1982-83

ANNUAL REPORT

Central Institute of Fisheries Technology
(Indian Council of Agricultural Research)
Cochin-682 029. India

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Matsyapuri P. O., COCHIN - 682 029

Prepared by

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Cover & Photography

K. BHASKARAN

CONTENTS

1. INTRODUCTION

The year 1982 stands out as a landmark in the history of Central Institute of Fisheries Technology which has completed 25 years of yeoman service to the country's seafood industry. Established in 1957 with Craft and Gear wing under the name Central Fisheries Technological Research Station in a godown at Kochangadi (Cochin), the organisation has, over the years, built for itself a structure and stature, which even many older Institutes in the line cannot boast of thanks to the relentless and dedicated efforts of all those Scientists and staff whose single minded devotion has provided a sound physical and physiological base to the Institute.

It is very heartening to note that the Silver Jubilee year of the Institute was chosen, appropriately, by the Society of Fisheries Technologists (India) to organise a National Symposium on Harvest and Post Harvest Technology of Fish at Central Institute of Fisheries Technology, Cochin. The symposium was attended by experts from India and abroad. It provided a much-needed forum for an overall view of the past developments and a futuristic view of the current and emerging problems in the area of fishery technology.

In the year under report, the Institute has continued to record steady progress in the on-going research programmes and has also initiated new programmes based on the current needs of the industry.

Studies were initiated to evolve suitable ways and means of reducing fuel consumption for propulsion and/or mechanised fishing. Preliminary results obtained so far with a tunnelised propulsion system in the form of a propeller cover fitted on a 32 feet wooden boat of CIFT design, have been very encouraging.

An enhancement of about 25 percent in mechanical strength of ferrocement, a boat building material, was achieved by impregnation with styrene monomer and polyester.

Further trials with toxic wood preservatives consisting of copper creosote on traditional craft gave encouraging results. Preservative treatment by the new method costs only about 50 percent of the cost of the traditional method.

An efficient non-living bait in the form of brick soaked in diesel oil was identified for use in lobster traps. This eliminates use of live mussels, which can be better utilised for human consumption.

Studies on sail-kites to increase the fish catch of high opening and large mesh demersal trawls were carried out at Veraval Research Centre. The results so far obtained indicate better catches with attachment of sail-kites as compared to nets without sail-kites.

As a result of comparative studies on gill nets of different colours at Veraval Research Centre, yellow coloured gill nets were found to be the best for exploitation of Hilsa and white coloured gill nets for pomfret.

Polypropylene was tested for use as a gear material and results obtained so far indicate its potentialities to replace nylon with advantage.

Design, fabrication and field trials of electronic ocean telelab capable of furnishing data on a number of parameters such as water current speed, direction, temperature, salinity etc., were completed. The instrument was fabricated utilising only indigenous components.

Calcium propionate, a cheap indigenously available chemical, was identified as a very efficient preservative for cured fish. This can replace with advantage the costly imported sodium propionate, hitherto recommended for the purpose.

Good quality sundried product from fresh water fish *Gudusia chapra* was developed by the Burla Research Centre of the Institute. This product has a storage life of about 7 months as compared to poor quality traditional product with a storage life of about 15 to 35 days.

A pickled product with a storage life of about 7 months was developed for the first time from low cost fresh water fish, by the Burla Research Centre.

Method has been worked out by Calicut Research Centre to render cured fish infested with red halophiles and fungi into organoleptically acceptable products.

Studies on freezing and frozen storage characteristics of mackerel (containing 4% fat) revealed that block frozen mackerel remain in acceptable condition even after 8 months storage at --23°C and is superior in texture, taste and overall acceptability to individually frozen mackerel.

Frozen storage period of minced cat fish meat can be prolonged by at least two months with the addition of 0.1% powdered spices such as cinnamon, clove or pepper.

A good quality fish sauce was developed from non-penaeid prawns by the Bombay Research Centre of the Institute.

Technology has been worked out to produce protein-rich, shrimp flavoured spray dried powder from shrimp extract and tapioca starch.

Study of the quality profile of fish sold in Bombay retail market revealed interesting results. Twentyseven percent of 167 samples examined were organoleptically poor while more than 20 percent were substandard on the basis of indicator counts. Four percent of the samples revealed salmonellae, which are potential human pathogens. Among *Salmonella* isolates were two rare serotypes, *S. eastbourne* from tuna and *S. oranienberg* from seer sample.

Economically viable technology has been worked out by the Calicut Research Centre to produce quick lime from mussel shell, which is going waste at present.

A dismantlable type of mechanical fish drier of one tonne capacity with provision for reheating and recirculation of air was designed, fabricated and installed. Similarly a smoker drier, with body made of angle iron frames covered with asbestos sheet, capable of handling 250 kg of fish per batch was also designed, fabricated and installed.

High density polyethylene, polypropylene and rayon were evaluated for their suitability for use as strapping material in seafood export trade. Polypropylene straps of 12 mm width and 0.5 mm thickness were found to be the best for reinforcement of master cartons.

Flexible pouch packs suitable for pickled mussel meat were developed to replace glass bottles.

Several training and training-cum-demonstration programmes were arranged at the Institute and in fishermen's villages to dissipate the technologies developed by the Institute as well as to train suitable man-power required by the processing establishments.

C. C. PANDURANGA RAO,
DIRECTOR

1.1. ORGANISATIONAL SET-UP

The Institute is headed by the Director with whom all administrative and financial powers regarding research and management of the Institute are vested. He is assisted by a Sr. Administrative Officer, Administrative Officer and Asst. Administrative Officer for dealing with matters relating to general administration, an Accounts Officer and Asst. Accounts Officer for looking after the financial and accounting aspects as also internal audit of the Institute. One Junior Technical Officer attends to the technical matters including those connected with research projects handled by the Institute at its Head-quarters at Cochin and Research Centres at Veraval (Gujarat), Kakinada (Andhra Pradesh), Burla (Orissa), Calicut (Kerala), Bombay (Maharashtra) and Panaji (Goa).

The research work is carried out by the following Research Divisions:

1. Biochemistry and Nutrition
2. Microbiology
3. Processing and Packaging
4. Craft
5. Gear
6. Engineering
7. Electronics and Instrumentation
8. Extension, Information and Statistics

1.2. MANAGEMENT COMMITTEE

The Management Committee of the Institute was reconstituted during the year under report with the following members:

1.	Director, CIFT	..	*Chairman*
2.	Director of Fisheries, Govt. of Kerala, Trivandrum	..	*Member*
3.	Director of Fisheries, Govt. of Tamil Nadu	..	—do—
4.	Director of Research, Kerala Agricultural University, Mannuthy, Trichur	..	—do—
5.	President, All India Fishermen's Federation Limited, Bombay	..	—do—

6. Shri N. M. Shetty,
Chairman & Managing Director,
Ganesh Flour Mills, Delhi .. —do—

7. Dr. P. N. Kaul,
Scientist S-3, CIFT .. —do—

8. Shri P. Vasudeva Prabhu,
Scientist S-3, CIFT .. —do—

9. Shri K. Devadasan,
Scientist S-2, CIFT .. —do—

10. Shri P. D. Antony,
Scientist S-2, CIFT .. —do—

11. Asst. Director General (F),
ICAR, New Delhi .. —do—

12. The Accounts Officer,
CMFRI, Cochin .. —do—

13. The Administrative Officer,
CIFT .. *Member Secretary*

The first meeting of the new Management Committee was held on 13-1-1983 and made some important recommendations.

1.3. STAFF JOINT COUNCIL

The Institute's Joint Council continued to function actively. Two meetings were held during the year at which various matters on service conditions etc. concerning the employees were discussed.

1.4. MONITORING CELL

The Monitoring Cell of the Institute met three times during the year under report and considered the progress made in plan expenditure, procurement of stores, vacancy position, filling up of posts and construction work.

1.5. GRIEVANCE CELL

The two Grievance Cells set up to consider the grievances of (1) officers of Class I Grade and above and (2) all other employees, continued to function during the period. The former was reconstituted with the following as members.

1.	Dr. C. C. Panduranga Rao, Director	..	*Chairman*
2.	Dr. K. Gopakumar, Scientist S-3		*Members nominated by Management Committee*
3.	Shri T. K. Sivadas, Scientist S-2		
4.	Dr. Jose Stephen. Scientist S-1		*Selected representatives of S-1 and S-2 Scientists*
5.	Shri V. Vijayan, Scientist S-1		
6.	Shri K. M. Mathai, Sr. Administrative Officer	..	*Member Secretary*

The first meeting of the above Cell was held during the year under report in which about 10 cases were considered.

1.6. PROJECT ADVISORY COMMITTEE

The Committee met regularly during the year to review the progress on the technical programmes handled on the various Research Projects at Head-quarters and Research Centres. The administrative and technical difficulties posed by the Scientists associated with the projects for executing the programmes were sorted out and recommendations made to stores purchase committee/monitoring cell etc. for follow-up action. The suggestions on the priority areas on research, physical facilities and man power, overlapping of work etc. as pointed out by the Council from time to time were taken into consideration while proposing the research project programmes for ensuing year (1983-84).

1.7. ADMINISTRATION

This Division deals with recruitment, service policy, discipline, staff welfare, land and buildings. procurement of stores, budget expenditure, settlement of claims etc.

The Research Centres continued to function in rented buildings. Addresses of the Research Centres are given as Appendix I. List of staff under Scientific, Technical, Administrative, Auxiliary and supporting categories as on 31-3-1983 is given as Appendix II.

Details of budget provision and actual expenditure are furnished as Appendix III.

1.8. TECHNICAL SECTION

The Section continued to assist the Director in collecting research materials from the different divisions at Headquarters and at Research Centres for preparation of technical notes and reports to be forwarded to the Council.

The Institute's Research Project programmes for the year 1982-83 were compiled, taking into consideration the recommendations of the various high level committees/meetings. Thirty-five projects were envisaged, of which four were new.

A mid-term assessment of all the plan and non-plan projects was made on the advice of the Asst. Director General (F), ICAR, and the difficulties in implementing them identified. The problems being faced by the traditional fishermen and the fishery industry as a whole were also identified. Future programmes are being chalked out on the basis of the informations thus gathered.

A total of 114 scientific/technical papers presented by the Scientists were processed for approval for publication.

1.9. STAFF RESEARCH COUNCIL

The Council met once to review the progress of various research programmes under implementation. Many useful recommendations which emerged from the deliberations were implemented expeditiously.

1.10. FIVE YEARLY ASSESSMENT

During the year, two Scientists in the S-1 Grade appeared before the Assessment Committee. Results are awaited. Six copies each of the 5 yearly assessment proforma/supplementary information proforma in respect of 11 Scientists in the S-1 and S Grades for the period ending 31-12-1979 were sent to ASRB for consideration. The assessment documents in respect of 14 Scientists in the S-3, S-2 and S-1 Grades, becoming eligible for assessment on 31-12-1980 were collected for onward transmission to ASRB.

1.11. QUINQUENNIAL REVIEW TEAM REPORT

For the benefit of the 2nd QRT, a concise report of 56 completed research project programmes of CIFT from 1970-'80 was prepared. A list of the scientific papers/popular articles published from each division at the Headquarters and Research Centres during the period 1970-'80 was also prepared for submission to the review team.

1.12. REGIONAL COMMITTEE

During the period, the 38 major recommendations which emerged from the fifth meeting of the ICAR Regional Committee No. 8 held on 29-30 October 1981 at the Tamil Nadu Agricultural University, Coimbatore were sent to the three Agricultural Universities, Government Departments and Central Institutes in the region for taking follow-up action.

These recommendations were put forth for effective implementation by the above development agencies. A working paper on the review of progress of the on-going programmes was prepared and included in the agenda for the ICAR Regional Committee No. 8 meeting held on 28 January '83 at IIHR, Bangalore.

1.13. LIBRARY

During the year, 1981 books and 200 bound volumes of journals were added to the collection at the Institute's library, bringing the total to 4963 books and 2225 bound volumes of journals.

One hundred and seventy five Indian and foreign journals were subscribed to during the year and 50 others received on gratis/exchange basis.

Indexing of current literature, compilation of bibliography on fishery technology, photo-copying service, ready reference service etc. were continued. In addition to the staff of the Institute, visitors, including students and research scholars from Universities, educational and research institutions and technical personnel from the fishing and fish processing industries made use of the facilities of the library. Inter-library loan facilities were maintained in collaboration with other Institutes.

1.14. COMMITTEES REPRESENTED BY THE INSTITUTE

Director served on the following Scientific and allied bodies:

1. *Member* .. Scientific Panel for Fisheries Research, ICAR
2. *Member* .. Board of Directors, Kerala Fisheries Corporation
3. *Member* .. Management Committee, Krishi Vigyan Kendra, CMFRI, Narakkal
4. *Member* .. Management Committee, Operational Research Project of CMFRI, Kovalam (Tamil Nadu).
5. *Member* .. Board of Studies in Marine Sciences, University of Cochin

6. *Member* .. Board of Studies, Kerala Agricultural University

7. *Member* .. Committee on Mechanisation of Boats in the Country

8. *Member* .. Integrated Fisheries Project. Consultative Committee

9. *Member* .. Committee on Utilisation of Trash Fish in Andhra Pradesh, constituted by Dept., of Agriculture, Govt. of India

10. *Member* .. Task Force of the State Dept., of Science and Technology, Kerala State

11. *Chairman* .. Fish and Fish Products Sectional Committee AFDC-27 of Indian Standards Institution

12. *Chairman* .. Committee on Aquaculture Engineering Research and Training

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

1. *Shri M. R. Nair,* Scientist S-3 as:-

   a) Alternate Member: ISI, AFDC-27, Fish and Fishery Products Sub-Committee

   b) Member: ISI, AFDC-27:2, Frozen Fish Products Sub-Committee

   c) Member: ISI, AFDC-36:9, Metallic Contaminants Sub-Committee

   d) Member: Panel of Experts for hearing appeals against rejection of canned prawns, Export Inspection Agency, Cochin

   e) Member: Panel of Experts for approval of processing Units as required under the Export of frozen froglegs (Quality Control & Inspection Rules, 1979).

   f) Member: Board of Studies, M.Sc., Mariculture (University of Cochin)

2. *Shri R. Balasubramanyan,* Scientist S-3. as:-

   a) Alternate Member: ISI, MCPD-2, Indian Harbour Craft and Fishing Vessels Sectional Committee

   b) Member: Marine Corrosion Sub-Committee of the CSIR

c) Member: Consultative Committee for FRP Technology of the National Council of Science and Technology

d) Member: ISI, MCPD-21, Fishing Vessels Sectional Committee

e) Member: Expert Committee for the Acquisition of Trawlers for the Tamil Nadu Fisheries Development Corporation Limited, Madras

f) Member: Co-ordinating Committee of MPEDA, Cochin, to promote shark fishing

g) Member: Co-ordinating Committee of MPEDA, Cochin, to promote lobster fishing

3. *Dr. K. Gopakumar,* Scientist S-3, as:-

a) Alternate Member: ISI, AFDC-27:5, Fish Meal Sub-Committee

b) Member: ISI Sub-Committee CDC 56:4 on Common Salt and Marine Chemicals

c) Panel Member: Committee for Administering Modified In-process Quality Control for Fish and Fishery Products, Export Inspection Agency, Cochin

4. *Shri T. K. Govindan,* Scientist S-3, as:-

a) Member: Sub-Committee to Examine Amendments and Instructions for Fish and Fishery Products, Export Inspection Agency, Cochin

5. *Shri T. S. Gopalakrishna Iyer,* Scientist S-3, as:-

a) Member: State Level Committee for the Co-ordination of Work on Marine Fisheries, Maharashtra

b) Member: Central Advisory Committee of the Exploratory Fisheries Project

c) Member: IPQC (Froglegs) Panel of Experts

6. *Shri K. K. Solanki,* Scientist S-2, as:-

a) Member: ISI, AFDC-27, Fish and Fishery Products Sub-Committee

7. *Shri K. K. Balachandran,* Scientist S-2, as:-

a) Member: ISI, AFDC-27:1, Canned Fish Products Sub-Committee

8. *Dr. K. Ravindran,* Scientist S-2, as:-

   a) Member: Marine Cargo Movement and Packaging Division Council (MCPDC)

   b) Member: Standing Working Committee on Marine and Cargo Movement (SWCMC)

   c) Subject Expert: Doctoral Committee, University of Cochin

9. *Shri H. Krishna Iyer,* Scientist S-2, as:-

   a) Member: Committee for setting up a computer at MPEDA

10. *Shri P. V. Prabhu,* Scientist S-2, as:-

   a) Principal Member: ISI, AFDC-27:5, Fish Meal Sub-Committee

   b) Alternate Member: ISI, AFDC-27:2, Frozen Fish Products Sub-Committee

11. *Shri V. C. George/Shri K. A. Sadanandan,* Scientist S-2, as:-

   a) Member Secretary: Working Group to device ways and means of exploiting fishery resources of inland waters

   b) Member: Co-ordination Committee, Federation Fishermen Co-operative Society, Hirakud Reservoir, Sambalpur

   c) Institute Representative: All India Co-ordinated Project of CIFRI on the Ecology and Fisheries of Fresh Water Reservoirs

12. *Shri P. Appukutta Panicker,* Scientist S-2, as:-

   a) Member: Consultative Committee of Exploratory Fisheries Project for Cochin, Tuticorin and Vizhinjam

13. *Shri S. Ayyappan Pillai,* Scientist S-2, as:-

   a) Member: ISI, MCPD-3:7, Sub-Committee on Machinery for Dredgers, Tugs, Trawlers, Hoppers, Barges and Mechanised Fishing Boats

   b) Member: National Committee of the International Institute of Refrigeration

   c) Member: Kerala State Committee for the Evaluation of the Scheme of Mechanisation of Country Crafts

   d) Executive Committee Member: Indian Cryogenic Council, South Zone

14. *Shri K. Sreedharan Namboodiri,* Scientist S-2, as:-

a) Member: ISI, MCPD-21:2, Sub-Committee on Mechanised Fishing Boats

15. *Shri G. Narayanappa,* Scientist S-2, as:-

a) Member: Consultation Group for EFP Bases

16. *Shri S. Gopalan Nayar.* Jr. Fishery Scientist, as:-

a) Principal Member: ISI, TDC-42, Textile Materials for Fishing Net Purposes, Sectional Committee

17. *Shri T. S. Unnikrishnan Nair,* Scientist S-1, as:-

a) Alternate Member: ISI, AFDC-27:3, Dried Fish Products Sub-Committee

18. *Shri D. Imam Khasim Saheb,* Scientist S-1, as:-

a) Member: Panel of Experts under IPQC/MIPQC Scheme of EIA

19. *Shri A. P. Valsan,* Jr. Scientist, as:-

a) Principal Member and Convener: ISI, AFDC-27:3, Dried Fish Products Sub-Committee

20. *Smt. K. Radhalekshmy,* Asst. Fishery Scientist, as:-

a) Alternate Member: ISI, TDC-42, Textile Materials for Fishing Net Purposes, Sectional Committee

1.15. SYMPOSIA/SEMINARS/MEETINGS/ WORKSHOPS ETC. ATTENDED

Dr. K. Ravindran, Scientist S-2, attended the meeting of the Standing Working Committee of Marine Cargo Movement and Packaging Division Council in Madras in March 1982.

