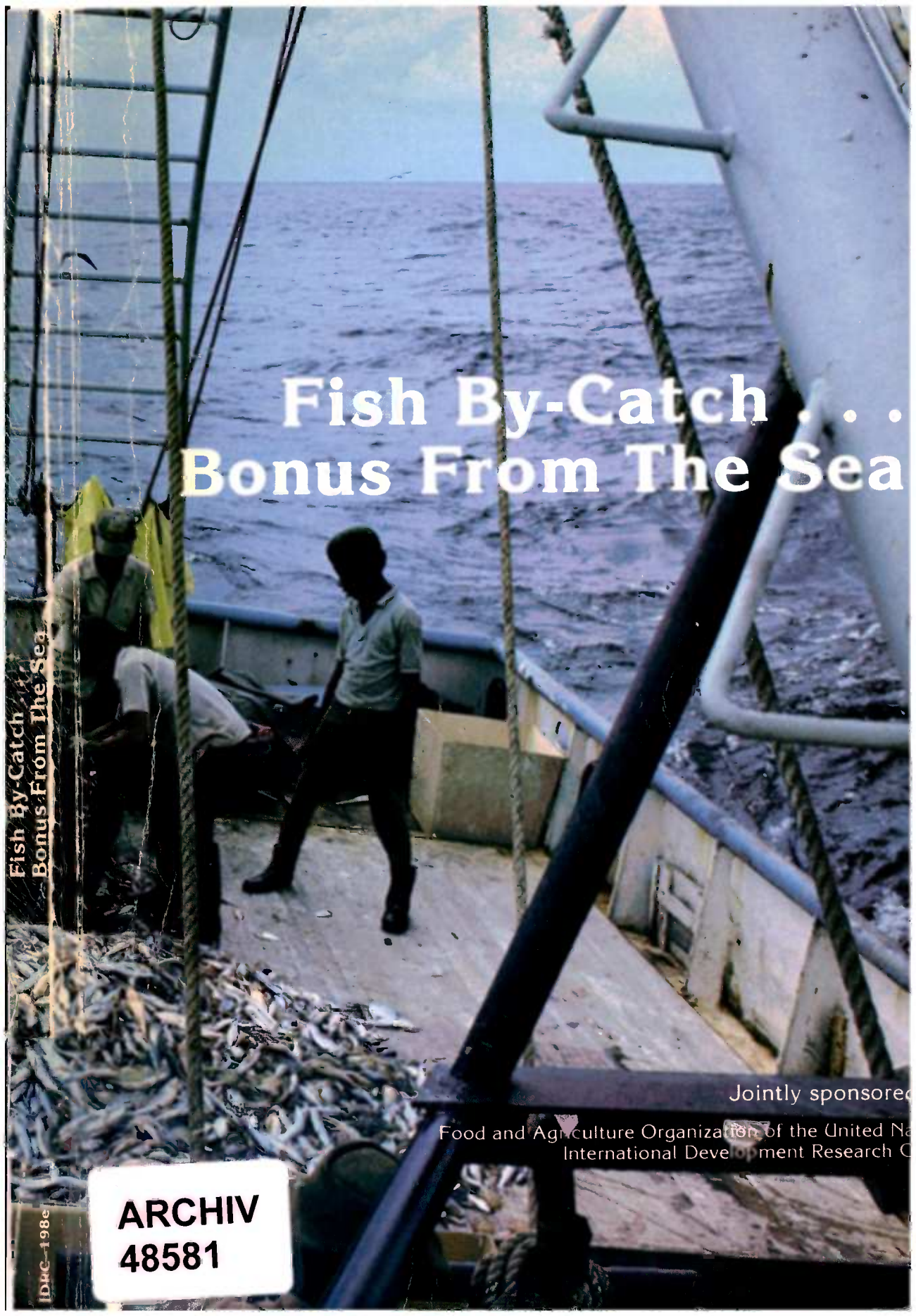


A photograph of a fishing boat deck. Two men are visible; one is standing and looking down, and the other is bent over a large pile of small fish. The background shows the ocean and the ship's structure with ropes and railings.

