Abu Dhabi Falcon Hospital, Abu Dhabi,
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HAEMATOLOGICAL VALUES OF GYR HYBRID FALCONS

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KEYWORDS

Birds - Gyr-saker hybrid falcon - Gyr-peregrine hybrid falcon - Haematology - Values

ABSTRACT

Haematological values for falcon species like gyr falcons, peregrine falcons and saker falcons are widely discussed in the literature. Due to the captive breeding of hybrid falcons, those falcons are seen in an increasing number in the Abu Dhabi Falcon Hospital, United Arab Emirates. The haematological parameters of two different hybrid species, gyr-saker hybrid falcons and gyr-peregrine hybrids falcons, had been studied to compare them with the purebred species in the literature and to establish reference parameters for those hybrid species.

1. INTRODUCTION

Although the saker falcon (*Falco cherrug*) is the traditional hunting bird in the Middle-Eastern Countries, it is not the commonly used falcon for falconry in the United Arab Emirates anymore. In the United Arab Emirates, the number of captive-bred gyr-saker hybrid falcons and gyr-peregrine hybrids falcons used for falconry has rapidly increased over the past few years. One of the main reasons is the new law Cites of October 2002 allowing only captive-bred falcons to be used for falconry purposes inside UAE. This leads to a change in the patients frequenting falcon clinics and hospitals throughout UAE as well to a great need to enhance research on these hybrids for the sake of their health. Although the haematological parameters are well-known in saker falcons (*Falco cherrug*) (SAMOUR et al. 1996; JENNINGS 1996), peregrine falcons (*Falco peregrinus*) (DÖTLINGER and BIRD 1995, JENNINGS 1996) and gyr falcons (*Falco rusticolus*) (WERNERY et al. 2004), only little information is available about those two hybrid species (WERNERY et al. 2004). The haematological blood picture can give significant hints for the avian practitioner about e.g. anemia, dehydration, infections and aspergillosis (CAMPBELL 1988). Due to the importance of the haematological blood parameters for the early detection of diseases in falcons, this study covers the haematological parameters of complete blood counts (CBC) for gyr-saker and gyr-peregrine hybrid falcons.

2. MATERIAL AND METHODS

2.1 Material

The haematological parameters of 689 clinically healthy hybrid falcons were evaluated. All falcons that were showing clinical signs or that were diagnosed with disease were excluded from in this study. The complete blood count (CBC) of 369 gyr-saker hybrid falcons and 320 gyr-peregrine hybrid falcons has been examined manually. After taking blood from the right or left basilic vein (Vena cutanea ulnaris superficialis) or the right or left caudal tibial vein (Vena metatarsalis plantaris superficialis), 0.5ml blood was stored in a 1.0 ml EDTA tube (Teklab). The blood count was performed directly after blood taking with a maximum delay time of 30 minutes.

2.2 Method

Red blood cell count (RBC) (SAMOUR et al 1996)

The working solution consists of 10ml 40% formaldehyde, 31.3g trisodium citrate and 1000ml distilled water. Four ml of this solution has been mixed in a plain sample tube with 20µl of the falcon blood stored in the EDTA tube. This diluted sample has been filled via a capillary tube in the improved Neubauer haemocytometer. After 5 minutes waiting time, the cells of 5x16 squares have been counted in the center of the counting grid. The counted cells had been calculated as follows:

N=Number of cells counted, then: $\frac{N}{100} = RBC \times 10^{12} / l$

White blood cell count (WBC) (SAMOUR et al 1996)

1.9ml of a 1% ammonium oxalate solution had been mixed with 100µl of the falcon blood sample and kept on a tube roller for 3 minutes. A small amount of the diluted samples has been filled via a capillary tube in the improved Neubauer haemocytometer. After 5 minutes waiting time, the cells of 4 outer large squares have been counted in the center of the counting grid. The counted cells had been calculated as follows:

N=Number of cells counted, then: $\frac{N}{20} = WBC \times 10^{9} / l$

Packed cell volume (PCV)/ **Haematocrit** (Hct) (SAMOUR et al 1996)

The PCV is measured by the used of microhaematocrit capillary tubes (Fortuna, Germany) and centrifuge (Hawsley, UK). In our study, the haematocrit is used as this might be the more accurate than the PCV (FUDGE, 2000)

Mean cell volume: $\frac{PCV \times 10}{RBC} = MCV(fl)$

Mean cell haemoglobin: $\frac{Hb \times 10}{RBC} = MCH\ (pg)$

Mean cell haemoglobin concentration: $\frac{Hb \times 100}{PCV} = MCHC\ (g/l)$

Haemoglobin

The haemoglobin is measured by capillary, venous or arterial blood used in EDTA. The optical eye of the HemoCue microcuvette contains reagents deposited on its inner wall and the blood sample is drawn in to the cavity by capillary action spontaneously mixed with the reagents. Used with the HemoCue photometer, the system provides a direct reading of the concentration of haemoglobin in a blood sample.

