

EFFECT OF STARVATION ON THE BLOOD CHARACTERISTICS  
OF TILAPIA ZILLII G. IN EGYPTIAN WATERS

By

A.M. FARGHALY<sup>1</sup>, A. EZZAT<sup>2</sup> and M.B. SHABANA<sup>3</sup>

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1 and 3 Zoology Department, Faculty of Science, Alexandria University, Egypt.

2 Oceanography Department, Faculty of Science, Alexandria University, Egypt.

#### ABSTRACT

Considerable variations in blood characteristics took place during the course of starvation ended by a marked decrease in the R.B.C. count, haematocrit value and haemoglobin content.

At the end of two months very slight increase in leucocyte count was recorded. Basophils were the least variable corpuscles among all leucocytes. Granulocytes increased with fasting.

Serum proteins showed a considerable decrease, alpha globulin increased, while beta and gamma globulins decreased.

Blood glucose level was minimal by the end of the period while blood creatinine level was above its normal value. Blood coagulation time increased after two month starvation.

#### INTRODUCTION

Starvation is one of the most drastic factors which might face the fish in its nature. Some authors have studied the effect of feeding on the physiology and blood values in fishes (Lysak and Wojcik 1960, Fine and Drillhon 1964 and Kuzmina 1966). The effect of starvation on the blood picture and physiology of fish were less extensively studied, although several papers have been published on this problem (Drilhon 1956 and 1964, Sano 1962, and Kamra 1966).

The present paper aims to clear out the variations taking place in the blood picture of *Tilapia zillii*, subjected to prolonged starvation.

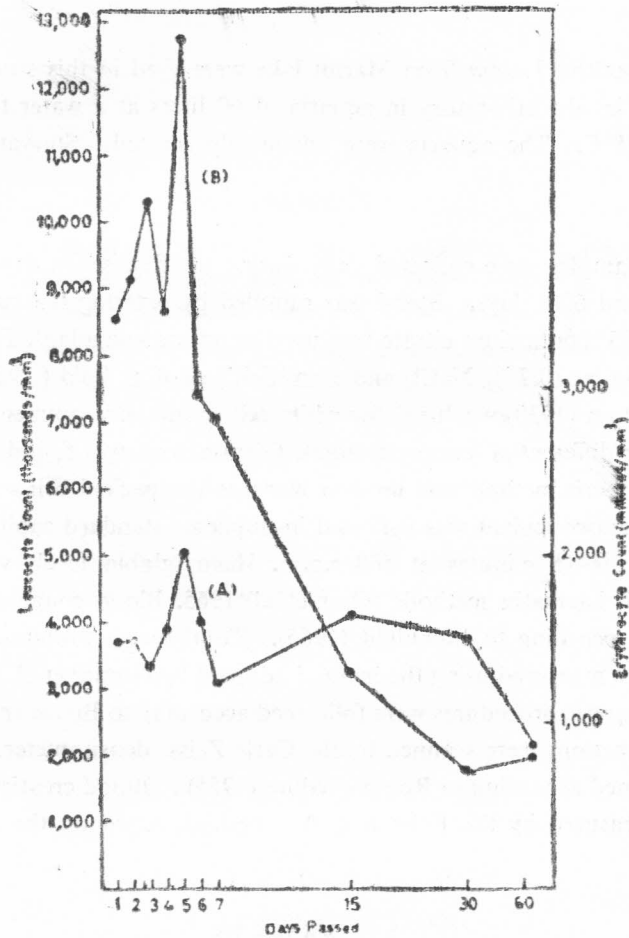


Fig. 1. Effect of starvation on leucocyte and erythrocyte counts.

**The packed cell volume :**

It is evident from (Fig. 2-A), that considerable variation in the packed cell volume took place during the course of starvation. On the 5th day, a marked increase is noted followed by a decrease until the 7th day after which an increase occurred. A slight decrease in the haematocrit value over the 30 days starved fishes is shown. Haematocrit values, reached a minimum at the end of 60 days.