Fish By-Catch . . . Bonus From The Sea

Fish By-Catch . . .
Bonus From The Sea

Jointly sponsored

Food and Agriculture Organization of the United Nations
International Development Research Centre

ARCHIV
48581

The International Development Research Centre is a public corporation created by the Parliament of Canada in 1970 to support research designed to adapt science and technology to the needs of developing countries. The Centre's activity is concentrated in five sectors: agriculture, food and nutrition sciences; health sciences; information sciences; social sciences; and communications. IDRC is financed solely by the Parliament of Canada; its policies, however, are set by an international Board of Governors. The Centre's headquarters are in Ottawa, Canada. Regional offices are located in Africa, Asia, Latin America, and the Middle East.

Published by the International Development Research Centre under special arrangement with the Food and Agriculture Organization of the United Nations

©1982 International Development Research Centre
Postal Address: Box 8500, Ottawa, Canada K1G 3H9
Head Office: 60 Queen St., Ottawa

FAO, Rome, IT
IDRC, Ottawa, CA

IDRC-198e

Fish by-catch — bonus from the sea : report of a technical consultation on shrimp by-catch utilization held in Georgetown, Guyana, 27–30 October 1981. Ottawa, Ont., IDRC, 1982. 163 p.

/Deep sea fishing/, /by-products/, /fish utilization/, /fishery product processing/ — /food supply/, /protein rich food/, /fish preservation/, /dried food/, /canned food/, /frozen food/, /fishery development/, /fishery management/, /economic aspects/, /agricultural wastes/, /conference report/, /list of participants/, /IDRC mentioned/.

UDC: 639.281.2

ISBN: 0-88936-336-6

Microfiche edition available

**Il existe également une édition française de cette publication.
La edición española de esta publicación también se encuentra disponible.**

48581

IDRC-198e

Fish By-Catch... Bonus from the Sea

Report of a Technical Consultation
on Shrimp By-Catch Utilization held in
Georgetown, Guyana, 27-30 October 1981



Jointly sponsored by:
The Food and Agriculture Organization of the United Nations and
International Development Research Centre

ARCHIV
639.281.2
T 4
1981

The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the United Nations or the Food and Agriculture Organization of the United Nations concerning the legal or constitutional status of any country, territory, or sea area, or concerning the delimitation of frontiers.

Contents

Preface 5

Introduction W.H.L. Allsopp 7

Summary 9

Conclusions and Recommendations 17

Background

Utilization of the Shrimp By-Catch **Joseph W. Slavin** 21

Use of Fish By-Catch from Shrimp Trawling: Future
Development **W.H.L. Allsopp** 29

By-Catch for Human Consumption **E.R. Pariser** 37

Assessment of the Resources

By-Catch from Shrimp Trawling in Guyanese Waters **Donald J.
Furnell** 43

Fish Discards from the Southeastern United States Shrimp
Fishery **Gilmore Pellegrin Jr** 51

Yields and Composition of By-Catch from the Gulf of California
**J. Perez Mellado, J.M. Romero, R.H. Young, and L.T.
Findley** 55

Processing at Sea

Handling Mixed Catches **Karsten Baek Olsen and Poul
Hansen** 59

Strategies to Avoid By-Catch in Shrimp Trawling **V. Sternin and
W.H.L. Allsopp** 61

Handling and Storage of Shrimp By-Catch at Sea **K. Crean** 65

Processing on Shore

The Guyana Project: Industrial Use of By-Catch **E. Ettrup
Petersen** 69

Effects of Acetic-Acid Aided Evisceration on Deboned Minces from By-
Catch Fish **Nigel H. Poulter and Jorge E. Treviño** 77

Salting of Minced Fish **E.G. Bligh and Roseline Duclos** 81

Concentration and Preservation of Mechanically Recovered Fish
Flesh **Poul Hansen** 84

Processing of By-Catch into Frozen Minced Blocks (Surimi) and Jelly
Products **Tan Sen Min, Tatsuru Fujiwara, Ng Mui Chng, and
Tan Ching Ean** 89

