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HEMATOLOGY AND SERUM CHEMISTRY VALUES IN CAPTIVE AND WILD PICHIS, *ZAEDYUS PICHIY* (MAMMALIA, DASYPODIDAE)

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ABSTRACT: As part of an ongoing study on the health status of pichis, *Zaedyus pichiy* (Mammalia, Dasypodidae), blood was collected under manual restraint from 72 free-ranging pichis captured in Mendoza Province, Argentina, between November 2001 and December 2006, and from 22 captive-kept pichis in January 2007. Reference values were established for hematology and serum chemistry. Pichis had lower leukocyte counts and higher mean corpuscular volumes than most other mammals. Blood values were similar for captive and wild pichis, and only a few significant differences were found among genders or age classes.

Key words: Dasypodidae, hematology, leukocyte morphology, reference values, serum chemistry, Xenarthra, *Zaedyus pichiy*.

INTRODUCTION

Hematology and serum chemistry values are essential diagnostic tools to assess the health of captive and free-ranging animal populations. Reference data from healthy individuals allow an early detection of disease epidemics through regular health evaluations of wild populations. They are also needed to monitor the impact of human activities on wild animal health and to determine the health status of seized animals before their release into the wild. Both absolute parameters and observed qualitative changes in leukocyte morphology can help in diagnosing pathologic states.

Armadillos (Mammalia, Dasypodidae) are semifossorial mammals that are intensely hunted over much of their range (Fonseca and Aguiar, 2004). The increased scientific interest in the ecology and natural history of armadillos (Abba et al., 2007; Soibelzon et al., 2007; Superina, 2007; Vizcaíno and Loughry, 2008) is a promising step toward the development of effective conservation strategies for these mammals. However, such studies need to be complemented with health evaluations of captive and free-ranging populations to obtain reference data on hematology, serum chemistry, and disease prevalence. Hematologic reference values have been established for nine-banded armadillos *Dasypus novemcinctus* (Purtilo et al., 1975; D'Addamio et al., 1978), seven-banded armadillos *Dasypus hybridus* (Cuba-Caparó, 1976) and *Dasypus septemcinctus* (Coppo et al., 1979), and hairy armadillos *Chaetophractus villosus* (Casanave and Polini, 1999; Polini and Casanave, 1999), while blood values of the remaining 17 extant species remain unknown. Similarly, we are not aware of any published description of the leukocyte morphology for any of the 21 extant armadillo species.

The pichi *Zaedyus pichiy* is a small, diurnal armadillo that inhabits arid and semiarid regions of central and southern Argentina and Chile (Meritt and Benirschke, 1973; Wetzel, 1985). Pichis are opportunistic omnivores (Superina et al., submitted) that weigh around 1 kg. They are capable of entering hibernation in winter and daily torpor outside of the hibernation season (Superina and Boily, 2007). No information is available on the size and density of wild pichi populations, but lower encounter rates suggest that the

populations have declined in the past years (Superina, 2008). These apparent declines have recently led to their classification as Near Threatened by the IUCN Red List of Threatened Species (Fonseca and Aguiar, 2004). The primary pressures on the wild populations are habitat degradation and excessive poaching. In addition, reports from locals in different parts of Mendoza Province, in central-west Argentina, suggest that disease epidemics have led to local extinctions. It is currently difficult to verify these reports in part because of the lack of reference values from healthy animals. The purpose of this study was therefore to provide baseline hematology and serum chemistry data for wild and captive pichis and to evaluate whether these parameters differ among genders and age classes. In addition, we describe the leukocyte morphology of healthy individuals. In combination with baseline data on the pathogens affecting pichis (Superina et al., 2009), these reference values will be essential for future health surveys of wild populations. Furthermore, they will allow to evaluate the health of confiscated live specimens before releasing them into the wild and to monitor the recovery of injured or weak individuals during rehabilitation.

