W H I T E F I S H A U T H O R I T Y

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TECHNICAL REPORT NO. 166

Frozen at Sea Blue Whiting 'Surimi' Production Trials Tokyo, November 1978.

December 1978.

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WHITE FISH AUTHORITY
Industrial Development Unit

Technical Report No. 166 December, 1978.

Frozen at Sea Blue Whiting 'Surimi' Production Trials Tokyo - November 1978.

1. INTRODUCTION

Spring 1978 saw the successful production of Blue Whiting Surimi during the Stornoway processing trials conducted in conjunction with Nippon Suisan Kaisha of Japan (N.S.K.). The follow up marketing assessment by N.S.K., in Japan, proved blue whiting surimi to be highly acceptable, with one major exception, which was product made from frozen at sea (FAS) material. This has since become a major problem in any future development, due to the Japanese company initially rejecting all product made from frozen raw material out of hand, even though sample results appeared to be adequate to meet their specifications.

Due to the seasonal aspect of blue whiting (limiting catching to a period of approximately three months), commercial analysis showed that any future development in the U.K. would have to rely heavily on frozen raw material, therefore the reasons for the reluctance by the Japanese to accept F.A.S. material needed closer examination.

Arising out of the Marketing Assessment discussions held in Tokyo, attended by Senior W.F.A. personnel and interested potential U.K. investors, was the necessity to prove or disprove the point of disagreement, i.e. could acceptable quality Surimi be made from F.A.S. raw material.

Prior to this most recent visit to Japan the specific reasons for N.S.K.'s rejection of F.A.S. raw material were always vague and sometimes confusing, but it was always claimed to be based upon experiences with other species, particularly Alaska Pollack. On this visit however a clear definition of the problem was explained in simple terms as follows:-

Fish tissue is made up of two types of protein - salt-soluble protein and water soluble protein. Both of these are detrimental to the *Ashi of the finished product when Surimi is frozen. Therefore in order to counteract these affects (a) the water soluble protein is removed by the severe washing and screening during the process, and (b) the salt soluble protein is counteracted by adding the *sugars and polyphosphate before freezing. If the washed mince is frozen without the additives described the Kamaboko forming properties are destroyed. These factors are said to be applicable to all fish flesh but for some species for example Croaker, the action of freezing has a less detrimental effect.

In an attempt to resolve the impasse N.S.K. agreed to conduct further trials with F.A.S. Blue Whiting, this time at the Hachioji Laboratories of N.S.K. in Japan. N.S.K. also agreed to the participation of a W.F.A. observer. Subsequently a 1 tonne sample of Frozen at Sea Blue Whiting caught and handled under W.F.A. supervision was despatched to Japan for the trials. (Specific catch data etc. are given in Field Report No. 623 Voyage on the 'Defiance').

*Ashi - 'chewiness'

*Sugars - consist of pure sugar and sugar substitute SORBITOL

*Tan Pin - Standard basic Kamaboko test 'sausage'

Hachioji Trials

1. OBJECTIVES

1.1. To investigate the reasons behind N.S.K.'s reluctance to accept F.A.S. Blue Whiting as a raw Material for 'Surimi'.

1.2. To ensure processing and test procedures as used at the Stornoway trials were duplicated as far as possible, in the Hachioji trial.

1.3. To measure and record and difierent methods or other factors which might influence product results.

1.4. To record yields throughout the test procedures.

1.5. To obtain, if possible, projected 1979 price estimations for all grades of Surimi

2. HACHIOJI TRIALS PROGRAMME

2.1. Programme

On arrival at the N.S.K. Laboratories an initial discussion took place with the author, Takeshi Ebi (N.S.K.'s Senior Technologist at Stornoway) and Masahiro Makuta (Quality Assessment Technologist at Stornoway). The two technologists pinpointed to two major problems of colour and texture as being the critical areas to concentrate our attempts at improvement. Makuta had set out a provisional list of objectives for the trials team and after considerable discussion and amendment a final programme was agreed as follows:-

2.2 Test Procedure Objectives

To improve on past results it was decided to compare jointly the results using various

known techniques of improving whiteness, which was claimed to be the major problem with F.A.S. material produced at Stornoway. A further attempt to that at Stornoway of whitening by use of Mono-Glyceride as a re-agent was also agreed upon.

In order to establish the best method of preparation to achieve the optimum results it was decided to make Surimi from a series of hand prepared samples of Blue Whiting as follows:-

2.2.1. Sample 1 - nobbed and gutted including partial removal of backbone, as normally performed on Japanese factory ships, with angled head cut, Fig. 3, and 3 to 1 water wash.

2.2.2. Sample 2 - nobbed and gutted as at Stornoway with right angled head cut Fig. 2 and 3 to 1 water wash.

2.2.3. Sample 3 - skinned and boned single fillet with 3 to 1 water wash.

2.2.4. Sample 4 - as in sample 1 using factory ship style preparation with angle head cut and a 3 to 1 water wash. Samples of this batch were used to test the reaction of adding egg white when making tan-pin.

