SMALL SCALE FISH DEBONER

Centre File 3-P-86-1001-02

Submitted to :

International Development Research Center

by

Sirilak Suwanrangsi

Fish Processing Subdivision

Fishery Technological Development Division

Department of Fisheries

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SUMMARY

The prototyped small scale deboner developed by the Canadian Institute of Fishery Technology and the Atlantic Bridge Company was shipped to Bangkok. The deboner was installed and modified at the Fishery Technological Development Division. Effect of tire pressure drum speed on deboning waw determined in orger of identify the optimum operating conditions. The results showed that the optimum operating conditions for Thai By-catch is 40 psi tire pressure and 46 rpm. drum speed. The input capacity were of 63-83 kg/hr. and lowered to 32-36 kg/hr. upon continuous operation, it is very much lower than the commercial deboner. Yield varied from species ranges and was about 10% lower than the commercial Taiwanese and Japanese deboner.

The in-plant feasibility study was carried out. It was shown that the prototype is not applicable in the factory. This was due mainly to its low input capacity incomparison to the commercial deboner and the manual filleting operation by skillful labour. Futher modification are required, besides increasing its capacity, for example improvement of the driving system, replacement of more durable belt and more powerful motor. At the preliminary testing, the local deboner manufactured at the cost of 30,000 Bahts (1,500 CAD), however the results of the in-plant studied showed that higher capacity is needed, therefore, the cost for manufacturing had to be increased accordingly.

Quality of minced fish obtained were of the same grade of the commercial deboner except the problem on filth occuring from the polyurethane belt. Filleting factory has objection on the used of filleting is very low. For fishball factory which used the surimi method, coloured of product is not major problem but it is of the capacity of the machine which is not fitted to the daily processing capacity of the plants.

INDRODUCTION

By-catch obtained from commercial trawler composed of 55% young economic species and 43% trash fish. The dominant species are threadfinbream, goatfish, lizard fish and trevally. The size of fish is varied but of approximately 10-20 cm. Various obtacles-technological, economic and socialogical, limit the betler utilization of by-catch species. A major problems are the small size and varied shapes, which often precludes marketing through conventional channels. Because of this constraints, mechanical deboning has been applied to by-catch species to produce a minced fish which may be used as raw - material of various fish products such as fishball, fishcrackers, fishsatay and many other items.

Due to limited supply of raw material and the expansion of the minced fish industry in Thailand, the used of sorted by-catch of certain species is increasing such as threadfinbream, lizard fish and flathead. Threadfinbream are generally used as raw material for surimi production, if of inferior quality it will be utilized by fishball factory which leaching process is applied. Lizard fish is mainly used in fish satay production and flathead is used in fishball production. The other common species used in fishball production are bigeye, flatfish etc. The competitive on raw material is very high. Fishball manufactures were pressed to use inferior quality in terms of freshness and size, because of its lower cost.

Commercial deboner is expensive and beyond the reach of small fish processors in Thailand. The design and manufacture of simplified deboning system, suitable for small batch plants would open up new opportunities for increasing fish utilization.

The Canadian Institute of Fisheries Technology, Technical University of Nova Scotia and the Atlantic Bridge Company, Canada developed a prototype small scale deboner which has ability to process small fish, a maximum capacity of 100 kg/hr. with a maximum cost of 6,000 CAD. (1981).

This studies was designed to testing the deboner on tropical by-catch to identify operating performance, necessary modification and improvement of the machine and to determine technical and economic feasibility of introducing the machine to the local fish minced product manufactures.

SMALL SCALE FISH DEBONER

The Conodion Institute of Fisheries Technology (CIFT) ond the Atlontic Bridge Compony Limited (ABCO) hos completed the development of the smoll scole fish deboner for fish processors in developing countries under IDRC supported project. The moin feotures of the opporotus includes stoinless steel perforoted drum, electricolly driven ond o vorioble pressure pneumotic tire. The tire is in force contoct with ond driven by the drum; they rotote in opposite direction ond couse seporotion of flesh from bone ond skin os the fish ore fed to the drum through o hopper ond rototing feed roller.

The initiol testing of the opporotus ot CIFT involved voriotions in tire pressure ond drum speed to estoblish on optimum operoting ronge. The deboning mochine showed to be versotile ond relioble. The moximum input copocity is 100 ks/hr with the estimoted monufocturing cost of $ 6,000 CAD. With Altontic smelt, the optimum operoting conditions were found to be 35 psi tire pressure ond 40 rpm drum speed. Under this condition input copocity wos 148 kg/hrond mince yield wos 70 percent.

DEBONER INSTALLATION

Smoll scole deboner wos shipped to FTDD ond wos instolled by CIFT engineer, Mr. Wil Robertson. The prototype smoll scole deboner wos equipped with

o. Perforoted drum (1/8" diometer hole)

b. Go kort tire

c. Texturized polyurethone belt

d. Feed roller 3" diameter

e. Stainless steel scraper

f. Motor 1/3 H.P

g. Pulley (s) and polyethylene plastic belt (s)

Tire pressure can be adjusted varied from 25-50 psi. With different ratio of pulley size and belt length, the drum speed could be adjusted varies from 30-46 rpm.

All spare parts in the front end; tire, perforated drum belt, feeder and scraper could be removed. This facillitates the cleaning of the equipment.

TEST RUN

Initially, the deboner was run with existing drive system as shipped from Canada. The test runs were performed on threadfinbream, which were to include a series of four (4) rpm and four (4) different tire pressures. From the outset it was recognized that problems existed in.

1. The drive system arrangement in particular, the belts.

The existing belts were round in shape (approximately 1/2 inch diameter) and made from polyethylene. These belts performed satisfactory at the medium RPMS. (i.e. 35, 40, 46) where the pulley diameter ratio was relatively low, but at the slow rpm. (i.e. 30) and the higher RPM (i.e. 54), problems occurred due to the stretching of the belt under loaded condition and due in part to the higher pulley diameter ratio.

To resolve the problem, a new drive system was replaced incorporating a rubber V belt in substitution for the plastic belt. Therefore, it is necessary to establish the RPM. because it would became fixed parameter due to limited size of V-belts. For plastic belt various lengths can be obtained via a heating and coupling apparatus, it is not so for the case of V-belts. The RPM of 46 was chosen. To accommodate the proper length of V-belt the placement of the electric motor was modified. The V-belt was placed on the friction drive side between the tire and feed roller pulley. A subsequent trial with small quantity of jewfish and bigeye proved successful with a new drive system.

2. Short circuit of fish around the feed roller

Is was found that fish were passed through the gap between the feed roller and pneumatic tire then fell to the bone and skin recieving area without being deboned. To prevent this, a piece of 1/2 inch diameter aluminium rod was placed betweeen the gap. The placement of this part reduced the gap substantially and in subsequent trials its performance was definitely improved. Although with some of the softer flesh fish, some small pieces or chunks of fish still had a tendency to collect there. On the other hand, no whole fish were rejected through this openning as was the case before the new part was installed. To eliminate the problem completely, a redesign would be necessary which would include enlarging the food roller slightly and placing it as close as possible to the surface of the inflated tire.

3. Insufficient scraping of the scraping assembly at the perforated drum

When scraping action is poor, due in most cases to insufficient scraper blade tension, on the drum fish residue and debris such as skin and bones have a tendency to lift the scraper blades from the drum as they pass over the drum, and as a result, they collect in the area between the drum and tire until such time as the tire stalls and then the operation ceases. The existing spring tension was found unsuitable for the fish species. To resolve problems, two additional higher tension springs replaced the two existing springs and increased the blade tension considerably. The scraping action was then improved immensely.

4. Scraping of stainless steel from perforated durm by scraper blade

This problem readily was recognized in Canada. To lessen the problem, a softer stainless steel than the stainless steel of the drum is required. However, it must be noted thot scroping of metal is going to occur despite the correct blades being in place. It is the problem experience in all deboning device, the solution is to reduce the wear of the drum as much as possible due to its high cost

5. The presence of pieces of plostic belts liner in the mince flesh

This problem was experienced on occasion, however it causes green filth in the mince. It was due to the scraping action from the pieces of high density polyethylene which enclosed the feed hopper and then caused the wear ridges on the tire surface. To eliminate the problem, the polyethylene parts contocting with the tire surfoce were ground down so os to clear the surfoce of the tire on inflotion to operoting pressure, in the cose 40 psi is recommended.

Moreover, scroping of tire belting surfoce by perforated durm occurred on o few occosion, only when the tire stolled for reason of jomed fish and the drum continued to turn. The drum would then scrope the surface of the belt with the perforoted holes acting os cutters ond subsequently dislodging plostic porticle on the separated meat. This did not occur often. However, to eliminote the problem is to chonge the drive system so thot both tire ond drum would be driven independently, then the friction is reduced. The drive system would then become more sophishticoted ond hence capital cost would increose.

6. Feeding techniques

In the test run with lorge omount of fish it wos noticed thot only little omounts of fish con be fed in ot a time to ovoid joming of the mochine. It wos observed thot when big size fish wos fed operaters hod to woit for mochine to cleor itself before feeding ony more. Moreover, it was discovered that if the fish wos fed toiled first, the machine operoted more effectively.

The Performance of Small Fish Deboner

Small Scale Fish Deboner were tested with sorted fish by-catch species in order to assess the performance of the deboner and to determine the optimum operating condition for Thai sorted by-catch species.

Materials and methods

Five (5) species of selected by-catch species were used as followed :

Threadfinbream	(Nemipterus sp.)
Bigeye	(Priacanthus sp.)
Jew fish	(Ephinephelus sp.)
Lizard fish	(Saurida sp.)
Flathead	(Platycephalus sp.)

Fish were procured from Samut Prakarn Fish Market, they were headed and gutted at filleting operation near the fish market. Headed and gutted fish were packed in ice and awaited for transportation to FTDD laboratory on the next day.

Upon the arrival at FTDD, fish were throughly washed and packed in ice. For determining the effect of tire pressure and drum speed on deboning efficiency 5 kg. of each species was fed through the deboner. Processing time and yield were recorded for each sample and throughputs were determined. Each trial was carried out in triplicate for each five selected tire pressure (25, 35, 40, 45, 50 psi.) and three drum speeds (30, 40, 36 rpm.).

The quality of minced fish were evaluated. Criteria for evaluating includes organoleptic acceptibility (appearance colour and texture), bone content and moisture content. Minced fish were also processed into surimi and fishball. Surimi was prepared by manually washing minced fish twice with 0.2 % and 0.3 % salt consecutively, wash minced were then dehydrated to remove excess water using dehydrator (centrifuge system) to the moisture content of approximately 80%. The washed mince was mixed with 0.2%polyphosphate, 0.5% salt and 3% sugar for 15 minutes. It was formed into 2 kg. square block and frozen at -40^{o}c. Surimi were stored at -18^{o}c freezer and were processed into fishball. Quality of fishball were determined organoleptically.

Results and discussion

Fish used in this experiment were fairly fresh as determined by the freshness scoring system and chemical determination. Fish is not a very small fish as usual sorted by-catch, since presently the species used in this experiment are very common utilized by fish ball and surimi factories. They are sorted out size to meet the demand of the industry. Therefore, request to sort only small size for the experiment could be obtained only occasionally. Threadfinbream, bigeye and jew fish are often of superior quality to lizard fish and flathead, this is due to they were better taken care off, more expensive and more in demand. Freshness score, TMA-N, TVB-N,and K-value of raw material were shown in Table 1.

Operoting Conditions

At vorious rpm. run (Toble 2-7), it wos found thot ot lower rpm (30), the mochine experienced problems especiolly ot tire pressure lower thon 50 psi, the belt of the pulley would stretch ond strip off. It wos olso found thot ot the drum speed of 46 rpm the yield obtoined ot oll pressure thon the other speed test (40,30 rpm). Hence, it wos chosen os the fixed drumspeed porometer for the test.

The pressure of the tire is o significont porometer in the meot bone seporotion. The yield would increose with on increose in tire pressure, o little voriotion occurred due to improper odjustment of woter for woshing the belt. However, the mince obtoined with high pressure hos dorker colour ond more impurities (skin ond kidney tissue) thon those of lower pressure. Moreover, ot higher pressure (50 psi), the tire is ot its highest tension, the service life will be reduced. In further study, the tire pressure of 45 psi were olso tested, however, there were only slight differences in yield omong 50,45 ond 40 psi. The minced meot obtoined with the 40 psi olso hos lighter colour.

Machine efficiency

At the optimum operotion condition (46 rpm ond 40 psi tire pressure), the results showed thot yield obtoined voried from species to species (See Toble 4-7). Inversely to the pressure effect os the rpm decreosed the input copacity decreosed becouse the fish were only portiolly deboned, thereby ollowing the fish to poss through the extroction zone rother quick. Input copacity ronges from 99, 177, 82 ond 119 kg/hr. for threadfin bream, bigeye, jewfish ond lizord fish respectively.

Output of each species.

Thread finbream; when passed through the deboner, yielded the medium soft mince of pinkish colour, however as the pressure increased defects from skin, kidney and peritoneum were obviously present. Mince yielded at the optimum operating conditions was 36.52 % skin, kidney and peritoneum tissue can still be observed, but it was of acceptable quality. The average bone content is 0.041 %

Minced fish yielded with bigeye were acceptable at all pressure applied. Since fish have tough skin defect from skin was not present. At optimum operating conditions, yield was found to be 21.48 % the mince was pinkish and bone content was only 0.024 %

White mince was obtained when jewfish was deboned, but as the pressure increased, mince become more greyish due to skin defect. Fish has soft skin and flesh. Yield was 32.1 % at the optimum operating conditions with bone content of approximately 0.035 %. The mince has dark colour but was acceptable.

Lizard fish yield was the highest among all species tested, which was 46.8 %. The mince were darker in colour than other species and also soft at all pressures applied, but was acceptable at the optimum operating conditions. The bone content was found to be 0.095 %. Defect presented in the mince were not only skin but also the black peritoneum skin.

The results were summerized in Table 8.

Initially testing with various fish species showed that small scale deboner was effective in deboning the Thai by-catch species at the optimum operating conditions of 46 rpm drum speed and 40 psi tire

It should be noticed that discolouration of the mince can be improved by thoroughly cleaning of the belly cavity and removing of kidney tissue.

In this test, it was also observed that defect from deboner, such as stainless steel from perforated drum, and pieces of green plastic belt, which was present in the mince, could cause the mince to be unacceptable, if present in high percentage.

The yield in comparison with the commercial deboner (Bibun SDX 13) was shown in Table 8. The yield obtained with commercial deboner was up to 10% higher, and the input capacity was over 30% faster.

Minced fish quality were improved greatly especially colour and gel forming ability due to the wash away of blood and water soluble protein. Fishball prepared from surimi made from Threadfinbream, bigeye and jew fish has acceptable gel quality. However, compliants of plastic belt filth were often reported. The filth were obvious as green dot on the surface and cut surface which could cause the products to be uncceptable. Gel strength of fishball made jew fish showed to be the highest followed by threadfinbream and bigeye. Table 9. showed the sensory score of fishball produced in the study in comparison to the commercial produced fishball which used the same lot of fish. It can be observed that gel strength of fishball were slightly different due to the percentage of water added, but still highly accepted by pannels.
Colour of fishball produced by manufacturer were lighter since in the mince washing process of the manufacturer the continuous process were use mince fish were washed more throughly than the manual wash applied in the loboratory.

As lizard fish is known as a poor gel forming ability fish, hence, mince fish from such species was not used for fish jelly product Minced fish obtained from the trial were sent to fish satay manufacturer No problem was reported in utilizing the lizard fish to fish satay.

Table 1 Freshness of headed and gutted fish*

Species	Freshness score (20)	TVB mg/100g.	TMA mg/100g.	K-value %	Average size cm.
Threadfin bream	15.1 ± 4.5	13.14 ± 2.3	3.59 ± 2.6	36.85 ± 8.6	12.65 ± 1.4
Bigeye	16.0 ± 2.6	15.17 ± 2.8	3.51 ± 2.7	29.42 ± 2.9	16.89 ± 1.05
Jew fish	12.5 ± 2	17.11 ± 9.8	6.89 ± 1.88	76.58 ± 2.4	13.9 ± 0.4
Lizard fish	12.33 ± 2.02	19.97 ± 1.36	7.82 ± 2.2	30.36 ± 9.9	20.87 ± 3.4
Flathead	10.65	42.01	13.88	79.26	14.37 ± 1.538

* Headed and gutted fish, belly flap was cut off, appearance of belly flap is not determined.

