid loss was similar in the case of ice stored oil sardines.

The total amino acid make-up followed almost the same pattern in the case of five commercially important fishes analysed — viz. mackerel, oil sardine, seer fish, black pomfret and jew fish. On a dry weight basis, proteins of these fishes contained 14 to 22% glutamic and aspartic acid, 6 to 8% phenyl alanine, tyrosine and tryptophane, 11 to 15% leucine and valine. In addition they contained 2 to 3% methionine and 3 to 4.5% of proline and hydroxy proline. Cystiene content was the lowest of all amino acids (0.5 to 0.8%). Practically no difference was observed in the case of essential amino acids with respect to species. Similar is the case with the vitamins of B group, niacin recording the highest value of 26.31 mg% in seer fish and 10.2 mg% in oil sardine followed by pantothenic acid 0.89 mg% in seer fish and 1.79 mg% in jew fish, riboflavin 0.81 mg% in seer fish to 0.4 mg% in oil sardine. Folic acid, Vitamin B12, pyridoxine and biotin were only present in traces.

RESEARCH CONTEMPLATED

1. Studies on the degradation of nucleotides and energy phosphates in fish muscle and their changes during handling and frozen storage.
2. Studies on the extent of protein cleavage brought out by proteolytic enzymes under different preservation conditions.
3. Studies on the intrinsic properties of proteins of important fishes and shell fishes and their thermal stability are to be attempted.
4. Investigations on free and combined amino acids and vitamins.
5. Toxic elements in fresh and processed fishery products.
6. Toxicity contributed by certain amines, peroxides and carbonyl compounds.

SCIENTISTS ASSOCIATED WITH THE PROJECT

COCHIN: P. D. Antony, A. G. Radhakrishnan, M. Arul James, Francis Thomas, P.G. Viswanathan Nair, M.K. Mukundan

5. FOOD POISONING MICROORGANISMS AND THEIR CONTROL

CHIEF FINDINGS

Salmonella was detected in samples of fresh prawns whereas they were absent in raw fish from local markets, frozen prawn and in ice and water used for processing. Studies on the effect of pH on the growth of Salmonella organisms at -18°C *showed that at pH* 5, 5.5 *and* 6, *cultures of* Salmonella anatum *survived in prawn substrate, recovery being effected by using pre-enrichment procedure. For* Salmonella anatum, *pasteurisation at 70°C was not sufficient to destroy* 100% *of cells. Pasteurisation for* 10 *minutes at* 80°C *killed all the cells when the inoculum was less than* 10^6 *cells/ml.*

RESEARCH IN HAND

Studies carried out on the incidence of Salmonella in seafoods indicated their presence in a few samples of raw prawns. The samples examined included, 35 samples of raw prawns, 20 of raw frozen prawns, 15 of cooked frozen prawns, 40 of dried raw fish from local markets and 90 of processing water/ice.

Studies on the recovery of Salmonella from artificially inoculated frozen prawn substrate were carried out. The effect of different pH on the growth of Salmonella organism was studied. Influence of lower pH, viz. 5.0, 5.0 and 6.0 with known number of cells of *Salmonella anatum* and low temperature of storage for 3 months was studied. The organisms survived under these conditions.

Investigations on the degree of survival as well as toxin production potential of *Clostridium* spp. under different conditions showed no growth at 56°C and also under aerobic conditions. Comparatively good growth was observed at room temperature in sulphite polymyxin sulphadiazine (SPS) agar and cooked meat medium. All the strains studied produced spores on SPS agar within 48 hours.

Thermal susceptibility of Streptococci strains in presence of various concentrations of nisin was studied. The pasteurisation temperatures of 50°C and70°C for 10 minutes were used. 5 and 10 units of nisin effected 50% to 70% reduction of strains at 50°C. At lower levels of nisin, there was no appreciable reduction. At 70°C, all the cells were destroyed irrespective of whether media contained nisin or not.

Bacteriological quality of fish landed at Veraval was surveyed by analysing fish samples collected from local fish markets and commercial

boats. Results showed higher incidence of gram positive cocci in those samples. Studies on the bacteriology of sea water off Veraval coast revealed that the sea water was contaminated with faecal microorganisms upto a distance of 5 kilometers from the coast.

Anticipating the introduction of 'compulsory inplant inspection' of seafood processing establishments, the Institute has taken up such an inspection on voluntary basis with the co-operation of the Sea Food Exporters Association of India. A proforma for inplant inspection was prepared and a few plants have already been inspected and the reports handed over to the respective factory owners for improvement of their factory to maintain the required quality standards.

Some of the primary prawn processing centres were also subjected to voluntary inspection. Twentyfive prawn peeling sheds were thus inspected covering condition of the sheds, fly proofiing, electrification, supply of raw material, hygienic condition etc. Details collected are being analysed.

Quality characteristics of commercially available samples of dried lactarius, silver belly and sole were studied with a view to formulating standard specifications for the same. Analytical service and technical guidance were extended to the fish processing industry. Routine analysis of frozen frog legs, frozen prawns, canned products, fish meal, deodorants etc. was also undertaken. 65 samples — 25 each of silver belly and sole and 15 of lactarius — of dried fish were collected from Cochin, Alwaye, Kottayam, Calicut and Tuticorin, and were examined for quality characteristics. Some of the defects noted are high moisture, high sand content and admixture with other foreign materials.

RESEARCH CONTEMPLATED

1. Investigations on organisms of public health significance.
2. Studies on composition of microflora of marine and fresh water fishes and their behaviour during iced storage and frozen storage.
3. Studies on quality changes in important species of fish|shell fish during handling, processing and preservation on board fishing vessel.
4. Quality control of frozen seafoods, especially prawns by control in production line, voluntary inplant inspection and maintenance of analytical service to the benefit of the industry.
5. Evaluation of quality of dried fish available in commerce.

SCIENTISTS ASSOCIATED WITH THE PROJECT

COCHIN: Cyriac Mathen, T. S. Gopalakrishna Iyer, V. Narayanan Nambiar, P. K. Surendran, M. K. Kandoran, M. Arul James, A. C. Joseph, Francis Thomas, Nirmala Thampuran.

VERAVAL: P. R. Girija Varma.

2.6. UTILISATION OF PROCESSING WASTE

CHIEF FINDINGS

Metal binding capacity of chitosan for heavy metal ions such as iron, copper, cobalt, zinc etc. was investigated. It was found that quantity of metal bond differs with different metals and viscosity has little effect on the metal binding capacity of chitosan. A simple method to extract protein from squilla in a dry powdery form was tried with considerable success and the yield of the dry powder was about 6% of the raw squilla. It was shown that about 10% meat can be recovered from the filleting waste of fish like cat fish and perch.

RESEARCH IN HAND

Research on the utilisation of processing waste was continued during the year under report. Studies on the affinity of chitosan for heavy metal ions like iron, nickel, cobalt, zinc, copper etc. were undertaken. It was observed that the adsorption of these ions from the solution was more in the initial stages and the adsorption completed in 2 hours time. The quantities adsorbed also varied with the type of metal. About 60% of its weight of copper sulphate could be adsorbed by chitosan.

Effect of chitosan as a paper size on the quality of paper was also studied. Chitosan treated paper showed better strength and low wetting property. However, mode of application of chitosan on paper has to be studied in detail.

Films of chitosan could be prepared from chitosan solution by spreading on metallic surface. The films are transparent and possess good breaking strength, puncture resistance and low thermal conductivity.

Chitosan as base for water based paint emulsion presented some difficulties. The acidic nature of the chitosan solution is not suited for such emulsion as most of the dyes and pigments used in paints require basic emulsions.

An adhoc scheme on "studies on the production and utilisation of chitosan and allied products from prawn shell waste" in collaboration with Cotton Technological Research Laboratory, Bombay and Bombay Textile Research Association was initated during the year as Cess fund project.

Studies on the utilisation on frog waste was initiated. Frog meal was prepared from the waste and the proximate composition of the samples collected was determined. The fat content was found to be very low in April-June period. The skin and trimmings obtained from the frog leg

processing factory also had very little fat. Simple boiling of the waste with water yielded only part of the oil. The oil separated by this method had very light colour. If the waste is heated directly without adding water more oil separated, but the colour of oil became dark brown.

Work on the filleting waste of cat fish and perch was also carried out. It was found that 10% of the edible meat can further be isolated by mechanical means from the skeletal portion. The remaining waste could be converted into fish meal. The composition and quality of fish meal from the waste were determined.

Preliminary investigations in extraction of protein from jawala (non penaeid) prawn free from shell and preparation of edible products like flakes were carried out. A complete project report for installation of a production unit for low cost protein food out of edible fish powder and tapioca powder was prepared and supplied to a private firm in Kerala.

RESEARCH CONTEMPLATED

1. Collection of data on recovery and wastage from peeling sheds and landing centres.
2. Further studies on the application of chitosan in industries such as paper, films etc. and studies on the intrinsic properties of chitosan.
3. Studies on the extraction of frog oil and utilisation of frog waste including the skin.
4. Investigation on the possibilities of preparing hydrolysates from filleting waste.
5. Preparation of fish feed and standardisation of method.

SCIENTISTS ASSOCIATED WITH THE PROJECT

COCHIN: P. Vasudeva Prabhu, P. Madhavan, K. G. Ramachandran Nair, A. Lekshmy Nair, P. N. R. Kaimal, A. K. Kesevan Nair, P. Srinivasa Rao.

BOMBAY: Jose Stephen, D. K. Garg.

