Serum Biochemical and Hematological Parameters of Captive White-tailed Fawns

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SUMMARY

Blood samples were collected, at one day of age and at weekly intervals from one through 25 weeks of age, from seven white-tailed fawns (Odocoileus virginianus) to determine the effect of age upon serum biochemical and hematological values. Serum total protein concentration increased continually during the six month period. The rate of anabolism of serum gamma-globulin exceeded the rate of catabolism at about seven weeks of age. Serum cholesterol concentration more than doubled from one day to eight weeks of age. Blood hemoglobin concentration and packed cell volume increased markedly during the first eight weeks of life, but tended to remain constant from eight to 25 weeks of age. Blood erythrocyte count increased throughout the duration of the study; however, the relative increase was greater during the first eight weeks of age than thereafter.

RÉSUMÉ

Les auteurs ont prélevé des échantillons hepdomadaires de sang chez des faons de cerfs de Virginie (Odocoileus virginianus), de la première à la 25e semaine d'âge. Ils ont cherché à déterminer la relation qui pourrait exister entre l'âge et les paramètres biochimiques et biologiques du sang. La concentration du sérum en protéines totales augmenta continuellement au cours de la période de six mois. Le taux d'anabolisme des globulines gamma du sérum dépassa leur taux de catabolisme vers l'âge de 7 semaines. Le taux de cholestérol sérique fit plus que doubler entre l'âge d'un jour et de 8 semaines. La concentration en hémoglobine et le volume du culot cellulaire augmentèrent de façon prononcée durant les premières huit semaines, mais se stabilisèrent ensuite entre la huitième et la vingt-cinquième semaine. Les valeurs érythrocytaires augmentèrent constamment au cours de l'étude mais cette augmentation fut relativement plus marquée au cours des premières huit semaines qu'ultérieurement.

INTRODUCTION

There are only a limited number of reports concerning the effect of age on serum biochemical and hematological parameters in deer (1, 2, 5, 6), and not all reported serum biochemical values are for live deer. To establish the normal concentrations and activities of serum and blood components during the first six months of life, an experiment was designed to evaluate the effect of age, from one day to 25 weeks of age, upon serum biochemical and hematological values.

MATERIALS AND METHODS

The white-tailed deer (*Odocoileus virginianus*) used in this study were born in captivity at the Charles W. Green Wildlife Research Area, in Central Missouri, between May 10 and June 25, 1968. The fawns (four males and three females) represented three sets of twins and one single birth from four mature does. Each doe and her offspring were confined in an individual 4.6 x 13.7 meter pen with a dirt floor. Does were fed dairy chow[1] and whole kernel corn The remainder was allowed to clot at room temperature for four hours, and the serum was separated by centrifuging at 0°C and 12,500 X g for ten minutes; the serum was recentrifuged at 0°C and 20,000 X g for five minutes. Each serum sample was frozen and stored at –10°C until analyzed; all tests were performed within three months after sample collection.

ad libitum. Fawns were permitted to suckle until they began consuming the dry feed and natural weaning occurred. There was no evidence of any clinical illness or parasitism in the fawns and their growth rate was similar to that of other white-tailed deer in captivity.

Fifty ml blood samples were collected, by venipuncture, at one day of age (after in-

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[1]D & F Dairy Chow: Ralston Purina Co., St. Louis, Missouri.

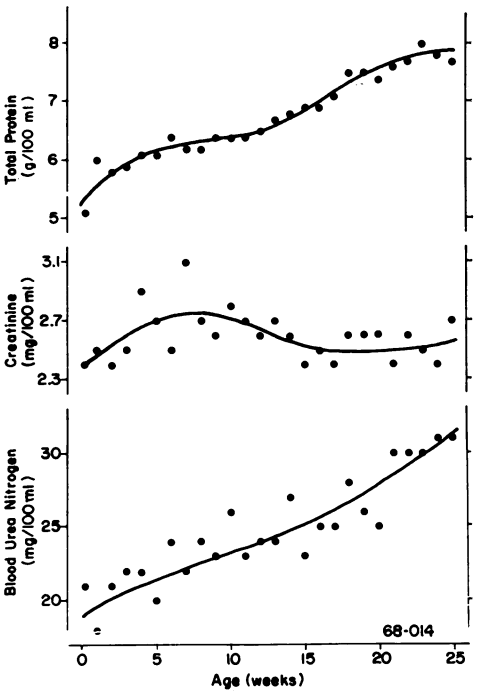

Fig. 1. Concentrations of total protein (g/100 ml), creatinine (mg/100 ml) and blood urea nitrogen (mg/100 ml) in serum from one day to six month old white-tailed deer.