### Haemoglobin content :

Considerable changes occurred in the haemoglobin content of starved fishes (Fig. 2-B). We note a considerable increase on the 5th day, followed by an obvious decrease on the 6th and 7th days. It increases again by the end of one weeks of starvation after which a gradual drop to a minimal value on the 60 th day occurred. The mean corpuscular haemoglobin showed very slight changes during starvation. It seems tha it is the only erythrocytic property which is slightly affected by starvta-tion.

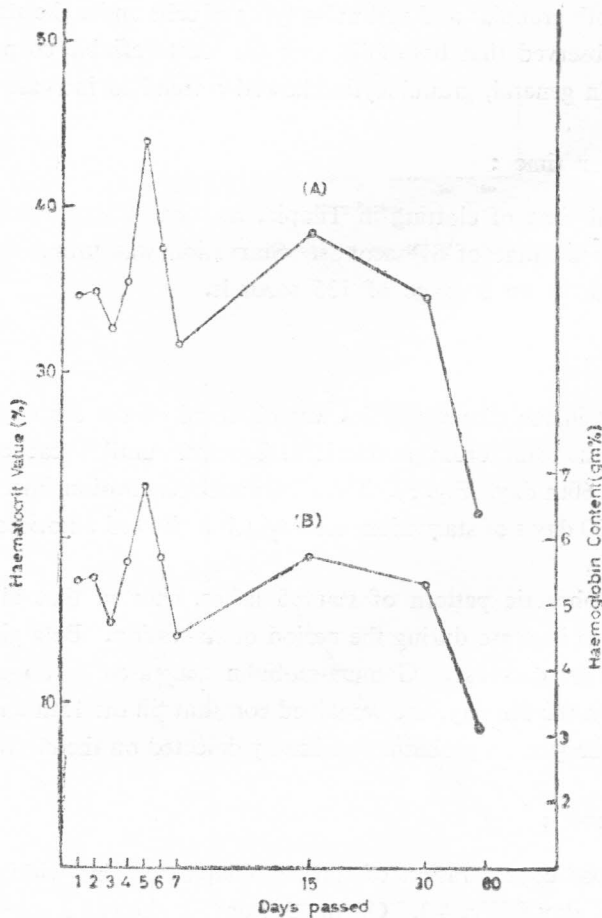


Fig. 2: Effect of starvation on packed cell volume and hemoglobin content.

**The white blood corpuscles :** ( Fig. 1-B )

Changes in the total leucocytes and their differential counts in Tilapia during 60 days of fasting are clearly demonstrated in the present work. On the 5<sup>th</sup> day, the total leucocyte count increases in a similar manner to that observed for the erythrocytes. After the 6<sup>th</sup> day a gradual decrease is observed until it reached a minimum value (1794 WBC/mm<sup>3</sup>) after a month of starvation. At the end of two months a very slight increase was observed.

As regards leucocytic differential counts, it was found that marked variations took place in both granular and agranular types of cells under the stress of starvation. It was observed that basophils were the least variable corpuscles among all leucocytes. In general, granulocytes showed a trend to increase with fasting.

**Blood coagulation time :**

The normal time of clotting in Tilapia, at room temperature is 70—110 seconds with an average of 81 seconds. Starvation was found to prolong the coagulation time to an average of 135 seconds.

**Serum proteins :**

An increase in the serum proteins was observed on the 5<sup>th</sup> day. As starvation continued, the total serum protein level fluctuates until it reached a markedly low level on the 60<sup>th</sup> day, (Fig. 3.) The albumin concentration fluctuated slightly during the first 30 days of starvation, after which it showed a noticeable decrease.

The electrophoretic pattern of starved fishes, showed that alpha globulin fraction tended to increase during the period of starvation. Beta globulin shows a trend of gradual decrease. Gamma-globulin decreased to about half of its original value, on the 5<sup>th</sup> day, and remained constant till the 15<sup>th</sup> day. At the end of the 60 days the gamma globulin was hardly detected on the electropherogram.

**Blood glucose level :**

Blood glucose concentration of starved Tilapia remains within the normal range till the 4<sup>th</sup> day ( Fig. 4 ). On the 5<sup>th</sup> day, it showed a marked increase. From the 6<sup>th</sup> day of starvation the blood sugar level undergoes gradual decrease until it reached its lowest value at the end of the starvation period.