Preparation of blood smear

Take one small drop of blood sample in a clean microscopic slide. Position a spreader slide in front of the drop of blood at an angle of about 45° and move the spreader backwards and touch gently the drop of blood which will run across the edge of the slide. Push the spreader with a steady forward movement to create a blood smear.

Staining method

The HEMAstain test is for the rapid, differential staining of haematological smears that yields qualitative results similar to Wright-Giemsa stain. The slide is dipped in fixative solution for 5 seconds, than in solution.1 for 5 seconds and than in solution 11 for 5 seconds. The excess solution is allowed to drain. The slide is rinsed with distilled or deionised water, then allowed to dry and examined under oil immersion lens.

The examination of the blood smear for the shape of the blood cells and avian blood parasites is routinely performed for each blood smear, but is not part of this study.

3. Results

The evaluation of the 369 (*Falco rusticolus x Falco cherrug*) hybrid falcons showed the following picture:

Table 1: Haematological parameters for gyr-saker hybrid falcons (Falco rusticolus x Falco cherrug)

Parameters		n=369	range
RBC ($x10^{12}$/l)		2.33±0.15	2.18-2.48
HB (g/dl)		17.73±1.50	16.23-19.23
Hct %		51.57±4.66	46.91-56.23
MCV (fl)		221.85±21.64	200.29-243.49
MCH (pg)		76.24±6.83	69.41-83.07
MCHC (g/dl)		34.42±1.57	32.85-35.99
WBC (x 10^9 /l)		7.50±2.22	5.28-9.72
Heterophils %		49.90±3.88	46.02-53.78
Lymphocytes %		44.11±2.91	41.20-47.02
Monocytes %		4.42±1.58	2.84-6.00
Eosinophils %		1.29±0.92	0.37-2.21
Basophils %		0.40±0.15	0.25-0.55

The 320 evaluated (*Falco rusticolus x Falco peregrinus*) led to those results:

Table 2: Table 1: Haematological parameters for gyr-peregrine hybrid falcons (*Falco rusticolus x Falco peregrinus*)

Parameters		n=320	range
RBC (x10^{12}/l)		2.39±0.26	2.13-2.65
HB (g/dl)		17.9±1.57	16.33-19.47
Hct %		52.00±4.75	47.25-56.75
MCV (fl)		219.7±25.38	194.32-245.08
MCH (pg)		75.59±8.45	67.14-84.04
MCHC (g/dl)		34.43±1.48	32.95-35.91
WBC (x 10^9 /l)		7.55±2.27	5.28-9.82
Heterophils %		49.91±3.50	46.41-53.41
Lymphocytes %		44.18±3.36	40.82-47.54
Monocytes %		4.40±1.63	2.77-6.03
Eosinophils %		1.37±1.08	0.29-2.45
Basophils %		0.14±0.014	0-0

4. DISCUSSION

Extensive work has been done on the haematological parameters of peregrine falcons. Although the range of some parameters is relatively close, significant differences can be seen in MCV, WBC, heterophils, lymphocytes, monocytes and eosinophils.

Table 3. Literature comparison of haematological parameters in peregrine falcons (*Falco peregrinus*)

Parameters	JENNINGS 1996	DOETLINGER and BIRD 1995	WERNERY et al 2004
	n=70	n=48	n=138
RBC (x10^{12}/l)	2.95-3.94	3.49±0.21	3.18±0.50
PCV %	37-53	----	----
HB (g/dl)	11.80-18.80	14.82±1.32	14.67±2.06
Hct l/l	-----	0.40±0.38	0.44±0.06
MCV (fl)	188-146	117.51±7.70	138.43±6.60
MCH (pg)	40.00-48.4	-----	46.13±2.10
MCHC (g/dl)	31.90-35.20	-----	----
WBC (x 10^9 /l)	3.30-11.00	12.56±3.06	9.32±4.69
Heterophils %	14.00-85.50	45.20±12.00	60.95±12.01
Lymphocytes %	11.00-33.00	55.20±13.60	32.00±11.81
Monocytes%	1.00-8.60	2.50±0.30	6.32±3.65
Eosinophils %	0-0.3	2.30±0.90	0.52
Basophils %	0-0.6	----	0.26