2.2.5. Sample 5 - as in sample 1 using factory ship style preparation, but with 5 to 1 water wash.

Tan pin samples were to be made from each of the test batches and assessed by the team for the best results. Subsequently the follow-up mini-plant tests were to be embarked upon. In making all the sample batches of Surimi the

moisture level was to be equalised to a level of 83% at press stage, to ensure accurate comparison.

2.2.6. Sample 6* - as in sample 1, using factory ship style preparation, nobbed and gutted with partial backbone removal with a 5 to 1 water wash.

2.2.7. Sample 7 - as sample 6 with a 3 to 1 water wash.

*Two Tan-pin samples to be made from the resulting Surimi, one with the Mono-Glyceride additive and one without.

2.3. Trials Equipment

The Mini Surimi Plant was about half capacity of the Stornoway system, with very little difference in design except for the wash tanks. These were a more efficient type of washer, more on the lines of a 'Z' blade mixer, being trough shaped and having very effective agitating blades. (Figure 1). All fish, prior to mincing/separating, were hand prepared by the trials team, the two significant styles of preparation are shown in Figures 2 and 3.

2.4. Additives

It was agreed that the additives for both the Surimi and Tan Pin would be as follows:

SURIMI	% LEVEL OF ADDITION BY WEIGHT
Sugar	4
'Sorbitol'	4
Polyphosphate	0.3
TAN PIN	
Nall	2.7
Corn Starch	3.0

NOTE (1)

The addition of the Mono-Glyceride 're-agent' to Sample 6 at a level of 0.3%.

NOTE (2)

Egg white was added to some fish from Sample 4 as was tried at Stornoway. The theory behind this test is based upon a known parasytical activity encountered in other species where jelly flesh is present(as with Blue Whiting). The parasite known as Myxosponidia, destroys fish tissue by enzyme activity, commencing upon death of the fish and most active at a temperature of 50°C. It is also known that with other species the addition of egg white counteracts this affect and so its use with Blue Whiting was re-tested.

3. RESULTS

3.1. In preparing the Surimi and subsequent Tin Pan samples using the various methods of preparation, all wholefish were defrosted in ambient temperatures overnight. Water was not used to assist defrosting as it was decided that this was unnecessary as the daily ambient was approximately 60°F. The fish were found to still retain some ice at the start of preparation but eased during handling a final temperature +4 to 6°C. General quality of all fish was not good in terms of texture and discolouration, the flesh showing typical signs of heavy bruising. As shown in Table 5& 6 the fish were of good size and most showed a good recovery of body weight after spawning.

3.2. Comparing the different preparation methods up to the mincing stage, showed no significant differences in whiteness except for a reasonable improvement from the skinless fillets. A short yield test was conducted to compare the difference of yield using

the 'Stornoway' style nobbing and the 'Japanese Mothership' methods of preparation. The results Table 1 showed that the removal of the backbone was almost exactly counteracted by the improved angled heading. The overall result showed an increase of 2% after bone separation for the improved 'Mothership' method. It should be noted however, that the Japanese stated that using a machine for this style of preparation would not give such a marked improvement.

TABLE 1

YIELD COMPARISON

	HAND PREPARED MOTHERSHIP STYLE (WITHOUT BACKBONE)		HAND PREPARED STORNOWAY STYLE (WITH BACKBONE)		
WHOLEFISH	5.0	Kgm	5.0	Kgm	
to	56.4%		57%		
NOBBED	2.82	Kgm	2.85	Kgm	
to	78.7%		74.4%		
DEBONED MINCE	2.22	Kgm	2.12	Kgm	
	44.4% yield				42.4% yield

3.3. After carrying out the various preparation tests the miniplant trial was jointly agreed to using the 'Mothership' style preparation and the increased 5 to 1 wash ratio, this was hoped to give the most favourable results. Observing the mince washing stages, it was immediately apparent based upon past expereinces, that the soluble proteins were not 'washing out' and subsequently the discolouration remained. After final washing had taken place the mince showed no significant improvement in colour to that at the start of the process. Subsequent dehydrated mince or press cake was of extremely low quality in terms of colour and it was noticeable that even the refiner waste was of comparable colour to the press-cake.

3.4. Following these disappointing results, an alternative trial, incorporating less washing (3-1 as Stornoway) was abandoned. The full Tan Pin test results are shown in Table 4.

3.5. The Japanese technicians, commenting on the poor colour achieved, referred to similar experiences

encountered with most other species when the raw material had been frozen and stored for any length of time. To illustrate the effect of frozen storage time, some test results achieved with other species were obtainedas follows:

TABLE 2

FROZEN ALASKA POLLACK

STORAGE	TYPE	TEXTURE	BENDING	JELLY STRENGTH
0 Months (Soon after freezing)	R	6	7	496
	R	6	7	475
	D	7	7	420
	F	5	7	456
	M	6	7	536
	R	4	5	366
1 Month	R	4	6	489
	R	3	6	370
	D	3-4	6	395
	F	3-4	6	340
	M	3	6	423
	R	3	6	386
3 Months	R	4	6	396
	R	3-4	6	500
	D	2	5	413
	F	3	5	406
	M	2	5	325
	R	3	6	443
6 Months	R	3-4	6	460
	R	4	6	379
	D	3	5	448
	F	3	5	409
	M	2	5	457
	R	3	6	494

R : ROUND (Wholefish)

D : DRESSED

F : FILLET

M : MINCED

TABLE 2 cont.

