SHARK LIVER OIL AND VITAMIN A CONCENTRATES

Fish fauna of the Arabian sea is a natural resource of great significance in the economy of Pakistan. The long West Pakistan coast offers exceptionally good opportunities for developing fisheries on a commercial scale. Along with the edible fishes a considerable number of sharks are landed throughout the year mostly at four or five coastal fishing villages along the Makran coast and around Karachi.

Shark liver oil is known to be a rich source of vitamin A. There are several other marine fishes that contain vitamin A in their livers. To name a few, cod, hallibut, sword-fish etc., are exploited for the extraction of liver oil which is sold in the world markets after the necessary refining and standardization. Pakistan imports large quantities of such liver oils for its vitamin A and D content along with other preparations containing synthetic vitamin A, and the country thus incurs a considerable amount of foreign exchange expenditure.

In view of the facts stated above, investigations were started over a year ago in the Central Laboratories of the Pakistan Council of Scientific and Industrial Research to study the possibilities of developing the shark liver oil industry in the country. As a result of these studies a process has been evolved for the simultaneous production of concentrates of vitamin A with a potency of around 1 million U.S.P. units per gram, and a deodorized, decolorized oil with a standardized vitamin A content of around 7000 U.S.P. units per gram. After completion of laboratory experiments the economics and optimum working conditions of the process have been thoroughly studied on a pilot plant.

The total capital investment for a unit with an annual production capacity as given below is estimated at approximately Rs. 3,30,000/-.

1. Refined shark liver oil, 7000 U.S.P. units per gram, approximately 16,800 lbs.
2. Vitamin A concentrate, 10,00,000 U.S.P. units per gram, approximately 34 lbs.
3. Emulsion, 2,400 U.S.P. unit per gram, approximately 40,000 lbs.

Total vitamin A content of the above products will be approximately 73 thousand million U.S.P. units, giving an average cost of Rs.-/5/6 for 1,00,000 U.S.P. units of vitamin A.

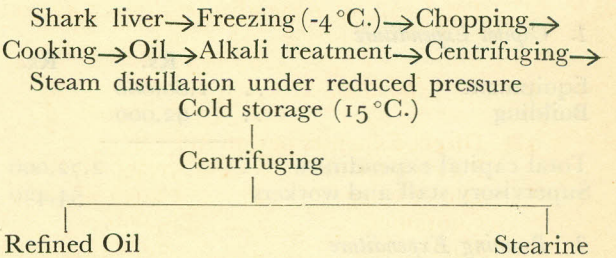
The retail market price of imported cod liver oil, *e.g.*, Seven Seas Cod Liver Oil, is Rs. 1/12/- for 8 oz. containing 1,60,000 U.S.P. units of vitamin A and 20,000 U.S.P. units of vitamin D.

If it is desired to produce an oil with both vitamins A and D, the latter may be added in the form of calciferol, at an additional cost of Rs. -/5/- for 20,000 U.S.P. units of vitamin D, giving the cost of the finished product comparable to Seven Seas Cod Liver Oil as below :—

1,60,000 U.S.P. units of vitamin A in shark liver oil	Rs. -/9/-
Additional cost of vitamin D, 20,000 U.S.P. units	Rs. -/5/-
	Rs. -/14/-

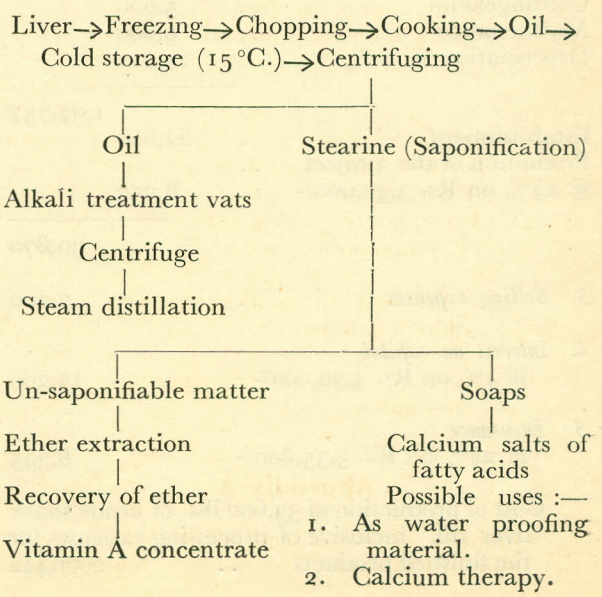
Process

The process follows the flow sheet given below :



(Preparation of shark liver oil emulsion)

A part of the oil can be used for the preparation of vitamin A concentrate as given in the flow sheet below :—



Equipment and Raw Materials

The equipment required consists of the following :—

Refrigeration units for cold storage, liver chopper, steam jacketted cooking pans, Sharples centrifuge, alkaline treatment vats, steam distillation apparatus, crude oil electric generator, overhead tanks, boiler, capsulating machine, spectrophotometer and other analytical equipment for the testing and standardization laboratory, homogenizer, Soxhlet type continuous extractor, and equipment for processing the by-products.

