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Influence of starvation on the brain and liver cholesterol levels of the cat-fish, *Heteropneustes fossilis* (Bloch)

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Abstract. Influence of starvation has been observed on the total cholesterol levels of the brain and liver of the cat-fish, *H. fossilis* (Bloch). The cholesterol level decreased with starvation in liver but in brain, after registering an initial fall, it showed a distinct rise. The variations in the cholesterol level of fish observed during starvation have been attributed to the changes in the rate of cholesterol synthesis and metabolism.

Keywords. Starvation influence; cholesterol level; *H. fossilis*.

1. Introduction

Many workers have reported the changes in the chemistry of fish tissue, blood and serum during starvation (Greene 1919; Love 1958; Phillips *et al* 1960; Scott 1962; Creach and Serfaty 1965; Inui and Ohshima 1966; Kamara 1966; Larson and Lewander 1973; Wilkins 1967). Many organs are able to synthesise cholesterol and its rate of formation is regulated by the amount present in the diet (Schoenheimer and Breusch 1933). Although studies have been made on the pattern of variations in the cholesterol content of animal tissue, blood and serum during short and prolonged starvation (Searcy 1969; Kerpel *et al* 1971), information on fish is far from complete. The present paper describes the influence of starvation on the total cholesterol levels of the brain and liver of the cat fish, *H. fossilis* (Bloch).

2. Materials and methods

Live *H. fossilis* of total length 17–25 cm were selected for the present study. The fishes were kept in an aquarium (95 × 35 × 45 cm) supplied with water at a temperature of 14 ± 2° C. The fishes were tagged by collar tags on the trunk region to record the decline in their weights during successive periods of starvation. Three fishes were taken out each time at an interval of ten days. An

equal number of controls were maintained to assess the normal values of the cholesterol. The starvation was continued over a total period of 50 days. The fishes were killed by a sharp blow on the head; the liver and brain were carefully removed and processed for chemical analysis. Total cholesterol was estimated using the method of Reinhold and Shiels as given by Hawk *et al* (1954) and calculated as mg/100 g wet tissue.

3. Results and discussion

As evident from table 1, starvation of fish resulted in a marked fall in total cholesterol content of the liver. In brain, however, the cholesterol level showed an initial decline upto 30 days of starvation but increased considerably thereafter. The fall in the cholesterol content of the liver as a result of 50 days of starvation was about 67%. The rise in the cholesterol content of the brain for the same period of starvation was 31%.

As the period of starvation progressed, a steady fall in the weight of the fishes also occurred. The decline in weight recorded every ten days during the entire period of starvation was of the order of 11·7, 13·1, 16·2, 19·2 and 20·9% respectively. On an average, the loss in the body weight of the fish was found to be 209·740 mg/day.

Though the fishes can survive short periods of starvation, longer periods may cause an imbalance and a major change in their metabolic economy (Love 1970). During prolonged fasting due to the inhibition of lipogenesis, the adipose tissue also indirectly becomes the main source of serum esterified fatty acids (Baker *et al* 1968).

Since cholesterol in the brain is primarily of endogenous origin, the relative low cerebral cholesterol level recorded in *H. fossilis* during starvation presumably indicate reduced synthesis of this sterol in the brain tissue. Cerebral cholesterol

Table 1. Effect of starvation on the total liver and brain cholesterol levels of the cat fish, *Heteropneustes fossilis* (Bloch)

Starvation period (days)	Liver				Brain			
	Cholesterol (mg/100 g tissue)	SE	*r*	Variance	Cholesterol (mg/100 g tissue)	SE	*r*	Variance
0	1216·00	25·43	3·61	1936·00	1771·33	37·75	2·13	1425·36
10	1161·00	51·00	7·59	7785·32	1629·33	29·48	3·13	2601·32
20	820·00	21·96	4·63	1444·00	1612·66	44·77	4·80	6001·29
30	563·33	30·15	9·26	2721·33	1564·00	42·77	4·73	5476·00
40	444·00	18·49	7·20	1024·00	1732·00	78·43	7·83	18411·99
50	396·00	27·16	11·86	2209·00	2322·66	112·14	8·35	37641·31

SE—standard error.
r—coefficient of variation.

synthesis may, however, be altered either by metabolic inhibition of any one step in the intermediary pathway of cholesterol synthesis or by limitation in the availability of co-factors for the reduction of demosterol to cholesterol (Shah 1972).

As already mentioned, liver may well be the chief organ responsible for the regulation of total body content of cholesterol and the control of plasma cholesterol levels. Besides, supplying endogenous cholesterol and cholesterol esters to plasma, it governs the bile acid production from cholesterol. Most cholesterol esters in the plasma are known to be formed by the action of lecithin cholesterol acyltransferase which utilises fatty acids from the plasma lecithin and thus are also indirectly dependent on the fatty acid supply (Glomset *et al* 1968).

The later phases of starvation perhaps result in an increased oxidation of fatty acids by the liver with a resultant increased elaboration and production of aceto-acetate and 3-hydroxy-butyrate and these compounds may become a major fuel for the brain. Since aceto-acetate is the precursor of cholesterol, the cholesterol content in brain should increase during the later stages of starvation, as is clear from the present studies. The liver thus occupies a central position in the metabolism of cholesterol as it does in the case of other lipids.

Our finding that liver cholesterol level is decreased in fasted fish seems consistent with the observations of Johnson and Shah (1974), who found that the conversion of liver squalene to cholesterol is reduced in starved rats. The depressing effect of fasting on the cholesterol biosynthesis of liver has also been pointed out eartier by West *et al* (1966).

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