ANNUAL REPORT 1970

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY
ERNAKULAM
COCHIN - 11

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

CONTENTS

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY

ERNAKULAM, COCHIN-11

ANNUAL REPORT FOR THE YEAR 1970

INTRODUCTION

Notable achievements were made in all the research investigations undertaken in the Craft and Gear and Processing Divisions and the Statistics Section of the Extension, Information and Statistical Division. The research projects were mostly oriented towards development of new and improved methods and equipment for ensuring modernisation and expansion of the industry and for solving specific technological problems faced by it from time to time. The findings of practical importance were transmitted quickly and efficiently to the trade through publications, practical demonstrations, 'Open House' discussions and replies to technical enquiries. Bacteriological surveys made in processing establishments and suggestions given thereon enabled them to maintain comparatively high standard of hygiene and quality of processed products. The export of fish products from the country was on the increase. As a direct result of the improvements effected by the Institute in the production of frozen frog legs the demand for this commodity increased during the year and its exports reached a record value of Rs. 3.29 crores.

Details of the significant achievements are given under the concerned sections in this report. With the installation of a refrigerated sea water plant at the Headquarters laboratory, investigations on this important technique of preservation of fresh fish was initiated and pursued actively during the period. Installation of a solar dryer as per the design developed by the Institute for dehydration of fish using solar radiation energy is another noteworthy development. Studies on the biochemical and bacteriological characteristics of a few more important fish and shell fish in fresh, ice-stored and frozen conditions carried out during the period resulted in findings of much value and practical application. A specific culture medium has been suggested for testing frozen prawns for bacterial load. To the list of speciality products from trash fish can now be included three more developed

during the period. Investigations aimed at economising operational costs in prawn processing factories resulted in the development of a peeling table for use in primary prawn process centres and an automatic brine dispenser for use in prawn canning lines.

Development of a bulged belly type trawl capable of increasing prawn catch by more than 30% is one of the significant achievements on the fishing craft and gear side. Among the new gear designs prepared include a 33 M. bulged belly type fish trawl, a 22 M. shrimp trawl for operation from trawlers of size group17.37 M. and a gill net design for seer fishery. Designing of a water circulation system for live bait tank and sprayer arrangement for chumming of fish for pole and line fishing, development of less expensive artificial jigs for trolling lines, a telemetering instrument for measurement of water flow in and around trawl nets, an electronic instrument for continuous measurement of the warp tension of trawl gear and an instrument for measurement of speed of fishing boats are a few of the other items on which substantial progress has been made. Trawling experiments at Kakinada (Andhra Pradesh) have established the relative efficiency of 29.26 M. four seam trawl of the Institute's design for exploitation of the prawn resources of the region.

The Institute continued to give technical assistance and guidance to the industry throughout the country for its overall development. Fish processing factories and primay processing centres were visited regularly for technical assistance in maintenance of factory hygiene and betterment of quality of products by demonstrations of the improved techniques and methods developed. Technical queries received from various organisations in different parts of the country were answered promptly. Design drawings of the gear, mechanical fishing aids, fish processing equipment etc. developed by the Institute were supplied on requests received. 'Open House' discussions on production of bacteriologically sound prawn products were organised in two important centres on the west coast. The Institute also participated in an Exhibition at Cochin.

ADMINISTRATION

In January 1970 Dr. V. K. Pillai, Fishery Scientist (Processing) assumed charge as Director of the Institute consequent on his selection for the post. In the capacity of Director, Dr. Pillai served on the following scientific and allied bodies.

1. Member - Advisory Board, Indian Council of Agricultural Research.
2. Member - Scientific Panel for Fisheries Research, Indian Council of Agricultural Research.

3.	Chairman	-	Fish and Fish Products Sectional Committee, AFDC: 27, Indian Standards Institution.
4.	Convener	-	Frozen Fish Products Sub-committee, AFDC 27 : 3 Indian Standards Institution.
5.	Convener	-	Committee to ensure proper co-ordination between Gear Research and Fishing Organizations.
6.	Ex-Officio Member	-	Panel of Experts for the purpose of hearing appeals-Export Inspection Agency, Madras and Cochin.
7.	Member	-	State Fishery Advisory Board, Kerala.
8.	Member	-	Advisory Board, Export Inspection Agency, Cochin.
9.	Member	-	Scientific Research Committee, Fisheries Technological Station, Kozhikode.
10.	Member	-	Central Advisory Committee on Exploratory Survey of Marine Fisheries
11.	Member	-	Marine Cargo Movement and Packaging Division Council (MCMPDC), Indian Standards Institution.

The other committees in which the Institute was represented were :

1. Textile Materials for Fishing Purposes Sectional Committee, TDC : 42 of the Indian Standards Institution (Shri G. K. Kuriyan, Fishery Scientist, as Chairman).
2. Sub-committee on work of the International Standards Organisation on Textile Materials for Fishing Purposes, TDC 42 : 1 of the Indian Standards Institution (Shri G. K. Kuriyan, Fishery Scientist, as Convener)
3. Working Party on Sardine and Mackerel Resources (Shri G. K. Kuriyan, Fishery Scientist, as Member)
4. Tender Committee for purchase of marine diesel engines, Development Department of Government of Kerala (Shri G. K. Kuriyan, Fishery Scientist, as Member).
5. Board of Studies and Faculty of Fisheries of the University of Calicut (Shri G. K. Kuriyan, Fishery Scientist, as Member).
6. Sub-committee to consider matters relating to the Import of Trawlers by the Government of India (Shri G. K. Kuriyan, Fishery Scientist, as Member).
7. Marine Corrosion Sub-committee of the Metals Committee of the Council of Scientific and Industrial Research (Shri R. Balasubramanyan, Junior Fishery Scientist, as Member).
8. Marine Engineering and Ship Building Sectional Committee of the Indian Standards Institution (Shri M. Velu, Junior Fishery Scientist, as Member).

During the year under report the vacancies of Quality Control Officer, Assistant Extension Officer and Assistant Fishery Scientist (Processing) were filled up by appointing Sarvashri Cyriac Mathen, M. K. Kandoran and K. K. Solanki respectively. The two vacant posts of Skippers sanctioned for the 15.24 M. vessels stationed at Cochin and Veraval were also filled up. Besides these, a number of other vacancies in the Class III and Class IV categories could be filled up with suitable candidates. Sanction to recruit 10 Senior Research Assistants in the scale of Rs. 325-575 in lieu of 15 existing vacancies of Research Assistants in the junior scale of Rs. 210–425 was obtained. A post of Administrative Officer in the scale of Rs. 350–900 was also sanctioned on an *ad-hoc* basis in lieu of the permanent post of Administrative Officer in the scale of Rs. 350–575.

Shri S. D. Deshpande, Junior Fishery Scientist (Craft and Gear) resigned his post and was relieved in February 1970. The resignation tendered by Shri P. V. Kamasastri from the post of Junior Fishery Scientist (Processing) is pending acceptance by the Council.

The CIFT Unit at Nangal was wound up by the end of 1970 after completing the programme of work envisaged for the Unit. The staff employed at the Unit was absorbed in the other centres of the Institute. Sanction was received for implementing two co-ordinated research projects namely, (1) Transportation of Fresh Fish with centres at Veraval, Kakinada, Bombay and Jadavpur and (2) Utilisation of Trash Fish with centres at Cochin, Tuticorin and Mangalore. The co-ordinating centre of the above projects will be attached to the CIFT, Cochin.

HONOURS, AWARDS

Shri T. S. Gopalakrishna Iyer, Assistant Fishery Scientist (Processing) at this Institute was awarded a prize of Rs. 500 by the Invention Promotion Board for his work on "A Humane Method of Cutting Frog legs". The award was announced as part of the 1970 Independence Day Awards to Inventors.

SEMINARS, SYMPOSIA

Shri R. Balasubramanyan, Junior Fishery Scientist (Craft and Gear) participated in the seminar on "Cast Iron Today" organised by the Institute of Indian Foundrymen, Bombay during Februay 1970. Shri M. Velu, Junior Fishery Scientist (Craft and Gear) presented a paper titled 'Indigenous Production of Equipment for the Deep Sea Fishing Industry' at the symposium on 'the Development of Deep Sea Fishing Industry' organised by the Government of India, Ministry of Food and Agriculture, Department of Agriculture, at Cochin in February 1970. Shri T. S. Gopalakrishna Iyer, Assistant

Fishery Scientist (Processing) also participated in a symposium on "Microbial Spoilage of Food" organised by the Association of Food Technologists and the Association of Microbiologists at Mysore during October 1970. Sarvashri T. S. Gopalakrishna Iyer and Cyriac Mathen, Assistant Fishery Scientists (Processing) participated in the seminar on "Quality Control of Food" organised at Cochin by All India Institute of Small Scale Industries, Government of India.

The Budget estimate and the actual expenditure during the fiscal year 1970-71.

	Sanctioned Budget Grant		Actual Expenditure	
NON-PLAN:	Rs	Ps.	Rs	Ps.
Pay of Officers	3,20,000		3,06,159	49
Pay of Establishment	3,45,000		3,85,715	72
Allowances	4,47,500		5,41,678	28
Leave Salary, Pension and Provident Fund Contribution	2,300		2,108	00
Other Charges	4,75,000		4,49,369	82
Total	15,89,800		16,85,031	31
PLAN:				
Pay of Officers	5,000		—	
Pay of Establishment	35,000		12,785	30
Allowances, Leave Salary, Pension Contribution etc.	29,000		10,097	62
Other Charges	7,31,000		4,74,188	76
For Additional Centres to be opened	2,00,000			
Total	10,00,000		4,97,071	68

VISITORS TO THE INSTITUTE

Officials from Government Departments, scientific workers from Research Institutions, trainees from State Fisheries Departments and other organisations, students from Universities and persons connected with fishing and fish processing industries visited the Institute during the year under report. Visitors to the Institute also included the following persons from abroad.

1. Mr. S. Sakamoto, Consultant, Japan Marine Products Importers' Association, Sashi Kaikan, 8th Floor, 1-7 Yurakucho, Chiyoda-ku, Tokyo.

2. Dr. D. D. Moss, Associate Professor (Fisheries) Auburn Fisheries Building, Auburn University, Albama 36830, accompanied by Dr. G. Rangaswami, Dean of University of Agricultural Sciences, Bangalore.

3. Dr. John C. Marr, Project Manager, Indian Ocean Programme, FAO.

4. Dr. Sigeiti Hayasi, Agr. Sc., Far Seas Fisheries Research Lab., Orido 1000, Simizu, Sizuoka, on assignment with FAO.

5. Dr. Roland Moal, Docteur-Veterinaire, Inspecteur, Eu ehef Deta; Chef du Department Peches, 5/7 Rue Bellini, SCET Co - operation 92 Puteaux, France.

6. Mr. P. F. Howgate, FAO/UNDP Fish Processing Specialist, Government of Thailand.

7. Dr. Arlow R. Tussing, University of Alaska, Economic consultant, FAO/UNDP Indian Ocean Fisheries Survey and Development Programme, Rome.

8. Mr. Bogg (Project Manager), Mr. Kelly (Project Engineer), Mr. Wijkstrom (Economist) and Mr. M. Bhakta (Project Director) of the U.N.D.P. Survey Team of Pre-Investment Survey of Fishing Harbours (visited the Institute's Sub-station at Kakinada).

9. Dr. Graham A. Vonde Rhoer, UNESCO Associate Expert with Institute of Economic Growth, New Delhi. (visited the Institute's Sub-station at Kakinada).

PROCESSING DIVISION

CHEMISTRY SECTION

Chief Findings

Studies on flavour bearing components in fish muscle showed that dephosphorylation occurs to a great extent in fresh fish before it is stored in ice as revealed by high levels of inosine monophosphate.

The phospholipids in most of the important species of fish were found to be composed of phosphatidyl choline in the range 55 to 70% and phosphatidyl ethanolamine 20-30%. Study of the fatty acid composition of the fish tilapia showed that polyunsaturated acids are present only to an extent of 8% revealing the poor nutritional quality of the oil.

Kinetic studies conducted to determine the effect of inhibition by cysteine, tyrosine and diethyl dithiocarbamate on dopa oxidation of tyrosinase showed that only cysteine is a non-competitive inhibitor. This finding reveals the possibility of using cysteine as an effective inhibitor to reduce blackening of prawns.

Disc electrophoresis of fish myogens on polyacrylamide was found to be a very reliable method for species identification since the electrophoretic pattern was specific for each species and the pattern remained unaltered even on chill storage of the fish.

RESEARCHES IN HAND

i) Biochemical changes in fish and prawn held in ice

The glycolytic activity in oil sardine stored in ice was found to be more pronounced during the first four days of storage. Studies on sugar phosphates and nucleotides in fish showed that fresh fish contained higher amounts of inosine monophosphate (IMP). This is indicative of the great extent of dephosphorylation occurring in fish even before it is stored in ice.

ii) Investigation on fish lipids

During frozen storage of fish, free fatty acids are found to be preferentially released from phospholipids, particularly from phosphatidyl choline and phosphatidyl ethanolamine. The amounts of individual phospholipids were determined in case of oil sardine, mackerel, seer, pomfret, lactarius, anchovy and prawn. Phosphatidyl choline was in the range of 55 to 70% and phosphatidyl ethanolamine 20 to 30% of the total lipids. The fatty acid composition of the oil of tilapia, a fresh water fish, was also determined for comparison of the composition with that of oils of marine fishes and for evaluation of its nutritional quality. Poly unsaturated acids were found to be present only to the extent of 8% in the tilapia oil showing its poor nutritional quality. Further, odd numbered fatty acids, C_{15}, C_{17} and C_{19} acids, were also present in the lipids of this fish to the extent of 1.4, 3.9 and 0.7% respectively which are not commonly seen in the lipids of marine fish.

iii) Investigation on fish enzymes

For determining the effect of inhibitors on dopa oxidation of tyrosinase leading to formation of melanin which causes melanosis or blackening in prawns, inhibitors like cysteine, tyrosine and diethyl dithiocarbamate were experimented. Kinetic studies on enzyme inhibition by these inhibitors were

also made. It was found that cysteine is a non-competitive inhibitor, revealing the prospective use of the compound in reducing blackening in prawns. Further, the phenolase enzyme tyrosinase was extracted from the head juice of prawns of the species *Metapenaeus monoceros*. For removing any interfering compounds which may affect the inhibitory activity of the tested inhibitors (cysteine, tyrosine and diethyl dithiocarbamate), a five fold purification of the enzyme was effected and the specific activity determined in each stage of purification.