Shri A. P. Valsan, Technical Officer & Shri T. K. Srinivasa Gopal, Scientist S-1 attended Seminar on Packaging and Packing of Marine Products organised by Marine Products Export Development Authority and Indian Institute of Packaging, Bombay on 22 May, 1982.

Shri P. Ravindranathan, Librarian & Smt. Mary Thomas, Scientist S-1 attended the Seminar on Role of Information Service in Rural Development organised by Kerala Library Association at Cochin on 29th May, 1982. One paper was presented at the Seminar.

Dr. C. C. Panduranga Rao, Director, attended Seminar on Development and Environment organised by University of Cochin, Ernakulam on 5th June, 1982.

Shri R. Balasubramanyan, Scientist S-3, attended first meeting of Expert Committee for Aquisition of Trawlers for Tamil Nadu Fisheries Development Corporation at Madras on 19th June, 1982.

Dr. C. C. Panduranga Rao, Director and Shri A. K. Chattopadhyay, Scientist S-1, attended the All India Small and Medium Scale Seafood Exporters' Convention sponsored by the Marine Products Export Development Authority and Seafood Exporters' Association of Orissa at Bhubaneswar on 30th June and 1st July 1982.

Shri D. Imam Khasim Saheb, Scientist S-1 participated in the National Seminar on Status and Impact of Heavy Metal Pollution in India, organised by Centre of Environmental Studies, College of Engineering, Anna University, Guindy, Madras.

Shri P. Madhavan, Scientist S-2, attended the Second International Conference on Chitin and Chitosan, organised by the Japanese Society of Chitin and Chitosan at Sapporo, Japan, from July 12-14, 1982. A paper was also presented at the Conference.

Dr. C. C. Panduranga Rao, Director and Shri P. Appukutta Panicker, Scientist S-2, attended the Seminar on Economic Analysis of the Purse Seining Industry organised by the University of Agricultural Sciences at Mangalore on 27th & 28th July, 1982.

Shri K. Krishna Rao, Scientist S-2, participated in the Sixth Conference of Agricultural Research Statisticians organised at New Delhi by the Indian Agricultural Statistics Research Institute from 6 to 8 October, 1982. One paper was also presented at the Conference.

S/Shri K. Krishna Rao & H. Krishna Iyer, Scientists S-2, attended the Workshop on Acquisition and Dissemination of Data on Marine Living Resources of Indian Seas organised by the Central Marine Fisheries Research Institute at Cochin during 21 to 23 October, 1982.

Shri T. S. Gopalakrishna Iyer, Scientist S-3 and Shri M. Arul James, Scientist S-2, attended the National Seminar on Salmonella Infections in India organised by the Central Research Institute at Kasauli, Himachal Pradesh on 22 and 23 October 1982. Two technical papers were also presented at the Seminar.

Shri R. Balasubramanyan, Scientist S-3 and Shri T. K. Sivadas, Scientist S-2 attended the Seminar on Fisheries Education and Research organised by the Fisheries Faculty of Kerala Agricultural University at Cochin on 13 November 1982 and presented two papers.

Shri P. A. Perigreen, Scientist S-2, attended the Seminar on Seafood Processing Industries in Karnataka organised by Small Industries Service Institute at Mangalore on 9th December, 1982.

Shri R. Balasubramanyan, Scientist S-3, organised and attended the 8th meeting of the Fishing Vessels Sectional Committee of ISI : MCPD 21 at Cochin on 7th February, 1983.

Dr. K. Ravindran, Scientist S-2, and Shri A. G. G. K. Pillai, Scientist S-1 attended the Central Electro-Chemical Research Institute (CECRI)-Industry Get-Together at Cochin in February 1983 and presented a paper.

In addition to the above, almost all the Scientists of this Institute participated in the Symposium on Harvest and Post-Harvest Technology of Fish organised by the Society of Fisheries Technologists (India) at Cochin from 24-27 November 1982. Of the 162 technical papers presented 86 were contributed by the staff of this Institute. The papers were presented in ten technical sessions at the Symposium which were attended by officials representing 46 Institutions.

1.16. FELLOWSHIP/TRAINING/DEPUTATION

Shri S. Ayyappan Pillai, Scientist S-2, attended a Computer programming course (BASIC Language) for 3 months from January-March 1983 conducted by M/s Cochin Computer Systems (P) Ltd., Cochin.

1.17. AWARD/DEGREE

The University of Cochin awarded the degree of Master of Technology in Faculty of Engineering to the following Scientists.

Shri S. Ayyappan Pillai, Scientist S-2, M.Tech. (Electrical) — Industrial Electronics.

Shri P. K. Chakraborty, Scientist S-2, M.Tech. (Chemical) — Project Engineering.

Shri P. N. Joshi, Scientist S-1, M.Tech. (Mechanical) — Engineering Design.

An open-house discussion between members of fishermen community and CIFT Scientists

cift

Completes 25 Years

Visitors in the exhibition pavilion

A scene from a malayalam skit propagating the improved method of handling and transportation of fish developed by CIFT.

Shri S. M. S. Abuthahir Ali, Scientist S-1, M.Tech. (Chemical) — Project Engineering.

The University of Cochin awarded Ph.D. degree in the faculty of Marine Sciences to Shri P. T. Lakshmanan for his thesis entitled 'Investigations on the Chemical Constituents and Trace Metal Indicators in Some Bivalve Molluscs of the Cochin Backwaters.' He conducted his research under the guidance of Dr. P. N. Krishnan Nambisan, Prof. of Marine Chemistry, Dept. of Marine Sciences, University of Cochin.

The University of Kerala awarded Ph.D. degree in Biochemistry to Shri P. G. Viswanathan Nair, Scientist S-2, for his thesis entitled 'Studies on the Lipid Composition of Marine, Freshwater and Shell Fishes.' He conducted his research under the guidance of Dr. K. Gopakumar, Scientist-in-Charge, Processing and Packaging Division.

1.18. SILVER JUBILEE CELEBRATIONS OF CIFT

The Institute completed 25 years of its fruitful research during the year 1982. The Jubilee celebrations were held from 15-18 December 1982 at the Institute's premises. An exhibition depicting the Institute's quarter century research and development activities especially modern fishing methods and fish processing techniques as well as film shows were held on all the four days. At a special function organised on 18 December, Dr. K. Gopalan, Vice Chancellor, University of Cochin, who was the Chief Guest, released a Souvenir entitled '25 years of CIFT.' Shri K. Parameswaran, Managing Director, Kerala Fishermen Welfare Corporation presided over the function. The programmes of the concluding day were especially meant for members of the fishermen community who availed this opportunity to discuss and exchange with the Scientists of this Institute, ideas and problems relating to fishing and fish processing. The celebrations came to an end with a cultural programme in which members of the fishermen community also took part.

1 19. CONSULTANCY SERVICE

Consultancy service was undertaken by the Institute in setting up a fish drying plant at Agartala at the request of the Govt. of Tripura. A complete project report on the same was also prepared.

Technical assistance was also rendered in organising shark fishing off the coast of Kerala at the request of the Deputy Director of Fisheries, Cannanore. A pilot scheme for shark fishing using hook and line from 30-32 ft. small mechanised boats was also drawn up.

1.20. VISITORS

Foreign and Indian dignitaries, students from educational institutions and others visited the Institute during the year. These include:-

1. His Excellency, Hammer De Roburt, O.B.E. President, Republic of Nauru.
2. Mr. Chen Sei-Poh. FAO Rome and Mr. Sharipah Nor Hidayat, Food Tech. Division, Mardi, Malaysia.
3. Mr. Samrit Cheijychun and Mr. Sinthao Cruafa. Thai nationals. Members of Study Tour on Food Sanitation with WHO Fellowship.
4. Mr. Gileng Kambar, Dept. of Commerce & Industry, Papua, New Guinea.
5. Mr. O. G. B. de Silva & Mr. K. K. L. Pijasera from Srilanka.
6. Mr. Hassan Mustafa, Ministry of Industry, Jordan.
7. Mr. W. Nelson, Management Development & Productivity Institute, Ghana.
8. Mr. Ahmad El Khatib, Ministry of Agriculture, Damascus, Syria.
9. Mr. Sarj. B. Bayang, Indigenous Business Advisory Services, Ghambia, W. Africa.
10. Mr. T. Tonnessen, Mr. U. Martens and Mr. Figdis Fain, Norad, Oslo.
11. Mr. Md. Liaquat Ali, Project Director. Fisheries Resources Survey, Directorate of Fisheries, Bangladesh.
12. FAO Study Team of 8 members to investigate possibilities of processing Anchoviella into fish products like fish sauce and boiled, dried Anchovy for export to S. East Asian markets.
13. Dr. D. P. Sen, Member, Quinquennial Review Team, Burla Research Centre.
14. Hon. Union Agriculture Minister, Mr. Rao Birendra Singh, Veraval Research Centre.
15. Official Language Implementation Committee of 8 Members of Parliament - Veraval Research Centre.

This Institute was also honoured by the visit of the President of India, Shri Giani Zail Singh, accompanied by his daughter, Dr. (Mrs.) Manjit Kaur on 13th September 1982.

THE PRESIDENT

The President in the Exhibition Pavilion specially arranged on the occasion of his visit

A set of CIFT publications is handed over to the President

VISITS *cift*

2. SCIENTIFIC TALKS

During the year under report, it was decided to hold 'Scientific talks' on important topics of direct relevance to the research activities of the Institute, on those topics on which work is already going on at the Institute and on topics on which work is not at present being done but is required to be taken up in view of their importance. Dr. K. Ravindran, Scientist S-2, was nominated as Convener to formulate the programmes both at the Headquarters and at the Research Centres. A list of the talks delivered during the year is given below.

Date	*Name of speaker*	*Topic*
7-6-'82	Dr. P. N. Kaul, Scientist S-3	Audio-visual in Research and Training.
7-8-'82	Shri Jose Joseph, Scientist S-1	NORAD Course in Fishery and Fish Technology.
7-9-'82	Shri P. Madhavan, Scientist S-2	Resume of Proceedings on "2nd International Conference on Chitin and Chitosan" held in July '82 at Sapporo, Japan.
23-12-'82	Shri T.K. Sivadas, Scientist S-2	Marine Electronics and Instrumentation in Fisheries.
13-1-'83	Dr. K. P. Buch Principal Scientific Officer, Naval, Chemical and Metallurgical Laboratories, Bombay.	Corrosion Control in Naval Ships

3. PROGRESS OF RESEARCH

3.1 CRAFT MATERIALS

CHIEF FINDINGS

More boat building yards in the private sector are now adopting FRP (Fibreglass reinforced plastics) technology for the construction of small fishing crafts.

Ferrocement technology as available at present has not shown encouraging trends for the development of small fishing crafts as alternatives for the wooden traditional canoes.

Marine quality aluminium alloys designated as M 57 A and D 54 S conforming to IS 52000 and IS 54300 respectively,

currently in production in India, have been identified as suitable construction materials for marine crafts.

Galvanic corrosion has been identified as a serious malady in fishing trawlers for which suitable remedial measures have been worked out through the installation of external anodes.

The design of a tilting furnace for casting ternary aluminium alloys in an inert atmosphere was finalised.

In the course of development of mercury free ternary aluminium alloys for the cathodic protection of fishing boats and marine structures, compositions of five alloys have been arrived at for evaluation of their electrochemical efficiencies.

Vial tests were conducted on toxic wood Polymer composites (TWPC) by incorporation of higher levels ($>0.5\%$) of tributyl tin oxide (TBTO) and creosote in styrene monomer system. Studies upto 5% loading of the toxic chemicals with respect to monomer showed no inhibition of polymerisation under gammaradiation. A higher loading with toxic chemicals enhances the biodeterioration of TWPC which is of great importance in marine service.

A novel combination of styrene monomer and polyester was used as an impregnant for enhancing the mechanical strength and decreasing the water permeability of ferrocement composites. Polymer impregnated ferrocement was evaluated for mechanical properties like tension, compression and flexure and in general an enhancement in mechanical strength of over 25% was achieved by the treatment.

Copper creosote was found to be an effective wood preservative for fishing boats.

RESEARCH IN HAND

Boat Building Materials

i) *Fibreglass Reinforced Plastics*

Based on the technology developed at this Institute, a large number of private boat building yards started constructing FRP boats and several types of light fishing crafts were put into operation. Development of a 7.5 m OAL FRL gill netter and 9 m OAL canoe deserves special mention.

ii) *Ferrocement*

Adoption of ferrocement technology for the construction of smaller fishing crafts especially as alternatives to the traditional wooden canoes has not been encouraging. Further studies are being carried out.

Theoretical studies on mix ratio, reinforcement factor and polymer loading were made for enhancement of strength of plain ferrocement (PFC) and that containing fly ash (FFC). Based on these, PFC and FFC slabs were fabricated and tested for tension, flexure and compression. PFC slabs were further treated with a novel combination of styrene polyester resin mix under a nitrogen pressure of 7 Kg/cm^2 after evacuation. The specimens were subsequently heat-polymerised and comparative evaluation of FFC, PFC and polymer incorporated ferrocement (PIFC) made with regard to tension, compression and flexure. Over 25% enhancement in mechanical strength was observed as a result of polymer impregnation.

iii) *Marine Plywood*

Though marine plywood laminated with phenol-formaldehyde glue can be used for construction of lighter fishing crafts, its continuous and prolonged immersion in sea-water result in onslaught by marine organisms. The exposed surfaces have therefore to be rendered adequately toxic.

iv) Rotting of wood due to fungal infection is a serious problem encountered in wooden structures above water-line. Suitable remedial measures like continuous application of toxic wood preservatives as recommended by this Institute are essential to increase the service life of such boats.

Wood Preservatives.

Work on the development of newer wood preservatives for traditional crafts, demonstration of their efficacy and monitoring of the overall cost benefits were continued in Chellanam village in Ernakulam District and extended further to the village of Puthuvaippu.

Marine Corrosion

Cathodic protection using galvanic anodes is quite efficient for fishing boats and marine metallic structures. Studies were initiated to develop high efficiency, high current output, ternary aluminium alloys free from mercury for this purpose. Design of an inert atmosphere tilting furnace for casting the alloy was completed. The metallurgical compatibility of the alloy constituents was studied as also the electro-chemical characteristics of high purity zinc, tin and aluminium and the influence of traces of impurities on them.

The technique of addition of low melting zinc and tin in small quantities to molten aluminium having been accomplished, five alloys of aluminium-zinc-tin of different compositions were arrived at and cast under inert atmosphere for use as galvanic anodes. The electrode potential referred to as saturated calomel electrodes was within the acceptable limit in all the five alloys. The stability of potential was also quite satisfactory. The electro-chemical efficiency of the anodes is under evaluation.

Wood Polymer Composites

In continuation of the studies on the efficiency of toxic wood polymer composites (TWPC), a few vial tests were conducted in collaboration with M/s Western India Plywood Ltd., Baliapatanam, on incorporation of toxic chemicals at levels above 0.5%. Logs of balsa wood (*Ochroma lagopus*) were seasoned for conversion into TWPC containing 5% of TBTO and 5% creosote in two series for further tests.

RESEARCH CONTEMPLATED

1. Further studies on alternative building materials, methods of construction and maintenance of fishing crafts
2. Further studies on the development of high current output aluminium alloy anodes, free from mercury, for cathodic protection of fishing boat and marine structures
3. Studies on the enhancement of mechanical strength and bio-resistance of wood through conversion to TWPC
4. Studies on polymer impregnated ferrocement composites for marine applications
5. Studies on chemical wood preservatives for traditional crafts

SCIENTISTS ASSOCIATED

COCHIN: R. Balasubramanyan, Dr. K. Ravindran, N. Unnikrishnan Nair, A. G. Gopalakrishna Pillai, K. Sreedharan Namboodiri, P. N. Joshi

3.2 GEAR: MARINE

3.2.1 TRAWLS (A) EVOLUTION OF SUITABLE GEAR FOR INSHORE FISHING

CHIEF FINDINGS

Field trials carried out to study the effect of larger meshes in the bosom area of a 10.3 *m. unequal panel midwater trawl re-*

vealed the efficiency of the larger mesh net in landing quality fishes. Studies on the optimum bridle length for the 10.3 *m. unequal panel trawl were completed. Of the three lengths tried, viz.,* 30 *M,* 40 *M and* 50 *M, the last one was found to be most effective. In the case of a* 15 *m. bulged belly trawl, significantly higher catches* ($P < 0.05$) *were obtained with a* 20 *m long bridle compared to* 10 *m and* 30 *m long bridles.*

Studies with 13.6 *m vertical double trawls were completed. The catch rate compared favourably with that of bulged belly trawl. The lower net landed bottom fishes and the upper one off-bottom fishes like ribbon fish and silver bellies.*

Twin trawling with two 10 *m nets operated simultaneously with a pair of otter boards of size* 1.15 *m* x 0.63 *m and a* 0.8 x 0.4 *m sled showed the gear to be effective in landing bottom fishes.*

Further studies with the high opening and bulged belly trawls have confirmed the superiority of the former over the latter. Off-bottom fishes like Trichiurus, *silver bellies etc formed* 40% *of the catch of the high opening trawl indicating its better vertical spread. Trawls fitted with sail kites were found to be significantly more effective in catch of column fishes compared to those without sail kites.*

RESEARCH IN HAND

Studies were continued at Kakinada with the 11 m unequal panel mid-water trawl to study the feasibility of this gear for trawling in that area and to assess the resource potentialities. Fishing trials were made employing Suber-Krub type of otter boards. The catch consisted of seer, ribbon fish and other off-bottom fishes. Further studies are in progress.

Besides escapement of fishes, mesh size also affects the resistance of the gear. With a view to studying the effects of various mesh sizes and improving the efficiency of the gear, investigations were undertaken to evolve suitable mesh size for different parts of a trawl. Bulged belly trawls with different mesh sizes were operated along with a standard trawl. During 20 days of fishing, the catch rate per hour for the big mesh, control and small mesh trawls worked out to 18.68 kg, 16.24 kg and 13.01 kg respectively. Further studies are in progress.

In order to study the effectiveness of sail kites in achieving further vertical spreads in trawl nets, comparative fishing trials were carried out at Veraval with 25 m high opening and 32 m large mesh demersal trawls, with and without attaching sail kites. In both cases, the attachment of sail

kites proved to be highly effective, especially for column fishes like ribbon fish eel, *Lactarius* etc. as shown below. Substantial differences were also observed in the total catches of the nets with and without sail kite.