MATERIALS AND METHODS

Sample collection

Vehicle, walking, and horseback transects of varying length were performed between November 2001 and December 2006 in different areas of Mendoza Province, central-west Argentina (66°30′ to 70°00′W and 32°00′ to 37°30′S), at altitudes between 380 and 2,500 m. Study sites were selected based on previous knowledge of the presence of pichis and accessibility. Samples were collected at all times of the year, between 10:00 AM and 8:30 PM. Seventy-two pichis were captured by hand and classified as juveniles, yearlings, or adults based on their body mass, morphometric measurements, and capture date, and their capture site was recorded with a handheld global positioning system unit. Animals were restrained manually for physical examination and sample collection, and head shield and carapace were photographed. Clinical examinations focused on body condition, visible external lesions and scars, rectal temperature, symptoms of pathologic processes, and the presence of ectoparasites. Because the samples were collected over a period of 5 yr, recaptures were expected. We therefore compared a posteriori the gender, number of bands, head shield scute pattern, and scars of all pichis that had been captured within an area of 10 km to confirm that none of the animals had been sampled twice. Blood samples were collected from the medial coccygeal vein within 15 min of capture using 21 or 23-gauge sterile needles. Because of the small size of this vein and rapid coagulation, blood was collected directly from the needle into heparin-coated and uncoated microcapillaries (Biocap S.A., Buenos Aires, Argentina); these where sealed with plasticine (Critoseal, Oxford Labware, St. Louis, MO). Thin smears of fresh blood were air dried and stored in a slide holder. Coated microcapillaries were stored in a cool box with cold packs and transported to the lab. Uncoated microcapillaries were first kept at 30 C until coagulation and retraction of the blood clot occurred (less than 15 min), then transferred to the cool box. All animals were released at their capture site within 45 min.

Captive pichis were maintained in a private facility in Luján de Cuyo, Mendoza Province, Argentina (33°01′S, 68°55′W, 1,000 m above sea level) in individual, open pens with abundant natural substrate for digging. Food consisted of a varying mixture of fruits, vegetables, meat, dry cat food, rice, and a vitamin-mineral supplement and was offered once daily; water was provided ad libitum. Blood samples from 22 animals (nine wild caught, kept in captivity >16 mo; four captive born, 13 mo of age; nine captive born, <4 mo of age) were obtained under manual restraint between 8 and 30 January 2007. All animal work was approved by the Institutional Animal Care and Use Committee of the University of New Orleans and the Dirección de Recursos Naturales Renovables of Mendoza Province, Argentina.

Sample analysis

The small blood volumes that could be collected from wild pichis did not allow us to perform a complete blood screening for all individuals. We therefore prioritized those hematologic parameters that are most commonly used for rapid health screenings and analyzed biochemical parameters whenever possible. Blood smears were fixed with meth-

anol, stained with Giemsa solution (Merck, Buenos Aires, Argentina), and examined by light microscopy for the differential leukocyte count and to evaluate the morphologic characteristics of the white blood cells (WBCs). For determination of the packed cell volume (PCV), blood samples were centrifuged on a microhematocrit centrifuge (CH 24, ROLCO, Buenos Aires, Argentina) for 5 min at 10,000 rpm (microhematocrit method; Kraft and Dürr, 2000). Total erythrocyte and total leukocyte counts were obtained using a improved Neubauer hemocytometer chamber with 0.85% saline solution for red blood cell count (RBC) and a 2% solution of acetic acid with methylen blue for WBC count (Medway et al., 1980). Serum biochemical assays were performed by spectrophotometric methods using a Spectrum SP-1103 spectrophotometer (Spectrum Instruments Company Ltd., Shanghai, China) and commercial kits (Wiener Lab, Rosario, Argentina) following the manufacturer's indications and using the blank and standard solutions provided by the manufacturer for calibration. They included the determination of the following parameters: blood urea nitrogen (BUN, enzymatic method, 540 nm); alanine aminotransferase (ALT) and aspartate aminotransferase (AST, colorimetric method, 505 nm); total proteins (Biuret method, 540 nm); albumin (colorimetric method, 625 nm); globulins (total protein concentration minus albumin concentration); calcium (cresolphtalein complexone method; 570 nm); and alkaline phosphatase (AP, optimized kinetic method, 405 nm).