Table 2 Yield and capacity at 30 rpm

Fish Species : Threadfin Bream

Tire pressure (psi)	Run Number	Product in (p+w) (kg.)	Product out (kg.)	Time (min)	% Yield	Input Cap (kg./hr)	Mean		± St. Div.	
							Yield	Cap	Yield	Cap
50	1	5	3.00	3.42	60.0	87.72				
50							59.50	88.37	0.71	0.92
	2	5	2.95	3.37	59.0	89.02				

Table 3 Yield and capacity at 40 rpm

Fish Species : Threadfin Bream

Tire pressure (psi)	Run Number	Product in (p+w) (kg.)	Product out (kg.)	Time (min)	% Yield	Input Cap (kg./hr)	Mean		± St. Div.	
							Yield	Cap	Yield	Cap
50	1	5	2.90	3.67	58	81.74	64.67	84.05	6.11	6.57
	2	5	3.30	3.80	66	78.95				
	3	5	3.50	3.28	70	91.46				
40	1	5	3.10	3.25	62	92.31	59.33	93.09	2.31	1.35
	2	5	2.90	3.25	58	92.31				
	3	5	2.90	3.17	58	94.64				
35	1	5	2.95	3.03	59	99.01	62.00	79.19	3.61	17.16
	2	5	3.30	4.33	66	69.28				
	3	5	3.05	4.33	61	69.28				
25	1	5	2.60	4.78	52	62.76	53.67	67.42	2.08	5.07
	2	5	2.65	4.50	53	66.67				
	3	5	2.80	4.12	56	72.92				

Table 4 Yield and capacity at 46 rpm

Fish Species : Threadfin Bream

Tire pressure (psi)	Run Number	Product in (p + w) (kg.)	Product out (kg.)	Time (min)	% Yield	Input Cap (kg./hr)	Mean		± St. Div.	
							Yield	Cap	Yield	Cap
	1	5	3.50	2.73	70.0	109.89				
50	2	5	3.45	2.52	69.0	119.05	68.67	114.34	1.53	4.59
	3	5	3.35	2.63	67.0	114.07				
	1	5	3.30	3.12	66.0	96.15				
	2	5	3.00	3.67	60.0	81.74				
40	3	5	2.95	3.22	59.0	93.17	59.30	98.81	4.38	14.11
	4	5	2.70	2.50	54.0	120.00				
	5	5	2.30	2.33	57.5	103.00				
	1	5	3.10	2.72	62.0	110.29				
	2	5	3.28	2.57	65.6	116.73				
35	3	5	3.20	2.67	64.0	112.36	63.60	96.42	4.04	18.73
	4	5	2.90	3.58	58.0	83.80				
	5	5	3.10	3.67	62.0	81.74				
	6	5	1.40	1.63	70.0	73.62				
	1	5	2.90	2.67	58.0	112.36				
25	2	5	2.85	2.73	57.0	109.89	56.33	107.09	2.08	7.10
	3	5	2.70	3.03	54.0	99.01				

Table 5 Yield and capacity at 46 rpm

Fish Species : BIGEYE

Tire pressure (psi)	Run Number	Product in (p+w) (kg.)	Product out (kg.)	Time (min)	% Yield	Input Cap (kg./hr)	Mean		± St. Div.	
							Yield	Cap	Yield	Cap
50	1	5	2.60	2.42	52.0	123.97	50.87	121.10	1.03	13.88
	2	5	2.50	2.25	50.0	133.33				
	3	5	2.53	2.83	50.6	106.01				
45	1	5	2.48	2.97	49.6	101.01	51.20	124.71	2.43	40.46
	2	5	2.70	2.95	54.0	101.69				
	3	5	2.50	1.75	50.0	171.43				
40	1	5	2.50	1.72	50.0	174.42	49.80	177.28	0.85	53.24
	2	5	2.53	1.40	50.6	214.29				
	3	5	2.43	1.38	48.6	217.39				
	4	5	2.00	2.33	50.0	103.00				
35	1	5	2.40	1.33	48.0	22[illegible].56	48.07	225.78	0.12	8.50
	2	5	2.40	1.38	48.0	217.39				
	3	5	2.41	1.28	48.2	234.38				
25	1	5	2.00	1.47	40.0	204.08	40.67	211.44	1.15	7.45
	2	5	2.10	1.37	42.0	218.98				
	3	5	2.00	1.42	40.0	211.27				

Table 6 Yield and capacity at 46 rpm

Fish Species : Jew fish

Tire pressure (psi)	Run Number	Product in (p+w) (kg.)	Product out (kg.)	Time (min)	% Yield	Input Cap (kg./hr)	Mean		± St. Div.	
							Yield	Cap	Yield	Cap
50	1	5	2.6	2.75	52.0	109.09	59.33	97.63	6.43	18.81
	2	5	3.1	3.52	62.0	83.80				
	3	5	3.2	3.00	64.0	100.00				
45	1	5	3.2	3.66	64.0	81.97	55.67	95.11	9.99	36.34
	2	5	3.2	5.83	64.0	51.46				
	3	5	3.3	5.17	66.0	58.03				
	4	5	2.4	2.50	48.0	120.00				
	5	5	2.2	2.17	44.0	138.25				
	6	5	2.4	2.48	48.0	120.97				
40	1	5	2.5	3.72	50.0	80.65	51.33	82.78	1.15	2.62
	2	5	2.6	3.66	52.0	81.97				
	3	5	2.6	3.50	52.0	85.71				
35	1	5	2.40	4.03	48.0	73.53	47.33	100.71	4.41	21.54
	2	5	2.45	3.72	49.0	80.65				
	3	5	2.75	3.25	55.0	92.31				
	4	5	2.15	2.55	43.0	117.65				
	5	5	2.25	2.63	45.0	114.07				
	6	5	2.20	2.38	44.0	126.05				
25	1	5	2.3	3.33	46.0	90.09	43.33	102.96	2.31	11.65
	2	5	2.1	2.66	42.0	112.78				
	3	5	2.1	2.83	42.0	106.01				

Table 7 Yield and capacity at 46 rpm

Fish Species : Lizard Fish

Tire pressure (psi)	Run Number	Product in (p+w) (kg.)	Product out (kg.)	Time (min)	% Yield	Input Cap (kg./hr)	Mean		± St. Div.	
							Yield	Cap	Yield	Cap
50	1	5	2.90	4.83	58	62.11	60.67	90.31	2.31	24.58
	2	5	3.10	2.95	62	101.69				
	3	5	3.10	2.80	62	107.14				
45	1	5	3.10	2.75	62	109.09	61.33	95.16	0.58	13.68
	2	5	3.05	3.67	61	81.74				
	3	5	3.05	3.17	61	94.64				
40	1	5	3.10	2.75	62	109.09	62.67	119.28	1.15	9.49
	2	5	3.10	2.50	62	120.00				
	3	5	3.20	2.33	64	128.76				
35	1	5	2.90	2.83	58	106.01	58.00	91.76	0.00	19.70
	2	5	2.90	3.00	58	100.00				
	3	5	2.90	4.33	58	69.28				
25	1	5	2.50	3.26	50	92.02	50.67	95.18	1.15	23.40
	2	5	2.60	4.08	52	73.53				
	3	5	2.50	2.50	50	120.00				

Table 8.. Output of Fish Species mechanically deboned by small scale deboner and commercial deboner (BIBUN SDX - 13)

Species	Type of deboner	Yield	Input capacity	Moisture content	Bone content
Threadfin bream	Small scale deboner	36.52 ± 1.42	63.38 ± 10.1	81.79 ± 1.8	0.014
		1) 32.0	36,62	83.56	0.161
	BIBUN	46.93 ± 2.46	122.5	82.15 ± 2.5	0.115
Bigeye	Small scale deboner	21.38 ± 1.09	82.05 ± 9.8	80.9 ± 0.7	0.024
	BIBUN	34.90	141.82	81.1 ± 1.0	0.102
Jew fish	Small scale deboner	32.06 ± 4.7	65.96 ± 10.9	82.31 ± 0.5	0.035
	BIBUN	47.99 ± 7.9	92.53	81.37 ± 0.5	0.088
Lizard fish	Small scale deboner	46.82 ± 2.5	73.98 ± 4.8	80.7 ± 0.2	0.095
	BIBUN	56.43 ± 10.38	142.52	80.24 ± 0.1	0.070
Flathead	Small scale deboner	19.06	32.1	82.35	0.115
	BIBUN	1) 40.79	72.3	81,97	0.08

Remarks : 1) Results were obtained with the run of 20 kg. fish into machine, not 5 kg. as the rest.

Table 9 Comparison of quality of fishball produced in the laboratory and commercial manufacturer

species	*Source of fishball	Fishball Quality				
		General Appearance		Texture	Flavour	Total
		Colour (5)	Impurities (5)	(15)	(5)	(30)
Threadfin bream	Laboratory	4.27	4.25	12.75	3.63	24.90
	Commercial	4.59	4.33	12.25	4.46	25.63
Bigeye	Laboratory	4.05	4.13	11.09	3.59	22.86
	Commercial	4.42	4.25	11.33	4.0	24.0
Jew fish	Laboratory	3.63	3.84	13.20	3.63	24.30
	Commercial	4.3	4.08	11.58	3.75	23.71

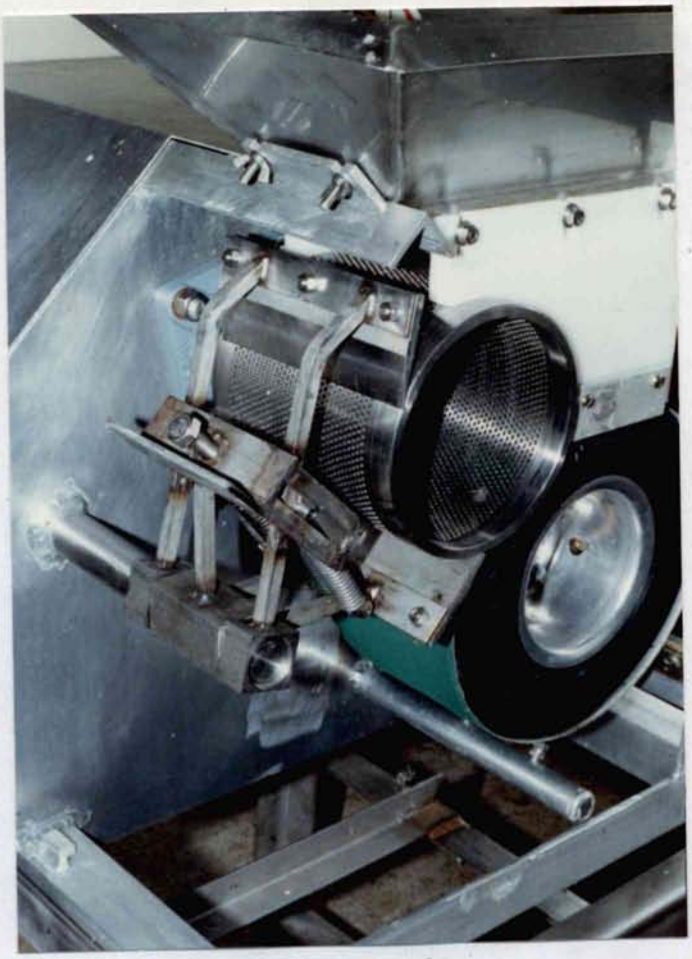
* Fishball were made from the same lot of fish

1. Small scale fish deboner

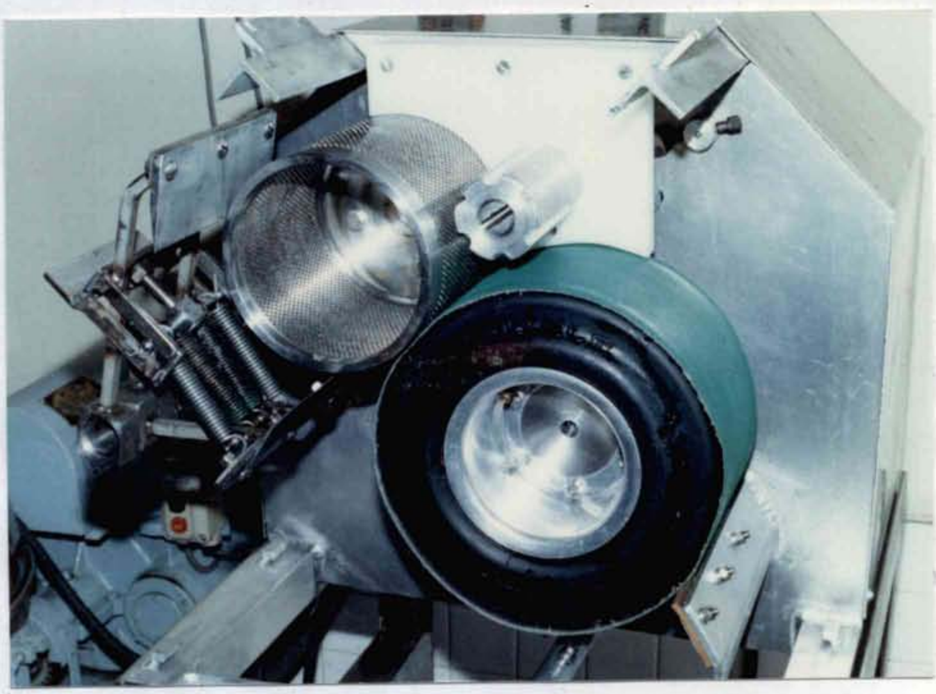
2. Front part

3. Top part of the deboner

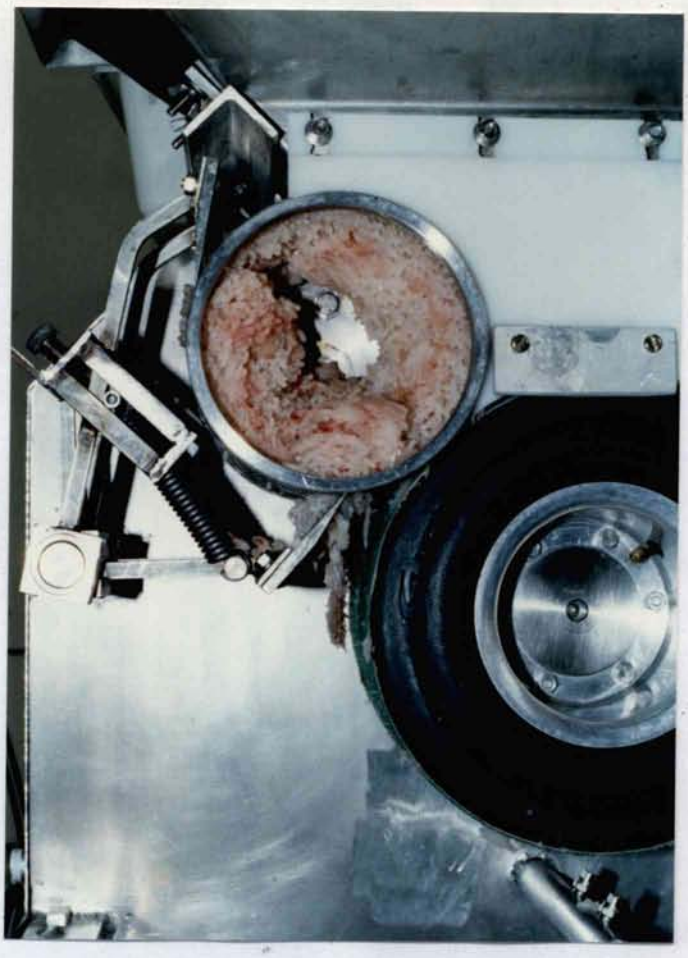
4. Top part of the deboner



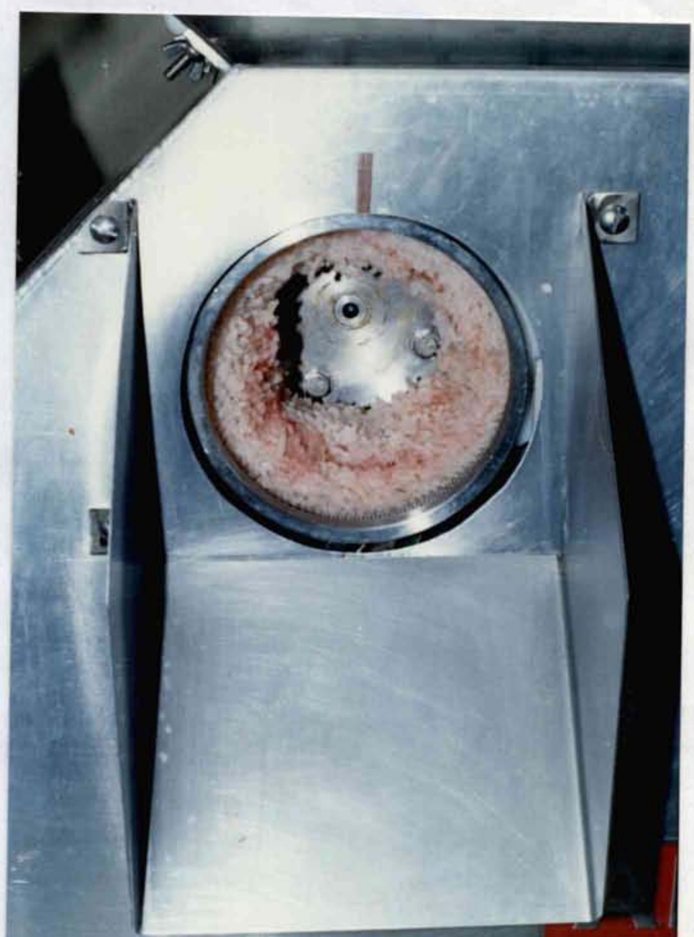
5. Front part of the deboner shown the perforated durm