A similar picture shows the literature comparison of the haematology values of saker falcons (*Falco cherrug*). Major differences can be found in MCV, MCH, WBC, heterophils, lymphocytes and monocytes.

Table 4: Literature comparison of haematological parameters in saker falcons (*falco cherrug*)

Parameters	JENNINGS 1996	SAMOUR, D'ALOIA 1996	WERNERY et al 2004
	n=50	n=25	n=146
RBC (x10^{12}/l)	2.54-3.96	2.64±0.08	3.18±0.29
PCV %	38-49	----	-----
HB (g/dl)	11.50-16.50	15.93±0.38	15.00±1.46
Hct l/l	----	0.47±0.59	0.45±0.04
MCV (fl)	124-147	183.16±3.84	141.50±5.89
MCH (pg)	41.40-45.40	60.74±1.42	47.17±1.73
MCHC (g/dl)	30.40-34.90	33.28±0.63	-----
WBC (x 10^9 /l)	3.80-11.50	5.70±0.31	10.21±3.53
Heterophils %	26.00-58.50	41.40±2.40	61.78±11.16
Lymophocytes %	8.00-42.50	13.30±0.90	31.11±11.46
Monocytes %		2.10±0.30	4.72±3.02
Eosinophils %	0-2	0	1.12
Basophils %	0-0.45	0.80±0.10	0.4

Only little information is available on the gyr falcons (*Falco rusticolus*).

Table 5: Literature data of haematological parameters in gyr falcons (*Falco rusticolus*)

Parameters	WERNERY et al 2004
	n=187
RBC (x10^{12}/l)	3.23±0.28
HB (g/dl)	15.00±1.33
Hct l/l	0.45±0.04
MCV (fl)	139.32±5.44
MCH (pg)	45.78±1.84
WBC (x 10^9 /l)	8.71±3.80
Heterophils %	58.53±12.90
Lymphocytes %	37.54±12.98
Monocytes %	3.72±2.50
Eosinophils %	0.2
Basophils %	0

The value ranges of the gyr peregrine hybrid falcons (*Falco rusticolus x Falco peregrinus*) differ especially of RBC, MCV, WBC, heterophils and eosinophils (table 6). RBCs in the range of 3.35 are very rarely evaluated among our patient clientele. As per our observation at the Abu Dhabi Falco Hospital, falcons with a WBC of 12.55 and 70% heterophils, being the maximum range of WERNERY et al. (2004), show already clinical signs of reduced well-being like reduced appetite, not flying well and not gaining weight.

Table 6: Comparison between haematologicalvalues in the literature and our laboratory results of gyr-Peregrine hybrid falcons (*Falco rusticolus x Falco peregrinus*)

	WERNERY et al	**Study results**
Parameters	**n=267**	**n=320**
RBC ($x10^{12}$/l)	3.35±0.12	2.39±0.26
HB (g/dl)	15.33±0.62	17.9±1.57
Hct %	46.00±2.0	52.00±4.75
MCV (fl)	137.31±4.15	219.7±25.38
MCH (pg)	45.70±3.43	75.59±8.45
MCHC (g/dl)	----	34.43±1.48
WBC (x 10^9 /l)	9.31±3.24	7.55±2.27
Heterophils %	60.00±10.00	49.91±3.50
Lymphocytes %	37.43±11.18	44.18±3.36
Monocytes %	2.57±1.23	4.40±1.63
Eosinophils %	0	1.37±1.08
Basophils %	0	0.14±0.014