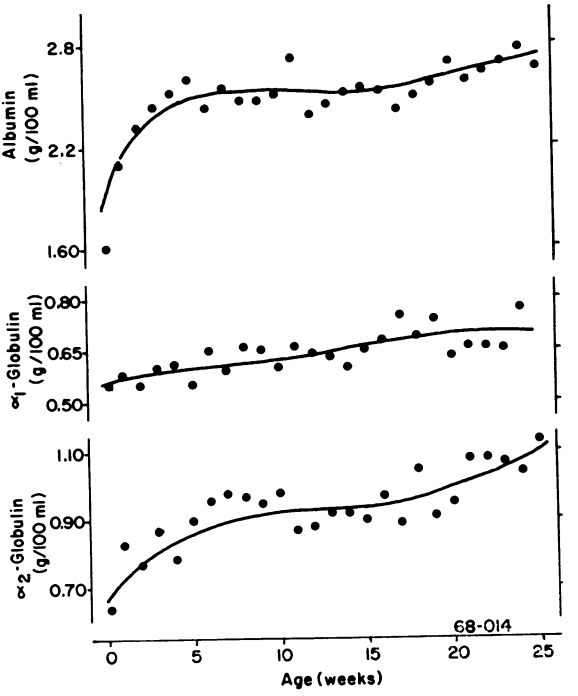

Fig. 2. Concentrations (g/100 ml) of albumin, alpha$_1$-globulin and alpha$_2$-globulin in serum from one day to six month old white-tailed deer.

gestion of colostrum) and weekly from one through 25 weeks of age. Three ml of the blood, to be used for hematological determinations, were collected using EDTA-K (2 mg/ml of blood) as the anticoagulant.

Serum levels of lactic dehydrogenase (LDH), alkaline phosphatase (AP), glutamic-oxaloacetic transaminase (G-OT), total protein (TP), blood urea nitrogen (BUN), creatinine (Crt), calcium (Ca), inorganic phosphorus (IP), chloride (Cl), cholesterol (Chol), glucose (Glu) and total bilirubin (TB) were determined using a modified survey model Sequential Multiple AutoAnalyzer[2] (SMA-12/30) (4). The serum protein fractions, albumin (Alb), *alpha*$_1$globulin (α_1-Glob), *alpha*$_2$-globulin (α_2-Glob), *beta*-globulin (-Glob) and *gamma*-globulin (γ-Glob), were separated electrophoretically, on cellulose polyacetate strips, stained with Ponceau S and quantitated using a densitometer[3]. From these values the albumin/globulin (A/G) ratios were calculated. Serum sodium (Na) and potassium (K) concentrations were determined by flame photometry[4].

Erythrocytes (RBC) and leukocytes (WBC) were enumerated using an electronic cell counter, with a 70 μ aperture, and the erythrocyte cell size distributions were determined using a particle size distribution analyzer plotter[5]. Hemoglobin concentrations (Hgb) were determined using an hemoglobinometer[6] and packed cell volumes (PCV) were determined by the microhematocrit method. Mean corpuscular volumes (MCV), mean corpuscular hemoglobins (MCH) and mean corpuscular hemoglobin concentrations (MCHC) were calculated.

RESULTS AND DISCUSSION

The mean concentration of serum TP increased from one day (5.1 g/100 ml) to one week (6.0 g/100 ml) of age; from one to 25 weeks of age there was a continued increase in serum TP concentration (Fig. 1). The increase in serum TP, during the first two months, was due to increases in serum Alb, α_2-Glob and β-Glob concentrations (Fig. 2 & 3); whereas the continued in-

[2]Technicon Corporation, Tarrytown, New York.
[3]Gelscan; Gelman Instrument Co., Ann Arbor, Michigan.
[4]Model 105; Beckman Instruments, Fullerton, California.
[5]Model B counter and model J plotter; Coulter Electronics, Hialeah, Fla.
[6]Model 231; Instrumentation Laboratory, Watertown, Massachusetts.

