Southeast Asian Fisheries Development Center
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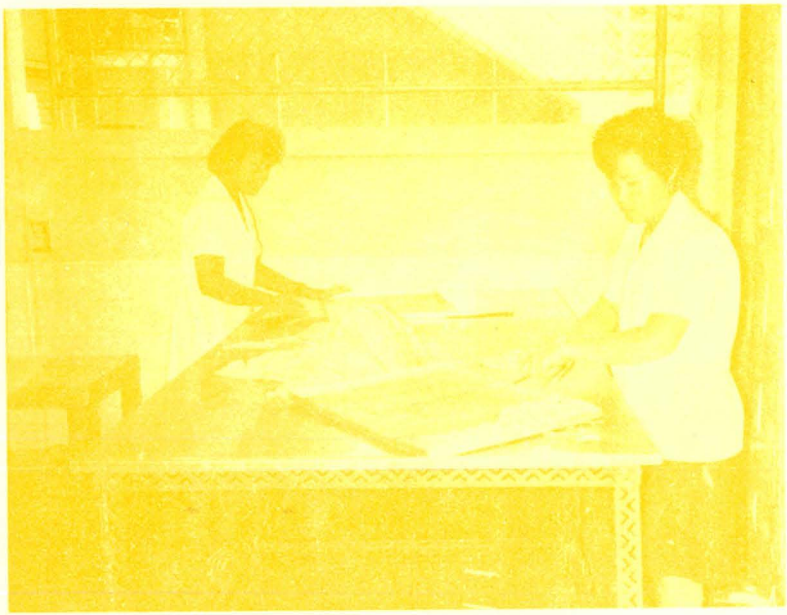
FISH NOODLES



by

Bent R. Jenser

SEC/SM/33 SAFIS Manual No. 33

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This manual was prepared by Mr. Bent R. Jenser while serving as an Associate Expert (Product Development) for the Food and Agriculture Organizations of the United Nations (FAO) Regional Office for Asia and the Pacific in Bangkok, Thailand. The research was actually conducted at the Institute of Food Research and Product Development on the campus of Kasetsart University, Bangkok.

SAFIS wishes to express sincere appreciation to Mr. Jenser for preparing the text of this manual, and to Mr. V. Picteresz and Mr. David James for their cooperation in the arrangements for printing this brochure as a SAFIS Extension Manual.

CONTENTS

1. INTRODUCTION

This study is concerned with the making of fish noodles using sardine mince in combination with wheat flour. However, cheaper products might be achieved if fish mince is added to other cereals/ vegetables, e.g. to rice noodles or mung bean noodles.

Fish proteins have a high biological value. Especially because the content of the amino acid lysine is high. As cereal proteins usually have a low content of this amino acid, a combination of fish and cereal in the diet will improve the biological value of the proteins in the latter. Moreover, marine fish are the richest source of iodine and a good source of flouride. (DAVIDSON *et al.*,1979; HUSS, 1983).

In fish noodles, comminuted fish (fish mince) is added to the wheat flour. The fish mince is usually obtained from a mechanical deboner and so under-utilized fish species, e.g. trawler by-catch, small pelagic species, etc., can be used. These fish species sell at the lowest market price and thus raw material costs will be low. Also dried, minced fish such as RDF (Roller-Dried Fish) and FPC (Fish Protein Concentrate) may be used; however, drying costs will have to be added to the raw material costs.

Previous studies on fish noodles have been done by PRUTHIARENUN & SETABRAHAMANA (1978) and SRISAVAT *et al.* (1980). In both studies mince from threadfin bream *(Nemipteridae)* was used in combination with wheat flour. In the former

study the authors found that up to 35% of the wheat flour could be substituted with fish mince, while in the latter study 17.1%, 22.3% and 31.8%, respectively, of fish mince was added. The most acceptable product in the latter study contained 17.1% fish mince.

Finally, another kind of fish noodle exists on the local market. The texture is similar to the texture in fish balls, and, as in the fish balls, flour is only added as a processing aid (PARAMADILOK *et al.*, 1981).

2. NUTRITIONAL ASPECTS OF FISH NOODLES

As mentioned above, the biological value of fish proteins is high. This is due to the amount and composition of the essential amino acids in the proteins. One method to estimate the value of the proteins is to calculate the chemical score. In this method the amount of the essential amino acids is compared to the amount of the same amino acids in a reference protein which has an optimum composition (DAVIDSON *et al.*, 1979). In table 2.1 the amino acid composition of selected fish species and cereals is given together with the amino acid composition of the FAO/WHO recommended reference protein.