6. Close up of the major parts in deboning operation



7. Separtion process



8. Output at the front end

9. Cleaning of the machine

10. Major parts can be taken off for thoroughly cleaning

11. Headed and gutted bigeye awaited for deboning

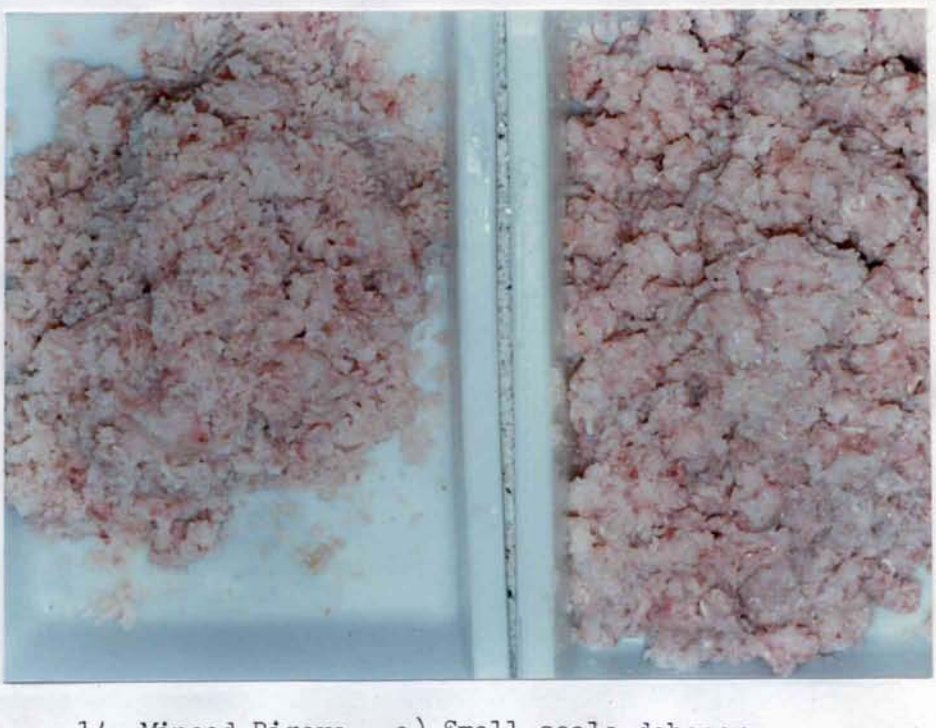
12. Jew fish

13. Minced Jew fish

a) Small scale deboner

b) Bibun SDX 13

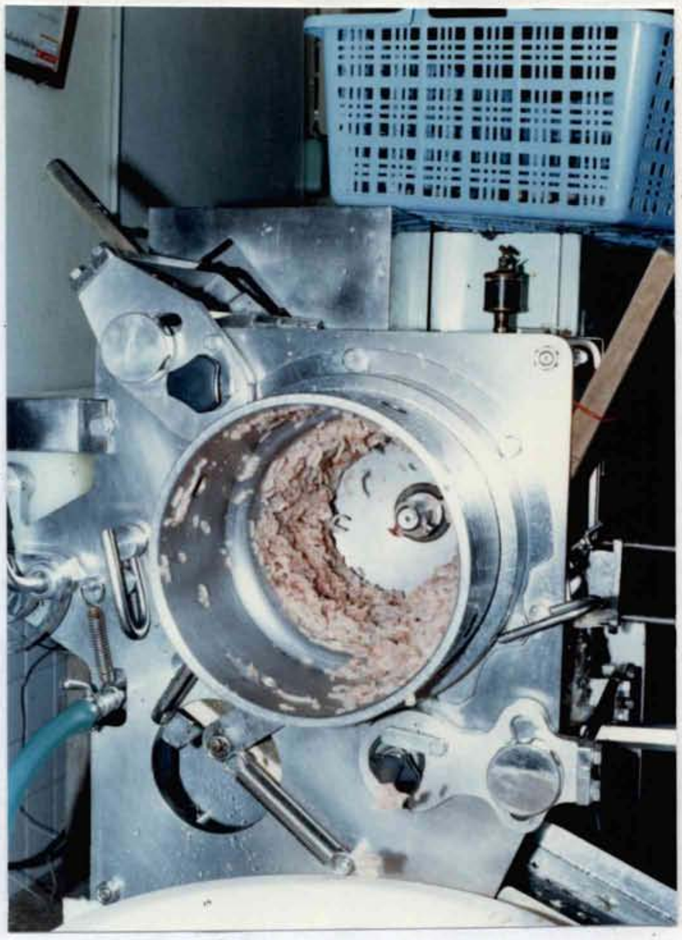
a)



b)

14. Minced Bigeye a) Small scale deboner

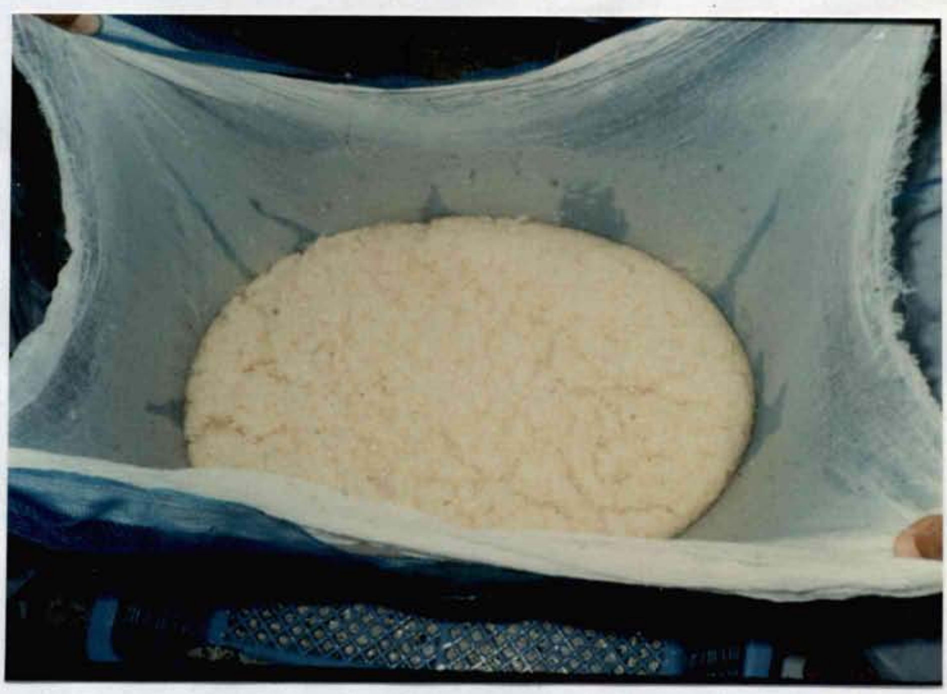
b) Bibun SDX 13



15. Meat bone separtion using commercial deboner (Bibun - SDX 13)

16. Washing of the mince for further utilization

17. Removing of excess water



18. Washed mince prior to final dewatering

19. Appearance of minced bigeye at various deboning operation

20. Appearance of Jew fish mince at various deboning operation

THE INDUSTRIAL TRIALS OF SMALL SCALE DEBONER

Following the preliminary testing in the laboratory, the prototype small scale deboner was set up at the filleting and small scale minced fish factory. This was aimed to determine the feasibity of operating the deboner in local fish meat factory and of using minced fish in traditional products and also to collect data for economic feasibility of introduce the deboner for fish processing in Thailand.

MATERIALS AND METHODS

Two factories in different areas were chosen, one is the filleting and fishball factory at Samutprakarn province, another one is fishball and fish satay factory in Samut sakorn province.

At the first factory, fish were procured from the Samutprakarn fish market nearby the factory through the fish agent. Threadfin bream, bigeye and flat fish were chosen for the trails. Fish were then washed and devided into two portions one was filleted by land, another portion was headed, gutted and mechanical deboned using the small scale deboner. Time used in filleting and deboning as well as yield were recorded whole fish, fillet fish and minced fish were sampling for chemical determination to evaluate the freshness and bone content. Fish mince were then processed to fishball using the traditional metohds. (See Diagram 1.) Appearance of minced fish were recorded after the evaluation of the factory owner.

At the second factory, threadfin bream as used as raw material. Fish were procured from Samutsakorn fish market. Upon arrival at the factory, they were washed headed and gutted. Fish were devided into two portions and then was deboned by small scale deboner and Taiwanese commercial deboner using in the factory. Time required in deboning and yield were recorded. Fish mince were washed with diluted brine twice for 15 min. each, dewatered and strained using strainer. Washed mince were used as raw material for fishball and fish finger (Diagram 2.) Quality of minced fish and products were determined.

The project economist had interviaved the factory owners in order to get data for the economic studies.

RESULTS AND DISCUSSIONS

Three species tested were of fairly good freshness as shown in Table 10. The deboned mince were in all species darker in colour than the mince obtained with passing the fillet through the mechanical mincer. Bone content of the deboned mince was less than the fillet fish for in filleting pieces of bone also be cutted off together with the meat.

Mince yield of the deboner was slightly lower than filleting. (Table 10.) The yield of filleting were 37.8%, 27.2% and 25% for threadfin bream, bigeye and flatfish, respectively while of mechanical deboner were 34.2% and 27.0% for threadfin bream and bigeye. In deboning bigeye, it was found that some flesh still left on the frame and scale mass, therefore, the fish were passed through machine twice, hence, yield was higher than laboratory testing. Flatfish could not be deboned due to its thiness shape and tough skin, fish would slipped through without being deboned.

Time used in deboning and filleting were compared. A skillful labour could manage to fillet the fish at the rate of 7.5-20 kg/hr., while deboner input capacity only 35-37 kg/hr. The opration of the deboner was slow in this test because of various contraints. The major problem is the ceasing of the machine. In this industrial trial deboner were fed continually with a bulk of fish of not less than 60 kg.per run., however, the operation was stopped at every 8-10 minutes due to the slipping of the belt off the pneumatic tire (Photo 7-8), the collected mass at the back of the feeder and between the two blades (Photo 9-10). The machine would ceased because of the friction between the pneumatic tire and the perforated drum in this case, the operators had to pash the pulley to case the operation (Photo 11-12)

The minced fish obtained with each species were considered by the factory owner as inferior grade to fillet fish because of its darker colour. Mince were used as raw material for fishball and deep fried fishball, the cost of product ranges from 15-25 bahts. (almost 50% flour in products)

Because of various contraints in the operation of the small scale deboner as mentioned above, the amount of fish used in experiment were cut down from the amount proposed in the project proposal.

The operation at the first factory showed that the small scale deboner was inferior to the manual fillet operation by four labours. Therefore, the factory owner at this point did not find the necessity of using the deboner even though in some case fish to be fillet are of small size and difficult to fillet because of the shape. Moreover, he has no preference of using deboned mince as raw material due to its dark colour, it required washing to improve colour, additional cost is then occurred. His factory has a stamping type deboner but has not been used because it produced dark colour mince. He commented that among all the deboners. The stamping type is the fastest to debone the fish.

The second factory was chosen on the basis that the factory fimiliar to use minced fish as raw material and the factory has the washing operation similar to the surimi process. Threadfin bream is a major specice used by this plant.

Yield and input capacity of small scale deboner, Japanese and Taiwanese commercial deboner were compared. It was obvious that yield and input capacity was different as shown in Table 12. This was due to the difference in size, motor power and contact area between belt and rotating drum. Table 13. shwoed the difference of the major component of the Japanese commercial deboner. Taiwanese deboner has the highest input capacity of 710 kg/hr. while Japanese and small scale deboner have only 123.46 and 50.30 kg/hr. respectively. Constraints in operation occurred in the same manners as the previous study. The problem on filth from the polyurethane belt occurred even more extensively.

Quality of mince as determined visually has no difference except that deboned mince of small scale deboner had smaller particle due to smaller perferation of the rotating drum and the presence of filth. However, after leaching, deboned mince of Taiwanese commercial deboner has lighter colour than of the small scale deboner. This may due to the discolouration of small scale deboned mince by the wash off colour of pneumatic tire. (See Photo 10). It can be observed that TVB-N and TMA-N of the mince was greatly reduced by water washing (Table 14). Washed mince in all case has loght colour and no fishy odor. Minced fish were processed into fishball and fish finger. The product were off good and acceptable quality (See Table 15). However, compliants on filth were also reported. Fishball were of top grade, sale price are of 50 bahts/kg sale price of fish finger is 80 bahts/kg.

Comments on small scale deboner performance at factories were summerized in Table 15.

It is observed that fish used in the tests was of larger size than normal size of sorted by-catch which may effect the efficiency of the machine. However, when fish of 10-12 cm. was used as were in some trials using flathead and threadfin bream, it produced no defference results.

CONCLUSION

The prototype small scale deboner performed very well under small load of raw material (5 kg/run). The yield of mince was 10% lowered than the commercial deboner, however, input capacity was 30-50% lower than the Japanese deboner and over 100% lower than the Taiwanese deboner. Problems occurred while running with big load of fish. Machine would stop running due to insufficient driving force for the pneumatic tire and perforated drum to seperate the meat. Frequently, the machine was stopped to adjust the plastic belt back on the tire and to clear the collected mass at the gap between the feed roller and the

tire, also between the two blades of the scraping assembly, The latter, if extensively, would cause disloading of plastic filth to the seperated meat. These made the industrial used of the machine improper.
Daily input of raw material of each factory tested were 1 tons at their mininum. The machine would require to run continually which is impossible with the prototype. For smaller factory, utilization of fillet fish is very much cheaper. Fillet fish cost 12-20 bahts only, mincer is also cheaper than the cost of the deboner (30,000 bahts as quotes by local manufacturer).

However, modification in order to improve the efficiency can be done as follow.

- Increase contact area between drum and tire to provide better seperation.
- Replacement of more durable polyurethane belt in order to reduce damage upon friction.
- Increase the motor power to provide more driving fore for the tire.
- Increase tension of spring of the scraper blades to provide sufficient cleaning of the mass after deboning, however this may effect the wearing of the drum.

More modification for example additional of driving system for the drum would increase the capital cost and it involoes changing the lay out of the machine.

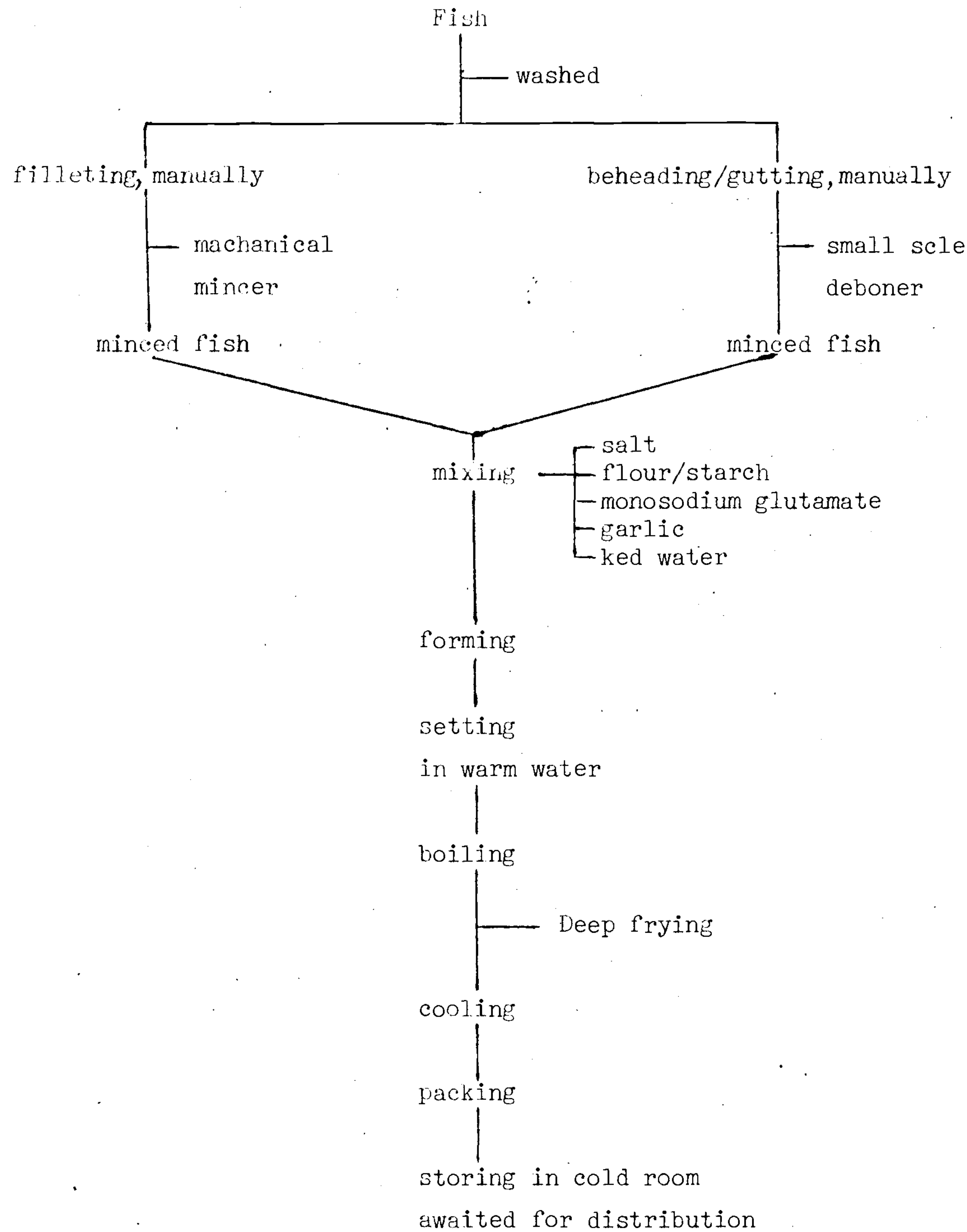


Diagram 1 Flow diagram of the process at filleting and traditional fishball factory.

