FISHERIES OF THE WEST COAST OF INDIA

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FISH OILS

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While the medicinally important shark liver oil has received considerable attention very little work has been done in India on the production and utilisation of fish body oils. Therefore in this paper the potentialities for the development of fish body oil, are considered briefly at the outset followed by consideration of the liver oil industry.

Sardines and other clupeids account for about 20% of our marine fish landings which approach 1 million tons per annum. The potential capacity of oil production from these and other fatty fishes, is considerable. The methods currently employed in the manufacture of fish oils are crude and inefficient yielding an oil poor in quality. However, using improved methods of cooking the fish, pressing, filtration to remove the protein debris, and centrifugation for separating the oil it is possible to obtain a product which could be used industrially for various purposes.

Fish oils find application in leather dressing, in the manufacture of insecticidal soap, as quenching medium for tempering steel, for smearing the outer surfaces of boats for preservation, etc. There is a substantial demand from our leather industry for suitable fish oils which is not met by the indigenous supply. The *iodine* and *acid* values as well as the colour of the oil are important in considering the suitability of the oil for this purpose. Ray liver oil which contains very little vitamin A, alone is being used commercially in leather dressing. Recent work carried out abroad has shown however that liver oils have no special advantage over the body oils in treating skins in the tanning process. Improvements in the technique of production of the fish body oils and an evaluation of the chemical and physical constants of body oils of different fishes, in different seasons and from different environs are necessary in order to offer a suitable quality of oil to the leather industry. Analyses of fish oils obtained from different sources and by varying techniques are being carried out at the Central Marine Fisheries Research Station with the view of standardising the quality.

Besides these uses of the fish body oils new fields for their use are worth exploitation. The fish oils have a rather unusual chemical structure in that long chain fatty acids (mainly C_{20} and C_{22}) having a number of double bonds up to 6, are present. Such long chain poly-unsaturated fatty acids are found in other animal and vegetable oils only to very limited extent unlike in the fish oils. The high degree of unsaturation of the fish oils render them less stable than other oils and hence reduce their market value in comparison with the other oils. But due to this unusual property their use in other fields is potentially very important. Some of the fatty acids and their derivatives can be used in various ways as indicated below: Poly-unsaturated fatty alcohols prepared from fish oils are important as starting material for preparation of several derivatives such as Alkyl halides, Silicones, and Quaternary ammonium salts. Considerable research work from the basic aspects is necessary for developing processes for utilisation of the body oils.

Importance of liver oils.—" The average Indian diet is deficient in vegetables and fruits which supply some of the vitamins. Milk and eggs contain relatively large amounts of two other vitamins A and D and the fact that only small section of the population can afford their use in adequate amounts results in deficiency of these Vitamins A and D in the diet of large sections of the people" so reported the Bhore Committee appointed to review the health of the nation in 1946. A recent medical inspection of the students of a premier college in Madras City, the majority of whom came from the well-to-do section of society, showed that nearly 25% showed definite signs of Vitamin A deficiency. Further, there is ample evidence that Vitamins A and D are the two vitamins commonly in short supply in these days of food shortage. Before World War II, we depended for supply of these two vitamins A and D on cod-liver oil imported mainly from Norway and later on from England. During the early stages of vitamin research cod-liver oil was thought to be a very rich source of Vitamins A and D. Cod-liver oil on an average contains about 1000 international units of Vitamin A per gram; never exceeds 3000 generally. Halibut liver oil, on the other hand, contains on an average 50,000 international units per gram and sometimes tops 300,000 units. Indian shark-liver oil averages about 10,000 to 15,000 and at times reaches 200,000. Today, therefore, cod-liver oil is considered, comparatively, a poor source of Vitamins A and D.

Development of the industry.—It was the World War II that promoted the establishment and the quick development of shark-liver oil industry. The dearth of cod-liver oil, consequent on the Nazi conquest of Norway, created a huge demand for alternative sources of Vitamins A and D and

all over the world shark-liver oil was soon produced, first as a substitute for and later to replace cod-liver oil. In India, the Government of Madras was the pioneer in the industry followed by Bombay, Sind, Baroda and Travancore. Bengal and Orissa have since organized production of the oil. The Government of Madras set up the Government Oil Factory at Kozhikode (Calicut) in 1940 for the refining and marketing of shark-liver oil. The factory is now fully equipped with the most modern extraction and testing equipment. On reorganization of States in 1956 the factory has became a Kerala Government concern.

Sharks and shark-fishing.—Vitamins A and D are concentrated in the oil of the liver of sharks. The liver alone, therefore, is separated and treated for oil. There are about 57 species of sharks which frequent our coasts but only livers of 20 of them are of commercial importance. Sharks are of various sizes and some of them grow up to 40 feet. Shark fishing in this country is still primitive and a risky avocation. They are caught by hook and lines and the fishermen sometimes have to brave twenty miles out into the sea to catch them.