4 BY-CATCH

- Development of a Salted, Minced Product from Mexican Shrimp By-Catch **R.H. Young** 93
- Canned, Frozen, and Dried Products from By-Catch Fish **Nigel H. Poulter** 96
- Acceptability and Storage Characteristics of Frozen, Minced Products from Mexican By-Catch **M.A. Tableros and R.H. Young** 99
- Pepepez — a New, Frozen Minced Product **Productos Pesqueros Mexicanos** 101
- Fish Silage from By-Catch **J.E. Treviño, R.H. Young, A. Uvalle, K. Crean, D.H. Machin, and E.H. Leal** 103

Marketing, Economic, and Resource-Management Aspects

- Possibilities of Marketing Shrimp By-Catch in Central America **Miguel S. Peña** 107
- Financial Projections for Industrial Production of Minced By-Catch Fish **R.H. Young** 110
- Optimization of Processing of Three Underutilized Fish Species **John W. Brown and Melvin E. Waters** 113
- Economic Profiles for Three Products Made from By-Catch **I. Misuishi** 118
- Management of Shrimp Fisheries **J.F. Caddy** 120

Regional and Country Developments

- Fishery Development: the Latin American Model Revisited **Julio Luna** 125
- French Guiana **M. Lemoine** 128
- Guatemala **Etienne Matton** 130
- Guyana **Ronald M. Gordon** 131
- Sabah, Malaysia **Datuk Chin Phui Kong** 135
- Mexico **José Manuel Grande Vidal and María Luz Díaz López** 137
- Mozambique **H. Pelgröm and M. Sulemane** 139
- Sri Lanka **S. Subasinghe** 141
- Thailand **Bung-orn Saisithi** 143

Bibliography 147

Participants 161

Effects of Acetic-Acid Aided Evisceration on Deboned Minces from By-Catch Fish

Nigel H. Poulter and Jorge E. Treviño *ITESM/TPI Project, Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM), Guaymas, Sonora, Mexico, and Tropical Products Institute (TPI), London, England*

We studied gutting and cleaning methods that might be conducted efficiently and rapidly at a minimum cost. Five fish species that are frequently found in the by-catch were used. They were cleaned semiautomatically with 4% aqueous acetic acid as the active agent (AE — acetic-acid aided evisceration). We deboned the material, using a Paoli deboner and then analyzed the minces, comparing the findings with those for deboned minces prepared from manually gutted and cleaned fish (ME). We were able to process larger quantities of by-catch fish in shorter intervals with the AE method than with the ME method, and recoveries of deboned minces were similar (60%). The proximate composition of deboned minces was generally unaffected by the method of gutting and cleaning, although the extractability of nitrogen and the water-holding capacity tended to decrease in minces prepared from AE fish. Besides the colour of minces, few differences existed between the individual fish species. The use of the AE method with by-catch fish may radically improve the economic potential of this underutilized resource, without adversely affecting the quality of the deboned minces.

By-catch from the Gulf of California is a complex mixture of marine organisms, and the finfish portion comprises many small demersal fish species. Although it has been shown that it is possible to prepare by-catch

fish manually on a factory scale in Mexico, labour requirements are extensive. Further, even though deboned minces from whole fish have successfully been used in dried, salted fish cakes (Young 1978b), the minces obtained are generally poor quality. The disruption of fish tissues and the intimate mixing that occurs during deboning can allow undesirable chemical changes to proceed more rapidly (Lee and Toledo 1977; Raccach and Baker 1978). These changes are further promoted if the deboned material contains the viscera of fish, and they result in dark minces that can have a high bacterial load. These factors may severely limit the utilization of minces prepared from whole fish.

Prototype machines capable of efficiently gutting small fish have been proposed for commercial processing, but they are designed for regularly shaped fish that are at least 20 cm long (Mendelsohn and Callan 1981). Thus, we studied a method of gutting and cleaning by-catch fish species in an attempt to reduce labour costs and time. The method consists of cutting the fish and soaking them in an acid medium.