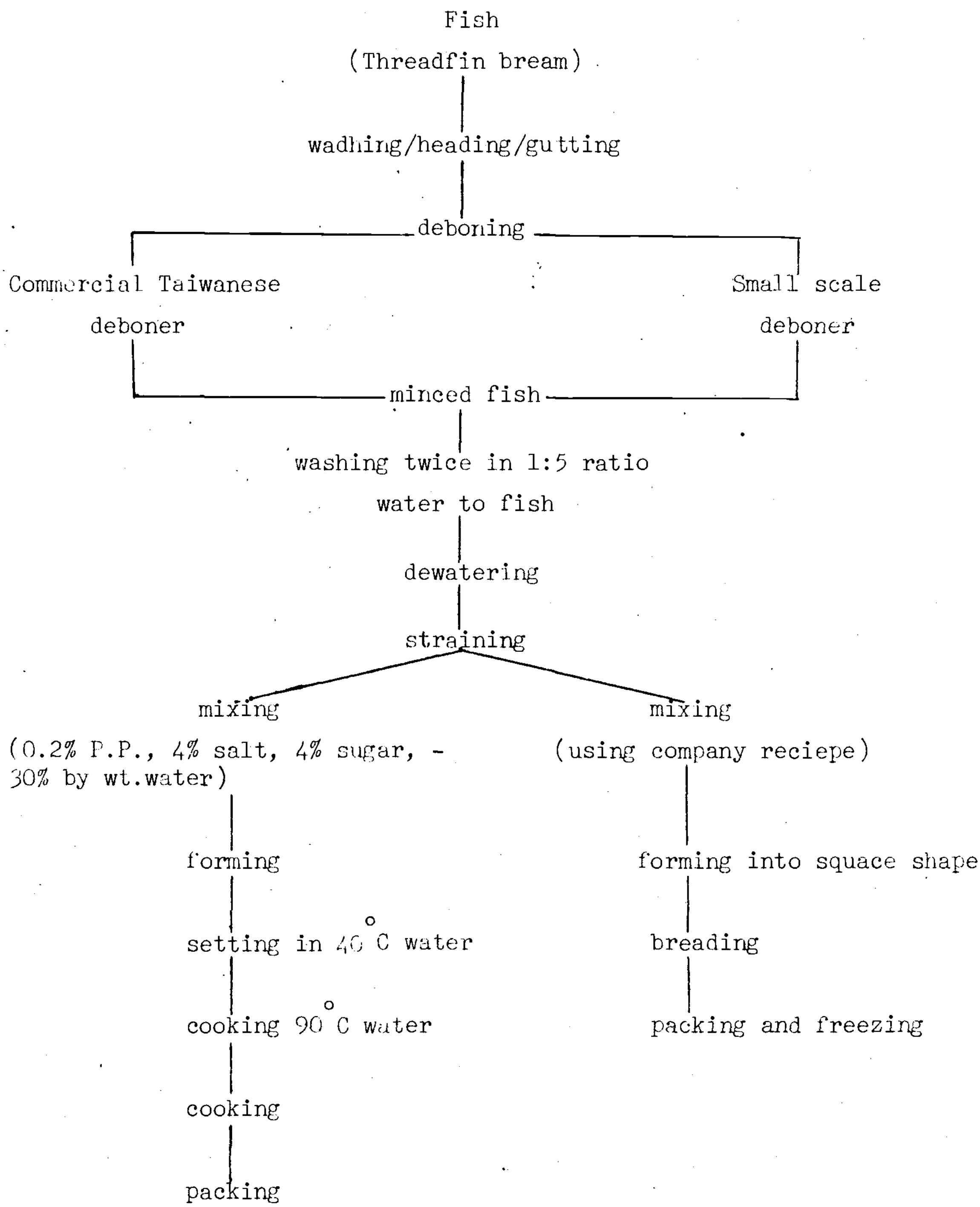


Diagram 2 Flow chart of the trial in the fishball factory.

Table 10 Quality of whole fish, fillet and deboned mince determined chemically.

Species	Freshness score (40)	TVB mg%	TMA mg%	K value %	Moisture %	bone content %	size (cm)
Threadfin bream	34						15.47±1.2
- deboned mince		9.11	2.31	45.12	81.22	0.1035	
- white meat fillet (manual)		10.31	3.64	46.79	81.90	0.1965	
- red meat		12.45	2.67	47.40	81.10	0.3585	
Bigeye	32						20.99±2.2
- 1st deboned mince		10.07	1.44	33.43	79.55	0.0325	
- 2nd deboned mince		9.37	1.57	43.43	80.29	0.0620	
- fillet		8.47	1.30	42.98	78.55	0.3510	
- scrap mince		9.08	1.77	31.83	80.74	0.3945	
Flat fish	28						23.69±3.7
- deboned mince		10.86	6.99	82.68	83.08	0.0235	
- fillet		17.45	13.41	80.69	82.02	0.1833	

Table 11 Comparison of yield and time use in filling and mechanical deboned using small scale deboner

Species	Filleting		Small scale deboner	
	yield	rat kg (hr/person)	yield	input capacity kg. hr *
Threadfin bream	37.8	12	34.2	36.91
Bigeye	27.2	20	27.0	35.35
Flatfish	-	7.5	-	- **

* Time was recorded only when machine was operated

** Flatfish can not be deboned by small scale deboner

Table 12 Comparison of yield and time used by in deboning threadfin bream small scale deboner and commercial deboner

	yield	input capacity
Small scale deboner	39.42	50.30
Bibun (SDX 13)	42.31	127.46
Taiwanese commercial deboner	46.73	710.0

Table 13 Main specification of the mechanical fish deboner

	Bibun SDX 13*	Small scale deboner
Overall height (mm)	1,180	869.75
Overall width (mm)	900	551.25
Overall length (mm)	940	600.25
Screen role diameter (mm)	222	159.25
Rubber role width (mm)	204.5	140
Required horse power (HP)	2.0	1/3
Screen roll revolution (rpm)	15.5	46
Process ability (kg/hr)	650-700	60

* Source : Instruction manual for installing and Operation SDX 13
Bibun Machine Construction

Table 14 Sensory evaluation score for various products

	General appearance		Texture		Flavour (5)
	Colour (5)	Impurities (5)	gel strength (15)	hardness (5)	
Fishball	5.0	4.06±	7.81±1.5	4.38±1.06	4.0±0.9
	General appearance		Colour	Odour	Flavour
Fish finger	7.33±0.5		7.17±0.8	7.5±0.5	7.5±0.8

Table 15 Quality of fish at various operation

Species	TVB mg%	TMA mg%	K value mg%	Moisture Content mg%	Bone Content mg%	Size (cm)
Threadfin bream						15.2±1.7
- fillet	19.11±5.6	12.37±0.3	25.56±6.8	79.2±2.0	0.2742±0.3	
- mince (commercial deboner)	30.52±10.6	6.75±0.8	59.92±9.2	80.93±0.5	0.0410±0.01	
- mince (small scale)	23.74±8.9	8.88±3.5	45.62±9.1	80.15±1.6	0.0465±0.01	
- washed mince (c)	1.19±0.1	1.15±0.7	60.71±6.5	79.50±1.3	0.1218±0.05	
- wash mince (s)	1.34±0.7	0.8±0.4	49.02±10.43	79.93±0.5	0.1301±0.04	

Table 16 General comments on small scale deboner

General Appearance	- Satisfy with major parts and body which made of stainless steel. - Size of machine is rather big comparing to the capacity.
Principle of operation	- Contact area between tire and drum is small may cause unclean seperation of the meat. - Tire pressure has to be pumped in when used and release when washing is required which made operation aucward. Moreover extra pump is needed. - Pneumatic tire was continually rubber when it is wet its colour was washed off and discoloured the mince. (See Photo 10) - The driving force of the motor is not enough, therefore the machine ceased many times during operation. - More durable belt is required.
Quality of minced fish	- Defect from plastic tire and stainless-steel present so extensively. - Colour of deboned mince was darker than fillet, leaching is required to improve colour
Yield	- Low

1. Filleting of bigeye

2. Filleting and scraping of the meat from the frame

3. Fish was headed and gutted manually

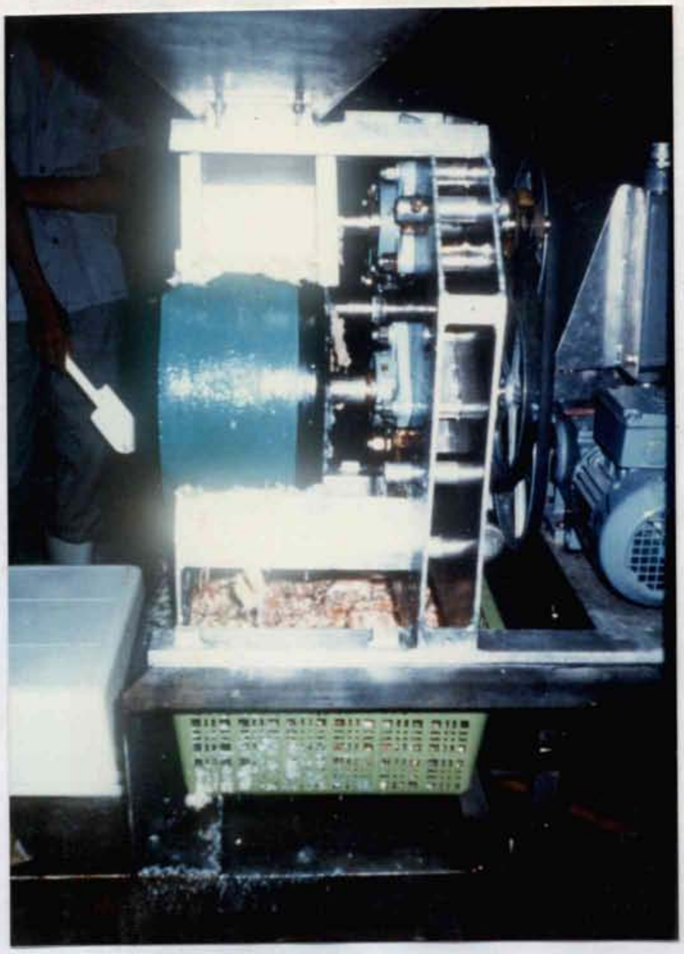
4. Headed and gutted threadfin bream

5. Deboning by small scale deboner

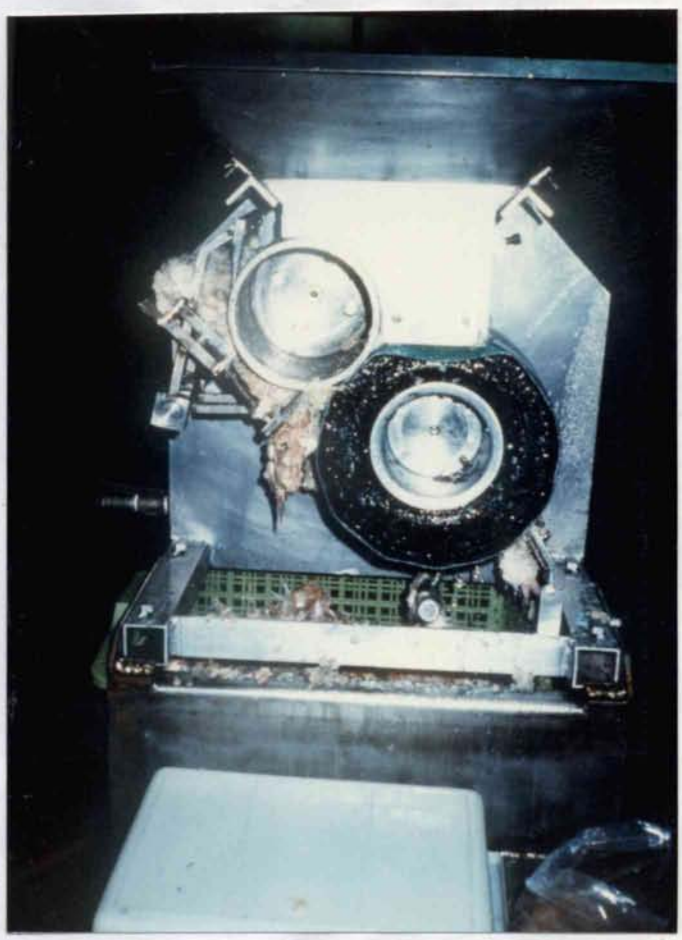
6. Factory owner and worker observe the operation of small scale deboner

7. After a period of operation, filth is extensively occurred

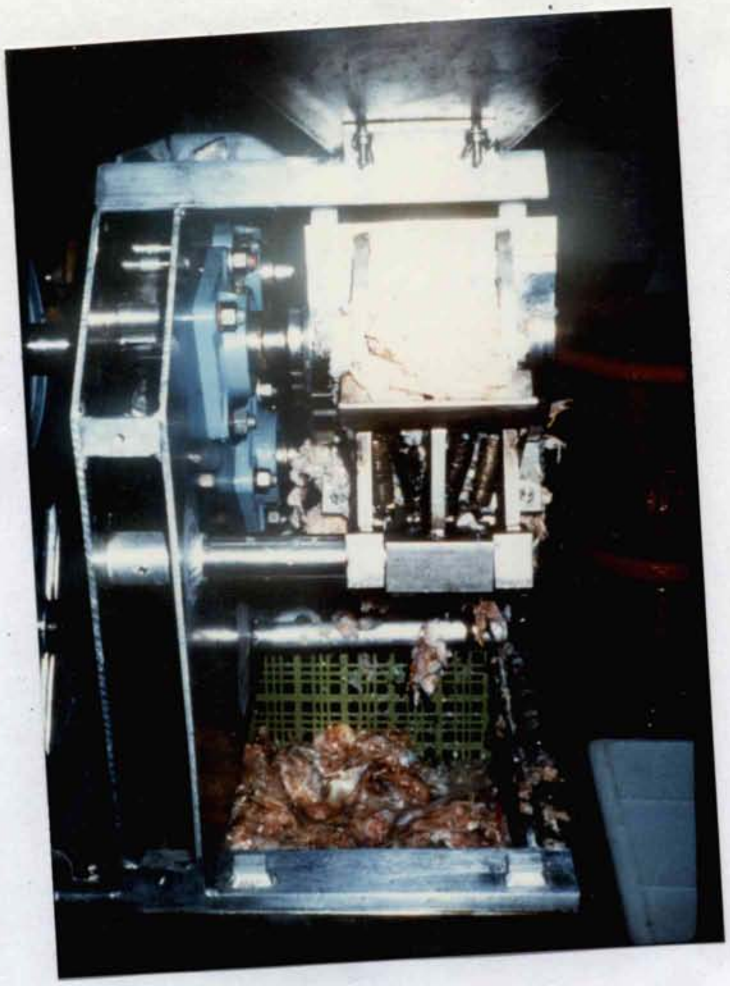
8. Minced fish obtained, the filth can be obviously seen



