THE SEASONAL HAEMATOLOGY OF THE SMALL-MOUTH YELLOWFISH (*BARBUS HOLUBI*)

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ABSTRACT

Haematological parameters in small-mouth yellowfish (*Barbus holubi*) have been examined from February to November. Seasonal variations were observed in several of the parameters studied. Sexual differences were slight and no significant changes in haematology could be related to breeding season. The results are discussed in relation to other published observations.

INTRODUCTION

It is well known that the environment plays an important role in the physiology of fish and that haematological parameters can give an indication of the patho-physiological state of the animal (Blaxhall & Daisley 1973). No detailed observations concerning the normal seasonal effects on the haematology of the small-mouth yellowfish (*Barbus holubi*) are available. Recently Fourie & Hattingh (1976) have studied the influence of season on the haematology of the carp *Cyprinus carpio*, and the present study was conducted to establish a possible similar influence of season on the haematology of *B. holubi* under laboratory conditions, and also to see whether these haematological parameters may be used as an early indicator of breeding activity. This would be useful information because of problems encountered in the artificial breeding of these animals (Mulder 1971).

MATERIALS AND METHODS

The fish used in the present study were seined each month in the Boskop Dam near Potchefstroom and in the Vaal River near Standerton during the period February to November 1974. They were transported to and maintained in the laboratory as described previously (Hattingh *et al.* 1975). A total of 80 fish, all sexually mature and in good health, was used.

The methods used for anaesthetization, blood sampling and the determination of standard haematological parameters have been described in detail elsewhere (Hattingh 1973, 1974).

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RESULTS

Haematological results

Tables 1 and 2 show the results obtained. Blood pH varied between 7,20 and 7,47. This variation is not attributable to season but rather to experimental conditions (Hattingh *et al.* 1975) Haematocrit (Hc), haemoglobin concentration (Hb) and mean cell volume (MCV) all fluctuated during the year but showed maximum values during September. In contrast, the plasma protein concentration (P. prot.) showed a minimum value during this month. The erythrocyte counts stayed remarkably constant throughout the year, and the leucocyte counts showed peaks during February and July–August. Average corpuscular haemoglobin (ACH) showed a minimum value during July–August and mean corpuscular haemoglobin concentration per cent (MCHC) peaked during June.

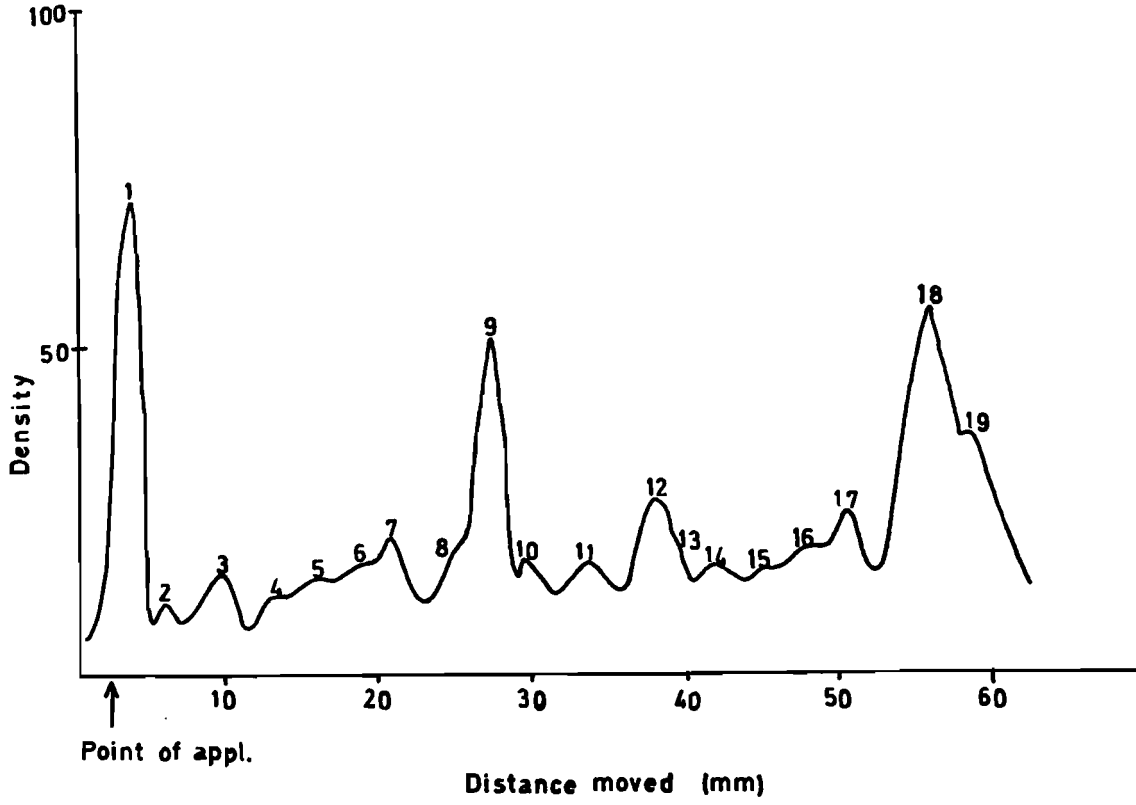

FIGURE 1

Polyacrylamide gel electrophoresis of *B. holubi* plasma. The electrophoretogram showed a standard pattern throughout the study period with small variations in concentration of some fractions (see text).

