

**SOME ASPECTS OF THE HAEMATOLOGY OF FOUR RED
SEA FISH SPECIES DURING THEIR SPAWNING PERIOD**

By

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SUMMARY

1.—An investigation was made of some aspects of the haematology of four marine fish species, *Epinephelus fasciatus*, *Epinephelus summana*, *Epinephelus areolatus* and *Epinephelus tauvina* taken from the Marine Biological Station at Ghardaqa (Red Sea).

2.—The authors were mainly interested in the determination of the number of erythrocytes, haemoglobin content and haematocrit values in the four mentioned species during their spawning period.

3.—Visible differences can be observed in the three parameters studied among the different species. This variability may be corroborated that the more active type of fishes have higher values than the less active species have.

4.—Marked quantitative differences in the values of the three mentioned parameters exist between the sexes of the same species, being always lower in females than in males. The preparation period and the spawning process may cause this considerable decrease.

5.—The species studied have the same correlation between the number of erythrocytes, haemoglobin content and haematocrit values as that previously arrived at for fresh water fishes and other vertebrates.

INTRODUCTION

There is a notable lack of physiological informations concerning many Red Sea fish species. Therefore some aspects of the haematology of four closely related Red Sea fish species were studied here including an investigation of erythrocyte number, haemoglobin content and haematocrit value.

The specific biological character and the variety of fish species make the comparison of haematological indices exceptionally difficult. The dependence of haematological, indices on physiological and environmental conditions and also on the age and sex of fish belong still to the controversial subjects in literature. Some authors do not find differences connected with sex dimorphism as e.g. SMITH (1930) for *Salmo trutta* L. and GLAZOVA (1967) for *Acipenser ruthenus* L. and *Acipenser stellatus* Pall. Others

like LANGE (1919) and PAVLOV and KROLICK (1935) justify the quantitative changes in the composition of the circulating blood of males and females for optional months of the annual cycle. IVLEV (1955) observed even in winter similar correlations in the blood of *Lota lota* (L.), *Silurus glanis* L. and *Cyprinus carpio* L. Furthermore, SCHLICHER (1927), PAVLOV and KROLICK (1935) state that the number of erythrocytes and haemoglobin is higher during the entire year in the blood of males than of females.

Other authors find the differences connected with the sex of fish only during the production of gonads and spawning. ROBERTSON et al. (1961) proves that the haematological indices are considerably lower in the blood of females during the spawning migrations of *Oncorhynchus tshawytscha* (Walb). The results of CERNIKOVA (1967) for *Coregonus lavaretus* bearii kassl. are approximate. But according to SCHLICHER (1927) the quantitative changes in some fresh water fishes during spawning are the same in the blood of males and females.

The ability of the blood to carry oxygen depends on the concentration of the respiratory pigment present and its nature. A knowledge of the amount of haemoglobin in the blood of fishes can be of considerable significance in understanding their ecological and physiological relationships.

The haemtocrit is one of the most important of all clinical constants because of its high degree of reproducibility. This parameter is most useful for detection of anaemia (ELIS, 1956) and may also indicate the presence or absence of haemolysis in the blood samples which cannot be ascertained by counting erythrocytes. Haemtocrit is extremely reliable and can be easily and rapidly performed with fish blood (SNIESZKO, 1960).

Extreme differences in erythrocyte counts have been found for various species of fishes. Many interesting opinions have been expressed concerning the significance of these differences. BONNET (1926) found that the erythrocyte counts of different species of fish increased when the fish held in water of low oxygen content. On the other hand, this number considerably decreases during the spawning season (ORECKA, 1970).

Many authors reported a close correlation among the mentioned parameters in fresh water fishes (EISLER, 1965; SUMMER-FELT et al., 1967b; DE WILDE & HOUSTON, 1967; BADAWI, 1968; BADAWI & SAID, 1971; EL DOMIATY, 1972; and EL BESHRY, 1974). With the present investigation it was intended to find out whether this same relationship exists among the different species of marine teleosts studied. Also the research work aims at determining sexual differences in the proper haematological indices mentioned.

MATERIAL AND METHODS

Four mature Red Sea species, *Epinephelus fasciatus* (Forsk.) *Epinephalus summana* (Forsk.), *Epinephalus areolatus* (Forsk.) and *Epinephalus tauvina* (Forsk.) of both sexes which have similar physiographical conditions were investigated. The blood for investigation was taken from the vena caudalis. The time of the collection of blood samples since taking the fish out of water did not exceed one minute. Coagulation was prevented by the use of heparin. The blood so obtained was used for red cell counts for the determination of haemoglobin and for volume of packed red cells.

