STUDIES ON SHARK LIVER OIL

Part II.—Recovery of Vitamin 'A' by Different Digestion Methods

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Introduction

Fish livers have been classified[1] according to their oil and vitamin 'A' contents, as (i) low potency, high oil-content livers, (ii) high potency, low oil-content livers and (iii) high potency, high oil-content livers. Class (i) livers are generally digested with steam or simply hot water, while for those belonging to class (ii) and (iii) the digestion process is modified, the purpose in each case being the optimum extraction of both oil and vitamin A. Simple digestion of the livers of type (ii) and (iii) with hot water or steam always leaves a portion of the oil and the vitamin firmly bound in the tissue, and complete digestion to a liquid or semi-liquid state becomes imperative for total recovery of oil and vitamin A.

Steam, alkali, and enzyme digestion, and also solvent extraction have been employed by various workers [2,3,4], on different fishes, and most of these processes are covered by patents. Keeping in view the efficient exploitation of the vitamin A resources of Pakistan, five possible methods have been studied in the present investigation in order to evolve a process which could be commerically feasible for the maximum extraction of oil and vitamin A from indigenous sharks.

Experimental

Liver of two species of sharks, *P. cuspidatus* and *S. blochii*, were procured from Khadda Market, Karachi. These livers were washed, passed through a meat chopper and digested in the following manner:—

(*i*) *Water treatment* : To 500 g. of liver 500 ml. of tap water was added, followed by heating at 80-85 °C. for 45 minutes with occasional stirring. The oil was separated by centrifugation and filtered hot through anhydrous sodium sulphate into a tared flask.

(*ii*) *Alkali digestion* : (2% *alkali*) : To 500 g. of liver in 500 ml. of water, 15 ml. of saturated aqueous sodium hydroxide (equivalent to 10 g. of NaOH) was added with constant stirring. The mass was digested at 75-80 °C. for about 20 minutes, whereupon all the tissue had been dissolved and an emulsion obtained. The excess aqueous phase was removed in a separating funnel and the emulsion was broken by the addition of an equal volume of 5% hot sodium chloride solution. The oil thus liberated wa centrifuged, dried and filtered into a tared flask.

(*iii*) *Papain digestion* (1% *Papain*) : 5g. of crude papain was suspended in 100 g. of warm water at 50 °C. This suspension was added to 500 g. of liver, the whole was diluted with 400 ml. of water, and was then digested at 55 °C. for 3 hours, with occasional stirring. When the digestion was complete, the oil was recovered in the usual manner.

(*iv*) *Steam digestion* : Steam was injected for about 30 minutes into a two litre flask containing 500 g. of liver and 500 ml. of water. The liberated oil was collected as usual.

(*v*) *Ether extraction* : 500 g. of liver were ground with about 100 g. of anhydrous sodium sulphate and repeatedly extracted with ether, until a portion of the extract left no residue on evaporation. The oil was recovered from the extract by distilling off the ether.

The acidity of the oil was determined in terms of oleic acid, and its vitamin A content was estimated spectrophotometrically.[5] The results are tabulated in Tables 1 and 2.

Discussion

The tables show that the maximum yield of oil is obtained with ether extraction, while alkali and papain digestion come fairly close to this. Water and steam both give low yields, amounting to about two-thirds of the maximum. On the basis of recovery of vitamin A, ether digestion again yields the maximum quantity, but alkali digestion is now equally efficient and is closely followed by papain. Water extraction again gives the lowest yield and steaming is slightly better, the difference being more conspicuous with medium oil content liver. Another noteworthy feature is that alkali and papain digestion yield a more potent oil than that obtained by water, steam, or ether extractions.

Alkali, as expected, yields oil with the lowest

TABLE 1.—ANALYSIS OF OIL EXTRACTED FROM HIGH OIL CONTENT LIVER (*P. Cuspidatus*).

Extraction method	Oil from ½ kg. liver in grams	Yeild of oil % age	Acidity (as oleic acid) % age	Vit. A (I. U. per g. of oil)	Units of Vit. A per kg. liver in million units
Water ..	190	38	0.56	12,300	4.7
2 % Alkali ..	250	50	0.08	15,700	7.8
1 % Crude papain	240	48	1.80	14,900	7.2
Steam ..	190	38	0.73	14,300	5.4
Ether ..	280	56	0.76	13,800	7.7

TABLE 2.—ANALYSIS OF OIL EXTRACTED FROM MEDIUM OIL CONTENT LIVER (*S. blochii*).

Extraction method	Oil from ½ kg. liver in grams	Yield of oil % age	Acidity (as oleic acid) % age	Vit. A (I.U. per g. of oil)	Units of Vit. A per kg. liver in million units
Water ..	101	20	1.47	44,300	8.9
2 % Alkali ..	150	30	0.28	62,600	18.8
1 % Crude papain	120	24	1.81	62,700	15.0
Steam ..	110	22	1.46	51,902	11.4
Ether ..	170	34	1.50	55,300	18.8

acidity, while maximum acidity is obtained with papain digestion, due to the action of fat-splitting enzymes. It is to be noted that the oil obtained by the four processes other than alkali digestion needs neutralisation before being used.

From the above results, it follows that the best extraction method for indigenous shark livers is alkali digestion. This conclusion is in agreement with the experiments of Hartman[6] and others.[3,4] However, when the residual liquid is to be further processed for obtaining the anti-anaemic factor and other water soluble vitamins, papain digestion will be the most suitable.

References

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