9. Belt is slipping off from pnuematic tire after the period of operation



10. Slipping of the belt from pnuematic tire seen from the front view and also storing up of mass between the two blades



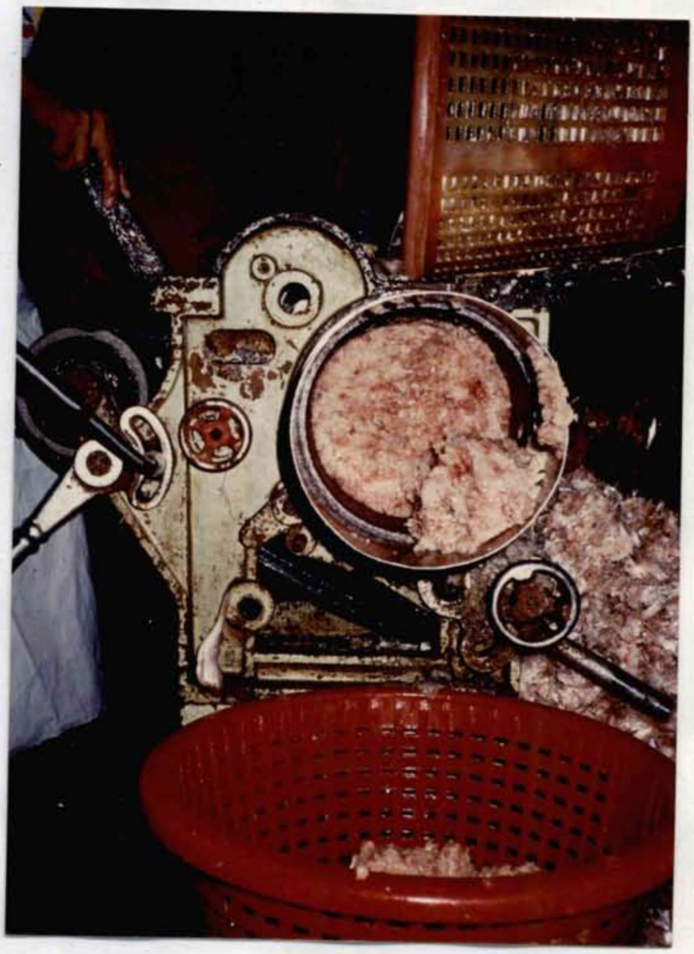
11. Stored up of mass at the back of pnuematic tire

12. Discoloured mince around the pnuematic tire

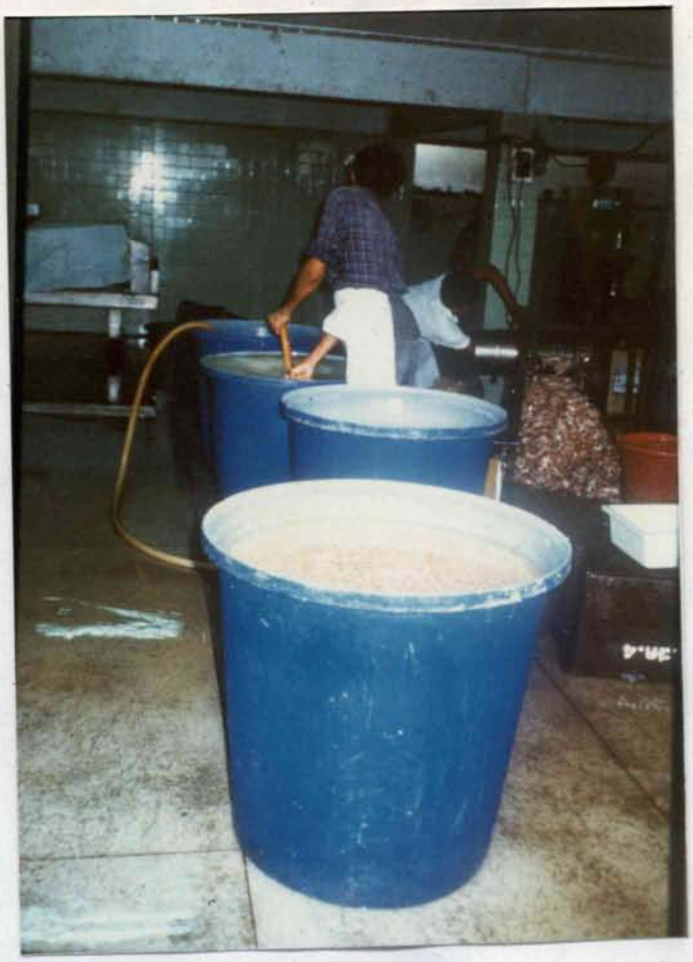
13. The rear part of deboner

14. Pushing the reel to ease the rotating of the pnuematic tire

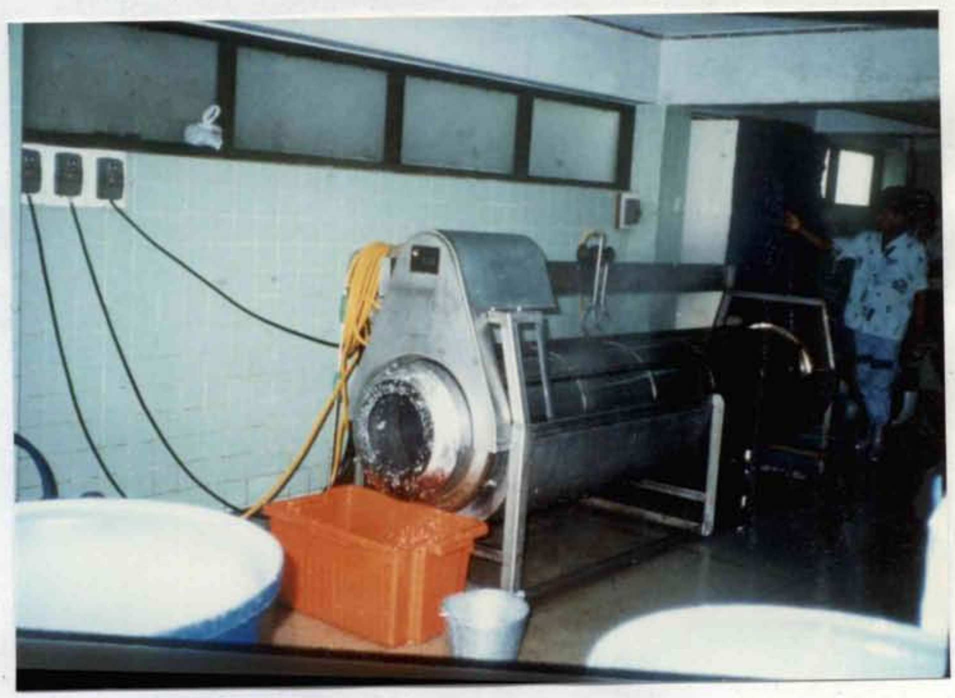
15. Feeding fish into Taiwanese commercial deboner



16. Deboning by Taiwanese commercial deboner



17. Washing of the mince



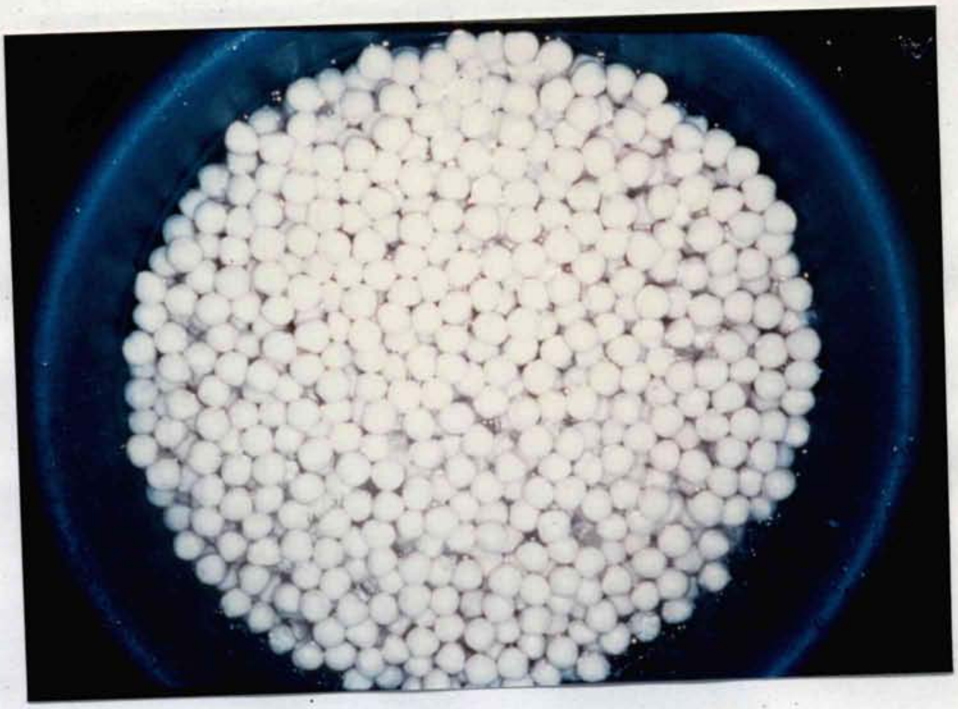
18. Dewatering

19. Continuous dehydrator

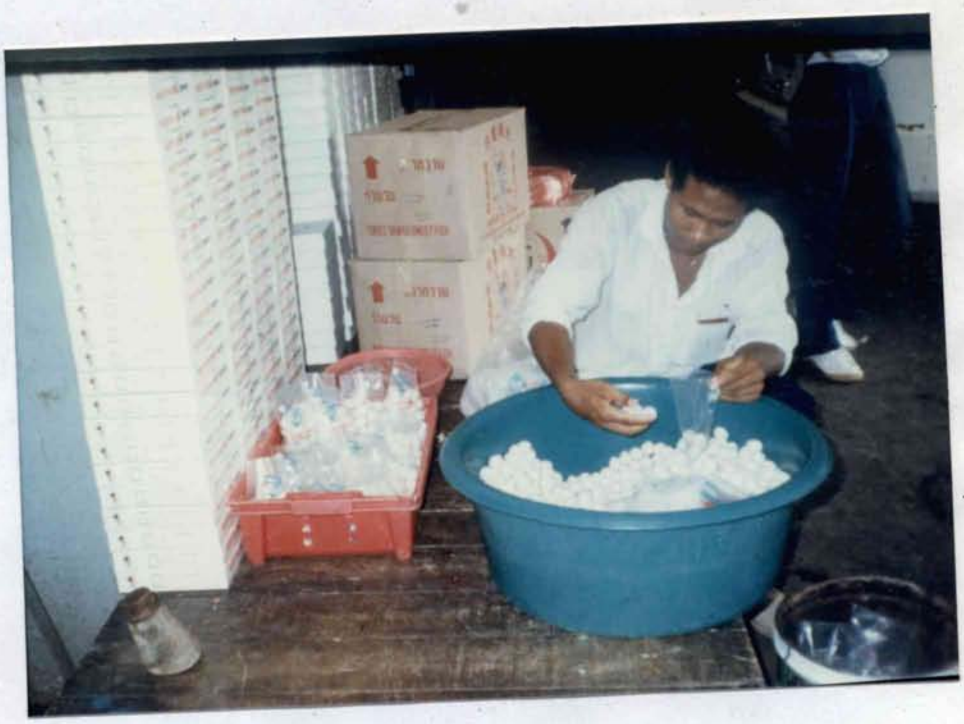
20. Dewatered mince

21. Straining

22. Mixing with ingredients and additives



23. Fishball produced at fishball factory



24. Packing of fishball for retailed sale

25. Fish satay minced fish product made from lizard fish.

26. Another style of
of fish satay

ANNEX A

Summary Report of Mr. G.W. Robertson

IDRC DEBONER PROJECT - THAILAND

- SUMMARY REPORT -

G.W. (WIL) ROBERTSON P.Eng.

CIFT, HALIFAX, NOVA SCOTIA

CANADA

Initially began testing the deboner with existing drive system as shipped from Canada. The first series of tests were performed on threadfin bream, a medium-soft textured fish. The testing regime was to include a series of (4) four RPM'S and (4) four different tire pressures. From the outset it was recognised that a problem existed in the drive system arrangement, in particular, the belts. The existing belts were round in shape (≈ 1/2 " Dia) and made from polyethylene. These belts performed satisfactory at the median RPMS (ie (35) 40, 46) where the pulley diameter ratio was relatively low, but at the slow RPM (ie 30) and the higher RPM (ie 54), the machine experienced problems in that the belt would stretch, or expand in length, under loaded conditions, due in part to the higher pulley diameter ratio. To resolve the problem, a new drive system was proposed incorporating a rubber V-belt in substitution for the plastic belting. It was then necessary to establish a suitable operating RPM, because this would become a fixed parameter due to limited sizes in V-belts. While it is quite easy to vary the length of the plastic belting via a heating and coupling apparatus, it is not so for the case of V-belts. From past experience and limited present experience an operating RPM of 46 was chosen. The placement of the electric motor had to be modified somewhat to accomodate the proper length of V-belt. Also, a V-belt was placed on the friction drive side between the tire and feed roller pulleys. A subsequent trial with a small quantity of jewfish and Bigeye proved successful with the new drive system.

Another minor problem encounter was that of short circuiting of fish around the feed roller to become lodged between it and the back of the feed hopper. To prevent this, a piece of 1/2 "dia aluminum rod (brought from Halifax, Canada) was cut to a suitable length and placed between the bottom of the feed roller and the top of the pneumatic tire. Holes were drilled into the two pieces of high density polyethylene to facilitate placement and removal of the aluminum rod for operating and/or cleaning. The placement of this part reduced the gap substantially and in subsequent trials with different species of fish, its performance was a definite improvement. Although with some of the softer fleshed fish, some small pieces or "chunks" of fish or fish debris still had a tendency to collect here. On the other hand no whole fish were rejected through this opening as was the case before the new part was installed. To eliminate this problem altogether, a simple redesign would be necessary which would include enlargering the feed roller slightly (say from 3 " to 4 " or 5 ") and positioning it in such a manner so as to come as close as possible to the surface of the inflated tire.

Once modified with the two preceding alterations (ie new drive system and aluminum rod placement) operation of the deboner was reasonably smooth, especially with Bigeye, the fish which was thought as the species to give the most trouble because of its extremely tough skin. The results were quite the contrary, this fish passed through the machine rather easily and cleanly, and in fact it was probably due to its tough skin that it worked so well.

The last species of fish used was lizard fish, some of which were quite large in length (≈ 10 - 12 inches) and substantial in diameter at the largest section (≈ 2 - $2\frac{1}{2}$ inches). The deboner stalled on a couple of occasions when these larger fish were introduced, although if placed one at a time they proceeded through the machine readily. A note on feeding the deboner would include that the operator use a little common sense when operating it. If the "throat" of the machine (ie the area between the top of the feed roller and perforated drum, visible while looking into the feed hopper) is full of fish, wait a few seconds for the machine to clear itself before forcing any more material into the machine, because this may stall it. Once cleared, feeding can resume of a normal pace. This practice should be observed especially with large lizard fish.

Other minor problems experienced were that of galling or scraping of stainless steel from the perforated drum by the scraper blades. This problem was boned to happen and was recognized back in Canada. As discussed with FTDD personnel, to lessen this problem, a softer stainless steel blade is required or the use of cast iron blades is also acceptable. It must be noted however, that some scraping of metal is going to occur despite the correct blades being in place. This is experienced on all deboning devices, the solution is to reduce the wear of the stainless steel drum as much as possible due to its extremely high component cost.

The prescence of pieces of the plastic belt liner from the tire surface in the mince fish flesh was experienced on occasion, primarily

During testing of jewfish and bigeye, another operational discovery became apparent, in that the method of feeding the fish to the machine could actually aid the machine in processing the fish and thus increase the feed rate substantially. Initially, fish were "fed" to the deboner in any orientation one at a time but it was discovered that if the fish were fed tail first, the machine operated more efficiently and effectively. When orientated in a tail-first fashion, the fish seemed to proceed through the "extrusion zone" between the perforated drum and pressurized tire continuously experiencing few problem with "jamming" or stalling of the deboner, as experienced earlier.

It must be noted that the problem of "jamming" and thus stalling of the apparatus was also experienced earlier due to inefficient scraping of the perforated drum by the scraping assembly. When scraping action is poor, due in most cases to inappropriate or insufficient scraper blade tension on the perforated drum, fish residue and debris such as skin and bones have a tendency to lift the scraper blades from the drum as they pass over the drum, and as result, they collect in the area between the drum and tire until such time as the tire stalls and then operation ceases. The scraper assembly is the backbone of the machine and must work properly to ensure efficient operation of any deboning apparatus. In early trials it was found that the existing spring tension was unsuitable for Thai fish species. To resolve this problem, two additional higher tension springs brought from Halifax replaced two of the existing springs and hence increased the blade tension considerably. With these new springs in place, scraping action was improved immensely.

due to the scraping action from the pieces of high density polythylene which enclose the feed hopper at the front and back. Wear ridges on the tire belting surface were evident after several trials with fish. To eliminate this wear, the polyethylene parts should be ground down so as to just clear the surface of the tire on inflation to operating pressure (approx 40 psi preferred). Also, scraping of the tire belting surface by the perforated drum occured on a few occasions, but only when the tire stalled and the drum continued to turn. If and when the tire stalled for reasons of jammed fish or similar problems, and the drum continued to turn, it would scrape the surface of the belting with the perforated holes acting as cutters and subsequently dislodging some plastic particles from the belt which found their way into the drum. This did not occur often and might not constitute a serious problem. However, one method to eliminate this occurence would be to change the drive system so that both the tire and drum would be driven independently instead of only the drum being driven and the tire being driven try friction. The drive system would then become more sophisticated and hence capital costs would increase somewhat, however, the machine would not be proved to stalling and wear of the tire belting surface would not deteriorate as a result. As said previously, this did not occur often, so the decision is really a matter of economics.

