Short communication — Kort berig

Biochemical composition of urine from farmed ostriches (*Struthio camelus*) in Botswana

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ABSTRACT

Biochemical and qualitative evaluation of the supernatant of urine from hydrated farmed ostriches *(Struthio camelus)* indicated that the urine was comparable to that described by other workers. The disparities obtained between the biochemical constituents in the present and previous studies were partly attributed to the state of hydration influenced by climatic factors. Results of the cytological examination of the supernatant and the sediment concurred with the observations of other workers. It was therefore concluded that parameters from both the quantitative and qualitative analyses could be used as a guideline to monitor the health status of farmed ostriches in Botswana.

Key words: Botswana, farmed ostrich, urinalysis.

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Although ostriches are classified as birds, they differ from other birds in that their urine is deposited separately from the faeces[8,13]. Urine collects in the coprodaeum, which functions in a manner similar to the urinary bladder. Numerous diseases irrespective of aetiology are associated with a decrease or absence of water and/or feed intake[3]. Urinalysis can be used to evaluate the health of birds. The nature of the urine is therefore a useful indicator of the hydration status of the ostrich and possible ill-health[9]. Some authors have reported that ostriches conserve body water by means of an excellent renal concentrating mechanism that excretes urates[11]. These authors also suggested that the production of white urine may indicate illness or water deprivation.

The main objective of this study, therefore, was to obtain baseline biochemical values for urine of farmed ostriches (*Struthio camelus)* in Botswana. The urinalysis results obtained in this study could be used to monitor renal function and the general health status of the birds.

Thirty-five farmed ostriches between 4 and 6 months of age and 15–20 kg body weight were used. The ostriches were housed in fenced pens and were fed *ad libitum* on a commercial feed ration. The feed contained the following constituents: plant protein (cotton seed cake), 15.4 %; crude fibre, 12.0 %; calcium, 1.7 %; phosphorus, 1.0 %; magnesium, 0.48 %; manganese, 360 mg/kg; zinc, 175 mg/kg; selenium, 0.42 %; vitamin E, 49 mg/kg. In addition, the birds were given finely chopped lucerne along with the concentrate. Water was given *ad libitum.*

A urine sample was collected as it was voided by each of the 35 well-hydrated ostriches into sterile plastic containers. It was then transferred to sterile polystyrene tubes that were transported on ice to the laboratory. Qualitative analysis was carried out on all the urine samples before centrifugation using a dipstick Combur-9 stix (Boehringer Mannheim). The specific gravity of urine was determined using a refractometer (Model Atago, Tokyo), after blanking with de-ionised water. Thereafter, the urine samples were centrifuged at 3000 g for 10 minutes to obtain a supernatant and a sediment.

Various chemical constituents of the supernatant, namely urea, uric acid, creatinine, protein, magnesium and phosphorus, were determined using a chemical analyser (Vitalab Selectra, Merck). The levels of copper were assayed spectrophotometrically (Model UV 1604/Shimadzu, Tokyo) using commercial kits (Boehringer Mannheim Diagnostics).

Levels of electrolytes (sodium, potassium and chloride) were determined using an isoselective electrode fitted onto the chemical analyser.

Microscopic examination of wet preparations of the sediment was performed under low power objective and subdued light. To facilitate visualisation of cells, a drop of 1 % methylene blue stain was introduced under the coverslip using a Pasteur pipette. Air-dried, Giemsa-stained smears of the sediment were examined under a high power objective in order to evaluate the cytological composition.

All determinations were conducted within 4 hours of obtaining the urine, which was always collected in the afternoon when the birds were well hydrated.

The results of the qualitative and quantitative analysis of urine of farmed ostriches are summarised in Tables 1 and 2 respectively. Although the daily volume of urine voided was not investigated in this study, as much as 2.0 mℓ was collected at once from some ostriches. This was suggestive of uncompromised excretory capacity of the kidney. A well-watered ostrich can yield as much as 2.5 mℓ urine per day[20]. Water deprivation causes haemoconcentration, which reduces the bird's urine volume and exerts deleterious effects on the osmolality of urine[18].