The activity was found to be as follows:

	Specific activity (mgm. of nitrogen)
Aqueous extract (isolated stage)	1.05
After purification through :	
(a) alumina gel absorption	1.19
(b) sephadex gel filtration on G-50	1.90
(c) sephadex gel filtration on G-200	5.05

(iv) Investigation on fish proteins.

Electrophoretic patterns of the muscle myogens of a number of species of common marine and fresh water fishes were determined by disc electrophoresis on acrylamide gel. The patterns were found to be specific for each species of fish and remained unaltered even on ice storage of the fish.

The sarcoplasmic and myofibrillar proteins from oil sardine and different species of prawns were fractionated by sephadex gel filtration. The myofibrillar protein from oil sardine was found to have two definite components. Study on the solubility of muscle proteins at different ionic strengths showed that solubility decreased with increasing ionic strength. At each ionic strength, the solubility also decreased with increase in time of ice-storage of the fish. Actomyosin was almost insoluble at ionic strength of 0.25.

Research workers associated with the projects

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

Researches contemplated

All the above items of work will be continued in the ensuing year. Besides, studies on fish hormones are proposed with the objective of isolating and characterising major hormones in fish. Particular attention will be given to the study of the active components in the pituitary hormone complex.

BACTERIOLOGY SECTION

Chief Findings

Study on the effect of intense cold on different bacterial cultures showed that strains of *Pseudomonas* lost their viability sooner at —5°C than at —15°C. A culture medium containing complex nutrients along with 0.5% or more of sodium chloride was found to be more effective and suitable for the determination of total bacterial plate counts from frozen fishery products-

Researches in hand

i) Effect of intense cold on bacterial cultures

For assessing the viability of individual bacterial cultures at sub-zero temperatures, study was undertaken with gram positive organisms such as *Corynebacterium*, *Bacillus* and *Micrococci*. The *Corynebacterium* strains tested lost their viability during one month's storage at —15°C. *Micrococci* and *Bacillus* strains were viable at the stages of 4 and 5 months of storage respectively at-15°C. The viabilities of individual bacterial cultures at —15°C and —5°C were compared using strains of *Pseudomonas*, *Vibrio*, *Flavobacterium* and gram positive *Micrococci*. The *Pseudomonas* strains lost their viability sooner at —5°C than at —15°C.

ii) Bacteriology of canned prawns

Among the 161 strains of bacteria isolated from canned prawn products, water, ice as well as surface swabs from canning factories, 20% was gram positive spore formers, 15% gram positive *Cocci*, 30% gram negative and weakly gram positive *Cocci*, 23% gram negative rods and 12% gram positive non-spore forming rods. Among the gram positive spore formers, *Bacillus brevis* and *B. megatherium* were the predominant types. About 47% of the strains produced hydrogen sulphide and 28% showed growth at 56°C. No obligate thermophiles could be isolated.

iii) Use of antibiotics in fish preservation

Seasonal variation in the suppression of growth of the commensal bacterial flora on oil sardine and mackerel in medium containing chlorotetracyclin

(CTC) at 5 ppm level was under study. In the case of oil sardine, the maximum suppression was noted in January, and the levels of suppression noted in the skin, muscle, gills and guts of the fish were 58.3%, 78.7% and 98.07% respectively.

Three hundred and twenty four resistant strains composed of *Pseudomonas* (36%), *Vibrio* (28%), *Achromobacter* (8%), *Micrococci* (4%) *Bacillus* (4%) and other types (20%) isolated from sea water agar plates containing the antibiotic at 5 ppm level, were biochemically and morphologically characterised. The extent of development of CTC tolerance in marine bacteria was also investigated using 29 strains isolated from fresh oil sardine. One strain developed tolerance to 8 ppm CTC, 3 strains to 6 ppm, 4 strains to 4 ppm and 4 to 2 ppm by six successive transfers.

iv) Choice of media for determination of total plate count

A medium containing peptone, beef extract, glucose and agar in specific proportion together with sodium chloride at 0.5% level has been found to be more satisfactory for determination of total bacterial plate counts from frozen fishery products. However for fresh fish the commonly used sea water agar medium was found more suitable. The ability of marine bacteria to produce B vitamins and amino acids was also under investigation. Of the 142 strains of bacteria isolated from oil sardine, only 14 showed ability to produce nicotinic acid, pantothenic acid, pyridoxine and biotin in the culture medium. None of the strains produced any of the essential amino acids.

Researches contemplated

Investigations on all the above aspects are to be continued next year. Besides, studies on isolation and rapid detection of small numbers of *Salmonella* and other pathogenic organisms and fungi in fish and fishery products are proposed during the ensuing year.

Research workers associated with the projects

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

PROCESSING SECTION

Chief Findings

The method worked out for canning oil sardine in brine is significant

in as much as the costly oil medium at present used can be replaced and points out possibility of using the cheap brine medium for canning other types of fish also. Field trials with the prawn peeling table designed and constructed by the Institute proved its benefits in handling prawns hygienically during peeling and saving labour to a significant extent. An automatic brine filling machine developed for use in prawn canning lines is expected to be of great advantage to the industry and is a significant achievement in the investigations aimed at economising operational costs in processing factories. An instrument developed for determination of concentration of boiling brine used for blanching prawns can fulfil the long-felt need of the industry. That solar radiation energy could be effectively utilised for production of quality dry fish products was demonstrated with the installation of a prototype solar dryer constructed. Investigation on preparation of speciality products from trash fish resulted in working out methods for preparation of fish sausage, a protein enriched food composition containing fish protein concentrate and fish hydrolysate.

Researches in hand

i) Fish preservation and transport

Experiments to improve the efficiency of the conventional bamboo baskets indicated that insulation with 2 to 3 cm. thick saw dust with lining of polyethylene film could greatly increase the storage life of fish. Iced jew fish (1 : 1) remained in good condition in the container for 32–36 hours at room temperature whereas in the uninsulated basket the storage period was only 12 hours.

The thermistor thermometer designed earlier for measuring temperature of frozen fish was further improved by designing a thermistor probe for easy piercing of frozen fish and a null deflection type temperature measuring unit. The improved instrument is more compact and easier to operate and has accuracy of ± 0.25°C in the range of measurement O to —25°C. With this instrument measurement can be made within 2 minutes.

A refrigerated sea water (RSW) plant was installed in the Institute during the period for study of the storage characteristics of commercially important types of fish and shell fish. Oil sardines both in the whole and eviscerated forms were used in the initial experiments. The fish preserved in RSW at a temperature of 0.5 to 1.5°C was found satisfactory for canning even after 4 days. The RSW stored fresh sardines were found to have firmer texture than the ice-stored fish but the flesh near the backbone developed slight discolouration. Eviscerated sardine stored in RSW became rancid and lost the characteristic flavour very rapidly.

ii) Freezing of fish and crustaceans

The influence of fat on the frozen storage characteristics of oi sardine was studied. Fish with fat content of 10 to 25% (DWB) were found to have frozen storage life of 12-16 weeks and those with fat content of 25-40% (DWB) only 8-10 weeks at storage temperature of -18°C. No appreciable difference was observed in the total non-protein nitrogen (TNPN) and free alpha amino nitrogen contents of the samples of varying fat content. Denaturation of protein and development of free fatty acid (FFA) were observed to be more in samples with less fat content.

Tilapia from fresh and brackish water sources behaved differently both during ice-storage and frozen storage. The former showed an ice-storage shelf life of 15 days while the latter showed 8-10 days without apparent spoilage. In freezing characteristics the samples from the two sources exhibited far more significant variations. The fish from fresh water and iced for 15 days before freezing preserved well for over 6 months at frozen storage temperature of -18°C. while that from brackish water stored in ice for 10 days gave a shelf life of only 5 months under similar conditions of freezing and frozen storage. Even lesser period of ice-storage of 5 days was not found to increase the frozen storage shelf life to more than 5 months.

The studies also revealed significant differences in some of the essential flavour characteristics between the male and female tilapia, the females showing better flavour and practically no yellow discolouration of the meat during the early stages of frozen storage. Detailed studies indicated a higher level of glycine of the order of 41 mg/100g. meat in the female samples as against an average of 24 mg in the males, although the total free amino acids in both remained more or less equal. The more prominent free amino acids in the male specimens were arginine, glycine, valine, glutamic acid and proline in decreasing intensity while in females the order was glycine, arginine, proline and glutamic acid with traces of valine.

Brackish water milk fish (*Chanos chanos*) had ice-storage life of 6 days. Storage life of the frozen product processed from fresh fish (uniced) was more than 6 months. Development of rancidity was the major factor limiting ice-storage life of the fish. The major free amino acids in the fish are histidine, valine, glycine, glutamic acid and proline, in decreasing order. Compared to tilapia, this fish has higher free amino acid content.

The maximum shelf life of mackerel in ice was seen to be 3 days. Development of rancidity limits further storage. Storage in refrigerated fresh water extended the shelf life to 5 days. Eviscerated mackerel developed rancidity raipdly on ice-storage.

Quality determination of frozen headless shell-on, peeled and deveined, cooked and peeled, and peeled, deveined and cooked prawns stored at frozen storage temperature of −18°C was made and all the samples were seen acceptable after 6 months of the study. Judged on organoleptic quality, preference was in the order headless shell-on, cooked and peeled, peeled and deveined, and peeled, deveined and cooked.

The pre-process ice-storage life of crab meat was found to be 6 days. The shelf life of frozen products processed from the meat cooked for 5 minutes after ice-storage of 9, 7, 4 and 0 days were 22, 28, 41 and 47 weeks respectively. During frozen storage, discolouration was observed in the product processed from meat stored in ice for more than 6 days. Crabs frozen and stored as body meat, claw meat and shell-on showed that the loss of nutritive value is the least in case of the shell-on type.

The efficiency of the electrical resistance method developed for thawing frozen prawn blocks was compared with the methods of thawing in water, air and refrigerated air. The time required in these cases were 50 mts, $1\frac{3}{4}$ hours (at the water flow rate of 2 litres/minute), $5\frac{3}{4}$ hours (at air temperature of 29-31°C) and 72 hours (at 5°C) respectively.

iii) Canning of fish and fishery products

Oil sardine canned in brine was found equally good as that packed in oil and stored well during 4 months of the study. Use of tomato sauce and mayonnaise sauce was also tried in canning sardine and mackerel after cooking as well as smoking. Smoked sardine canned in tomato sauce was found quite acceptable.

In the investigations on canning, development of a suitable lacquer for cans used for packing fishery products was also initiated. Several compositions containing alkyl resins, dehydrated castor oil resins, epoxy resins, phenolic resins and drying and hardening agents were tried.

Development of an automatic brine dispenser is a significant outcome of the investigations towards economization of operational costs in prawn processing factories. A brineometer developed for determination of the concentration of boiling brine used for blanching prawns can also be of much use in the absence of any satisfactory device for the purpose at present. The equipment can be used for direct reading of the concentration to a reasonable accuracy by dipping its component electrode in the brine. Design of a simple equipment has also been prepared for spray blanching of prawns instead of blanching by dipping prawns in boiling brine. Yet another achievement in the investigations towards automization of processing operations is the design and fabrication of a peeling table for use in prawn processing factories. The table consists

of a mechanically driven conveyer through which whole prawns charged into a hopper are moved to the workers standing by the side of the table. Field trials with the table showed that saving of about 33 man hours can be achieved per tonne of raw material peeled. Based on the result of the field trials, a table of 15.5M. length which can accommodate about 100 workers has also been designed for use in processing establishments.

iv) Speciality products from trash fish

In this field of investigation, studies were mainly on the development of sophisticated products like fish sausage of export value and ready-to-use food compositions incorporating fish protein in different forms. A method worked out for preparation of fish sausage from trash fish meat incorporating prawn meat, starch and spices to taste has been found suitable in as much as the product had good flavour and taste as determined by taste panel study and stored in good condition in frozen storage upto six months without any noticeable change.

Composition of a food preparation incorporating fish protein concentrate was worked out. The preparation is in the form of flakes, and can be consumed after stirring with boiling water or boiling milk. Fish hydrolysate prepared from trash fish is also found to have use in formulation of a product of high protein value. When mixed with malt extract, sugar and cocoa in suitable proportion, a palatable preparation was obtained.

v) Dehydration of fishery products

With the construction and installation of a laboratory model solar dryer with a capacity of 50 kg. raw material as per the design of the Institute, study on the effective utilisation of solar radiation energy for dehydration of fish under hygienic conditions and within a lesser time than ordinary sun-drying was initiated. Drying conditions for salted jew fish and unsalted threadfin bream (*Nemipterus japonicus*, locally known as 'Kilimeen') were worked out. These two species could be dried within 14 and 13 hours respectively to a moisture content of 20% at the temperature of 44–46°C at air velocity of 122 M/minute.

Development of testing and measuring instruments required in the laboratory during experimental studies and also for use in the industry was an integral part of the investigations under the project. For measurement of moisture in salted and dried fish products a method has been worked out based on diclectric principles. An apparatus has also been fabricated for measuring salt content of dry fish products and the method of measurement has been standardised. In this method the sample is first dried to a uniform

moisture level (2%) before salt content is measured directly in a calibrated meter. The measurement is instant and accuracy ± 5% of chemical values. (In the conventional method, it requires about 2 hrs. for the measurement.)

The pattern of pigments responsible for characteristic colour of different species of prawns was also under study with reference to prawns of marine, fresh water and brackish water origin. It is observed that the fundamental nature of the pigment pattern of prawns is essentially the same, except for certain differences in concentrations of different fractions of pigments. Prawns of the species *Penaeus indicus* of backwater origin contained lesser amounts of the red pigment in shell and meat than that in the marine species.