As can be seen from the table, the high lysine content in the fish would supplement very well the low lysine content in wheat flour and in the rice noodles.

Table 2.1 Essential amino acids and chemical score of selected foods[1]) (mg N/g N).

amino acid	Wheat flour (80-90% extraction)	dried rice noodles	anchovy	herring	sardine	FAO ref. protein
Isoleucine	220	261	338	290	371	250
Leucine	361	532	568	560	575	440
Lysine	170	203	598	620	680	340
Methionine/ Cystine	96 n.a.	334	291	290	290	220
Phenylalanine/ Thyrosine	266 n.a.	442	532	460	563	380
Threonine	204	171	321	320	346	250
Tryptophan	72	217	83	61	80	65
Valine	268	361	366	370	458	310
Chemical score	50	60	[2])	94	[2])	100
Limiting amino acid	Lysine	Lysine	-	Trypto-phan	-	-

n.a. = not available. [2]) The chemical score exceeds 100.

[1]) From FAO/WHO Food Composition Tables for use in East Asia. 1972.

Table 2.2 shows the chemical score of different combinations of wheat flour and sardine. The chemical score is calculated using the data from table 2.1. Table 2.2 also shows the percentage of sardine mince to be used instead of wheat flour to increase the chemical score to the value shown in the table. The amount of sardine mince is based on a protein content of 12% for wheat flour and 18% for sardine mince.

As shown in table 2.2, approximately 25% of the wheat flour should be substituted with sardine mince to have a chemical score close to 100.

Table 2.2 Chemical score of combinations of wheat flour and sardine mince,

amino acid	ref. protein	Wheat flour protein to sardine mince protein ratio					
		100:0	90:10	80:20	75:25	70:30	65:35
Isoleucine	250	220	235	250	258	265	273
Leucine	440	361	382	404	415	425	436
Lysine	340	170	221	272	298	323	349
Methionine/ Cystine	220	96 n.a.	115	135	145	154	165
Phenylalanine/ Tyrosine	380	266 n.a.	295	325	340	355	370
Threonine	250	204	218	232	240	247	254
Ttyptophan	65	72	73	74	74	74	75
Valine	310	268	287	306	316	325	335
Chemical score	100	50	65	80	88	95	99
Limiting amino acid	-	Lys	Lys	Lys	Lys	Lys	Leu
mince in flour	-	0%	7%	14%	18%	22%	26%

n.a. = not available

3. METHOD

In figure 3.1 is shown a flow diagram for the making of fish noodles. As mentioned above, this study is based on the use of sardine mince but any fish species may be used. The freezing and thawing step is not necessary, but as fish quality and supplies vary with the season and the weather, frozen storage or fish mince might be unavoidable. In this study frozen mince was used, as mince and noodles could not be prepared on the same day.