2.7. CRAFT MATERIALS

CHIEF FINDINGS

Detailed investigations have shown better cathodic protection by ternary aluminium alloy compared to the conventional zinc anodes. Studies on the strength properties of mango wood have shown a correlation between moisture content and breaking strength. Increase in moisture content resulted in a steep decrease in tensile strength. Above this level of moisture, strength remained uniform. This suggested an exponential relation between moisture content and breaking strength. Tributyl Tin Oxide, the promising toxin for antifouling purposes was found quite compatible with indigenous resins.

RESEARCH IN HAND

1. *Marine fouling*

The physical characteristics of Tributyl Tin Oxide (TBTO) were investigated further and it was found quite compatible with indigenous resins like Cashew Nut Shell Liquid (CNSL) resin in linseed oil at various proportions. The different formulations were subjected to leaching rate studies in the laboratory simulator.

The CIFT formulation of antifouling paint was put to extensive use in all the Institute's vessels operating at different locations on the east and west coasts.

2. *Marine fungi*

Wooden panels treated with coal tar derivatives, penta-chlorophenol, copper chrome arsenic compound and organo tin compounds and subjected to accelerated fungal attack for varying periods were analysed for their tensile strength along with controls. Panels treated with copper chrome arsenic compound, and TBTO exhibited better fungi resistant properties.

The relation between moisture and strength properties of mango tree test panels was also determined. An increase in moisture content above fibre saturation (25%) showed more or less uniform strength properties, while a steep increase was recorded when moisture was decreased below fibre saturation. Proper pre-seasoning of boat-building timbers appears to be very essential.

3. *FRP and Ferrocement boats*

Technical data on the rigid polyurethane foam as a core material for Malabar dug-out canoes were collected. Two mock-up models of FRP

canoes were completed by hand lay up process. Necessary data for fabricating 2 prototype FRP canoes were furnished to boat builders.

Further technical data on ferrocement structures were gathered.

4. *Cathodic protection*

Study was undertaken to evolve a suitable and cheap anode system for protecting the metallic sheathing of fishing trawlers.

Anodes made of electrolytic zinc and ternary aluminium were electrically coupled with mild steel, copper, aluminium-magnesium alloy in sea water and the effects of polarisation potential, current density etc. were measured at different intervals. The studies showed that this protection was adequate. Field trials on Aluminium and Zinc anodes installed in the Departmental vessels also showed that the wearing of aluminium anode was lesser than that of zinc anodes.

RESEARCH CONTEMPLATED

1. Studies on FRP and Ferrocement boat construction with special reference to rural areas.
2. Utilisation of seasoned and treated timbers in boat construction.
3. Further studies on the development of antifouling paint incorporating newer pigments for enhanced protection.
4. Studies on inter-relation of fouling and corrosion.
5. Development of a heavy duty anticorrosive paint for boat hulls.

SCIENTISTS ASSOCIATED WITH THE PROJECT

COCHIN: R. Balasubramanyan, N. Unnikrishnan Nair, A. G. Gopalakrishna Pillai, M. Shahul Hameed.

2.8. GEAR MATERIALS

RESEARCH IN HAND

Analysis of physical properties of polyethylene braided twines were carried out to test their suitability for fishing gear. Properties such as knot strength, knot stability and abrasion resistance of braided twines were determined in comparision with twisted monofilaments, tapes and nylon.

With the introduction of nylon yarn of 420, 630, 840 and 1260 denier in fish net fabrication, it was felt imperative to incorporate specifications for twines made out of them. The matter was also put forward by the Indian Standards Institution and work on suitable formulation of standards for high denier twines was taken up during the year under report.

Weather deterioration of synthetic twines in controlled conditions was studied at 80% R.H. and room temperatures. The materials exposed were nylon twines of different specifications below 1 mm. diameter since the action of u.v. rays on twines above 1 mm. diameter is not much pronounced. The work is under progress.

Samples of fishing net twines and floats of different specifications were tested from 12 different firms as per their request and comments on their suitability were forwarded to them. Samples requiring modifications were also advised accordingly.

RESEARCH CONTEMPLATED

1. Studies in braided twines and specifications for nylon twines made of high denier yarns are to be continued.
2. Weather resistance of synthetic fibre twines under controlled conditions.
3. Testing of a preservative developed by South Indian Textile Research Association on cotton fishing nets.

SCIENTISTS ASSOCIATED WITH THE PROJECT

COCHIN: K. Radhalakshmi, N. Subramonia Pillai.

2.9. INDIGENOUS GEAR

RESEARCH IN HAND

19 numbers of lobster traps of Colachel type with the following specifications were procured.

1. 60 cm. length, 45 cm. width and 45 cm. height
2. 75 cm. length, 60 cm. width and 45 cm. height
3. 105 cm. length, 75 cm. width and 60 cm. height

The traps were given preservation treatments using copper-chrome arsenic compound and creosote in oil and were put to operation from Goa Research Centre.

Morphometric data were collected regularly from the landing centres.

RESEARCH CONTEMPLATED

1. Field trials with indigenous traps are to be continued.

SCIENTISTS ASSOCIATED WITH THE PROJECT

COCHIN: K. Sreedharan Namboodiri, R. Balasubramanyan.

GOA: T. Joseph Mathai, T. P. George.

2.10. TRAWLS

CHIEF FINDINGS

Midwater trawl operations were conducted from Cochin and Madras Centre in collaboration with Central Institute of Fisheries, Nautical & Engineering Training, Cochin and State Fisheries, Madras, respectively. Suitable combinations of otter boards were designed and fabricated and trial operations were conducted successfully. Fishing operations conducted at Cochin using 'trawl eye' indicated a vertical opening of 70-80% of head rope length for the gear.

RESEARCH IN HAND

A new design of 11 x 11 meter midwater trawl for operations from medium class vessels in combination with two pairs of otter boards of 170 x 90 cm. and 90 x 53 cm. having 128 and 20 kg. weight respectively was successfully operated from Cochin base. Experimental fishing operations were conducted with 11 metre midwater trawl from Madras Centre using vertical curved otter board of dimension 120 x 60 cms. Design and fabrication of 11 metre unequal panel and 10.5 metre equal panel nets were taken up and completed at Goa Centre.

At Veraval, twin trawl was experimented using single cable with sled. Twin body trawl experiments were conducted at Cochin and Kakinada Centres. At Cochin, twin body trawl was compared with 17 metre bulged belly trawl. At Kakinada Centre, twin body trawls in two combinations i.e. parallel double trawls and vertical double trawls were experimented. Necessary modifications based on the observations, were made for 18.6 metre parallel double trawl net and the preformance of the gear was found satisfactory. Designs of two 10 metre four seam trawls with a pair of otter boards of 130 x 70 cm. having 55 kg. weight were made ready. The gear was tested to undertake studies on vertical trawls.

Comparative fishing experiments conducted at Veraval Centre with bulged belly, long wing and six seam nets indicated the superiority of bulged belly net followed by long wing and six seam nets in capturing bottom fishes. Studies on 'V' shaped otter boards are in progress. Bulged belly trawl net of 20 meters head rope length was operated from Kakinada Centre at a depth of 60 to 80 metre from the departmental vessel, landing 168 kg. of prawns and decapterus per hour. Fishing experiments done at Goa showed, flat rectangular otter boards are more suitable for six seam trawl net.

A design of 32 metre large mesh trawl was made to conduct studies off Cochin and trial operations were found successful. Fabrication of another 32 metre bulged belly net to be operated from Goa base in collaboration with Exploratory Fishery Project is underway.

The fabrication work of 'V' shaped otter boards was completed for conducting operations from smaller classes of vessels.

Oceanographic studies to predict the occurrence of prawns and their depthwise distribution were continued at Cochin base by collecting and analysing the bottom deposits and water samples. Hydrographic winch and davit for the purpose were designed and fabricated for a detailed study in collaboration with Marine Science Department of Cochin University.

RESEARCH CONTEMPLATED

1. Studies on midwater trawl to be continued from Cochin, Goa and Madras Centres.
2. Twin trawling experiments to be continued from Cochin, Veraval and Kakinada.
3. Studies on large mesh trawl of 32 metres in offshore waters to be continued from Cochin and Goa base.
4. Field trials with separator trawl, studies on parachute trawl and collection of oceanographic data are to be continued from Cochin Centre.

SCIENTISTS ASSOCIATED WITH THE PROJECT

COCHIN: P. Appukutta Panicker, R. S. Nair, T. M. Sivan, K. N. Kartha, V. Vijayan, N. Subramonia Pillai, R. S. Manohardoss, C. Hridayanathan.

VERAVAL: K. K. Kunjipalu, A. C. Kuttappan, P. George Mathai.

KAKINADA: K. A. Sadanandan, A. V. V. Satyanarayana, K. Gopalakrishnan, Percy Dawson, S. V. S. Rama Rao, J. Sitarama Rao.

GOA: H. N. Mhalathkar, T. Joseph Mathai, T. P. George.

MADRAS: K. N. Kartha, G. Jegatheesan, R. S. Manohardoss, M. Syed Abbas.

2.11. GILL NETS

CHIEF FINDINGS

Studies on the eradication of forage fish in Hirakud reservoir using different mesh sizes indicated that gill nets with 30 mm. bar are most effective.

RESEARCH IN HAND

Field trials with gill nets of 30, 35, 40 and 45 mm. bar were undertaken for eradication of forage fish. Efficiency of frame gill nets was compared with simple gill nets of different mesh sizes for the capture of commercial size groups of *Catla catla.*

Studies on hilsa gill nets with vertical and horizontal lines were continued at Veraval. A net hauler designed and fabricated by the Institute for mechanical hauling of the gear was installed and trial operations with shark gill nets were carried out.

Fabrication of 18 units of gill nets using different twine sizes and mesh sizes for capturing prawns was taken up and completed. Trial operations with the gear were undertaken at Kakinada Centre.