Data analysis

Data were analyzed using a statistic software program (SPSS, version 11.0, SPSS Inc., Chicago, Illinois, USA). Only samples from clinically healthy individuals were used for the determination of reference values. Hematology and serum chemistry data were explored by means of basic statistics, stem and leaf plots, box plots, and histograms, and mean, median, 95% confidence interval, and absolute maximum and minimum values were determined for each blood parameter. Values for PCV, RBC, mean corpuscular volume (MCV), BUN, protein, albumin, calcium, ALT, AST, and AP were normally distributed; Student's *t*-tests were therefore used to evaluate whether significant differences exist between genders, age classes, and reproductive status for these parameters (Sokal and Rohlf, 2001). Mann-Whitney *U*-tests were utilized to evaluate these differences in WBC and differential leukocyte counts because they were not normally distributed. Calculated P values ≤ 0.05 were considered statistically significant.

RESULTS

Based on the clinical examinations, all evaluated wild and captive pichis were considered to be in good health, and all collected blood samples were therefore used to establish the hematologic and serum chemistry reference values (Tables 1 and 3). Blood values for captive pichis were similar to the values for their wild conspecifics, except for significantly lower PCV, higher lymphocyte counts, and higher band neutrophil counts in captive animals (Table 1). Adult wild pichis had significantly higher PCV and RBC counts and lower monocyte counts than juveniles (Table 2), but more samples from juveniles are needed to confirm these differences. The PCV was significantly higher in males than females, whereas females had higher WBC values and significantly higher lymphocyte and eosinophil counts (Table 2). No other significant differences between genders or age classes were found. The blood values of nonlactating adult females were within the range of values for lactating females, and reproductively active adult males, as determined by enlarged testes, had blood values similar to those of males sampled outside the breeding season ($P > 0.05$ in all cases).

The following characteristics were observed during morphologic evaluation of WBCs. For neutrophils (Fig. 1a), cytoplasm was usually colorless and granules were rarely visible. Nuclear outline tended to be smooth and became slightly jagged in more segmented neutrophils. Nuclear lobes were frequently joined by fine, sometimes almost imperceptible filaments. Normally, three to four lobes were present. Lymphocytes (Fig. 1b) tended to be medium sized, but large lymphocytes were not infrequent. Nuclear shape varied from round to oval with slight irregularities in the contour; indentations were

TABLE 1. Hematologic values of wild and captive *Zaedyus pichiy*.

Parameter[a]	Status	*n*	Mean (SD)[b]	Median	95% CI[c]	Min[d]	Max[e]
PCV (%)	Wild	72	49.3 (6.0)*	49.0	47.9–50.7	36	60
	Captive	22	45.7 (7.1)*	48.0	42.7–48.9	29	57
RBC (10^6/μl)	Wild	25	4.30 (1.05)	4.14	3.86–4.73	2.60	6.50
	Captive	9	3.50 (1.37)	4.05	2.45–4.56	1.68	5.35
Hemoglobin (g%)[a]	Wild	1	16.0				
MCV (fl)	Wild	25	120.2 (30.0)	115.6	107.8–132.6	72	185
	Captive	9	136.3 (44.3)	115.0	102.3–170.4	91	223
WBC (10^3/μl)	Wild	66	4.7 (2.9)	3.9	4.0–5.4	1.0	14.8
	Captive	22	5.1 (2.1)	4.6	4.2–6.1	2.1	10.3
Neutrophils (10^3/μl)	Wild	54	2.74 (1.93)	2.16	2.21–3.27	0.50	8.88
	Captive	22	2.48 (1.20)	2.54	1.95–3.01	0.91	5.14
Band neutrophils (10^3/μl)	Wild	54	0.01 (0.37)†	0.00	0.00–0.02	0.00	0.22
	Captive	22	0.04 (0.06)†	0.00	0.01–0.06	0.00	0.25
Lymphocytes (10^3/μl)	Wild	54	1.31 (1.08)††	1.11	1.01–1.60	0.14	5.55
	Captive	22	1.92 (1.04)††	1.82	1.46–2.38	0.22	4.23
Eosinophils (10^3/μl)	Wild	54	0.38 (0.45)	0.26	0.26–0.50	0.00	2.68
	Captive	22	0.44 (0.46)	0.29	0.24–0.64	0.00	1.95
Monocytes (10^3/μl)	Wild	54	0.19 (0.17)	0.13	0.14–0.23	0.00	0.71
	Captive	22	0.19 (0.18)	0.10	0.11–0.27	0.00	0.62
Basophils (10^3/μl)	Wild	54	0.07 (0.11)	0.02	0.04–0.09	0.00	0.51
	Captive	22	0.05 (0.09)	0.00	0.01–0.09	0.00	0.31