The raw-materials are shark liver and chemicals.

Summary of Pre-Construction Cost Estimation

(to process ¼ ton shark liver oil per day)

	Rs.	Rs.
1. Capital Expenditure		
Equipment ..	1,80,000	
Building ..	92,000	
Total capital expenditure ..		2,72,000
Supervisory staff and workers		54,420
2. Running Expenditure (per annum)		
Raw materials ..	63,645	
Direct wages ..	31,800	
Containers ..	50,000	
Power ..	10,500	
Contingencies ..	5,000	
Maintenance ..	9,600	
Depreciation @ 10% ..	27,212	
		1,97,757
Establishment ..	22,620	
Promotion of the project .. @ 2½% on Rs. 3,30,000/- ..	8,250	
		30,870
3. Selling expenses ..		7,200
4. Interest on capital @ 4% on Rs. 3,30,000/-		13,200
5. Insurance @ 2½% on Rs. 3,35,800/-		8,395
Cost of production of 33,600 lbs. of crude shark liver oil, inclusive of processing expenses for the finished products ..		2,57,442

SUBSTITUTE FOR BIDI LEAVES

The importance of bidi leaves (commonly called Tendu leaves and imported from India) for the local bidi industry is well known. On account of its high cost and import restrictions, a search for alternative leaves of Pakistani origin assumed great urgency immediately after independence. As a result of investigations carried out in the Council's Central and East Regional Laboratories, it has been possible to evolve a process for utilising the Kumbi leaves, found extensively in the forest area of Bahawal, Rajendrapur, Srepur etc. and obtainable at a nominal royalty of Rs. -/1/- per maund to the Forest Department.

The leaves as such, after drying, cannot be utilised as bidi wrappers, because of the disagreeable smell on burning and a number of other drawbacks *e.g.*, the difficulty of obtaining a continuous burning, wrinkle formation, and greenish colour persisting even after drying. These difficulties with the Kumbi, which is otherwise a tough leaf, have been overcome satisfactorily by a simple chemical and physical processing which can be carried out on a cottage industry scale.

Considerable quantities of bidies were made in the Laboratories with processed Kumbi leaves by a skilled Bidi maker using the same tobacco as used in bidies made out of imported bidi leaves from India. These bidies were given an extensive use as trial during the PIIF exhibition to a large number of visitors, and it can be said on the basis of reports received from the users, that the bidies made with treated Kumbi leaves are just as satisfactory as those made from Indian bidi leaves. The process can be carried out on a cottage industry scale with a total capital investment of about Rs. 1000 and on the basis of cottage production the cost of one seer is estimated to be about Rs. -/5/8.

Process

The leaves are boiled within 72 hours of plucking or after drying. The freshly collected leaves are dipped into boiling water for half an hour to forty minutes. These are then washed with fresh cold water several times and then processed with a chemical solution as below. The hot treated fresh leaves assume a light yellow colour somewhat similar to bidi leaves.

The leaves are next steeped overnight in a chemical solution (1%) in wooden vats and then taken out and air dried. When the moisture

content falls sufficiently, the leaves are rolled between heated rollers in a simple hand-operated machine designed for the purpose in the Council's Laboratories. As they come out of the roller, they are suitable for packing and marketing.

Equipment and Raw Materials

Equipment required for this industry consists of a series of wooden vats, a few aluminium receptacles for boiling, coal or wood fired heating ovens, and a retting machine which can be fabricated locally according to specifications.

The raw-materials required for this industry are Kumbi leaves which are easily available in East Pakistan and a small amount of chemicals.