Possibility of freeze-drying prawns in headless, shell-on condition was examined. It is seen that there is substantial reduction in reconstitution property of the final product and also significant toughening of texture and certain amount of shrinkage. Although the latter two were found to be prevented by giving a cut on the dorsal side of the prawns from head to tail the reconstitution property of the freeze-dried product remained low.

RESEARCHES CONTEMPLATED

All the above items of investigations are to be continued next year. Besides, studies on packaging of fish and fishery products with the objective of making a critical evaluation of the efficiency of packaging materials at present used and of evolving and standardizing suitable packing materials for different types of fresh and processed fishery products are also proposed for the coming year.

RESEARCH WORKERS ASSOCIATED WITH THE PROJECTS

1. Dr. V. K. Pillai, Director.
2. T. K. Govindan, Jr. Fishery Scientist.
3. Cyriac Mathen, Quality Control Officer.
4. C. V. N. Rao, Asst. Fishery Scientist.
5. S. Ayyappan Pillai, Asst. Fishery Scientist.
6. K. K. Balachandran, Asst. Fishery Scientist.
7. P. K. Chakraborthy, Asst. Fishery Scientist.
8. P. A. Perigreen, Asst. Fishery Scientist.
9. A. Vasantha Shenoi, Research Assistant.
10. P. R. Girija Varma, Research Assistant.
11. Smt. P. L. Chinnamma, Research Assistant.

BY-PRODUCTS SECTION

Chief findings

Samples of shrimp extract prepared from prawn shell wastes by the method worked out earlier were found to keep in good condition for more than a year when canned and for 4-5 months under refrigerated temperature (0–5°C). Investigations towards economic utilization of prawn shells resulted in working out method for preparation of another product, chitosan, which is of industrial use. Fractions of unsaturated fatty acids having iodine value as high as 200 could be isolated from sardine oil.

RESEARCHES IN HAND

i) Utilisation of prawn shell waste

Samples of shrimp extract containing about 35% moisture prepared out of prawn shells using the method worked out earlier could be stored in excellent condition for more than a year in cans hermetically sealed and sterilized in steam. Storage in polythene bags or glass bottles was not suitable, since mould attack was observed at room temperature. But at refrigerated temperature (O —5°C) the product in these containers remained in good condition for 3—4 months. Storage life of frozen shrimp extract was 4—5 months.

Prawn shells could be utilised for preparation of the product chitosan, which is of industrial use. In this method, initially, chitin is isolated by treating prawn shells with hot potassium hydroxide and hydrochloric acid of specific strengths. The chitin obtained is converted to chitosan by refluxing with 25% sodium hydroxide in aqueous alcohol.

ii) Industrial utilisation of sardine oil

Fractions of unsaturated fatty acids having different melting points could be separated by repeated cooling (to low temperature) and thawing of the fatty acids obtained by saponification of sardine oil. Fractionation was also effected by fractional distillation of methyl esters of the fatty acids and by formation of urea complexes of the acids. The last method was found more efficient and fractions of unsaturated fatty acids having iodine value as high as 200 could be obtained.

iii) Investigation on fish protein concentrate

In case of fish protein concentrate prepared using n-hexane and

alcohol of commercial quality for extraction, an objectionable solvent flavour was noticed on cooking. It has been observed that by using pure hexane as solvent the undesirable flavour was reduced considerably.

Researches contemplated

Investigations on the above aspects are to be continued in the ensuing year.

Research workers associated with the projects

1. P. Vasudeva Prabhu, Asst. Fishery Scientist.
2. P. Madhavan, Asst. Fishery Scientist.
3. P. K. Chakraborthy, Asst. Fishery Scientist.
4. A. G. Radhakrishnan, Research Assistant.
5. K. G. Ramachandran Nair, Research Assistant.

QUALITY CONTROL SECTION

Chief Findings

Determination of the bacteriological quality of frozen peeled and deveined prawns processed from material treated in mixture of sodium tripolyphosphate and potassium dihydrogen phosphate (for prevention of 'thaw-drip-loss' in the frozen product) showed definite improvement in quality of the product in that a reduction of 30% of the *Staphylococci* count was effected in the treated sample. A survey of the sources of supply and chemical quality of water used in processing establishments in Cochin area revealed that only 40% of the total samples tested are of standard quality and that about 25% of the processing establishments used water from unprotected sources like wells and ponds. A survey of the bacteriological quality of frozen prawns produced commercially revealed that 14% of the headless shell-on type product and 23% of the peeled and deveined frozen type are sub-standard. *Staphylococci* count was found to decrease by 30-60% during freezing raw peeled and deveined prawns. Complete destruction of the organisms was noted after 5 months of frozen storage at —18°C, in case where the initial count was less than 500 / gm.

Research completed

Bacteriological quality of phosphate treated frozen prawns

The effect of treatment of prawns in the mixture of sodium tripolyphosphate and potassium dihydrogen phosphate (for preventing 'thaw-drip-loss' in frozen prawns as recommended earlier) on the bacteriological

quality of the material was investigated. It is seen that the treatment improves bacteriological quality of the material in that the *Staphylococci* count is brought down by about 30% in the treated sample. The total plate count, *E. coli* and faecal *Streptococci* counts did not manifest significant differences within the treated and untreated samples either after freezing or during storage upto six months at —18°C.

Researches in hand

I Process control and quality of fresh and processed fishery products

i) Chemical quality of water used in fish processing

A survey was carried out on the sources of supply and chemical quality of water used in fish processing establishments in Cochin area. It is seen that in about 25% of the establishments water from private sources like wells and ponds are used. Only 40% of the samples of water tested are of standard quality. Alkalinity, iron, dissolved solids, chlorides, hardness, sulphate and pH are above the prescribed limits in the other cases.

ii) Comparative study of sensory evaluation and objective quality tests

The common chemical indices of quality (TVN, VAN, α—NH_2-N, TNPN, SSN, PV and FFA) and bacterial counts were compared with organoleptic quality variations in fresh water fishes tilapia and milk fish and marine fishes like sardine and mackerel during storage in ice. In the fresh water fishes only bacterial counts showed correlation with organoleptic quality variations. In the case of sardine and mackerel, the PV and FFA contents showed correlation.

II Bacterial quality of fresh and processed fishery products

i) Studies on coagulase positive *Staphylococci*

The rate of destruction of *Staphylococcus* in prawns on freezing and frozen strorage was studied. The *Staphylococci* count of raw peeled and deveined prawns was seen to be reduced by 30-60% during freezing at —40°C. The count reduced gradually further during frozen storage at —18°C and complete destruction was noted in 5 months of storage when the initial count in the raw material was less than 500/gm. Temperature of freezing was also seen to influence the rate of destruction of the organisms. Freezing at —5°C brought about 30% reduction of the organisms in cooked prawns while at —18°C and —40°C only 5% were destroyed.

ii) Factory sanitation

The survey of sanitary conditions of prawn processing factories and

primary processing centres and bacteriological quality of commercially frozen prawns was further intensified during the period in Cochin and Quilon areas. During the survey, 830 utensils, 250 samples of water, 250 samples of ice and 700 samples of frozen (raw) prawns were examined for determination of total plate count, *Escherichia coli*, faecal *Streptococci* and coagulase positive *Staphylococci*. Bacteriological quality of majority of the samples, utensils, water and ice was sub-standard. Fourteen percent of the samples of headless shell-on frozen prawns and 23% of the peeled and deveined frozen prawns were also bacteriologically defective. However, *Salmonella* was not present in any of the samples. In all cases of surveys conducted, the results of the survey and suggestions for overcoming the defects observed were furnished to the processors for effecting improvements.

iii) Quality specifications for fishery products

Draft quality standards were formulated in the case of lactarius canned in oil, fresh mackerel, frozen mackerel, fresh seer fish and frozen seer fish and the standards were furnished to the Indian Standards Institution. With a view to revise the tolerance limits of copper and iron specified in the existing Indian Standards in respect of canned prawn and fish products the levels of these metals in a number of samples of canned sardine, mackerel and tuna were determined and average values worked out as below:

Product	Copper content (average)	Iron content (average)
Sardine canned in oil	9.4 ppm	204.7 ppm
Mackerel canned in oil	8.2 ppm	67.5 ppm
Tuna canned in oil	4.8 ppm	64.8 ppm

Analysis of samples of processed fish products and by-products and water used in processing factories was also a routine activity of the Section.

The Section imparted training in bacteriological examination and quality control of processed fish products to five nominees of the Export Inspection Agency, Cochin and eight nominees of fish processing factories. The training was of 1 – 2 months duration and research workers of the Section also visited processing factories in Cochin and Quilon to give technical assistance in processing bacteriologically sound frozen frog legs and cooked prawns, prevention of 'thaw-drip-loss' in frozen prawns and blackening in canned prawns and treatment of frog legs for improving colour of the frozen products.

Researches contemplated

Investigations on process control and quality of fresh and processe d fishery products, bacterial quality of fresh and processed fishery products and quality specifications for fishery products are to be continued in the ensuing year.

Research workers associated with the projects

1. Cyriac Mathen, Quality Control Officer.
2. T. S. Gopalakrishna Iyer, Asst. Fishery Scientist.
3. A. Vasantha Shenoy, Research Assisant.
4. A. C. Joseph, Research Assistant.
5. Francis Thomas, Research Assistant.

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY SUB-STATION, VERAVAL

Chief Findings

The insulated plywood box designed earlier for transportation of fish over long distance was further improved by providing an inside lining with 25 G. aluminium sheet to make the container more rigid and prevent damage to thermocole used as insulant in the box. This type of container was seen very useful in carrying ice on board fishing vessels during fishing trips. A method worked out for smoking shark fillets has been found to yield smoked product having good appearance, taste and odour and holds out possibility of more economic utilisation of shark flesh.

Researches in hand

i) Improvement in the methods of handling and preservation of major types of commercial fishes

Development of suitable method for prevention of mould growth commonly encountered in dried Bombay duck products was under investigation. Preliminary trials of irradiation at doses of 15, 20, 25 Krad of commercially dried and laminated Bombay duck samples did not reveal significant benefits. Packing of the products in air-tight containers controlled mould attack and discolouration. Further, insect attack was very much less in smoked Bombay duck than in sun-dried or artificially dried (tunnel dried) products.

Study on the freezing characteristics of black and silver pomfrets in whole (undressed) form showed that black pomfret yielded frozen product

of very low quality. The frozen product on thawing lost muscle juice to a great extent and became mushy with putrid odour. Silver pomfret yielded good quality frozen product.

The insulated plywood container designed earlier for transport of iced fresh fish was further improved by providing an inside lining with aluminium sheet of 25 G. thickness. The lining protected the thermocole insulant in the container from damage during transport and made the container more rigid. The improved container was found especially suitable for carrying ice on board fishing vessels. Ice in the container stored for about 96 hours. The box has capacity to hold 65 Kg. of ice.

ii) Standardisation of processing techniques for commercially important fishes

In this sphere of study the emphasis was on finding out the smoking characteristics of a few types of commercially important fishes. Shark fillets could be smoked to yield a product having good appearance, flavour and odour. The method of smoking worked out consists of brining shark fillets (of size 18 cm. x 2.5 cm.) in 20% solution for one hour followed by desalting in fresh water. The fillets are then drained for half an hour and smoked overnight in a smoke kiln. Urea content of the finished product was not significant to produce any undesirable odour.

Light and hard smoking was also tried for preservation of Bombay duck and product of good flavour and odour was obtained when the fish was hard smoked. T · method of smoking worked out in this respect is of much significance ıı ·iew of the export potential of the smoked product.

Smoked eel fillets prepared by the method worked out earlier were under evaluation of keeping quality especially with reference to humidity condition of the storage environments. The optimum level of relative humidity to retain appearance, taste and texture of the product was found to be 80%. At lower relative humidity levels, the product got dehydrated and crystals of salt appeared on the surface. At higher levels, it got spoiled due to heavy attack of moulds within two weeks.

iii) Study on the economic utilisation of miscellaneous trash fish

The most important types of trash fish landed by trawlers in the region are dhoma and lactarius. In the study on economic utilisation of dhoma, yields of flesh from different size groups of the fish were worked out as below.

Size group	Yield of muscle from fresh dhoma (average)	iced dhoma
Small size (3 – 15 cm.)	30%	...
Medium size (16 – 20 cm.)	30.2%	32.6%
Big size (21 cm. and above)	34.1%	40.5%

Removal of muscle from small and medium size dhoma was found to be time consuming and uneconomical. Only big size dhoma was suitable for separation of muscle.

Researches contemplated

All the above items of work will be continued in the ensuing year.

Research workers associated with the projects:

1. R. Venkataraman, Fishery Scientist.
2. K. K. Solanki, Research Assistant.

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY UNIT, BOMBAY

Researches in hand

Freezing and cold storage of commercially important fishes.

Study on the technological problems associated with freezing and cold storage of commercially important fishes of the Maharashtra coast was continued in the Unit. The storage conditions and spoilage pattern of the fishes jew fish (dhoma-*Johnius spp.*), anchovy (*Engraulis spp*) and lactarius were investigated. It was observed that the fishes remained in good condition for 5 days in ice, but the optimum ice-storage period before taken for freezing was 3 days. The cooked meat was found to be in good condition as judged by organoleptic characteristics for a period of 15 hours when kept at room temperature and for a period of 4 days when kept at 3 –5°C. Fresh dhoma fish paste also could be stored in good condition for 5 days at ice temperature.

Research workers associated with the project

1. P. V. Kamasastri, Jr. Fishery Scientist.
2. D. K. Garg, Research Assistant.

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY UNIT, CALICUT

Chief Finding

In the investigations undertaken in the Unit, emphasis was mainly on methods of prevention of the common types of spoilage encountered in commercially cured fish products and improvement of quality and strorage life of smoked fish products by adoption of better processing techniques. Assessment made of the influence of heavy metal ions like cupric and ferrous ion on development of brown discolouration in cured fish products on storage, points out the necessity for preventing external contamination with these metal ions during processing of the products. A method developed for smoking sardines in fillet form to get product of appealing colour, flavour and odour holds out possibility of commercial application for economic utilisation of the fish. The finding that self brine at present discarded in large quantities from fish curing yards is of high fertilizer value is also of significance in as much as it reveals possible utilisation of the waste.