[a] MCV = mean corpuscular volume; PCV = packed cell volume; RBC = red blood cell count; WBC = white blood cell count. Hemoglobin was not determined for captive animals. Note that not all parameters were determined for each individual because of the low quantity of blood that could be extracted per animal.

[b] *Significant difference ($P \leq 0.05$), *t*-test; † significant difference ($P \leq 0.05$), †† significant difference ($P \leq 0.01$), Mann-Whitney *U*-test.

[c] 95% CI = 95% confidence interval.

[d] Min = Absolute minimum value observed.

[e] Max = Absolute maximum value observed.

usually observed. Chromatin was condensed and stained densely. Cytoplasm was scant, and stained mildly and granules were not commonly observed. Monocyte (Fig. 1c) nuclei were usually pleomorphic. Cytoplasm stained mildly grayish and had very slight vacuolization. Granules were usually not visible. Eosinophils (Fig. 1d) had granules that were small, round, and very abundant. These cells stained intensely and were clearly individualized. The background cytoplasm was clear, and vacuolization was not observed. The nucleus varied in shape; multilobular nuclei consisting of three-to-four lobes that were sometimes joined by filaments predominated, but nonsegmented nuclei were also present. In basophils, granules were small, round, and stained deep purple. The nucleus was usually segmented and clearly visible; it was rarely obscured by the numerous granules.

DISCUSSION

The present study provides the first hematologic and serum chemistry reference values for wild-caught and captive-kept *Zaedyus pichiy* of different genders and age classes and the first morphologic description of the WBCs of any armadillo species. The number of biochemical parameters that could be determined per animal was limited because of several difficulties related to blood collection. The small diameter of the coccygeal vein and the rapid clotting prevented the extraction of large quantities of blood. In addition, capture stress and low environmental temperature often seemed to

TABLE 2. Hematologic values of wild *Zaedyus pichiy* for which a significant difference was observed between males and females, or between adults and juveniles.

Parameter[a]	Age/sex[b]	*n*	Mean (SD)[c]	Median	95% CI[d]	Min[e]	Max[f]
PCV (%)	Juv	17	47.1 (5.6)*	48.0	44.2–49.9	37	57
	Ad	43	50.8 (5.6)*	50.0	49.1–52.5	39	60
	M	38	51.3 (5.5)**	51.5	49.5–53.1	39	60
	F	33	47.4 (5.6)**	48.0	45.4–49.4	37	58
RBC (10^6/μl)	Juv	4	3.48 (3.10)**	3.40	2.98–3.97	3.20	3.90
	Ad	16	4.52 (1.08)**	4.41	3.94–5.10	2.60	6.50
WBC (10^3/μl)	M	32	3.88 (2.22)†	3.30	3.08–4.68	0.95	9.10
	F	33	5.39 (3.35)†	4.50	4.20–6.58	1.05	14.79
Lymphocytes (10^3/μl)	M	26	0.97 (0.79)†	0.67	0.66–1.29	0.14	2.84
	F	27	1.62 (1.25)†	1.25	1.12–2.12	0.26	5.55
Eosinophils (10^3/μl)	M	26	0.27 (0.33)†	0.13	0.13–0.40	0.0	1.43
	F	27	0.49 (0.53)†	0.32	0.28–0.70	0.03	2.68
Monocytes (10^3/μl)	Juv	9	0.31 (0.17)†	0.22	0.14–0.47	0.03	0.56
	Ad	33	0.15 (0.13)†	0.10	0.10–0.19	0.0	0.57

