NOTE ***Biochemistry***

Hematological and Plasma Biochemical Values in Captive Eld's-Brow Antlered Deer (*Cervus eldi thamin*) in Thailand

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ABSTRACT. Blood samples were collected from 20 sedated captive Eld's-Brow Antlered deer (*Cervus eldi thamin*), aged over 1.5 years, to define their mean hematological values (packed cell volume and hemoglobin) and mean plasma biochemical parameters. Male deer had a significantly higher plasma glucose level and aspartate aminotransferase activity than female deer.—KEY WORDS: blood chemistry, *Cervus eldi thamin*, hematology.

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Eld's-Brow Antlered Deer (*Cervus eldi thamin*) are patchily distributed throughout Southeast Asia: Thailand, Laos, Cambodia, Vietnam, as well as India. Throughout several decades, Eld's deer has been one of the game animals for sport hunting and for food, but the alarming rate of destruction of wildlife habitats to increase the extent of arable land for cultivation and living to meet the needs of both the human population and economic expansion during the last 20 years has placed Eld's deer in Thailand on the list of endangered species today. Consequently, many projects in wildlife conservation and production in forms of open zoos and farms have been launched in an effort to restore the near-extinct population.

As production is closely related to the health and nutritional status of all animals, hematological and plasma biochemical evaluation is considered to be a basic aid in this determination, but because deer are highly excitable animals in the presence of man, it is almost impossible to obtain normal resting blood values. Many publications on normal hematological and serum biochemical values in deer of different species have been published [1, 5, 15] but compilation of the data is required concerning means of blood sampling of deer, whether done under physical restraint [6] or sedation with chemical drugs [7], or under trapped [9] of shot [12] conditions. Information on basic hematological and biochemical profiles in Eld's deer is almost non-existent. The present study was therefore conducted to gather information for further scientific and clinical use.

The study was conducted in twenty wild Eld's deer (*C. eldi thamin*), aged over 1.5 years, maintained in an outdoor pen in Khao Khiew Open Zoo, Chonburi, during April, 1995 (summer). Blood samples were collected by jugular venipuncture immediately after recumbancy under the effect of xylazine hydrochloride (Rompun®) in combination with ketamine hydrochloride (Ketalar®) administered by means of a compressed air gun. Three m*l* of the collected blood was immediately put into a sodium fluoride-sodium citrate tube for blood glucose analysis, and the remaining 10 m*l* was put into an heparinized tube for the determination of plasma chemistry, the hemoglobin concentration and packed cell volume (PCV). Plasma separation was done by centrifugation, then stored at −20°C for further analysis.

In heparinized whole blood, the packed cell volume (PCV) was determined by microhematocrit centrifugation (Hematokrit, Hettich®) and hemoglobin content (Hb) by cyanmethemoglobin method. The time elapse between sample collection and laboratory tests was less than 3 hr.

Frozen plasma samples were analysed within 2 weeks for aspartate aminotransferase (AST), alanine aminotransferase (ALT) by the Rietman and Frankel method, alkaline phosphatase (AP) by p-Nitrophenyl phosphate method, and glucose by the O-toluidine method. Triglyceride was determined by the heptane extraction method. Uric acid, blood urea nitrogen (BUN), creatinine, calcium, phosphorus, chloride, potassium and sodium levels were analysed by the standard method, with commercial kits (Clinical Diagnostics Ltd.). All analyses were done by means of a spectrophotometer (Shimadzu® UV-160). Total plasma protein electrophoresis patterns were determined with cellulose acetate and the products of Helena Laboratory, Texas, U.S.A.

Mean, standard deviation and 95% confidence limits for means of each parameter and direct comparison of means were calculated for animals grouped by sex difference, with Microsoft Excel for Windows 95.

The results for packed cell volume (PCV) and the hemoglobin (Hb) concentration, given in Table 1, showed no significant difference ($p>0.05$) between sexes.

The mean, standard deviation, number of Eld's deer and confidence limit for different plasma biochemical parameters in each sex group are shown in Table 2. Among the plasma biochemical parameters studied, only the glucose concentration and AST activity showed significant differences ($p<0.05$) between sexes. Results of cellulose acetate electrophoresis showed the electrophoretic separation of the plasma protein components into densitometric curves of albumin, α1-globulin, α2-globulin, β-globulin, fibrinogen

Table 1. Mean ± SD of hematological values in Captive Eld's-Brow Antlered Deer (*Cervus eldi thamin*)

Blood parameter		Mean
PCV (%)	Stags (n=10)	41.20 ± 6.22
	Hinds (n=10)	38.28 ± 4.19
	Total (n=20)	39.74 ± 5.65
Hb (g/d*l*)	Stags (n=10)	12.91 ± 1.89
	Hinds (n=10)	11.71 ± 1.57
	Total (n=20)	12.31 ± 1.80

PCV: packed cell volume, Hb: hemoglobin.

and γ-globulin, respectively.

The mean Hb concentration and PCV measured in this study were similar to those previously reported in Russa deer (*C. timorensis russa*) and White-tailed deer under chemical immobilization [3, 11] but were lower than in other reports under physical restraint [16]. Chemical sedation has been shown to significantly lower Hb and PCV values when compared with physical restraint, and xylazine is one of the drugs which causes such a reduction [11, 13]. It is well known that during excitement and physical exertion, as in the case of physical restraint, the spleen, which is a large reservoir of erythrocytes, can contract and release more red cells into the circulation within minutes under the influence of epinephrine, so that the relaxing effect of certain tranquilizers or anesthetic drugs may by-pass the excitement stage and result in a resting or near resting level of PCV and Hb, as observed in this study with the xylazine/ketamine combination.