Gill nets of standard CIFT design and improved version were operated from Goa Centre for the capture of lobsters.

RESEARCH CONTEMPLATED

1. Studies on the eradication of uneconomical varieties of fish and comparative studies with simple gill nets and frame nets are to be continued at Burla.
2. Continuation of studies on hilsa, shark and lobster gill nets at Veraval.
3. Field trials with prawn gill nets from Kakinada Centre.
4. Survey on landing statistics and collection of limnological and hydrographic data from fishing centres.

SCIENTISTS ASSOCIATED WITH THE PROJECT

BURLA: V. C. George, G. Narayanappa, R. M. Naidu, A. A. Khan.

VERAVAL: K. K. Kunjipalu, P. George Mathai, A. C. Kuttappan.

KAKINADA: J. Sitarama Rao, Percy Dawson, K. Gopalakrishnan.

2.12. LINES

RESEARCH IN HAND

Long line fishing experiments using different baits namely buffalo meat, chirocentrus and dhoma were tried from Veraval Centre to study the selectivity of baits. Studies on light fishing for cephalopods were initiated by procuring underwater light, and cables. Designs of hooks for lines and frames for lift nets also were taken up.

Squid fishing was conducted from Sindhukumari and the performance of the gear was found satisfactory.

RESEARCH CONTEMPLATED

1. Continuation of long line operations for shark and squid.
2. Studies on the attraction of light and effectiveness of different coloured jigs.
3. Studies on troll lines for tuna.

SCIENTISTS ASSOCIATED WITH THE PROJECT

VERAVAL: K. K. Kunjipalu, P. George Mathai, A. C. Kuttappan.

COCHIN: N. A. George, K. Sreedharan Namboodiri, N. Subramonia Pillai.

2.13. ROUND HAUL NET

RESEARCH IN HAND

Small purse seine net of 265 metre length and 25 metre depth was put to fishing operations off Cochin from medium vessels landed 6.4 tonnes of sardines by 13 operations. The main observation was that escape of fish was above the seine which reduced the efficiency of the gear. To cope with this finding, the depth of the gear was increased by 3 metres more, thus bringing the chance of escape to the minimum. The modified gear had an overall length of 250 M and 28 metre depth.

RESEARCH CONTEMPLATED

1. Field trials with the modified design of purse seine.
2. Standardisation of the purse seine for operation from different classes of vessels.

SCIENTISTS ASSOCIATED WITH THE PROJECT

COCHIN: P. Appukutta Panicker, T. M. Sivan, N. A. George.

2.14. FISHING ANCILLARIES

RESEARCH IN HAND

Fabrication of underwater telemeter instruments like net depth meter, mesh distortion meter, warp load meter etc. which are developed by the Institute is under progress. A laboratory model fish pump was designed and fabricated for using in purse seining operation. It was found to produce sufficient suction to pump out the fish. Circuit diagram for the bilge water indicator has been prepared.

The radio telephone equipment fabricated by M|s. Bharat Electronics, Bangalore, as per the requirements of fishing vessels as suggested by the Institute was tested by installing one set at the Institute premises and another on board M. F. V. Varuna of Integrated Fisheries Project and the operation was found satisfactory upto a distance of 260 Kms.

Design of the power-take-off clutch developed by the Institute suitable for power transmission of 10 to 15 H.P. was supplied to a private firm through NRDC for commercial production.

A hydraulic drive for winches in small fishing boats manufactured by M|s. Vickers Sperry (India) Ltd. was tested by installing in one of the fishing boats of the Institute. It was found to work very efficiently. The winch has a capacity of 1.5 tons and is suitable for 30' to 36' trawlers.

RESEARCH CONTEMPLATED

1. Fabrication of underwater telemetering instruments.
2. Fabrication of full scale model of fish pump and field testing of the pump.

SCIENTISTS ASSOCIATED WITH THE PROJECT

COCHIN: M. Velu, K. Sreedharan Namboodiri, K. Ramakrishnan, K. Vijayabharathy.

2.15. WEED HARVESTER

The aquatic weed harvester fabricated by the Institute was taken to Bhubaneswar, Kalyani and Gauhati and the operation of the machine for removal of water hyacinth was demonstrated at each location.

The design and technology of aquatic weed harvester developed by the Institute was handed over to a private firm through NRDC for commercial production of the machine.

SCIENTISTS ASSOCIATED WITH THE PROJECT

COCHIN: M. Velu, K. Sreedharan Namboodiri.

2.16. TESTING OF MARINE ENGINES

As per the Indian Standard 8013|1976, it has become obligatory for the manufacturers of the marine diesel engines to get their engines offered for fishing tested by CIFT. The main tests to be conducted are on board and are to cover primarily bollard pull and endurance under fishing duties. During the year under report, two manufacturers viz. M|s. Ruston & Hornsby Ltd., Poona and M|s. Kirloskar Oil Engines, Poona had offered some of their engines for type testing. The Engineering Division carried out the tests after studying their performance, their suitability for installation in fishing boats. The details of the engines tested are as follows:

Manufacturer	Type of engine
M|s. Ruston & Hornsby Ltd., Poona	3YDAM MK II
	4YDAM MK II
	6YDAM MK II
	2YDA Mark 2
	3YDA Mark 2
	4YDA Mark 2
	6YDA Mark 2
	2YD Mark I
	3YD Mark I
	4YD Mark I
	6YD Mark I
M|s. Kirloskar Oil Engines Ltd., Poona	RBV 2M
	RBV 3M
	RBV 4M
	RBV 6M

2.17. TECHNICAL CONSULTANCY SERVICE

576 technical queries received from State Fishery Departments and other fishing and fish processing units all over the country on different topics relating to fish processing and fishing craft and gear were replied during the period. Details furnished on fish processing include methods worked out for canning, freezing and drying different varieties of fish and shell fish, preservation of fishmeal by use of antioxidants, transport of live lobsters, method for laminating Bombay duck, processing of shark fins and beach-de-mer, utilisation of small size prawns belonging to the group of *Acetes,* economics of transportation of fresh fish, extraction of shark liver

oil, schemes for canning and freezing plants, use of cuttle fish bones, on changes in quality of product as a result of slow and quick-freezing, preparation of isinglass from fish maws, conditions of drying of fish in solar dryer and use of multi-deck tunnel dryers for drying fish and flakes, feasibility report on production of edible fish powder, details on liquid nitrogen freezing, on the use of benzoic acid for fish preservation, keeping quality of different species of fish in cold storage, processes for removal of urea from shark flesh and methods for preparation of a variety of speciality and by-product like fish wafers, soup powder from trash fish, shrimp extract, fish ensilage and bacteriological peptone.

Details furnished on fishing craft and gear include comments on quality of 840 den. yarns for fish nets supplied by a manufacturing firm, results of statistical analysis of data of fish catch by gill nets, estimated requirements of fish net webbings in India by 78-79, details of machinery for net manufacture, comments on suitability of different sizes of nets for boats of different sizes fitted with engines of varying H.P., on the quality of wire ropes for fishing, on use of venteak, cast iron fittings etc. in construction of fishing vessels, suitability of *'Artocarpus chaplasha'* for boat construction, comments on a suitable wood as substitute for Balsa wood in manufacture of sandwiched structures for marine application, technical comments on boats built by Andhra Fisheries Corporation, on the suitability of aluminium alloy for fishing boat construction, estimated requirements of radio-telephone sets for fishing vessels during the VIth Five Year Plan and an estimate for development and fabrication of prototype of weed harvester. Technical details and guidance were also given to more than 500 visitors to the Institute who called for such details and guidance concerning processing methods, fishing units, fish processing units and connected subjects.

Research Centres also imparted technical guidance to those engaged in fishing and fish processing industry on various aspects.

SCIENTISTS ASSOCIATED WITH THE PROJECT

COCHIN: P. N. R. Kaimal, Mary Thomas.

2.18. SUMMER INSTITUTE

A Summer Institute on 'Coastal Fishing Methods' was conducted by the Institute for the benefit of those engaged in fishing. There was good participation from the Government as well as private agencies who sponsored 19 of their technical personnel. Lectures on different aspects of fishing craft and gear technology were delivered by the staff of the Institute as well as guest Lecturers from outside besides giving practical training and study tours.

2.19. REFRESHER COURSES

A refresher course of one week's duration was conducted by Bombay Research Centre, on the processing of good quality frog legs with particular emphasis to the incidence of salmonella and its control. 11 candidates sponsored by different agencies both Government and private attended the course.

The following are the particulars of personnel who were given short term training at the Institute:

Name of Trainee	Sponsored by	Period	Subject
(1)	(2)	(3)	(4)
Shri M. R. Francis, Production Manager	M/s. Kadeeja Industries, COCHIN-5.	15-7-1976 to 14-8-1976	Processing and quality control of frozen prawns and frog legs.
Smt. Leelamma John	M/s. Chemmeens (Regd.), COCHIN.	14-6-1976 to 29-6-1976	Quality control and bacteriology.
Smt. Sridevi	Marine Products Export Development Authority, COCHIN-16.	2 weeks 27-9-1976 to 8-10-1976	Analysis of toxic elements in fish.

Shri M. K. Kandoran was the Scientist-in-Charge of training programmes conducted during the year under report.

