SHARK MEAT FLOUR

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Shark meat minced, washed and treated with soya-bean powder, as a source of urease, gives urea free meat. It is then dried in a hot air blower and subjected to extraction with solvents to remove the incorporated fat. Finally it is dried in a hot air blower. Such a processed meat flour was free from fishy odour and had a protein utilization value of 61.

The importance of protein as a food constituent is universally recognized. However the superiority of fish protein over that of vegetable protein needs a word of explanation. It has been observed[1] that chickens fed on a diet consisting of 2-5% of fish protein grow better than those on a diet composed wholly of vegetable food. Thus the addition of about 5% of fish protein to their feed increased the growth rate of chickens in the first year by about 7% and decreased the feeding requirements by about 20%. According to Slovtzov[2] fish protein is equal to that of beef. Moreover when fish is substituted for beef the nitrogen is utilized better, resulting in a decreased excretion of uric acid in the urine. Further, fish meat produces a good influence on the assimilation of magnesium and phosphorus. Unfortunately the fishy odour is not usually liked and limits the use of fish as food. It is estimated[1] that about 2.7 million metric tons, i.e. about 13% of world catch of marine fishes, go to manufacture fish meal and oil. According to Dr. M.R. Qureshi, Director of Fisheries, Government of Pakistan, the landing at Karachi and the local consumption of all fishes for 1957 were as given in Table 1.

It is evident from Table 1 that only 1/6th of the total catch is consumed fresh and the rest, along with the total catch of sharks, generally goes to the curing yards for being salted and dried which is partly transported inland but mostly exported to foreign countries. It therefore seemed worthwhile to preserve such meat to its best advantage. Of all fishes shark meat deserved the most consideration. As compared with other fishes, shark flesh contains urea and on account of it receives a differential treatment. Whereas all other fishes are salted and dried, shark meat is first cut into slices and then thrown into pits with layers of salt in between and allowed to putrify. When most urea has been decomposed by bacteria, it is taken out and dried in the sun. Such urea-free salted shark meat however has a very unpleasant odour and is exported usually to Ceylon where apparently its putrid odour is no disqualification.

In order that shark meat may be generally used it had to be processed differently. The present trend is to make fish meat flour which can be used to fortify food stuffs and increase their portein value. The form in which fish meat is finally consumed, and its acceptability are the two factors which have been kept in mind during the experiments that are being described.

Experimental

Fresh sharks were procured from the market. The flesh together with the cartiledge was minced in a mincing machine washed rapidly with three changes of fresh water, and treated with a crude solution of urease. This consisted of 1% soya-bean powder which was added to the last washing

Table 1

No.	Names	Production in metric tons	Marketed fresh in metric tons
1.	Salmon and allied fishes	513	283
2.	Teleostean flat fishes	254	204
3.	Tunas, true mackerals and similar species	6337	1200
4.	Herrings, sardines etc.	6591	1000
5.	Other marine teleosteans	4050	1350
6.	Perches, croackers and other species	15345	3000
7.	Elasmobranchii	10000	—
	Total =	43090	7037

and the mixture was warmed to 40° C. to increase the activity of the urease. Finally the meat was tested for urea. After the complete removal of urea the meat was separated from most of its water in a basket type centrifuge without trying to remove soya-bean powder which could only enrich the protein. The meat was then dried at 50-55° C. in a hot air blowing oven. The dried material was powdered in a grinding machine so as to pass through a 30 mesh sieve. The shark contains only cartiledge which was also powdered along with the meat.

On drying, the loss by moisture was 65% but still left 10% of it. In this condition the fat was 4.0% or 1.0% of fresh weight. The dried powder with fat was transferred to a steam jacketed deodorising machine, which was provided with an electric stirrer, a suitable condenser and a thermometer for controlling temperature. "Solvent oil" (60-120°C. B.P. Burmah Shell) was added in the ratio of 1:6 w/v, on the dry weight basis. Extraction was allowed to continue for 3 hours with constant stirring at 65° C. The solvent oil was removed by filtering and then again the same quantity of fresh solvent oil was added and the pH of the mixture adjusted to 8.0 with a 6% ethanolic sodium hydroxide solution. The mixture was then refluxed for another 3 hours with constant stirring with the same pH and temperature. After 3 hours the mixture was removed from the solvent extraction vessel and transferred to a big pan. The excess alkali was neutralised with hydrochloric acid added dropwise. The mixture was allowed to stand for some time. The supernatant liquid was decanted off. The residue was filtered and the solvent oil from the wet residue was replaced by shaking it twice with petroleum ether which was used as 1:3 on the basis of the dry weight w/v. It was decanted and the meat further pressed and finally kept in a vacuum oven at 50° C. until the traces of petroleum ether were removed. After complete removal of petroleum ether the product was found free from its fishy odour. The deodorised product was found to contain 85% protein as determined by nitrogen estimation.