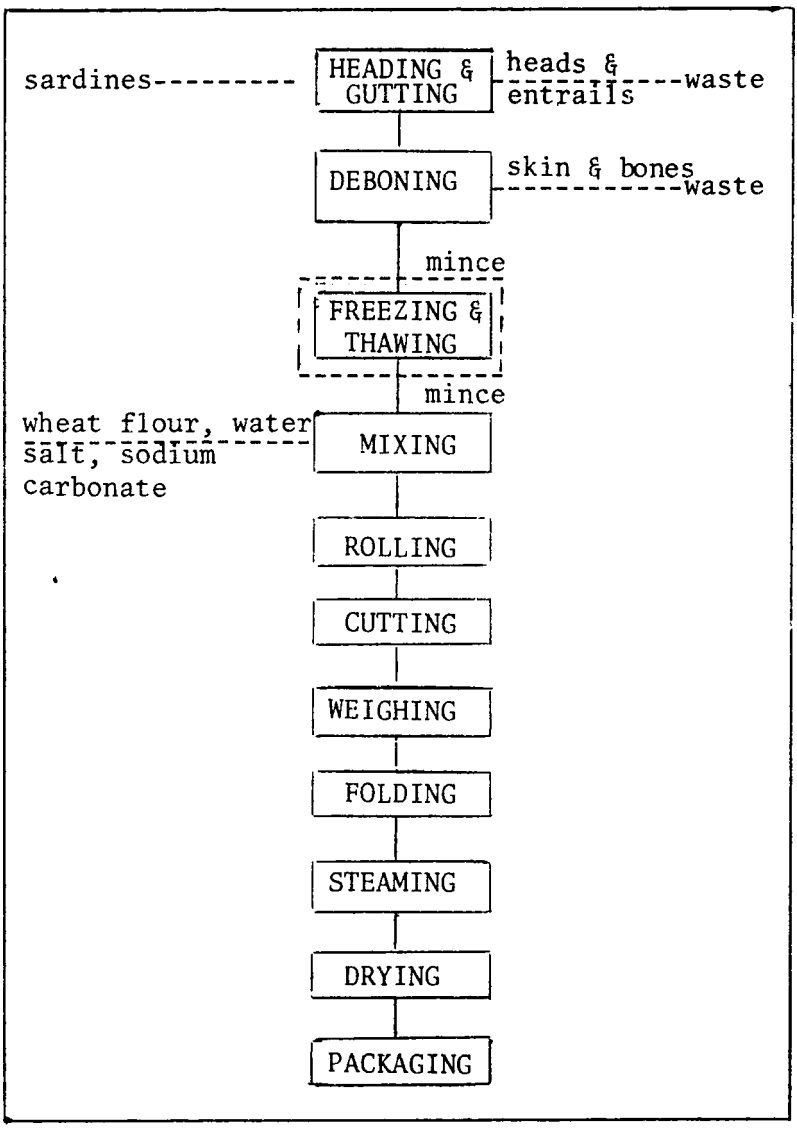
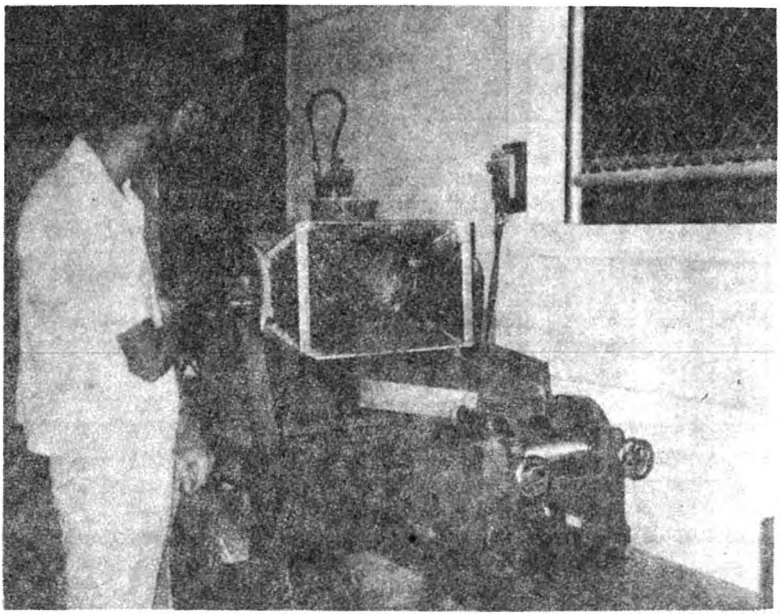
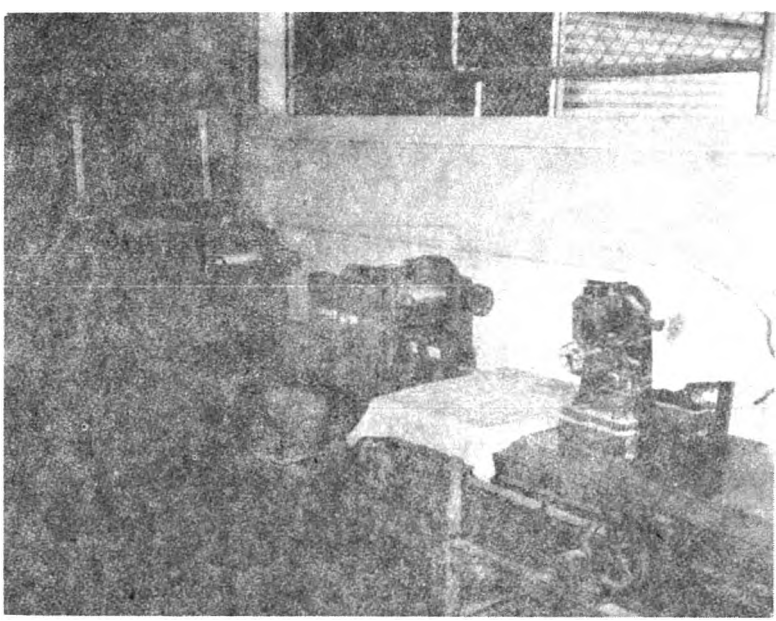


Fig. 3.1 Flow diagram for the fish noodle process. The freezing & thawing step can be avoided if the process is made continuous



Author standing beside the fish noodle machine



Fish noodle apparatus

3.1 Apparatus

A BIBUN SDX 13 meat separator equipped with a 1.2 mm double screen is used for deboning the headed and gutted sardines. The double screen is used for obtaining a mince that contains very few remnants of bones and skin.

