PRELIMINARY EVALUATION OF SERUM PROTEIN ELECTROPHORESIS AS A DIAGNOSTIC TOOL IN THE BLACK RHINOCEROS (*Diceros bicornis*)

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Abstract

Serum protein electrophoresis (SPE) is a valuable tool for the diagnosis of certain diseases in humans and animals.[1,3-8,12] This technique could be particularly beneficial when applied to health monitoring in the black rhinoceros (*Diceros bicornis*), a species which is predisposed to a number of diseases in captivity, the etiologies of which are not yet fully understood.[2,14-19] Serum protein fractionation varies widely between species, thus it is necessary to establish a reference range in order to interpret SPE for a given species.[10,13,20] This study has two purposes. The first is to determine normal ranges and patterns of serum proteins separated by SPE in the black rhinoceros. The second is to make a preliminary evaluation of the diagnostic potential of SPE for this species.

Serum protein electrophoresis was performed on samples from both clinically healthy (n = 38) and clinically ill (n = 16) black rhinoceroses. Data gathered from healthy individuals were used to establish reference ranges for SPE. The absolute ranges for total protein, albumin, and gamma (γ) globulins in the black rhinoceros are similar to those of domestic mammals, however the albumin to globulin ratio and alpha (α) globulins tend to be lower while the beta (β) globulins tend to be higher in the black rhinoceros than in domestic mammals. Preliminary evaluation of data gathered from ill and subclinically ill individuals indicates that serum protein electrophoresis is helpful in the diagnosis of clinically inapparent disease in the black rhinoceros. Research toward identifying and characterizing electrophoretic patterns associated with subclinical and clinical disease in the black rhinoceros continues.

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Table 1. Serum protein electrophoresis: protein fractions and components.[9,11]

Protein fraction	Major protein constituents		
Albumin	Albumin		
α_1 Globulins	α_1-Acid glycoprotein	α_1-Antithrombin III	α_1-Lipoprotein[a]
	α_1-Antichymotrypsin	α_1-Antitrypsin	
α_2 Globulins	α_2-Globulin	α_2-Macroglobulin	Haptoglobin
	α_2-Lipoprotein[b]	Ceruloplasmin	Protein C
β Globulins	Amyloid A	C4 Complement	Hemopexin
	β_2-Lipoprotein[c]	C-Reactive protein	Plasminogen
	C3 Complement	Ferritin	
	Transferrin		
γ Globulins	Immunoglobin A	Immunoglobin G	
	Immunoglobin E	Immunoglobin M	

[a]High density lipoprotein (HDL).
[b]Very low density lipoprotein (VLDL).
[c]Low density lipoprotein (LDL).

Table 2. Differential diagnoses of serum protein alterations.[9,11]

Protein fraction		Differential diagnoses[a]
Albumin	**Increase:**	Dehydration
	Decrease:	Hepatic disease, gastrointestinal disease, renal disease, internal parasites, overhydration, malnutrition, blood or plasma loss
α_1 Globulins	**Increase:**	Acute inflammatory disease, pregnancy
	Decrease:	Hepatic disease, pulmonary disease, nephrotic syndrome
α_2 Globulins	**Increase:**	Acute inflammatory disease, nephrotic syndrome, hepatic disease, diabetes mellitus, hypothyroidism
β Globulins	**Increase:**	Acute hepatitis, chronic active hepatitis, nephrotic syndrome, suppurative dermatopathy, anemias
	Decrease:	Autoimmune disease
γ Globulins	**Increase:**	Chronic inflammatory disease, immune mediated disease, infectious disease, suppurative disease, connective tissue disease, multiple myeloma, lymphosarcoma
	Decrease:	Immune deficiency diseases

[a] Evaluation of serum protein status should include assessment of the albumin to globulin ratio (A:G).

Table 3. Reference ranges for SPE in the black rhinoceros (n = 33).

	Quantity (g/dl)			Percent of total protein (%)		
Protein fraction	Range	Mean	SD	Range	Mean	SD
Total protein	6.00-8.40	7.37	0.71	N/A	N/A	N/A
A:G ratio	0.31-0.79	0.53	0.13	N/A	N/A	N/A
α Globulins	1.79-3.41	2.49	0.37	23.6-44.1	33.5	5.20
α_1 Globulins	0.09-0.27	0.16	0.05	1.2-4.7	2.3	0.84
α_2 Globulins	0.23-0.68	0.45	0.11	3.9-9.2	6.0	1.31
β Gobulins	1.69-3.33	2.51	0.38	26.9-43.8	34.3	5.05
γ Globulins	1.08-2.58	1.76	0.43	15.4-34.4	23.8	4.58

Table 4. SPE reference ranges (g/dl) for the black rhinoceros compared to domestic animals.

Protein fraction	Black rhinoceros[a,b]	Horse[c]	Cow[c]	Dog[c]	Cat[c]
Total protein	6.00-8.40	5.20-7.90	6.74-7.46	5.40-7.10	5.40-7.80
A:G ratio	0.31-0.78	0.62-1.46	0.84-0.94	0.59-1.11	0.45-1.19
Albumin	1.79-3.02	2.60-3.70	3.03-3.55	2.60-3.30	2.10-3.30
α Globulins	0.33-1.00	0.37-2.01	0.75-0.88	0.50-1.60	0.50-1.60
α_1 Globulins	0.10-0.32	0.06-0.70		0.20-0.50	0.20-0.50
α_2 Globulins	0.23-0.68	0.31-1.31		0.30-1.10	0.30-1.10
β Globulins	1.81-3.33	0.69-2.47	0.80-1.12	1.30-2.70	1.30-2.70
γ Globulins	1.08-2.58	0.55-1.90	1.69-2.25	0.90-2.20	1.70-4.40

[a]Reference ranges for the black rhinoceros are repeated from Table 4 for ease of comparison.
[b]Rhinoceros values determined by agarose gel SPE; domestic animal values by cellulose acetate SPE.[9]