CROAKER (FROM URUGUAY)

	TEXTURE	BENDING	JELLY STRENGTH
1 FRESH	7	7	500-700
2 AFTER 6 MONTHS FROZEN STORAGE	4	4.5	340

CROAKER (GULF OF MEXICO)

3 FRESH	7	7	500-600
4 AFTER 7 DAYS FRESH STORAGE	7	7	580

During the follow up discussions in which sensory assessment of the trial samples were carried out along with samples made from frozen Surimi made at Stornoway, and stored for approximately 6 months, the results showed the trial material was very poor compared to the Stornoway-produced product. Mr. S. Kinoshita of N.S.K.'s sales division, having sampled the Hachioji produced product, confirmed that N.S.K. had no desire to import any product with such a low quality rating, but confirmed conversely that a good Blue Whiting product could eventually become highly prized in Japan.

3.6. Pricing

The current wholesale market price structure was as follows:-

GRADES		PRICE/KILO (YEN)	
SPECIAL		390	
A	FACTORY SHIP GRADES	370	
A		170	
FIRST	LAND PRODUCED GRADES	200	- (normally produced to requirement)
SECOND		180	
*THIRD		100	

* CLASSED BY N.S.K. AS BEING OUT OF GRADE - ONLY SUITABLE FOR VERY LOW QUALITY PRODUCTS OF FISH CAKE

This price structure was estimated to remain stable for the major part of the coming year due to the very large stocks of material.

4. CONCLUSIONS

4.1. The situation regarding the use of F.A.S. Blue Whiting for Surimi, would now appear to be impractical. The current high level of Surimi stocks in Japan indicate that material produced from F.A.S. raw material would not find a market at present.

To become economically viable to produce surimi in the U.K. the position would seem to have to alter in one of the following ways:

A marked change in demand for lower quality Surimi.

The availability of fresh Blue Whiting all year round.

Alternative markets for Blue Whiting press-cake/Surimi being established.

New technology being applied enabling the successful production of Surimi from F.A.S. material.

In short, surimi produced from Blue Whiting remains a long term development prospect.

4.2. The trials of Hachioji were conducted with extreme determination, on behalf of both N.S.K. and W.F.A., in an effort to produce sucessful end results. Unfortunately the entire range of samples, incorporating the various techniques used to improve whiteness and texture, produced negative results. In fact in terms of texture and whiteness

alone the Tan-Pin samples produced were of the lowest quality produced yet with White Fish Authority involvement.

4.3. The N.S.K. technicians were disappointed with the results but not unduly surprised pointing out the similar results obtained with other fish including Alaska Pollack and Croaker, when the raw material had been stored for any significant period. So emerged, what appears to be a positive relationship between the Surimi-making properties of Blue Whiting and the length of frozen storage time. The material used in the Hachioji trials had been stored for approximately 6 months.

4.4. During this visit it became evident to the author that Blue Whiting Surimi made from fresh raw material has very special properties in the eyes of the Japanese and the resultant Kamaboko would rank something of an elite product. This theory was acknowledged when put to several of the N.S.K. experts. Therefore considering the potential market of such a superior product, it would be extremely beneficial to retain the superior image by not exporting any second grade material to Japan. By maintaining the highest quality level in such a manner a new price maximum might well be created and hopefully sustained. So examining the situation simply from a marketing viewpoint it would be better to only export Surimi made from fresh material and subsequently demand a higher price.

TABLE 3

Results of Surimi made from F.A.S. Blue Whiting

SAMPLE		NO. 1	NO. 2	NO. 3	NO. 4	NO. 5	NO.6
WHOLEFISH	Kg	15.10	13.00	10.00	10.00	10.00	87.10
FILLET	Kg	N/A	7.10	3.46	4.80	5.00	49.70
MINCE	Kg	4.30	4.75	3.46	3.10	3.50	37.10
WASH WATER		3 to 1	3 to 1	3 to 1	3 to 1	5 to 1	5 to 1
PRESS CAKE	Kg	3.64	3.23	2.80	1.66	2.09	23.30
PRESS CAKE MOISTURE %		84.00	85.10	85.70	77.40	79.80	81.70
PRESS CAKE 'EQUALISED' TO 83% BY CALCULATION Kg		3.42	2.83	2.35	2.21	2.48	25.00
* % YIELD		22.60	21.80	23.50	22.10	24.80	28.70
WASTE FROM REFINER %		-	-	-	-	-	14.7

TABLE 4

Tan-Pin Results Achieved from Tokyo Produced Surimi and Selected Stornoway Produced Surimi