Researches completed

i) Influence of metallic ions on development of brown discolouration and rancidity in cured fish products

The effect of heavy metallic ions like cupric and ferrous ion on the onset of brown discolouration and rancidity in cured fish products was studied with reference to cured cat fish, shark, sardine and mackerel. It is conclusively proved that fishes with moderate or high fat content are very much susceptible to the catalytic action of cupric ions on the development of brown discolouration and rancidity. Ferrous ions have no such action. Fishes with very low fat content are also free from the influence of these ions on the development of browning and rancidity. For prevention of these undesirable changes, application of sodium propionate (3%) in refined salt containing Butylated Hydroxy Anisole (BHA) (in the ratio 1 : 1500) was found effective.

ii) Recovery and use of self brine as a manure

The study aimed at proper utilisation of self brine at present discarded from fish curing yards in large quantities resulted in the finding that it is of high fertilizer value. The self brine contains good quantity of salt and elements of fertilizer value like nitrogen, magnesium and calcium. The yield of total chlorides and the elements together from self brine is 36% on an average.

Researches in hand

Improvements in smoke curing of fish

The study was mainly on smoking of oil sardines in fillet form and clams and mussels. Sardines in fillet form yielded smoked product of good appearance, flavour and odour. At present the fish is used mainly for extraction of oil and wet curing apart from consumption in fresh form and the method of smoking the fish in fillet form worked out at present assumes importance in view of commercial application. The method consists in treating the dressed fish in saturated brine for 10 minutes, draining and smoking in a smoke kiln for 6 hours at temperature of 70 to 90°C. Coconut shell, husk and saw dust can be used as source of smoke. The fish is then skinned and the flesh fillets are separated from the backbone, removing as much spines as possible. About 25 gm lots of the fillets are packed suitably in cellophane paper and is rolled and pasted. The edges are then trimmed and the product again wrapped in another piece of cellophane paper. The product in such consumer packets was well accepted. It has storage life of about 20 days but can be extended to two months by sprinkling dry refined salt on it while packing.

Preliminary study has shown the suitability of clams also for smoking.

Researches contemplated

All the items of research in hand are to be continued in the coming year. Bssides, study on desanding of commercially important clams and other bivalves is proposed to be undertaken during the ensuing year.

Research workers associated with the projects

1. A. P. Valsan, Asst. Fishery Scientist.
2. T. S. Unnikrishnan Nair, Research Assistant
3. V. Muraleedharan, Research Assistant.
4. V. Narayanan Nambiar, Research Assistant (at Headquarters handling bacteriological problems)

CRAFT AND GEAR DIVISION

GEAR MATERIALS SECTION

Chief Findings

Methods for testing diameter, weight and twist of fish net yarns worked out by the Institute were accepted as an Indian Standard. Investigations

on the webbings of polyethylene twisted monofilaments showed that the strength of this material is 4.34 gms. denier, while the values for cotton and nylon are 1.57 and 3.9 respectively. Twist constants for cotton ropes of ZSZ and ZZSZ construction were evolved.

Research in hand

Gear Materials

a) Cotton ropes

Twist standards were worked out for cotton ropes of ZSZ of and ZZSZ constructions. The value of the twist constant 'K' in the relation $T_0 = \sqrt[n]{No.}$ (where T_0 = No. of outer twists/metre; K = Twist constant, No. = Count no. of yarn in British system; n = Total no. of yarns) for the ZZSZ construction was found to be 27.4, and the same for ZSZ construction to be 35.4. Strength per yarn ranged between 0.274 — 0.392 kg. in the former and 0.26 — 0.36 Kg. in the latter with corresponding extension values of 35 — 40% and 26 — 38% respectively. The relationships between the outer twist (T_O) and inner twist (T_i) for the ZSZ type construction has been worked out as follows.

$$T_O : T_i = 1 : 1.9.$$

In the case of ZZSZ type construction the relationship between rope twist (T_r) twine twist (T_t) and strand twist (T_s) is as follows:

$$T_r : T_t : T_s = 1 : 3.14 : 0.75$$

In the above relationship the twists are given per unit length of 10 cms.

It has been observed that the strength is more for ropes of ZZSZ type than ZSZ type. The high strength observed in the case of ZZSZ type construction is attributable to the superiority of cable laid construction over twine type or to the 'twist-on-twist' of yarn and strand in ZZSZ type construction as opposed to 'twist-against-twist' in the ZSZ type.

To study the effect of the direction of twist on cotton ropes the second phase of the experiment changing the direction of twist from ZSZ to ZZS construction was taken up.

b) Polyethylene monofilament

Preliminary quality standards were worked out for twisted monofilament twines and these are shown in the following table.

Standards for Polyethylene Monofilament Twines

Nominal dia.	Construction *	Turns per metre Inner +	Outer	Runnage Max. m/Kg	Breaking load max. Dry & Wet. Kg.	Elongation at break Max. Dry & Wet
0.50	0.20-2 x 3	264	410	4400	6.0	
0.75	0.20-3 x 3	220	360	3000	8.0	
1.00	0.20-5 x 3	170	280	1600	15.5	45
1.25	0.20-6 x 3	155	250	1300	19.0	—
1.50	0.20-9 x 3	130	220	850	29.0	20
2.00	0.20-15 x 3	120	200	550	40.0	
2.50	0.20-24 x 3	90	155	325	65.0	
3.00	0.20-30 x 3	82	140	230	90.0	
3.50	0.20-45 x 3	75	125	150	140.0	
4.00	0.20-60 x 3	70	120	125	170.0	

* for yarn size other than 20 gauge the construction has to be suitably modified to get the corresponding dia.

\+ for guidance only.

c) Mercerization of cotton

This new item of investigation initiated in the middle of the year aims at evolving suitable conditions of mercerization of cotton twine for improving its efficiency as fish net material. Determination of the dimensional changes of the twine and the change in properties like resistance to rotting, strength, stretch etc., due to mercerization formed part of the study. Twines twisted to different specifications in both soft and hard lays were subjected to mercerization by treating in caustic soda solution of 10-50% strength for periods of 1 - 10 mts. and the properties of the samples thus mercerized were determined.

Researches contemplated

Investigations on all the above items are to be continued next year. Besides, it is proposed to undertake study on the suitability of synthetic weaving tapes for twines for manufacture of fish nets.

Research workers associated with the projects

1. Smt. K. Radhalakshmi, Asst. Fishery Scientist
2. Smt. P. J. Cecily, Research Assistant
3. Varghese Paul, Research Assistant

FISHING METHODS SECTION

Chief Findings

In shrimp trawling, the resistance offered by the gear was found to vary between 350 – 400 kg. at trawling speed of 2 knots within the depth range of 7–21 M. For bulged belly type trawls, straight jib was found to be better suited than slanting jib. In this type of trawl, the escapement of prawns was found to be more to the extent of about 54.5% through the posterior region of the belly, throat and posterior region of side panel. A 33 M. bulged belly type fish trawl and 22 M. shrimp trawl have been designed for use from Jhinga type trawlers of 17.37 M. length. Gill nets of mesh bar 75 mm and made of twines of size 210D/12/3 were found to be superior to all other types of nets tried for capture of commercially significant size groups of seers off Cochin. Further, the most predominant size group of seers in the area was found to be between 80 – 100 cm. length.

Galvanised iron was found to be a cheap and effective material for fabrication of artificial jigs for trolling lines.

Researches in hand

I - Trawl fishing

a) High opening trawl

Studies initiated on the ten important parameters of the 15 M bulged belly type trawl designed earlier made good progess. The gear offers a resistance of 350 – 400 Kg. at a towing speed of 2 knots within the depth range of 7 – 21 metres. About 12% of the BHP of engine power is utilized for towing the gear. The scope ratio of length of warp increases inversely as the depth of operation and size of net. The optimum scope ratio of warp required for operation within 15 metres depth can be incorporated in the relation SR = 15.27 – 0.57D where SR stands for scope ratio and D for depth of operation. For bulged belly trawls, straight jib was found to be better suited than slanting jib. Escapement of prawns in this type of trawl was found to be more through the posterior region of the belly, throat and posterior region of side panel. The percentage of escapement works out to be 54.5. The high rate of escapement through the throat is attributed

to the difference in stretched length of the second and third belly pieces which might have affected the uniform water flow inside the gear. Increase in the no. of meshes in the throat region from 30 to 60 meshes is therefore suggested.

The 11 m. four seam equal panel trawl was modified for bottom operations by attaching 5.5 m. detachable wing on either side of the basic design. Forty comparative hauls were carried out with 15 M. bulged belly type trawl. The dual purpose trawl caught significantly higher quantity of prawns.

b) Trawl net designs

Designing of trawls suitable for medium and larger vessels was initiated during the period. A 21.3 M. (70 ft) cotton trawl net was designed and fabricated for operation from a steel vessel of size 25.4 M. L. O. A. fitted with 240 H. P. engine and the performance of the gear was noted to be good. Another heavier trawl of size 22.8 M. was fabricated and operated from a 23.3 M. steel vessel fitted with 600 H. P. engine. However, the net was found to be too small for the vessel. A 33 M. bulged belly fish trawl and 22 M. shrimp trawl have been designed for use by the 17.37 M. Jhinga type trawlers.

c) Survey of trawl nets in operation on the Indian coast

A detailed survey of the trawls operated along the west coast as well as in the southern regions of the east coast was undertaken during the year under review with a view to find out whether any drastic changes have taken place in the design aspects of the gear since their introduction a decade back. The survey was carried out from Tuticorin on the east coast and from Cochin, Mangalore and Malpe on the west coast. The analyses of the data collected during the survey revealed that the surveyed gear fall under 30 different designs of four seam trawls and 14 of two seam trawls. Interpretation of the design aspects of the four seam trawls has shown certain interesting facts as summarised below.

1. There is an average increase of 4% in the size of trawl (length of head rope). This may be due to the decrease in the diameter of the twine used for fabrication of the nets.

2. There is a 4% decrease on an average in the minimum width of the belly and 2% decrease in the depth of the belly. This may be due to the combined effect of different tapering ratios adopted for streamlining the tapering edge of the belly.

3. A 6.6% increase in the width of the side panel and 26.8%

increase in the buoyancy of floats observed indicate the necessity for increasing the vertical opening of the nets.

4. A 6.3% increase was observed in the height of jibs used in the nets.

5. The weight of sinkers was found to be increased on an average by 7.4% which probably would have become necessary to compensate for increased buoyancy of floats used.

The pattern of variations thus observed in the trawls in commercial use is indicative of the fact that fishing enterprises and individuals are slowly switching over to altered designs so that the nets will be able to simultaneously catch fish and prawn. It is also seen that the majority of the variations introduced in the designs are aimed at obtaining optimum vertical opening for the net. The recent introduction of the bulged belly type trawl by this Institute assumes greater significance as this concept provides for all these factors.

The present survey has also enabled to work out the relationships between various component parts of the four seam nets now in operation.

II Investigations on seer gill nets

a) Selective action of mesh size and mesh size-twine size relationship

The studies conducted during the seasons 1968-69 and 1969-70 by operating 16 combinations of gill nets having four different mesh sizes, viz. 70 mm., 75 mm., 80 mm. and 85 mm. fabricated out of four different specifications of twines, viz. 210D/6/3, 210D/8/3, 210D/9/3 and 210D/12/3 have clearly shown the superiority of mesh bar 75 mm. in capturing commercially significant size group of seers of the species, *Scomberomorus commersoni* of size 70-100 cms. and the superiority of twine size 210D/12/3 over others closely followed by 210D/9/3.

Out of a total of 116 fishes caught, nearly 76% were of length range 80 to 100 cm. which can be taken as the most predominant size group available in the stock. The selective action of the different mesh sizes, viz. 70 mm., 75 mm., 80 mm. and 85 mm. bar over this predominant size group was in the ratio of 2:3:2:1 respectively. The number of fishes taken by the nets of different twine sizes, viz. 210D/6/3, 210D/8/3, 210D/9/3 and 210D/12/3 was in the ratio 4:3:4:5.

b) Lunar periodicity and effect of tide in seer gill net fishing

The investigations carried out have indicated the existence of significant relationship between the abundance of seer and the lunar phase and

tidal rhythms. The best period for the efficient exploitation of the fish has been found to be darker nights with low tide.

III Line Fishing

Studies on the utility of galvanised iron as lure in troll line

Studies on the utility of cheap and easily available indigenous materials such as galvanised iron as lures in trolling line were initiated during the season. Galvanised iron jigs were made in six different specifications viz. 12.5 cm. and 15 cm. length in 50, 60 and 70 grams weight, for the study. Twelve valid operations were completed out of the 20 valid operations required for the study. General observation reveals that galvanised iron which is cheap and indigenously available can be effectively utilised in the manufacture of artificial lures for trolling lines.

Research contemplated

Investigations on the above aspects will be continued next year. The following additional programmes are also envisaged for the ensuing year.

1. Evolution of trawl gear and accessories for medium and large size vessels.
2. Study on the efficiency of trawls made of different gear materials.
3. Investigations on lines for perches proposed to be carried out from the 15.24 M. investigational fishing vessel 'Sindhukumari' of the Institute.

Research workers associated with the projects

1. G. K. Kuriyan, Fishery Scientist.
2. K. A. Sadanandan, Jr. Fishery Scientist.
3. S. Gopalan Nayar, Asst. Fishery Scientist.
4. P. Sulochanan, Asst. Fishery Scientist.
5. R. S. Nair, Asst. Fishery Scientist.
6. K. Sreedharan Namboodiri, Asst. Fishery Scientist.
7. T. K. Sivadas, Asst. Fishery Scientist.
8. M. Mukundan, Research Assistant.
9. T. Joseph Mathai, Research Assistant.
10. K. N. Kartha, Research Assistant.