No large differences were observed between males and females. Mean values for Hc, Hb, erythrocyte and leucocyte counts were higher for the females during the periods June–August and September–November than for the males. The same tendency was observed in the mean MCV and ACH values, and the P. prot. and MCHC values were found to be very similar for both sexes throughout the study period.

Plasma protein electrophoresis

Polyacrylamide gel electrophoresis of the plasma proteins showed no sexual differences throughout the year. The standard pattern obtained is shown in Figure 1. Seasonal variations were slight. During winter (June–July) an additional fraction in low concentration appeared next to Fraction 2. During spring (September–October) Fractions 4 and 6 increased in concentration and Fractions 7, 8 and 9 decreased. During winter Fractions 13 and 15 increased in concentration and during autumn the same was observed for Fractions 11 and 17. No marked marked changes were observed in the electrophoretograms prior to or during the breeding season (September–November).

DISCUSSION

Although sexually mature animals, in so far as males could be distinguished from females, were used in this study, it is evident from Tables 1 and 2 that some of them were very young, especially during the first half of the year. This fact could explain the reversal observed in some of the haematological parameters where the males initially showed higher values than the females (first part of the year). However, the haematological parameters correlated poorly with both mass and length and the variations observed in these values are therefore probably not due to the differences in mass and length of the fish used.

When compared to the haematological parameters of the only other indigenous fish on which seasonal studies have been done, the carp, *B. holubi* shows lower mean Hb and erythrocyte counts, and higher P. prot. and leucocyte values (Fourie & Hattingh 1976). Also, in the carp, the males exhibit higher erythrocyte counts, Hc values and Hb concentrations than the females. The reverse was noticed in mean values in the present study (from June to November) and this also differs from the work of Ezzat *et al.* (1973) on *Tilapia zilli*. According to Fourie & Hattingh (1976) indigenous carp show maximum values in their erythrocyte counts during October and in their Hb and P. prot. concentrations during July, and a minimum value in leucocyte count during June. The last parameter was found to show a peak during July–August in the present study and Hc and Hb values showed maximum values during September. The results of the present work concerning Hb and Hc values are in agreement with the results of Umminger & Mahoney (1972) on *Salmo gairdneri* and Murachi (1959) on carp. Taken as a whole, therefore, it appears that different fish species respond differently to environmental conditions and that no definite reactions can be said to occur in the blood of fish due to season.

The plasma protein electrophoretogram of *B. holubi* differs sufficiently from that of other fish species to be used as a means of identification. In contrast to the carp (Fourie & Hattingh 1976), very little seasonal variation is apparent in this parameter and no marked changes occur

TABLE 1

Monthly haematological parameters for *B. holubi* (Means ± S.D.)

