***Psoroptes* mites infestation in a captive Burmese Red Serow (*Capricornis sumatraensis subspecies rubidus*) of Indo-Burma biodiversity hotspot**

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Received: 7 February 2018 / Accepted: 17 March 2018 / Published online: 13 April 2018
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Abstract An 8 years old male Burmese Red Serow (*Capricornis sumatraensis sub species rubidus*) from Aizawl Zoological Park was presented to the Teaching Veterinary Clinical Complex. An exploratory skin scraping revealed existence of nymphal as well as adult stages of mites of the *Psoroptes* spp. which were not associated with any overt lesions typical to mite infestation such as pruritus, erythema or scaling of the epidermis. The mites were identified as per their morphology, size and shape. Haemato-biochemical analysis revealed alteration of certain haematological and biochemical parameters. The red blood corpuscles were found to have anucleate cells with mild to absent central pallor. The absolute counts showed neutrophilic leucocytosis with mild monocytosis and lymphocytosis. Eosinophilic count was towards the higher side, indicating that the infestation was mild. The serum calcium, albumin, triglyceride, urea nitrogen (BUN) were found to be lower than normal, whereas serum ALT, AST,

LDH, ALP and serum amylase were higher than the established reference indices. Due to lack of haemato-biochemical reference values specific to captive Serow, emphasis was given in this report to establish baseline data for this species.

Keywords *Psoroptes* mites · Captive Burmese Red Serow · Indo-Burma biodiversity hotspot · Haemato-biochemical parameters

Introduction

The Burmese Serow or ‘Arakan Serow’ (*Capricornis sumatraensis*), one of the six recognized species of this wild-goat, is well distributed all over the hilly tracts of North eastern India (Choudhury 2003) and is state animal of Mizoram known as ‘Saza’ (Fig. 1). This wild-goat belonging to the Vulnerable IUCN status as per the Red list (Duckworth et al. 2008) is described by Lydekker as “In the cylindrical form of their horns, serow are, indeed, much more similar to some antelopes than they are to any of the goats; but on the other hand, in their clumsy build, heavy limbs, and stout hooves, as well as in their habits, they undoubtedly come nearer to goats. In order to express this dual relationship, they have been called goat-antelopes.” This description justifies the local name of serow, ‘kambing-utan’ meaning wild goat in Burmese. Red serow was first described as a separate species by Edward Blyth in 1863 since it had an unusual red tinge and a smaller body size as compared to the other known species (Lydekker 1907).

The Indo-Burma biodiversity hotspot holds remarkable endemism to a vast number of wildlife species including serow. This comprises of the evergreen forests in the

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Fig. 1 Natural habitat of Burmese Serow ('Saza') in Indo-Burma biodiversity hotspot

foothills of Chittagong in Bangladesh and extends through the Garo and Khasi Hills of Meghalaya in India, then eastwards through Manipur, Mizoram and Nagaland to encompass most of Myanmar (Fig. 1). Owing to the lack of connectivity and communication, the data available on wildlife, particularly on the serow is quite scarce.

Wild ungulates are subject to mite infestations which may not always present with severe clinical signs (Mazet et al. 1992). This report is one of the few existing ones regarding the subclinical *Psoroptes* spp. infestation in Red Serow, signifying the possible existence of widespread presence of the same in wild and captive populations. Haemato-biochemical alterations have also been studied for the case, considering the paucity of information about the species involved.

Materials and methods

An 8 years old male Burmese Red Serow (*Capricornis sumatraensis sub species rubidus*) from Aizawl Zoological Park was presented to the Veterinary hospital of Teaching Veterinary Clinical Complex, College of Veterinary Sciences and Animal Husbandry, Central Agricultural University, Selesih, Aizawl, Mizoram for health check-up. The animal was chemically restrained with Xylazine @ 0.1 mg/kg and Ketamine @ 11 mg/kg. Deep skin scraping was obtained with a sterile blade and was processed in 10% Potassium hydroxide. The contents of the test-tube were cooled and centrifuged at 3000 rpm for 5 min. A drop of the precipitate was taken on a glass slide and a coverslip was placed on it to observe under low power magnification (10× and 40×). 2 ml blood sample was collected from the jugular vein in a K₃ EDTA vacutainer and 5 ml blood collected for serum separation in a clot activator tube.

Complete Blood Count (CBC) was done by semi-automated blood cell counter (MS4e, Netherlands). The blood smear was prepared using Geimsa stain (Hi-Media Laboratories Pvt. Ltd., Mumbai.) and was examined for differential leucocyte count (DLC) and morphological changes in the cells. Complete serum biochemical profile was assessed by using Fujifilm Dri-Chem analyser (Fujifilm, Japan).