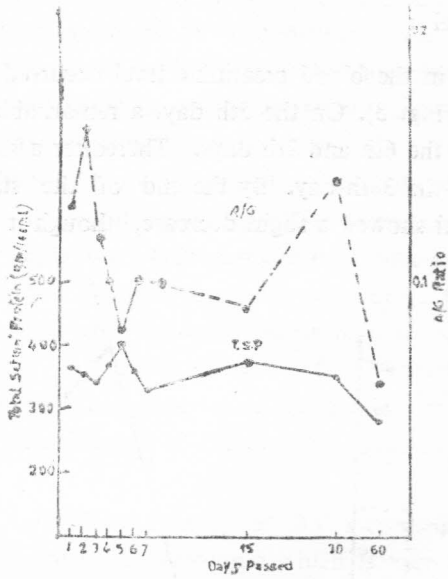


Fig. 3. Effect of starvation on total serum protein.

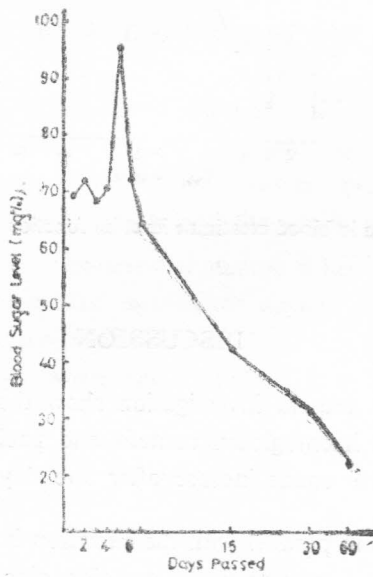


Fig. 4. Variation in blood-sugar level in function of starvation time.

**Blood creatinine level :**

A marked drop in the blood creatinine level occurred during the first four days of starvation (Fig. 5). On the 5th day, a remarkable increase took place then it fall again on the 6th and 7th days. Thereafter a sudden increase occurred which continued till the 30th day. By the end of the starvation period, the blood creatinine level showed a slight decrease, though it was still above its normal value.

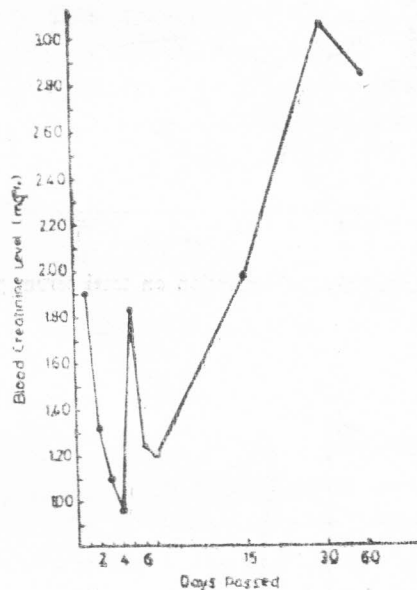


Fig. 5. Variation in blood creatinine level in function of starvation time.

**DISCUSSION**

The results of the present investigation show that in *Tilapia zillii* G., the erythrocyte count, the haemoglobin content and packed cell volume, together with the total leucocyte count increase after five days of starvation.

This increase goes in parallel with the elevation in the levels of the chemical components of the blood such as serum proteins, glucose and creatinine. Hence it is difficult to relate the increase in the R.B.Cs, haemoglobin and total leucocyte

count to haemopoiesis. Sano (1962) in his study on the Japanese eel *Anguilla japonica* observed such increase in the blood constituents during the early days of starvation, and attributed this to the decrease in the water content of the blood. Later, Kamra (1966) showed that there was an apparent increase in the blood elements of experimentally starved cod, *Gadus morrhua*. He concluded that dehydration and decrease in the total blood volume of the starved cod, leads to an apparent obvious increase in the blood constituents despite the considerable loss of body weight during food depletion. This seems to be a logic explanation for the rise in haemoconcentration of *Tilapia* that occurred during the early days of fasting. It appears that such tendency to dehydration is more vigorous during the first days of starvation. As starvation proceeds, a remarkable decrease in most of the blood constituents takes place, which reflects the variations in the rates of synthesis, turnover and utilisation of such constituents.