	25 *m high opening trawl*		32 *m large mesh demersal trawl*	
	With sail Kite	Without sail Kite	With sail Kite	Without sail Kite
Total catch (Kg)	71.6	43.32	38.52	28.69
Ribbon fish	56.47	27.62	1.69	1.44
Eel	5.2	3.23	0.22	0.183
Lactarius	—	—	6.04	3.13
No. of fishing operations	23		16	
Trawling hours (as on 10-2-83)	34 hrs 30 mts		24 hrs	

A few trials were also undertaken with the 21 m four equal panel mid-water trawl which was operated as a two boat mid-water net. Studies are being continued.

At Goa, two separator panels, of 6.0 cm and 5.0 cm mesh size were designed, fabricated and fitted in two tested designs of 15 m bulged belly trawl. A pair of cod-ends was also fitted in each net for collection of the fish and prawn after separation in the after belly. Field trials with the experimental nets are underway.

Design and fabrication were undertaken at Cochin of a 32 m. high opening two seam shrimp trawl, a 32 m. long wing four seam trawl, a 32 m high opening large mesh 2 seam demersal trawl and a 32 m four panel trawl. Comparative fishing trials with these nets are being undertaken.

Research Contemplated

1. Instrumentation studies for improving trawl gear
2. Studies on bottom currents and their effect on trawl gear performance and catch
3. Deep water trawling off Veraval between 50-70 m depth

Scientists Associated

COCHIN: K. N. Kartha, P. George Mathai, T. P. George, Dr. M. D. Varghese, A. C. Kuttappan.

VERAVAL: K. K. Kunjipalu, N. Subramonia Pillai, M. R. Boopendranath.

KAKINADA: G. Narayanappa, A. V. V. Satyanarayana, S. V. S. Ramarao, R. Mangayya Naidu, J. Sitaramarao.

GOA: H. N. Mhalathkar, T. Joseph Mathai, V. Vijayan, M. Syed Abbas.

TRAWLS (B) : DEVELOPMENT OF GEAR FOR OFFSHORE FISHING

RESEARCH IN HAND

A 12. 5 m. mid-water trawl was operated in combination with oval oval boards. The catch consisted mainly of silver bellies, pomfrets and anchovies. Yield per hour worked out to 117.75 kg.

RESEARCH CONTEMPLATED

1. Survey of the trawl gear of larger vessels
2. Fabrication of midwater trawls and vertical curved boards and comparative efficiency studies with these gears
3. Model testing of gear and accessories

SCIENTISTS ASSOCIATED

COCHIN: V. C. George, K. A. Sadanandan, P. Appukutta Panicker, K. N. Kartha, P. George Mathai, T. P. George, K. V. Mohan Rajan, Dr. M. D. Varghese. N. A. George, T. M. Sivan, A. C. Kuttappan

3.2.2 IMPROVEMENTS TO THE TRADITIONAL CRAFT, GEAR AND METHODS

COCHIN CENTRE

Craft Development

Studies so far conducted on boat building materials brought to light the possibilities of replacing Aini Wood (*Artocarpus hirsuta*) with preservative treated Mango (*Mangifera indica*) and Haldu (*Adina cardifolia*) woods for the construction of 'Thanguvallams' with built-up planks stitched together with treated coir ropes.

In addition to the wood preservatives already developed and tried in the field viz, arsenical creosote, a new preservative, copper-creosote in combination with natural resin was developed and put to field trials. Pre-

paration of the preservatives and the techniques of their application on the existing crafts were demonstrated to the local fishermen.

Ferrocement was not found to be ideal for the construction of canoes; but FRP, in spite of its initial high cost, gave encouraging results and was found to be more suitable for lighter crafts for operation both with motor and sail.

Motorization

Light, air cooled inboard diesel engines were found to be economical if installed in large sized 'thanguvallams.'

A number of alternatives are now available for motorizing the existing canoes where fishing gear and methods are selective and remunerative.

A combination of engine power and sail power is being recommended to the fishermen as a measure of fuel conservation.

Gear development

'Thanguvala' operations from motorized canoes continued to be more productive.

Experimental fishing with the mini purse-seine designed and developed by CIFT and operated from two motorized canoes showed that the age old artisanal fishing can be improved by resorting to this method. The net can be operated by a group of 20 fishermen and has maximum capacity of nearly 5 tonnes per operation. Catch comprised mainly of shoaling fishes like mackerel, sardines and the like.

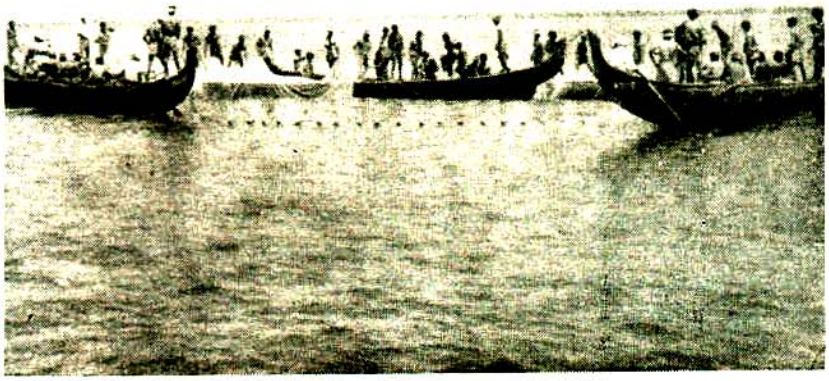
CIFT standard lobster traps continued to maintain their popularity in the field with more fishermen coming forward to adopt this new technology. Maritime States like Karnataka, Goa, Gujarat, Maharashtra and Orissa have evinced keen interest in its introduction in their States.

Different types of baits for attraction of lobsters into the trap were tried in the field and their comparative merits evaluated. Brick soaked in diesel oil was found to be very effective in luring the lobsters to the trap.

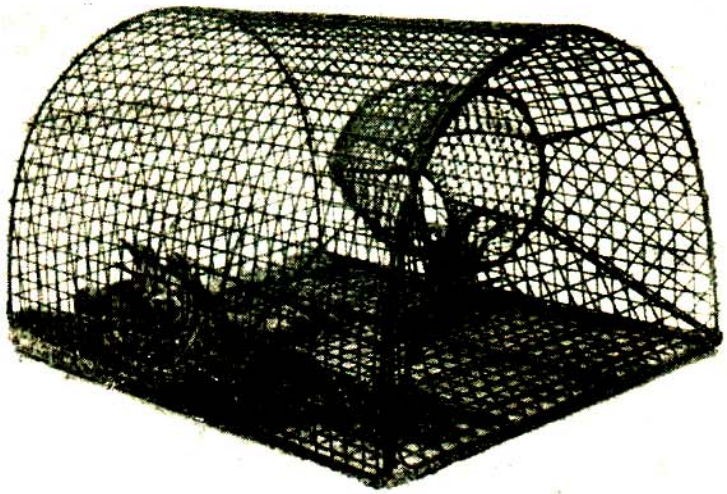
A battery of lobster traps was operated from mechanised fishing crafts covering comparatively deeper waters and the data are being analysed in detail for drawing up conclusions.

KAKINADA CENTRE

Intensive field trials were conducted with a newly designed bag net and the results compared with those from existing traditional nets. While



Mini-purse-seine in operation from traditional crafts



Standard lobster trap developed by CIFT

the latter landed mostly juveniles of prawns, catfishes and crabs, the former caught quality fishes. Further observations are being continued.

Multi-meshed gill nets of 30, 40 and 50 mm mesh size newly introduced in the field and operated from a 'Nava' (local traditional craft) gave encouraging results. The studies are being continued.

VERAVAL CENTRE

With the technical guidelines provided by this Institute, a private boat building yard developed an FRP canoe of 31'-6" suitable for operation with light out-board motor and sail power along with facilities for manual operation, if needed. This new craft is light and long lasting and more suitable for passive fishing gear and methods.

Out of a number of colours incorporated in the gill net webbings, yellow colour consistently showed encouraging results and more fishermen are slowly adapting to this new technology. Yellow coloured gill nets fabricated out of Nylon 210 D/2/3 with 60 mm mesh bar were found to be good for Hilsa fish while white nets of the same specification were good for pomfrets.

Studies were also initiated to evolve cheaper materials for fabrication of gill net webbings like monofilaments of nylon and polethylene and twisted polyethylene as suitable substitutes for the presently used costly nylon multifilaments.

GOA CENTRE

The encircling gill net designed and developed for the capture of mackerels has yet to undergo more field trials. Initial operations showed that nets with 5.0 cm and 5.5 cm mesh size are effective in catching mackerels in the size group 18-22 cm. The data obtained so far are being critically reviewed. A multi-mesh gill net is also being designed.

A field survey of the estuarine locations of this Centre indicated good scope for the introduction of 'chinese dip nets' of the type used in the Cochin backwaters. An experimental unit is proposed to be installed and tried in a selected area during the coming year.

A beach landing aid has been designed to facilitate easy hauling up of the canoes on the shore, which is presently being done with great effort using rough wooden rollers.

Future Programme of Work

From the results so far obtained from each Centre, acceptable technologies will be transferred to the end users with the co-operation of the

local fishermen and the concerned State Fisheries organisations. Other researches contemplated are introduction of chinese dip nets in Goa, and studies on efficiency of different sizes of sails as supplementary devices for powering crafts. Studies are also proposed on lobster fishing in Saurashtra coast.

SCIENTISTS ASSOCIATED

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KAKINADA:	G. Narayanappa, J. Sitarama Rao, S. V. S. Rama Rao, R. M. Naidu, A. V. V. Satyanarayana
VERAVAL:	N. Subramonia Pillai, K. K. Kunjipalu, M. R. Boopendranath
GOA:	T. Joseph Mathai, V. Vijayan, M. Syed Abbas

3.2.3. GEAR MATERIALS

RESEARCH IN HAND

Gill nets fabricated out of 1000 x 2 x 3 HDPE, fibrillated tape twines and nylon 210/1/3 twines were operated along with local ones with a view to studying their comparative efficiencies. A numerical increase in catch in the case of HDPE tape twines was observed. Further work is in progress.

Studies on the efficiency of polypropylene multifilament yarns and twines as a fishing gear material were continued. The denier size of polypropylene (PC) multifilament twine was reduced from 210 to 190. It was observed that the diameter and wet knot strength of the lower denier PP multifilament and 210 denier nylon were comparable indicating the possibility of replacing the latter by the former on equal code number basis.

Synthetic netting materials like PA and PP multifilament twines of less than 1 mm dia continued to be subjected to exposure to U.V. light, out-door environment, and sea water followed by U.V. rays with a view to working out standard test procedures. The data are being analysed.

RESEARCH CONTEMPLATED

The above work will be continued.

SCIENTISTS ASSOCIATED

COCHIN: S. Gopalan Nayar, K. Radhalekshmy, Dr. K. Ravindran, B. Meena Kumari

3.3. GEAR: INLAND

CHIEF FINDINGS

Frame nets fabricated out of nylon 210/2/3, *d/a (diameter/ mesh bar) value* 0.0055 *and mesh bar* 105 *mm were found suitable for exploitation of* Catla catla *in the Hirakud reservoir.*

Comparative studies on bottom trawling in the reservoir with a 12 *m high opening trawl and a* 13 *m bulged belly trawl showed the former to be far superior to the latter. The catches per hour recorded for both the nets were* 56.2 *kg and* 39.8 *kg respectively. This net can therefore be recommended for exploitation of the bottom dwelling uneconomical fishes of the reservoir.*

Of the different sizes of hooks and types of bait tried for set long lines and drop lines, hook size 20 *with earthworm and prawn as baits was found most effective for capture of predatory fishes.*

Studies on the intensities of occurrence of fishes like G. chapra, R. cotio, E. vacha *and* S. silondia *in the reservoir confirmed the earlier findings that the fishes are dominant during* 00.00-06.00 *hours. The nets used for the study were small meshed nets with* 25 *mm mesh bar.*

RESEARCH IN HAND

Biological and limnological studies of the Hirakud reservoir were initiated as an anciallary to fishing gear investigations. As the first step, data are being collected on dissolved oxygen, pH, conductivity, nutrients, intensity of plankton and dissolved organic matter.

Studies on midwater trawling in the reservoir have been initiated.

RESEARCH CONTEMPLATED

1. Development of suitable fishing gear and methods for reservoirs other than the one at Hirakud
2. Studies on attraction of fishes by different coloured lights
3. Determination of parameters for electrical fishing and development of suitable electric fishing devices

SCIENTISTS ASSOCIATED

BURLA: V. C. George, K. A. Sadanandan, A. A. Khan, R. A. Manoharadoss, M. D. Varghese, Percy Dawson, S. K. Bhattacharyya

3.4. DEHYDRATION AND SMOKING

CHIEF FINDINGS

A method has been developed for treating commercially dry-cured fish affected with fungus and red halophiles to yield good, organoleptically acceptable products.

The efficiency of betel leaf extract as an anti-oxidant in the curing of fatty fish has been successfully demonstrated. The treated samples can be stored upto a period of five months. Bacteriological studies showed that appreciable reduction in the standard plate count is attained on treating the samples with the extract. On storage also, the count remained at a low level.

Calcium propionate, indigenously available, was found to be a suitable substitute for the imported sodium propionate in preservation of cured fish products.

Studies on the quality of commercially dried non-penaeid prawns in Bombay markets were completed. Wide variations in the quality of the dried product are attributable to the defects in method of catch, subsequent handling and drying. In the existing method of preparation of dried non-penaeid prawns, catches from hauls taken at intervals of six hours based on tide are pooled together and brought to shore once a day without icing. The material which is at different levels of deterioration is dried on the beaches under unhygienic conditions. The final product therefore shows vast quality variations and mostly is of poor quality. Studies carried out by collecting samples from different hauls separately and analysing them revealed that samples of the first three hauls were at different stages of spoilage and only those of the fourth haul were of satisfactory quality. The dried product prepared from samples of the first three hauls is therefore of inferior quality. The main drawbacks observed in the production of sun-dried non-penaeid prawns are thus the inordinate time lag between catching and drying, careless and unhygienic handling, transportation, drying and packing. If these defects are overcome, good quality product fetching good foreign markets could be produced.

RESEARCH IN HAND

Studies on treating commercially dry cured fish affected with fungus and red halophiles to get good organoleptically sound products were continued. Of the different treatments tried, the following was found most successful. The infected samples were cleaned well in potable water using a soft brush and then dried sufficiently. A preservative mixture of sodium propionate in refined salt (3%) was then sprinkled over the surface of the dried fish in the ratio 1 : 10 (preservative : fish). Fungus and 'red' did not reappear in these products for more than six months.

Investigations on improving the quality of pickle cured sardines were continued. A series of experiments with larger quantiy of sardines were taken up during the year under report. The surface layer of the self-brine formed initially was removed for a few days, fresh saturated brine added so as to cover the whole fish and the salted fish pressed down using heavy weights on top each time. This process removed the excess fat and scum formed on the surface of the pickled fish. The quality of the product thus obtained was better by all standards than the control samples in which self brine was allowed to remain as such.

Experiments carried out to find out a suitable substitute for the imported sodium propionate showed that indigenously available calcium propionate could effectively substitute the same. Attempts were also made to develop natural preservatives as substitutes for the imported chemical. Studies on the preservative effects of certain medicinal plants frequently used in the Ayurvedic system of medicine were initiated in this regard.

Storage studies carried out at Burla Centre on market samples of sun-dried and smoke-dried fresh water fishes showed different storage lives ranging between 12 to 168 days, Moisture content varied between 6.42 to 15.4%, TVN : 34.97 to 153.8 mg%; α amino nitrogen : 83.6 to 361.7 mg% and total bacterial count 9.75×10^4 to 1.86×10^8/g. Better sun-dried products from *Gudusia chapra* could be obtained by blanching the fish in brine prior to sun-drying. Blanching in 7% brine for one minute gave comparatively better product with enhanced storage life of 7 months compared to those blanched for different periods in 0%, 2%, 5%, 10% and 15% brine. The conventional market products showed very low storage life of 15 to 35 days.

Pickled products were prepared from low cost freshwater fishes, viz. *Glossogobius giuris, Eutropiichthys vacha* and *Xanentodon cancila.* Most acceptable texture and desired pH of the fish muscle (below 4) were obtained by dipping the fish for 2 hours in 7% acetic acid containing 5% sodium chloride prior to mixing with spices and other ingredients. The products developed had good storage life of seven months.

Continuous curing of three different batches of ribbon fish using the same brine maintaining the initial concentration of salt (20%) was carried out at Kakinada. The first batch was cured on the first day, second batch on the second day and third batch on the third day. A constant build-up of total bacterial load (10^4 to 10^7/ml) as well as halophilic bacteria (10^4 to 10^7/ml) and a constant decrease in pH (7.1 to 6.35) of the brine were observed. The change in α-NH2 nitrogen content of the brine was negligible. But there was a constant increase in the TVB Nitrogen content (40 mg/100 ml to 240 mg/100 ml). It was also noticed that the scum portion of the used brine contained heavy load of total as well as halophilic bacteria (10^8/ml) compared to the rest of the brine. The rates of spoilage and build up of the bacterial load were found to be more during summer (37°C-43°C) than at lower temperatures (28°C-30°C). The brine got spoiled by the second batch of curing. Further studies on all these aspects are in progress.

Studies were initiated on production of 'Jithaka' smoked prawns using the newly constructed Jithaka smoking kiln.

RESEARCH CONTEMPLATED

1. Studies on the storage lives of the different types of traditionally smoked and sun-dried fish at different atmospheric conditions taking into consideration the total and pathogenic microflora and biochemical parameters of the products
2. Development of better dried products from lean and fatty fishes with different pre-treatments prior to sun-drying
3. Survey of traditional smoking practices in and around Sambalpur Dt., Orissa
4. Studies on the presence of carcinogenic materials, if any, in smoked prawns
5. Studies on prevention of infestation in cured and sun-dried samples

SCIENTISTS ASSOCIATED

CALICUT:	T. S. Unnikrishnan Nair, V. Muraleedharan, K. George Joseph, N. Kalaimani
BOMBAY:	A. P. Valsan, V. N. Nambiar, S. P. Damle, D. K. Garg
KAKINADA:	D. Imam Khasim Saheb
BURLA:	S. K. Bhattacharyya, J. K. Bandyopadhyay, A. K. Chattopadhyay

3.5. FREEZING

CHIEF FINDINGS

A survey conducted on the quality of squid and cuttle fish landed at the Fisheries Harbour, Cochin, showed that about 65% of the samples were on the border-line quality, and in many cases the ink sacks were broken and the inside portion of the mantles showed pink discolouration.

Squid and cuttle fish stored in chilled sea water or ice immediately after catch did not show any deterioration after two days storage. But samples kept uniced for 5 hrs and iced subsequently developed slight pink discolouration and off-odour after one day.

Spices like cinnamon, clove and pepper were found effective in reducing the oxidative changes in frozen minced meat from cat fish.