As far as testing results are concerned, they have yet to be finalized. Suffice to say that in comparison to the Bibur commercial deboning machine, the yield of the IDRC Deboner was usually 10 - 15 %

lower (due mostly to the limitation of internal pressure permitted by the tire - max. 50 psi) for each given fish species. However, quality was at least as good if not slightly better as was visual appearance. Moisture contents and bone contents appear to be comparable for each machine, at least at first glance of the data.

Further comments might include the fact that a larger sized machine would better be suited for medium and larger sized processors. The existing machine, it was in the opinion of FTDD staff, might be suitable only for very small rural processors, as the capacity was reckoned at a range between 100 - 200 kg/hr depending on the fish species being utilized. As far as modifying the machine into a larger capacity unit is concerned, the main problem lies in establishing a suitable tire size readily available " off the shelf ". Once found modifying the remainder of the components is rather straight forward. This is an exercise which will be undertaken back in Canada on return of the author. If it is deemed necessary to modify the machine into a larger capacity unit, FTDD engineering personnel in collaboration with resourceful local manufactures are more than capable in undertaking such a project.

P. Eng.

11/04/87

BANGKOK, THAILAND

ANNEX B

Project Proposal

PROPOSAL

BACKGROUND

1. It is estimated that the world demand for fish as human food will reach 1.0 x 10^8 tonnes annually by the year 2000. This is about double the equivalent demand in 1979. The increased supplies will have to be met by expanding aquaculture production, using fish now destined for animal feed and recovering the by-catch of shrimp fisheries. The single largest and most readily available resource is the latter one. Shrimp vessels throughout the world discard 5-16 million tonnes of by-catch at sea each year. Processing of this heterogeneous mixture of fish would contribute significantly to the world supply of fishery products for human consumption.

2. Various obstacles - technological, economic and sociological - limit the better utilization of shrimp by-catch. A major problem is the small size and varied shapes of by-catch fish, which often precludes marketing through conventional channels. Because of this constraint, mechanical deboning has been applied to by-catch fish to produce a minced fish flesh which may be formulated into traditional food products. Such products are particularly acceptable to S.E. Asian consumers in the form of fish balls, fish crackers, fish satay and many other items.

3. Commercially available fish deboning equipment is expensive and beyond the reach of the small fish processors in developing countries. The design and manufacture of simplified deboning equipment, suitable for small, batch plants, would open up new opportunities for increasing fish utilization in these regions.

4. Recognizing this need, IDRC has supported a project at the Canadian Institute of Fisheries Technology (CIFT), Technical University of Nova Scotia (TUNS), in Halifax and the Atlantic Bridge Company Ltd. (ABCO), in nearby Lunenburg, to develop such a small-scale deboner. Several design criteria were stipulated, including simplicity of operation and maintenance, an ability to process very small fish, a maximum throughput of 100 kg/hr, acceptable mince yield and quality, and a maximum cost in Canada of $6,000 (CAD 1981).

5. Based on fundamental engineering work, a comprehensive evaluation of various design parameters and test rigs was completed. This study has resulted in the construction of a prototype machine which has been fully tested in Canada and meets or surpasses the original design criteria. There is now a need for further testing on tropical, by-catch fish to determine operating performance, effect any necessary machine adjustments and assess the economic feasibility of introducing the technology. In addition, it is necessary to further modify the deboner so that it may be used to recover flesh from larger-boned species and fish frames. This would be of benefit to countries such as Chile where the underutilized resources include small- and medium-sized hake.

OBJECTIVES AND RESULTS OF PHASE I

7. Phase I was to develop a small-scale machine for deboning small and underutilized fish and suitable for application in developing countries. The specific objectives of Phase I were:

Objective a) To compare a range of design principles for ease of removal of fish flesh from skin and bones, within identified constraints

8. A prototype deboner design elaborated by ABCO some years ago was tested and subsequently rejected. The model was a relatively complex arrangement involving a series of spring-loaded vanes rotating against a perforated cylinder through which the fish flesh was extruded. The machine was extremely difficult to clean and too elaborate for developing country use.

9. Further design possibilities were assessed on the basis of simplicity combined with effectiveness. The belt and drum principle was selected as the most appropriate design to fulfill the project objectives. To obtain information on the optimum presssures required to extrude fish flesh through perforated drums, a comprehensive series of tests were undertaken using a laboratory rig. This was a simple plunger device which drops under standard pressure against a perforated plate. Optimum extrusion pressures, providing high flesh yields with low bone contents, were determined for different fish species of small size.

Objective b) To develop and test a prototype of the most suitable design and compare its performance, energy requirement and cost with commercially available large deboners

10. The preliminary engineering studies led to the design of a deboner, the main features of which include a stainless steel perforated drum, electrically driven, and a variable pressure pneumatic tire. The tire is in forced contact with and driven by the drum; they rotate in opposite directions and cause separation of flesh from bone and skin as the fish are fed to the drum through a hopper and rotating feed roller. Rotation of the drum may be achieved by a 0.25 HP motor or by manual cranking.

11. A prototype machine was constructed and tested. Testing involved varying the tire pressure and drum velocity to determine their effects on input capacity, product yield and quality of separated flesh. Atlantic smelts of good quality were used for these experiments. Seventy test runs were performed in which tire pressures were varied between 15-50 psi and drum velocities between 30-55 rpm.

12. With the species tested, optimum operating conditions were obtained at a tire pressure of 35 psi and a drum velocity of 40 rpm. Under these conditions, input capacity was 148 kg/hr and mince yield was approximately 70 percent. Mince quality was judged equal to or better than that obtained using existing commercial equipment.

13. Overall machine performance and individual component performance were also observed and analyzed on the basis of ergonomics, efficiency, workability and safety. Further modifications to the feed assembly and scraper blades, for removing debris from the

drum, were made. The machine was found to be versatile and reliable. One of its main attributes is simplicity, all components being readily accessible and easily removed for cleaning or replacement. It is also rugged and safe to operate. The estimated manufacturing cost is just below the $6,000 CAD 1981 limit defined in the project objectives, and will fall further if regular manufacture in the developing countries can be established.

Objective c) To evaluate the prototype and modify where appropriate in fish meat and fish ball factories in Bangkok, Thailand

14. This objective was not completed. The results on prototype testing were delayed by a year because ABCO fell into receivership and was later re-established under new management. It is now considered that evaluation of the deboner in Thailand should be the subject of a further phase.

OBJECTIVES

General Objective

15. To evaluate the technical and economic feasibility of the Halifax deboner for the manufacture of minced products from fish by-catch in Thailand and modify the deboner to process larger fish.

Specific Objectives

16. a) To assess the performance of the deboner and determine optimum operating conditions for several common by-catch species;

b) To determine the feasibility of operating the deboner in local fish meat factories and of using the mince in traditional products;

c) To evaluate the economic feasibility of introducing the deboner for fish processing in Thailand; and,

d) To develop and test modifications to the existing prototype to enable it to handle larger-boned species and fish frames.

RESULTS

17. If found feasible, the deboner will enable small fish meat processors in Thailand to utilize small, less expensive fish such as shrimp by-catch. This will increase profitability for the small processors and stabilize prices for the local consumers. It will also encourage better handling and increased recovery for human consumption of currently wasted by-catch fish. Furthermore, the availability of an efficient, low-cost deboner for small fish would benefit many other countries and regions where by-catch is wasted.

18. Personnel of the Fishery Technological Development Division (FTDD) will further develop their knowledge of fish deboning technology and their in-plant experience in the Thai fishery industry. The project will add to CIFT's experience in field work in developing countries and strengthen collaboration between FTDD and CIFT.

METHODOLOGY

Objective a) To assess deboner performance

19. The existing deboner prototype at CIFT will be fitted with a modified scraper assembly, tested, and shipped to Bangkok to be installed at FTDD laboratories. Liaison will be established with the Thai Fishermen's Association for the recovery of fresh by-catch fish for experimentation. At least four species of by-catch (e.g. threadfin bream, lizard fish, flatfish, goatfish) will be selected on board, washed and stored in ice. Heading and gutting will be carried out in the laboratory prior to testing.

20. For determining the effect of tire pressure and drum speed on deboning efficiency approximately 5 kg of each species will be used for one trial run. Processing time and mince yield will be recorded for each sample, and throughput determined. Each trial will be carried out in triplicate for each of four selected tire pressures (15, 25, 35, 50 psi) and four drum speeds (30, 35, 45 and 55 rpm). To define optimum operating conditions two sets of data will be obtained for each species. In the first set, drum speed will be a fixed parameter, while mince yield and input capacity will be plotted against tire pressure. In the second set, tire pressure will be a fixed parameter while mince yield and input capacity will be plotted against drum speed.

21. Using optimum operating conditions, in terms of yield and input capacity, the quality of the minced flesh obtained from the prototype deboner will be evaluated, for each fish species. Modifications to the recommended operating conditions may arise as a result of these tests. FTDD engineers will collaborate in this area. Parallel trials will be conducted using a commercial deboner (Bibun Ltd., Japan). Results will be compared.

22. Criteria for evaluating minced fish quality will include organoleptic acceptability, colour, texture, bone content and moisture content. Organoleptic acceptability will be assessed by hedonic scaling using up to thirty untrained panellists. Both raw minces and prepared products (such as fish balls) will be evaluated. Commercial products will be included as controls. Colour will be objectively compared using methods recommended for canned tuna by the Canadian Fish Inspection Branch. Texture will be compared using a standard texturometer (Food Checker, Yamamoto Ltd., Japan). Bone and moisture contents will be determined by oven drying methods.

23. To assist the installation of the Halifax deboner and the assessment of its performance, a researcher from CIFT will visit the FTDD during the initial six weeks of the project.

Objective b) To determine in-plant feasibility

24. Following preliminary testing, and after any necessary modifications are effected, the deboner prototype will be installed at a fish meat factory in Bangkok. These factories prepare fish fillets and minces for subsequent distribution to secondary fish processing plants. FTDD have previously collaborated with the fish meat plant and will explain and discuss the objective of the study with the plant manager beforehand. At the secondary processing plants, FTDD will also exploit prior contacts established with the factory operators.

25. The deboner will be operated continuously in the fish meat plant for a period of approximately two weeks. Sorted by-catch, obtained directly from shrimping vessels, will be headed and gutted and thoroughly washed prior to deboning. An average daily throughput of 300-400 kg of prepared fish will be targeted. Using optimum machine settings, as defined in the preliminary studies, data will be routinely collected on input capacity and mince yield. Operating problems and any special operator requirements will be noted and discussed with plant personnel.

26. Fish mince will be collected and either chilled or frozen for subsequent processing. Mince quality will be periodically assessed using indicators such as colour, texture and bone contents (as described in paragraph 22). Microbiological quality of minces will also be monitored by measuring total viable bacterial count and the presence of pathogenic microorganisms.

27. Fish mince obtained from the process will be transferred to secondary fish processing factories, manufacturing fish ball (lukchin), seasoned fish ball (tod-marn) and seasoned dried fish (satay). The mince will be processed, using traditional techniques, by the factory operators. Product quality will be evaluated in the plants by untrained personnel, using hedonic scaling. Product samples will be marketed through traditional channels for a preliminary assessment of sales performance.

28. The project will cover all raw material, labour, transportation and marketing costs associated with this in-plant testing stage.

Objective c) To evaluate economic feasibility

29. A consultant economist will be locally hired to advise on methodology design and data analysis for the economic feasibility study. At an early stage of the project, liaison with a local engineering firm will be established. Given the machine specifications and engineering drawings, the feasibility of local manufacture will be evaluated. Needs for imports of any components will be identified. Local manufacturing cost will be estimated.

30. The estimated capital cost of the deboner will be incorporated into a cost-benefit analysis of its introduction into the fisheries industry under study. During the in-plant operational study, data will be gathered on costs related to raw materials, materials handling, labour, machine power requirements, other service requirements (e.g., water, steam), storage, transportation and marketing. These data will be collected in both fish meat and secondary fish processing plants. Retail value of final products will be assessed from market response and current prices of traditional products.

31. The data will be used to calculate the impact of deboner introduction on the profitability of three sectors: shrimp fishermen, fish meat processors and secondary product processors. Potential demand for the small deboner will also be assessed.

32. At the end of the study, three methods of dissemination of the results will be employed. Firstly, an investment promotion document will be prepared for the Thai government and private industry. Secondly, a workshop will be organized for local processors. Thirdly, newspaper and broadcasting staff will be encouraged to report on the activity.

Objective d) To develop and test deboner modifications

33. Another deboner, similar to the existing prototype will be manufactured in Canada for further trials and demonstration activities. This would also ensure that a second machine is available should the original prototype be damaged or lost.

34. Engineering modifications will be introduced to the machine to enable it to handle substantially larger bones. The prototype machine, while suitable for small fish, is not able to handle large items such as medium-sized cod frames. It does not have sufficient power and it incorporates a fricton drive which tends to slip when an item such as a large backbone is introduced. The ability to handle larger bones would enable the processor to debone fish such as small- to medium-sized haddock and hake. This would widen the scope for the machine in both developing and developed countries. It is likely that modifications to the feeding mechanism and to the size of the drum perforations will be required. Throughput, yield and mince quality will be evaluated using the methodology described in paragraphs 20-21.

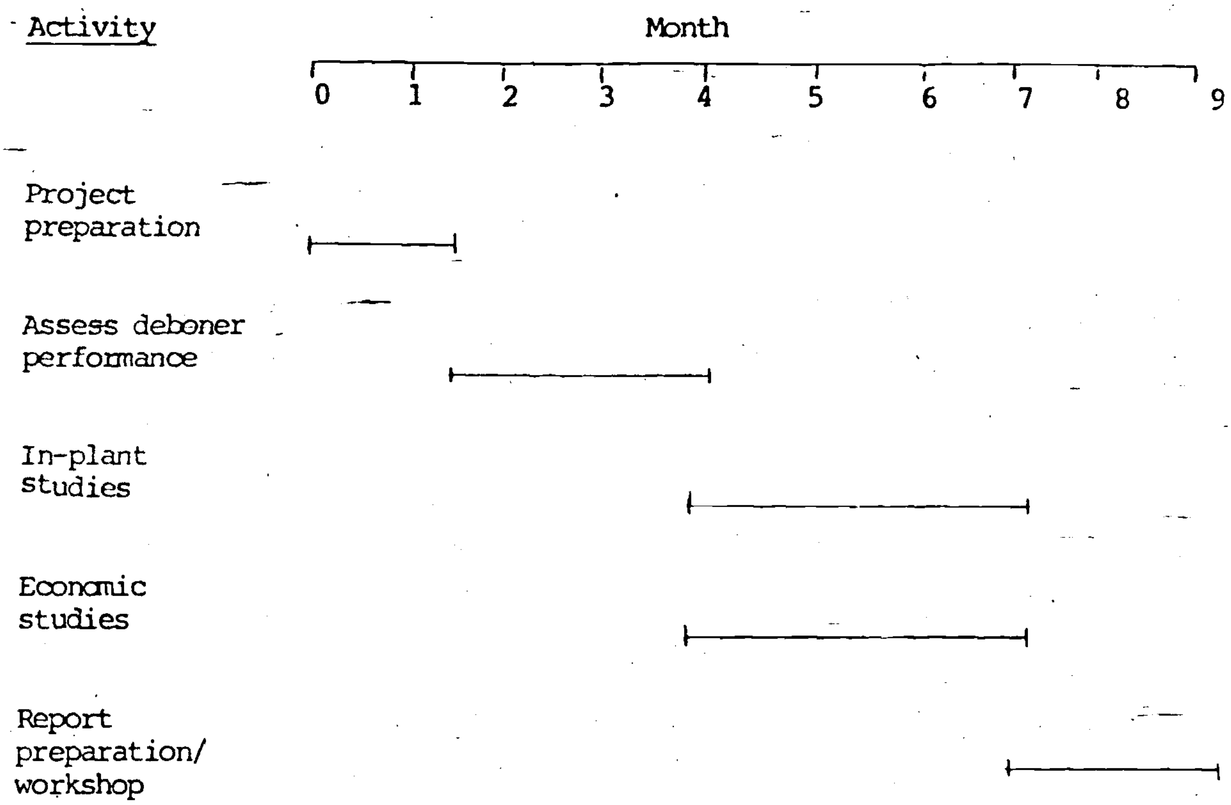
INSTITUTIONS

35. FTDD is a Thai government institution which carries out research aimed at improving fish handling and processing in the country. The institute has established close links with fishermen and fish processors. IDRC has previously supported a fish processing project at the institute.