3. ALL INDIA CO-ORDINATED RESEARCH PROJECT

Transportation of Fresh fish and Utilisation of Trash fish

CHIEF FINDINGS

The pattern of spoilage in fresh water fishes was found to be entirely different from that of marine fish. So the transportation problems for these fishes were studied in detail. Investigations have shown that fish transported from Kakinada could be further preserved in ice for a period of 3-5 *days without detectable changes in quality. Studies and evaluation of the fish at Bombay fish market indicated that the quality varied from absolutely substandard to very fresh and this suggests the need for laying down quality standard and its enforcement. Significant decrease in coliform counts does occur in fish packed in ice during transportation from Kakinada to Howrah. Swabs from deck surfaces of boats at Kakinada revealed the presence of typical* E. coli *suggestive of faecal contamination of deck surfaces. Potential pathogens of public health importance such as* Entero cocci E. coli, Pseudomonas aeruginosa *were recovered from some of the fish samples from market and landing centres.*

A simple method was worked out at Cochin Centre for the preparation of edible fish powder from cheap varieties of fish. Pet food was developed from cheap fish incorporating vegetable and cereal mix.

Review of work done at Institute Centres

VERAVAL

The Centre continued to despatch experimental consignments of frozen fish to Bombay and Calcutta in thermocole insulated teachests. Of the consignments sent to Bombay, 4 were in frozen state. Dressed dhoma, silver pomfret, black pomfret, hilsa, razor edge were the species of fish employed. Nine consignments of fresh water fish were sent to Calcutta in thermocole insulated tea chests in iced condition in collaboration with M|s. Central Fisheries Corporation, Calcutta. Along with these, control consignments in uninsulated containers were also sent for comparison. The bacteriological and biochemical aspects of quality of the different fishes have been determined before despatch.

The survey of the local fish processing plants, fish markets, fishing boats and analysis of water used in processing were continued to be undertaken during the period with a view to determine sources of bacterial contamination.

BOMBAY

The fish consignments sent from Veraval were received in good condition and the samples of fish have been subjected to detailed analytical study with respect to organoleptic, biochemical and bacteriological parameters. The fish were subsequently disposed off by public auction through G.F.C.C.A. Ltd. and the sale proceeds remitted to Headquarters.

With a view to evaluate the quality of fresh fish arriving at Bombay fish markets, 84 random samples were drawn during the period under review. The analysis has shown that the quality of fish coming to Bombay market was highly varying from absolutely substandard to very good. It was evident that adequate precautions are not being taken in handling, icing, packing and transporting of fresh fish required by the city.

KAKINADA

More than 40 consignments of iced fish consisting of polynemus, ribbon fish, chanos, sciaenids, synagris, pomfrets, eel and catfish were transported by rail to Howrah. All of them were received in good condition at the destination as revealed by the chemical, bacteriological and organoleptic examination, except two consignments which were received in a substandard condition due to delay in transit. Synagris, sciaenids and chanos frozen at -20°C were sent to Howrah by rail with no additional ice.

The containers employed in the above studies were exclusively second hand tea chests. Insulation materials used were gunny cloth and bagasse board, all sealed in polythene sheets.

None of the samples was found to reveal salmonella, *V. parahaemolyticus* and coagulase positive staphylococci. But pseudomonas aeruginosa and typical *E. coli* were isolated from some of the fish samples at despatching end.

One aluminium box of about 200 kg. was got fabricated. One hundred and ten kgs. of chanos obtained from the local brackish water fish farm were transported to Howrah by rail in this box with ice (1:1) and two layer gunny insulated. The quality parameters in respect of this consignment of fish were studied both at the despatching and receiving centres. The fish reached Howrah in good condition.

Fillets from 2 varieties of fish viz., seer and eel were tested for their amenability to transportation from Kakinada to Howrah. In all, four consignments of fish fillets including one consignment of frozen fillets were sent to Howrah. 41 samples of fish from landing centres and 5 from local fish market were subjected to microbiological examinations. None of the samples was found to reveal the presence of salmonella, *V. parahaemoly-*

ticus and coagulase positive staphylococci. But *Pseudomonas aeruginosa* and typical *E. coli* were isolated from some of the samples. Swabs from surface of fishing boats were also examined for the presence of pathogenic bacteria.

COCHIN

Rsults of the experimental fish consignments sent from Veraval to Bombay in 80 kg. and 110 kg. capacity containers and from Kakinada to Calcutta in 35 to 60 kg. capacity containers were subjected to statistical analysis. The average transporting cost incurred per kilogram of fish in frozen and iced conditions were worked out separately. The studies on the economic advantage of the two containers used at Veraval indicated that the container with capacity 110 kg. is more economical than the other with capacity of 80 kg. It was further established that the economic optima (fish and ice) can be obtained only with the full utilisation of the capacity of the containers. Further, the market survey data collected from the despatching centre were compared with experimental vessel samples. The results again established the superiority of the quality of the experimental consignments over the others.

Samples of peptone from *Nemipterus* sp. were subjected to further studies particularly with regard to their ability to support the growth of micro-organisms. The peptone was incorporated into synthetic media and the organisms *Bacillus cereus, Staphylococcus aureus, Escherchia coli* type I and *Salmonella anatum* selected as test strains. The peptone supported the growth of the organisms exactly similar to Difco peptone.

Fish powder samples have been prepared from miscellaneous fish by 3 different methods (1) by cooking minced meat in 0.5% acetic acid, followed by pressing and drying the cake. The dried cake is powdered and maintained at ambient temperature; (2) by cooking the minced meat in 0.5% phosphoric acid, followed by pressing, drying and pulverizing; (3) suspending minced meat in cold alkali for 3 hours, bringing to pH 5.0 with HCL followed by heating for 10 mts. at 85°C and again bringing up the pH to 7.0. The mass was pressed out, dried and powdered. All the samples were examined for evaluation of their shelf life at room temperature. The viable counts after one month's storage were within limits, the pathogenic organism being totally absent.

The Project Co-ordinator visited the centres of Co-ordinated Research Project at Mangalore, Madras, Kakinada, Paradeep (Majidia and Kujanga) and Jadavpur in July-August, 1976.

The fourth Workshop on the Co-ordinated Research Project was held at CIFT, Cochin on 27th and 28th October, 1976 in which 57 dele-

gates participated. The Workshop reviewed the progress of work on the project during the previous year and also forwarded the technical programmes for the ensuing year.

SCIENTISTS ASSOCIATED WITH THE PROJECT

COCHIN: M. Rajendranathan Nair, K. Mahadeva Iyer, K. Gopakumar, R. Rajagopalan Unnithan, R. Thankamma.

KAKINADA: C. C. Panduranga Rao, T. K. Govindan, Sibsankar Gupta.

VERAVAL: R. Venkataraman, P. T. Mathew.

BOMBAY: A. P. Valsan.

4. PUBLICATIONS

LIST OF SCIENTIFIC PAPERS PUBLISHED

1. **Balachandran, K. K.**

   On the Carotenoid pigments in Indian prawns — *Fish. Technol.* 13(2) 121-125, 1976.

2. **Balachandran, K. K. and T. S. Unnikrishnan Nair**

   Diversification in canned fishery products — Canning of clams and mussels in oil. Proceedings — Symposium on Fish Processing Industry in India, 13-14, Feb. 1975 at CFTRI, Mysore.

3. **Balachandran, K. K. and P. K. Vijayan**

   Processing aspects of Indian mackerel — A review. *Fish. Technol.* 13 (2): 81-87, 1976.

4. **Balachandran, K. K. and M. Rajendranathan Nair**

   Prospects of canning fish and shell fish in India — Symposium on Handling, Processing and Marketing of Tropical Fish, Tropical Products Institute, London, 5-9 July, 1976.

5. **Balachandran, K. K. and P. Madhavan**

Canning of lactarius — *Fish. Technol.* 13(2): 159-160, 1976.

6. **Chakraborty, P. K.**

Multideck tunnel dryer — a new concept in hot air dehydration — Symposium on Fish Processing Industry in India, 13-14 Feb. 1976. at CFTRI, Mysore.

7. **Chakraborty, P. K.**

A pilot plant for fish protein concentrate, *Fish. Technol.* 13(1):62-68, 1976.

8. **Chakraborty, P. K. and M. Arul James**

Pilot plant for the production of fish ensilage and the economics of production. *Fish. Technol.* 13(2):115-120, 1976.

9. **Chakraborty, P. K.**

Design of commercial dehydration plant and economics of production, Symp. on Handling, Processing and Marketing of Tropical Fish, Tropical Products Institute, London, 5-9 July, 1976.

10. **Chakraborty, P. K.**

Edible Fish Powder, An ideal solution to the problem of malnutrition. *Seafood Export Journal,* VIII (8):10-17, 1976.

11. **Devadasan, K. and R. Venkataraman**

Smoke curing — *Seafood Export Journal,* 9 (1): 51-56, 1976.

12. **Chinnamma George and M. R. Nair**

Technological aspects of preservation and processing of edible shell fishes -VI. Freezing of precooked crab and mussel meat and raw and cooked crab claws — Paper presented at the symposium on Handling, Processing and Marketing of Tropical Fish, 5-9 July, 1976, TPI, London.

13. **Govindan, T. K.**

Fresh fish utilisation in India: ways and means for its improvement. *Seafood Export Journal,* 8 (4): 29-35, 1976.

14. **James M. Arul**
K. Mahadeva Iyer and
M. R. Nair

Comparative study of fish ensilage prepared by microbial fermentation and formic acid ensilage. Symp. on Handling, Processing and Marketing of Tropical fish, Tropical Products Institute, London 5-9 July, 1976.

15. **Joseph, A. C.**
Cyriac Mathen and
T. S. Gopalakrishna Iyer

Potential sources of Salmonella in frozen prawns. (Internal circulation)

16. **Joseph, A. C.**
Cyriac Mathen and
T. S. Gopalakrishna Iyer

Incidence of Vibriopara haemolyticus in commercial frozen shrimp (Internal circulation).

17. **Kandoran, M. K.**

Fish in nutrition and economy. *Seafood Export Journal,* 8 (4):23-27, 1976.