11. C. P. Varghese, Research Assistant.
12. Syed Abbas, Research Assistant.
13. N. Subramonia Pillai, Research Assistant.
14. R. S. Manohardoss, Research Assistant.
15. V. Vijayan, Research Assistant.
16. M. Velu, Jr. Fishery Scientist.

CRAFT SECTION

Chief Findings

Fibreglass sheathing in combination with activated thermoplastic resins is recommended as substitute for the conventional sheathing with copper for protection of fishing boats against marine deterioration in addition to the special type of aluminium alloy sheathing recommended earlier. Investigations on cheap construction materials for fishing boats resulted in useful finding as regards the suitability of "spheroidal grain austenitic cast iron" known in trade as "Ni-Resist" for marine propellers.

Researches in hand

I - Protection of wooden fishing boats against deterioration

a) Boat building timbers

Further studies were carried out on the boat building timber *Raderimachera xylocarpa* known in Tamil as 'Onthi' and in Malayalam as 'Vedankorana'. Though scarcely distributed in South India, the wood appears to be suitable for restricted use in boat building as it seasons well with care, is easy to work with, finishes with generally straight grains and coarse texture and is quite durable. It is cheaper than Teak and Aini but costlier than Venteak.

Scrutiny of the data collected on heavy timbers like *Hopea sp.* has revealed their suitability for backbone assembly of fishing boats comprising of keel, stem and stern portions. The timber stands the continuous immersion in seawater resisting marine borers and foulers and due to its heaviness provides adequate stability to the hull. Further details on the wood are furnished below in comparison with Teak (*Tectona grandis*), Padri (*R. xylocarpa*) and Bahera (*Terminalia belerica.*)

Characteristics of Hopea parviflora and H. glabra

Characteristics	Teak (Standard 100%)	*R. Xylo-carpa*	*Terminalia belerica*	*Hopea parvi-flora*	*Hopea glabra*
Weight	100	100	115	155	160
Strength as beam	100	80	100	120	125
Stiffness as a beam	100	80	115	120	130
Suitability as a post	100	85	105	120	130
Shock resisting ability	100	65	95	115	135
Retention of shape	100	85	65	65	60
Shear	100	104	104	135	155
Hardness	100	115	115	200	225
Availability	Most common	Scarce	Most common	Common	Common
Durability	10 years & above	5 years & below	5 years & below	10 years & above	10 years & above
Treatability	Difficult	—	Heart-wood treatable	Difficult	Difficult
Refractoriness for air seasoning	Moderat-ely refr-actory	Moderat-ely refr-actory	Moderat-ely refr-actory	Highly refract-ory	Highly refract-ory
Trade name	Teak	Padri	Bahera	Hopea	Hopea
Malayalam	Thekku	Vedan-korana	Tani	Thambagam or Irumbogam	
Tamil	Thekku	Onthi	Tani	Vellaigongu	

All these timbers require special protection against marine wood borers and foulers under continuous immersion.

Similar characteristics of 32 different species of timbers suitable for boat building purposes have been consolidated.

Experimental panels fabricated out of treated Mango (*Mangifera indica*) and Haldu (*Adina cordifolia*) timbers and installed as deck fittings on board the 15.24 M. wooden trawler have given excellent service without any deterioration after 3 years of continuous exposure. It is thus possible to effect considerable reduction in the overall cost of wooden fishing boats by introducing cheaper timber species after suitable seasoning and proper preservative treatment especially for bulkheads, shelves, stringers, deck beam, deckplanks and hatchcovers.

b) Wood preservation

Study on arsenical creosote as a wood preservative initiated in November 1968 was completed during the year under report. The chief findings of the study are listed below.

1. Fortification of creosote with arseneous oxide is advantageous as only small dosage is required for treating timber.

2. Panels treated by hot-dip are superior to those treated by brush application and the former resists borer attack for over seven months of continuous immersion in the Port of Cochin.

3. Studies on leaching rate under laboratory conditions of the aged panels from 36 to 283 days have shown that ageing has very little effect on the preservative showing its good holding power on timber. Accelerated leaching rate studies under laboratory conditions also confirm this observation.

4. Treated panels kept in the laboratory for over three months recorded no weight loss showing better fixation of the arsenical creosote in wood. There was weight loss in panels treated by creosote alone.

5. There was no sign of appreciable corrosion recorded on panels viz. copper, aluminium, galvanised iron (G. I.) and mild steel immersed in the preservative fortified with sodium chloride and treated with saw dust. The tests extended from 1-12 months.

6. No qualitative corrosion could be observed on screws driven into the panels and exposed in sea water of salinity 35‰ from 1 - 12 months. Aluminium, G. I. and brass screws were studied.

7. Arsenical creosote at level of 0.5% appears to be sufficient for tropical application.

Based on the above findings the preservative can be recommended for treating secondary species of timbers like Mango and Haldu. Different species of timber test panels treated with arsenical creosote have been exposed to marine borer and fouler attacks at regional test sites at Veraval (Gujarat), Goa and Kakinada (Andhra) for further confirmation of the efficiency of the preservative.

Further field trials with timber test panels treated with tributyl tin oxide (TBTO) in dilution with kerosene have shown the protective efficiency

of TBTO against most of the marine wood boring organisms like ship worms, paddocks and pill bugs. Fungal infestation was also under control. Untreated timber panels were completely destroyed within 3 months. Treated panels have been exposed at the regional centres for further evaluation.

Special surface coating compounds were prepared with cashew nut shell liquid resin as well as with activated polyester resin ('Hylak HSR 8131' Isophthalic type). As caulking compound and as an adhesive for joinery wood work, these two preparations were found to be quite suitable for boat building purposes. Timber surfaces treated with these preparations were free from water absorption as well as surface cracking. The performance of the preparations was compared with coatings prepared out of indigenous natural plant resins as well as the imported natural resin, Dammar batu. Test blocks were prepared and sent to a few fishermen of South Gujarat for their observation. Field demonstrations were also conducted at Bulsar and Umbergoan fishing villages.

Fibreglass reinforced plastic sheathing

The experimental window sheathed with 2 layers of fibreglass chopped strand mat (FRP) in combination with activated polyester resin and installed below the water line on the wooden hull of the 15.24 M. trawler has been performing very well as a protective sheathing. There has been no water absorption and no softening of the sheathing material. The FRP sheathing was holding on to the wooden hull tenaciously. When the surface coating of antifouling paint was completely leached out, fouling organisms started settling on the sheathing. It is thus necessary that FRP sheathing on boat-hulls should receive a fresh coating of antifouling paint after a thorough scrubbing of the hull to free the foulers. Epoxy resin in combination with fibreglass ('E' type) chopped strand mat and woven roving gave better performance than the polyester resin but the cost of the former is on the high side and is likely to increase the over all cost of the hull sheathing. The possibility of utilising cashew nut shell liquid resin with fibreglass is being investigated.

c) Studies on marine fouling

During the year under report, studies on the settlement and rate of growth of some fouling bryozoans in the Port of Cochin have been completed.

As protection against marine fouling, toxic paints formulated with TBTO gave better performance when compared to copper-aceto-arsenite with particular reference to aluminium sheathing.

II Marine corrosion in fishing boats

a) Corrosion in metal fastenings

The protective value and limits of the indigenous hot-dip zinc coating prepared out of electrolytic zinc have been assessed with reference to protection of ordinary steel in marine atmosphere, in underwater fittings and boat fastenings. However, under possible bi-metallic contacts either direct or indirect, the protective zinc coating is likely to suffer due to galvanic corrosion particularly in the presence of uncoated steel, copper or brass fittings. Galvanising, painting with zinc-rich coatings and zinc dust spraying on exposed steel surfaces are protective measures recommended for underwater hull. Cadmium coating, though it lasts longer than zinc coating, is costlier. Anodising of aluminium enhances the corrosion resistance of this light metal as has been seen on such deck fittings on fishing boats.

Samples of aluminised iron boat fastenings have been put to salt spray test for assessing their corrosion resistance in comparison with galvanised iron boat fastenings and observations are being made.

b) Dezincification of manganese bronze marine propellers

A case of accelerated corrosion of marine propellers cast out of manganese bronze in 6 of the fishing trawlers in Cochin was investigated in detail. Six of the 31″ x 24″ propellers during the course of 18 to 24 months became completely brittle and easily broke off at the edges. Both field and laboratory investigations were made and it was found to be a typical case of 'dezincification' most commonly met with in all manganese bronze propellers, improperly alloyed without the addition of inhibiting arsenic at 0.02 to 0.06% level. The corroded propellers have been damaged beyond any further use with all zinc contents completely gone and the copper having become brittle.

Design of a propeller has been finalised for fabrication out of nickel alloy. Preliminary analysis of the alloyed material has shown 23.10% nickel with Brinell Hardness at No. 116, tensile strength at 50.84 Kg/mm^2 with very good elongation as required.

c) Hydrographical studies at the CIFT test site

With a view to correlating the abundance of the marine boring and fouling organisms with that of the hydrographical features prevalent at the CIFT test site, regular data on the physical and chemical aspects of the water were recorded. Data collected so far for a period of 10 years were

examined and the results revealed that the fluctuating salinity plays an important role in regulating the biological organisms in the Cochin backwaters. However, the water appears to be corrosive for most of the year. The data will be collected continuously.

Researches contemplated

1. Studies with a view to improving the performance of creosote with the further addition of arsenic compounds in various dosages and on the use of low temperature creosote and wood tar will be taken up.

2. Studies on bacterial destruction of underwater structures and associated biochemical changes are proposed for detailed investigations.

3. Preliminary studies with reference to 'Ferrocement' test panels have been planned and the field performance of a 9.75 M. 'Ferrocement' prototype boat built in the private sector will be assessed in detail.

Research workers associated with the projects

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

MECHANICAL ENGINEERING SECTION

Chief Findings

Designs of a water circulation system for live bait tanks and sprayer arrangement for chumming of fish for pole and line fishing have been completed.

Preliminary studies conducted with a view to substituting copper alloys with aluminium alloys have shown that the latter can be used for manufacture of stern tubes.

An electronic instrument for measurement of flow of water in and around trawl nets under operation and another instrument specially intended for continuous measurement of the warp tension of trawl gear from the vessel have been designed. An instrument designed for measuring speed of fishing boats is undergoing tests.

Researches in hand

I Development of mechanical accessories for fishing boats

Designs of a water circulation system for live bait tanks and sprayer arrangement for chumming of fish for pole and line fishing have been completed. Based on the designs developed, two boats belonging to the Administration of the Union Territory of Laccadives are being fitted with the equipment.

Testing of a Kirloskar RVM 6 engine was completed and the test report incorporating defects observed and suggestions for improvement was furnished to the manufacturers. Testing of another Kirloskar engine viz. RVM 4 engine, has been taken up at the request of the manufacturers. Installation of the engine has been completed.

II Deweeding of lakes and bheels

Fabrication of full scale equipment for clearing submerged aquatic weeds has been taken up based on the design earlier developed. On completion, this machine will be subjected to field trials. It has been designed to operate faster and to suit larger water areas.

III Development of cheaper stern gear

Preliminary field trials have indicated the suitability of aluminium alloys for manufacture of stern tubes for wooden fishing boats. A full scale stern tube has been fabricated out of aluminium alloy. It will be subjected to field trials. The aluminium alloys showed good corrosion resistance under marine conditions indicating their compatibility with commercial marine quality steel that goes for construction of fishing boats.

IV Fish hold refrigeration

Work has been taken up to study the refrigeration requirements of fish holds. The work so far carried out was aimed at collecting basic data on distribution of temperature at different points of fish hold, heat leakages through different parts of the hull, deck, bulkheads etc.

V Studies on power requirement of deck equipment

Studies on power requirement of trawl winch have been initiated and necessary equipment for measurement of warp tension while the warp is being wound on the winch has been fabricated. Measurements have been completed in 9.8 M. (32′) class of boats. The studies are being continued with larger boats.

VI Measuring and testing instruments

a) Vertical opening meter

Work on the development of a telemetering instrument for measurement of the vertical opening of trawl net was continued. Methods based on the hydrostatic pressure difference between the head and foot ropes were not successful because of the very little pressure difference between the two. Instead, an attempt is now being made to measure the vertical opening by converting the vertical distanee into angular movements by use of reduction gear and then into corresponding electrical signals.

b) Portable electronic tension meter

The electronic part of a portable electronic tension meter has been developed and preliminary trials carried out successfully. A portable unit incorporating necessary modifications in the design is being constructed.

c) Rudder position indicator

Development of a simple instrument to indicate the position of the rudder has been completed and the instrument has been subjected to laboratory trials with satisfactory results. Fabrication of the instrument is in progress.

d) Electronic net-flow meter

An electronic telemetering instrument has been designed for measurement of flow of water in and around trawl nets under operation. The instrument senses the water flow in terms of the resistance offered by a neutrally buoyant float. The resistance is converted into corresponding electrical signals and transmitted to the boat. This instrument is very light and requires no special mounting. The main features of the instrument are:

Range	:	0 – 5 knots
Weight in air (sensor only)	:	110 gms.

e) Ship-installed tension meter

An electronic instrument specially intended for continuous measurement of the warp tension from the vessel has been developed. It measures the tension when the warp is being wound. This operates on a power supply of 24 volt D. C. The range is at present 0–500 kg. which can be changed by simple adjustments.

f) Boat speed meter

An instrument has been designed for measuring the speed of fishing boats. The meter indicates the speed in terms of pressure. The pressure acting upon a small area immersed in water and normal to the direction of movement of the boat, is proportional to the velocity of the boat. The instrument is designed to be rugged and the delicate propeller mechanism which is normally used in conventional boat speed indicators is dispensed with. The instrument is being tried under field conditions.

Researches contemplated

1 Development of hydraulic deck equipment

A project is being taken up in collaboration with the Central Mechanical Engineering Research Institute, Durgapur, W. Bengal and a manufacturing firm for development of hydraulic motor, pump and controls for fabrication of hydraulic trawl winch and other deck equipment.

2 Development of measuring and testing instruments

Work on development of (i) a multichannel telemetering link between the net and boat for simultaneous operation of more numbers of instruments on the net, (ii) a catch-in-net measuring instrument and (iii) an electronic impulse generator is proposed to be taken up during the coming year.