36. The CIFT, at the Technical University of Nova Scotia in Halifax, is responsible for developing capabilities in fisheries education, research, development and design. The institute has specialized expertise in the areas of fisheries engineering, marine oils, fish biochemistry and process technology. The institute is actively involved in training developing country researchers in various apsects of fish technology.

37. The project co-ordinator at FTDD has specialized training in fish technology and recently received a Master's degree from CIFT. The co-ordinator will be assisted by a food technologist and engineers of FTDD. CIFT's Professor of Engineering will be responsible for the Canadian component of the project. The visiting Canadian researcher to FTDD will be the CIFT technologist who has previously gained wide experience with the prototype deboner.

SCHEDULE OF ACTIVITIES



	IDRC CONTRIBUTION TOTAL (9 MONTHS) In Canadian Dollars	RECIPIENT CONTRIBUTION TOTAL (9 MONTHS) In Canadian Dollars
TO BE ADMINISTERED BY FTDD		
Salaries and Allowances		
Project Co-ordinator (2 person months)	--	400
Food Technologist (9 person months)	1,900	--
Engineer (2 person months)	--	400
Technician (4 person months)	--	600
Driver (3 person months)	--	200
Research Expenses		
Fish Supplies	4,500	--
Labour	8,600	--
Vehicle Repair	2,300	--
Local Travel		
Vehicle Fuel and Oil	1,000	--
Reports and Publications	800	--
Conference/Workshop	1,100	--
Equipment		
Computer and Software	4,850	--
TOTAL FTDD-ADMINISTERED	25,500	1,600
TO BE ADMINISTERED BY IDRC		
Equipment		
Spectrophotometer	1,500	
Consultant	6,000	
Contingency	3,300	
TOTAL IDRC-ADMINISTERED	10,800	
TOTAL GRANT TO FTTD in Canadian Dollars	36,300	

An in-kind contribution will be provided by the Fishery Technological Development Division consisting of chemicals and reagents, fish containers, vehicle, laboratory equipment, and secretarial facilities. This contribution is valued at 23,300 CAD over nine months.

BUDGET NOTES

FTDD-ADMINISTERED

Salaries and Allowances

1. A food technologist will be hired specifically for the project. Salary is budgeted at 4,000 THB per month, which should be sufficient to attract a capable person for a nine-month contract.

Research Expenses

2. The cost of fish supplies is calculated as follows:

FTDD trials	:	400 runs	x	5 kg/run	x	10 THB/kg	=	20,000 THB
In-plant trials	:	500 kg/day	x	14 days	x	10 THB/kg	=	70,000 THB
Bibun trials	:	50 runs	x	10 kg/run	x	10 THB/kg	=	5,000 THB
								95,000 THB

3. Labour costs will be incurred during the in-plant studies for on-board sorting (10 THB/kg), heading and gutting (3 THB/kg), deboning (3 THB/kg) and secondary processing (3 THB/kg). A total of 20 THB/kg has therefore been allowed for labour charges. Total expenditure is calculated as follows:

In-plant trials	:	500 kg/day	x	14 days	x	20 THB/kg	=	140,000 THB
FTDD trials (on-board sorting only at 10 THB/kg)	:	2500 kg			x	10 THB/kg	=	25,000 THB
								165,000 THB

4. FTDD will provide a vehicle for the project. However, some repairs to engine and bodywork are required at an estimated cost of 45,000 THB.

Local Travel

5. Vehicle fuel and oil will be required for fish collection and product distribution. The cost is calculated as follows:

Fish collection for FTDD studies	:	10 journeys at 300 THB/journey	=	3,000 THB
Fish collection for in-plant studies	:	hired truck at 500 THB/day x 14 days	=	7,000 THB
Transfer of material to processing plant	:	20 journeys at 400 THB/journey	=	8,000 THB
				18,000 THB

Reports and Publications

6. This is to cover the costs of pnotocopying and report preparation in English and Thai.

Conference/Workshop

7. During the final month of the project, a local workshop to disseminate the project results to fishery industry personnel will be held.

8. The computer package requested is an HP 86 B with disk drive, printer, and software, all available in Bangkok. Specialized software for analyzing the project data to be collected is available from CIFT and will improve the speed and accuracy of analyzing the considerable volume of data to be collected.

Consultant

9. The assistance of a local consultant economist will be required. Fees of 6,000 CAD (30 days @ 200 CAD per day) are included.

ANNEX C

Improved By-catch Utilization in Thailand

Minced Fish from Bycatch

A study on bycatch use in the form of minced fish product was supported by the International Development Research Centre of Canada. Fishball, a popular gel product processed widely in Thailand, was chosen. The fundamental steps involved grinding the meat with sodium chloride to form a gel. Salt is used to increase ionic strength of the mince and dissolve actomyosin in fish muscle to form a sol. Heating of actomyosin sol until it reaches 90^{o}C produces a network structure with an elastic texture. The fish must contain protein suitable for gel formation, kept at low temperature but not frozen and processed as soon as possible after landing.

A survey by SRG (1978) revealed at least 40 fishball factories in the Bangkok metropolitan area alone, most relying on traditional methods. At least 64 factories outside Bangkok utilize 3,466 t of raw material annually (Department of Fisheries 1986). Common species used are shark, barracuda, bigeye, eel, which are filleted. Since 1980, the manufacturers have been faced with the problem of price and supply of raw material.

Last-day bycatch produce was also considered. Species were sorted and kept in ice. Storage life in ice varied from species to species at 9-15 days. Gel strength of fishball produced from stored bycatch kept in ice for 10-12 days is fairly good (Suwansakornkul 1983). Ice retards degradation of salt-soluble protein responsible for gel formation.

Fig. 1 presents the method for fishball production. Fish must be kept cool at a temperature not exceeding 10^{o}C. Grinding temperature should be controlled to prevent denaturation of protein. Suwanrangsi and Kiatkungwalkrai (1983) recommend a double step heating. When the gel passes the 60^{o}C mark, part of it is destroyed due to alkaline protease which is active at 60-70^{o}C (Suzuki 1981).

Flat fish, flathead, threadfin bream and goat fish sorted from ten species in the bycatch have the suitable flesh characteristics for raw material (Suwanrangsi and Kiatkungwalkrai 1983). The fishball produced was acceptable but did not compare with the commercial produce in texture and appearance.

Improvement of gel strength (elasticity) of products can be made by leaching or washing the mince with diluted salt solution. The method has shown improvement both in texture characteristics and color. Minced fish is washed in 0.2% and 0.3% at pH of 6.5-7 for 15 min. Soluble protein which interferes the gel formation is washed away as well as blood. Leaching causes the removal of fat from fatty mince up to 70% (Suwanrangsi 1985). The pilot-scale production showed that leaching does not have a distinct effect on improved gel texture. Leaching lessens the interference but does not affect the amount of gel protein.

Gel-forming ability of bycatch varied among species (Suwanrangsi and Kiatkungwalkrai 1983). Yamprayoon (1985) showed that the texture quality of fishball also varied according to species composition of bycatch.

Minced bycatch can be kept for seven days at 7^{o}C. Storage life could be extended to 13 days if the mince is leached with salt solution. Fishballs produced from non-leached mince have poor quality on the first day; fishballs from leached mince have good and acceptable texture quality for up to nine days.

The price of the sorted bycatch should fall between the price of bycatch and economic species. At least 1 t/day of bycatch is needed by factories. Minced bycatch should be frozen for long-term use. The technology of Surimi production could then be applied to maintain the gel-forming ability of frozen minced fish. In the process, minced meat is washed at control pH at least three times. Sugar alcohol such as sorbitol and manitol and polyphosphate are added. Frozen minced fish block (Surimi) has a storage life of not less than one year without changes in texture quality.

Other Promising Products from Bycatch

Fish protein concentration (FPC type B) is a high protein product with the minimum content of 60% (Protein Advisory Group specifications). Yamprayoon and Kiatkungwalkrai (1983) have developed a processing technique to improve the sandy texture and water absorbency of the product. FPC produced from bycatch has met the standard requirement of the Protein Advisory Group. Yield of FPC is 4.55:1. The FPC is well accepted in the market.

Fish satay is another bycatch product using low-cost fish, mostly lizard fish, which has low gel-forming ability. It is a minced dried fish product containing 14.0% protein, 10% fat, 64% carbohydrate and 12% moisture. This type of product does not require elasticity. The processing involves deboning the fish, mixing with salt, sugar, flour and sesami seed, spreading into a round sheet, drying for 4-5 hours and then deep frying. The product can be kept for at least five months. Due to its high protein and calories, the Department of Fisheries encourages the use of this product to alleviate malnutrition especially in school children. Fish satay is produced also for export.

Bycatch can also be used in canned products because of the long storage life. Local recipes have been used to appeal to a wider circle of consumers.

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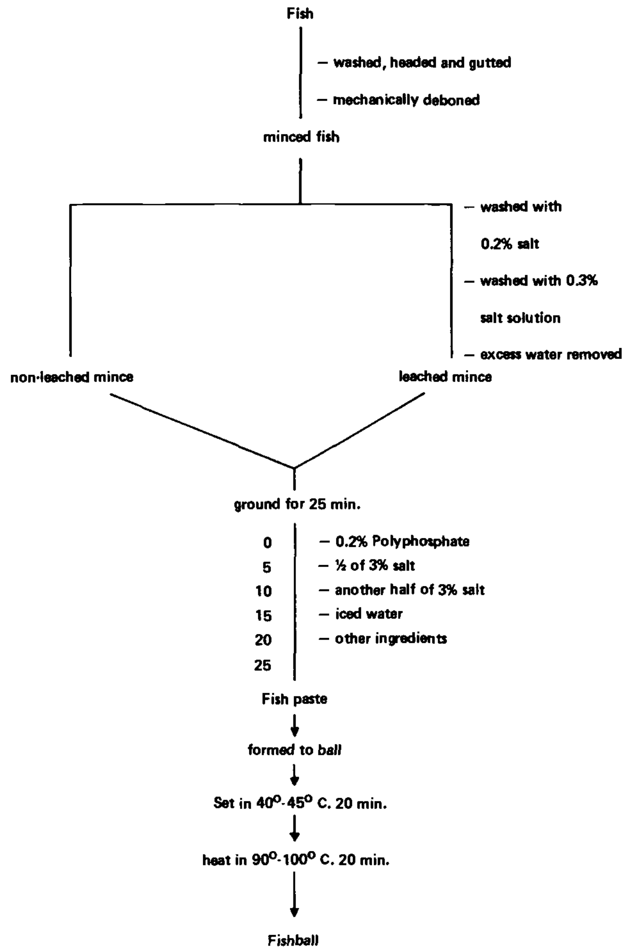

Fig. 1. Fishball production.

Table 1. Production of Thai fisheries, 1971-1983 in tonnes. (Source: Fisheries Statistics of Thailand, 1971-1983).

Year	Total production	Freshwater fish Quantity	Freshwater fish % of Total catch	Marine fish Quantity	Marine fish % of Total catch	Bycatch Quantity	Bycatch % of Marine production
1971	1,587	117	7.36	1,470	82.64	655	44.57
1972	1,679	131	7.82	1,548	92.18	719	46.45
1973	1,678	140	8.39	1,538	91.61	804	52.31
1974	1,510	158	10.52	1,351	89.48	690	51.01
1975	1,555	160	10.33	1,394	89.64	634	45.53
1976	1,699	147	8.67	1,551	70.86	620	39.99
1977	2,189	122	5.59	2,067	94.41	836	40.46
1978	2,099	141	6.74	1,958	93.26	847	43.28
1979	1,946	133	6.84	1,813	83.16	784	43.25
1980	1,793	144	8.09	1,647	91.91	786	47.75
1981	1,989	164	8.27	1,824	91.73	796	43.67
1982	2,120	133	6.30	1,986	93.70	812	40.91
1983	2,225	155	6.89	2,099	93.11	803	38.25

ANNEX D

Case study : Development of Minced Fish Industry in Thailand

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Republic of Singapore

**SEMINAR ON
DEVELOPMENT OF FISH PRODUCTS
IN SOUTHEAST ASIA**
Singapore 27-31 October 1987

Development of Minced Fish Industry In Thailand

DEVELOPMENT OF MINCED FISH INDUSTRY IN THAILAND

by

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ABSTRACT

Fishball is the popular minced fish products in Thailand. The product is produced by traditional method and improvement has been done mostly in terms of equipment replacing manpower. In 1980, shortage of raw material occurred, the utilization of low value fish was considered. Technology was introduced to improve quality of fish and the products. By-catch was utilized into fishball with the application of leaching which is one of the surimi production technology. Meanwhile, the surimi factory and technology are booming. Increasing in number of surimi factories as well as demand for raw material forced the utilization of low value species. Pattern of utilization has changed, sorted by-catch are now used as raw material eventhough it is still a second option. Moreover, technology to improve quality of fishball, surimi and to develop products from surimi is required especially product suitable for local market or new product like immitation crabmeat. Demand for raw materials is inreasing, technology for pelagic fish is needed to be developed in order to inrease supply for minced fish factories. Minced fish technology has contributed to the industry the better incomes for fishermen, increasing employments, and the benefits to consumers.

INTRODUCTION

Minced fish can be obtained from various species, it opens opportunity for utilization of fish in various form and size. However, the characteristics of product destine the type of raw material used. For Asian, products of good elasticity are preferred, therefore, fish of good gel forming ability are chosen as raw material. In Thailand, when there is no technology developed, fish of good characteristic was used by only mixed with salt and seasoning such as chilli paste or vegetable. Types of raw material used have been changed as the result of shortage of raw material, elevation in price of certain species and demand from other products of higher value. Moreover, as the technology developed, opportunity in utilizing low valued marine fish are openned. Common species which can be used for minced fish products processing are

Spotted featherback (Notopterus chitala)
Barred spanish mackerel (Chirocentrus nudas)
Spotted spanish mackerel (Scomberomorus guttatus)
Black barracuda (Cyanoglossus macrolepidotus)
Ocean barracuda (Sphyraena picuda)
Yellow barracude (Syhyraena optusata)
Tongue sole (Cyanoglossus macrolepidotus)
Large head ribbon fish (Trichiurus haumera)
Japanese threadfin (Nemipterus japonicus)
Sixth tooth threadfin (Nemipterus hexodon)
Spotted finned bigeye (Priacanthus tayenus)
Spiny bigeye (Pseudopriacanthus niphodia)
Rough flathead (Grammoplites scaber)
Spotted flathead (Thysanophrys crocodilus)
Blackspotted trevally (Caranc leptolepis)
Lizard fish (Suarida sp.)

Presently, Spanish mackerel, barracuda and spotted featherback are used only maong restuarants and noodle shops. Fishball factories mostly use bigeye, ribbon fish and sole, other low value species such as flathead, and trevally would be their second option. Surimi factories would utilize the available threadfin bream and conger eel while bigeye and croaker would be their second option. Lizard fish is commonly utilized by fish satay plants.

Total production of those species are shown in Table 1. It can be observed that production of each species is stable but value is increasing. Price of spanish mackerel is level off, fishball processing factories could no longer effort the utilization, it is used for salted fish which is a high value products. Moreover, fish were utilized in other form such as dried salted, smoked and fermented, of which the demand is increasing due to increasing production for export. The growing of minced fish factories as well as increasing in number as processing technology developed were significant as well result in increasing demand for raw material. Fishball factories itself have increased the production capacity and number. Surimi factory increased substantially since 1981. The number of fishball factory and surimi factory from 1981-1987 is shown in Table 2.

TECHNOLOGY DEVELOPMENT

Development in minced fish technology in Thailand involves improvement of machinery to replace man power and development of new processing techniques and improve utilization of underutilized species as follows.

Mechanical fish deboner

The machine is required in preparing the mince in medium-large scale processing factories. At present there are 2 types of machine used.

1. Stamping type : the equipment was developed and produced in Thailand. High input-output capacity can be obtained but the flesh characteristic is inferior to the roller type deboner.

2. Japanese roller type deboner and Taiwanese deboner : this machine offer the better yield, flesh appearance, since the contact area between fish and the separation device is greater. Pressure also can be

adjusted. However, price is more expensive especially Japanese deboner.

Headed and gutted machine which is one of the nessessary equipment in minced fish processing factory has not been popular eventhough heading and gutting is labour intensive. This is due to the fact that labour cost for headed and gutted is low, the cost varies from 0.40 bahts to 0.50 bahts. Fillet fish are however, still demanded by fishball factories because cost for filleting is varied only between 1.25-2.00 bahts depending on species.