The noodle plant (figure 3.2) consists of a mixer and three pairs of rollers of which the last pair is equipped with a cutter when the noodle sheets are cut into strands. The capacity is 10 kg per batch.

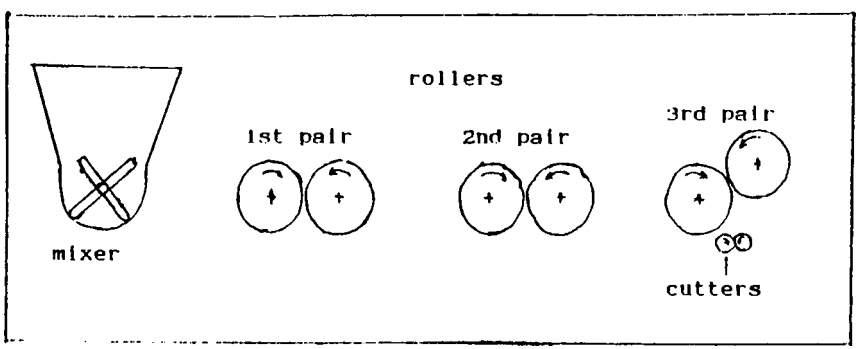
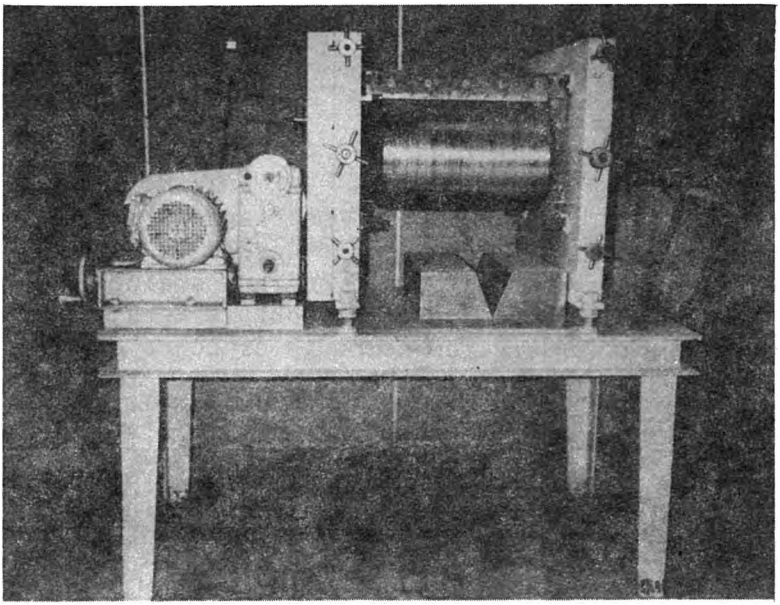


Fig. 3.2 A sketch of the noodle plant.

The folding of the noodles is done by hand. The noodle strands are placed on trays of wire gauze and steamed before drying in a cabinet dryer.



Rolling machine

Folding of the noodles by hand

3.2 Summary of production method

Table 3.1 Lists of ingredients from different experiments.

SOURCE---> INGREDIENTS (%)	PRUTHIARENUN & SETABRAHAMANA, 1978	SRISAVAT *et al.* 1980		JENSEN 1985
Wheat flour	61.1	68.2	58.0	66.1
fish mince	36.7	17.1	17.1	22.0
water		12.7	12.7	8.8
sodium chloride	1.0	1.3	1.3	1.8
sodium carbonate	1.0	0.3[1]	0.3[1]	1.3
phosphate	0.3[2]	0.3[3]	0.3[3]	-
cassava flour	-	-	10.2	-
C.M.C. V-1500[4]	-	0.1	0.1	-