Research workers associated with the projects

1. M. Velu. Jr. Fishery Scientist.
2. K. Sreedharan Namboodiri, Asst. Fishery Scientist.
3. T. K. Sivadas, Asst. Fishery Scientist.
4. R. Krishnaswamy, Research Assistant.
5. V. Vijayan, Research Assistant.

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY SUB-STATION, VERAVAL, GUJARAT STATE

Fishing Gear Branch

Researches in hand

1 Investigations on trawl nets

In the studies on the comparative catch efficiency of 18.3 m. four seam trawl and 15.8 m. six seam trawl a total of 15 fishing trips were made. The data collected are as follows :

	15.8 m. six seam trawl	18.3 m. four seam trawl
Total No. of hauls	18	18
Total duration	14 hrs. 45 mts.	14 hrs. 10 mts.
Average duration per haul	49 minutes	47 minutes
Depth of operation	24 m. to 36 m.	24 m. to 36 m.
Average towing speed	2 knots/hour	2 knots/hour
Total catch (Kg)	3,411.00	2,703.00
Prawn catch (Kg)	161.00	205.00
Fish catch (Kg)	3,280.00	2,498.00
Average catch per hour (Kg)	233.00	191.00

The above data tend to show the better efficiency of the six seam trawl. However, further experiments are necessary to confirm the findings.

II Improvement of design of pomfret gill nets

Studies on the comparative efficiency of the local method of hanging gill nets and the CIFT method were undertaken. The data collected so far are tabulated below:

Number of units	:	30
Material	:	Nylon 210D/3/3
Mesh size	:	73 mm. bar
Total number of trips	:	82
Total duration	:	290.5 hours
Total No. of pomfrets landed	:	844
No. of pomfrets in CIFT method of hanging	:	469
No. of pomfrets in local method of hanging	:	375
Total weight of miscellaneous fishes landed	:	1,732 kgs.

It may be mentioned that the pomfret fishing was a failure during the year along the coast and so the project will be continued during the next season for obtaining conclusive results.

Researches contemplated

Studies on all the above aspects are to be continued in the ensuing

year. Further, investigations on standardisation of mesh size, twine size and effective take-up ratio of gill nets for hilsa fishery in the region are proposed during the coming year.

Research workers associated with the projects

1. S. D. Deshpande, Jr. Fishery Scientist.
2. H. N. Mhalathkar, Asst. Fishery Scientist.
3. T. M. Sivan, Asst. Fishery Scientist.
4. P. George Mathai, Research Assistant.

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY SUB-STATION, KAKINADA, ANDHRA PRADESH

Chief Findings

Comparative shrimp trawling experiments with 29.26 m. long wing four seam net and 18.26 m. two seam conventional net conclusively showed the superiority of the long wing net. in which the prawn catch per unit effort was almost 2 times of that in the conventional type net. Studies on the different shaped otter boards for trawl nets reveal that the gear operated with V-shaped steel doors bring comparatively better catch.

Researches completed

Shrimp trawling

Studies on the design and operational aspects of a suitable shrimp trawl for the east coast of India were initiated in June 1967 and completed by June 1970 as per schedule. The findings in the studies are summarised below:

i) Out of four different designs of shrimp trawls i. e. 18.26 m. two seam, 21.32 m. four seam, 19.36 m. four seam and 29.26 m. four seam, 18.26 m. two seam net gave better catch rate of prawn as well as fish. But in spite of the low catch obtained with 29.26 m. net, the prawn content was higher than that in the other nets.

ii) When the 18.26 m. two seam net was operated with 15 and 13 floats as against constant lead, the catch rate was found to be more or less

same, but prawn content was clearly high by 3.5 kgs. per trawling hour with reduced buoyancy. The increase in prawn catch is about 50% more than that by the net of increased buoyancy.

iii) Comparative fishing with 29.26 m. and 18.26 m. nets reveals that the former brings more catch per unit effort than the latter. In terms of prawn catch, the increase is found to be on an average two times, which indicates the superiority of the 29.26 m. net. The behaviour of the net under varying conditions at the centre is found satisfactory. This new net also can suitably be operated from different horse-powered trawlers by effecting slight modifications.

Researches in hand

I Studies on otter boards

Study on the relative efficiency of three different shaped otter boards, viz. horizontal curved, vertical curved and V-shaped metal boards was continued. Designs of the three otter boards to suit their operation from the boat 'Fishtech No.7' (12. 2 M. boat with 60 H. P. engine) were prepared with the following main specifications.

Type of otter board	Length	Breadth	Weight	Material
Horizontal curved	120 cm	60 cm.	50 to 55 kg	Wood and Iron
Vertical curved	60 cm.	120 cm.	50 to 55 kg	- do -
V. shaped	122 cm.	74 cm.	60 kg.	Iron

Comparative fishing with (i) horizontal and vertical curved otter boards and (ii) all the three otter boards were undertaken and the results obtained in the latter series are given below.

Type of otter board	Horizontal curved	Vertical curved	V-shaped
Number of hauls/ towing time (hrs.)	—	15/15.00	—
Average towing speed (knots)	2.05	2.02	2.15
Average horizontal opening between O. B. (m.)	19.8	22.3	20.3
Average warp resistance (kg)	476.0	492.0	490.0
Catch (kg)/trawling hr.	54.8	50.3	56.0

The catch per unit effort of the gear operated with horizontal curved otter board is found to be 1.60 times more indicating that it is more effective for bottom trawling, when compared to vertical curved otter board. It is also seen that the gear operated with V-shaped steel otter board obtained more catch in comparison with the other two.

The study is to be continued to obtain confirmatory results.

II. Gill netting

Regular observations were made at the local gill net landing centre to study the trend of seer fishing from the local boats. Seer constituted about 21.04% of the total catch during the year as compared to 19.54% and 35.50% in 1969 and 1968 respectively. *Scomberomorus guttatus* represented 91.8% as against 39.4% in 1969, while *S. commersoni* and *S. lineolatus* were only 6.6 and 1.6% as against 44.2 and 16.4% in the previous year. The predominant size groups of *S. guttatus* were found to range between 45 to 60 cm. while the other two were within the size group of 85—95 cm.

Researches contemplated

Studies on the development of a combination trawl for shrimps as well as fish on the east coast for medium sized trawlers are additionally proposed to be undertaken during the ensuing year.

Research workers associated with the projects

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

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY SUB-STATION, BURLA, ORISSA STATE

Chief Findings

Higher fish concentrations were observed in the upper reaches of the Hirakud Reservoir during the first quarter of the year and in the middle reaches during the second quarter and both in middle and upper reaches during the last quarter. Majority of fishes were caught from

3—4 metres depth. The optimum frame size for frame nets was found to be 1.75 metres. The best ratio for inner to outer webbings in trammel nets was found to be 1:3.

Researches in hand

I - Exploratory fishing

Exploratory fishing was continued and 119 observations were made from 13 fishing stations in the Mahanadi river course of Hirakud Reservoir upto November. During the first quarter of the year fish concentration was mainly in the upper reaches and in the second quarter it shifted to the middle reaches. In the last quarter fish concentration was observed both in middle and upper reaches. The lower reaches were found invariably less productive irrespective of the seasons. This was nearly in confirmity with last year's findings. Percentage of scale fish was on the increase in the total landings.

II - Comparative studies on simple gill net, vertical lines net and frame net

With a view to studying the relative catch efficiency of different designs of gill nets, comparative fishing was conducted with simple gill nets, vertical lines net and frame nets. The data collected during 117 fishing operations were analysed. The results are furnished below:

	Turbid water (May - October)	Limpid water (November - April)
	Catch per 1000 sq. m. of webbing (Kg.)	
Simple gill net	2.82	1.55
Vertical lines net	5.80	1.04
Frame net	7.81	1.63

In turbid waters the frame nets recorded 2.77 and 1.33 times more catch than simple gill net and vertical lines net respectively. The vertical lines net has yielded 2.06 times more catch than conventional simple gill net. However, in limpid waters the catch per unit effort is almost same in both simple gill nets and frame nets.

III - Studies on trammel nets

Study was continued to find out the suitable mesh size ratio between inner and outer webbings of trammel nets. The average catch per unit effort of the trammel net having 1:3 (inner to outer) mesh ratio was higher than nets with 1:4 and 1:5 mesh ratios this year also. The average catch per unit effort was found to be as follows:

Gear	Catch/1000 sq. m. (kg)
Trammel net with 1:3 mesh ratio	4.261
-do- 1:4 -do-	3.836
-do- 1:5 -do-	3.567

IV Studies on the optimum parameters of compartmentalisation in frame nets

This study was continued to arrive at the optimum frame size among the five frame sizes set in the frame nets. Based on catch of four commercially important types of fishes in Hirakud Reservoir, it was concluded that the net with 1.75 sq. m. frames was superior over the others and it also showed significance for *Cirrhina mrigala*.

The average catch of the different types of nets was as below:

Gear	Catch/1000 sq. m. (kg)
Net with 1.00 m. frames	4.139
— do — 1.25 m. frames	4.617
— do — 1.50 m. frames	4.975
— do — 1.75 m. frames	6.636
— do — 2.00 m. frames	5.484

Researches contemplated

1. Optimum size of fishing fleet of gill nets (Trammel and frame nets)

2. Effect of colour on the catches of gill nets.

Research workers associated with the projects

1. Y. Sreekrishna, Asst. Fishery Scientist.
2. R. M. Naidu, Research Assistant.
3. K. K. Kunjipalu, Research Assistant.

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY UNIT, NANGAL, PUNJAB

I Improvement in the design of inland gill nets

For standardisation of mesh size of gill nets for exploitation of the

fish resources of the reservoir, fishing experiments were continued using gill nets in the mesh range of 45-55 mm. with a variation in mesh size of 2.5 mm. These nets were operated from different centres in the upper and middle reaches of the reservoir under identical fishing conditions and data on the length, girth and weight of fish caught in relation to the net of each mesh size were collected separately. It has been generally noticed that the landings of *Labeo diplostoma* were comparatively better from nets in the mesh bar range of 45 mm. to 50 mm., which may be due to the fact that the average size of the above species is slightly decreasing year by year.

During summer months, large scale migration of fish from the upper reaches to the deeper zone of the reservoir has been noticed during the previous experiments. With a view to assess the availability of fish in the deeper zone and the effectiveness of column set gill nets in the capture of fish during this period, experiments were conducted in the months of May and June by setting gill nets one metre below the surface and the catch was compared to that of surface set nets of the same specifications operated in the same area. About 50% increase in catch per unit area has been noticed in the case of column nets. The reason for this may be the fact that owing to high surface temperature of water in peak summer, the fish migrated to the lower layers of water.

II Exploratory fishing

Exploratory fishing in the reservoir has been continued. During the year under review, trial operations were mainly confined to the upper and middle reaches of the right bheel of the reservoir. During the winter months, large fish concentration has been noticed at the tail end of the reservoir which may be apparently due to the winter migration of fish to the shallow regions. During summer months better landings were recorded from the middle reaches of the reservoir, which account for summer migration of fishes to the deeper zone of the reservoir. A total of 135 fishing trips was undertaken during the year landing 5025 fishes weighing 4207.7 kg. As a result of the investigations a number of highly productive fishing grounds have been located and the State Fisheries Department and private fishermen engaged in fishing in the reservoir are successfully exploiting these fishing grounds utilising the fishing methods developed by this Unit.

The activities of this Unit are being wound up towards the end of the year under report as most of the fishing problems of Gobindasagar have been successfully tackled during the course of this Unit's six years functioning at Nangal.

Research workers associated with the projects

1. N. A. George, Asst. Fishery Scientist.
2. Anwar Ahmed Khan, Research Assistant.
3. Om Prakash Pandey, Research Assistant.

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY UNIT, GOA

Chief Findings

Experimental shrimp trawling with CIFT design nets has indicated the availability of prawns in the 8 to 35 m. depth range at a uniform rate.

I Studies on shrimp trawls

Experimental fishing operations were conducted in the 8 to 35 m. depth range with CIFT design trawl nets. The operations were conducted from 3 fishing vessels of 9.14 M. (30′), 9.75 M. (32′) and 12.28 M. (40′) L. O. A. The catch details on analysis have shown that the availability of prawns in the depth range is almost uniform. However, an increase in the availability of *Penaeus indicus* was noticed as the depth range increased.

Research workers associated with the project

1. P. Appukutta Panicker Jr. Fishery Scientist.
2. P. R. Senthivelan, Research Assistant.
3. Jagatheesan, Research Assistant.

EXTENSION, INFORMATION & STATISTICAL DIVISION

STATISTICS SECTION

Chief Findings

Study on the variations in prices of Indian frozen prawns in the U. S. market has shown that there is an upward trend in prices from January to June for the headless, shell-on type product, as noted from the monthly indices of prices. The monthly indices have given indication to such a trend in case of peeled and deveined frozen prawns also. A tentative scoring scale has been developed for the quality assessment of 3 species of prawns in ice-storage from absolute freshness to complete spoilage, on the basis of flavour, odour and texture.

Researches in hand

I Studies on the fluctuations in drained weight of canned and frozen prawns

Analysis of data on drained weights of canned prawns have shown that of the size grades tiny and small, a higher proportion of cans of tiny size-grade has excess drained weight than the declared weight. Further, the count (No. of pieces) in the can and corresponding drained weight are correlated, but not in all cases.

In the study on the probable factors responsible for variations in drained weight of canned prawns from the declared drained weights, the effect of time of cooling prawns after blanching was investigated. It is seen that variations even to the extent of 3—15 minutes in the time of cooling do not cause changes in gross weights which have already been seen to be correlated to the drained weights.

II. Price study of frozen prawns in the U. S. A. market

Average monthly price data in case of Indian frozen prawns of the types headless, shell-on and peeled and deveined, in the New York market for the 5 year period from 1965 to 1969, were analysed to find out the seasonal variation, if any. Month-wise indices were worked out on the basis of annual average price of the respective years. The monthly indices show an upward trend from January to June for headless, shell-on type product. No such clear trend has been noticed in the case of peeled and deveined type so far, though there is an indication of the existence of such a trend in some years.