SAMPLE	MOISTURE	JELLY STRENGTH	BENDING	TEXTURE	COLOUR	WHITENESS
NO 1	76.1	383	5	5	2.5	46
NO 2	76.6	325	2	3	2.5	44.9
NO 3	78.4	320	3.5	4	3	51
NO 4	77.2	343	2	3	2	43.2
NO 5	76.6.	405	3.5	4	2.5	45.3
NO 6 G.	77.4	294	1.5	2	3	49
NO 6	77.1	298	1.5	2	2.7	47
CODE 420	77.2	567	6.5	6.5	6.5	57.5
CODE 504	76.5	675	5.5	5	5	52.1
CODE 512	75.0	684	5.5	5	5	49.1
CODE 512 WITH EGGWHITE	75.2	855	5	4	5	51.8
CODE 531	76.8	585	6	6	5.5	52.5

KEY:

420 STORNOWAY BOXED AND ICED PRODUCT

512, 504 STORNOWAY F.A.S. PRODUCT

531 STORNOWAY R.F.W. PRODUCT

NO. 6 G WITH MONO GLYCERIDE.

TABLE 5

Body Length and Weight of Blue Whiting

NO	WEIGHT	LENGTH	NO	WEIGHT	LENGTH
	gms	mm		gms	mm
1	80	256	26	122	281
2	86	257	27	122	305
3	89	259	28	123	316
4	90	268	29	126	320
5	92	263	30	129	316
6	93	274	31	129	297
7	98	288	32	130	298
8	100	267	33	130	312
9	101	284	34	132	302
10	104	282	35	133	312
11	106	299	36	134	312
12	108	304	37	135	296
13	108	302	38	135	298
14	109	293	39	142	315
15	109	281	40	143	312
16	110	292	41	146	331
17	111	296	42	150	323
18	112	291	43	153	311
19	112	274	44	153	317
20	112	294	45	154	330
21	116	289	46	158	330
22	119	286	47	164	332
23	120	306	48	165	313
24	120	315	49	171	337
25	121	306	50	180	337
			mean	123.7 gms	299.6 mm