18. **Kandoran, M. K.**

Technological aspects of freezing. *Seafood Export Journal,* 8 (9):21-30, 1976.

19. **Kartha, K. N.**

Evolution of suitable type of bottom trawls for the medium size steel trawlers of Orissa Fisheries Department. *Fish. Technol.* 13 (2):126-132, '76.

20. **Kunjipalu, K. K. and**
P. George Mathai

Catch of a whale shark, Rhincodon typus (Smith) off North West Coast of India (Veraval). *Fish. Technol.* 13 (2):161-162, 1976.

21. Kuriyan, G. K.

Towards a better export performance. *Indian Seafoods,* 11 (1-4): 72-73, 1976.

22. Kuriyan, G. K.

Fish Product development in India. Symp. on Handling, Processing and Marketing of Tropical Fish, Tropical Products Institute, London, 5-9 July, 1976.

23. Kuttyayappan, M. P. A, Vasanth Shenoy and K. Gopakumar

Proximate composition of 17 species of Indian Fish. *Fish. Technol.* 13 (2):153-155, 1976.

24. Mathen Cyriac A. C. Joseph and Francis Thomas

Preparation of an instant deodorant for fish processing industry. *Seafood Export Journal,* 8 (3): 19, 1976.

25. Mathen Cyriac

Phosphate treatment in commercial shrimp freezing (Internal Circulation).

26. Mathen Cyriac

Bacteria of public health significance in seafoods. Note in the proceedings of the Summer Institute on coastal Fishing Methods, June-July 1976, CIFT, Cochin.

27. Mathen Cyriac

Hygiene and sanitation on board fishing vessels. Note in the proceedings of the Summer Institute on coastal Fishing Methods, June-July, 1976.

28. Muraleedharan, V. and A. P. Valsan

Preparation of smoke cured fillets from oil sardines. *Fish. Technol.* 13 (2):146-152, 1976.

29. **Naidu R. Mangayya, Anwar Ahmed Khan and G. Narayanappa**

Comparative efficiency of frame nets and trammel nets. *Fish. Technol.* 13 (1):59-61, 1976.

30. **Nair, P. G. Viswanathan, K. Gopakumar and M. R. Nair**

Lipid and fatty acid composition of clams (Villorita cyprinoids). All India Symposium on fats and oils in relation to food products and their preparation, CFTRI, Mysore, 3-5 June, 1976.

31. **Nair, P. G. Viswanathan, K. Gopakumar and M. R. Nair**

Lipid Hydrolysis in mackerel (Rastrelliger kanagurta) during frozen storage. *Fish. Technol.* 13 (2):111-114, 1976.

32. **Namboodiri, K. Sreedharan**

Reliability and need for standardisation of electrical systems in small wooden fishing vessels. *Fish. Technol.* 13 (1):1-3, 1976.

33. **Perigreen, P. A. and M. R. Nair**

Handling and Transportation of fish in India — Paper presented at the symposium on Handling, Processing and Marketing of Fish, Tropical Products Institute, London, 5-9 July, 1976.

34. **Pillai, S. Ayyappan**

Application of IQF for freezing fish and the prospects of these techniques in India. Published in the Souvenir released during the second symposium in Cryogenics held from 8-10, Dec. 1976 at IIT, Madras.

35. **Prabhu, P. Vasudeva, A. G. Radhakrishnan and T. S. G. Iyer**

Chitosan as a water clarifying agent. *Fish. Technol.* 13 (1): 69-72, 1976.

36. **Satyanarayana, A. V. V. and G. Narayanappa**

Preliminary observations in the design and operation of a three panel, double trawl net. *Fish. Technol.* 13 (1):54-58, 1976.

37. **Satyanarayana, A. V. V., G. Naraynappa and Percy Dawson**

Studies on longwing trawl for shrimps off Kakinada (A.P.) Coast — 1. Results of comparative fishing experiments with the conventional two seam trawl. *Fish. Technol.* 13 (2):101-104, 1976.

38. **Shenoy, A. Vasanth**

Freezing characteristics of tropical fishes III Spotted seer (*Scomberomorus guttatus*) *Fish. Technol.* 13(2):105-110, 1976.

39. **Shenoy, A. Vasanth, M. P. Kuttyayappan and K. Gopakumar**

Fish protein concentrate from trash fish. —Symp. on Handling, Processing and Marketing of Tropical Fish, Tropical Products Institute, London, 5-9 July, 1976.

40. **Solanki, K. K., M. K. Kandoran and R. Venkataraman**

Seasonal variations in the chemical composition of pomfret — II — Silver pomfret. *Fish. Technol.* 13(1):49-53, 1976.

41. **Surendran, P. K. and K. Mahadeva Iyer**

Bacterial flora of fish and iced Indian mackerel (Rastrelliger kanagurta) and its response to chlorotetracycline (CTC) treatment. *Fish. Technol.* 13 (2): 139-145, 1976.

42. **Unnithan, G. Rajagopalan, H. Krishna Iyer and K. Krishna Rao**

Weightloss in frozen prawns. *Fish. Technol.* 13 (2):133-138, 1976.

43. **Valsan, A. P. and T. S. Unnikrishnan Nair**

Utilisation of the fish waste self-brine of fish curing industry as farm fertiliser. *Fish. Technol.* 13(2):156-158, 1976.

44. **Venkataraman, R. and K. Devadasan**

Some suggestions for the better utilisation of the fishery resources of Gujarat. *Seafood Export Journal,* 9(1):87-91, 1976.

45. **Venkataraman, R., P. R. G. Varma, P. V. Prabhu and A. P. Valsan**

Transportation of fish. I — A preliminary study on insulated containers and their efficacy in long distance transportation. *Fish. Technol.* 13 (1): 41-49, 1976.

The following two Bulletins were published by the Institute during the year under report.

1. Special Bulletin No.3 "Bibliography of Trawl gear" Compiled by C. P. Varghese, S. Gopalan Nayar and K. Radhalakshmy.

2. Special Bulletin No. 4 "Bibliography on Marine Fouling Organisms"

   Compiled by N. Unnikrishnan Nair.

5. APPENDICES

APPENDIX — I

HEADQUARTERS: CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY, Willingdon Island, Cochin- 29 P.C. 682029 Kerala.

TLX No. 0885-440

Telephone No. 6845 (10 lines)

Telegram: MATSYAOUDYOGIKI or FISHTECH COCHIN

Director's Telephone: Per.:6880, Res.: 35263.

DIRECTOR	..	Shri G. K. KURIYAN
Project Co-ordinator	..	Shri M. Rajendranathan Nair
Scientists-in-Charge		
Processing & Packaging Division	..	Shri P. Vasudeva Prabhu
Biochemistry & Microbiology Division	..	Shri K. Mahadeva Iyer
Craft Division	..	Shri R. Balasubramanyan
Gear Division	..	Shri K. A. Sadanandan
Engineering Division	..	Shri S. Ayyappan Pillai
Extension Division	..	Shri P. N. R. Kaimal

RESEARCH CENTRES

Sl. No.	Place	Address	Telephone No.	Telegram	Scientist-in-Charge
(1)	(2)	(3)	(4)	(5)	(6)
1.	VERAVAL	Research Centre of CIFT Bunder Road, Veraval-362265, Gujarat.	297	MATSYAOUDYOGIKI	Shri R. Venkataraman
2.	KAKINADA	Research Centre of CIFT, D. No. 1-14-7, Sreeram Nagar Kakinada-533003. Andhra Pradesh.	4436	MATSYAOUDYOGIKI	Dr. C. C. Panduranga Rao
3.	BURLA	Research Centre of CIFT, Burla P.O. P.C. 768017, Sambalpur Dist, Orissa State.	19	MATSYAOU DYOGIKI	Shri V. C. George
4.	BOMBAY	Research Centre of CIFT, Sassoon Dock, Colaba, Bombay-400005, Maharashtra.	213892	FISHPROCESS(FT)	Shri A. P. Valsan
5.	CALICUT	Research Centre of CIFT, C/o. CMFRI Sub-Station, West Hill, Calicut-700005. Kerala.	76607	CARE KADALMEEN	Shri T. S. Unnikrishnan Nair
6.	GOA	Research Centre of CIFT, 2nd Floor, 'Shanta', 18 June Road, St. Inez, Panaji-403001, Goa.	2049	MATSYAOU DYOGIKI	Shri H. N. Mhalathkar
7.	MADRAS	Research Centre of CIFT, C/o. Inshore Fishing Station, 62,C. S. N. Chetty Street, Royapuram, Madras-600013 Tamilnadu.	812053	—	Dr. G. Jegatheesan