[a] PCV = packed cell volume; RBC = red blood cell count; WBC = white blood cell count.

[b] Ad = adults; F = females; Juv = juveniles; M = males.

[c] *Significant difference ($P \leq 0.05$), ** significant difference ($P \leq 0.01$), *t*-test; † significant difference ($P \leq 0.05$), Mann-Whitney *U*-test.

[d] 95% CI = 95% confidence interval.

[e] Min = Absolute minimum value observed.

[f] Max = Absolute maximum value observed.

reduce blood flow in this vein, thus impeding blood extraction. Nevertheless, puncture of the coccygeal vein was considered the method of choice for sample collection because it did not require chemical restraint of the animals. Although the saphenous vein can be used for cannulation in anesthetized armadillos

TABLE 3. Serum chemistry values of wild and captive *Zaedyus pichiy*.

Parameter[a]	Status	*n*	Mean (SD)	Median	95% CI[b]	Min[c]	Max[d]
BUN (mg/dl)	Wild	71	31.4 (10.9)	31.3	28.8–34.0	13.1	65.4
	Captive	17	28.3 (10.8)	28.5	22.8–33.9	13.5	50.0
Protein (g/dl)[e]	Wild	17	6.5 (1.5)	6.4	5.7–7.3	4.1	10.2
Albumin (g/dl)[e]	Wild	13	3.3 (0.4)	3.5	3.1–3.6	2.5	4.0
Calcium (mg/dl)[e]	Wild	20	9.8 (1.8)	9.9	9.0–10.7	7.2	13.5
ALT (U/l)	Wild	11	8.8 (4.3)	8.0	5.9–11.7	3	16
	Captive	6	12.3 (10.7)	9.0	1.1–23.6	2	33
AST (U/l)	Wild	4	13.0 (7.2)	13.5	1.6–24.4	5	20
	Captive	6	23.5 (34.5)	5.0	0–59.7	4	90
AP (U/l)	Wild	3	144.0 (93.5)	179	0–376.4	38	215
	Captive	5	196.0 (62.7)	200	118.2–273.8	108	258

[a] ALT = alanine aminotransferase; AP = alkaline phosphatase; AST = aspartate aminotransferase; BUN = blood urea nitrogen. Note that not all parameters were determined for each individual because of the low quantity of blood that could be extracted per animal.

[b] 95% CI = 95% confidence interval.

[c] Min = absolute minimum value observed.

[d] Max = absolute maximum value observed.

[e] Total protein, albumin, and calcium levels were not determined for captive animals.

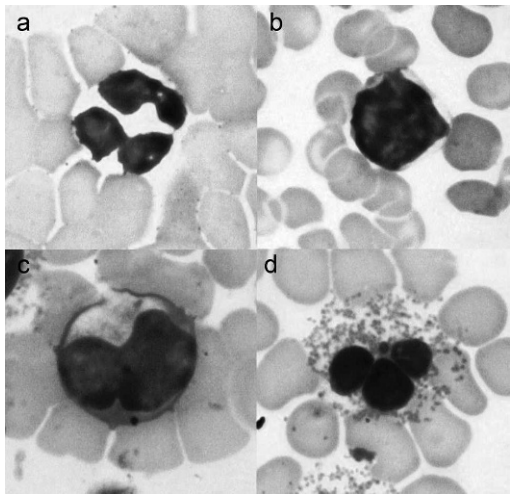

FIGURE 1. Leukocyte morphology of *Zaedyus pichiy:* Segmented neutrophil (a), lymphocyte (b), monocyte (c), eosinophil (d), all pictures 1,000×, oil immersion.