Results and discussion

The skin scraping revealed mites which were identified on the basis of morphology as described by Soulsby (1982). The nymphal stages and adult were found on examination bearing 3 pairs of legs (Fig. 2). Morphological features typical to that of *Psoroptes* spp., such as an ovoid body shape, legs extending beyond the body margin bearing setae at each end and the tarsal suckers have jointed and segmented pedicels (Elsheikha and Khan 2011). The genera of importance in the *Psoroptidae* family of mites include *Psoroptes*, the cause of psoroptic mange in ovine, caprine, bovine and equines. *Chorioptic* mange in Japanese serow has been also reported previously (Shibata et al. 2003).

In the present case, skin lesions of any kind were not observed. These mites were associated with minimal to almost absent cutaneous lesions. Presence of minor scaling was probably a manifestation of the so called 'latent' cases in which small lesions may exist for months in skin (Soulsby 1982).

To the best of our knowledge, the haematological and biochemical profile is not established for Burmese Red Serow. Hence the available data on reference of the Japanese Serow (*Capricornis crispus*), the Goral

Fig. 2 Microscopic view of *Psoroptes* spp. **A** Nymphal stage (10×). **B** Nymphal stage (40×). **C** Adult stage (10 ×). **D** Adult stage (40×)

(*Naemorhaedus goral*), and goat (*Capra hircus*) have been utilized to compare this particular case (Tables 1 and 2) since all the animals are closely related to the Burmese Red Serow (*Capricornis sumatraensis subspecies rubidus*).

Typical to the mammalian erythrocyte morphology, the RBCs were found to have anucleate cells with mild to absent central pallor. There was moderate anisocytosis and adequate platelets on the smear (Fig. 3). Haemoglobin, Mean Corpuscular volume (MCV), Mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) and platelet indices such as mean platelet volume (MPV), total platelet count and plateletcrit (Pct) were found to be in normal range whereas platelet distribution width (PDW) was found to be lower than normal (Table 1). These results were compared with earlier report published by Soma (1987), Miller and Fowler (2015), Messick (2012) and Weiss and Wardrop (2011). Wiwanitkit (2004) reported that there was a significant correlation between PDW and RDW and anisocytosis of red blood cells found in this case might be due to low PDW. However, these data are basic observations; further in-depth evaluation of the platelet parameters is recommended. White blood cell (WBC) count was higher than normal as compared with reported data for *Capricornis sumatraensis subspecies rubidus* (Soma 1987) which indicated an infection. Similar type of total leukocyte count was also reported by earlier studies in buffalo (Bala and Rath 2006; Bal et al. 2009). The increase in WBC is indicative of a systemic inflammatory status in mange

infestation. This could be due to excoriation of the skin of the animal which allows penetration of invading microorganisms which elicit the production of leucocytes as reported in goats with sarcoptic mange by Adejinmi et al. (2000).

The DLC was done and the reference intervals were compared to that of the established values of the Himalayan Goral (*Naemoredus goral*) due to unavailability of data on the Burmese Red Serow. The absolute counts showed neutrophilic leucocytosis with mild monocytosis and lymphocytosis (Table 1). Hypersegmentation was observed in certain neutrophils (Fig. 3). Eosinophilia and neutrophilia has been observed in Psoroptic mange in sheep (O'Brien et al. 1995) which is a usual host response in ectoparasitic infestation (Khatak 2008). However, this was not noticed in this case and the eosinophils were within range. Since the infestation was at latent period but established the eosinophil count was towards the higher reference value (Table 1) which is an indicator of such ectoparasitic infestation. A lower than expected eosinophil, neutrophilia and neutrophilic hypersegmentation could be explained by transit stress induced release of endogenous corticosteroid in the systemic circulation (Thrall et al. 2012).

The estimated biochemical values are given in Table 2. Serum Glucose, cholesterol, total protein, uric acid, creatinine, potassium, magnesium, Creatine Phosphokinase (CPK), Lactate Dehydrogenase (LDH) and lipase were observed to be within range. The serum calcium, albumin,

Table 1 Haematological parameters of Serow infested with *Psoroptes* mites

Sl. no.	Parameter	Value	Published value of <i>Capricornis sumatrensis</i> subspecies <i>rubidus</i> (Soma 1987)	Published value of <i>Naemorhaedus goral</i> (Miller and Fowler 2015)	Published value of <i>Capra hircus</i> (Messick 2012; Weiss and Wardrop 2011)
1	WBC (m/mm ³)	72.83	32.75 ± 9.23	–	–
2	RBC (m/mm ³)	13.11	12.12 ± 2.98	–	–
3	Haematocrit (%)	40.9	41.5 ± 10.4	–	–
4	MCV (fl)	31.2	–	–	16–25
5	Hb (g/dl)	13.7	14.4 ± 4.3	–	–
6	Platelet (× 10 ³ /ml)	306	–	250–900	–
7	MPV (fl)	7.8 1	–	–	3.7–7.1
8	Pct	0.24	–	–	0.16–0.36
9	PDW	9.4	–	–	56–107
10	MCH (pg)	10.4	–	–	5.2–8
11	MCHC (g/dl)	33.4	–	–	30–36
12	Neutrophils (/ml)	6099.	–	1100–3200	–
13	Lymphocytes (/μl)	710.0	–	750–2500	–
14	Eosinophils (/μl)	163.86	–	0–200	–
15	Monocytes (/μl)	309.52	–	0–300	–