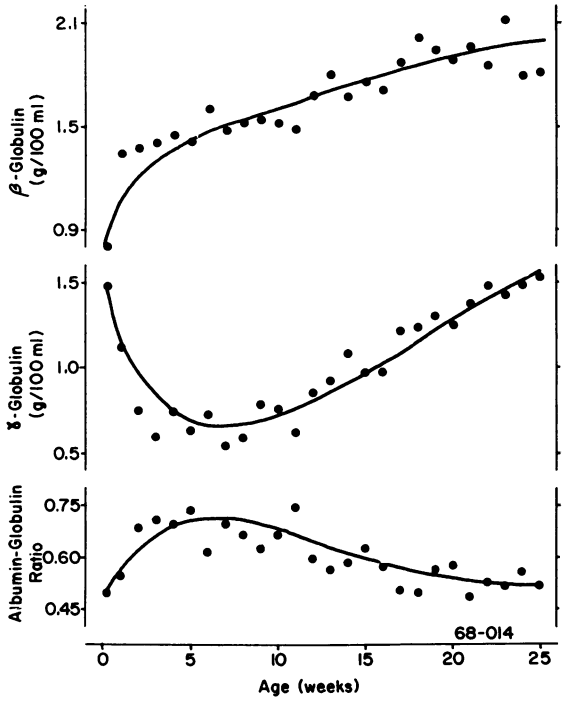

Fig. 3. Concentrations (g/100 ml) of beta-globulin and gamma-globulin and albumin/globulin ratios in serum from one day to six month old white-tailed deer.

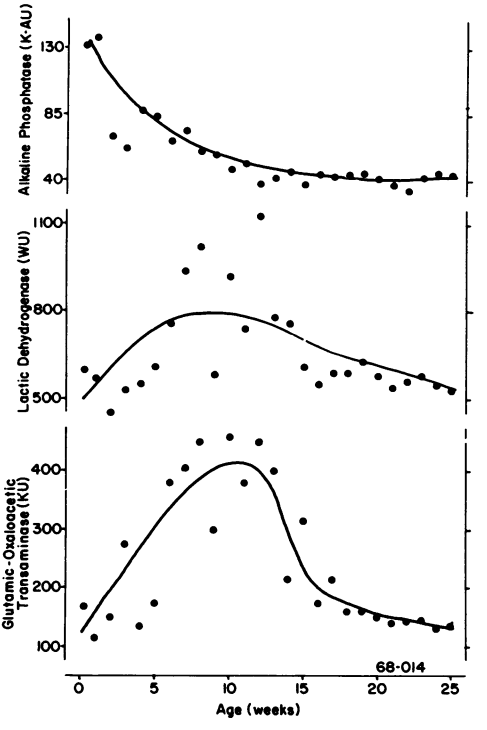

Fig. 4. Activities of alkaline phosphatase (King-Armstrong Units), lactic dehydrogenase (Wacker Units) and glutamic-oxaloacetic transaminase (Karmen Units) in serum from one day to six month old white-tailed deer.

crease in serum TP concentration, from two to six months of age, was due to increases in serum γ-Glob and β-Glob concentrations.

The A/G ratio (Fig. 3) increased curvilinearly during the first five weeks of age due to the catabolism of colostral γ-Glob in the serum and the anabolism of serum Alb; during the period from six weeks to six months of age, the A/G ratio decreased curvilinearly due to the relative increase in serum γ-Glob, β-Glob and α_2-Glob concentrations, while the increase in serum Alb concentration was relatively small. In Vancouver Island black-tailed deer, the percentage concentration of serum Alb decreased and the percentage of β-Glob and γ-Glob increased between five and 15 months of age (1). Serum γ-Glob concentration (Fig. 3) decreased from one day to five weeks of age; whereas, there was an increase from five weeks to five months of age. Serum TP concentration (7.8 g/100 ml) of five to six month old fawns (Table I) was greater than reported for two year old white-tailed deer (3, 5). Due to the relatively greater percentage of globulin than previously reported, the A/G ratio was lower.