Plasma glucose was higher in the stag than in the hind ($p<0.05$) deer tend to have a higher blood glucose level than domestic ruminants. This may be associated with the nervous temperament and higher metabolic rate of the deer, particularly when physical restraint is employed. The hyperglycemic effect of epinephrine released in a physically stressed animal prior to blood sampling can therefore result in variation in the plasma glucose concentration depending on the level of stress. Tranquilizers such as xylazine have been reported to also have a hyperglycemic effect through alpha-2-mediated hypoinsulinemia [13, 17].

Although the levels of plasma AST, ALT and AP activities were similar to those previously reported [4, 9,

Table 2. Blood biochemical data on Captive Eld's-Brow Antlered Deer (*Cervus eldi thamin*)

Parameter		Values	Parameter		Values
Glucose (mmol/*l*)	Stags (n=10)	7.64 ± 1.46	Creatinine (mmol/*l*)	Stags (n=10)	226.85 ± 19.95
	Hinds (n=10)	5.60 ± 1.84		Hinds (n=10)	228.85 ± 32.88
	Total (n=20)	6.62 ± 1.93		Total (n=20)	227.48 ± 26.48
AST (IU/*l*)	Stags (n=10)	73.70 ± 21.14	Calcium (mmol/*l*)	Stags (n=10)	1.86 ± 0.25
	Hinds (n=10)	52.00 ± 13.70[a]		Hinds (n=10)	1.87 ± 0.29
	Total (n=20)	62.85 ± 20.60		Total (n=20)	1.86 ± 0.27
ALT (IU/*l*)	Stags (n=10)	24.00 ± 3.56	Phosphorus (mmol/*l*)	Stags (n=10)	3.83 ± 0.63
	Hinds (n=10)	23.90 ± 0.49		Hinds (n=10)	3.50 ± 0.67
	Total (n=20)	23.95 ± 7.49		Total (n=20)	3.67 ± 0.66
AP (IU/*l*)	Stags (n=10)	81.26 ± 49.70	Chloride (mmol/*l*)	Stags (n=10)	102.68 ± 4.56
	Hinds (n=10)	60.79 ± 31.84		Hinds (n=10)	99.35 ± 7.13
	Total (n=20)	71.02 ± 41.96		Total (n=20)	101.02 ± 6.07
Cholesterol (mmol/*l*)	Stags (n=9)	4.34 ± 1.05	Potassium (mmol/*l*)	Stage (n=10)	4.73 ± 0.87
	Hinds (n=10)	5.40 ± 3.13		Hinds (n=8)	3.54 ± 1.20
	Total (n=19)	4.90 ± 2.39		Total (n=18)	4.20 ± 1.17
Triglyceride (mmol/*l*)	Stags (n=10)	1.13 ± 0.19	Sodium (mmol/*l*)	Stags (n=10)	113.64 ± 10.83
	Hinds (n=10)	1.23 ± 0.29		Hinds (n=8)	108.95 ± 19.47
	Total (n=20)	1.20 ± 0.24		Total (n=18)	111.56 ± 14.97
Uric acid (mmol/*l*)	Stags (n=10)	52.25 ± 12.90	Total protein (g/*l*)	Stags (n=10)	65.08 ± 6.64
	Hinds (n=10)	56.10 ± 4.53		Hinds (n=10)	60.54 ± 5.16
	Total (n=20)	54.17 ± 9.61		Total (n=20)	61.31 ± 5.84
BUN (mmol/*l*)	Stags (n=9)	5.43 ± 1.47			
	Hinds (n=10)	6.36 ± 1.01			
	Total (n=19)	5.92 ± 1.30			

AST; aspartate aminotransferase, ALT; alanine aminotransferase, AP; alkaline phosphatase. BUN; blood urea nitrogen.

[a] significantly difference between sexes at confidence limit 95%. Data are expressed as the mean ± SD.

17], only a sex difference result for AST was observed in this study. Plasma AP has been reported to show seasonal variation [14], rising rapidly in the spring and early summer months when antler tissue is proliferating. The result of a sex difference in plasma glucose and enzyme(s) implies that there may be a close relation between seasons, sexual and metabolic hormones, antler proliferation and possibly nutritional status. Further studies are therefore required.

The cholesterol concentration found in this study was higher than previously reported but no sex difference was evident. Plasma cholesterol has also been found to have a seasonal trend [14], in which nutritional availability plays an important role. The average BUN concentration of 5.92 mmol/*l* was lower than the mean value reported by Wilson and Pauli [17], but was still within the range (3.0–13.8 mmol/*l*) reported in a number of other deer species.

Electrolyte values (chloride, potassium and sodium) reported in this study were approximately the same as those published by Douglas and Warren [8], Kokan *et al.* [11] and Morris and Bubenik [14]. No sex difference for these electrolytes, or for calcium and phosphorus, was observed, although the latter two parameters showed some differences from previously reported values. This may be due to the influence of seasonal and nutritional variation.

The concentration of total plasma protein in this study was closer to those reported by Chapman and Chapman [4], Hyvarinen *et al.* [10] , Kokan *et al.* [11] and Morris and Bubenik [14]. Conventional fractions of albumin and globulin (α-1, α-2, β and γ) were observed by electrophoresis. Due to the application of plasma instead of serum in cellulose acetate electrophoresis, the protein pattern observed was different from the serum pattern and the value for each protein fraction could not be correctly determined. As there was a fibrinogen peak in the densitometric curve in between the β-globulin and γ-globulin peaks, the ratio of albumin to globulin (A:G ratio) could not be determined by the usual method of subtracting the albumin value from the total protein value [2].

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