APPENDIX — II

List of personnel in CIFT as on 31-12-1976

SCIENTIFIC PERSONNEL

Sl. No.	Name	Designation
(1)	(2)	(3)
1.	Shri G. K. Kuriyan ..	Director
2.	Shri R. Venkataraman ..	Scientist — S3
3.	Shri M. Rajendranathan Nair ..	Scientist — S3
4.	Dr. C. C. Panduranga Rao ..	Scientist — S3
5.	Shri K. Mahadeva Iyer ..	Scientist — S2
6.	Shri T. K. Govindan ..	Scientist — S2
7.	Dr. K. Gopakumar ..	Scientist — S2
8.	Shri S. Ayyappan Pillai ..	Scientist — S2
9.	Shri P. Vasudeva Prabhu ..	Scientist — S2
10.	Shri K. A. Sadanandan ..	Scientist — S2
11.	Shri V. C. George ..	Scientist — S2
12.	Shri K. Devadasan ..	Scientist — S2
13.	Shri Cyriac Mathen ..	Scientist — S2
14.	Shri R. Balasubramanyan ..	Junior Fishery Scientist
15.	Shri A. V. V. Satyanarayana ..	Junior Fishery Scientist
16.	Shri A. P. Valsan ..	Junior Scientist
17.	Shri P. N. R. Kaimal ..	Junior Scientist (Extension)
18.	Shri P. Appukutta Panicker ..	Scientist — S1
19.	Shri P. D. Antony ..	Scientist — S1
20.	Shri H. N. Mhalathkar ..	Scientist — S1
21.	Shri M. K. Kandoran ..	Scientist — S1
22.	Shri K. Sreedharan Namboodiri ..	Scientist — S1
23.	Shri K. K. Balachandran ..	Scientist — S1
24.	Shri P. Madhavan ..	Scientist — S1
25.	Shri P. K. Chakraborty ..	Scientist — S1
26.	Shri T. S. Gopalakrishna Iyer ..	Scientist — S1
27.	Shri P. A. Perigreen ..	Scientist — S1
28.	Shri M. Arul James ..	Scientist — S1
29.	Shri A. K. Kesavan Nair ..	Scientist — S1
30.	Shri A. G. Radhakrishnan ..	Scientist — S1
31.	Shri P. K. Surendran ..	Scientist — S1
32.	Shri K. K. Solanki ..	Scientist — S1
33.	Smt. Chinnamma George ..	Scientist — S1
34.	Smt. Mary Thomas ..	Scientist — S1
35.	Shri P. R. Girija Varma ..	Scientist — S1

(1)	(2)		(3)
36.	Shri K. K. Kunjipalu	..	Scientist — S1
37.	Shri V. N. Nambiar	..	Scientist — S1
38.	Shri K. G. Ramachandran Nair	..	Scientist — S1
39.	Shri A. Vasantha Shenoy	..	Scientist — S1
40.	Shri T. S. Unnikrishnan Nair	..	Scientist — S1
41.	Shri P. N. Joshi	..	Scientist — S1
42.	Shri Sibsankar Gupta	..	Scientist — S1
43.	Shri Korah Eapen	..	Scientist — S1
44.	Shri G. Narayanappa	..	Scientist — S1
45.	Dr. Jose Stephen	..	Assistant Fishery Scientist
46.	Shri R. S. Nair	..	Assistant Fishery Scientist
47.	Shri T. M. Sivan	..	Assistant Fishery Scientist
48.	Shri N. A. George	..	Assistant Fishery Scientist
49.	Smt. K. Radhalakshmy	..	Assistant Fishery Scientist
50.	Smt. A. Lekshmy Nair	..	Assistant Fishery Scientist
51.	Shri R. Mangayya Naidu	..	Assistant Fishery Scientist
52.	Shri N. Unnikrishnan Nair	..	Scientist — S
53.	Shri T. Joseph Mathai	..	Scientist — S
54.	Shri K. N. Kartha	..	Scientist — S
55.	Shri N. Subramonia Pillai	..	Scientist — S
56.	Shri Francis Thomas	..	Scientist — S
57.	Shri J. Sitarama Rao	..	Scientist — S
58.	Shri S. V. V. Rama Rao	..	Scientist — S
59.	Shri A. C. Joseph	..	Scientist — S
60.	Shri V. Vijayan	..	Scientist — S
61.	Shri A. A. Khan	..	Scientist — S
62.	Shri M. Syed Abbas	..	Scientist — S
63.	Dr. G. Jagatheesan	..	Scientist — S
64.	Shri R. S. Manohardoss	..	Scientist — S
65.	Shri A. G. Gopalakrishna Pillai	..	Scientist — S
66.	Shri P. Srinivasa Rao	..	Scientist — S
67.	Shri Percy Dawson	..	Scientist — S
68.	Shri V. Muraleedharan	..	Scientist — S
69.	Shri G. Rajagopalan Unnithan	..	Scientist — S
70.	Shri D. K. Garg	..	Scientist — S
71.	Shri P. George Mathai	..	Scientist — S
72.	Shri C. Hridayanathan	..	Scientist — S
73.	Dr. M. Shahul Hameed	..	Scientist — S
74.	Shri A. C. Kuttappan	..	Scientist — S
75.	Shri K. George Joseph	..	Scientist — S
76.	Shri T. P. George	..	Scientist — S
77.	Shri R. Gopalakrishnan	..	Scientist — S

(1)	(2)		(3)
78.	Shri M. D. Varghese	..	Scientist — S
79.	Shri P. K. Vijayan	..	Senior Research Assistant
80.	Shri K. Ramakrishnan	..	Senior Research Assistant
81.	Smt. K. Vijayabharathy	..	Senior Research Assistant
82.	Smt. R. Thankamma	..	Senior Research Assistant
83.	Smt. T. T. Annamma	..	Senior Research Assistant

ARS PROBATIONERS

1.	Shri M. K. Mukundan	..	Scientist — S1
2.	Shri P. G. Viswanathan Nair	..	Scientist — S1
3.	Smt. Nirmala Thampuran	..	Scientist — S1
4.	Shri T. K. Thankappan	..	Scientist — S1
5.	Shri P. T. Mathew	..	Scientist — S1
6.	Shri Jose Joseph	..	Scientist — S1
7.	Shri D. I. Khasim Saheb	..	Scientist — S1
8.	Shri Himadri Sekher Biswas	..	Scientist — S1
9.	Shri Rajendra Badonia	..	Scientist — S1
10.	Shri Harinder Krishan Beri	..	Scientist — S1
11.	Shri Abuthahir Ali S. M. S.	..	Scientist — S1
12.	Shri Subrata Basu	..	Scientist — S1
13.	Shri Anwar Haider Zaidi	..	Scientist — S1

TECHNICAL PERSONNEL

Sl. No.	Name		Designation
(1)	(2)		(3)
1.	Shri M. S. Fernando	..	Skipper
2.	Shri A. P. Jayaprakash	..	Skipper
3.	Smt. P. J. Cecily	..	Junior Technical Officer
4.	Smt. Annamma Mathew	..	Senior Analyst
5.	Shri K. Vasudevan Nair	..	Senior Analyst
6.	Shri V. K. Ibrahim	..	Head Draughtsman
7.	Shri C. Chandrasekharan	..	Superintendent (E&M)
8.	Shri N. Vareethiah	..	Glass Blower
9.	Shri P. Ravindranathan	..	Senior Library Assistant
10.	Shri M. L. Anslem	..	Senior Draughtsman
11.	Shri A. Kassimkunju	..	Analyst
12.	Shri P. Sadanadan	..	Analyst

(1)	(2)		(3)
13.	Shri T. K. Sayed Ali	..	Analyst
14.	Shri G. Mohanan	..	Artist
15.	Shri K. J. Augustine	..	Senior Turner
16.	Shri O. Subramonian	..	Senior Welder
17.	Shri K. Bhaskaran	..	Photographer-cum-Artist
18.	Shri M. John	..	Instrument Technician
19.	Shri K. K. Poulose	..	Instrument Technician
20.	Shri Varghese Paul	..	Technical Assistant
21.	Shri M. Abdul Sathar	..	Media Supervisor
22.	Shri M. R. Nair	..	Bosun
23.	Shri N. Bahuleyan	..	Bosun
24.	Shri A. K. Jaisingh	..	Bosun
25.	Shri B. Anandan	..	Foundry Assistant
26.	Shri E. K. Balakrishnan	..	Draughtsman
27.	Smt. K. Sarasamma	..	Draughtsman
28.	Shri M. U. Vijayan	..	Senior Mechanic
29.	Shri S. R. Jethwa	..	Senior Mechanic
30.	Shri T. S. Bhaskara Menon	..	Senior Mechanic
31.	Shri K. E. Mani	..	Senior Mechanic
32.	Shri T. K. David	..	Fitter
33.	Shri G. Ratnakaran Nair	..	Refrigeration Mechanic
34.	Shri P. M. Joseph	..	Machinist
35.	Shri K. V. Madhavan	..	Electrician
36.	Shri V. S. Augustine	..	Senior Carpenter
37.	Shri Philip Durom	..	Senior Carpenter
38.	Shri A. R. Dharaneedharan	..	Media Assistant
39.	Shri K. K. Subramanian	..	Engine Driver
40.	Shri K. V. Baladasan	..	Engine Driver
41.	Shri Mohammed Jaffar	..	Engine Driver
42.	Shri V. V. Johny	..	Senior Field Assistant
43.	Shri M. K. Sasidharan	..	Senior Field Assistant
44.	Shri A. Haranath	..	Senior Field Assistant
45.	Shri Nallababu Rao	..	Senior Field Assistant
46.	Shri Chaman Lal Klair	..	Senior Field Assistant
47.	Shri Thomas J. Mammoottil	..	Senior Laboratory Assistant
48.	Shri V. K. Ramachandran	..	Senior Laboratory Assistant
49,	Shri T. John	..	Senior Laboratory Assistant
50.	Shri P. K. Damodaran	..	Senior Laboratory Assistant
51.	Shri V. Venkata Rama Krishna	..	Senior Laboratory Assistant
52.	Shri A. Veeranjanayulu	..	Senior Laboratory Assistant
53.	Shri V. Gopalakrishna Pillai	..	Senior Laboratory Assistant
54.	Shri P. V. Channey	..	Senior Laboratory Assistant