Details.—Experiments were conducted to determine the minimum period of treatment, using samples of 25 g. with 150 ml. solvent oil, at pH 8 and a temperature of 65°C. Samples collected at hourly intervals showed that 6 hours were required to satisfactorily deodorize shark meat. Next was required to determine the best ratio between the dry meat powder and the solvent which was to deodorize it. The satisfactory ratio proved to be 1:6, details being given in the Table 2.

The total recovery of the solvent oil was 85-90% and of petroleum ether 90%.

TABLE 2

S. No.	Wt. of sample	Quantity of sol. oil	Ratio	Deodorization
1.	25 g.	75 ml.	1:3	Not satisfactory
2.	25 g.	150 ml.	1:6	Satisfactory

The digestibility of the processed meat flour was found to be 99. Its protein utilization value was 61. These findings were carried out in Europe and we are obliged to Dr. van Veen of F.A.O., Rome, for kindly helping us in obtaining these data. The formula according to which digestibility and protein utilization value are calculated are given in an article by Griswald[3] and are reproduced in the following. Percentage digestibility is :

$$\frac{\text{Food N}-(\text{fecal N}-\text{metabolic N})}{\text{Food N}} \times 100$$

where metabolic nitrogen is fecal nitrogen on a nitrogen free diet. Biologic value or percentage of absorbed protein that is retained equals:

$$\frac{\text{food N}-(\text{fecal N}-\text{metabolic N})-(\text{Urinary N}-\text{endogenous N})}{\text{food N}-(\text{fecal N}-\text{metabolic N})} \times 100$$

where endogenous nitrogen is total urinary nitrogen on a nitrogen free diet.

The shark meat powder as determined here contained 800 mg. phosphorus and 300 mg. calcium per 100 g. of sample. On hydrolysis with papain the deodorized protein was found to contain appreciable amounts of the essential amino acids, amongst which, methonine, lysine and tryptophane may be especially mentioned. Their identification was carried out by paper chromatography using butanol, acetic acid and water as solvents. Solution of ninhydrin in butanol 0.2% was used as the spray reagent.

Discussion

Various methods have been tried by other workers to deodorize fish meat, including that of shark. There is a fermentation process[4] where the flesh is fermented in the presence of defatted butter milk. The method is found to be particularly suited to fishes, where the body oil is very low as is the case with the shark. Fermentation is claimed to result in almost complete removal of urea and partial deodorization.

South African scientists[5] have developed a process in which fish flour is treated with a mixture of ethyl alcohol and ethyl acetate in the ratio of 9:1. Five or more extractions were suggested, until the solvent appeared colourless. The processed flour was dried under vacuum to give a product free from fishy odour.

Iodine was also used to deodorize fish meat. Saturated iodine solution (4.2 ml.) in ethyl alcohol was mixed with glacial acetic acid (10.6 g.) and the solution diluted to 300 ml. with water and added to 1 kg. dried fish meat. The mixture was kept overnight in a sealed container and then dried to obtain a product claimed to be free from its odour.[6] In another effort by the Japanese scientists, raw whale meat was immersed, for 2 hours, in a solution composed of 11.5% $CaCO_3$, NaH_2PO_4 and KNO_3, and later on, for 1 hour in an acetic acid -tartaric acid solution of pH 5.0—6.0, to give an odourless product.[7]

In an Indian method,[8] alkali digestion was employed for deodorization of fresh meat which was first digested with 1% glacial acetic acid; this softens the meat and facilitates further operations. After separating water and removing traces of acid, the meat was refluxed with a suitable quantity of ethanol for 7 to 8 hours at 65-70°C. After necessary drying, the residue was digested with dilute sodium hydroxide. This treatment resulted in a fairly good solution of the meat. After filtering through a cotton plug, the filtrate was neutralized by adding dilute acetic acid and the protein precipitated and dried. The preparation obtained by this method was claimed to be almost free from any smell.

Several experiments were conducted by us to remove the fishy odour from shark meat by means of solvents like benzene, hexane, petroleum ether, "aviation spirit," etc., but in each case the odour returned on storing the samples. The only common solvent which proved successful was ethyl alcohol. The results obtained by ethyl alcohol and solvent oil, the latter being used in the present experiments, were almost the same. So far as the question of cost is concerned, solvent oil is far cheaper than alcohol and it is easily available in the local market. Solvent oil is Rs. 1/8/- and alcohol Rs. 3/8/- per gallon. The loss in the recovery of the solvent oil at the end of the process, was only 10%. The oil can be used again after freeing it from all odoriferous matter by treating the solvent with an oxidizing agent, e.g., $KMnO_4$ and distilling it, first on water bath at 80° C. and finally on an electric heater at 120° C. 2-3% of moisture was found in the final deodorized product. For the gift of Griswald's publication our thanks are due to Asia Foundation and particularly to Mr. Banningan, its present Representative.

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