Cost of Production

	Rs.	a.	p.
Capital expenses for equipment	570	0	0
Cost of raw materials for 20 seers of finished leaves	2	7	1
Repairs, maintenance, unskilled labour & miscellaneous (water lighting, etc.)	3	10	8
Depreciation, rent and taxes	1	0	6
Cost of production of 20 seers of finished leave	7	2	0
Cost of production per seer	0	5	8

PREPARATION OF MIXED BILE SALTS AND ACIDS FROM BILE

Mixed bile acids and salts are used in a number of pharmaceutical preparations and media for the cultivation of organisms. The pharmacopial preparations include desiccated bile, bile extract, acidium dehydrocolicum and its sodium salt. A large number of properietary drugs (shown in the appendix) are sold in the market in which the principal constituents are mixed bile salts and bile acids. A fairly large amount of bile salts also find use in the preparation of media for the cultivation of certain types of organisms in bacteriological laboratories.

Substantial amounts of bile are available in the slaughter houses in different parts of the country.

Approximately 13,000 lbs. of ox bile annually is available in one of the slaughter houses in Lahore alone. It is estimated that almost all the requirements of the country should be met from sources available within the country. Other products which can be made from mixed bile salts and bile acids are (1) mixed bile acids and salts (2) cholic acid (3) desoxy-cholic acid (4) choleic acid. These also find use in therapeutics preparations and in special media.

The most easily marketable product and the one which has a large demand is mixed bile salts and acids. It can be readily prepared from suitably treated bile. This commercial product of mixed bile acids and salts does not need the setting up of an elaborate factory but could be taken up by pharmaceutical concerns in a relatively small shed of 15′×15′.

The total capital investment in a unit with a production capacity of 12,000 lbs. per annum is estimated at Rs. 6,560.

It has not been possible to ascertain the prevailing market prices of these materials. But on the basis of finished proprietary drugs marketed in the form of tablets etc., it is estimated that the cost of production in the proposed unit compared to the prevailing cost will be of the order of 1 to 20.

Raw Materials and Equipment

Raw materials: Bile, commercial sodium hydroxide, and commercial sulphuric acid.

Equipment: Kettles made of copper, 100 lbs. capacity; 4 condensers spiral type 3′×1′ and 1′ diameter with water jacket 4′×2′ made of iron sheet of 24 gauge and suitable angle iron stand ; one storing drum ; one mixing tank ; 12 coarse wooden trays ; and one pestle and mortar.

Pre-Construction Cost Estimation

Capital Expenditure :

	Rs.	Rs.
Cost of equipment, erection of a stove and shed ..		2,375

Running Expenditure per mensem :

Cost of 1000 lbs. of bile	250	
Cartage ..	60	
Cost of chemicals ..	190	
Fuel ..	400	
Establishment ..	495	
		1,395

Yield of mixed bile acids from 1000 lbs. of liquid bile	44 lbs.
Cost of one pound of mixed bile acids	Rs. 32

Appendix

Bilisalin : Sold as tablets each containing bile salts 4 gr. and hepatic substance 2 gr.

Bilron : Sold as capsules each containing 5 gr. iron bile salts.

Desibyl Capsules : Each containing desicoated whole bile 5 gr.

Glanfel Tablets : Enteric-coated tablets 1 or 3 gr. consisting chiefly of sodium glycocholate and sodium taurocholate in proportion existing in the fresh bile. This is nothing but mixed bile acids.

Hydro-Bilein : Tablets each containing dried purified ox bile 2 gr. and dehydrocholic acid 2 gr. which is an oxidation product of cholic acid.

Felamin : Hexamine (0.225 g.) with cholic acid (0.075 g.).

Veracolate, Bicolate and Biledase: Contains sodium taurocholate and glycocholate with cascara, phenophthalein and capsicum.

Taxol Pancrobilin, Desicol and Jubol : All these preparations contain mixed bile salts.

INSULATING TAPES

A dielectric or insulating material may be characterised roughly as having an electric conductivity of less than 10^{-6} mhos/cm. Materials with conductivities in the range of 10^{-6}, 10^{-3} mhos/cm are semi/conductors. Usually, mechanical, chemical, thermal and cost considerations determine the choice of an insulating material. The cheapest and the simplest form of insulation is the insulating tape made of cloth or paper and coated with an insulating material. Even this type of insulating material is imported in Pakistan. It is estimated that Pakistan consumes annually about 3 lac spools of 1/2″ width and 50 yards length. A spool of these measurements imported from abroad costs about Rs. 2/- to Rs. 2/8/-

As a result of investigations carried out at the Central Laboratories of the Council of Scientific and Industrial Research, Karachi, it has been possible to evolve a process for the manufacture of insulating tape from exclusively indigenous raw materials. The tape is about 100% above the British Standards Specifications (B.S.S.).