(1)	(2)		(3)
55.	Shri G. P. Vaghela	..	Senior Laboratory Assistant
56.	Shri P. M. Pattanayak	..	Senior Laboratory Assistant
57.	Shri M. M. Devassya	..	Junior Library Assistant
58.	Shri R. Gopalakrishnan Nar	..	Computer
59.	Shri T. Neelakandan	..	Projector Operator
60.	Shri V. Gasper	..	Field Assistant
61.	Shri K. V. Rajan	..	Junior Laboratory Assistant
62.	Shri P. T. Sebastian	..	Junior Laboratory Assistant
63.	Shri P. S. Alias	..	Junior Laboratory Assistant
64.	Shri B. Ramaiah	..	Junior Laboratory Assistant
65.	Shri N. M. Vasu	..	Junior Laboratory Assistant
66.	Shri T. K. Bhaskaran	..	Junior Laboratory Assistant
67.	Shri K. B. Thilakan	..	Junior Laboratory Assistant
68.	Shri M. N. Jungi	..	Junior Laboratory Assistant
69.	Shri T. K. Vasudevan	..	Junior Laboratory Assistant
70.	Shri T. K. Aravindakshan	..	Junior Laboratory Assistant
71.	Smt. K. K. Sumathy		Junior Laboratory Assistant
72.	Shri C. C. Gandhi	..	Plant Attendant
73.	Shri N. C. Bhaskaran	..	Plant Attendant
74.	Shri K. R. Kesavan	..	Plant Attendant
75.	Shri T. Gopalakrishnan	..	Metal Worker
76.	Shri Tomy B. Fonseka	..	Boilerman
77.	Shri Gurudas Ram	..	Tindal
78.	Shri V. Veer Raju	..	Tindal
79.	Shri C. P. Bhensla	..	Tindal
80.	Shri M. S. Rajan	..	Tindal
81.	Shri T. N. Manibhadran	..	Tindal
82.	Shri T. Balan	..	Tindal
83.	Shri N. J. Tandel	..	Driver (Launch)
84.	Shri K. K. Pappukutty	..	Driver (Launch)
85.	Shri A. B. Varghese	..	Driver (Launch)
86.	Shri Muraleedhara Mishra	..	Driver (Launch)
87.	Shri A. Gopalakrishnan Nair	..	Staff Car Driver
88.	Shri P. P. Poulose	..	Staff Car Driver
89.	Shri P. Natarajan	..	Driver
90.	Shri M. G. Narayanan Nair	..	Driver
91.	Shri Narasingh Pande	..	Driver
92.	Shri M. Venkateswara Rao	..	Driver
93.	Shri Chantrakant X. Halernekar	..	Driver
94.	Shri P. Bahulayen	..	Telephone Operator-cum-Receptionist
95.	Shri S. Laxmanadu	..	Deckhand

(1)	(2)		(3)
96.	Shri G. B. Tandel	..	Deckhand
97.	Shri K. K. Lakshmanan	..	Deckhand
98.	Shri H. M. Kotiya	..	Deckhand
99.	Shri P. K. Pushpangadan	..	Deckhand
100.	Shri G. R. Bhogte	..	Deckhand
101.	Shri P. A. John	..	Deckhand
102.	Shri K. Sarangadharadu	..	Deckhand
103	Shri T. K. Dasan	..	Deckhand
104.	Shri Malam Bachu Sidi	..	Deckhand
105.	Shri K. Gangaraju	..	Deckhand
106.	Shri G. Subba Rao	..	Cook
107.	Shri E. R. Krishnan	..	Cook
108.	Shri T. A. Francis	..	Cook

ADMINISTRATIVE PERSONNEL

Sl. No.	Name		Designation
(1)	(2)		(3)
1.	Shri K. B. Kandankoran	..	Administrative Officer
2.	Shri A. Chakrapany	..	Asst. Administrative Officer
3.	Shri M. V. Rangan	..	Accounts Officer
4.	Shri V. Joseph	..	Superintendent
5.	Shri P. J. Joseph	..	Superintendent
6.	Shri S. Sadanandan	..	Superintendent
7.	Shri K. J. Thomas	..	Senior Stenographer
8.	Smt. T. N. Ambujakshy Amma	..	Assistant
9.	Shri P. A. Uthup	..	Assistant
10.	Shri M. George Joseph	..	Assistant
11.	Shri S. Naveen Chandra Prabhu	..	Assistant
12.	Smt. K. A. Devaky	..	Assistant
13.	Smt. Mariamma Sadanandan	..	Stenographer
14.	Shri K. Ravindran	..	Stenographer
15.	Smt. K. R. Gita Rani	..	Junior Stenographer
16.	Shri A. A. Sankarankutty	..	Junior Stenographer
17.	Shri P. Vasudevan	..	Senior Clerk
18.	Smt. Alice M. Joseph	..	Senior Clerk
19.	Smt. Nafeessa Ali	..	Senior Clerk
20.	Shri T. M. Padmanabhan	..	Senior Clerk
21.	Smt. N. K. Sulochana	..	Senior Clerk
22.	Smt. T. K. Sarala	..	Senior Clerk

(1)	(2)		(3)
23.	Shri R. S. Shanmukhan	..	Senior Clerk
24.	Shri A. L. John	..	Senior Clerk
25.	Shri M. Gopalakrishnan	..	Senior Clerk
26.	Shri V. N. Rajasekharan Nair	..	Senior Clerk
27.	Shri M. T. Joseph	..	Senior Clerk
28.	Shri P. Vijayan	..	Senior Clerk
29.	Shri M. J. Sebastian	..	Senior Clerk
30.	Shri V. Raman Menon	..	Senior Clerk
31.	Shri A. K. Venugopal	..	Senior Clerk
32.	Shri M. Ravindran	..	Senior Clerk
33.	Smt. Annamma Varghese	..	Senior Clerk
34.	Smt. C. G. Marykutty	..	Senior Clerk
35.	Shri G. Sasidharan	..	Senior Clerk
36.	Smt. M. S. Susanna	..	Senior Clerk
37.	Smt. N. Prabhavathi Amma	..	Senior Clerk
38.	Shri C. Ravindran Nair	..	Junior Clerk
39.	Shri T. M. Ramaraj	..	Junior Clerk
40.	Shri Y. W. Mhadgut	..	Junior Clerk
41.	Shri N. Venugopalan	..	Junior Clerk
42.	Shri M. Balan Nambiar	..	Junior Clerk
43.	Smt. N. K. Saraswathy	..	Junior Clerk
44.	Shri Veer Singh	..	Junior Clerk
45.	Shri G. Somappan	..	Junior Clerk
46.	Shri V. R. Kesavan	..	Junior Clerk
47.	Smt. Smita K. Shrishkar	..	Junior Clerk
48.	Smt. M. Jully	..	Junior Clerk
49.	Shri K. Bhaskaran	..	Junior Clerk
50.	Smt. M. A. Prasanna	..	Junior Clerk
51.	Smt. K. A. Nazeem	..	Junior Clerk
52.	Shri A. Chakrapany	..	Junior Clerk
53.	Shri Y. Philipose	..	Junior Clerk
54.	Shri A. B. Rodrigues	..	Junior Clerk
55.	Shri Kailash Chandra Sahoo	..	Junior Clerk
56.	Shri Ch. Satyanarayana	..	Junior Clerk
57.	Shri T. Veerabhadra Rao	..	Junior Clerk
58.	Shri C. K. Muraleedharan	..	Junior Clerk
59.	Shri P. K. Sreedharan	..	Junior Clerk
60.	Smt. K. Gracy	..	Junior Clerk

(1)	(2)		(3)
61.	Shri M. K. Kuttykrishnan Nair	..	Junior Clerk
62.	Smt. B. Hemaletha	..	Junior Clerk
63.	Shri P. V. Venugopalan	..	Junior Clerk
64.	Shri A. George Joseph	..	Junior Clerk
65.	Shri Govindan Moosad	..	Junior Clerk
66.	Shri K. P. Velayudhan	..	Junior Clerk
67.	Smt. T. K. Susannamma	..	Junior Clerk

SUPPORTING STAFF

1.	Shri S. S. Salvi	..	S.S. Grade III
2.	Shri T. K. Bava	..	S.S. Grade III
3.	Shri B. Suryaprakash Rao	..	S.S. Grade III
4.	Shri E. Gangadharan Nair	..	S.S. Grade III
5.	Shri Koppada Gandhi	..	S.S. Grade III
6.	Shri Gajendra Karali	..	S.S. Grade III
7.	Shri M. K. Prabhakaran	..	S.S. Grade III
8.	Shri K. K. Radhakrishnan	..	S.S. Grade III
9.	Shri N. K. Kunjan	..	S.S. Grade III
10.	Shri O. C. Lonan	..	S.S. Grade III
11.	Shri E. S. Balachandra Pai	..	S.S. Grade III
12.	Shri E. S. Sreedharan	..	S.S. Grade III
13.	Shri C. G. Tank	..	S.S. Grade III
14.	Shri Krishna Chandra Maher	..	S.S. Grade III
15.	Shri V. V. John	..	S.S. Grade III
16.	Shri Mohanlal Manubhai Vara	..	S.S. Grade III
17.	Shri S. M. S. Yadav	..	S.S. Grade III
18.	Shri P. A. Thomas	..	S.S. Grade III
19.	Shri C. S. Govindan	..	S.S. Grade III
20.	Shri K. Balakrishna Pillai	..	S.S. Grade III
21.	Shri C. M. Gopalan	..	S.S. Grade III
22.	Shri D. R. Apparanthi	..	S.S. Grade III
23.	Shri P. J. George	..	S.S. Grade III
24.	Shri P. C. Sukumaran	..	S.S. Grade III
25.	Shri A. G. Vasu	..	S.S. Grade III
26.	Shri C. A. Subran	..	S.S. Grade III
27.	Shri B. Thirupathi Rao	..	S.S. Grade III
28.	Shri D. Gopalakrishna Rao	..	S.S. Grade III
29.	Shri Radhu Pandey	..	S.S. Grade III
30.	Shri A. T. Waghmere	..	S.S. Grade III