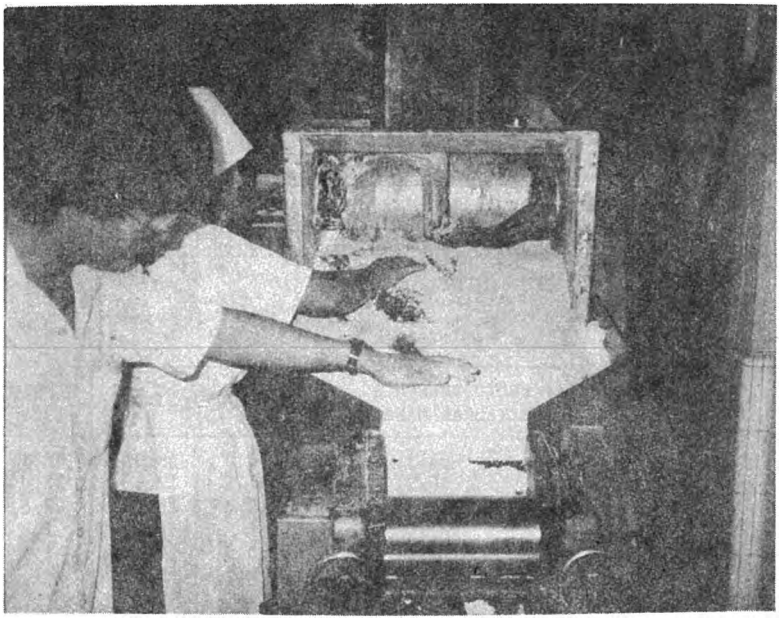
[1]) sodium bicarbonate; [2]) potassium pyrophosphate;

[3]) B-25· 0.2% and Accord· 0.1%, both consists of sodium tripolyphosphate and hexa-metaphosphate. [4]) carboxy methyl cellulose.

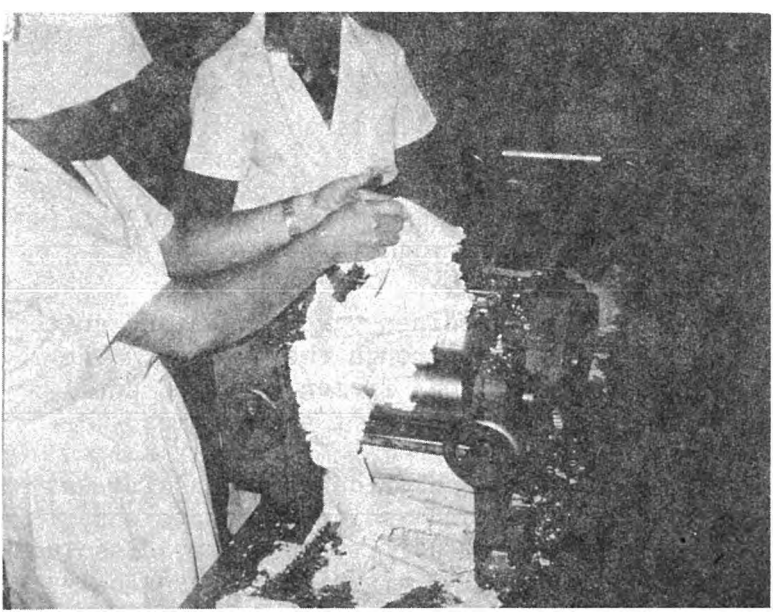
In table 3.1 is shown the list of ingredients for the making of fish noodles, together with lists of ingredients from previous experiments by PRUTHIARENUN & SETABRAHAMANA (1978) and SRISAVAT *et al.* (1980).

The sardines were headed and gutted before being passed through the deboner. The mince obtained was kept frozen at -18°C until the day of the production of the noodles.

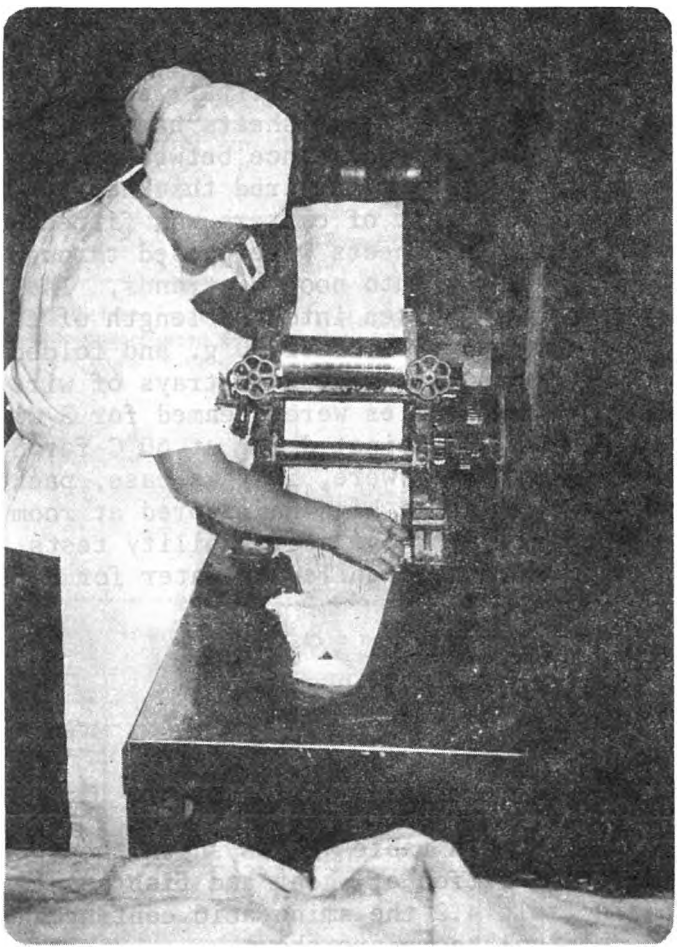
Sodium chloride (common salt) was dissolved in water and sodium carbonate was, due to its slight solubility in water, dissolved in the thawed mince. This mixture was slowly added to the wheat flour while mixing. Further