Extraction of liver oil.—The livers vary in size also, largely depending on the size of the shark. A single liver may be anywhere from a few pounds to 400 lb. in weight. The oil and vitamin content also vary from shark to shark and season to season. There are various methods of extraction of oil. Vast progress has been made in the extraction methods since early days. The simplest method, of course, is to chop them up and cook them in water. The oil which oozes out may then be collected. In this the maximum yield of oil and vitamins is not obtained. The alkali digestion method is much favoured in commercial establishments where efficiency of extraction is of great importance. In this the livers are pulped in a disintegrator. This mass is then digested in stainless steel vessels under careful temperature and alkaline conditions by open steam. When completely digested the mass is sent through a centrifuge to separate the debris, water and oil. The liver debris can be dried and made into a poultry feed. Oils prepared thus have only a faint fishy odour and taste and can be blended without elaborate refining. Here, however, the protein portion of the liver is completely destroyed and lost. To save this, the livers are sometimes solvent extracted and the liver debris used as animal feed. But this is a costly method. There are other digestion methods also but details of these are closely guarded secrets of individual factories.

Estimation of Vitamin A in shark-liver oil.—There are three methods—biological, colorimetric or chemical and physical—available for the

estimation of Vitamin A potency of fish-liver oils. The last two offer advantages of speed and reproducibility while the biological method is fundamentally more accurate and reliable.

Biological method.—In broad outline, the biological method consists in feeding young albino rats carefully bred for the purpose from the age of five weeks, when they weigh about 60 grams, on an artificial diet balanced in all respects except for the absence of Vitamin A. Fed on such a synthetic diet the rats cease to grow after a month. Known quantities of the substance to be tested are then given and the response in growth is then taken as a rough measure of the amount of Vitamin A contained in the supplement administered. The procedure is repeated with cod-liver oil of known potency or of B carotene and the potency of the unknown ascertained. This is a complicated procedure and involves considerable amount of time and money.

Colorimetric method.—Oils containing Vitamin A when dissolved in chloroform and mixed with a chloroformic solution of antimony trichloride give a blue evanescent colour. The intensity of the colour is a measure of Vitamin A potency. This method was previously used in the Government Oil Factory but now the Vitamin A potency is determined spectrophotometrically according to internationally accepted methods.

Physical or spectrophotometric method.—This physical method is based on the fact that Vitamin A is characterized by selective absorption in the ultra-violet region of the spectrum. When any substance containing vitamin A is dissolved in a suitable solvent and kept in the path of ultra-violet rays, Vitamin A absorbs a portion of the rays in a certain region, depending on the concentration of Vitamin A in that substance. If the intensity of absorption is measured then the Vitamin A potency can be estimated. For this purpose a spectrophotometer is used. Ultra-violet light from a constant source is passed through the solution of the substance or its unsaponifiable portion dissolved in ethyl alcohol or cyclohexane and another beam through the pure solvent used. Photographs are taken of the spectra at various intensities and from these the quantity of light absorbed by, and hence concentration of, Vitamin A contained in the substance calculated. A recent improvement is the photoelectric spectrophotometer which dispenses with the taking of photographs. The beams of light passing through the solvent and solution fall on a photoelectric cell and difference in the electric current generated in the cells can be easily read off on a galvanometer and hence the Vitamin A potency can be calculated. The Government Oil Factory is equipped with the Beckman Photoelectric Spectrophotometer,

Hence the standardization of the products of the factory is comparable with those of the most modern pharmaceutical firms anywhere in the world.

Vitamin D.—The Vitamin D unit adopted by the International Conference is the biological activity of a milligram of the International standard solution of irradiated ergosterol which has been found to be equivalent to that of 0·025 microgram of crystalline Vitamin D. There is unfortunately no sure chemical method of estimation of Vitamin D; it has to be assayed biologically. There are two or three methods of carrying out the biological assay but they need not be detailed here.

Blending of shark-liver oil.—As stated above the Vitamin A potency of shark-liver oil varies vastly and hence the standardization of the oil is absolutely necessary. During early days of the World War II, a substitute having the same specifications as imported cod-liver oil was required. As shark-liver oil generally contained more Vitamin A than cod-liver oil, it was found necessary to blend shark-liver oil with a vegetable oil which did not contain Vitamin A and market the blend having cod-liver oil potency. This is sound in principle and practice too. In addition, pure high potency shark-liver oil is also marketed after refining and standardization.

Clinical data for shark-liver oil.—Although the shark-liver oil marketed by Government Oil Factory and other factories owned by other States Governments was superior to imported cod-liver oil, the early expansion of the market was hampered because of the stigma attached to " shark " and the reputation which cod-liver oil had gathered during the past decades. But the value and efficacy of standardized shark-liver oil like Seagold brand shark-liver oil and Adamin soon became evident to the medical profession. Recently Adamin High Potency Shark-Liver Oil was tried clinically in the important hospitals in the city of Madras with encouraging results. The clinical data convincingly proves that standardized shark-liver oils like Adamin are comparable in quality and in biological potency, to any foreign oil of similar standard.

A vital industry.—The importance of Vitamins A and D in nutrition should need no emphasis. Ample supplies of these are required throughout life. A great deal of sickness and diseased condition is traceable to the deficiency of Vitamin A. In our country Vitamin A deficiency is widespread and hence the importance of the shark-liver oil industry cannot be overestimated. Good nutrition is the key not only to the physical and mental well-being of the individual but also to the progress of the nation. Putting more life into the years and more years into life is nowhere so urgent as in India today.