Table 6

Histogram of weight of B/W used in Tokyo

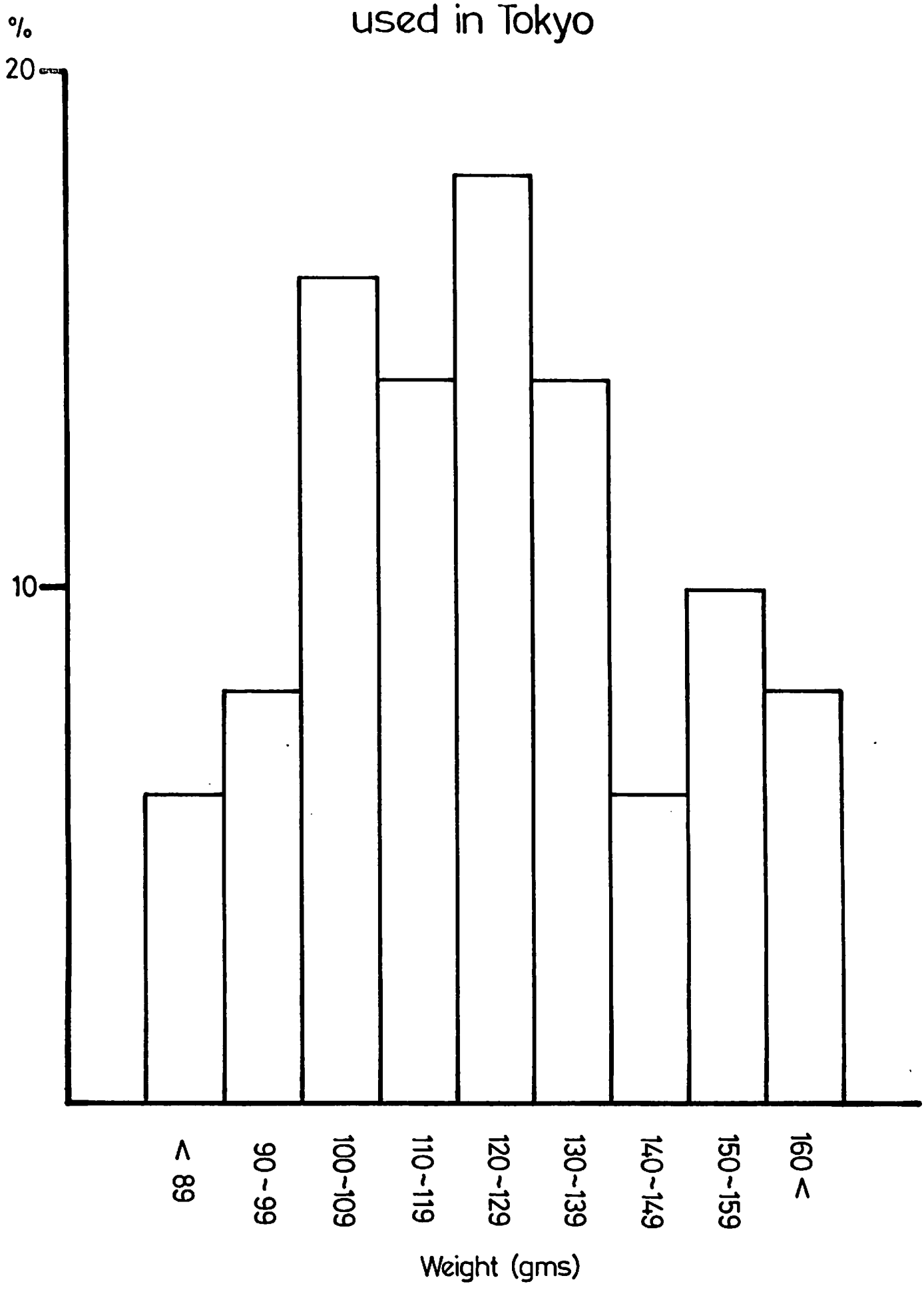
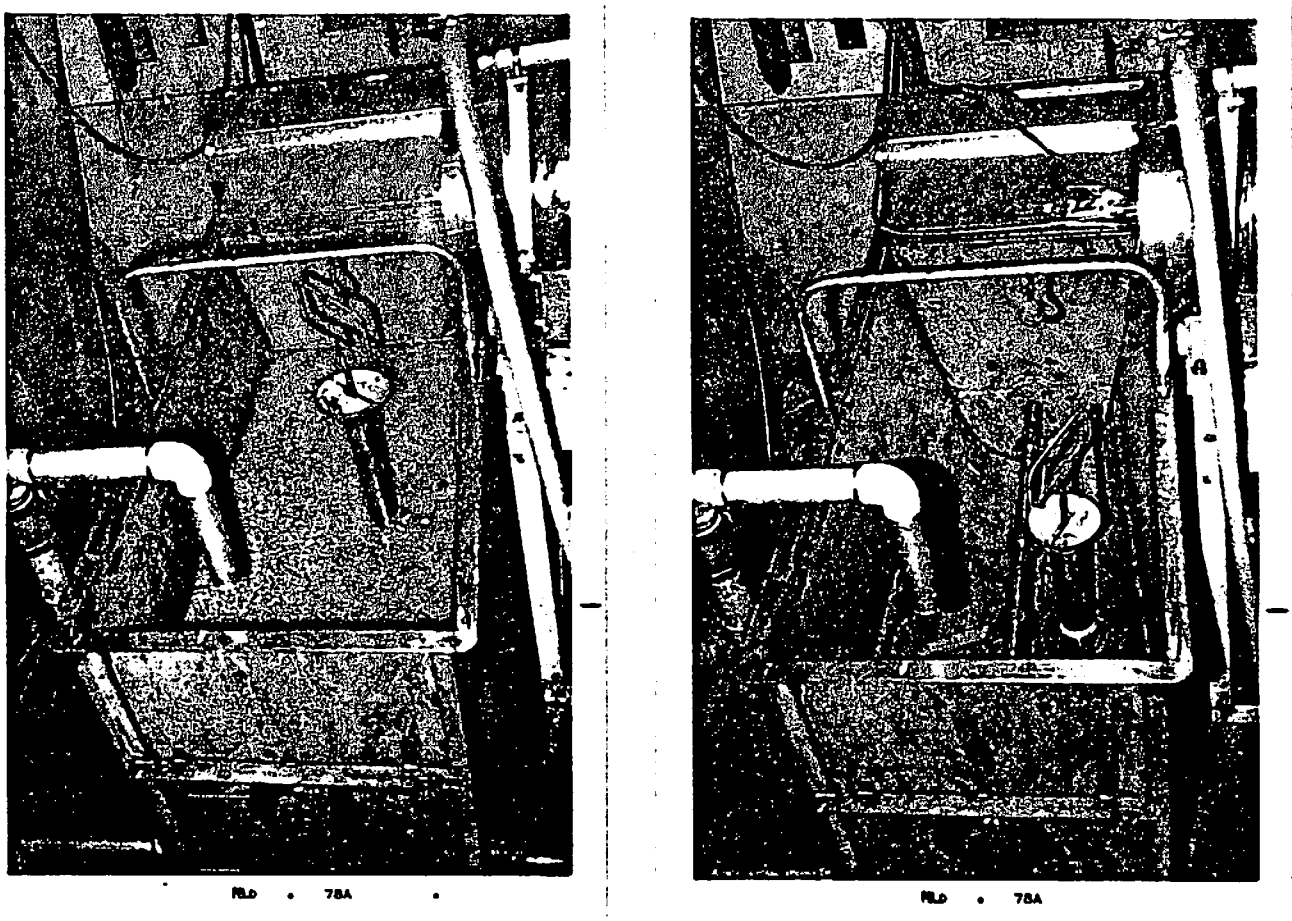


FIGURE 1



SURIMI PROCESS WASH TANKS USED AT THE HACHIOJI TRIALS. THE VIEW ON THE RIGHT CLEARLY SHOWS THE EFFECTIVE 'PADDLE' ARRANGEMENT THAT WAS HOPED WOULD IMPROVE THE WASHING RESULTS.