Erythrocyte counts were carried out according to the procedure described by HESSER (1960) using the diluting solution recommended by HENDRICKS (1952).

Haemoglobin content was determined colorimetrically by the alkali haematin method (OSER *et al.*, 1965).

Haematocrits were measured according to the method of LARSEN and SNIESZKO (1961 a) using heparinized (10%) capillaries and a scaled reading device

RESULTS

The tabulated data show visible differences in the number of erythrocytes, haemoglobin content and haematocrit values between males and females of all species studied. The average values of males were always higher than those of females during the experimental period. The results obtained are shown in tables I-III.

Definite variations between species were detected. The highest relative indices (average contents) was recorded for *Epinephalus summana*, the other values ranged downward, the lowest was reported for *Epinephalus tauvina*.

DISCUSSION

The author's private observations show a marked species variability in the number of erythrocytes, haemoglobin content and haematocrit values. This may be corroborated that the more active type of fishes have higher values than the less active species have.

Quantitative amounts are always lower in females than in males in all the species studied during the experimental period. This decrease in the instance of females may be parallel with development and gonad resorption as blood estimations were carried out during the spawning period. Thus for the first time a division connected with sexual dimorphism takes place and in accordance with the results of SCHLICHER (1927), PUCKOV & FEDOROVA (1951) for other fish, the values of the three parameters just mentioned are higher in males.

Always constant is evidently the relationship between erythrocyte count, amount of haemoglobin and haematocrit values. This correlation is exactly the same as that previously arrived at for fresh water fishes by EISLER (1965), SUMMERFELT *et al.*, (1967 b), DE WILDE & HOUSTON (1967), BADAWI (1968), BADWI & SAID (1971), EL DOMIATY 1972) and EL BE-SHRY (1974) and for other vertebrates (WINTROBE, 1934).

TABLE 1. Measurements of the red blood cells (per cmm.) during the spawning period.

		Males	Females
Epinephelus fasciatus	Range	1.20%1.25	0.97—0.99
	Average	1.23×10^6	0.98×10^6
	S.D.	0.4	0.2
Epinephelus summana	Range	1.97—2.01	1.74—1.76
	Average	1.99×10^6	1.75×10^6
	S.D.	0.3	0.2
Epinephelus areolatus	Range	1.6—1.72	1.52—1.50
	Average	1.80×10^6	1.54×10^6
	S.D.	0.15	0.2
Epinephelus tauvina	Range	1.20—1.22	0.97—0.999
	Average	1.21×10^6	0.99×10^6
	S.D.	0.2	0.21

TABLE II : Percentage of packed red blood cells during the spawning period.

		Males	Females
Epinephelus fasciatus	Range	32.9—33.2	31.8— 32.2
	Average	33	32
	S.D.	0.2	0.1
Epinephelus summana	Range	46.9—47.1	45.2—45.8
	Average	47	45.5
	S.D.	0.1	0.1
Epinephelus areolatus	Range	35.6—36.4	34.8—35.3
	Average	36	35
	S.D.	0.2	0.2
Epinephelus tauvina	Range	34.6%35.2	33.1—33.8
	Average	35	33.5
	S.D.	0.26	0.3

TABLE III. Haemoglobin values (g/100 ml blood) during the spawning period

		Males	Females
Epinephelus fasciatus	{ Range	8.7—9.3	8.4—8.65
	{ Average	9.1	8.6
	{ S.D.	0.21	0.1
Epinephelus summana	{ Range	13.9—14.15	13.1—13.48
	{ Average	14.1	13.4
	{ S.D.	0.12	0.22
Epinephelus arcolatus	{ Range	12.1—12.25	10.8—11.19
	{ Average	12.2	11 0.23
Epinephelus tauvina	{ Range	9.85—10.11	9.21—9.42
	{ Average	10	9.3
	{ S.D.	0.12	0.2