Processing techniques

Fishball, the popular minced fish products, is produced in the same principle of mixing fish with salt and ingredients, setting in warm water and cook in boiling water. Fillet fish are normally used in the mixture of barious species. Ingredients are salt of approximately 4 % monosodium glutamate 1 % pepper 1-3 %. Ice and vegetable. Unknown amount of $NaCO_3$ was sometime added. Starch of flour is added at various percentage from 5-20 % according to the end product required. Processing is done according to experience, and mostly under no form of weight control. As fish used are the common species which are known to have good gel forming ability. Processing techniques has not been developed but instrument were gradually replaced man power in the mixing stage and product forming. Fishball forming machine was developed, and was the only technical improvement for traditional fishball processing.

In 1980, The Fish processing Subdivision of the Fishery Technological Development Division by the support of IDRC seek for the possibiligy of using sorted by-catch as raw material for fishball. Together with that the leaching method modified from surimi production was introduced to improve gel forming ability of the raw material. Food additive such as polyphosphate of various typles were tried. New processing method (MFRD, 1980) were studied and recommended to the private industry. This method involves washing minced meat with diluted salt solution, controlled mixing time, sequential additional of ingredients and double step heating, The new method has shown to improve quality of fishball produced from sorted by-catch. Besides fishball various products using washed minced fish were developed and promoted such as fish finger, fish sausage.

Since 1983, the surimi technology are booming throughout the world. Surimi industry in Thailand has its starting point around 1970 with total production of only 5,000 tons/years. Surimi technology is a package of import technology compose of machinery, techniques and technologist.

The method was developed to suit the local species. Machinery used are from 2 sources; Japan and Taiwan which has different layout and different design for washing tanks. Refiner will gradually replace the strainer because strainer causing temperature elevation of 3-4° c. Polyphosplhates such as sodium polyphosphate, sodiumpyropospohate and sodium tripolyphosphate of 0.3 % are used. No polyphosphate surimi are also produced because of the demand of the market, however, it has short storage life. Quality control in the production line is of great importance.

Critical control point are as follow

1. Freshness and temperature of fish
2. Water-temperature
   - hardness
   - pH
   - metal content
   - Volume used.
3. time in washing
4. washed mince temperature
5. ingredients
6. Freezing and storage temperature
7. Plant sanitation

Product inspection

1. Gel strength
2. Whiteness

3. Imputities

4 Microbiology

Standard for the above items are set according to requirement of buyers.

Product development

Surimi is an intermediate products which can be used as raw material for various kind of products, in the process different quality can be obtained. Surimi is commonly devided into 3 grades AA, A and B according to its gel strength and colour, AA grade will have over 1,000 gm. cm, A : over 700, B : 500 - 700. Price varies according to the grade. High grade surimi are all exported, however, completitive market structure may force the utilization high grade surimi to value added products prior to export. Various kind of products were studied and introduced to producer and consumer such as fish finger, fish roll, fish noodle, fish wonton and fish sausage. However, no market testing was carried out.

FTDD are now working on product diversification based on technologies available by the Thai food processing industry. Among these, sausage and canned products have the best future, but marketing has to be done along with.

Surimi processing technology for pelagic fish, which are abandant, are developed, however lack of equipment retarded this development. Freshwater fish was also used in Surimi production in pilot scale.

Moreover, FTDD through the Analytical Research Subdivision will set up the pilot immitation crabmeat plant for research and development project, the facillities will latter be allowed to be used by private sector. The purpose of the project is to expand the production to mesh with the real production. Research and development using various species such as threadfin bream, jew fish, sardine and lizard fish will be carried out in depth, to get information to be utilized by the industry.

Future Development

Several topic in minced fish, surimi manufacturing and fabrication of minced fish and surimi based products need to be studied further. Research areas that require further study include.

- Development of proper storage system on board to preserve fresh fish and handling of fish on shore. CSW should be encourage to replace conventional ice storage system.
- Utilization of red meat fish in the form of minced fish product
- Product development from Surimi for local consumer
- Heat sterilization of surimi products
- Fabrication of Surimi products

SOCIOECONOMIC FACTOR

As statistics data for demand and supply of fish in minced fish business as well as data on labour and income are not available. The following section will be based on the interview data.

Minced fish factory has contributed to the fishery industry and social being in several views.

1. Increasing in price of raw material

According to FMO (1977-1986), mode auctioning price of fish has been increasing for almost 50 % especially threadfin bream, flatfish (See Table 2). In practice fish which was sold as trash fish are now gradually sorted out for surimi processing, price is increased from 1.50 baht to at least 3.50 bahts.

However, competition in procurement of raw material are occurred among surimi factories and cured fish processing factory.

2. Increasing labour

Labour was normally required in filleting house preparing raw material for fishball factory. When the surimi factory expanded to from 3 to 8 in central Thailand and another 3 in southern part. Number of labour for headed and gutted was estimated to increase from 350 people in 1980 to 1m200 people in 1987.

Not only in surimi factory, small scale factories producing dried minced sheet (fish satay) have significantly offerred job to labour in village and town the factories located. It is estimated by the owner of the fish satay that labour could earn varies from 2,000-4,000 bahts, according to their experience.

3. Consumer benefit

Consumer are offerred with better quality and safe products. Consumer usually have bad impression on minced fish and fishball on the type of fish used and ingredient especially the addition of borax in fishball. With new processing method, the product has no offensive fish odour and good elasticity by fish meat alone.

Fish mince could also be utilized in various form which offer the industry new oportunities and invention.

TECHNOLOGY TRANSFER

Since 1983 The Fishery Technological Development Division has been dilivered method on fishball production to all levels of fish processors through seminar and training. Technical assistance to processors are also provided upon request.

Transfer of technology are done in 3 levels

1. Food processors

Seminar and workshop have been conducted for food processors in the aim to introduce utilization of by-catch, new processing methods, equipment as well as quality control program.

2. Consumer

The workshop was carried out in the aim to train consumer how to utilize fish mince, preservation and product development. Workshop was carried out through both mobile training and pilot scale training.

3. Extention officer

Extention officer who will then approarch consumer in their responsible area was trained in the FTDD lab for 3-5 days. Training covers utilization and preservation of fish, minced fish processing is one of the topic discuss.

All training were done on not the regular program because of lack of staff and budget. The workshop and seminar were done under the technical project. Extention work especially mobile training and technical assistance were done through aid program.

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Table 1 Quantity and Value of selected marine species 1974-1984

Quantity : metricton
Value : 1,000 bahts.

Species		1974	1976	1978	1980	1982	1984
Threadfin bream	Q.	18,975	16,904	23,678	18,016	17,340	15,052
	V.	79,696	71,842	124,547	111,339	117,867	90,227
Monocle bream	Q.	4,630	3,555	191	635	5,877	1,292
	V.	10,186	10,132	818	4,204	79,561	6,626
Conger eel	Q.	1,822	2,306	3,472	2,651	2,141	1,559
	V.	6,194	10,147	18,749	17,921	19,890	10,127
Croaker	Q.	17,933	9,786	15,241	11,206	10,977	11,534
	V.	44,835	46,944	100,896	61,835	64,928	79,352
Bigeye	Q.	12,454	11,673	13,861	16,429	9,630	10,000
	V.	23,633	33,852	73,324	79,024	62,878	43,699
Lizard fish	Q.	12,160	10,644	12,592	10,273	8,614	9,723
	V.	26,753	28,208	47,220	52,803	40,916	35,597
Ribbon fish	Q.	5,542	6,316	8,353	5,987	5,150	3,660
	V.	16,071	19,895	39,677	31,072	27,333	21,348
Wolf herring	Q.	1,454	1,523	3,470	3,574	2,844	2,598
	V.	9,305	11,497	32,756	29,092	29,364	30,159
Mackerel	Q.	4,857	8,849	9,376	11,354	10,252	10,364
	V.	58,771	120,778	141,203	195,630	247,664	288,642
Barracuda	Q.	3,757	3,166	5,044	5,103	5,626	5,261
	V.	20,666	19,469	41,513	45,774	51,936	47,012
Flatfish	Q.	4,092	6,053	7,896	5,969	6,830	5,782
	V.	8,593	22,396	41,549	31,217	41,728	34,927
Scad	Q.	34,792	83,760	107,376	30,964	35,838	44,256
	V.	66,105	137,038	403,734	121,998	169,146	175,455
Trevallies	Q.	10,602	22,284	35,587	23,431	12,851	20,323
	V.	34,986	103,621	224,554	203,147	104,525	178,633
Sardinellas	Q.	58,222	105,622	145,278	105,413	116,898	117,323
	V.	58,222	213,333	408,419	314,131	418,810	352,939
Other food fish	Q.	82,041	81,875	98,897	84,381	84,505	95,291
	V.	336,368	317,061	517,864	478,878	436,423	535,220
Trash fish	Q.	690,270	620,646	847,421	786,853	812,789	757,637
	V.	690,270	682,711	1,271,132	1,447,818	1,529,226	1,555,038

Source : The Marine Fisheries Statistics, 1974-1984, Department of Fisheries

Table 2 Number of fishball and Surimi factories, 1981-1987

	1981	1983	1985	1987
Fishball factory[1.]	no record	117	139	-
Demand for raw material (ton/day)	-	37.87	36.5	-
Surimi factory[2.]	3	4	6	11
Demand for raw material				
- full capacity (ton/day)	100	125	225	400
- run 50 % capacity[3.]	50	62	112	200

Source : Department of Fisheries (1981-1986)

1. Department of Fisheries statistics and estimated figure for Bangkok area by SRG (1978)
2. survey data
3. at peak season (Sept-Dec.), big factory can take in raw material as much as 80 tons/day

Table 3. Price of outstanding fresh marine fish auctioned at Bangkok fish market, 1977-1986

(BAHT/Kg.)

Species		1977	1980	1982	1984	1986
	MIN	2	2	2	2	4
Hairtails	MAX	9	15	15	29	18
	MODE	4	8	12	12	13
	MIN	3	4	5	4	4
Wolf-Herrings	MAX	23	26	45	40	65
	MODE	12	14	23	18	17
	MIN	2	4	4	2	3
Trevallies	MAX	16	8	25	20	18
	MODE	7	12	14	12	12
	MIN	11	10	5	8	12
King mackerel	MAX	33	40	70	70	75
	MODE	24	24	35	45	50
	MIN	2	3	2	2	3
Croakers	MAX	17	18	22	23	30
	MODE	7	10	12	15	16
	MIN	2	2	2	2	3
Big-eyes	MAX	8	7	8	7	7
	MODE	4	6	5	5	6
	MIN	1	2	2	2	2
Monocle bream	MAX	5	5	10	16	10
	MODE	2	3	4	4	6
	MIN	2	3	3	3	3
Treadfin bream	MAX	19	12	18	18	18
	MODE	6	8	11	12	12

	MIN	2	2	2	2	2
Lizard fishes	MAX	6	7	8	8	9
	MODE	5	5	5	4	5
	MIN	2	3	3	3	4
Flatfishes	MAX	15	16	28	27	30
	MODE	7	8	17	20	20
	MIN	–	2	2	2	4
Scads	MAX	–	8	10	8	10
	MODE	–	6	7	5	7
	MIN	3	4	4	4	4
Conger eels	MAX	9	8	12	8	12
	MODE	6	6	10	6	10
	MIN	3	4	5	4	5
Barracuda	MAX	18	16	30	28	32
	MODE	10	12	20	20	25

Source : The Fish Marketing Organization Fisheries Record (1977-1986)

ANNEX E

Administrative Aspects

ADMINISTRATIVE ASPECTS

The project was administrated by the project coordinator under the guidance of the project adviser and leader. Project staffs are of the Fish Processing Subdivision, who help the coordinator in the efficiency test and laboratories work and of the Engineering Subdivision who assisted the Engineer from CIFT to install the equipment. Private sector, the fish agent in Samut Prakarn Fish Market aided in supplying the sorted by-catch for the experiment at the FTDD and industrial trial in Samut Prakarn area. The fishball factory in Samut Prakarn of Mr. Vannuk was chosen on the basis that he participated in the previous IDRC project on Fishball, he owns both filleting house and fishball factory which produce low grade fishball for low purchasing power group. The Fishball and Fish Satay factory of Ms. Julaiporn was chosen on the basis that the factory processed fishball using the leaching method (similar to Surimi process) and also produce other products (fish satay) which minced fish could be used in wider scope. The surimi manufacturers were interviewed in order to gain data on supply of fish since presently to sorted by-catch were also used by Surimi plant.

List of public personnel and private sector involved in the project are given below.

Project Leader	: Mr. Udom Sundaravipat
Project Adviser	: Mrs. Rerngrudee Pruthiarenun
Project Coordinator	: Ms. Sirilak Suwanrangsi

Project Staff :

1. Mr. Cherdsak Suthijit (Engineer)
2. Ms. Kisana Sapanpang (Food Technologist)
3. Ms. Niparat Sangkasarnchart (Temporary Technologist)
4. Mr. Panrap Krataitang (Mechanic)
5. Mr. Sutat Petchruchee (Workers)
6. Mr. Rangsan Ngamtrang (Driver)
7. Mr. Chackrit Pangsri (Driver)
8. Ms. Wipada Kasemsuk (Administration officer)
9. Ms. Sunitsa Srichareon (Administration officer)

Private sector :

1. Mr. Samsak Chatumpun
   Fish Agent at Samut Prakarn. Fish Market
2. Mr. Vannuk Kavintheerapap
3. Ms. Julaiporn Tawarntaweewang
   Fishball and Fish satay factory Manager, Samutsakarn
4. Mr. Saril Tahtubtiang, Kuaeng Pei San Food Products Co., Ltd, (Surimi and Canned seafood manufacturer)
5. Mr. Wichai Tawarntaweewang, Pacific Fish Processing Co.,Ltd. (Surimi and Fish Finger manufacturer
6. Mr. Saha Srisaqwakul , Lucky Food (Thai) (Surimi Manufacturer)

Project Title Fish deboner (CIFT/THAIALND) II

Centre File 3-P-86-1001-02 Financial Report

For Period (1) From 1 December 1986 to 31 August 1987

Item (2)	Budget	Actual Expenses Cash Expenses	Accured Expenses	Variance	Explanation of Variance
Salaries and Allowances					
Food Technologist (8 months 12 days)	36,000.00	24,363.84	-	11,636.16	Food Technologist was paid at the normal rate of Government (2965 ฿/m) Initially it was planned that Food Technologist can be hired for 12 months.
Research Expenses					
Fish Supplies	95,000.00	24,555.50	-	70,444.50	Fish used in experiment was in smaller than it was planned, moreover some factory didn't want to charge for labour cost or charge to very low rate.
Labour *	165,000.00	10,199.50	-	154,800.50	
Vehicles repair	45,000.00	43, 000.00	-	2,000.00	
Local travel					
vehicle Fuel and Oil	18,000.00	7,540.00	-	10,460.00	
Report and Publications	15,000.00	-	15,000.00	-	
Conference/Workshop	20,000.00	-	-	20,000.00	No workshop was held.
Equipment					
Computer and Software	92,700.00	-	92,700.00	-	Software will not be provided because price has gone up over the allocated budget which initially was very tight.
Less second allocation	-78,853.94	-	-	-78,853.94	
(First allocation)	407,846.06	109,658.84	107,700.00	190,487.22	

* Labour : includes cost for the stainless steel deboner stand made by the Engineering Subdivision of FTDD

SUBMITTED BY: (signature) Project Leader (signature) Institution's Finance Officer

Report No. 3

Project Title: Fish Deboner (CIFT/Thailand)
Centre File: 3-P-86-1001-02

CASH SUMMARY

A. Cash Receipt from IDRC:

Date Received	Amount (In Canadian Dollars)	Amount (In Local Currency)
11 Nov. 86	$ 21,700 CAD	407,846.06
TOTAL CASH RECEIPT	$ 21,700 CAD	407,846.06

B Add: Cash Receipt from Other Sources

Source*	
-	-
-	-
TOTAL CASH FROM OTHER SOURCES	

C. TOTAL CASH FROM ALL SOURCES (A+B) — 407,846.06

D. Less: Project Cash Expenses
Period Covered:

From	to	19	
1 Dec. 86	31 Aug.,	1987	109,658.84
TOTAL PROJECT CASH EXPENSES			

E. Cash Balance as at 31 Aug. 1987 (C-D) — 298,187.22

F. Less: Accrued Expenses
31 Aug. 87 to 31 Dec. 87 — 15,000.00

Estimated Expenses for next year
31 Dec. 87 to 31 Mar. 87 — 92,700.00

G. Estimated Cash Balance as at 31 Mar. 1987 (E-F) — 190,487.22

* Refers to cash receipt resulting from the IDRC-assisted activity (e.g. interest income, sale of research products)