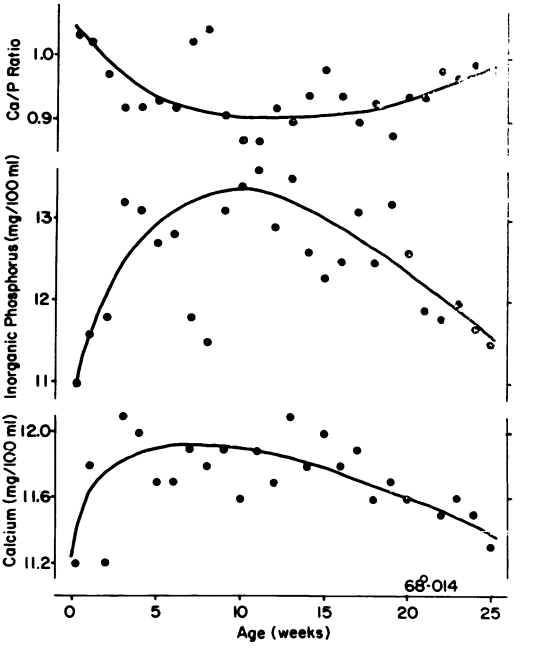

Fig. 5. Concentrations (mg/100ml) of calcium and inorganic phosphorus and calcium/phosphorus ratios in serum from one day to six month old white-tailed deer.

TABLE I. Means and Standard Deviations of Serum Biochemical and Hematological Values for Seven White-tailed Deer (Odocoileus virginianus) from 22 through 25 Weeks of Age

Parameter	$\overline{X}$	S.D.
Total protein, g/100 ml	7.8	0.4
Albumin, g/100 ml	2.69	0.30
α_1-Globulin, g/100 ml	0.66	0.25
α_2-Globulin, g/100 ml	1.08	0.17
β Globulin, g/100 ml	1.90	0.27
γ-Globulin, g/100 ml	1.48	0.35
Albumin/globulin ratio	0.53	0.10
Glutamic-oxaloacetic transaminase, K.U.	137	28
Alkaline phosphatase, K.-A.U.	42	11
Lactic dehydrogenase, W.U.	551	63
Blood urea nitrogen, mg/100 ml	30	5
Creatinine, mg/100 ml	2.5	0.3
Calcium, mg/100 ml	11.5	0.5
Inorganic phosphorus, mg/100 ml	11.8	0.9
Calcium/phosphorus ratio	0.98	0.05
Sodium, mEq/l	159	4
Chloride, mEq/l	111	3
Potassium, mEq/l	6.4	0.7
Cholesterol, mg/100 ml	118	29
Glucose, mg/100 ml	133	30
Total bilirubin, mg/100 ml	0.4	0.1
Erythrocyte count X 10^6, cells/mm^3	19.0	1.8
Packed cell volume, %	52.5	3.1
Hemoglobin concentration, g/100 ml	18.5	1.2
Mean corpuscular volume, μ^3	27.6	2.6
Mean corpuscular hemoglobin, $\mu\mu g$	9.8	1.3
Mean corpuscular hemoglobin conc., %	35.2	2.8
Leukocyte count X 10^3, cells/mm^3	4.07	1.34

The concentration of serum Crt was variable, but did not change markedly during the course of the study (Fig. 1). The concentration of serum BUN increased linearly throughout the duration of the study (Fig. 1); however, subsequent to three months of age, there was no apparent reason for the continued rise. During the first three months of age, there was a continual, but variable, increase in serum G-OT activity (Fig. 4). The increased serum G-OT activity may have resulted in an increased serum BUN concentration, due to the increased metabolism of proteins. The slight elevation in serum Crt concentration, during the first three month period, may be indicative of the increased excretion of nitrogen, via an alternate pathway, which resulted from the increased protein metabolism. Serum LDH activity (Fig. 4) was variable, but tended to follow the same pattern as the serum G-OT activity. The level of serum BUN, in five to six month old

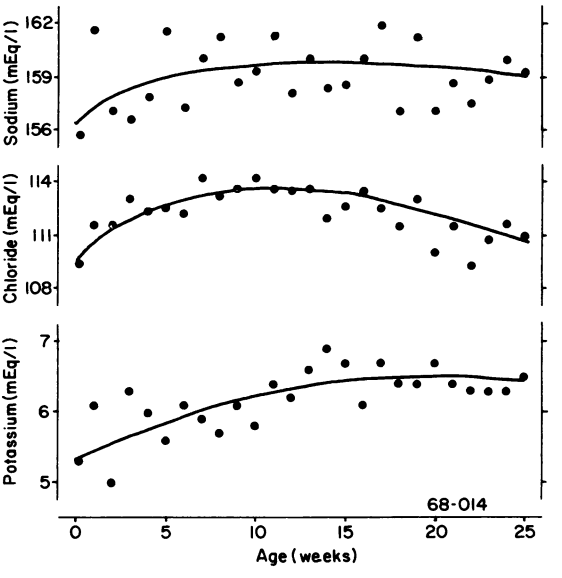

Fig. 6. Concentrations (mEq/l) of sodium, chloride and potassium in serum from one day to six month old white-tailed deer.