Materials and Methods

By-catch fish were obtained fresh from commercial trawlers in the Gulf of California during the latter half of the 1980–81 season. The five species groups, which are frequently found in the by-catch (Young and Romero 1979), were mojarras (*Eucinostomus* spp.), orangemouth corvina (*Cynoscion xanthulus*), Gulf croaker (*Micropogon altipinnis*), bronzestriped grunt (*Orthopristis reddingi*), and cabaicuchos (*Diplectrum* spp.). Their average length is 12–17 cm and their weight 38–57 g. Analar grade acetic acid was used in the study.

Quantities of the fresh by-catch (60 kg/species) were divided into two equal lots, one to be cleaned by hand (ME) and the other to be cleaned with acetic acid solution (AE). The manual process involved cutting the fish heads off and slitting open the belly cavity so that the viscera could be removed. The carcasses were then cleaned, the black peritoneum and kidney tissues being removed when scrubbed by hand in ice-cooled water. Fish to be cleaned with acetic-acid solution were knobbed with a sharp knife. Carcasses were then chopped laterally into

Table 1. Basic analytical data for deboned minces (Gulf croaker, bronzestriped grunt, orangemouth corvina, cabaicuchos, and mojarras^a), eviscerated manually (ME) and with the aid of acetic acid (AE).

	Gulf croaker		Bronzestriped grunt		Orangemouth corvina		Cabaicuchos		Mojarras	
	ME	AE	ME	AE	ME	AE	ME	AE	ME	AE
Gutted, cleaned fish (as % of whole fish)	58.4	51.9	53.3	57.7	68.0	64.7	63.8	54.4	60.7	60.7
Deboned mince (as % of whole fish)	36.0	33.6	33.5	43.3	45.8	41.9	32.1	26.8	37.8	37.8
Deboned mince (as % of gutted fish)	61.6	64.5	63.1	75.0	67.4	64.8	51.1	49.3	62.1	62.1
Total crude protein ($N \times 6.25$) (%)	16.30	15.69	17.06	17.41	17.81	17.43	17.93	15.77	16.37	16.37
Moisture (%)	80.63	81.46	78.77	78.78	77.96	79.22	78.30	79.82	79.31	79.31
Lipid (%)	1.50	1.85	2.75	2.95	2.72	1.34	2.75	1.24	2.35	2.35
Ash (%)	0.93	0.73	1.19	0.81	0.99	0.78	1.25	0.80	0.90	0.90
pH	6.5	5.4	6.4	5.5	6.5	5.3	6.8	6.6	5.0	5.0
Total nitrogen (%)	2.61	2.51	2.73	2.79	2.85	2.79	2.87	2.52	2.62	2.62
N extracted by water (%)	30.30	25.24	27.73	22.62	24.89	22.83	31.73	27.60	21.31	21.31
N extracted by 5% NaCl (%)	58.15	37.02	40.78	39.88	43.86	45.85	36.45	41.27	28.99	28.99
N extracted by 10% TCA (%)	4.60	5.20	5.11	4.99	3.87	4.90	4.36	2.55	4.75	4.75
Drip (% — v/w — liquid lost on thawing)	0.1	9.2	0.8	4.0	0.1	9.8	0.1	0.2	2.0	2.0
TEF ^b (% — v/w — liquid lost on centrifugation)	29.8	48.0	43.4	39.8	28.8	45.4	28.8	37.6	39.2	39.2
Total weight, bones and scales (% dry-weight basis)	0.38	0.24	1.14	0.63	0.37	0.00	0.50	0.56	0.07	0.07

^aMojarras were not prepared manually because of their small size: average weight 38 g; average length 12 cm.^bTEF is total expressible fluid.

roughly 3-cm pieces and added to a 4% (v/v) aqueous solution of acetic acid (fish/solution, 1 : 1) in a plastic container. The mixture was stirred continuously for about 1 hour at ambient temperature (27°–33°C), strained and rinsed in two separate volumes of ice-cooled water. Both manually and acid-cleaned fish were then minced coarsely (Paoli mincer, model 863) and deboned by a Paoli deboning system (model 19-529). Deboned minces were frozen after being packed in polyethylene bags and stored at -20°C prior to analysis.