Month	*pH*	*Mass g*	*Length cm*	*Hc %*	*Hb g%*	*P. Prot. mg/ml*	*Erythro-cyte $10^6/mm^3$*	*Leuco-cytes $10^3/mm^3$*	*MCV u^3m*	*ACH ng*	*MCHC %*
February	7,47 ± 0,18	199,24 ± 0,84	21,98 ± 3,47	31,10 ± 5,48	7,32 ± 2,05	27,78 ± 14,90	1,22 ± 0,51	17,03 ± 3,66	299,53 ± 135,20	66,53 ± 21,97	23,77 ± 7,33
March	7,37 ± 0,06	171,48 ± 38,44	24,71 ± 1,72	34,88 ± 4,84	8,12 ± 1,32	28,51 ± 5,58	1,28 ± 0,31	12,92 ± 4,85	256,57 ± 76,04	62,22 ± 17,17	23,45 ± 2,24
April	7,21 ± 0,11	197,28 ± 46,60	25,75 ± 1,98	35,45 ± 8,46	9,04 ± 1,97	33,45 ± 2,35	1,33 ± 0,03	6,01 ± 1,94	268,80 ± 51,24	60,67 ± 10,33	22,80 ± 3,38
May	7,38 ± 0,13	157,75 ± 47,62	24,05 ± 2,11	30,97 ± 4,83	7,78 ± 1,73	28,08 ± 8,89	1,19 ± 0,02	7,14 ± 3,01	262,36 ± 43,06	65,27 ± 12,31	24,52 ± 3,16
June	7,29 ± 0,07	183,74 ± 106,59	25,88 ± 4,43	30,07 ± 13,45	8,28 ± 3,77	23,55 ± 4,77	1,34 ± 0,02	5,38 ± 0,93	206,76 ± 92,87	65,21 ± 13,43	34,11 ± 14,92
July	7,43 ± 0,04	167,52 ± 39,34	23,92 ± 1,26	39,44 ± 13,11	7,30 ± 1,52	26,12 ± 4,49	1,27 ± 0,02	17,03 ± 9,07	306,40 ± 61,40	57,42 ± 6,02	19,08 ± 2,70
August	7,41 ± 0,41	299,32 ± 60,45	27,60 ± 1,92	34,44 ± 4,20	6,78 ± 1,06	25,60 ± 4,97	1,30 ± 0,14	17,52 ± 6,80	267,05 ± 41,32	52,93 ± 12,11	19,72 ± 2,23
September	7,20 ± 0,06	301,10 ± 65,41	30,40 ± 1,20	45,60 ± 2,13	8,46 ± 0,27	19,24 ± 4,34	1,25 ± 0,08	7,70 ± 2,70	358,16 ± 38,86	68,08 ± 4,34	18,58 ± 1,24
October	7,26 ± 0,07	587,83 ± 370,03	37,26 ± 4,08	35,53 ± 4,51	8,33 ± 0,95	24,52 ± 2,97	1,23 ± 0,13	7,53 ± 3,32	279,42 ± 13,40	68,97 ± 6,65	24,85 ± 3,07
November	7,34 ± 0,08	479,70 ± 104,91	31,44 ± 10,89	27,80 ± 6,83	7,34 ± 0,86	25,24 ± 6,84	1,11 ± 0,40	6,45 ± 1,56	244,96 ± 53,22	66,04 ± 7,69	27,72 ± 7,85

TABLE 2

Seasonal values for different sexes of *B. holubi* (Means ± S.D.)

Season	*Sex*	*pH*	*Hc* %	*Hb* g%	*P. Prot.* mg/ml	*Erythro-cyte* $10^6/mm^3$	*Leuco-cytes* $10^3/mm^3$	*Mass* g	*Length* cm	*MCV* u^3m	*ACH* ng	*MCHC* %
March–May	Male	7,25 ± 0,14	37,08 ± 7,79	8,47 ± 1,62	31,03 ± 7,73	1,28 ± 0,28	13,04 ± 10,51	177,50 ± 50,39	24,88 ± 2,27	297,40 ± 70,99	67,55 ± 13,97	22,89 ± 2,81
	Female	7,33 ± 0,14	30,72 ± 7,54	7,52 ± 1,79	30,16 ± 7,54	1,22 ± 0,33	6,95 ± 3,24	174,43 ± 49,83	24,81 ± 2,16	262,32 ± 42,63	62,10 ± 10,98	23,85 ± 3,06
June–August	Male	7,36 ± 0,15	26,36 ± 8,63	7,02 ± 1,07	24,15 ± 6,41	1,28 ± 0,15	11,80 ± 9,13	208,96 ± 85,40	24,41 ± 3,07	219,53 ± 74,52	55,85 ± 9,36	28,49 ± 15,82
	Female	7,36 ± 0,08	36,50 ± 12,48	8,61 ± 1,88	25,38 ± 2,78	1,35 ± 0,76	11,65 ± 8,50	215,15 ± 112,26	25,29 ± 3,82	271,25 ± 84,46	63,27 ± 12,96	23,90 ± 8,97
September–November	Male	7,30 ± 0,05	32,48 ± 8,52	7,58 ± 1,03	24,90 ± 6,24	1,17 ± 0,13	7,18 ± 1,43	486,92 ± 259,22	32,68 ± 5,68	277,38 ± 63,72	65,00 ± 6,67	24,06 ± 3,86
	Female	7,22 ± 0,07	40,27 ± 5,88	8,42 ± 0,63	21,05 ± 4,49	1,22 ± 0,10	8,05 ± 2,71	621,25 ± 308,34	35,21 ± 5,97	330,55 ± 46,05	69,27 ± 5,50	21,35 ± 3,88

during the breeding season. In the laboratory, many of the fish studied during October and November were ripe, *i.e.* with mature sperm and ova in their gonads, but the slight changes occurring in the electrophoretogram and other blood parameters were not sufficient to allow the identification of a ripe fish. This again differs from the situation in carp (Fourie & Hattingh 1976). Haematological study in the small-mouth yellowfish does therefore not lend itself to the detection of breeding activity, at least not in the laboratory.

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