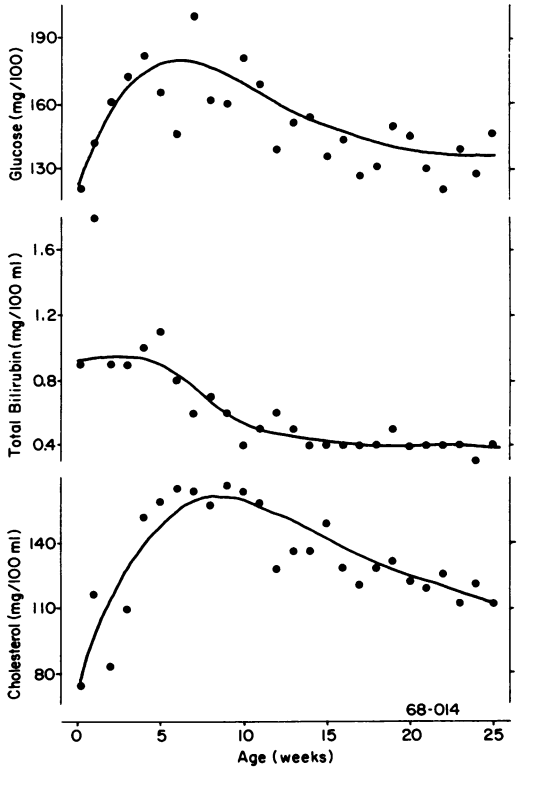

Fig. 7. Concentrations (mg/100ml) of glucose, total bilirubin and cholesterol in serum from one day to six month old white-tailed deer.

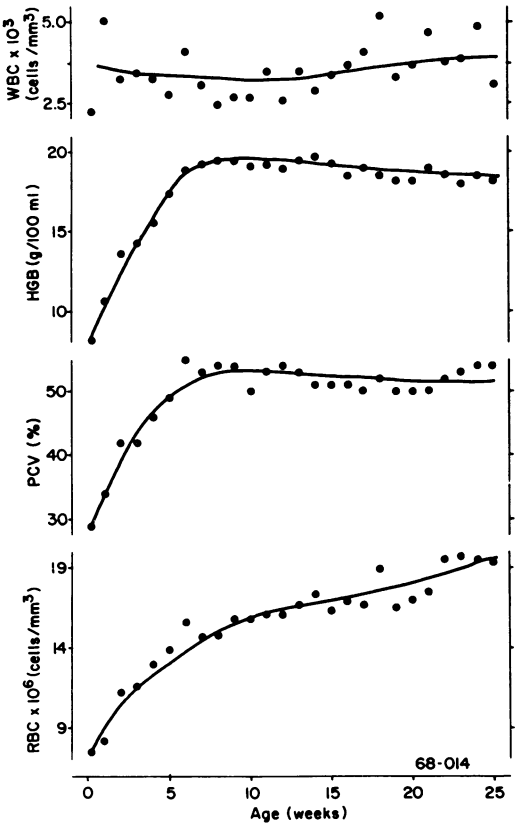

Fig. 8. Leukocyte counts (WBC) (thousand cells/mm^3), hemoglobin concentrations (HGB) (g/100 ml), packed cell volumes (PCV) (%) and erythrocyte counts (RBC) (million cells/mm^3) in blood from one day to six month old white-tailed deer.

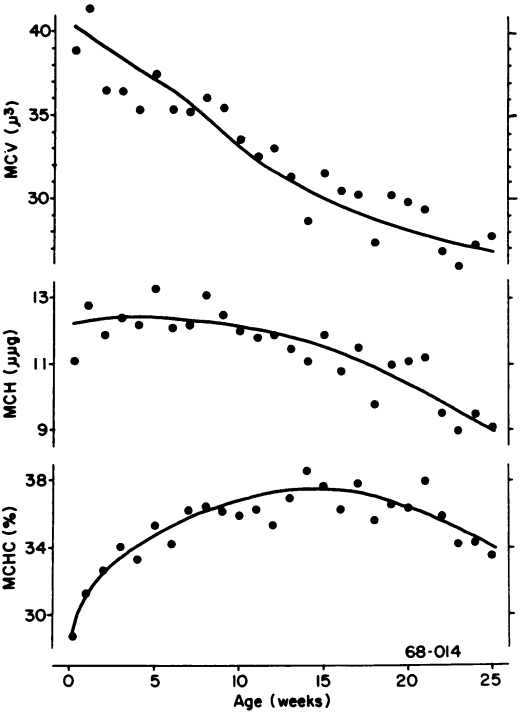

Fig. 9. Mean corpuscular volumes (MCV) (μ^3), mean corpuscular hemoglobins (MCH) ($\mu\mu$g) and mean corpuscular hemoglobin concentrations (MCHC) (%) in blood from one day to six month old white-tailed deer.