After mixing, the dough is prepared by the first pair of rollers



The dough is kneaded and made into sheet in the second pair of rollers



The sheets are cut into strands

mixing was done for 5 to 10 minutes after the mixture had been added. Then the dough was prepared by passing it through the first pair of rollers, and made into sheets in the second pair of rollers. The sheets were faced together and passed through the last pair of rollers several times until the sheets had a smooth surface. Then the distance between the rolers was decreased to the desired thickness (approx. 1 mm) and the pair of cutters was fitted on. Afterwards, the sheets were passed through the rollers and cut into noodle strands. These strands, were broken into the length of ca. 50 cm, weighed in lots of 70 g. and folded into bundles which were placed on trays of wire gauze. Finally, the noodles were steamed for 5 min. and dried in a cabinet drier at 60°C for 8 hours. The dried noodles were, in this case, packed in bulk in plastic bags and stored at room temperature. For the acceptability tests these noodles were boiled in water for 8-10 min.

4. RESULTS

4.1 Chemical analyses

In table 4.1 is shown the approximate composition of wheat and fish noodles; and in table 4.2 the amino acid content and the chemical score are shown.

Table 4.1 Approximate composition of wheat and fish noodles.

in % of:	WHEAT NOODLES		FISH NOODLES	
	wet weight	dry weight	wet weight	dry weight
moisture	10.37	-	13.01	-
crude protein	10.9	12.1	14.8	17.0
fat (Soxleth)	0.2	0.2	0.2	0.2
carbohydrate[2]	76	85	68	78
crude fibres	0.2	0.2	0.4	0.4
ash	2.71	3.0	3.71	4.3

[2]) the carbohydrate content is calculated as being the remaining substance unaccounted for (100 - total of other substances).

Table 4.2 Amino acid content and chemical score of wheat and fish noodles (mg amino acid/gN).

amino acid	wheat noodles		fish noodles		FAO ref. protein
Isoleucine	227		256		250
Leucine	451		488		440
Lysine	130		274		340
Methionine/ Cystine	108 / 122	230	138 / 109	247	220
Phenylalanine/ Tyrosine	283 / 181	464	278 / 187	465	380
Threonine	176		221		250
Tryptophan	n.d.		n.d.		65
Valine	253		283		310
Chemical score	38		81		100
Limiting amino acid	Lysine		Lysine		n.a.

n.d = not determined. n.a. = not applicable.

Table 4.1 shows that by adding sardine mince to the noodles both the protein content and the ash content increase. The higher ash content shows that a larger amount of minerals, e.g. iron, calcium, potassium and phosphorus, are available, whereas not only the protein content but also the quality of the protein has increased (cf. table 4.2) confirming the theoretical considerations in section 2. The chemical scores are, however, lower than expected which is likely to be due to the fact that the protein in the wheat flour has a lower chemical score than originally assumed.

The 50 g bundle of dried noodles is supposed to be of a proper portion or size. The protein and energy content in one protion of dried noodles will thus be $\frac{1}{5}$ and $\frac{1}{15}$, respectively, for the wheat noodles and $\frac{1}{4}$ and $\frac{1}{15}$, respectively, for the fish noodles of the recommended daily intake (FAO/WHO, 1972) for the two groups in the preference test. This indicates that the fish noodles give a higher intake of protein than the wheat noodles whereas the energy intake has not changed very much.

4.2 Preference tests

The fish noodles were tested among pupils from a primary and a secondary school. The test was repeated in both schools ten days later.