REFERENCES

- Badawi, H.K.** 1968.—A haematological study of healthy and diseased rainbow trout (*Salmo gairdnerii irideus*). Ph.D. Thesis, Tokyo Univ.
- Badawi, H.K. and Said M.M.** 1971.—A comparative study of the blood of four Tilapia species (Pisces). *Marine Biology*, 8 (3) : 202-204.
- Bonnet, V.** 1929.—De L'influence de L'hémorragie et de L'asphyxie sur le nombre de hématies dans le sang circulant des vertébrés inférieurs. *J. Phys. Path. Gen.*, 27 (4) : 735-740.
- Cernikova, B.B.** 1967.—Indicants of the blood of fresh water fishes in the summer - autumnal period. In : *Obmen veshchestv i biohimija ryb*, 163-168, Moskva. Izdat, "Nauka".
- De Wilde, M.A. and Houston, A.H.** 1967.—Haematological aspects of the thermoacclimatory process in the rainbow trout, *Salmo gairdneri*. *J. Fish. Res. Bd. Canada*, 24 (11) : 2267-2281.
- El-Bishry A.** 1974.—A haematological study of healthy *Anguilla vulgaris* and *Mugil cephalus*. M. Sc. Thesis.
- El-Domiaty, N.A.** 1972.—A comparative Study of the blood of *Cyprinus carpio* L. and *Bagsus bayad*. Ph. D. Thesis.

- Fisler, R.** 1965.—Erythrocyte counts and haemoglobin content in 9 species of marine teleosts. *Chesapeake Sci.* **6** (2) : 119-120.
- Glazova, T.N.** 1967.—Physiological and biochemical blood characters of some acipenserids fishes. In : *Obmen veshchestv i biohimija ryb*, 159-163. Moskva, Izdat "Nauka".
- Hendricks, L.J.** 1952.—%Erythrocyte counts and haemoglobin determinations for two species of suchers, genus *Catostomus* from Colorado. *Copea*, **4** : 265-266.
- Hesser, E.F.** 1960.—Methods for routine fish haematology. *Prog. Fish. Cult.*, **22** (4) : 164A171.
- Ivlev, V.S.** 1955.—The influence of coldness conditions on the blood of some fresh water fishes. *B jull. Mosk. Obsc. Ispyt. Prir., Otd. Biol.*, **60** : 73-78.
- Langet W.** 1919.—Untersuchungen Uber den Hamoglobin gehalt, die Zahl und Gosse der roten Blutkorperchen. *Zool. Jb. Abt. Allg. Zool. Phyl. Tiere.*, **36** : 657-698.
- Osert B.L., and Others** 1965.—Haws physiological chemistry, the fourteenth edition. McGraw-Hill Nook Company, New York, 1472.
- Oreckat E.** 1970.—Quantitative changes in the circulating blood of Tench (*Tinca tinca* L.) in the anual cycle. *Pol. Arch. Hydrobiol.* **17** (30) :436-444.
- Pavlov, V.A. and Krolick, B.** 1935.—The haemoglobin content and number of erythrocytes in the blood of some fresh water fishes. *Trans. Boradino Biol. St.* **9** (1) : 5-28.
- Puckov, I.V., Feqorova, A.L** 1951.—Investigations of carp blood composing variation (*Cyprinus carpio*) on account of starvation an refrigeration. *Trudy Mosrybtuza*, **4**.
- Rouertson, O.H., Krupp, M.A., Favour, C.B., Hane, S., Thomas, F.T.** 1961.—Physiological change occurring in the blood of the pacific Salmon (*Oncorhynchus tshawytscha*) accompanying sexual maturation and spawning . *Endocrinology*, **68** : 733-746.
- Schlicher, J.** 1927.—Vergleichend-Physiologiche Untersuchungen der Blutkorperchenzahlen bei Knochenfischen. *Zool. Jb. Abt. Allg. Zool. Physiol. Tiere*, **42** : 121-200.
- Smith, Ch.** 1940.—A comparative study of the total red counts of wild and liverfed rout. *Proc. Soc. exp. Biol. Med.*, **27** : 670-673.
- Sniescko, S.F.** 1960.—Microhaematocrit as a tool in fishery research and management. *U.S.F.W.S. Spec. Sci. Rept. Fisheries* **341** : 15.

- Sniescko, S.F.** 1961.—Microhaematocrit values in rainbow trout, brown trout and black trout. *Prog. Fish. Cult.* **23** (3) : 114-119.
- Summerfelt, R.C., Lewist, W.M. and Marich, M.G.** 1967.—Measurement of some haematological characteristics of the gold fish. *Ibid.* **29** (1) : 13-20
- Wells, Benjamin, B.** 1955.—Clinical pathology xvii and 488 pp. 2nd ed. W.B. Saunders Compar. Phil.
- Wintrobe, M.M.** 1934.—Variations in size and haemoglobin content of erythrocytes in the blood of various vertebrates *Folia haematologica*, **51** (1) : 32-49.