The ranges of monthly indices of prices varied between 93.7 and 104.0 for headless, shell-on prawns, while the corresponding values for peeled and deveined prawns were 95.9 and 105.8.

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

The study aims at formulation of a numerical scoring system for assessment of the organoleptic characteristics of ice-stored prawns from absolute freshness to putridity and to connect the numerical scorings with descriptive expressions of flavour, odour and texture. Study conducted with three different species of prawns viz. *Metapenaeus affinis*, *M. dobsoni* and *Parapenaeopsis stylifera* resulted in working out a

tentative scoring scale. It is an eleven point scale graduated from zero to ten for flavour and odour and a five point scale for texture. In the case of odour and flavour, zero in the scale corresponds to strong putrid odour and flavour and ten corresponds to sweet characteristic odour and flavour of the species. In the texture scale 1 corresponds to pasty or tough and 5 corresponds to soft and firm. Analysis of the data collected has shown that significant changes in the quality index were detected by a decrease of 0.5 to 1.5 points in the flavour scale, 1 to 1.5 points in the odour scale and 0.5 to 1 point in the texture scale for the three species mentioned above. Experiments with other species of prawns viz. *Penaeus indicus* and *M. monoceros* are under progress.

IV Study on the economics of operation in prawn processing factories

This study initiated during the period under report is aimed at working out the economics of operation in prawn processing factories. Data on rate of peeling and deveining of different species of prawns, sorting and grading, transport charges, freight rate to different countries and cost of packing materials were collected during the year. Preliminary analysis of the data collected showed that the rate of peeling and deveinig varies with different species of prawn and with the age of the workers employed. Beheading rate of the species, *Penaeus indicus* (locally known as sea naran) was on an average 28 numbers with a standard deviation of 6 numbers per minute. The rate of sorting and grading of sea naran and the species *Metapenaeus monoceros* (known locally as Karachemmeen) was worked out to be 20 kg. per hour per worker. The average sorting and grading rate of medium sized river naran was 18 kg. per hour per worker. Based on the data collected, an estimate of the average cost involved in freezing of 50 Ibs. (about 23 kg.) of prawns, exclusive of material cost, is being worked out.

Researches contemplated

All the above projects are to be continued during 1971. In addition to these, the following studies are proposed for the coming year.

1. Studies on the optimum size of fishing fleet for a viable integrated fish processing factory, aimed to find out the optimum number of fishing boats a factory should possess in relation to the installed capacity of the factory for economic operation.

2. A study on the location and optimum capacity of fish processing plant in India, aimed to estimate the extent of idle capacity existing in the fish processing plants at present operating and to find out the means for reducing the extent of idle capacity so as to achieve more economic operation of the plants.

Research workers associated with the projects

1. K. Krishna Rao, Asst. Fishery Secientist.
2. H. Krishna Iyer, Asst. Fishery Scientist.
3. N. Balraj, Research Assistant.
4. R. Gopalakrishnan Nair, Computer.

EXTENSION AND INFORMATION SECTION

1) Technical consultancy service

i) Replies to technical queries

Furnishing information and advice on the technical queries received from the fishing, fish processing and related industries, State Fisheries Departments and other fishery interests on the various aspects of fishery technology was one of the main activities of the Section. A total of 380 such queries were replied during the period of which 216 related to subjects pertaining to fish processing and 164 to fishing craft and gear. The details furnished on the fish processing industry include schemes for setting up canning, freezing and dehydration plants including scheme for canning fresh water fishes, methods for freezing, canning and dehydration of different types of fish and shell fish, details of accelerated freeze-drying methods for prawn and fish products including estimates of costs of production, effect of fluctuating temperatures on frozen prawn products in cold storage, preparation of fish protein concentrate, extraction of sardine oil and preparation of different products from the oil preparation of bacteriological peptone from trash fish and chitosan from prawn shell waste, extent of loss of weight of frozen prawns on thawing and refreezing, methods for retardation of jellying in canned prawns and determination of titratable acidity, data on ice-storage life of commercially important fish and shell fish etc. The technical details furnished with respect to fishing craft and gear include twist specifications of nylon and monofilament twines, comments on the suitability of monofilaments for fishing nets, technical details on nets, otter boards, winches etc. suitable for different sizes of boats, scheme for fish net making plant and twine testing laboratory, estimated requirements of materials for and costs of different sizes of boats, suitability of aluminium alloy for construction of fishing vessels, use of cashew nut shell liquid resin as coating on wooden fishing boats, details of equipment and tools required for a boat building yard and marine workshop, stern gear equipment for marine engines of different horse powers, specifications of propellers for marine engines etc.

ii) Technical assistance through personal discussion

In addition to the technical information and guidance given

through correspondence, such assistance was also provided regularly to representatives of the fishery industry, new entrepreneurs etc. who called at the Institute for gathering information and advice pertaining to setting up new processing units as well as important findings of the Institute in different fields. Due attention was paid in furnishing them with the required information, arranging for discussions with the concerned scientific staff, demonstrating the working of the different equipment installed at the Institute, etc. A total of 130 such parties called at the Institute during the period.

iii) Testing of materials and products

Arrangements were made for testing samples of fish net twines, fish products etc. received from indigenous manufacturers and processors. Twenty samples of polyethylene monofilament and nylon twines, 1 of monofilament tape, 4 samples of anticorrosive and antifouling paints and paint remover, 1 of aluminium alloy sheet and 443 samples of canned prawns, lobsters, tuna, frozen prawns, lobsters and frog legs, fish and prawn meals and water were analysed and results of tests furnished to the concerned parties with suggestions for improvement wherever necessary. The test reports and comments enabled the manufacturers and processors in improving the quality of the materials and products.

iv) Visits to fish processing factories and conduct of demonstrations

A total of 8 freezing factories in Cochin, Quilon and Mangalore areas were visited on specific requests and technical advice on handling, preparation and processing of prawns and frog legs were given to the parties concerned. Demonstrations on the schedule of cleaning recommended by the Institute for maintenance of sound factory hygiene and method of freezing prawns and forg legs were conducted at these factories. Apart from this, regular visits were also made to fish processing factories in and around Cochin and discussions held with the concerned people on the findings of this Institute for adoption in the fish processing industry and problems faced by the industry. Further, on the basis of the bacteriological survey of the factories and primary processing centres conducted by the Quality Control Section of the Institute, technical assistance was given to the concerned parties through regular visists for improving the sanitary conditions and overcoming defects observed.

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

Eighteen sets of designs of trawl nets and suitable otter boards, 29 sets of designs of trawl winches for different sizes of boats, 1 of a hydrographic winch, 1 design of a gallow for a 13.81 M. (45′) boat, 1 of a gurdy, a set of designs of the equipment for removal of submerged aquatic

weeds, 1 set of drawings of clutch-pulley installation, 3 drawings showing arrangement of sprinkler and live bait tank in pole and line fishing vessel, 1 design of line-hauler-cum-gurdy, 19 drawings of the rotary drum dryer of ½ tonne raw material capacity for production of fish meal, 4 of the tunnel dryer of 1 tonne raw material capacity for dehydration of fish and layouts for canning and freezing factories, all designed by this Institute, were supplied to interested parties on request. Besides, 6 copies of the booklet on 7.6 M. (25') open power fishing boat, published by the Institute, were also supplied on request.

vi) Film shows and Exhibitions

Two film shows were conducted for the benefit of the trainees of the Fishermen Training Centre at Ernakulam.

The Institute put up an exhibition pavilion in the Indo-Norwegian Project premises in connection with the 'Open House' conducted by the Project in December 1970. Exhibits on the various achievements of the Institute in fish processing methods and products and development of fishing craft and gear and equipments with informative write-ups were displayed at the exhibition which was visited by thousands of people during the 3 days of the exhibition.

2) Publications

i) Fish Technology Newsletter

Fish Technology Newsletter, Vol. X, Nos. 1, 2, 3 and 4 were brought out during the period. The notes published in the publication include details of a mechanised peeling table for prawn processing factories, methods for canning frog legs and preparation of chitosan from prawn shell waste, method of freeze-drying prawns and advantages of freeze-drying, economic efficiency of trawlers built to CIFT designs and results of study on the selective action of mesh size and relationship between mesh size and twine size of seer gill nets.

ii) Leaflets and information sheets

Research results as follows were brought out in the form of cyclo-styled leaflets during the period.

a) Method for the preparation of laminated Bombay duck.
b) Methods for canning pomfrets and frog legs.
c) Preparation of chitosan from prawn shell waste.
d) Mechanised prawn peeling table.
e) Utilisation of frog wastes.
f) Formulation of a new antifouling paint.

Copies of the different leaflets and information sheets so far published were supplied to interested parties on specific requests.

Lists incorporating addresses of dealers in fishing gear and gear materials in India, marine engines and engine spares, dealers in mechanical fishing accessories and materials required for sheathing wooden hulls of fishing boats were revised on the basis of the supplementary information received from the different State Fisheries Departments and other sources. Besides, the list of fishing boat building yards in the different maritime States of India published earlier was also revised to include up-to-date information as far as possible. A list of chemicals and equipments required for a quality control laboratory for testing canned and frozen prawn and fish products was also brought out in cyclostyled form.

Draft of a write-up on the results achieved by this Institute during the 12 years from the time of its inception was prepared and is proposed for publication. In addition to the above, several technical reports and notes on the different aspects of the investigations carried out at the Institute and results achieved were prepared and furnished to different Governmental and private organisations against specific requests received.

3) Open House discussions

In view of the proposal of the Government of India to introduce compulsory bacteriological quality control in case of frozen prawn products exported from India, 'Open House' discussions were held by the Institute both at its headquarters at Cochin and at Mangalore on the 21st, 23rd, 25th, 28th and 30th March 1970 and 16th May 1970 respectively. These discussions were held in order to educate the Indian processors in the various technical aspects of production of frozen prawn products of specified bacteriological quality. Sources of bacterial contamination of the raw materials from the time of catch, through the different stages of preservation and preparation to processing of the final products and storage, and measures for prevention of contamination were discussed in full detail with the help of suitable slides prepared for the purpose. About 124 persons from the prawn processing industry and related establishments participated in these discussions which proved to be of great benefit to the processors.

Technical Assistance by Sub-stations and Units

Apart from the technical assistance and guidance given by the Extension and Information Section, such assistance was given by the Sub-stations and Units of the Institute also regularly to the fishing and fish processing industries in the concerned regions. The Sub-station at Veraval rendered technical assistance particularly in trawl fishing for prawn catch,

handling, icing and transportation of fish and processing of dried Bombay duck. The Sub-station at Kakinada rendered assistance in rigging of trawlers and operation of trawl nets. The Unit at Nangal gave technical help to the local fishermen in fabrication, mounting and mending of gill nets. The Unit at Bombay gave assistance to the freezing factories in the region in maintenance of sound factory hygiene, processing of frog legs of sound bacteriological quality and also frozen prawns and lobsters. The Unit at Calicut, apart from giving technical assistance to the freezing and canning factories in the region in processing methods and maintenance of factory hygiene, undertook analysis of samples of processed fish products and by-products and water for use in fish processing establishments as per requests received.

Persons associated

1. P. N. Ravindranatha Kaimal, Extension Officer.
2. M. K. Kandoran, Asst. Extension Officer.
3. Smt. Mary Thomas, Extension Assistant.

SUMMARY

Studies on flavour bearing components in fish muscles showed that dephosphorylation occurs to a great extent in fresh fish before it is stored in ice as revealed by high levels of inosine monophosphate. The phospholipids in most of the important species of fish were found to be composed of phosphatidyl choline in the range 55 to 70% and phosphatidyl ethanolamine 20 to 30%. Study of the fatty acid composition of the fish tilapia showed that poly unsaturated acids are present only to an extent of 8%, revealing the poor nutritional quality of the oil. In the investigations on the effect of inhibitors on dopa oxidation of tyrosinase leading to formation of melanin it was seen that cysteine is a non-competitive inhibitor thereby indicating the prospective use of the compound in reducing blackening in prawns. Disc electrophoresis of fish myogens on polyacrylamide was found to be a very reliable method for species identification since the electrophoretic pattern was specific for each species of fish.

Investigation on the effect of intense cold on different bacterial cultures showed that strains of *Pseudomonas* lost their viability sooner at -5°C than at -15° C. A culture medium containing complex nutrients along with 0.5% or more of sodium chloride was found to be more effective and suitable for the determination of total bacterial plate counts from frozen fishery products. Bacteria isolated from canned prawn products, water, ice and from factory environs were found to be heterogeneous in character consisting of an average of 20% gram positive spore formers, 15% gram positive *Cocci*, 30% gram negative and weakly gram positive *Cocci*, 23% gram negative rods and 12% gram positive non-spore forming rods.

A refrigerated sea water plant was installed in the Institute for study of the storage characteristics including shelf life of commercially important types of fish and shell fish. The optimum periods of ice-storage prior to freezing and frozen storage periods were assessed in the case of four more species of fish. The method worked out for canning oil sardine in brine is significant in asmuchas the costly oil medium at present used can be replaced and points out possibility of using the cheap brine medium for canning other types of fish also. Field trials with the prawn peeling table designed and constructed by the Institute proved its benefits in handling prawns hygienically during peeling and saving labour to a significant extent. An automatic brine fiilling machine developed for use in prawn canning lines is expected to be of great advantage to the industry in economising operational costs. An instrument developed for determination of concentration of boiling brine used for blanching prawns can possibly fulfil the long-felt need of the industry for a satisfactory device for the purpose. A prototype solar dryer constructed as per the design finalised by the Institute proved that solar radiation energy can be effectively utilized for production of quality dry fish products within much less time than that required in ordinary sun drying. Investigation on preparation of speciality products from trash fish resulted in working out methods for preparation of fish sausage, a protein enriched food composition containing fish protein concentrate and fish hydrolysate.