Table 2 Biochemical changes of Serow infested with *Psoroptes* mites

Sl. no	Parameter	Value	Published value of <i>Capricornis sumatrensis</i> subspecies <i>rubidus</i> (Soma 1987)	Published value of <i>Naemorhaedus goral</i> (Miller and Fowler 2015)	Published value of <i>Capra hircus</i> as per Blash et al. (2012) and Bagnicka et al. (2014)
1	Glucose (mg/dl)	182	158 ± 115	–	–
2	Cholesterol (ml/dl)	59	50.8 ± 10.4	–	–
3	Triglyceride (mg/dl)	8	45 ± 25	–	–
4	Total Protein (g/dl)	7.2	8.5 ± 2.6	–	–
5	Albumin (g/dl)	3.1	4.1 ± 0.9	–	–
6	Blood Urea Nitrogen(mg/dl)	12.8	28.5 ± 12.1	–	–
7	Uric acid (mg/dl)	0.5	1.4 ± 0.9	–	–
8	Total Bilirubin (mg/dl)	1.1	2.85 ± 1.21	–	–
9	Direct Bilirubin (mg/dl)	0.6	–	–	0.0–0.1
10	Creatinine (mg/dl)	1.2	1.6 ± 0.9	–	–
11	Calcium (mg/dl)	9.2	12.9 ± 3	–	–
12	Chloride (mEq/l)	108	–	100–109	–
13	Potassium (mEq/l)	3.0	5.1 ± 2.7	–	–
14	Sodium (mEq/l)	141	–	144–150	–
15	Phosphorus (mg/dl)	3.5	–	4.7–7.7	–
16	Magnesium mg/dl	1.6	2.0 ± 0.3	–	–
17	Alkaline Phosphatase U/L	227	75.4 ± 84.1	–	–
18	SGOT (U/L)	422	102 ± 91	–	–
19	SGPT(U/L)	54	8.64 ± 0.48	–	–
20	CPK (IU/L)	331	535 ± 435	–	–
21	LDH (U/L)	900	696 ± 614	–	–
22	Amylase(U/L)	177	17 ± 8.69	–	–
23	Lipase (U/L)	34	–	–	0–71

Fig. 3 Blood cell picture and characteristic of different cell count (Giemsa stain) in 100× microscopic observation. **A** Anisocytosis. **B** Platelet. **C** Segmented neutrophil. **D** Eosinophil. **E** Monocyte. **F** Lymphocyte

blood triglyceride, urea nitrogen (BUN) were lower than normal whereas serum Alanine transaminase (ALT), Aspartate Transaminase (AST), LDH, Alkaline Phosphatase (ALP) and amylase were higher than the established reference intervals. Hypoalbuminemia maybe associated with some hepatocyte dysfunction indicated by high enzymes of liver function that is AST and ALT. The lower level of blood calcium maybe related to hypoalbuminemia. The low BUN value maybe related to hepatic insufficiency, low protein diet, significant protein loss and other causes. The lower level of protein, albumin and globulin in this case due to loss of appetite, changes in hepatic function, structure and decrease in nutrients digestion in infested serow that agreed with Vishe et al. (2012) which reported that the infestation with *Psoroptes* was associated with anemia and decreasing in total protein. Infections with different species of mange lead to inflammation resulting into malnutrition and debility which are reflected by haemato-biochemical responses. Decreased GFR, severe dehydration, renal disease, urinary tract obstruction, pancreatitis, intestinal disease and hepatic disease are some of the implicated causes of high serum amylase level (Vaden et al. 2011).

Conclusions

Unavailability of data as regards to the haemato-biochemical parameters in Burmese Red Serow has possibly limited the scope of this paper. This emphasise the importance of establishment of baseline data regarding the normal haemato-biochemical reference indices. However an attempt has also been made to compare the obtained values with the other closely related species such as the goral and the Japanese Serow. To the best of our knowledge, no study has been done to describe any kind of ectoparasite infestation in this particular species and this report is a first of it's kind. Though the infestation is of subclinical or 'latent' nature, there is the probable threat of cross-infestation to and from feral or domesticated large animals. It is important to further investigate the presence of such infestations which may spread to other susceptible wild and domestic populations in case these affected animals have to be translocated to other territories.

Authors contributions All the authors performed the clinical examination, developed the diagnosis, designed the treatment of the animals, summarized the results of the cases and drafted the manuscript, performed the dermatological skin examination, skin sampling and microscopic analysis and drafted parts of the manuscript. All authors contributed to the development and the revisions of the manuscript and approved the final version.

Compliance with ethical standards

Conflict of interest The authors declare that there is no conflict of interest.

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