The deboned minces were analyzed for total crude protein ($N \times 6.25$), lipid, moisture, and ash contents. All analyses were carried out in duplicate. Nitrogen extracted from deboned fish minces in water and in 5% sodium chloride was also determined. The solutions contained sodium bicarbonate (0.02 M) to maintain the pH at 6.5–7.0 during the homogenization. Samples were homogenized and then centrifuged (3500 g, 30 minutes) and the supernatants analyzed for their nitrogen content. The non-protein nitrogen (NPN) content of minces was determined in a similar manner, although ice-cold 10% trichloroacetic acid was used as the extractant and the bicarbonate was omitted.

We measured the pH of 2 g of mince homogenized in 10 ml of neutralized sodium iodoacetate solution (0.005 M) and determined water-holding capacity (WHC) of the minces following the method described by Tableros and Young (1981), giving values for free liquid lost from frozen minces after 3 hours of thawing and total liquid lost from thawed minces after centrifugation.

Bone and scale contents of minces were also determined, 10 g of fresh mince being dried to constant weight and then ground in a mortar. The mince disintegrated to a fine powder, and the residue consisted of the more durable bones and scales. These were counted and weighed and their combined weights expressed as a percentage of the dried weights of the minces.

Results

The use of an acetic-acid solution greatly reduced (more than 50%) the time required for gutting and cleaning. During the period that the chopped fish pieces were in the acid

baths, the viscera of the fish disintegrated and dissolved to a large extent. The black peritoneum lining the body cavity became detached and the skin and scales could be rubbed off easily. This cleaning action may be caused by increased activity of the proteolytic enzymes endogenously present in the alimentary tract and on the skin.

Recoveries on gutting, cleaning, and deboning varied considerably for the fish species studied, regardless of the method of preparation (Table 1). This variation was $\pm 30\%$ of the species mean calculated for deboned minces from whole fish and $\pm 20\%$ for deboned minces from gutted and cleaned fish. The means obtained for deboned minces from fish prepared manually or by the use of acetic acid were similar.

The total crude-protein values of manually prepared fish were slightly higher than those of fish prepared with acetic acid, whereas the moisture values were a little lower (Table 1). The lipid contents of the deboned minces from the five fish species were all less than 3%. The ash contents of the minces were consistently reduced (20–30%) by the use of the AE method, and, as was expected, the pH levels of AE-deboned minces were lower than those of fish prepared manually (pH 5.4 and 6.5, respectively).

Larger amounts of nitrogen were extracted with 5% NaCl solution than with water (Table 1). There was no significant trend in the individual values obtained for ME and AE fish, although the mean values tended to be lower for AE-prepared minces. Similarly, there was no consistent trend for the nitrogen extracted by 10% TCA.

The water-holding capacity of minces when thawed was considerably reduced in those minces that had been prepared by the AE method, as indicated by the higher values for liquid lost during both thawing and centrifugation. The AE-prepared minces tended to have a lower bone/scale content because of a reduction in the number of scales (Table 1).

The colour of the deboned minces was subjectively determined and varied greatly between species: bronzestriped grunt and mojarra minces were extremely gray, whereas the other minces were white to cream. The AE method produced lighter-coloured minces from bronzestriped grunt than did manual evisceration, but no differences in inherently light-coloured minces were discernible.

Conclusions

The quality of deboned minces from fish gutted and cleaned either manually or with the aid of acetic acid was similar, although there were interspecies differences, especially with regard to their colour. The acid-aided method of evisceration considerably reduced the time and effort required and had the added advantage of lightening the dark

minces. The water-holding capacity of the minces was reduced by the AE method, and this may affect their potential uses in the unprocessed form.

We are indebted to the Director and staff of the school of marine and food sciences of the Monterrey institute of technology (ITESM) for providing the facilities for this study and to Alma Rosa Rivas E. and Jorge Ramirez F. for technical help.