31.	Shri N. Gnanaranjan Rao	..	S.S. Grade III
32.	Shri P. A. Abdul Rahman	..	S.S. Grade III
33.	Shri Digambur D. Naik	..	S.S. Grade III
34.	Shri K. K. Appachan	..	S.S. Grade III
35.	Shri K. X. Joseph	..	S.S. Grade III
36.	Shri T. T. Das	..	S.S. Grade III
37.	Shri Laba Nag	..	S.S. Grade III
38.	Shri Satrugan Kumara	..	S.S. Grade III
39.	Shri O. M. Thankappan	..	S.S. Grade III
40.	Shri O. A. Krishnan	..	S.S. Grade I
41.	Shri M. K. Thevan	..	S.S. Grade I
42.	Shri P. M. Pakeer Mohammed	..	S.S. Grade I
43.	Shri K. Raghavan	..	S.S. Grade I
44.	Shri Ramachandra D. Padnekar	..	S.S. Grade I
45.	Shri Vasudeva G. Kubal	..	S.S. Grade I
46.	Shri Santhosh Banchor	..	S.S. Grade I
47.	Shri Gokulchandra Mehar	..	S.S. Grade I
48.	Shri Rattan Chand	..	S.S. Grade I
49.	Shri Menino Souza	..	S.S. Grade I
50.	Shri Satrughan Seth	..	S.S. Grade I
51.	Shri Naran Lakham Chorwadi	..	S.S. Grade I
52.	Shri K. K. Madhavan	..	S.S. Grade I
53.	Shri P. S. Morajkar	..	S.S. Grade I
54.	Shri S. Rajan	..	S.S. Grade I
55.	Shri C. Kamaraju	..	S.S. Grade I
56.	Shri Voleti Kamaraju	..	S.S. Grade I
57.	Shri T. V. Manoharan	..	S.S. Grade I
58.	Shri Sadhucharan Mehar	..	S.S. Grade I
59.	Shri Chandru B. Shirodkar	..	S.S. Grade I
60.	Shri K. Kameswara Rao	..	S.S. Grade I
61.	Shri Malladi Perraju	..	S.S. Grade I
62.	Shri K. C. Fofandi	..	S.S. Grade I
63.	Shri E. K. Chinnappan	..	S.S. Grade I
64.	Shri B. S. Tambi	..	S.S. Grade I
65.	Shri Gordhan Mulji Vaghela	..	S.S. Grade I
66.	Shri P. Padmanabhan	..	S.S. Grade I
67.	Shri C. A. Krishnan	..	S.S. Grade I

68.	Shri Krishna Chandra Nayak	..	S.S. Grade I
69.	Shri P. A. Shanmukhan	..	S.S. Grade I
70.	Shri K. N. Mukundan	..	S.S. Grade I
71.	Shri P. Gopalakrishnan	..	S.S. Grade I
72.	Shri V. P. Raphael	..	S.S. Grade I
73.	Shri Govind Laxman Tandel	..	S.S. Grade I
74.	Shri Karsan Arjan Masani	..	S.S. Grade I
75.	Shri K. A. Gopinath	..	S.S. Grade I
76.	Shri P. D. George	..	S.S. Grade I
77.	Shri K. B. Bhaskaran	..	S.S. Grade I
78.	Shri K. K. Karthikeyan	..	S.S. Grade I
79.	Shri N. N. Goswami	..	S.S. Grade I
80.	Shri T. T. Velayudhan	..	S.S. Grade I
81.	Shri K. A. Kunjan	..	S.S. Grade I
82.	Shri A. P. Gopalan	..	S.S. Grade I
83.	Shri T. T. Thankappan	..	S.S. Grade I
84.	Shri P. R. Unnikrishna Panicker	..	S.S. Grade I
85.	Shri R. Chellappan	..	S.S. Grade I
86.	Shri T. Kochukuttan Nair	..	S.S. Grade I
87.	Shri V. S. Ambasudhan	..	S.S. Grade I
88.	Shri Rama Chandra Mirdha	..	S.S. Grade I
89.	Shri Kirtan Kisan	..	S.S. Grade I
90.	Shri G. Chinna Rao	..	S.S. Grade I
91.	Shri Vasipalli Vellaiah	..	S.S. Grade I
92.	Shri M. K. Asokan	..	S.S. Grade I
93.	Shri A. R. John	..	S.S. Grade I
94.	Shri A. A. Kunjappan	..	S.S. Grade I
95.	Shri C. N. Raghavan	..	S.S. Grade I
96.	Shri Orilika Heman	..	S.S. Grade I
97.	Shri K. Apparao	..	S.S. Grade I
98.	Shri A. Ravindran Nair	..	S.S. Grade I
99.	Shri B. Sivanandan	..	S.S. Grade I
100.	Shri Harbhajan	..	S.S. Grade I
101.	Shri Bandu M. Gharo	..	S.S. Grade I
102.	Shri P. N. Sukumaran Nair	..	S.S. Grade I
103.	Smt. P. L. Roseilly	..	S.S. Grade I

ON DEPUTATION

Sl. No.	Name	Deputation with	Designation
1.	Shri M. Velu, Fishery Scientist (Mech. Engg.)	Cochin Port Trust, Cochin-3.	Dy. Chief Mechanical Engineer
2.	Dr. K. Ravindran, Scientist — S1	Marine Products Export Development Authority, Cochin.	Dy. Director
3.	Shri P. Sulochanan, Scientist — S1	Exploratory Fisheries Project, Kandla Base, Block No. 80|262, Kutch.	Dy. Director
4.	Shri T. K. Sivadas, Scientist — S1	National Institute of Oceanography, Dona Paula, Panjim, Goa.	Scientist - C
5.	Shri H. Krishna Iyer, Scientist — S1	National Institute of Oceanography, Cochin-18.	Scientist - B
6.	Shri C. V. N. Rao, Scientist — S1	Office of the Development Commissioner (Small Scale Industries), Nirman Bhavan, New Delhi-110011.	Dy. Director
7.	Shri K. Krishna Rao, Scientist — S1	Pelagic Fishery Project, Cochin-16.	Statistician
8.	Shri Y. Sreekrishna, Scientist — S1	Central Institute of Fisheries Education, P. B. No. 7392, Kakori Camp, J. P. Road, Bombay-58.	Professor (Fisheries Technology)
9.	Shri S. Gopalan Nayar, Junior Fishery Scientist	Marine Products Export Development Authority, Cochin.	Dy. Director
10.	Shri M. Mukundan, Scientist — S	Central Institute of Fisheries, Nautical & Engineering Training, Cochin-16.	Instructor (Operation)
11.	Shri R. Rajendran, Scientist — S	—do—	Instructor (C & G)
12.	Shri O. P. Pandey, Scientist — S	Export Inspection Agency, Thamarakulam, Quilon.	Junior Scientific Assistant
13.	Shri C. P. Varghese, Scientist — S	Integrated Fisheries Project, P. B. No. 1801, Cochin-16.	Asst. Director
14.	Shri R. Krishnaswamy, Scientist — S	Integrated Fisheries Project, Cochin-16.	Asst. Engineer (Electronics)
15.	Shri Varghese Paul	C.P.C.R.I., Kasaragode.	Asst. Administrative Officer
16.	Shri M. P. Chandrasekharan.	C.T.C.R.I., Trivandrum.	Superintendent

APPENDIX — III

FINANCE

Details of the budget provision and the actual expenditure during the financial year 1976-1977.

PLAN		Sanctioned Budget grant Rs.	Actual expenditure Rs.
Salary of Officers	..	—	1,27,623
Salary of Establishment	..		2,03,346
Dearness Pay & Allowances	..		1,13,424
Overtime allowance	..	9,60,000	2,554
House Rent Allowance	..		28,900
City Compensatory Allowance	..		4,555
Other Allowances	..		4,178
Travelling Allowance	..	40,000	62,447
Other charges	..	25,00,000	23,97,990
TOTAL	..	35,00,000	29,45,017
NON-PLAN			
Salary of Officers	..	6,50,000	5,60,484
Salary of Establishment	..	13,56,000	10,76,239
Dearness Pay & Allowances	..	8,54,000	7,05,132
Overtime Allowance	..		1,664
House Rent Allowance	..	2,28,000	1,62,398
City Compensatory Allowance	..	30,000	22,925
Other Allowances	..	1,16,000	42,274
Travelling Allowance	..	34,000	55,234
Provident Fund, Leave Salary Contributions	..	3,000	3,292
Other expenditure	..		312
Other charges	..	4,78,000	4,59,415
Fellowship	..	—	—
Grant-in-aids	..	—	—
TOTAL	..	37,49,000	30,89,569

6. *ABBREVIATIONS*

1.	AFDC	..	Agriculture and Food Products Division Council.
2.	BHA	..	Butylated hydroxy anisole.
3.	CP	..	Cooked and peeled.
4.	CPCRI	..	Central Plantation Crops Research Institute.
5.	CRP	..	Co-ordinated Research Project.
6.	CTCRI	..	Central Tuber Crops Research Institute.
7.	FAO	..	Food & Agricultural Organisation.
8.	FRP	..	Fibreglass reinforced plastics.
9.	GFCCA	..	Gujarat Fisheries Central Co-operative Association.
10.	HL	..	Headless.
11.	ISI	..	Indian Standards Institution.
12.	MCPD	..	Marine Cargo and Packaging Division.
13.	MPEDA	..	Marine Products Export Development Authority.
14.	NRDC	..	National Research Development Corporation of India.
15.	PD	..	Peeled and deveined.
16.	PUD	..	Peeled and undeveined.
17.	TBTO	..	Tributyl tin oxide.
18.	TDC	..	Textile Divisional Committee.
19.	UNDP	..	United Nations Development Programme.