Block frozen glazed mackerel (fat content 4% on wet weight basis) remained in acceptable condition even after 8 months of storage at --23°C. *Block frozen samples were found superior to the individually quick frozen samples with respect to taste, texture and overall acceptability.*

Comparative studies on the ice-storage characteristics of Labeo rohita, L. calbasu, L. gonius, Cirrhinus mrigala *and* C. reba *showed that larger fishes had longer storage life than smaller ones. The refrigerator/storage studies of dressed pieces of* L. rohita *were also completed. When stored in the freezer cabinet of the refrigerator at* --10°C *the fish remained in good condition upto* 33 *days with little change in nitrogen and moisture contents. TVN and* α-NH2 *nitrogen contents increased to maximum* 28.0 *mg and* 68.37 *mg % respectively during long storage.*

Comparative studies on the frozen storage characteristics of gutted and beheaded shark (Scoliodon laticudus) *in skinless and skin-on forms showed that the former had better shelf-life compared to the latter.*

Removal of blood clots prior to mincing dressed Dhoma yielded an organoleptically superior product.

RESEARCH IN HAND

The effect of delayed icing or chilling on the quality of squid and cuttle fish was studied. Squid and cuttle fish collected from the departmental

vessels immediately after catch, were washed in sea-water and stored in chilled sea-water (CSW) and crushed ice. Uniced samples were used as control. On reaching the laboratory, after about 5 hours, portions of the samples were dressed and frozen. The uniced (control) sample was then stored in ice to study the changes in quality. Storage in CSW and ice was continued. The control sample stored in ice developed slight pink colour and off-odour after one day's storage whereas the other one showed no signs of spoilage even after two days. The samples were then frozen and storage characteristics studied upto 4 months. Even after 4 months storage the samples were in acceptable condition. There was no difference between the CSW stored and ice stored samples. In some samples of cuttle fish, blue spots were observed in the thawed fillets kept at refrigerated temperature. But at room temperature the blue spots disappeared.

The effect of spices like cinnamon, clove and pepper on the frozen storage characteristics of minced meat from cat fish was studied. Minced meat mixed with finely powdered spices (0.1% on the basis of meat) showed better frozen storage life (7 months) compared to controls which had a storage life of just 5 months. The spiced samples showed low levels of PV and TBA.

The frozen storage characteristics of individually frozen and block frozen (BF) glazed mackerel (fat content 4% on original weight basis) at --23°C were studied upto 8 months. The biochemical, microbiological and organoleptic changes taking place were studied systematically. The block frozen samples were found quite superior to the individual quick frozen sample in terms of texture, flavour and overall acceptability. Development of rancidity was also less in block frozen material and it was acceptable even after eight months of storage at --23°C. The TPC decreased in both samples during frozen storage. Similar studies using mackerel of fat content 9% (on wet weight basis) are in progress.

Comparative studies were made on the ice-storage characteristics of *Labeo rohita, L. calbasu, L. gonius, Cirrhinus mrigala* and *C. reba*. The interspecies differences in muscle pH, biochemical parameters like moisture, TVN, alpha-amino nitrogen, peroxide value, total bacterial count and organoleptic score and their changes during storage in ice were noted. It was observed that in each species larger fish retained their qualities longer in iced condition than smaller fish.

Frozen storage characteristics of gutted and beheaded shark (*Scoliodon laticudus*) individually packed in polythene bags in skinless and skin-on forms were studied for a period of 28 weeks. The overall quality and shelf life of the skinless fillets were better than those of the skin-on ones except for the initial bacterial counts which were higher in the former.

Fish mince from Dhoma was prepared both after washing of the dressed fish to remove the blood clot etc and without washing and their frozen storage characteristics studied. Both samples were in good organoleptic condition even after 40 weeks of storage; but former showed comparatively better organoleptic characteristics.

Yield ratios of different parts of blood clam, viz. viscera, foot, mantle, gills and adductor muscle were estimated and their proximate compositions determined. Foot, viscera and gills account for 35.4%, 28.2% and 17.8% respectively of the whole clam meat. Acid insoluble ash (sand) content was found to be retained more in the gill portions of the clam after starvation.

Freezing clam meat in different forms viz. 1) as blanched meat with gills and mantle removed, 2) as boiled meat, also with gills and mantle removed 3) as raw whole meat and 4) as boiled whole meat were initiated. Studies on frozen storage and its effect on the bacteriological and biochemical qualities of the frozen samples are in progress. Preliminary observations indicate that the blanched and boiled meats were in good condition even after five months' storage.

RESEARCH CONTEMPLATED

1. Further studies on freezing of squid and cuttle fish
2. Studies on freezing and storage of minced fish meat and products using fish mince to be continued. Also studies on freezing and storage of mixed fish minces
3. Studies on freezing and storage of fatty fishes-biochemical, microbiological and organoleptic changes in fatty fishes at -20°C and -35°C and time-temperature tolerance of fatty fishes
4. Studies on the spoilage characteristics of fresh water fishes stored in ice
5. Freezing and storage of Elasmobranchs

SCIENTISTS ASSOCIATED

COCHIN:	Dr. K. Gopakumar, P. A. Perigreen, Chinnamma George, Jose Joseph, P. Ravindranathan Nair, Nirmala Thampuran
VERAVAL:	K. K. Solanki, A. C. Joseph, Anil Agarwal, M. R. Raghunath
KAKINADA:	D. Imam Khasim Saheb, R. Chakraborty
BURLA:	S. K. Bhatttacharyya, J. K. Bandyopadhyay, A. K. Chattopadhyay

3.6. CANNING

CHIEF FINDINGS

Two curry formulations having hot and mild flavours were worked out. They were canned by two different methods and their relative merits assessed. Storage properties of the above formulations were studied.

Investigations on canning of wild grown oyster meat were continued. This does not however appear to be an economic proposition owing to the extremely poor yield of the canned meat.

RESEARCH IN HAND

Studies on canned curried fish with a view to standardising the formulae as well as methods of preparation were continued. Out of the several combinations tried, two formulae and two methods of preparation were finalised for further trials. A formula which yielded a curry with hot flavour incorporated vegetables and spices including green chilly and red chilly powder. In the other, red chilly powder was excluded and the quantities of ginger and green chilly reduced. A mild hot taste was obtained for the curry by addition of pepper powder.

In one of the two methods of preparation finalised, fish was dressed, cold blanched and precooked and to this, a measured quantity of curry mixture was added and further heat processed. In the second one curry was added to the dressed fish and boiled till the fish pieces absorbed the spices. This was packed in cans and further processed. While the second method yielded a curried product of better flavour, consistency etc, the first one had the advantage that the proportion of fish in curry (fixed as 60:40) could be scruplously maintained.

Fifty cans each of sardine and mackerel canned by both the formulations were subjected to storage studies for 10 months. The cans used were S. R. lacquered ones. It was observed that the products remained in acceptable condition with regard to their flavour, taste, odor, consistency etc. throughout the storage period. The pH of the curry was in the range 5.30 to 5.00 and at this pH, the lacquer was not affected. None of the ingredients appeared to have any deleterious effect on the lacquer of the can.

Studies were continued on canning the meat of wild grown oysters. The meat was more slimy compared to that of the cultured samples and hence a pre-blanching treatment with brine was necessary to remove the

slime. However, the ultimate canned yield of the meat was extremely poor, going even below 20% in many cases, making the process uneconomical.

Bacteriological evaluation of canned samples prepared using different combinations for curry and different types of oysters was regularly carried out. Heat processing requirements were also worked out to attain sterility in the product by trial and error method.

Storage studies of canned Hilsa roes in tomato juice were continued in Veraval. The product remained in good organoleptic condition even after 8 months of storage at room temperature. A considerable penetration of tomato juice into the egg mass was observed during storage. Storage studies of canned squid mantles in their own recovered blanching brine were also continued. The product remained in good, acceptable condition even after 8 months of storage at room temperature.

RESEARCH CONTEMPLATED

1. Thermal distribution studies in canned products
2. Studies on smoked and canned fish
3. Evaluation of bacterial safety VS heat processing practices in canned products

COCHIN: K. K. Balachandran, P. V. Prabhu, P. K. Vijayan, Dr. P. K. Surendran

VERAVAL: K. K. Solanki, A.C. Joseph, Anil Agarwal, M. R. Raghunath

3.7. PROTEINS, ENZYMES AND LIPIDS

CHIEF FINDINGS

Heating fish proteins in an aqueous medium upto 60°C resulted in a gradual uncoiling of polypeptide chains as shown by the increase in the -SH content. Continued heating above 60°C led to formation of -S-S- bonds and possibly isopeptide bonds, as revealed by subsequent decrease in -SH content as well as dye-binding in the electrophoretic patterns. Oleic acid and oxidised oleic acid when added to extractant reduced protein solubility during extraction. Gel filtration of these extracts did not show any aggregation of proteins. Reduced solubility appeared to be more due to formation of a hydrophobic surface on protein micelles as a result of fatty acid adsorption. Lipase from hepatopancreas of oil sardine was more active towards glycerides

of lower fatty acids. Immobilization on polyacrylamide improved the temperature and pH tolerance of this enzyme. Mackerel lipids showed almost equal amounts of oleic and stearic acids compared to sardine lipids which contained more of oleic acid. Percentage of docosahexa-enoic acid registered the lowest value when fat content was highest in oil sardine (in November-December) and vice versa. *Oil sardine was found to be a rich source of nicotinic acid. Red meats of fishes showed higher calorific values compared to white meat. Hydrolytic enzymes were more in red meat. Rats fed on red meat showed higher lipolytic activity in the liver.*

RESEARCH IN HAND

Studies on the heat coagulation of fish muscle protein in an aqueous medium, under varying time-temperature conditions showed that up to 90 minutes at 90°C, coagulation increased, after which the curve levelled off. Heating upto 60°C resulted in an increase in -SH content after which it registered a fall. Electrophoretic patterns of 8 M urea extracts of heat coagulated fish muscle samples showed reduced dye-binding of peptide chains upto 60°C and formation of -S-S and isopeptide bonds above 60°C.

Gel filtration of extracts of fish proteins to which fatty acids and oxidised fatty acids were added showed no aggregation of proteins. Decreased solubility due to the addition of these compounds to the extractant during extraction thus appeared to be more due to surface adsorption of these compounds on the protein micelles and consequent formation of a hydrophobic surface.

Lipase from hepatopancreas of oil sardine was more active towards glycerides of lower fatty acids. C_{12} and $C_{22:4}$ acids were however hydrolysed at relatively faster rates. No clear correlation between the fatty acids chain length and rates of hydrolysis could be established. Immobilization on polyacrylamide was found to improve the temperature and pH tolerance of this enzyme. Autolysis was found to be practically nil in fresh tilapia and pearl spot over a period of 2½ hours. In mackerel, in over a period of 1½ hours, slight proteolysis was observed. Heating enhanced the rate of hydrolysis of fish proteins by pepsin.

Volatile carbonyls from catla and cat fish could be separated into 11 different compounds by TLC. Mackerel lipids showed almost equal quantities of oleic and stearic acids, whereas sardine lipids were richer in oleic acid. In oil sardine when fat content is highest, percentage of docosahexa-enoic acid is lowest and *vice versa*. No other correlation between season and fatty acid composition could be observed. Oil sardine was found

to be a rich source of nicotinic acid. During June-July season it showed upto 8 mg. nicotinic acid|100g. muscle. Red meat had higher calorific value and higher concentration of hydrolytic enzymes when compared to white meat in fishes. Albino rats fed on red meat of fishes had higher lipolytic activity in liver compared to those fed on white meat.

RESEARCH CONTEMPLATED

1. Toxic components in fish muscle
2. Effect of lipid oxidation on nutritional quality of fish proteins
3. Location of economic source of lipases in fishes
4. Self digestion of muscle constituents in fishes
5. Composition and nutritional characteristics of condensed fish solubles
6. Volatile flavorous principles in fish

SCIENTISTS ASSOCIATED

COCHIN: M. R. Nair, K. Devadasan, P. D. Antony, A. G. Radhakrishnan, Dr. P. G. Viswanathan Nair, Dr. Jose Stephen, Dr. M. K. Mukundan, K. Ammu

3.8. FOOD POISONING FROM FISH AND ITS CONTROL

CHIEF FINDINGS

Studies on the quality of fresh fish sold in six retail markets situated at different places in Bombay were completed. The samples were analysed for physical, organoleptic, biochemical and bacteriological qualities including presence of faecal indicator organisms and pathogens like coagulase positive Staphylococci, Salmonella *and* Clostridium spp. *In all* 167 *samples were collected during the year for analyses. Based on the physical and organoleptic characteristics and TVN values,* 21% *could be categorized as good,* 52% *as average and* 27% *as poor. On the basis of total bacterial count,* 30% *of the samples were of good quality,* 37% *of average quality and* 33% *of poor quality.* 23% *of the samples showed an* E. coli *count of more than* 20|g, 29% *showed* Faecal streptococci *more than* 1000|g. *and* 9% *showed coagulase positive* Staphylococci *more than* 100|g. Salmonella *was detected in* 4% *of the samples from two markets and* Clostridium *in* 3% *of the samples drawn from three markets.*

A rare serotype of Salmonella, *namely* S. eastbourne *was isolated from fresh tuna and another rare serotype* S. oranienburg *from seer fish for the first time in India.* Clostridium spp. *was also isolated for the first time from grey mullets, sole, mackerel and catla.*

RESEARCH IN HAND

Quantitative and qualitative studies of the microflora on "Pallikkora" (*Otolithus argenticus*) in fresh condition showed a bacterial density of 3.2 x 103|g to 1.08 x 105|g on the muscle with skin samples. Qualitatively, the microflora showed a pre-dominance of gram-negative rods, viz. *Alcaligenes, Flavobacterium, Arthrobacter* and *Pseudomonas.*

As part of the work on development of methodology for bacterial enumeration, several trials were undertaken for standardisation of the procedure for estimating the bacterial load by drop plate method using pour plate as control. Sea water agar containing 1% peptone was used as the medium. Studies are in progress.

Studies on comparative efficiencies of various selective media for the recovery of the following serotypes of *Salmonella,* viz. *S. typhimurium, S. newport, S. roan* and *S. enteritides* have shown that recovery was 80-90% in Brilliant green agar and Hectonic enteric agar and 73% in Bismuth sulphite agar.

With respect to pure cultures of bacteria, a linear reaction was found to exist between the catalase activity and number of bacterial cells generating the catalase. The possibility of using this observation for rapid enumeration of bacteria is being worked out.

At Bombay, bacteriological studies on fresh chorbombil (*Synodontidae* spp.) and microbial changes during ice storage were studied. In the case of samples stored in contact with ice, the total bacterial count showed a slight decrease in the beginning and then increased gradually whereas in those stored out of contact with ice, the bacterial load initially increased, then showed a slight decrease and thereafter increased gradually. Qualitatively, 75% of the flora consisted of gram negative rods and 25% gram positive organisms. Their biochemical characteristics were also determined.

Studies on the incidence and isolation of pathogenic organisms in fish and fishery products were continued. At Veraval, 51 samples of different species of marine and fresh water fish, processed fishery products and swab samples collected from local markets were examined for the incidence of *Salmonella* and *Vibrio parahaemolyticus.* None of the samples

showed the presence of these organisms. Sixty samples of commercial fish meal also showed absence of *Salmonella*. At Cochin, 22 samples of fish and 7 of water analysed were free from pathogens, Viz. *Acromonas salmonicida* and *Vibrio anguillarum*. About 400 samples of frozen seafoods comprising shrimp, crab meat etc. were collected and analysed. *Salmonella* was noticed in about 1% of the samples while *Vibrio cholerae* was absent in all the samples.

At Kakinada, about 250 samples of different varieties of fish and shell fish collected from different areas exposed to pollution were analysed for heavy metals like Hg, Pb, Cd, Zn, Cu and Fe. Of all the samples tested, cadmium, (Cd) content was seen most in the mantle and gill portions of the blood clam (*Anadara granesa*) and window pane oyster from Kakinada Bay. The level of lead (Pb) content was also more in molluscs, blood clam and window pane oyster. Accumulation and concentration of zinc (Zn) followed a similar pattern as that of Cd. and Pb. Regular monitoring of heavy metal levels in blood clams in the Kakinada Bay and their changes during processing is being carried out. High levels of mercury (Hg) were found in some fresh water fishes from Godavari river near Rajahmundry. A detailed study on this aspect is being taken up. About 150 samples of fresh and 75 of canned fishery products were analysed at Cochin for heavy metals which were found to be below the permitted level in all the samples, except some canned products in which copper and zinc were above the permitted levels.

Studies on onboard preservation of fish and effect of delayed icing on the quality of the fish were initiated.

About 300 samples of frozen shrimp of different types of packs and size grades were analysed for presence of filth. Compared to the PD and PUD shrimp, HL shrimps were almost free from filth. In the PD and PUD shrimp, occurrence of filth was more in the small size grades.

Research Contemplated

Studies on the different aspects mentioned above will be continued.

Scientists Associated

COCHIN: K. Mahadeva Iyer, M. Arul James, P. R. G. Varma, Dr. P. K. Surendran, Nirmala Thampuran, K. V. Lalitha, S. Sanjeev, Dr. P. T. Lakshmanan, Francis Thomas

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KAKINADA: D. Imam Khasim Saheb

BOMBAY: T. S. Gopalakrishna Iyer, V. Narayanan Nambiar, S. P. Damle, D. K. Garg

3-9. PACKAGING OF FISH AND FISHERY PRODUCTS

CHIEF FINDINGS

Of the different synthetic strapping materials used in the frozen fish export industry, polypropylene straps of 12 *mm. width and* 0.5 *mm. thickness were found to be the most ideal for reinforcement of master cartons. The studies covered their physical properties like tensile strength, elongation in both dry and wet conditions, melting point etc. The strapping materials examined were high density polyethylene (both virgin and recycled), polypropylene and rayon, both in fresh condition and after keeping in frozen storage for different durations.*

Mussel meat pickled in oil remained in good condition for six months in flexible pouches made of 12 *micron polyester film laminated with* 150 *gauge low density polythene.*

RESEARCH IN HAND

Mussel meat pickled in oil was sealed in flexible pouches made of 100 gauge polypropylene film, 12 micron polyester film laminated with 150 gauge low density polythene, saran coated 300 gauge cellophane- polythene laminate and glass bottles (used as control) and stored at ambient temperature conditions. It was observed that the product packed in 12 micron polyester film laminated with 150 gauge low density polythene remained without any appreciable change for six months and was comparable in quality to that stored in glass bottles.

Blanched prawns packed in pouches of 300 gauge polypropylene along with brine, heat-sealed and processed at 115°C under 1.05 kg./sq.cm. steam-air pressure for 15 to 20 minutes, cooled and further sealed in 12 micron metallised polyester laminated with 150 gauge low density polythene gave encouraging results. Work is in progress to improve the method.

Salted and dried mackerel, treated superficially with preservative mixtures containing sodium benzoate and sodium propionate as the main ingredients along with anti-oxidants and packed in various synthetic film pouches showed that the product sealed in 200 gauge low density polythene film had a sufficiently long shelf life of 270 days at ambient temperature.