FIGURE 2

HAND PREPARED B/W AT HACHIOJI
'STORNOWAY-ARENCO' STYLE.

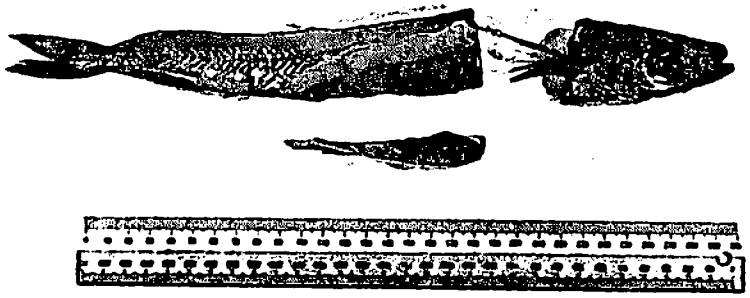


FIGURE 3

HAND PREPARED B/W AT HACHIOJI
AS 'MOTHERSHIP' AL./POLLACK.

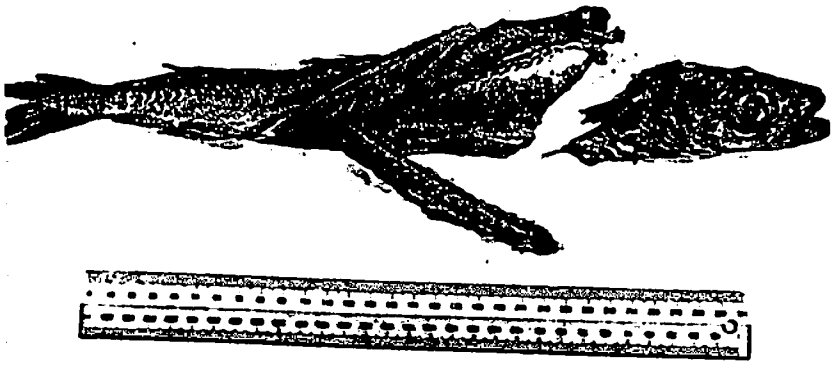
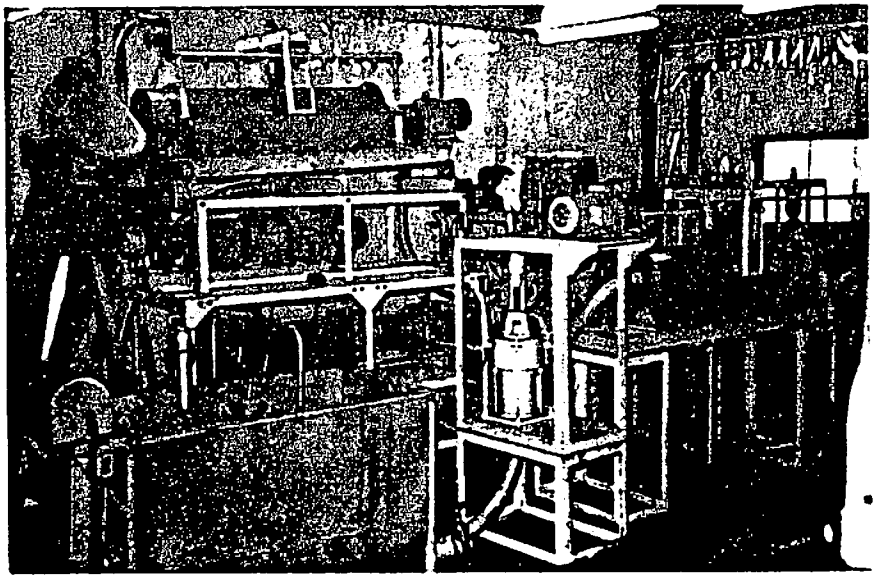


Figure 4.



GENERAL VIEW OF THE HACHIOJI 'MINI PLANT'

APPENDIX I

Visit to Toyo Suisan Ltd.

1. INTRODUCTION

The opportunity was taken to visit the manufacturing premises of Toyo Suisan Ltd., at Osaka by arrangement through N.S.K. Toyo, one of the two major filleting machine manufacturers in Japan, were given a few blocks of Blue Whiting and a subsequent machine trial was arranged.

2. OSAKA

On arrival at Toyo T. Ebi and I were met by the M.D. Mr. Matsubayashi and Senior Technician, Mr. H. Suzuki and after the general discussions about Toyo's range of machines we were shown a specially prepared area with the proposed trial machine. It was decided that we would process the defrosted (ambient thawed) Blue Whiting both 'Mothership' style and 'Stornoway' style, but in both instances the head cut would be angled.