The total capital investment for a unit of production for manufacturing 300,000 spools (1/2″×50 yards) per annum is estimated at approximately Rs. 2,14,000. The average cost of a spool in a unit of this size works out to Rs. 1/7/-, inclusive of overhead expenses, as against the present market price of a spool *viz.* Rs. 2/- to Rs. 2/8/-.

Process

The process involves the following unit operations : mixing the various ingredients, coating of the tape, drying of the tape at controlled temperature, and winding of the tape and cutting into spools of required sizes.

Equipment and Raw Materials

The equipment required for the process consists of : jacketed vessel with mixing and temperature control device, bath for coating purpose, drying chambers, and winding and cutting machine.

The raw materials required are : insulating medium, vehicle, filler and cloth.

All these materials are available in the country.

Summary of Pre-Construction Cost Estimation

(Production Capacity—3,00,000 spools per annum or 100 spools per day)

		Rs.	Rs.
I. Capital Expenditure			
Equipment	..	70,000	
Building	..	43,000	
Total capital expenditure	..		1,13,000
II. Running Expenditure (Per annum)			
1. Direct Expenses			
Raw materials	..	3,41,100	
Direct wages	..	13,320	

		Rs.	Rs.
	Containers ..	3,900	
	Power ..	10,000	
	Contingencies ..	6,000	
	Depreciation @ 10%	11,300	
		..	3,85,620
2.	Indirect expenses		
	Establishment ..	12,840	
	Promotion of the project @ 2 % on Rs. 2,14,000	5,350	
			18,190
3.	Selling Expenses ..		5,040
4.	Interest on capital @ 4% on Rs. 2,14,000/-		8,560
5.	Insurance @ 2½% on Rs. 4,54,100/- ..		11,353
	Cost of production of 3 lacs spools of tape ..		4,28,763

Average cost Rs. 1/7/- per spool.

PETROL GAS PLANT

A regular supply of gas is one of the essential requirements of a laboratory. The gas is usually obtained from the city gas supply, or generated in large plants of Mansfield type, installed at site. So far there is no city gas available anywhere in Pakistan and although with the discovery of the Sui Gas it is expected that gas will be available for domestic consumption in some of the cities, an independent gas plant will continue to be a necessary item of laboratory equipment. While some of the larger institutions have installed Mansfield type gas plant, most of the smaller industrial laboratories, have been experiencing considerable difficulty in this respect. During the last few years imported gas plants of the Aerogen type have been obtained at considerable cost from abroad, but on account of the fact that even a small size gas plant sufficient for 60 burners costs about Rs. 8000, a good part of which amount represents foreign exchange, a large number of smaller institutions have practically no arrangements for the supply of gas. In order to meet this requirement the Chemical Engineering Section of the Central Laboratories of the Council of Scientific and Industrial Research took up the design and fabrication of a portable, low-cost gas plant. The gas plant, of which many units have already been fabricated in the workshop of the Laboratories, has the following general specifications :—

1. 500 cu. ft. gas/gallon petrol.
2. 300 B.T.U-/cu. ft. of gas.
3. 300 cu. ft. of gas/hr. for 60 burners.
4. Overall dimensions : 4′-8″×2′-4″×5′-2″.
5. Power required : 185 watts.

The cost of the plant has been worked out to be about Rs. 1300. All parts of the plant can be fabricated except a high speed motor which will have to be imported. On the basis of comparative performance under similar conditions, the gas plant fabricated in the Council has been found to possess many advantages over similar imported gas plants. Some of the special features of the plant are, that it gives a longer flame, takes less time to generate the same quantity of gas, maintenance is easier, wear and tear is much less and the gas plant is more compact, requiring much less floor space compared to imported gas plants of the same capacity.

The fabrication of the gas plant can be taken up in any good workshop at an estimated cost, as indicated below :—

Summary of Pre-Construction Cost Estimation

I. Direct Charges		Rs.	Rs.
A.	M.S. sheets and other materials ..	250	
	Fabrication of carburetting unit ..	150	
	Driving unit and accessories ..	400	
B.	*Labour* ..	300	
			1,100
II. Indirect Charges			
1.	Overhead charges ..	200	
2.	Electric charges ..	50	
3.	Depreciation on machinery	50	
4.	Contingencies @ 5% on labour and material ..	50	
5.	Unforseen expenses ..	75	
			425
	Cost of production of Petrol Gas Plant ..		1,525