RESEARCH CONTEMPLATED

1. Improvements in functional properties of corrugated fibre board master cartons by plastic and wax coating

2. Studies on the effect of packaging materials on the shelf life and quality of frozen fishery products

3. Development of bulk packaging materials for dry fishery products for export and internal distribution

4. Further studies on development of retort pouches using indigenous films in order to replace conventional cans

5. Transportation of live clams

SCIENTISTS ASSOCIATED

COCHIN: T. K. Govindan, P. A. Perigreen, C. V. N. Rao. T. K. Srinivasa Gopal, K. P. Antony

3.10. DIVERSIFIED PRODUCTS FROM FISH AND UTILISATION OF PROCESSING WASTES

CHIEF FINDINGS

A feasibility report on the production of Chitosan and protein extract from prawn head and shell waste as well as from squilla was prepared from the experience gained from the semi-commercial operations of the pilot plant installed at the Institute.

Poultry feed formulated with prawn waste and fish meal when put to actual field trials in a private poultry farm showed the same results as obtained at the Kerala Veterinary College and Research Institute. With continuous feeding, the efficiency in egg production decreased, but weight gain of the birds increased. Animal feeding experiments on cereal supplementation studies with shrimp extract at various levels showed that diet containing 6% shrimp extract did not record any marked increase in body weight, whereas at 10% level, the growth rate was much better although lower than that of control rats fed with casein. A formula and technology were developed for producing protein rich, shrimp flavoured spray dried powder from whole shrimp extract powder and tapioca starch.

Chitosan coated and stabilised paper cartons when stored in frozen storage behaved similar to wax coated cartons.

A method was developed for converting mussel shells, at present thrown away as waste, into quicklime.

A simple method was also worked out for preparing excellent quality fish sauce from non-penaeid prawns.

Research in Hand

Fish and poultry feeds were formulated with fish meal, dry prawn shell and partially demineralised prawn shell, both individually and in combination with other ingredients. Feeding experiments were conducted with carp fingerlings. Feeds containing dry prawn shell showed similar results as in the case of those containing fish meal whereas demineralised prawn shell showed comparatively poor growth rate.

The poultry feed, formulated at the Institute and tested at the Kerala Veterinary College and Research Institute was put to actual field trials in collaboration with a local poultry farm by feeding several series of layers of white leghorns and compared with a commercial feed. On continuous feeding, the efficiency of the experimental feed in egg production was found to be low, although the weight of the birds increased.

Different samples of prawn shell powders prepared by cooking in water, autoclaving and acetic acid treated were subjected to feeding experiments on albino rats in comparison with casein. In all cases, the feed in-take, gain in body weight and PER values were lower than in those fed with casein. Samples prepared by autoclaving showed highest PER.

Cereal supplementation studies were conducted with shrimp extract at various levels. Diet containing 6% shrimp extract did not record any increase in weight whereas at 10% level, growth rate was better although it was lower than that of casein-fed control rats.

Whole shrimp extract was mixed with starch and the optimum condition for producing protein rich, shrimp flavoured spray dried material worked out.

Studies on the behaviour of chitosan from four different sources with respect to their metal binding properties were continued. The rate of adsorption of Hg^{++} by chitosan from squilla was faster and the quality adsorbed was more than that by chitosan from other sources. The influence of sources of chitosan, particle size, time of treatment and initial concentration of metal on adsorption rate was studied. The treatment with chitosan could reduce the Hg ion concentration to below 0.01 ng per ml. in residual solution. Studies on the recovery and reuse of chitosan are in progress.

Application of chitosan in paper finishing was studied with its solution in formic acid, and treatment with ammonia. Cobb value, tearing strength and tensile strength were significantly improved in chitosan treatment. This was more pronounced in the case of formic acid-chitosan stabilised in ammonia.

Paper cartons coated with chitosan in acetic acid and stabilised were stored in frozen condition for six months and found to be comparable with wax coated cartons.

Studies on application of chitosan in Chromatography were continued. It was found to be effective in paper and thin layer chromatographic separation of amino acids, gycine, p. alamine, leucine, isoleucine and glutamic acid. Experiments for the separation of metal ions by column chromatography using chitosan are being carried out.

A method has been developed for the isolation of protein from squilla by mechanical separation. The PER of the precipitated squilla protein as well as the water soluble fraction and whole protein extract powder were determined. The PER of whole spray dried squilla protein is comparable to that of casein. The deleterious effect noticed in the previous feeding experiment using whole squilla extract was not noted in the present study.

The production parameters of spray dried squilla extract in combination with starch have been worked out.

Feasibility reports on chitosan, fish flakes, shark fin rays and fish soup powder were prepared and are being finalised.

Storage studies on the fish powder incorporated 'Dhokra' ready mix developed at Veraval showed that fermentation of the mix is a vital factor contributing to the quality of the final product. Incorporation of milk powder was beneficial only in the initial stages. Buttermilk had to be used in the later stages to achieve a satisfactory level of fermentation.

A method has been developed at Bombay for preparing good quality sauce from non-penaeid prawns employing bulk quantities. The optimum conditions for producing a good quality product were worked out and studies are in progress to ascertain the yield and keeping quality of the sauce.

Ribbon-form isinglass was prepared using the simple hand operated machine developed at the Kakinada Centre. Some samples of isinglass procured from England were analysed for soluble nitrogen, collagen nitrogen and intrinsic viscosity for comparison with the indigenous product.

Stearin, which is a processing waste obtained during oil extraction, was collected from the Shark Liver Oil Extraction Plant of Andhra Pradesh Fisheries Corporation and analysed. It was found that the waste contained mainly fatty materials with high saponification values. Other factors estimated were iodine value, unsaponifiables and free fatty acids (FFA). The FFA and peroxide values were found to be very high. Methods are being worked out to reduce the FFA and peroxide values.

As a part of the programme on utilisation of low-cost fish, preliminary experiments were carried out on preparation of salted and dehydrated mince from jew fish, incorporating salt levels of 10% and 15% in the minced meat. Frozen storage studies of the products for 9 and 14 weeks respectively showed that high initial moisture and salt contents adversely affected the storage properties. Products with less initial moisture content and high salt content showed better storage life. At room temperature the total bacterial count of both the batches did not show any significant increase. No pathogenic organisms were encountered in any of the samples during the whole period of storage.

Further experiments were conducted with dehydrated salt mince prepared from threadfin bream, laying greater emphasis on biochemical and microbiological change aspects. Minced meat was prepared using a meat separator. The yield was about 40% to the entire fish weight. Three different samples with only 15% salt were prepared. Sample I was kept overnight in the chill room after applying salt, sample II dried immediately after applying salt and sample III, incorporated with 0.1% citric acid and 0.125% butylated hydroxyanisole besides salt. All the three samples were then dried first in the tunnel dryer and then under the sun. Drying was carried out at 51°C for 30 hours. The dried samples were sealed in polythene bag and kept for storage studies. Moisture contents of all the samples were less than 10% and salt content nearly 35%. Further studies are in progress.

Under the programme on improvement of the quality of tuna meat, *Euthynnus affinis* was subjected to analysis of proximate composition of dark and white meat in fresh and cooked form as well as their nutritional evaluation on weaning rats using diets incorporating red and white meat powders at 10% protein level studied. The studies are continued.

Research Contemplated

1. Further studies in fish powder incorporated products and keeping qualities of fish sauce prepared from non-penaeid prawns
2. Further studies on isinglass and fish air bladders
3. Studies on canning clam meat

4. Better utilization of seasonally available low priced fishes at Kakinada, such as *Psenus, Decapterus* etc

5. Further studies on salt mince, protein isolates and animal feeds

6. Studies on utilization of stearin for human consumption.

SCIENTISTS ASSOCIATED

COCHIN:	Dr. K. Gopakumar, P. V. Prabhu, K. Mahadeva Iyer, P. Madhavan, K. G. Ramachandran Nair, A. Lekshmy Nair, A. V. Shenoy, R. Thankamma, P. T. Mathew, T. K. Thankappan, P. Ravindranathan Nair, S. M. S. Abuthahir Ali
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3.11. IDRC PROJECT 'FISH PROCESSING—INDIA'

Fish Dryer

A modified design of the fish dryer was made incorporating the following characteristics:—

(1) The inside body made of fiberglass and the outside, galvanised iron with 50 mm thick fiberglass crown slab insultation between the walls

(2) The body of the dryer built in four pieces in such a manner as to be readily assembled/dismantled at will facilitating easy transport and installation at any place

(3) The heating unit as well as the blower unit fixed in the same floor as the dryer allowing reheating and recirculation of air, heating unit consisting of 60 Nos. of 100 watts capacity heaters (the temperature in the dryer being controllable between 30 and 100°C), mounted in a double walled chamber with necessary control and blower unit consisting of a centrifugal type air blower of capacity 286 to 429 cu.m./min.

(4) Provision made for suitable types of trolleys and trays for carrying fish and the other accessories required

Smoker dryer

A design was developed and fabrication undertaken of a smoker dryer, the body being made of angle iron frame covered with asbestos sheet. The dryer has a capacity to handle 250 Kg. of fish per batch.

Nobbing Machine

A nobbing machine was received through IDRC and the same has been installed at M/s Kerala Fisheries Corporation. A few trial runs with sardine were undertaken.

Fish Drying and Consumer Acceptability Studies

Using the laboratory model dryer available at C.I.F.T., 12 batches of dry fish were prepared for trial marketing and consumer acceptability studies. Kilimeen (*Nemipterus japonicus*) was used mostly in these studies. Three different salt to fish ratios viz 1 : 4, 1 : 5 and 1 : 6 were employed. The fish was dried to a moisture level of 15% and packed in 150 gauge polythene bags @ 200 g per bag. The Kerala Fisheries Corporation undertook the marketing of the product in the High Ranges as well as in Palghat and Trichur Districts. The fish could be sold at the rate of Rs. 2/= per packet of 200 g without any difficulty. The fish salted in the ratio of 1 : 4 and 1 : 5 were reported to be 'dry' having excessive saltish taste while those salted in the ratio 1 : 6 were liked by the consumers. The salting ratio of 1 : 6 has therefore now been recommended for the process. Fresh samples were subsequently prepared after salting in this ratio. The yield of dry fish worked out to 33% at the final moisture level of 15%. The Corporation has since reported that the results of marketing are encouraging.

A proforma was drawn up for collecting the consumers' reaction to the product and supplied along with the fish.

Marinated mussel meat

Attempts were made at preparation of marinated mussel meat. The meat shucked from steamed mussel was kept under acetic acid with and without addition of salt. 2-4% acetic acid and upto 2% salt were employed. Initial studies showed that a product containing 4% acetic acid alone or in combination with salt yielded a product which could be kept in good condition in sealed bottles protected from light for a period of one month.

Further studies were undertaken by employing fresh shucked as well as steamed and shucked meat, using different concentrations of acetic acid and salt with and without the addition of spices. Some of the spices components, particularly the curry leaves, were found to cause some discolouration of the product, even though there was some improvement in the

flavour. The storage life could not be improved by any of the techniques employed.

Pasteurized mussel meat

Pasteurized mussel meat was prepared by steaming and shucking the meat, holding in 4% acetic acid overnight, packing in dilute acid of varying concentrations and heat processing in water at 70°C. Judged organoleptically, all the samples had a high acid taste, the pH of the meat ranging from 3.75 to 3.4 and as such was not relished when tested in the laboratory.

Marinated sardines

Marinades were prepared out of sardine as well. The fish after dressing and cleaning, were kept immersed in acetic acid-salt solution. 12% and 16% salt solutions containing 2, 4 and 6% of acetic acid were employed in the study. Samples kept well for a period of one week and thereafter showed signs of the meat becoming highly soft. Softness of the meat and excessive acidity even at 2% acid level reduced its acceptability. However, partially fried sardines marinated in 2% acetic acid and 4% salt has been found to be satisfactory when prepared in the usual curry form.

Canning of sardines

It was proposed to popularise 'Natural Pack' canned sardine as per the process developed earlier at the Institute. Accordingly, 150 cans of sardines in 301 x 309 size cans, each holding 350 g net contents were processed and are shortly to be handed over to Kerala Fisheries Corporation for test marketing.

The present lessee of the Kerala Fisheries Corporation Plant got convinced of the quality of 'Natural Pack' sardine and of the technology involved in its processing and started commercial packing of the product for marketing within the country.

SURVEY OF DRY FISH MARKETS

a) *Dry fish producing centres*

A survey was conducted of the major dry fish production centres like Sakthikulangara (Neendakara), Beypore, Calicut (all in Kerala) and Kanyakumari (in Tamil Nadu). Data on production centres, curing yards, processors, drying/curing practices, types of fish used etc. were collected. Estimates were prepared of the total production and distribution in each centre, the inflow and outflow of dry fish with quantity and methods of transportation, availability for local consumption etc. Investigations were

also undertaken on the employment opportunities in production, marketing and distribution channels and price structures at each centre in different seasons. Consumer acceptability studies have been initiated.

Considering one centre, viz; Sakthikulangara the biggest dry/cured fish production centre in Kerala, there are about 65 curing yards employing more than 300 persons in fish salting and drying. In the peak season (June-August), about 160 tonnes of the fish are processed daily for about 65 to 70 days. During September to February only about 6-8 tonnes of fish are processed per day reaching around 25 tonnes during March-May. *Sciaenids,* sole, lactarius, catfish etc. form the bulk of fish used for curing. There are about 10 small scale processors processing around 50 Kg of fish per day which is mostly used for local sales. The yields in these cases are reported to be around 65%, apparently due to insufficient drying.

The cured fish is packed in baskets made of coconut leaves and transported in lorries to the major consuming centres like Alwaye, Changanachery, Kottayam, Calicut, Trichur, Palghat, Tirur etc. About 15 wholesalers purchase the fish from the drying yards and distribute them through the agents to different consuming centres. About 15 small scale merchants distribute about 45 tonnes of dry fish in a week in nearby consuming centres.

b) *Dry fish consuming centres*

Dry fish consuming centres mainly in the eastern hill region were visited and information was collected on the quantum of cured fish sold, price structure as also the source from where the fish was obtained. There are markets selling 2 to 18 tonnes of dry fish per week. The supplies are received weekly from the wholesale markets of Kottayam, Changanachery, Alwaye and Neendakara in Kerala and Tuticorin and Mandapam in Tamil Nadu. The popular varieties are shark fillets, ray fillets and cat fish followed by miscellaneous varieties. Cured mackerel and sardine are also available, but are not in much demand. The fish is sold out in a week and the balance if any is sold as manure which fetches around Rs. 300|= tonne. At the end of one week after receipt, the fish becomes almost unsaleable due to maggots, 'red', ammoniacal odour etc. The selling price of fish varies from Rs. 3/= to Rs. 12/= per Kg. Normally moisture is high varying from 40-45%.

The samples of fish collected and tested in the laboratory showed that many of them were infected with maggots and have off odours. "Red" is common in cat fish and mackerel. The samples could not be stored for more than 2 weeks by which time they became putrid.

Fish soup powder

Soup powder was prepared out of the picked meat of miscellaneous fish and handed over to Kerala Fisheries Corporation for test marketing. Prepared soup sold through their snack bars was well accepted by the upper class people. Reaction was mixed in the lower and middle class people probably because they are not accustomed to such a product. Samples packed in polythene bags at 50 g per packet were sold at Rs. 1.50|- per packet. For prolonged storage, polythene was not found to be a suitable packaging material since insect attack was noticeable suggesting the requirement of improved packaging.

SCIENTISTS ASSOCIATED

COCHIN: P. V. Prabhu, S. Ayyappan Pillai, K. K. Balachandran, Francis Thomas, G. R. Unnithan

3.12. MARINE ENGINEERING

CHIEF FINDINGS

Comparative studies on the performance of different types of drive systems for mechanising traditional fishing crafts showed that though initially the indigenously developed systems worked satisfactorily, after some time their performance became unsatisfactory.

Designs of transducer and electronic circuit for the torque/rpm measuring devices were completed. Fabrication of the same is in progress.

Studies on methods to reduce cost of operation of mechanised fishing vessels showed an increase in bollard pull by using a propeller cover. Bigger trawl nets which are normally operated from medium size vessels with higher H.P. engine could be easily operated using a smaller H.P. engine with propeller cover.

RESEARCH IN HAND

The performances of the indigenously developed drive systems and the imported outboard motors on traditional craft were closely evaluated. It was seen that though initially the indigenously developed systems worked satisfactorily, in course of time, their performance became unsatisfactory, owing to use of sub-standard materials in the drive systems. The manufacturers were appraised of the defects and the units were taken back for rectifying the defects. The performance of the imported outboard motors, on

the other hand, was quite satisfactory. More and more fishermen are going in for such units.

Preliminary studies were initiated to develop ways and means for reducing the cost of operation of mechanised fishing vessels. As a first step, a propeller cover was designed, fabricated and fitted on a 9.76 m. (32 ft.) wooden departmental vessel. On trials it was observed that there was an increase of about 11% in the bollard pull of the vessel by using the new device. The cover was further modified, fabricated and fitted on the vessel. Trials with the modified cover are in progress.

Both fishing and speed trials were carried out with and without the propeller cover. It was observed that a bigger trawl net eg; 23 m. bottom trawl, normally used by the local fishermen on a 9.76 m. (32 ft.) vessel with 64 H.P. engine could be easily operated from the same vessel with a 37.5 H.P. engine by using the propeller cover.

Modifications of the existing deck equipments and innovation of new ones for installation on mechanised fishing vessels to suit different fishing operations were initiated.