(Moore, 1983), it is difficult to puncture in unsedated pichis because it often rolls away from the hypodermic needle and cannot be seen or palpated in well-fed individuals. The cephalic vein is not easy to puncture in armadillos because the carapace, the short forearm, and the long elbow make it difficult to immobilize the leg and apply a tourniquet or digital pressure. The jugular vein has been described as a less convenient venipuncture site in armadillos because it cannot be located visually or by palpation and often collapses during aspiration (Moore, 1983), whereas cardiac puncture is ethically unacceptable in live animals because it damages the myocardium and can lead to death.

A comparison of blood values of pichis and other species is difficult because different studies use varying sampling and analytic techniques. The RBC count of pichis was considerably lower than in other mammals, whereas the mean cell volume was almost twice the average MCV of 288 mammalian species, but lower than in *Myrmecophaga tridactyla* (Gascoyne and Hawkey, 1992). These differences were not unexpected because the size and number of RBCs vary considerably across taxa (Gascoyne and Hawkey, 1992). When compared to other armadillos, the RBC count was slightly higher than in *C. villosus* (Casanave and Polini, 1999) and *D. septemcinctus* (Coppo et al., 1979), but lower than in *D. hybridus* (Cuba-Caparó, 1976).

The PCV was significantly higher in males than females, in adults than in juveniles (Table 2) and in wild pichis than in captive individuals (Table 1). The reason for the former is not known but may be related to behavioral differences, such as males having larger home ranges than females and thus suffering higher degrees of dehydration and hemoconcentration because of the low water availability in their environment. Age differences in the PCV are normal in domestic mammals, with newborns usually having high RBC and PCV values that fall rapidly during the first weeks of life and gradually increase starting around the second month until adult levels are reached at about one year of age (Jain, 1993). In contrast to their wild conspecifics, captive animals had free access to water, which may have prevented dehydration and hemoconcentration and led to a lower PCV.

The low WBC count in wild and captive pichis was striking. Total WBC count varies greatly among species and is influenced by stress, diseases, and allergic reactions. Pichis had a considerably lower WBC count than any other studied armadillo species (*D. novemcinctus*, Purtilo et al., 1975; D'Addamio et al., 1978; *D. hybridus*, Cuba-Caparó, 1976; *D. septemcinctus*, Coppo et al., 1979; *C. villosus*, Casanave and Polini, 1999). The WBC count was also lower than in most other mammalian species, except for a few nondomestic ruminants (Hawkey, 1977; Jain, 1993). Neutrophils may be proportionally higher during acute infections, while lymphocytes typically increase proportionally during chronic infections (Kraft and Dürr, 2000). The neutrophil-to-lymphocyte ratio is usually not calcu-

lated during routine evaluations of individual animals, but it is a good indicator to compare the relationship between these WBCs among species. Captive pichis had a considerably lower neutrophil-to-lymphocyte ratio (1.29) than their wild conspecifics (2.10). Presumably the captive animals were used to human presence and handling, whereas capture and sampling were stressful events for wild individuals. In the latter, the consequent release of catecholamines led to an increased release of neutrophils, thus leading to a stress leukogram characterized by neutrophilia and lymphopenia and the observed shift in the ratio of these leukocytes. The neutrophil-to-lymphocyte ratio was also higher in wild *Z. pichiy* than in *D. septemcinctus* (1.9, Coppo et al., 1979), *C. villosus* (1.42, Casanave and Polini, 1999), and *D. hybridus* (1.71, Cuba-Caparó, 1976), whereas *D. novemcinctus* had a neutrophil-to-lymphocyte ratio of 2.26–2.54 (Purtilo et al., 1975; D'Addamio et al., 1978). Eosinophil counts were higher in females than in males, but the reason for this difference is not clear. Eosinophilia is often associated with parasitism (Jain, 1993), with males of many vertebrate species tending to have higher parasite loads than females (Wilson et al., 2002). Parasite-induced eosinophilia is therefore expected to be more frequent in males, which is opposite to our results.