3. MACHINE DESCRIPTION

The general overall appearnce was similar to the familiar Arenco CIS/CIF line and the right angled heading section layout was also similar. The machine on demonstration was normally used for mackerel type fish and it was explained that the heading transfer was obviously far too large for Blue Whiting. Owing to the short notice given for the demonstration of less than one week modification on this scale was not possible. However, small modifications were made to the filleting unit, but most adaptation was confined to adjustment of the existing guides etc. The machine was claimed to operate at 150 fish/minute.

4. PERFORMANCE AND YIELDS

4.1. Operation

The fish are fed in to the machine in the same manner as for an Arenco and Baader nobbing unit. The heads are removed with an angled cut

using a simple 'stop' which tilts the heads as they enter the blade. (Figure 6). Once headed the fish transfer to the 'filleting' unit by dropping into a 'V' slot and are then picked up by the familiar rubber belts (as on Arenco machine's) which carry the fish through the knives. Stone 'knives' were used for the belly cavity as nylon brushes, not normally used, were not available. When producing the Stornoway style nobbed fish a set of knives were taken off so leaving the backbone intact.

4.2. Performance

The machine operated remarkably well on both styles of product and the technicians claimed that given more time a first class result would be no problem, singling out the obvious oversized transfer slot as being the main alteration required. (Figure 7). Showing me a Sardine unit, the technicians stated that a Blue Whiting unit would be of similar proportions, (Figure 5). Later discussions centred about availability of a Blue Whiting machine and price. A period of 3 months notice would be required for Toyo to produce a Blue Whtiing machine, stated Mr. Matsubayashi and a figure of Y380,000 ex. works was the current estimated price. Plus 15% for an F.O.B. figure. The obvious comparison to an Arenco unit would make the Japanese equipment about half price.

4.3. Yields

TEST	FISH COUNT	RAW WT. Kgm	FINISHED WT. Kgm	% YIELD
1	50	6.45	3.65	56.58
2	50	7.00	4.26	60.85
3	50	6.20	3.85	62.09

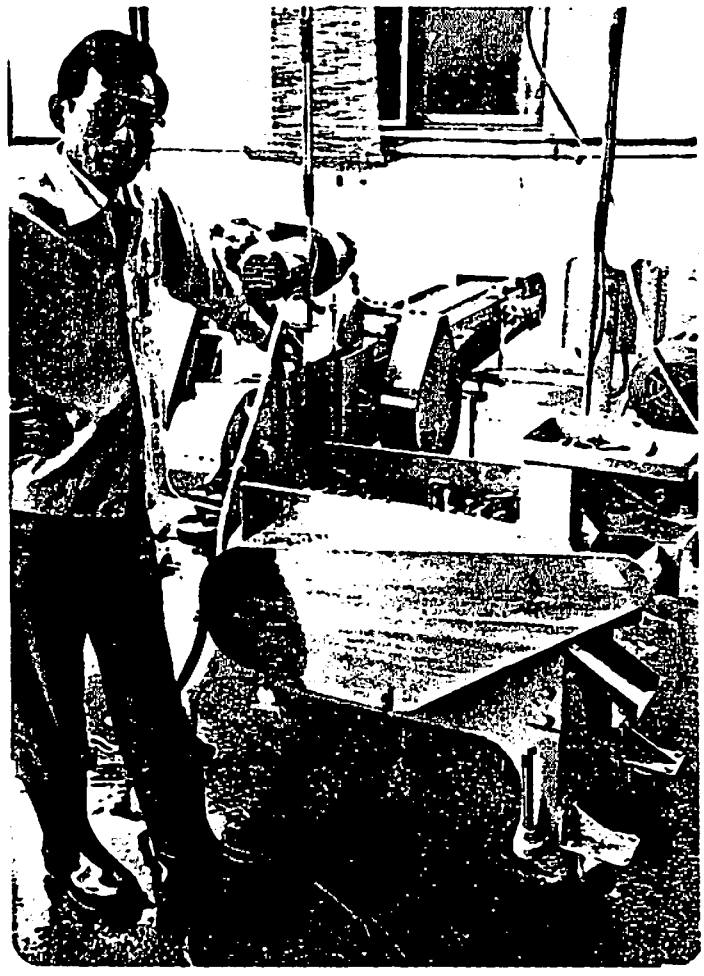
1. 'Mothership' Method (Partial Backbone Removal)
2. 'Stornoway' Method (With Flank Knives
3. 'Stornoway' Method (Without Flank Knives)

** Approx. Comparable Yields at Stornoway on Arenco = 51.52%

Toyo Suisan supply all N.S.K.'s needs of 'filleting' equipment both for shore based and sea going plants. A selection of brochures were brought back to U.K. showing equipment they manufacture, covering a range from Sardines to Horse Mackerel to Eels. The main advantages of looking at using Japanese made equipment seem to be a particular expertise which they have developed for processing of small and difficult species and a financial advantage compared to other European manufactured equipment currently available.