RESEARCH CONTEMPLATED

Development of hand/pedal operated propulsion for country crafts

SCIENTISTS ASSOCIATED

COCHIN: S. Ayyappan Pillai, K. Sreedharan Namboodiri, P. N. Joshi, K. N. Kartha

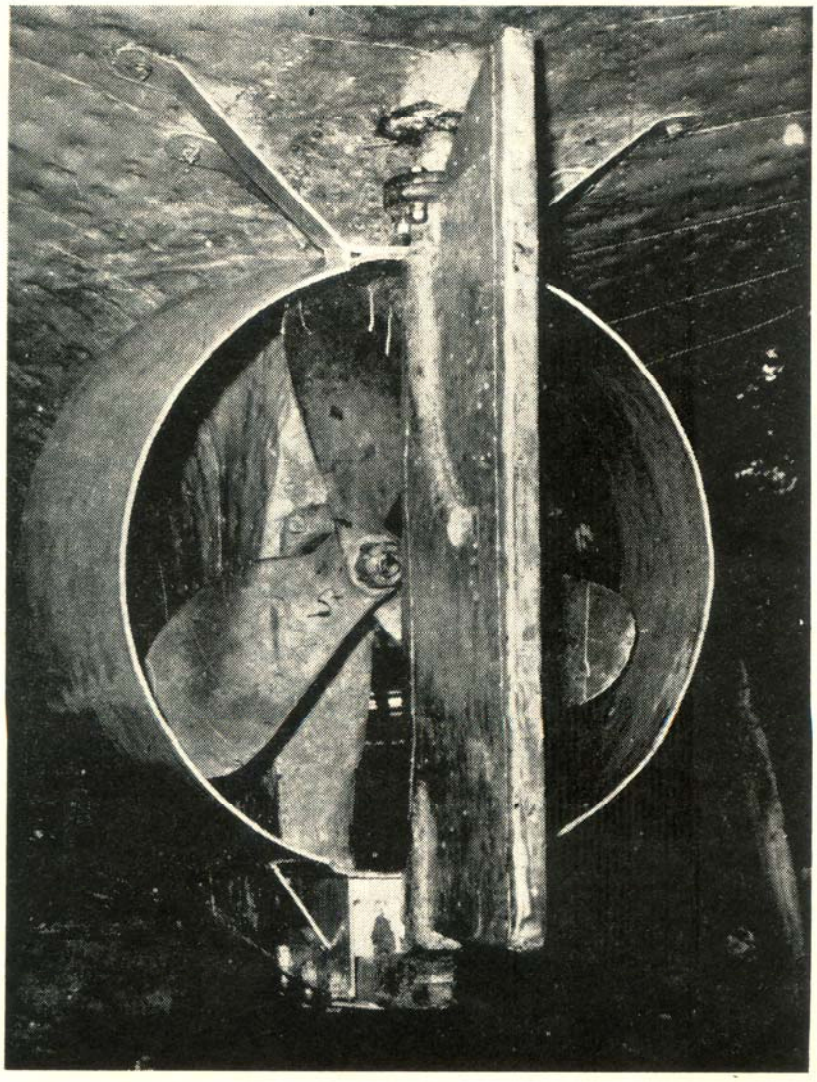
3.13. PROCESSING ENGINEERING

CHIEF FINDINGS

Experiments conducted under different drying conditions indicated that drying of fish took place entirely under falling rate period, the optimum drying conditions being 45°C, 60% R.H. and 120 m/min. air velocity.

Different components of a deep freezer to maintain — 30°C were erected complete with all service connections such as water and electronic supplies.

Fabrication of a pilot model mechanical device for processing prawns and subsequently cooling it under pressure was completed.



A view of the propeller with cover

Design of a prawn washing machine to remove sand, filth and other extraneous matter was completed.

A process was developed to treat industrial effluents with chitosan for removal of mercury. A method of regeneration of chitosan for further use was also worked out. Design of a commercial plant to produce 250 kg/day of chitosan was completed.

Research in Hand

Investigations were carried out on production of smoked fishery products in the electrothermal smoke kiln developed earlier.

The fabrication of prawn washing machine and the different machineries required for the glucosamine hydrochloride pilot plant was taken up.

An improved method of treating industrial effluents with chitosan to remove mercury by the addition of chitosan powder to the solution and vigorous stirring followed by filtration, was developed. The quantity of chitosan to be added for the complete removal of mercury from effluents can be calculated by an equation, when the initial concentration of mercury is known. This method differs from the conventional method of percolation of liquid (effluent) through a bed of chitosan where there is no initimate contact between the solute and adsorbent. So by adopting conventional method complete removal of mercury is theoretically impossible and the same is not suitable for commercial application. The method of regeneration of chitosan for further use by treating with potassium iodide solution and the recovery of mercury in a concentrated form were also worked out.

Preparation of a project report for the commercial chitosan plant was then taken up.

Research Contemplated

Development of mechanical drying in conjunction with solar drying technique to bring down the cost of drying

Design and development of dryers for fish and fishery products

Design and development of methods and equipment for the removal of heavy metals from industrial effluents using chitosan

Scientists Associated

COCHIN: S. Ayyappan Pillai, P. K. Chakraborty, P. N. Joshi, S. M. S. Abuthahir Ali

3.14. ELECTRONICS AND INSTRUMENTATION

CHIEF FINDINGS

Design, construction and field trials of the Ocean tele-lab were completed. This remote sensing instrumentation system has been developed for on-the-spot measurement of water current (speed and direction), temperature, salinity and depth using a single sensing probe and a single console unit for fishery hydrographic investigations and for several other marine applications. The instrument was tested at the towing tank of CWPRS, Poona. It has been developed fully out of indigenous components and approximate cost is Rs. 25,000|-

RESEARCH IN HAND

Buoy Telemetry System

A multiplexer for handling 16 channel data is being designed and developed.

Crane Load Monitor and Alarm

The unit is being prepared for installation on a crane in Bombay Port Trust. The fabrication of a large digital display unit is under progress.

Low-cost Fish Finder

Testing of the transmeter unit is in progress.

Remote operated water density meter

Performance of the remote operated density sensor for developing an instrument for the instantaneous and remote measurement of water density at different depths of the sea is being studied.

RESEARCH CONTEMPLATED

Development of an emergency radio beacon for safety in small crafts

SCIENTISTS ASSOCIATED

COCHIN: T. K. Sivadas, K. Ramakrishnan, K. Vijayabharathi,

4. EXTENSION ACTIVITIES

Replies to Technical Queries

During the year, more than 450 queries were replied to on different aspects of fishing and fish processing. Comments were offered on the use

of liquid nitrogen as a refrigerant for freezing and transportation of fish and storage of prawns in chilled brine. Information was furnished on the common antioxidants used to treat fish products against rancidity and method for processing salmonella free frozen frog legs.

Methods were also furnished on canning and freezing a variety of fish and shell fish, production of dehydrated fish, and comments offered on the storage life of dried fish products. Process details given include those of production of edible fish powder, speciality and by-products from fish like fish soup powder, fish pickle, masmin from tuna, chitosan from prawn shell waste, details of converting mussel shell into lime and composition for fish feed.

Comments on the use of BHA in production of fish meal and moisture level permissible, on the suitability of 'Baader Fish Cutter,' on the scalene content of shark and utilization of shark resources were provided as also details of tests for determining mercury content of fish, details of the insulated fish box developed by the Institute and information on synthetic resin glues normally used for lamination.

On fishing craft and gear side, details were provided of the marine electronic instruments developed by CIFT, the tonnage recommended for medium size-groups of vessels, on the suitability of ferrocement boats for Indian waters, their efficiency and availability, comments on copper sheathing wooden hulls without tar-felt, details of marine coatings developed from Cashewnut shell liquid, on the demand for outboard motors and comments on the method of determination of H.P. of marine engines for installation in fishing vessels.

Testing of materials and products

Analysis reports of 528 products and materials as detailed below wre furnished during the year under report.

	No. of samples
Canned fish and shell fish products	36
Frozen fish and shell fish products	315
Dried fish products	3
Freeze dried prawns	6
Speciality products	2
By-product	1
Fresh fish samples	5
Live fish	1
Packaging material	6
Chemicals and deodorants	3

Water	70
Ice	47
Fishing craft material	6
Fishing gear	2
Fishing gear material	7
Marine engines	8

In addition, 142 samples of fish meal, water, ice and processed fishery products were also analysed at the Veraval Research Centre and 15 samples at the Calicut Centre.

Publications

The following publications were brought out during the period.

1. Synthetic Fish Net Twines: Technical pamphlet
2. Development of Fishing Boats: Technical pamphlet (Malayalam)
3. Marine Electronic Instruments Developed in CIFT: Technical pamphlet (English and Hindi)
4. Cleaning in Fish Processing Industry: Technical pamphlet (English, Hindi and Marathi)
5. Aims and Achievements of the Bombay Research Centre of Central Institute of Fisheries Technology: A Silver Jubilee Release.
6. 25 years of CIFT: A Silver Jubilee Release
7. Salient Research Achievements and Their Application to Fishermen and the Industry
8. Fish Technology Newsletter, Vol. III. Nos. 2 to 5.
9. Abstracts of CIFT Publications-1957 to '80 — Special Bulletin-8.
10. Indigenous Marine Fishing Gear and Methods of India-Part I — Karnataka State—Special Bulletin-9

Supply of designs and publications

Thirty nine designs of gear, craft, fishing accessories and dryers were issued as detailed below.

Particulars	*No. of designs*
Trawl nets	2
Otter boards	21
Fishing craft	5
Dryers	10
Gill net hauler	1

One hundred and forty three copies of the publication "Quality Control in Fish Processing", fifteen copies of the Special Bulletin I—'An Account of the Inland Fishing Gear and Methods of India' and thirty three of the Special Bulletin 9 - 'Indigenous Marine Fishing Gear and Methods of India - Part I - Karnataka State' were also supplied to interested parties on request.

Exhibitions and Film Shows

Fourteen film shows were conducted during the year for the benefit of students, visitors to the Institute etc.

The Institute participated in the Health, Education, Agricultural and Industrial Exhibition conducted by the Corporation of Calicut from 24 April to 31 May 1982. Exhibits by way of products and photographs were also sent for the Embassy Science Fair at London, International Trade Fair, New Delhi, International Agricultural Fair at Yugoslavia and the Barcelona and Bagola Trade Fairs. The Institute also participated in the Fisheries Exhibition at Lakanpur Block, Sambalpur District, Orissa, organised by the State Fisheries Department from 27-29 January 1983. An exhibition was also held at the Institute's premises from 15-18 December 1982 in connection with the Silver Jubilee Celebrations of the CIFT. Film shows were also held on all the four days of the exhibition.

Extension Training

A refresher training course on Bacteriology and Quality Control of Seafoods was held from 10 January to 19 February 1983. Eight candidates representing different fish processing establishments participated in this course. A training course was also held at Malpe in collaboration with the Dept. of Fisheries, Karnataka State from 2-5 March 1983 on production of cured and diversified products from fish and shell fish. Forty four trainees attended this course.

PERSONS ASSOCIATED

Dr. P. N. Kaul, M. K. Kandoran, P. N. R. Kaimal, S. Balasubramanian, Dr. G. R. Desai, Mary Thomas, K. C. Purushothaman

Information-seeking Behaviour in Fisheries Technology

During the period January 1981 to December 1981,514 technical queries were received. The largest number (39.11%) was received during April-July 1981. The number of queries received declined from 8.17% in January to 2.14% in December. The largest number of queries were received in July (10.89%), the second largest in April (10.31%). The number of queries declined suddenly from 7.59% in November to 2.14%

in December. The queries from foreign countries were 3.5%. Among the Indian States, some of the top ones are Kerala (34.82%), Tamil Nadu (9.92%), Delhi (8.95%), Karnataka (8.56%) and Maharashtra (7.00%). Subject-matter-wise distribution of the queries is as under: Publications (16.67%), Analysis pertaining to fish processing (13.57%), Training (12.21%), Engineering and Engine testing (6.78%), Fish by-products (6.59%), Fishing craft (5.43%), and Fishing gear (5.04%): (for this analysis, N = 516, as some parties asked for information under more than one subject). Complete replies were sent for 93% and partial replies for 7% of the queries. The average number of days taken in replying was 23.45 with S.D. = 15.82.

SCIENTISTS ASSOCIATED

COCHIN: Dr. P. N. Kaul, Mary Thomas

Adoption in Innovations Developed at CIFT

RESEARCH IN HAND

Pre-testing of the questionnaire prepared for collecting information on adoption of CIFT designs of fishing boats was completed and the same modified for printing. A similar questionnaire on adoption of gear designs is also being finalised.

As regards study on the technological gap among traditional and mechanised fishing boat owners, data have been collected from 80 traditional fishing boat owners in Kerala and 70 in Karnataka, as also from 45 mechanised boat owners in Kerala and 70 boat owners in Karnataka. The data collected are under analyses.

Recommended practices with respect to quality control of seafoods are being sorted out for study. A questionnaire on frogleg processing was drafted and the list of extension trainings conducted so far finalised. Preliminary investigations have revealed that a number of parties have adopted our technologies with respect to manufacture of chitosan, fish wafers, fish soup powder, fish pickle etc.

RESEARCH CONTEMPLATED

Further studies on extent of adoption of CIFT designs of fishing craft and gear, technological gap among traditional and mechanised fishing boat owners and other aspects

SCIENTISTS ASSOCIATED

COCHIN: Dr. P. N. Kaul, M. K. Kandoran, H. Krishna Iyer, A. K. Kesavan Nair, Mary Thomas, S. Balasubramaniam, Dr. G. R. Desai

Ad-hoc Training

Subject/Area	*Place*	*Duration*	*No. of trainees*
Processing and canning crab meat.	Cochin	5 days	1
Preparation of fish wafers, soup powder and fish pickle.	Cochin	5 days	2
—do—	Cochin	9 days	3
Processing mussel meat.	Calicut		3
Microbiological analysis of seafoods.	Cochin	15 days	1
—do—	Cochin	1 month	2
—do—	Cochin	1½ months	8
Bacteriology and quality control of seafoods.	Cochin	2 weeks	1
Dry curing of fish.	Cochin	40 days	3
Dry curing of fish.	Calicut		
Trawl fishing in reservoir (3rd batch).	Burla (Orissa)	10 days	17
US FDA Quality Control Methodology for fish processing technologists (with MPEDA collaboration)	Cochin	3 batches, each of 10 days duration	47
Handling practices of fish and shell fish.	Cochin	2 batches of 5 days each	
Fish preservation and processing (Organised by MPEDA)	Junput (West Bengal)	3 days	

Radio Talk

Shri S. Ayyappan Pillai, Scientist S-2, delivered a talk on 'The Role of Engineering in Fish Processing' over All India Radio, Trichur.

5. STATISTICS

CHIEF FINDINGS

The idle capacity of fish processing (freezing) plants in India for the years 1980 *and* 1981 *were estimated by taking into account* 250 *normal working days and double shift per day. The all India estimate of idle capacity of the plants for* 1980 *and* 1981 *were* 71.7% *and* 67.8% *respectively. A decreasing trend was observed in the idle capacity. Plants under* 5 *tonnes capacity per day were seen having comparatively less idle capacity. Shortage of raw material (shrimps) for processing was the prime factor responsible for the idle capacity of the plants.*

A mathematical model for working out the economics of operation of smaller trawlers was developed and using this model the break-even points for 32' *and* 36' *trawlers operating along Kerala Coast were worked out.*

The total quantity of raw material received by the processing plants at Cochin and Kakinada for the year 1981 *worked out to be* 27,104 *and* 2,767 *tonnes respectively.*

For comparing the efficiency of fishing gears using analysis of variance-F test, about 35 *sets of comparable hauls were found sufficient for sets of data for which standard error per unit as percent of the mean (after logarithmic transformation) was* 30% *or less. Wilcoxon's matched-pairs signed-rank test was found to be as sensitive as or more sensitive than analysis of variance-F test when both tests were applied to several sets of data for comparing the efficiency of two gears. The existence of a critical number of fish in the fishing area was found to be required for comparing the efficiency on the basis of catch data.*

RESEARCH IN HAND

The state-wise, coast-wise and all India estimates of idle capacity of fish processing plants were estimated using a stratified sampling plan for the years 1980 and 1981. A decreasing trend in the idle capacity was observed in plants situated in both east and west coasts. The estimate of idle capacity based on 250 normal working days in a year and double shift per day for the years 1980 and 1981 for the west coast was 71.7% and 67.4% respectively and for the east coast 71.7% and 69.1% respectively. The all India estimate of idle capacity for the two years were respectively 71.7% and 67.8%. Among different strata, plants above 10 tonnes capacity per day were found to have the maximum idle capacity and plants under 5

tonnes daily capacity comparatively low idle capacity. The percentage error of estimates of idle capacity worked out for the years 1980 and 1981 were 4.3 and 4.7 respectively. Substantial under-utilisation of plants in both the coasts were attributable mainly to the non-availability of raw material. Apart from this, high cost of production, shortage of power, scarcity of ice and potable water during peak season were found to be the major constraints faced by the processing plants.

A mathematical model for working out the economics of operation of small fishing trawlers was developed, based on which, the profit of 32' and 36' trawlers of over all length were worked out. The profits of 32' and 36' trawlers for one full fishing season were worked out to be 26.9% and 21.7% respectively on the basis of 225 fishing trips in a year. The break-even points of these two size of trawlers lie between 175 and 185 fishing trips in a year. Fuel alone contributes to nearly 45% of the cost of operation of the boat.

A proforma for collection of data regarding the study on "role of women in the fish processing industry" was prepared and data collection initiated.

The total quantity of raw material received by the processing plants located at Cochin and Kakinada for the year 1981 worked out to be 27,104 and 2,767 tonnes respectively. The plants at Cochin received 17,911 tonnes (comprising 66% of the total quantity) from centres near about Cochin and the rest from other places. The material was mostly PD, PUD and head-less shell-on prawns, followed by froglegs, cuttlefish and squids. 2,057 tonnes of material, of which 2,026 tonnes were forglegs, was received from other states. At Kakinada, almost the entire quantity of material was received from local centres itself and consisted of head-on, headless and PD, PUD prawns.

The problems involved in applying analysis of variance-F test for comparing the efficiency of fishing gears were investigated. In the light of the results of the study, an investigation on the existence of a critical number of fish in the fishing area for comparison of the efficiency of fishing gears was also made. A search for a suitable test procedure was made by comparing the sensitivity of the tests when applied to several sets of data.

Research Contemplated

The above studies will be continued.

Persons Associated

COCHIN: K. Krishna Rao, H. Krishna Iyer, A. K. Kesavan Nair, G. R. Unnithan, P. Srinivasa Rao, R. G. Nair, P. J. Cecily, Dr. P. T. Lakshmanan

VERAVAL:	Anil Agarwal
KAKINADA:	R. Chakraborthy
BOMBAY:	T. S. G. Iyer

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About 86 papers as listed below were also presented by the staff of this Institute at the Symposium on Harvest and Post-Harvest Technology of Fish held during 24-27 November 1982 at Cochin.

45. *Ali, S. M. S. Abuthahir & Thankappan, T. K.* - Pilot plant for the production of shrimp extract.

46. *Ammu, K. Devadasan, K. & Antony, P. D.* - Change in nicotinic acid content during chilled storage of fishes and shell fishes.

47. *Bandhyopadhyay, J. K., Chattopadhyay, A. K. & Bhattacharya, S. K.* - Studies on the iced storage characteristics of commercially important fresh water fishes.

48. *Bhattacharyya, S. K., Bandhyopadhyay, J. K. & Chattopadhyay, A. K.* - Improved dried product on blanching of *Gudusia chapra* prior to sun drying.

49. *Cecily, P. J. & Radhalekshmy, K.* - Synthetic fibres in Indian fishing industry.

50. *Chakraborty, P. K.* - Design of semi-commercial plant for the production of shark liver oil.

51. *Chattopadhyay, A. K., Bhattacharyya, S. K. & Bandhyopadhyay, J. K.* - Development of pickled products from low cost fresh water fishes.

52. *Devadasan, K. (Reppen, A. T. & Johannes Opstvedt)* - Rate of abomassum emptying in kids fed on fish proteins subjected to heat treatment under different conditions.

53. *Devadasan, K. (Reppen, A. T. & Johannes Opstvedt)* - Influence of the fat content of raw material used for the manufacture of fish protein concentrates on the nutritional quality of the protein.

54. *Garg, D. K. & Jose Stephen* - Iced storage of ghol (*Pseudosciaena diacanthus*) fillets.

55. *Garg, D. K. & Jose Stephen* - Frozen storage studies of Rawas (*Eleutheronema tetradactylus*).

