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Doc 385

United Nations Industrial Development Organization

Distr.
LIMITED

ID/WG 48/3
24 November 1969

ORIGINAL: ENGLISH

Joint UNIDO/FAO Expert Group Meeting on the
Production of Fish Protein Concentrate

Rabat, Morocco, 15 - 19 December 1969

# PRODUCTION OF FISH PROTEIN CONCENTRATE FROM MOROCCAN SARDINES 1/

by

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1003-999C

United Nations Industrial Development Organization

Distr.
LIMITED

ID/WG.1[illegible]/5 SUMMARY
12 November 1969

ORIGINAL: ENGLISH

[illegible] UNIDO/FAO Expert Group Meeting on the
[illegible]ution of Fish Protein Concentrate

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# SUMMARY

## PRODUCTION OF [illegible] FOR HUMAN FOOD USES [1]

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The efforts to produce an edible fish protein concentrate or fish flour in Morocco began about 10 years ago.

At that time Societe de AZOTE UNION at Safi understood the development of a process and ultimately built a pilot plant capable of making about 500 kg/day of product.

Since the product of this pilot plant was considered quite acceptable, safe and highly nutritious, in 1964, the Government of Morocco, in partnership with AZOTE UNION, financed the construction of the commercially sized plant located at Agadir.

This plant, patterned after the small one at Safi which had operated so successfully, carried out a process consisting of the following steps:

1) Fish were reduced to meal in a small reduction plant by cooking, pressing to remove most of their water and oil, and drying in a steam-tube rotary drier (to minimize oxidation of lipids).

2) The resulting meal was extracted once with approximately its own weight of ethyl alcohol, and then 3 to 4 times with about 60% of its weight of hexane.

3). The extracted meal was dried under vacuum, then ground, screened, and packaged.

Unfortunately, the quality of the product from the larger plant was not as good as that from the pilot production. While the flour was safe, sanitary and nutritious, it imparted some undesirable taste, odour and colour to food into which it was incorporated. Because of this disappointing result, the extraction plant has made only two campaigns, producing 32 tons in 1965, and 143 tons in 1966.

At the request of the Government of Morocco, the United Nations sent a mission to Agadir in 1967 to assess the situation of the plant, and to recommend a course of action.

The mission formulated a 4-phase programme to develop the information needed to establish a commercially viable FPC operation based on the work done so far. Phase I, which is complete, proved the expected fact that raw sardines extracted with isopropyl alcohol can make an acceptable FPC. Phase II, which is in progress at the time of writing, is using the existing plant as a pilot operation to make 20 to 30 tons of good quality FPC, and to get sufficient engineering data to design an economical plant and to predict the necessary investment and the cost of production.

Phase III will be a study directed towards the marketing and use of FPC in Morocco, while Phase IV will involve revision of the present plant to make it more effective.

The present effort in Phase II involves extraction of press cake (cooked and pressed fish) with alcohol alone - either ethyl or isopropyl alcohol. The main cause of the unpleasant odour and flavour of the previous production is thought to be oxidation of lipids during the first drying step. Extracting the residual lipids and moisture from the wet cooked fish avoids this problem, while the cooking and pressing remove most of the water and oil from the sardines more cheaply than can be done by extraction. Furthermore, this method involved no modification to the present plant and it was therefore the easiest scheme to implement.

Results have been very encouraging. FPC with considerably less than 0.5% lipids and practically no odour or taste can be made quite readily.

The extraction procedure consists of three washings, each with a weight of solvent 2½ to 3 times that of the wet press cake. The first washing is with once-used solvent, and the next two use the purified alcohol. Unfortunately, the available equipment does not permit making a true three-stage countercurrent extraction, which would be a more efficient use of the solvent. Also liquid does not drain from the extractor as completely as it might, which makes the washing less efficient.

Before extraction, the press cake contains approximately 50% moisture and 5% oil, and after extraction and drying, the FPC has about 0.3% oil and 4% moisture. The yield FPC is close to 4½% by weight of the press cake charged to the extractor, and the yield based on raw fish is about 15%.

The colour of this product is darker than desired, but the fact that the plant is made from plain low carbon steel may be part of the cause, while the cooking and the sardines themselves are also responsible.

The very objectionable and persistent flavour of oxidized lipids (resembling varnish) is not present in the freshly made flour, and it is hoped that addition of anti oxidant (BHT) to the solvent will inhibit oxidation of the small amount of lipid remaining in the FPC.

Likewise, "fishy" odours and flavours attributed to amines are lacking. By acidifying the used solvent to PH 6.5 with phosphoric acid before distilation, these substances are removed from the system with the bottom liquors. Previous work has shown that accumulation of these amines in the solvent causes fishy odours to develop in the FPC during storage.

Furthermore, use of good fresh fish is extremely important, as action of bacteria and enzymes generate foul-smelling amines, and cause oxidation of lipids very rapidly in small fatty fish such as sardines.

It is also important to stress the need for cleanliness and sanitation in the whole plant. Despite the fact that extraction with hot alcohol effectively sterilizes the fish protein, contamination can occur all too easily in handling the product. Touching the product should be avoided, it must be stored in well-sealed, watertight containers; the product area must be

kept clean, as must the rest of the plant to prevent contamination. These precautions require the utmost care.

Only very tentative predictions of production costs are possible at this stage of the Phase II work, but with suitable revisions, the SONAPAP plant should be able to produce a high quality EPC for no more than 3.66 $/kg if the fixed charges on the present investment are not included. A larger plant could reduce this cost significantly.

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## I. INTRODUCTION :

Before beginning this discussion of the technology of making Fish Protein Concentrate, I would like to repeat a few facts which emphasize its potential.

You all know that somewhere between one-half and one-third of the world's population suffers from protein malnutrition, and you probably also know of the strong evidence that protein starvation in early childhood permanently stunts a person's mental development. Think of the human advancement possible from a production of even several tons daily of high grade protein, when one ton per day can significantly supplement the diets of 100,000 people.

Moreover, the large scale production of FPC is quite possible: the technology is not elaborate, and enough of the inexpensive small industrial fish are already being caught. These comprise 40% of the world's fish catch and they could, as FPC, provide a useful daily protein supplement to 750 million people, instead of feeding poultry in the US and Western Europe.

Thus, the need, the resources, and the know-how for a large-scale FPC industry all exist. Certainly the logic of the product will ultimately force its widespread production.

Right now, however, powerful constraints work to stifle the enterprises. People who need more protein usually do not know it, at least they are not sufficiently convinced to pay more for enriched bread that tastes and looks no different from ordinary bread. Furthermore suspicions and rumours, as well as a general reluctance to modify traditional tastes, inhibit the adoption of new foods. Also, because of the marketing problems, capable manufacturers and distributors are unwilling to invest in FPC. These hard facts all mean that time, persistence, skill and money will be needed in generous amounts to bring this worthwhile industry to commercial maturity.