fawns (Table I), was similar to that reported for adult white-tailed deer (6).

The mean serum Ca concentration (11.5 mg/100 ml), of five to six month old fawns (Table I), was similar to that reported for one year old white-tailed deer (6). There was an increase in serum IP concentration (Fig. 5), from one day to ten weeks of age, and a subsequent decrease. The increase in serum Na, Cl and K concentrations (Fig. 6), during the first two months of age, may have been a result of the increased packed cell volume. Therefore, the increased electrolyte concentration would reflect the decreased plasma volume. The mean concentration (159 mEq/l) of serum Na, for five to six month old fawns (Table I), was similar to that reported for adult white-tailed deer (6). The mean serum Cl concentration (111 mEq/l) for five to six month old fawns (Table I), was similar to that reported for one year old white-tailed deer (6).

Serum Chol concentration (Fig. 7) more than doubled from one day to eight weeks of age. The mean concentration (118 mg/100 ml) of serum Chol, of five to six month old fawns (Table I) was similar to that reported for adult white-tailed deer (6). The decrease in serum Chol concentration, subsequent to eight weeks of age, may be a reflection of the change in diet; i.e., the fawns began to eat grain and forage at that time. The mean concentration (0.4 mg/100 ml) of serum TB, for five to six month old fawns (Table I), was similar to that reported for adult white-tailed deer (6). Mean serum Glu concentration (Fig. 7) was higher than would be expected for ruminants; however, the deer were not immobilized; consequently, there possibly was a transient hyperglycemia at the time of sampling.

RBC (Fig. 8) increased throughout the duration of the study; however, the relative increase was greater during the first eight weeks of age than thereafter. Hgb and PCV also increased markedly during the first eight weeks of life; however, both values then tended to remain constant from eight to 25 weeks of age. Mean RBC, PCV and Hgb values, for five to six month old fawns, were 19.0 X 10^6 cells/mm^3, 52.5%

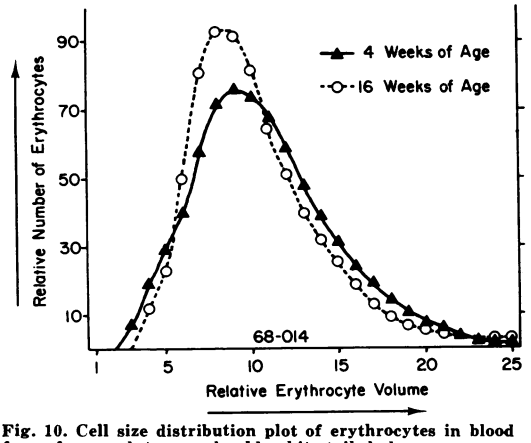

Fig. 10. Cell size distribution plot of erythrocytes in blood from four and ten week old white-tailed deer.

and 18.5 g/100 ml, respectively (Table I). Previously reported (2) values for RBC, PCV and Hgb, for adult white-tailed deer were similar to the values reported herein.

The calculated MCV, MCH and MCHC values (Fig. 9) reflected the changes in RBC, PCV and Hgb values (Fig. 8). The decrease in MCV (Fig. 9), with increasing age, was also reflected in the relatively greater number of smaller erythrocytes at ten weeks of age than at four weeks of age (Fig. 10). The MCV value (27.6 μ^3), for five to six month old fawns (Table I), was similar to that reported for adult white-tailed deer (2). The MCHC value (35.2%), for five to six month old fawns (Table I), was similar to that reported for adult white-tailed deer (2). WBC (Fig. 8) did not change throughout the first six months of life. Mean WBC, for the six month period, was 3.53 X 10^3 cells/mm^3. The mean WBC value (4.07 X 10^3 cells/mm^3), for five to six month old fawns (Table I), was similar to that reported for adult white-tailed deer (2).

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