Creatinine, was the only blood component that increased during the later period of starvation. In contrast to ammonia which is excreted by the gills, creatinine is excreted by the kidneys in fishes (Smith 1929). Therefore, an elevation such as occurred during the later days of starvation may be due to a deficiency in the excretory function of the kidney.

### SUMMARY AND CONCLUSIONS

The effect of starvation on the blood characteristics of *Tilapia zillii* G. was investigated. During a period of 60 days of starvation, the values of haematocrit red cell counts, white cells, total and differential counts, coagulation time haemoglobin, blood sugar and creatinine levels and the serum protein concentration were measured. Electrophoretic patterns of starved fishes were described. The results obtained suggest that the fish in the early days of starvation, shows signs of dehydration. After a longer starvation period the fish suffers from anaemia, hyperglycemia and leucopenia. Moreover, the kidney loses its excretory capacity.



Table (1) : Effect of starvation on blood characteristic of *Tilapia zilli* G.

Blood charact.	Days of starvation . . .									
	1	2	3	4	5	6	7	15	50	60
Erythrocyte count millions/mm <sup>3</sup>	1.49	1.50	1.34	1.57	2.03	1.62	1.24	1.65	1.51	0.90
Hemoglobin content gm %	5.35	5.40	4.70	5.65	6.80	5.70	4.55	5.76	5.30	3.10
Hematocrit value %	34.50	34.80	32.60	35.40	44.00	37.50	31.70	38.40	34.60	21.50
Erythrocyte volume mm <sup>3</sup>	231.54	232.0	241.8	225.5	216.7	231.5	255.6	232.8	229.1	244.3
Erythrocytic haemoglobin ug	35.90	33.00	35.07	36.98	33.49	35.18	36.69	34.90	35.09	35.22
Total leucocyte count	8,504	9,116	10,309	8,643	12,739	7,400	7,060	3,287	1,794	1,952
Agranulocyte %	72.50	65.00	74.00	81.50	70.50	54.50	42.00	33.50	48.00	53.00
Mn %	8.00	6.00	7.00	3.00	5.50	2.50	0.0	1.00	0.50	4.00
L.L. %	13.00	10.5	14.0	16.6	12.5	15.5	17.00	26.5	32.00	9.50
S.L. %	51.5	48.5	53.0	62.0	52.5	36.5	25.0	16.00	15.5	39.50
Gran. %	27.5	35.0	26.0	18.5	29.5	45.5	58.0	66.5	52.0	47.0
Nt. %	23.0	28.5	17.5	18.50	19.50	43.50	40.00	44.50	27.50	40.00
Es. %	4.00	6.50	7.50	9.00	8.50	11.00	16.00	20.50	22.50	7.00
Bs. %	0.50	0.0	1.00	1.00	1.50	1.00	2.00	1.50	2.50	0.00
Total serum protein gm %	3.65	3.55	3.40	3.70	4.00	3.60	3.28	3.75	3.50	2.80
Albumin gm %	0.42	0.52	0.36	0.41	0.32	0.35	0.30	0.33	0.44	0.17
Globulin gm %	3.23	3.05	3.04	3.30	3.68	3.25	2.98	3.42	3.06	2.63
Albumin/Globulin	0.13	0.16	0.10	0.10	0.08	0.10	0.10	0.09	0.14	0.06
Blood sugar level mg. %	69.60	72.40	68.50	71.00	95.80	72.30	64.30	42.70	31.80	22.60
Blood creatinine mg. %	1.91	1.32	1.10	0.96	1.83	1.24	1.20	1.98	3.05	2.71

Abbreviations : Mn : monocyte Nt = Neutrophils

L.L. = large lymphocytes

Es = Eosinophils

S.L. = small lymphocytes

Bs = Basophils

gran. = granulocytes

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