Mean BUN levels of pichis (Table 3) were almost three times higher than in *D. septemcinctus* (Coppo et al., 1979), but half the levels found in wild *D. novemcinctus* (Ramsey et al., 1981). Urea is mainly excreted through the kidney and can be used as an indicator of renal function. It may be elevated if blood sampling is performed after food intake, because of a high protein diet, or because of a reduced excretion via urine (Kraft and Dürr, 2000). Samples were extracted from wild-caught animals that were probably foraging at the time of capture and thus may have had elevated postprandial BUN levels. In addition, the low water availability in their natural habitat may require the pichis to minimize urine excretion to conserve body water, and a concomitant reduced urea excretion would lead to increased BUN levels. This hypothesis is supported by the fact that BUN levels were lower in captive pichis, which had unrestricted access to water.

Pichis had higher calcium and albumin levels than seven-banded armadillos (Coppo et al., 1979), but calcium levels were comparable to those reported for wild *D. novemcinctus* by Ramsey et al. (1981). Protein levels of *Z. pichiy* were within the range reported for wild *D. novemcinctus* (Ramsey et al., 1981) and for wild *D. septemcinctus* (Coppo et al., 1979). Depending on the species, ALT or AST are more appropriate to evaluate hepatic function (Kraft and Dürr, 2000), but further studies need to be performed in pichis to determine the relevance of each hepatic enzyme for clinical evaluations. Wild pichis had lower ALT levels than captive nine-banded armadillos (Giacometti et al., 1972) and wild seven-banded armadillos (Coppo et al., 1979). The values obtained for AST were lower than levels given for wild nine-banded armadillos by Ramsey et al. (1981) and for *D. septemcinctus* by Coppo et al. (1979). Although the mean values for AST shown in Table 3 suggest a significant difference between the levels of captive and wild pichis, this variation was mainly due to one captive individual having an AST level of 90 U/l. If this outlier is removed, the differences between mean AST values and 95% confidence intervals for wild (13.0 U/l; 95% CI 1.6–24.4 U/l) and captive (10.2 U/l; 95% CI 0–26.0 U/l) individuals are considerably smaller. Alkaline phosphatase is usually elevated during growth phases, that is, in juvenile animals, and in cases of cholestasis (Kraft and Dürr, 2000). It was higher in pichis than in *D. septemcinctus* (Coppo et al., 1979). It should be noted that the values presented for AST, ALT, and AP in Table 3 are based on a very low sample size and are

thus only of limited relevance as reference values.

Even though we observed special characteristics in the morphology of the leukocytes, their general features were common to those observed in other mammals. The different types of WBCs were clearly identifiable with the exception of the monocytes. They can be difficult to distinguish from the large lymphocytes because of the fact that the latter can vary considerably in size and shape of the nucleus and the lack of characteristic cytoplasmatic vacuoles in the monocytes. No morphologic abnormalities where observed, which could be because of the healthy condition of the studied animals. Furthermore, it is remarkable that no hemoparasites were observed.

In summary, we collected blood from a relatively large number of clinically healthy captive and free-ranging pichis to determine hematologic and serum chemistry values. Both genders and different age classes were represented. Captive and wild pichis had similar blood values. The most striking findings were the low leukocyte counts and high MCV, as well as significantly higher PCV and RBC values in males and higher WBC values in females. The present data will be of invaluable help for future health surveys of wild pichi populations and to monitor the health of captive individuals.

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