56. *George Chinnamma, Vijayan, P. K. & Perigreen, P. A.* - Utilization of frozen stored oil sardine for canning.

57. *George, V. C.* - The lure and lift net fishing techniques off Coromandal coast, Tamil Nadu, India.

58. *George, V. C., Khan, A. A., Varghese, M. D. & Percy Dawson* - Trends in reservoir fishing technology research in India.

59. *Gopal, T. K. Srinivasa, Balachandran, K. K., Surendran, P. K. & Govindan, T. K.* - Development of flexible packaging for mussel pickle in oil.

60. *Gopal, T. K. Srinivasa & Govindan, T. K.* - A study on physical properties of strapping materials used in frozen shrimp industry and the effect of frozen storage on them.

61. *Govindan, T. K.* - Handling and transportation of fresh fish in India.

62. *Hridayanathan, C. & Kartha, K. N.* - On the performance of bulged belly trawls from larger vessels.

63. *Iyer H. Krishna, Srinivasa Rao, P., Unnithan, G. R., Kesavan Nair, A. K. & Nair, R. G.* - Economics of operation of fishing vessels (trawlers).

64. *Iyer, H. Krishna, Srinivasa Rao, P., Unnithan, G. R., Kesavan Nair, A. K. & Nair, R. G.* - Idle capacity of fish processing (Freezing) plants in India - comparative study of plants in east and west coasts.

65. *Iyer, T. S. Gopalakrishna.* - On the isolation of *Salmonella alachua, S. muenchen* and *S. estabourne* from fresh fish.

66. *James, M. A., Iyer, T. S. G. & Panduranga Rao, C. C.* - Survival of *Salmonella* in shrimp and frog legs.

67. *Joseph, A. C. & Solanki, K. K.* - Frozen storage characteristics of shark (*Scoliodon laticaudus*).

68. *Joseph Jose* - Effect of superchilling on the quality of cod fillets.

69. *Joshi, P. N.* - Design and fabrication of a tilting kettle for fish processing industries.

70. *Joshi, P. N., Ravindran, K. & (Namboodiri, A. J. P.)* - Investigations on selected mechanical properties of ferrocement and polymer incorporated ferrocement.

71. *Kartha, K. N.* - Midwater trawling - A review.

72. *Kartha, K. N., George, T. P. & Sadanandan, K. A.* - Development of split belly trawls.

73. *Kartha, K. N. & Sadanandan, K. A.* - Two-boat midwater trawling along the South-West coast of India.

74. *Kaul, P. N. & Balasubramaniam, S.* - Personal and socio-economic correlates of adoption of improved fish curing practices.

75. *Lakshmanan, P. T. & (Krishnan Nambisan, P. N.)* - Uptake and loss of mercury in three bivalve molluscs, namely *Perna viridis* (Linnaeus) *Vellorita cyprinoides var. Cochinensis* and *Meretrix casta* (Chemnitz).

76. *Lalitha, K. V. & Mahadeva Iyer, K.* - Use of catalase values as an index of quality of oil sardine (*Sardinella longiceps*) in ice storage.

77. *Mathai, P. George, George, T. P. & Kuttappan, A. C.* - Studies on indigenous fishing gear - Thanguvala - Introduction of knotless webbing and its operation from motorised crafts.

78. *Mathew, P. T., Ramachandran Nair, K. G. & Madhavan, P.* - Formulation of artificial diets for common carp (*Cyprinus carpio*).

79. *Mukundan, M. K., Gopakumar, K. & Nair, M. R.* - Properties of immobilised lipase.

80. *Mukundan, M. K., Radhakrishnan, A. G., James, M. A.. & Nair, M. R.* - Nutritive value of red and white meat of oil sardine (*Sardinella longiceps*)

81. *Naidu, R. M.* - Catch efficiency of trammel nets in relation to twine size and hanging coefficient.

82. *Nair, A. K. Kesavan & (Alagaraja, K.)* - Statistical studies on gear efficiency.

83. *Nair, A. Lekshmy, Mathew, P. T. & Prabhu, P. V.* - Studies on hydrolysates from Jewfish (*Johnius* sp) waste.

84. *Nair, A. Lekshmy, Mathew, P. T. & Prabhu, P. V.* - Nutritional evaluation of products from squilla.

85. *Nair, K. G. Ramachandran & Gopakumar, K.* - Influence of habitat on the fatty acid composition of Tilapia (*Tilapia mossambica*).

86. *Nair, N. Unnikrishnan, Gopalakrishna Pillai, A. G., Ravindran, K. & Balasubramanyan, R.* - Wood preservation - An appropriate technology for the use of the small scale fishermen.

87. *Nair, P. G. Viswanathan, Devadasan, K. & Antony, P. D.* - Hypocholesterolemic effect of fish proteins and fish oils in albino rats.

88. *Nair, P. G. Viswanathan & Nair, M. R.* - Fatty acid compositions of muscle and skin lipids of oil sardine.

89. *Namboodiri, K. Sreedharan* - Development of a fish pump.

90. *Namboodiri, K. Sreedharan & Velu, M.* - Development of an aquatic weed harvester.

91. *Narayanappa, G., Rama Rao, S. V. S., Sitaramarao, J., Naidu, R. M. & Satyanarayana, A. V. V.* - An account of trawl fishing off Kakinada.

92. *Narayanappa, G., Rama Rao, S. V. S., Sitaramarao, J., Naidu, R. M. & Satyanarayana, A. V. V.* - Studies on high opening trawl-relative efficiency with bulged belly trawl.

93. *Nayar, S. Gopalan, Radhalekshmy, K & Meenakumari, B.* - Polypropylene netting yarns.

94. *Panicker, P. Appukutta* - Pelagic fishery resources and exploitation along Karnataka Coast - An assessment.

95. *Panicker, P. Appukutta.* - An economic analysis of purse seining from 13.25 m. purse seiner and from artisanal fishing craft 'Thunguvallam' along the Kerala Coast.

96. *Panicker, P. Appukutta, Sivan, T. M. & George, N. A.* - A new fishing gear for traditional craft.

97. *Pillai, A. G. Gopalakrishna & Ravindran, K.* - On the design and formulation of zinc rich paint and its evaluation by electrochemic and other accelerated tests.

98. *Pillai, N. Subramonia, Manohara Doss, R. S., Vijayan, V., Hridayanathan, C. & Gopalan Nayar, S.* - On the comparative efficiency of three different trawls suitable for the exploitation of the shallow water mix.

99. *Pillai, S. Ayyappan.* - Mechanisation of traditional fishing vessels in the South-West Coast of India.

100. *Radhakrishnan, A. G., Antony, P. D. & Nair, M. R.* - Change in major protein fractions of oil sardine (*Sardinella longiceps*) and mackerel (*Rastrelliger kanagurta*) during frozen storage.

101. *Radhakrishnan, A. G., Antony, P. D. & Nair, M. R.* - Heat coagulation studies on mixed systems of actomyosin and sarcoplasmic protein.

102. *Radhakrishnan, A. G., Jose Stephen, Mukundan, M. K. & James, M. A.* - Chemical composition of some food fishes.

103. *Radhalekshmy, K., & Gopalan Nayar, S.* - Fishing experiments with newer gear materials.

104. *Rama Rao, S. V. S., Narayanappa, G., Sitaramarao, J., Naidu, R. M. & Satyanarayana, A. V. V.* - On the relative efficiency of Mexican and conventional Otter boards.

105. *Rama Rao, S. V. S., Satyanarayana, A. V. V., Sitaramarao, J., Naidu, R. M. & Narayanappa, G.* - An appraisal of twin trawling with sled along the East coast.

106. *Rao, K. Krishna & Unnithan, G. R.* - Transportation of fish - Mathematical models for the expenditure pattern.

107. *Ravindran, K. Gopalakrishna Pillai, A. G. & Balasubramanyan, R.* - Corrosion behaviour of metallic fastening in contact with wood.

108. *Ravindran, K., Rani Mary Jacob & Unnikrishnan Nair, N.* - Elastometric antifouling antiboring coating - a novel approach.

109. *Ravindran, K., Unnikrishnan Nair, N. & Gopalakrishna Pillai, A. G.* - Copper creosote - A new preservative for marine wooden structures.

110. *Sanjeev, S., James, M. A. & Mahadeva Iyer, K.* - Incidence and growth of coagulase positive *Staphylococci* in cooked, picked and frozen crab meat.

111. *Satyanarayana, A. V. V., Gopalakrishnan, K. & Rama Rao, S. V. S.* - On the scope ratio studies in trawling off Kakinada (A.P.) on the East Coast of India.

112. *Sitaramarao, J., Satyanarayana, A. V. V. et al* - Indigenous fishing gear of Andhra Coast.

113. *Sivadas, T. K.* - Marine environmental monitoring systems for investigations in fisheries and allied fields.

114. *Sivadas, T. K. Ramakrishnan, K. & Vijayabharathi, K.* - Electronic instruments for testing and standardisation of fishing crafts.

115. *Sivadas, T. K., Vijayabharathi, K. & Ramakrishnan, K.* - Electronic wire telemetering instruments for the engineering studies of otter trawls.

116. *Solanki, K. K.* - Level of uric acid content as an index of unhygienic conditions and acceptability of insect infested fish products.

117. *Surendran, P. K. & Gopakumar, K.* - Preservation of oil sardine with propyl paraben dips.

118. *Surendran, P. K. & Gopakumar, K.* - Spoilage potential of marine bacteria.

119. *Surendran, P. K. & Mahadeva Iyer, K.* - Iced storage characteristics of pearl spot (*Etroplus suratensis*) caught from Cochin backwaters.

120. *Thampuran Nirmala & Mahadeva Iyer, K.* - Evaluation of certain factors affecting the TPC of frozen seafoods.

121. *Thankamma, R., Lekshmy Nair, A. & Madhavan, P.* - Nutritional quality of shrimp extract powder.

122. *Thankappan, T. K. & Madhavan, P.* - A comparative study on chitosan with reference to yield and viscosity.

123. *Thomas Francis & Varma, P. R. G.* - Filth in frozen shrimp.

124. *Valsan, A. P.* - Further steps to improve and economise the use of propionates in the preservation of cured fish.

125. *Valsan, A. P.* - Control of insect infestation in dry Bombay duck.

126. *Valsan, A. P., Nambiar, V. N., Damle, S. P., Garg, D. K., Gopalakrishna Iyer, T. S. & Vasu, N. M.* - Technological investigations on non-penacid prawn fishery - Quality survey of dry non-penacid prawn of Bombay markets.

127. *Varma, P. R. G., Cyriac Mathen & Annamma Mathew.* - Bacteriological quality of frozen seafoods for export with special reference to *Salmonella*.

128. *Varma, P. R. G., Cyriac Mathen & Francis Thomas.* - Use of freshness meters for quality assessment of tropical fishes.

129. *Vijayan, P. K. & Balachandran, K. K.* - Canning mackerel (*Rastrelliger kanagurta*) as fillets in oil.

130. *Vijayan, V., Joseph Mathai, T. & Mhalathkar, H. N.* - Studies on bridle length for 10.3 m unequal panel midwater trawl.

7. APPENDICES

APPENDIX - I

HEADQUARTERS: CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY,
Willingdon Island, Matsyapuri, P.O.
Cochin, P.C. 682 029, Kerala

TLX No. 0885-440

Telephone No. 6845 (10 lines)

Telegram: MATSYAOUDYOGIKI or
FISHTECH, COCHIN

Director's Telephone: Per: 6880

DIRECTOR		Dr. C. C. Panduranga Rao
	Scientist-in-Charge	
Biochemistry & Nutrition Division	..	Shri M. Rajendranathan Nair
Processing & Packaging Division	..	Dr. K. Gopakumar
Microbiology Division	..	Shri K. Mahadeva Iyer
Craft Division	..	Shri R. Balasubramanian
Gear Division	..	Shri V. C. George
Engineering Division	..	Shri S. Ayyappan Pillai
Electronics & Instrumentation Division	..	Shri T. K. Sivadas
Extension, Information & Statistics Division	..	Dr. P. N. Kaul

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 - 362 265, Gujarat	297	MATSYAOUDYOGIKI	Shri K. K. Solanki
2.	**KAKINADA**	Research Centre of CIFT D. No. 54-2-9, Yesuvari St., Jagannaickpur, Kakinada-533 002 Andhra Pradesh	4436	MATSYAOUDYOGIKI	Shri G. Narayanappa
3.	**BURLA**	Research Centre of CIFT Burla P.O. 768 017 Sambalpur Dist., Orissa	19	MATSYAOUDYOGIKI	Shri K. A. Sadanandan
4.	**BOMBAY**	Research Centre of CIFT 162, Sassoon Dock, Colaba, Bombay-400 005, Maharashtra	213892	FISHPROCESS (FT)	Shri V. Narayanan Nambiar
5.	**CALICUT**	Research Centre of CIFT Beach Road, West Hill, Calicut-673 005, Kerala	76607	CARE 'KADALMIN'	Shri T. S. Unnikrishnan Nair
6.	**GOA**	Research Centre of CIFT 2nd Floor, 'Shanta' 18th June Road, St. Inez, Panaji-403 001, Goa	5905	MATSYAOUDYOGIKI	Shri H. N. Mhalathkar

APPENDIX - II

List of Personnel in C. I. F. T. as on 31-3-'83.

SCIENTIFIC PERSONNEL

DIRECTOR

Dr. C. C. Panduranga Rao
(officiating)

Scientist S-3

1. Shri M. Rajendranathan Nair
2. Dr. K. Gopakumar
3. Shri R. Balasubramanian
4. Dr. P. N. Kaul
5. Shri T. K. Govindan
6. Shri P. V. Prabhu
7. Shri K. Mahadeva Iyer
8. Shri T. S. Gopalakrishna Iyer

Scientist S-2

1. Shri K. Devadas
2. Shri S. Ayyappan Pillai
3. Shri V. C. George
4. Shri K. A. Sadanandan
5. Shri C. V. N. Rao
6. Shri K. K. Balachandran
7. Shri P. Madhavan
8. Dr. K. Ravindran
9. Shri K. Sreedharan Namboodiri
10. Shri T. K. Sivadas
11. Shri M. Arul James
12. Shri P. D. Antony
13. Shri P. K. Chakraborty
14. Shri M. K. Kandoran
15. Shri H. Krishna Iyer
16. Shri K. Krishna Rao
17. Shri H. N. Mhalathkar
18. Shri P. Appukutta Panicker
19. Shri K. K. Solanki
20. Shri G. Narayanappa
21. Shri P. A. Perigreen
22. Shri A. K. Kesavan Nair

Scientist S-1

1. Shri P. N. R. Kaimal
2. Smt. Chinnamma George
3. Shri K. K. Kunjipalu
4. Shri T. S. Unnikrishnan Nair
5. Shri P. R. Girija Varma
6. Shri V. Narayanan Nambiar
7. Smt. Mary Thomas
8. Shri A. Vasanth Shenoy
9. Shri A. G. Radhakrishnan
10. Dr. P. K. Surendran
11. Shri K. G. Ramachandran Nair
12. Shri Sibsankar Gupta
13. Shri P. N. Joshi
14. Dr. Jose Stephen
15. Smt. Lekshmy Nair
16. Shri T. Joseph Mathai
17. Shri N. Unnikrishnan Nair
18. Shri K. N. Kartha

19. Shri A. G. Gopalakrishna Pillai
20. Shri N. Subramania Pillai
21. Shri Anwar Ahmed Khan
22. Shri J. Sitarama Rao
23. Shri S. V. S. Rama Rao
24. Shri V. Vijayan
25. Shri A. C. Joseph
26. Shri V. Muraleedharan
27. Shri P. George Mathai
28. Shri T. P. George
29. Shri P. K. Vijayan
30. Shri K. Ramakrishnan
31. Smt. K. Vijayabharathy
32. Shri P. G. Viswanathan Nair
33. Shri Jose Joseph
34. Shri T. K. Thankappan
35. Smt. Nirmala Thampuran
36. Shri P. T. Mathew
37. Dr. M. K. Mukundan
38. Shri H. K. Beri
39. Shri S. M. S. Abuthahir Ali
40. Shri T. K. Srinivasa Gopal
41. Shri Subrata Basu
42. Shri Imam Khasim Saheb
43. Kumari B. Meena Kumari
44. Shri K. V. Mohan Rajan
45. Shri M. R. Boopendranath
46. Shri Francis Thomas
47. Shri P. Srinivasa Rao
48. Shri G. Rajagopalan Unnithan
49. Shri K. George Joseph
50. Smt. K. Ammu
51. Shri S. Sanjeev
52. Dr. P. T. Lakshmanan
53. Shri Rup Sankar Chakraborty
54. Shri Anil Agarwal
55. Shri S. P. Damle
56. Shri S. K. Bhattacharya
57. Shri J. K. Bandhyopadhyay
58. Smt. K. V. Lalitha
59. Shri P. Ravindranathan Nair
60. Shri S. Balasubramaniam
61. Shri M. R. Raghunath
62. Shri A. K. Chathopadhyay
63. Shri N. Kalaimani
64. Shri R. Mangayya Naidu
65. Shri K. P. Antony
66. Dr. M. D. Varghese
67. Shri Percy Dawson
68. Shri Dinesh Kumar Garg
69. Dr. Gopal Rao Desai

Scientist S

1. Shri M. Sayed Abbas
2. Shri A. C. Kuttappan
3. Smt. R. Thankamma

TECHNICAL PERSONNEL

Technician T-7

1. Shri K. S. Ganesan . . Workshop Engineer
2. Shri M. S. Fernando . . Skipper
3. Shri A. P. Jayaprakash . . Skipper
4. Shri K. J. Francis Xavier . . Skipper

Technician T-6

1. Shri A. V. V. Satyanarayana	..	Technical Officer (Fish)
2. Shri S. Gopalan Nair	..	Technical Officer (Fish)
3. Shri A. P. Valsan	..	Technical Officer (Fish)
4. Smt. P. J. Cecily	..	Jr. Technical Officer
5. Shri K. C. Purushothaman	..	Editor-cum-Information Officer

Technician T-5

1. Shri T. M. Sivan	..	Asst. Technical Officer (Fish)
2. Smt. K. Radhalekshmy	..	Asst. Technical Officer (Fish)
3. Shri N. A. George	..	Asst. Technical Officer (Fish)
4. Shri M. S. Rajan	..	Fishing Mate
5. Shri N. Sriharshan	..	Engineer
6. Shri V. K. Ibrahim	..	Head Draughtsman
7. Smt. T. T. Annamma	..	Sr. Tech. Assistant
8. Shri K. Vasudevan Nair	..	Sr. Tech. Assistant
9. Smt. Annamma Mathew	..	Sr. Tech. Assistant