Samples of shrimp extract prepared from prawn shell wastes by the method worked out earlier were found to keep good for more than a year in canned condition and for 4–5 months under refrigerated temperature (0–5°C). Investigations towards economic utilization of prawn shells resulted in working out a method for the preparation of another product, chitosan. Fractions of unsaturated fatty acids having iodine value as high as 200 could be isolated from sardine oil. The slight objectionable solvent flavour noticed on cooking fish protein concentrate prepared by the method worked out earlier could be reduced almost completely by an improvement effected in the solvent extraction procedure.

Polyphosphate treatment has been found to substantially improve the bacteriological quality of peeled and deveined shrimp, apart from preventing 'thaw-drip-loss'. A reduction of 30% of the *Staphylococci* count was effected. A survey of the sources of supply and chemical quality of water used in processing establishments in Cochin area revealed that only 40% of the total samples tested are of standard quality and that about 25% of the processing establishments use water from unprotected sources like wells and ponds. A survey of the bacteriological quality of frozen prawns produced commercially revealed that 14% of the headless, shell-on type product and 23% of the peeled and deveined frozen type are substandard. *Staphylococci*

count was found to decrease by 30-60% during freezing raw peeled and deveined prawns. Complete destruction of the organisms was noted after 5 months of frozen storage at -18°C in case where the initial count was less than 500/ gm. The survey of sanitary conditions of prawn processing factories and primary processing centres in the Kerala coast was further intensified and in all cases of surveys conducted, the results and suggestions for overcoming defects observed were furnished to the processors for effecting improvements. Training in bacteriological examination and quality control of processed fish products was imparted to thirteen nominees of fish processing factories and the Export Inspection Agency. Draft quality standards were formulated in the case of lactarius canned in oil, fresh and frozen mackerels and seer fish.

Methods for testing diameter, weight and twist of fish net yarns worked out by the Institute were accepted as an Indian Standard Specification. Investigations on the webbings of polyethylene twisted monofilaments showed that the strength of this material is 4.34 gms. denier, while the values for cotton and nylon are 1.57 and 3.9 respectively. Twist constants for cotton ropes of ZSZ and ZZSZ construction were also evolved.

The resistance offered by the gear in shrimp trawling was found to vary between 350-400 kg. at trawling speed of 2 knots within the depth range of 7-21 M. For bulged belly type trawls, straight jib was found to be better suited than slanting jib. In this type of trawl the escapement of prawns was found to be more through the posterior region of the belly, throat and posterior region of side panel. A 33 M. bulged belly type fish trawl and 22 M. shrimp trawl were designed for operation from Jhinga type trawlers of 17.37 M. length. A survey was conducted of trawl nets in operation on the west coast and southern regions of the east coast.

Gill nets of mesh bar 75 mm. and made out of twines of size 210 D/12/3 were found to be superior to all the other types of nets tried for commercially significant size groups of seers off Cochin. The most predominant size group of seers in the area was found to be between 80-100 cm length.

Fibreglass sheathing in combination with activated thermoplastic resins was recommended as substitute for the conventional sheathing with copper for protection of fishing boats against marine deterioration in addition to the aluminium magnesium alloy sheathing recommended earlier. Spheroidal grain austenitic cast iron known in trade as 'Ni-Resist' was found to be a satisfactory substitute for the costly manganese bronze used for marine propellers. Aluminum alloy has been found to be a suitable construction material for stern tubes in fishing boats instead of the costly brass/bronze stern tubes conventionally used.

Designs of a water circulation system for live bait tanks and sprayer arrangement for chumming of fish for pole and line fishing have been completed. An electronic instrument for measuring the flow of water in and around trawl nets in operation was designed. Designs were also developed of an electronic instrument specially intended for continuous measurement of the warp tension of trawl gear and another for measuring the speed of fishing boats.

Study on the variations in prices of Indian frozen prawns in the US market has shown that there is an upward trend in prices from January to June for the headless shell-on type product, as noted from the monthly indices of prices. For the quality assessment of prawns in ice-storage from absolute freshness to complete spoilage, a tentative scoring scale has been developed on the basis of flavour, odour and texture in case of three species.

The Institute continued to render technical assistance to the fishing and fish processing industry, State fisheries departments and other fishery interests throughout the country and thus contributed to the modernisation and expansion of the industry. Technical enquiries numbering 380 received from the industry and related organisations were replied apart from giving information and guidance on various aspects of the industry to 130 parties who called at the Institute. Samples of fish-net twines, fish products etc. received from manufacturers and processors were tested. Fish processing factories and primary processing centres especially in Cochin area were visited regularly for giving technical assistance in maintaining sound factory hygiene and processing of quality products. Demonstrations of the important findings of the Institute were conducted in a few of the factories. Designs of fishing nets, mechanical fishing aids and fish processing equipment developed by the Institute were supplied to several parties on request. Leaflets (cyclostyled) were brought out on some of the important findings of direct application in the industry. 'Open House' discussions on production of bacteriologically sound prawn products were organised in Cochin and Mangalore for the benefit of the processors in the concerned areas. The Institute also participated in an exhibition at Cochin.

At the Sub-station of the Institute at Veraval the insulated plywood box designed earlier for transportation of fish over long distances was further improved by providing an inside lining with 25 G aluminium sheet making the container more rigid and preventing damage to thermocole used as insulant in the box. This type of container was seen very useful in carrying ice on board fishing vessels. A method worked out for smoking shark fillets has been found to yield smoked product having good appearance, taste and odour.

At the Bombay Unit, the storage conditions and spoilage pattern of the fishes dhoma, anchovy and lactarius were investigated.

In the Unit at Calicut, assessment made of the influence of heavy metal ions like copper and ferrous iron on development of brown discolouration of cured fish products on storage, pointed out the necessity for preventing external contamination with these metal ions during processing of the products. A method developed for smoking sardines in fillet form to get a product of appealing colour, flavour and odour holds out possibility of commercial application for economic utilization of the fish. The finding that self-brine at present discarded in large quantities from fish curing yards is of high fertilizer value is also of significance.

At the Sub-station at Kakinada, comparative shrimp trawling experiments with 29.26 m. long wing four seam trawl and 18.26 m. two seam conventional type net have conclusively proved the superiority of the long wing trawl over the other. The prawn catch per unit effort in the long wing trawl was almost 2 times of that in the conventional type of net. V-shaped steel otter boards brought in comparatively better catch when compared to horizontal curved and vertical curved boards.

The Institute's Sub-station at Burla observed higher fish concentrations in the upper reaches of the Hirakud Reservoir during the first and last quarters of the year and in the middle reaches during the second and last quarters. Majority of the fishes were caught from the 3–4 m. depth. The optimum frame size in frame nets for efficient operation was found to be 1.75 metre and the best ratio for inner to outer webbing in trammel nets, 1:3.

Exploratory fishing conducted by the Institute's Unit at Nangal in the Gobindasagar reservoir has resulted in locating a number of highly productive fishing grounds. Gill nets with mesh bar in the range 45 mm. – 50 mm. were found most effective for the exploitation of *Labeo diplostoma*, the major fishery of the reservoir.

At the Unit at Goa, trawling for prawns could be intensified in the depth range between 8–35 M.

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PERSONNEL

(Statement showing Division-wise staff position of the Institute as on 31-12-1970.)

Director Dr. V. K. Pillai.

HEADQUARTERS (COCHIN)

PROCESSING DIVISION

Sl. No.	*Name*	*Designation*
1.	Shri M. Rajendranathan Nair	Junior Fishery Scientist
2.	,, K. Mahadeva Iyer	-do-
3.	,, T. K. Govindan	-do-
4.	,, Cyriac Mathen	Quality Control Officer
5.	,, C. V. N. Rao	Asst. Fishery Scientist
6.	,, P. Vasudeva Prabhu	-do-
7.	,, M. Arul James	-do-
8.	,, S. Ayyappan Pillai	-do-
9.	,, P. Madhavan	-do-
10.	,, P. K. Chakraborty	-do-
11.	Smt. T. C. Karthiayani	-do-
12.	Shri K. Gopakumar	-do-
13.	,, P. A. Perigreen	-do-
14.	,, T. S. Gopalakrishna Iyer	-do-
15.	,, P. D. Antony	Research Assistant
16.	Smt. P. L. Chinnamma	-do-
17.	Shri V. Narayanan Nambiar	-do-
18.	,, K. Devadasan	-do-
19.	,, P. R. Girija Varma	-do-
20.	,, A. Vasanta Shenoy	-do-
21.	,, A. G. Radhakrishnan	-do-
22.	,, P. K. Surendran	-do-
23.	,, A. C. Joseph	-do-
24.	,, K. G. Ramachandran Nair	-do-
25.	,, Francis Thomas	-do-

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

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

CRAFT AND GEAR DIVISION

Sl. No.	*Name*	*Designation*
1.	Shri G. K. Kuriyan	Fishery Scientist
2.	,, R. Balasubramanyan	Junior Fishery Scientist
3.	,, M. Velu	-do-
4.	,, K. A. Sadanandan	-do-
5.	,, S. Gopalan Nayar	Assist. Fishery Scientist
6.	,, P. Sulochanan	-do-
7.	,, R. S Nair	-do-
8.	,, K. Sreedharan Namboodiri	-do-
9.	,, V. C. George	-do-
10.	,, T. K. Sivadas	-do-
11.	Smt. K. Radhalakshmy	-do-
12.	Smt. P. J. Cecily	Research Assistant
13.	Shri. M. Mukundan	-do-
14.	,, T. Joseph Mathai	-do-
15.	,, N. Unnikrishnan Nair	-do-
16.	,, K. Narayanan Kartha	-do-
17.	,, A. G. Gopalakrishna Pillai	-do-
18.	,, C. P. Verghese	-do-
19.	,, N. Subramania Pillai	-do-
20.	,, Shri V. Vijayan	-do-
21.	,, R. S. Manohardoss	-do-
22.	,, M. Syed Abbas	-do-

23.	,, M. Shahul Hameed	-do-
24.	,, R. Krishnaswami	-do-
25.	,, Verghese Paul	-do-
26.	,, C. Hridayanathan	-do-

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

Sl. No.	*Designation*	*Strength*
1.	Skipper	1
2.	Superintendent (Electrical & Mechanical)	1
3.	Engine Driver	1
4.	Draughtsman	2
5.	Fitter	1
6.	Welder-cum-Blacksmith	1
7.	Machinist	1
8.	Senior Mechanic	1
9.	Junior Laboratory Assistant	3
10.	Tindal	2
11.	Driver (Launch)	1
12.	Carpenter	1
13.	Deck hand	2
14.	Cook	1
15.	Laboratory Attendant	9
16.	Lascar	3
17.	Net Maker	4

EXTENSION, INFORMATION AND STATISTICAL DIVISION

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

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

Administration Section

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

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

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

Audit and Accounts Section

Name	*Designation*
Shri. K. Jayaraman	Accounts Officer

Other staff members in the Section are :—

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

Central Institute of Fisheries Technology
Sub-Station, Veraval

Processing Section

Sl. No.	*Name*	*Designation*
1.	Shri R. Venkataraman	Fishery Scientist
2.	Shri K. K. Solanki	Assist. Fishery Scientist

Craft & Gear Section

Sl. No.	*Name*	*Designation*
3.	Shri T. M. Sivan	Assist. Fishery Scientist
4.	,, H. N. Mhalathkar	-do-
5.	,, S. V. S. Rama Rao	Research Assistant
6.	,, P. George Mathai	-do-
7.	,, T. P. George	-do-

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

Sl. No.	*Designation*	*Strength*
1.	Skipper	1
2.	Senior Clerk	1
3.	Engine Driver	1
4.	Senior Mechanic	1
5.	Junior Clerk	1
6.	Junior Laboratory Assistant	2
7.	Jeep Driver	1
8.	Tindal	1
9.	Driver (Launch)	1
10.	Deck hand	4
11.	Laboratory Attendant	3
12.	Net Maker	1
13.	Peon	1
14.	Watchman	1

Central Institute of Fisheries Technology Sub-Station Kakinada

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

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

Sl. No.	*Designation*	*Strength*
1.	Bosun	1
2.	Engine Driver	1
3.	Junior Clerk	1
4.	Tindal	1
5.	Driver (Launch)	1
6.	Deck hand	2
7.	Cook	1
8.	Laboratory Attendant	3
9.	Peon	1
10.	Lascar	3
11.	Net Maker	2
12.	Watchman	2

Central Institute of Fisheries Technology Sub-Station Burla

Sl. No.	*Name*	*Designation*
1.	Shri Y. Sreekrishna	Asst. Fishery Scientist
2.	,, R. Mangayya Naidu	Research Assistant
3.	,, K. K. Kunjipalu	-do-

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

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

Central Institute of Fisheries Technology Unit, Bombay

Sl. No.	*Name*	*Designation*
1.	Shri P. V. Kamasastri	Junior Fishery Scientist
2.	Shri K. K. Balachandran	Assist. Fishery Scientist
3.	Shri Dinesh Kumar Garg	Research Assistant

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

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

Central Institute of Fisheries Technology Unit, Calicut

Sl. No.	*Name*	*Designation*
1.	Shri A. P. Valsan	Assist. Fishery Scientist
2.	Shri T. S. Unnikrishnan Nair	Research Assistant
3.	Shri V. Muraleedharan	-do-

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

Sl. No.	*Designation*	*Strength*
1.	Senior Laboratory Assistant	1
2.	Laboratory Attendant	1
3.	Watchman	1

Central Institute of Fisheries Technology Unit, Nangal

Sl. No.	*Name*	*Designation*
1.	Shri N. A. George	Assist. Fishery Scientist
2.	Shri Anwar Ahmed Khan	Research Assistant
3.	Shri Om Prakash Pandey	-do-

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

1.	Junior Laboratory Assistant	1
2.	Jeep Driver	1
3.	Tindal	1
4.	Laboratory Attendant	1
5.	Peon	1
6.	Lascar	2
7.	Net Maker	1
8.	Watchman	1

Central Institute of Fisheries Technology Unit, Goa

Sl. No.	*Name*	*Designation*
1.	Shri P. Appukutta Panicker	Junior Fishery Scientist
2.	,, M. D. Verghese	Research Assistant
3.	,, P. R. Senthivelan	-do-
4.	,, G. Jagadeesan	-do-

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

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