The pupils were served two dishes that only differed in that one contained wheat noodles (reference) and the other fish noodles. The noodles were boiled for ten minutes in water

and then served in hot chicken broth with fresh vegetables. The pupils themselves could add sugar, fish sauce, chili in vinegar and dried chili powder to make the dishes suit their taste. The pupils would taste the two dishes and then note down their decision on the questionnaire. The preference test was performed at lunch time. The dishes served as their lunch meal which they could finish after filling out the questionnaire. The test was performed at lunch time in order to get as close to a normal eating situation as possible. Besides, the "physical acceptability" could be observed, i.e. if both dishes were eaten; and number and kind of left-overs.

A summary of the results from the preference test is shown in table 4.3.

Table 4.3 Results from the preference test

trial number: / PREFERENCE	PRIMARY SCHOOL 1 %	PRIMARY SCHOOL 2 %	SECONDARY SCHOOL 1 %	SECONDARY SCHOOL 2 %
Like both wheat noodles and fish noodles	42	33	2	68
Like both but prefer wheat noodles	} 38	26 } 45	} 51	10 } 10
Like wheat noodles, don't like fish noodles		19		0
Like both but prefer fish noodles	} 19	14 } 21	} 47	7 } 14
Like fish noodles, don't like wheat noodles		7		7
Like neither wheat noodles nor fish noodles	2	0	0	7
Number of pupils	48	57	49	41

The results from both trials in the primary school are in agreement, whereas the results from the secondary school are not. However, the trials in the secondary school were more difficult to perform as they had to be done in the canteen. Here the subjects were mixed with other students. The results from the primary school are thus more reliable.

Table 4.3 shows that in the second trial 7% to 9% did not like the dish with the fish noodles. Conversely, 7% to 14% did not like the dish with the wheat noodles. Similar information is hidden in the results of the first trial but both trials showed a preference for the dish with wheat noodles; that is, when one of the dishes was prefered. About one third to two thirds, however, liked both dishes without stating any preference.

4.3 Direct production costs (in Thailand)

The direct costs of production have been estimated for the making of fish noodles in the pilot plant. This pilot plant has a capacity of 50 kg of raw materials per day with four persons operating the plant.

The direct costs of production are estimated to be 22.57 Baht/kg or 1.13 Baht for a 50 g bundle. A breakdown of the costs is shown in table 4.4

Table 4.4 Unit costs, quantities and direct production costs (D.P.C.) of fish noodles

		unit	unit cost Baht/unit	quantity (units)	variable Baht	Costs %
1	Sardine mince	kg	8.00	11.5	92.00	11.3
2	Wheat flour	kg	8.95	34.0	304.30	37.5
3	Sodium carbonate	kg	6.25	0.7	4.38	0.5
4	Salt	kg	6.00	0.9	5.40	0.7
5	Water	m^3	8.50	0.0035	0.03	0.0
6	Raw materials (1 to 5)				460.11	50.0
7	Labour	person/day	65.00	4	260.00	32.0
8	Steam	1000 kg	500.00	0.005	2.50	0.3
9	Electricity	kWh	2.50	32	70.00	8.6
10	Subtotal (6 to 9)				738.61	90.9
11	Other costs (10% of subtotal)				73.86	9.1
12	D.P.C.				812.47	100.0
13	D.P.C. per kg (D.P.C. per 50 g				22.57	(1.13)

The cost of sardine mince is seen to be an estimated 8 Baht per kg. When the experiments were conducted, sardines could be purchased at 4 Baht/kg and the yield of sardine mince was expected to be 50%. A later investigation showed an increase in the price of sardines but a higher yield of mince (55%). As the cost and yield of fish mince are likely to fluctuate, the D.P.C. per kg is shown in table 4.5 for different prices and yields. However, the cost of mince is only about 11% of the D.P.C., and hence the variations in D.P.C. are very small. Furthermore, the costs of raw materials are only 50% of the D.P.C. due to the labour-intensive production.

Table 4.5 Influence of cost and yield of sardine mince on the direct production costs per kg.