WERNERY et al. (2004) evaluated the gyr hybrid falcons by combining gyr-saker and gyr-peregrine hybrid falcons. The results of our study show that the haematological values of both hybrid species are relatively close to each other, yet far below the results measured in WERNERY et al. (2004). From our patients records hybrid falcons with such elevated blood parameters often display infections or aspergillosis. The high values might be related to the use of the Cell Dyn 3500 analyzer (Abbott Laboratory, North Chicago IL) used for the calculation of RBC, WBC and packed cell volume (WERNERY et al. 2004). When using the Cell Dyn 3500 analyzer (Abbott Laboratory, North Chicago IL) we experienced that this equipment can process only a low number of daily falcon blood samples with accurate results. For the examination of more than approx. 10 samples per day, the Cell Dyn 3500 analyzer is not able to run the falcon blood with its very thick consistency thus leading to unreliable results due to blockage of the washing function of the analyzer. This technical problem resulted in parameters showing very high values that were contradicting clinical conditions of the falcons. Due to these unreliable results, the Abu Dhabi Falcon Hospital returned to the manual haematology examination.

Table 7: Comparison between haematological values in the literature and our study in gyr-saker hybrid falcons (*Falco rusticolus x Falco cherrug*) and gyr-peregrine hybrid falcons (*Falco rusticolus* x *Falco peregrinus*)

Gyr hybrid (GS and GP)	WERNERY et al 2004	Study results	
Parameters	**GS and GP**	**GP**	**GS**
	n=990	**n=320**	**n=369**
RBC (x10^{12}/l)	3.14±0.31	2.39±0.26	2.33±0.15
PCV %	------		---
HB (g/dl)	14.67±1.33	17.9±1.57	17.73±1.50
Hct %	44.00±4.00	52.00±4.75	51.57±4.66
MCV (fl)	140.13±8.10	219.7±25.38	221.85±21.64
MCH (pg)	46.21±2.71	75.59±8.45	76.24±6.83
MCHC (g/dl)	-----	34.43±1.48	34.42±1.57
WBC (x 10^9 /l)	9.43±5.15	7.55±2.27	7.50±2.22
Heterophils %	60.42±14.68	49.91±3.50	49.90±3.88
Lymphocytes %	34.37±14.23	44.18±3.36	44.11±2.91
Monocytes %	4.73±3.67	4.40±1.63	4.42±1.58
Eosinophils %	0.31	1.37±1.08	1.29±0.92
Basophils %	0.04	0.14±0.014	0.40±0.15

The evaluation of the haematological parameters shows a big variety of value ranges especially of RBC, WBC, MCV, heterophils, lymphocytes and eosinophils. Major differences between our study and WERNERY et al. (2004) can be observed in hybrid falcons. These findings may caused by the hand-count method on the other hand and the use of the Cell Dyn 3500 analyzer (Abbott Laboratory, North Chicago IL) (WERNERY et al. 2004) which does not produce accurate results as soon as it is used for processing a large number of falcon blood samples per day on one hand. The relatively high ranges in the haematological parameters produced by the Cell Dyn 3500 analyzer were contradicting the clinically healthy picture of the falcons tested. Haematology results as one important piece of the disease picture should never be interpreted alone but always in connection with the clinical disease symptoms of the examined falcons.

5. CITATION INDEX

1. DÖTLINGER HS and BIRD DM. Haematological parameters in captive peregrine falcons (*Falco Peregrinus*). Falco Newsletter No 4, 1995. The Middle East Falcon Research Group, National Avian Research center, United Arab Emirates.
2. SAMOUR JH, D'ALOIA M-A and HOWLETT JC: Normal haematology of captive saker falcons (*Falco cherrug*). Com Haem Inter 1996; 6: 50 - 52.

3. JENNINGS I.B. Haematology. In: BEYNON P.H., FORBES N.A. and HARCOURT-BROWN N.H. (ed): Manual of raptors, pigeons and waterfowl. Gloustershire: BSAVA 1996; 68 - 78.
4. WERNERY R., WERNERY U., KINNE J and SAMOUR J: Colour atlas of falcon medicine. Hannover: Schluetersche Verlagsgesellschaft; 2004: 18.
5. SAMOUR J.H., BAILEY T.A., HOWLETT J.C., et al. Handbook of bustard haematology. National Avian Research Center 1996.
6. CAMPBELL T.W. Avian hematology. In: CAMPBELL T.W. Avian hematology and cytology. Ames, Iowa: Iowa State Press 1988; 3-17.
7. FUDGE A.M. Avian complete blood count. In: FUDGE A.M. Laboratory medicine: avian and exotic pets. Philadelphia: W.B. Saunders, 2000: 9-18.

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