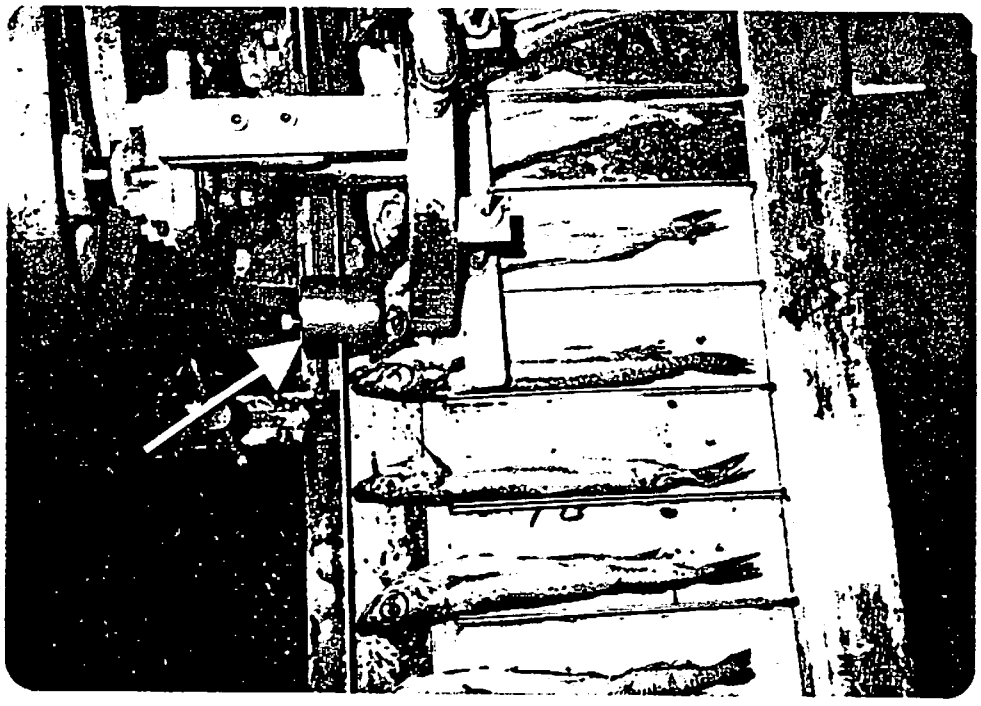
P. TIFFNEY
Processing & Marketing Devel. Officer

FIGURE 5



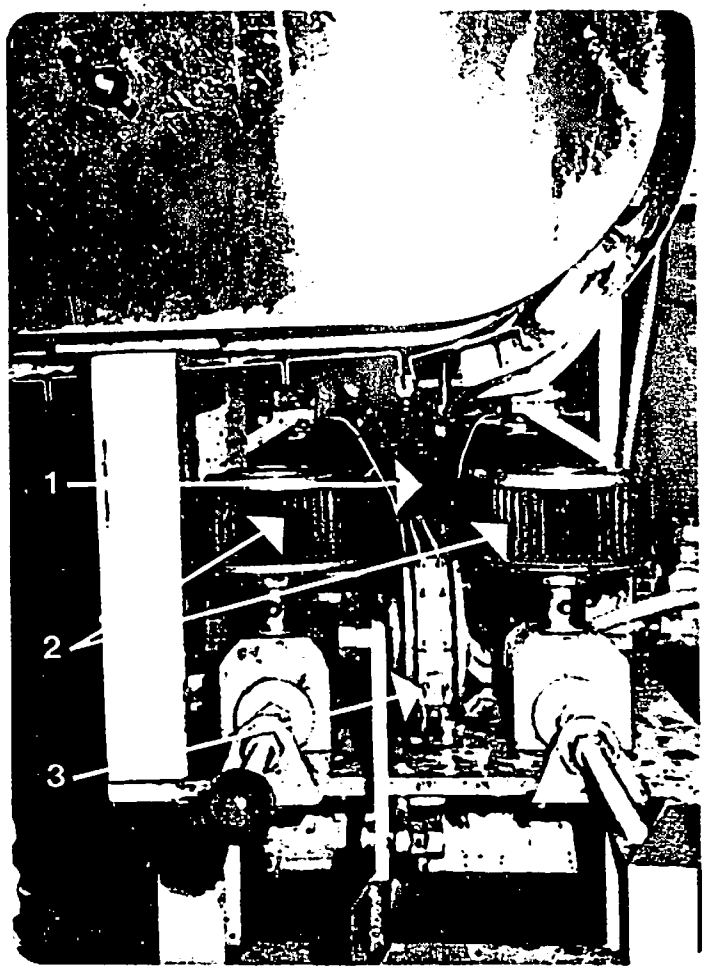
TOYO SUISAN 'FILLETING' UNIT OF COMPARABLE SIZE TO A BLUE WHITING UNIT

FIGURE 6



SEVERING SECTION OF THE TOYO TRIALS MACHINE. THE SIMPLE ANGLED HEADING 'STOP' IS ARROWED.

FIGURE 7



VIEW OF THE TOYO 'FILLETING' UNIT SHOWING THE TRANSFER SECTION AFTER HEADING (1). THE RUBBER GUIDE BELTS (2) AND THE TWIN SPIKED CARRIER BELT (3) ALSO VISIBLE.