Technician T-4

1. Shri Varghese Paul	..	Technical Assistant
2. Shri A. Kassim Kunju	..	Technical Assistant
3. Shri C. Chandrasekharan	..	Superintendent (E & M)
4. Shri N. Vareethiah	..	Glass Blower
5. Shri K. Bhaskaran	..	Photographer-cum-Artist
6. Shri G. Mohanan	..	Artist
7. Shri P. Ravindranathan	..	Sr. Library Assistant
8. Shri O. Subramanian	..	Sr. Welder
9. Shri K. K. Poulose	..	Instrument Technician

Technician T-II-3

1. Shri P. Sadanandan	..	Technical Assistant
2. Shri Thomas J. Mammoottil	..	Technical Assistant
3. Shri M. K. Sasidharan	..	Technical Assistant
4. Shri V. Gopalakrishna Pillai	..	Technical Assistant
5. Shri T. John	..	Technical Assistant
6. Shri A. Veerajaneyulu	..	Technical Assistant
7. Shri V. V. Ramakrishna	..	Technical Assistant
8. Shri G. P. Vaghela	..	Technical Assistant
9. Shri P. T. Sebastian	..	Technical Assistant

10.	Shri V. Gaspar	..	Technical Assistant
11.	Shri N. M. Vasu	..	Technical Assistant
12.	Shri T. K. Sayed Ali	..	Technical Assistant
13.	Shri Stanislas Kiro	..	Technical Assistant
14.	Shri Baikunta Pradhan	..	Technical Assistant
15.	Shri J. B. Paradwa	..	Technical Assistant
16.	Shri D. K. Ukabhai	..	Technical Assistant
17.	Shri C. Srihari Babu	..	Technical Assistant
18.	Shri P. S. Alias	..	Superintendent (Instrumentation)
19.	Shri M. L. Anslem	..	Sr. Draughtsman
20.	Shri M. Abdul Sathar	..	Media Supervisor
21.	Shri B. Anandan	..	Foundry Assistant
22.	Shri R. Gopalakrishnan Nair	..	Computor
23.	Shri M. U. Vijayan	..	Sr. Mechanic
24.	Shri T. K. David	..	Fitter

Technician T-I-3

1.	Shri K. J. Augustine	..	Sr. Turner
2.	Shri M. R. Nair	..	Bosun
3.	Shri A. K. Jaisingh	..	Bosun
4.	Shri A. B. Varghese	..	Bosun
5.	Shri S. Laxmanadu	..	Bosun
6.	Shri S. R. Jethwa	..	Sr. Mechanic
7.	Shri T. S. Bhaskara Menon	..	Sr. Mechanic
8.	Shri K. E. Mani	..	Sr. Mechanic
9.	Shri P. M. Joseph	..	Machinist
10.	Shri A. K. Dharaneedharan	..	Media Assistant
11.	Shri K. K. Subramanian	..	Engine Driver
12.	Shri K. V. Baladasan	..	Engine Driver
13.	Shri Mohammed Jaffar	..	Engine Driver
14.	Shri V. V. Johni	..	Sr. Field Assistant
15.	Shri V. K. Ramachandran	..	Sr. Lab. Assistant
16.	Shri E. K. Balakrishnan	..	Draughtsman
17.	Smt. K. Sarasamma	..	Draughtsman
18.	Shri G. Ratnakaran Nair	..	Refrigeration Mechanic
19.	Shri M. M. Devassya	..	Jr. Library Assistant
20.	Shri V. Veer Raju	..	Tindal
21.	Shri Gurdas Ram	..	Tindal

Technician T-2

1.	Shri Koruthu George	..	Engine Driver
2.	Shri M. M. Vara	..	Sr. Field Assistant

3.	Shri N. Babu Rao	..	Sr. Field Assistant
4.	Shri M. K. Kuttikrishnan Nair	..	Sr. Field Assistant
5.	Shri P. K. Damodaran	..	Sr. Lab. Assistant
6.	Shri P. M. Pattanayak	..	Sr. Lab. Assistant
7.	Shri T. Gangadharan	..	Sr. Lab. Assistant
8.	Shri Shaju A. Averah	..	Draughtsman
9.	Shri Shanmugavel	..	Refrigeration Mechanic
10.	Shri C. Rajendran	..	Refrigeration Mechanic
11.	Shri Jose Kalathil	..	Refrigeration Mechanic
12.	Shri N. A. Kunhikannan	..	Refrigeration Mechanic
13.	Shri K. V. Madhavan	..	Electrician
14.	Shri C. C. Sivan	..	Welder-cum-Blacksmith
15.	Shri K. V. Rajan	..	Jr. Lab. Assistant
16.	Shri B. Ramaiah	..	Jr. Lab. Assistant
17.	Shri K. B. Thilakan	..	Jr. Lab. Assistant
18.	Shri T. K. Bhaskaran	..	Jr. Lab. Assistant
19.	Shri N. J. Tandel	..	Driver (Launch)
20.	Shri K. K. Pappukutty	..	Driver (Launch)
21.	Shri T. Gopalakrishnan	..	Metal worker
22.	Shri P. A. John	..	Tindal
23.	Shri T. N. Manibhadran	..	Tindal

Technician T-1

1.	Shri T. K. Vasudevan	..	Jr. Lab. Assistant
2.	Shri T. K. Aravindakshan	..	Jr. Lab. Assistant
3.	Smt. K. K. Sumathy	..	Jr. Lab. Assistant
4.	Smt. Florence Joseph	..	Jr. Lab. Assistant
5.	Shri Kadermiyan Umermiyan	..	Jr. Lab. Assistant
6.	Shri D. R. Aparnathi	..	Jr. Lab. Assistant
7.	Smt. Tara Karupalli	..	Jr. Lab. Assistant
8.	Smt. M. K. Sreelekha	..	Jr. Lab. Assistant
9.	Shri O. M. Samuel	..	Jr. Lab. Assistant
10.	Shri G. M. Vaghela	..	Jr. Lab. Assistant
11.	Shri Damodar Rout	..	Jr. Lab. Assistant
12.	Shri K. V. S. S. S. Kusuma Haranath	..	Jr. Lab. Assistant
13.	Shri V. V. John	..	Jr. Lab. Assistant
14.	Shri A. A. Kunjappan	..	Field Assistant
15.	Shri N. Venkata Rao	..	Field Assistant
16.	Shri Radhupandey	..	Driver (Launch)
17.	Shri Prakash Rao	..	Driver (Launch)
18.	Shri Satrugan Kumura	..	Tindal
19.	Shri A. P. Joshi	..	Tindal
20.	Shri K. K. Narayanan	..	Boilerman

ADMINISTRATIVE PERSONNEL

Sr. Administrative Officer
Shri K. M. Mathai

Administrative Officer
Shri P. James Abraham

Asst. Administrative Officer
Shri Varghese Paul

Accounts Officer
Shri K. T. Abubacker

Asst. Accounts Officer
Shri S. P. Nair

Superintendent

1. Shri P. J. Joseph
2. Smt. T. N. Ambujakshy Amma
3. Shri P. A. Uthup
4. Shri M. George Joseph
5. Shri S. Naveenchandra Prabhu
6. Smt. K. A. Devaky

Sr. Stenographer

Shri K. J. Thomas

Assistant

1. Smt. Alice M. Joseph
2. Smt. Nafeesa Ali
3. Shri A. George Joseph
4. Shri R. Anil Kumar
5. Shri P. Vasudevan
6. Shri T. M. Padmanabhan
7. Smt. N. K. Sulochana
8. Smt. T. K. Sarala
9. Shri R. S. Shanmugan
10. Shri A. L. John

Stenographer

1. Smt. Mariamma Sadanandan
2. Shri K. Ravindran
3. Smt. N. K. Saraswathy

Sr. Clerk

1. Shri M. Gopalakrishnan
2. Shri M. T. Joseph
3. Shri V. N. Rajasekharan Nair
4. Shri P. Vijayan
5. Shri A. K. Venugopal
6. Shri M. J. Sebastian
7. Shri M. Ravindran
8. Smt. Annamma Varghese
9. Smt. C. G. Mary Kutty
10. Smt. M. S. Susanna
11. Smt. N. Prabhavathy Amma
12. Shri C. Ravindran Nair

13. Smt. K. R. Gita Rani
14. Shri N. Venugopalan
15. Shri T. M. Ramraj
16. Shri Y. W. Mhadgut
17. Shri M. Balan Nambiar
18. Shri G. Somappan
19. Shri K. Bhaskaran
20. Smt. M. Jully
21. Shri Y. Philipose
22. Smt. M. A. Prasanna
23. Shri R. Viswanathan

Jr. Stenographer

1. Smt. R. Vasantha
2. Shri P. K. Raghu
3. Kum. S. Kamalamma
4. Kum. V. P. Vijayakumari
5. Shrl K. Venugopalan

Jr. Clerk

1. Shri Veer Singh
2. Shri V. R. Kesavan
3. Smt. Smitha K. Shirishkar
4. Smt. K. A. Nazeem
5. Shri A. B. Rodrigues
6. Shri T. Veerabhadra Rao
7. Shri P. K. Sreedharan
8. Smt. K. Gracy
9. Smt. B. Hemaletha
10. Shri P. V. Venugopalan
11. Shri K. P. Velayudhan
12. Smt. T. K. Susannamma
13. Smt. P. C. Kamalakshy
14. Shri P. K. Sankarakutty
15. Shri K. Rajappan Pillai
16. Smt. N. I. Mary
17. Shri Gopal Chandra Adhikari
18. Shri Satish Chandra B. Purohit
19. Shri M. M. Damodara
20. Shri P. K. Thomas
21. Kum. P. K. Thankamma
22. Shri Udekar Pandey
23. Kum. A. A. Cousallia
24. Shri K. K. Sasi

Telephone Operator-cum-Receptionist

Shri P. Bahuleyan

Caretaker

Shri A. Chakrapani

Auxiliary Personnel

1. Smt. T. L. Hemalatha .. Hindi Translator
2. Shri V. S. Augustine .. Sr. Carpenter
3. Shri Philip Durom .. Sr. Carpenter
4. Shri Joseph Paul .. Carpenter
5. Shri A. Gopalakrishnan Nair .. Staff Car Driver

6.	Shri P. P. Poulose	.. Staff Car Driver
7.	Shri M. G. Narayanan Nair	.. Driver
8.	Shri V. P. Raphel	.. Driver
9.	Shri M. Venkateswara Rao	.. Driver
10.	Shri Narasingh Panda	.. Driver
11.	Shri T. Neelakandan	.. Projector Operator
12.	Shri C. C. Gandhi	.. Plant Attendant
13.	Shri N. C. Bhaskaran	.. Plant Attendant
14.	Shri K. R. Kesavan	.. Plant Attendant
15.	Shri G. B. Tandel	.. Deck hand
16.	Shri K. K. Lakshmanan	.. Deck hand
17.	Shri T. Balan	.. Deck hand
18.	Shri H. M. Kotiya	.. Deck hand
19.	Shri P. K. Pushpangadan	.. Deck hand
20.	Shri K. Sarangadharadu	.. Deck hand
21.	Shri G. R. Bhogte	.. Deck hand
22.	Shri T. K. Dasan	.. Deck hand
23.	Shri Malam Bachu Sidi	.. Deck hand
24.	Shri K. Ganga Raju	.. Deck hand
25.	Shri T. K. Bava	.. Deck hand
26.	Shri E. K. Chinnappan	.. Deck hand
27.	Shri M. K. Asokan	.. Deck hand
28.	Shri D. G. Rao	.. Deck hand
29.	Shri G. Subba Rao	.. Cook
30.	Shri E. R. Krishnan	.. Cook
31.	Shri T. A. Francis	.. Cook
32.	Shri G. L. Tandel	.. Cook

SUPPORTING STAFF

Supporting Staff Grade IV

1. Shri S. S. Salvi
2. Shri B. Suryaprakash Rao
3. Shri E. Gangadharan Nair
4. Shri Koppada Gandhi
5. Shri Gajendra Kerali
6. Shri M. K. Prabhakaran
7. Shri K. K. Radhakrishnan
8. Shri O. C. Lonan

Supporting Staff Grade III

1. Shri E. S. Balachandra Pai
2. Shri E. S. Sreedharan
3. Shri Krishna Chandra Meher
4. Shri S. M. S. Yadev
5. Shri P. A. Thomas
6. Shri K. Balakrishna Pillai
7. Shri C. M. Gopalan
8. Shri P. J. George

9. Shri P. C. Sukumaran
10. Shri A. G. Vasu
11. Shri C. A. Subran
12. Shri B. Tirupathi Rao
13. Shri A. T. Waghmare
14. Shri N. Gnanaranjan Rao
15. Shri P. A. Abdul Rahman
16. Shri Digambar D. Naik
17. Shri K. K. Appachan
18. Shri K. X Joseph
19. Shri T. T. Das
20. Shri Laba Nag
21. Shri O. M. Thankappan
22. Shri O. A. Krishnan
23. Shri M. K. Thevan
24. Shri P. M. Pakeer Mohammed
25. Shri Santhosh Banchor

Supporting Staff Grade II

1. Shri K. Raghavan
2. Shri Ramachandra D. Padnakar
3. Shri Gokulachandra Meher
4. Shri Rattan Chand
5. Shri Menino Souza
6. Shri Satrughan Seth
7. Shri K. K. Madhavan
8. Shri P. S. Morajkar
9. Shri S. Rajan
10. Shri C. Kama Raju
11. Shri Voleti Kamaraju
12. Shri T. V. Manoharan
13. Shri Sadhucharan Meher
14. Shri Chandru B. Shirodkar
15. Shri K. Kameswara Rao
16. Shri Vasudev G. Kubal
17. Shri M. N. Goswami
18. Shri T. T. Velayudhan
19. Shri Malladi Perraju
20. Shri K. C. Fofandi
21. Shri B. S. Thambe
22. Shri P. Padmanabhan
23. Shri C. A. Krishnan
24. Shri Krishna Chandra Nayak
25. Shri P. A. Shanmughan
26. Shri K. N. Mukundan
27. Shri P. Gopalakrishnan
28. Shri Karsan Arjan Masani
29. Shri K. A. Gopinath
30. Shri P. D. George
31. Shri K. B. Bhaskaran
32. Shri Kirtan Kisan
33. Shri G. Chinna Rao
34. Shri Orilika Heman
35. Shri K. K. Karthikeyan
36. Shri K. A. Kunjan
37. Shri A. P. Gopalan

Supporting Staff Grade I

1. Shri T. T. Thankappan
2. Shri P. K. Unnikrishna Panicker
3. Shri R. Chellappan
4. Shri V. S. Ambasudhan
5. Shri K. Kochukuttan Nair
6. Shri Vasipalli Vellaiah
7. Shri A. R. John
8. Shri C. N. Raghavan
9. Shri K. Appa Rao
10. Shri A. Ravindran Nair
11. Shri B. Sivanadam
12. Shri Harbhajan
13. Shri Bandu M. Ghare
14. Shri P. N. Sukumaran Nair
15. Smt. P. L. Roseilly
16. Shri Vinayak P. Halarnekar

17. Shri Thomas Topno
18. Shri Gopi Xenkar Chodankar
19. Shri T. K. Rajappan
20. Shri Chandrakant Kolvalkar
21. Shri S. Chakram
22. Shri S. Appa Rao
23. Shri Duda Pitha Parmar
24. Shri Bashir Mohammed Allarkha Khokhar
25. Shri K. N. Velayudhan
26. Shri Badrinarayan Guru
27. Shri K. K. Lakshmanan
28. Shri Jayasingh Oram
29. Shri P. K. Bhangaraj
30. Shri Satyanarayan Mirdhe
31. Shri T. G. John
32. Shri Premlal Panda
33. Shri Surjananda Dishri
34. Shri Godabari Mahanandia
35. Shri O. K. Xavier
36. Shri T. Mathai
37. Shri P. T. Anthappan
38. Shri T. K. Viswanathan
39. Shri P. A. Sivan
40. Shri D. B. Chudasanna
41. Shri Dibyalochan Pattanayak
42. Shri Kantilal Jivabhai Damor
43. Kum. C. G. Radhamany
44. Shri V. S. Salvi

ON DEPUTATION

Sl. No.	Name	Deputation with	Designation
1.	Shri P. Sulochanan Scientist S-2	Exploratory Fisheries Project, Kandla base, Block No. 80|262, Kutch	Deputy Director
2.	Shri Y. Sreekrishna Scientist S-2	Central Institute of Fisheries Education, P.B. 7392, Kakori Camp J. P. Road, Bombay-61	Professor (Fisheries Technology)
3.	Shri M. Mukundan Scientist S-1	Central Institute of Fisheries, Nautical & Engg. Training (CIFNET) Cochin-16	Instructor
4.	Shri R. Rajendran Scientist S-1	CIFNET, Coochin-16	Instructor (Craft & Gear)
5.	Dr. M. Shahul Hameed Scientist S-1	University of Cochin	Reader
6.	Shri C. Hridayanathan Scientist S	University of Cochin	Lecturer
7.	Dr. G. Jagatheesan	Tamil Nadu Agricultural University, Coimbatore	Associate Professor (Fish Technology)
8.	Shri K. Gopalakrishnan Scientist S-1	Exploratory Fisheries Project, Bombay	Deputy Director
9.	Shri S. Sadanandan Supdt.	ICAR Research Complex for NEHR, Shillong	Asst. A.O.
10.	Shri Cyriac Mathen Scientist S-2	College of Fisheries Kerala Agrl. University Panangad, Cochin.	Professor (Fish Processing)
11.	Shri C. K. Muraleedharan Jr. Clerk	ICAR Research Complex for NEHR, Shillong	Sr. Clerk
12.	Ch. Satyanarayana Sr. Clerk	Dte of Oil Seeds, Hyderabad	Sr. Clerk
13.	Shri R. S. Manoharadoss Scientist S-1	Tamil Nadu Agrl. University	Asst. Professor (Fisheries)

APPENDIX III

FINANCE

Details of budget provision and actual expenditure during the year 1982-83

PLAN

Head of Account	Budget Provision Rs.	Actual Expenditure Rs.
Salary of Officers	3,02,000	——
Salary of establishment	6,36,000	31,929.35
Dearness Allowance	7,33,000	33,128.60
Overtime Allowance	15,000	——
House Rent Allowance	1,40,000	6,678.80
City Compensatory Allowance	22,000	723.45
Other Allowance & Honoraria	60,000	693.20
Travelling Expenses	1,20,000	1,19,810.14
Other Charges	37,72,000	42,01,826.97
Total	58,00,000	43,94,790.51

NON-PLAN

Salary of Officers	15,50,000	14,91,063.61
Salary of establishment	15,03,000	13,50,899.53
Dearness Allowance	20,11,000	27,48,856.17
Overtime Allowance	14,000	26,088.45
House Rent Allowance	2,70,000	3,32,772.29
City Compensatory Allowance	32,000	30,029.40
Other Allowance & Honoraria	1,20,000	1,88,160.92
Travelling expenses	60,000	59,134.90
Leave Salary Contribution, Pension contribution and P. F. contribution	2,000	300.00
Other charges ,Grant-in-aid contribution etc.	6,00,000	8,49,024.33
Fellowships, Scholarships & Awards	5,000	——
Total	61,67,000	70,76,329.60