Sardines Baht/kg	Yield of sardine mince 40%	45%	50%	55%
3.00	22.39	22.10	21.87	21.67
4.00	23.27	22.88	22.57	22.31
5.00	24.25	23.66	23.27	22.95
6.00	25.03	24.44	23.97	23.59

5. CONCLUSION

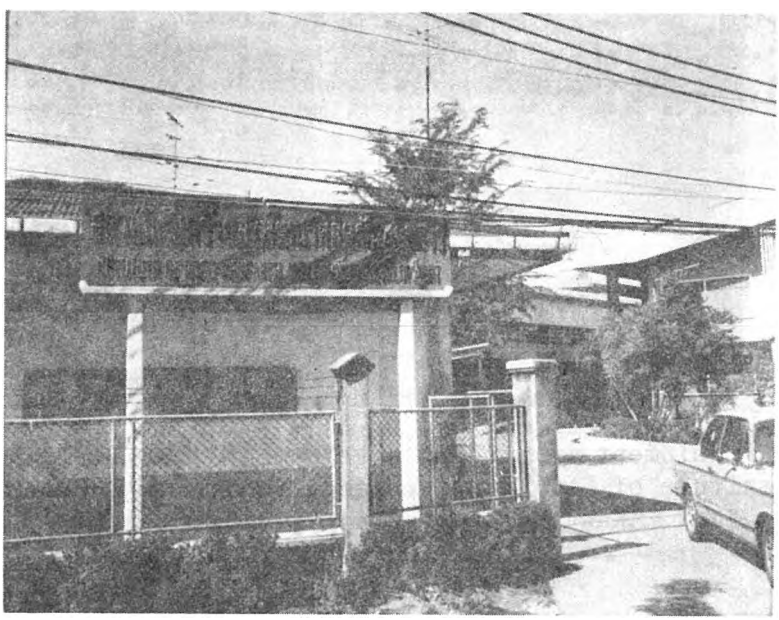
This study shows that the fish noodles were acceptable among primary and secondary school children. Although there was a slight preference for the wheat noodles, only about 20% rejected the fish noodles compared to about 15% rejecting the wheat noodles.

Moreover, the protein value of the wheat flour was enhanced by the addition of sardine mince without altering the energy content of the product very much, giving a more well-balanced composition with respect to amino acid, protein and energy content.

Also, the direct production costs turned out to be low and showed very little sensitivity to the yield and price of the sardine mince.

The intention of this product was to make a cheap and acceptable product which could be used in supplementary feeding programmes, and, as such, these preliminary investigations has been promising.

However, the elasticity and/or cohesiveness of the fish noodles are inferior to those of the wheat noodles and might therefore be a limiting factor for a wider use of the product. Thus, further development work on the use of suitable additives, such as gluten, for improving the texture is recommended. Then, if the texture is improved, the product is likely to be palatable to a much wider group of consumers and commercial production might be profitable.



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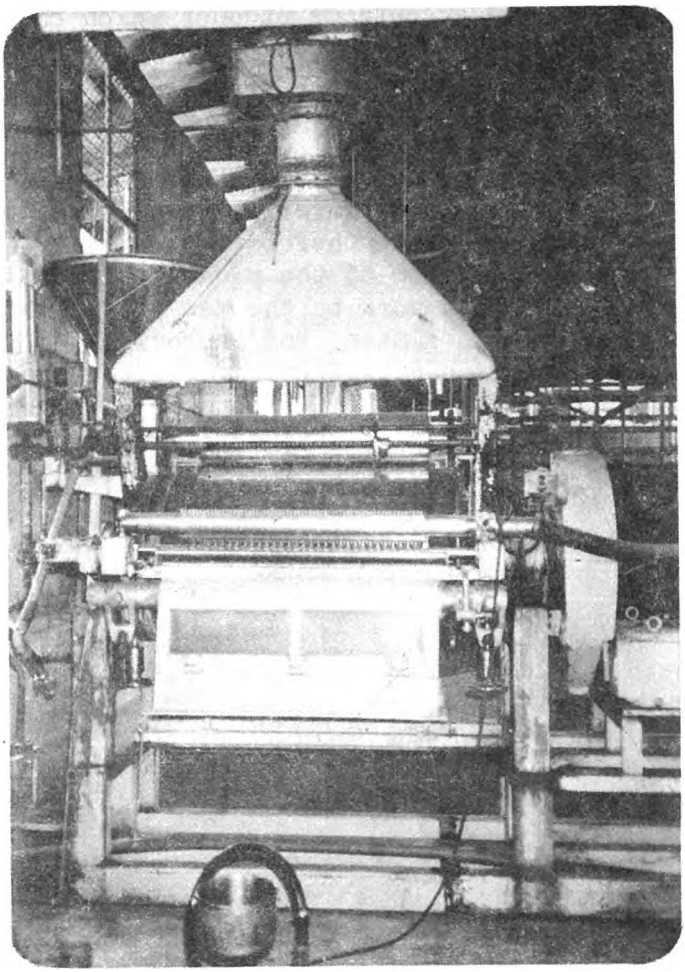

Equipment in product development workshed,
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