During periods of drought or water deprivation, the ostrich conserves water by concentrating urine[7,11,14,20]. The mechanism is comparable to that described for other ratites such as emus living in arid zones and also the camel[4,5,17,20,21]. Water conservation and excretion of urine are considered to be related to response of the skin to temperature changes resulting in the release of anti-diuretic hormone[1,4,6]. Ostriches used in this study were well hydrated since water was given *ad libitum,* and therefore no haemoconcentration was anticipated.

The average specific gravity of ostrich urine samples examined was 1.020, ranging from 1.010–1.050. The type of urine produced is known to be influenced by the composition of the feed or the presence of renal and hepatic disease. In the present study, most of the birds voided clear, colourless urine. Since the specific gravity of urine reflects the concentrating capacity of the kidney, the above findings were suggestive of intact

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Table 1: **Concentration of selected chemical constituents in farmed ostrich urine supernatant.**

Analyte	Units	Mean ± S.D.	Range	Reference		
				Schütte[16]	Louw *et al.*[13]	Levy *et al.*[11]
Calcium	mmol/ℓ	1.11 ± 0.05	0.20–1.50	2.27	–	–
Magnesium	mmol/ℓ	3.28 ± 1.70	0.20–4.50	–	–	–
Phosphorus	mmol/ℓ	2.27 ± 0.50	1.14–4.50	9.36	–	–
Copper	µmol/ℓ	83.03 ± 10.50	70.00–100.00	0.03	–	–
Sodium	mmol/ℓ	60.0 ± 1.50	50.00– 80.00	78.00	18–28	16.8 ± 2.5
Potassium	mmol/ℓ	14.2 ± 5.90	8.70–16.80	306.00	10–20	21.2 ± 11.0
Chloride	mmol/ℓ	51.0 ± 6.90	40.00–59.00	218.00	–	26.4 ± 7.2
Urea	mmol/ℓ	6.7 ± 3.50	0.60–9.00	66.6	–	15.1 ± 1.5
Uric acid	µmol/ℓ	7.6 ± 0.10	5.00– 9.00	–	–	7.1 ± 1.9
Creatinine	µmol/ℓ	0.09 ± 0.01	0.01–1.30	459.68	–	177.0 ± 71.0
Total protein	g/ℓ	2.60 ± 1.50	0.80–7.00	–	–	–
pH		7.6 ± 1.50	5.60 –12.0	–	–	–

Table 2: **Qualitative analysis of ostrich urine.**

Parameter	Positive samples/examined samples
Leukocytes	0/35
Protein	35/35
Glucose	0/35
Ketones	0/35
Urobilinogen	0/35
Bilirubin	0/35
Blood	3/35
Nitrites	30/35
White blood cells	2/35
Red blood cells	1/35
Cylinders	2/35

renal function.

The mean pH of urine in this study was 7.6 ± 1.5, which was well within the range previously reported for ostriches[16]. The ostriches used in this study were fed on concentrates and some freshly-chopped lucerne to prevent acidosis. Research on chickens has indicated that diets high in chloride but low in phosphorus resulted in an acidic urine with increased excretion of calcium[19]. It was not clear whether this could be extrapolated to ostriches. It is possible that some of the very alkaline urine obtained in this study was attributable to the lucerne diets. The results shown in Table 2 were not suggestive of disorder in acid-base equilibrium.

The mean quantitative protein content was 2.6 ± 1.5 g/ℓ with a range of 0.8–7.00 g/ℓ. Birds usually have low urine protein content, similar to mammals[3]. High urinary protein values in the presence of low specific gravity are often associated with kidney disease, urinary tract or cloacal infection. However, limited urinary loss of proteins in some birds such as pigeons is considered to be normal[14]. The lucerne diet probably contributed to the mild proteinuria. The urine that was analysed in the present study therefore had no pathological protein.

Approximately 89 % of the urine samples indicated the presence of nitrite. Since ostrich urine is voided separately from faeces, the most common source of nitrate-reducing bacteria, it was assumed that the nitrite was produced by the resident urinary tract microflora. This was, however, not indicative of a urinary tract infection, and was therefore of no clinical consequence.

The dipstick results in this study did not indicate the presence of urinary glucose, urobilinogen, bilirubin and ketones. These results agreed with the findings of other authors pertaining to urine from other avian species[3]. Ketone bodies, mainly acetoacetic acid (diacetic acid) and β hydroxybutyric acid from which acetone is derived, are intermediate products of fat metabolism[10]. They form as a result of starvation or inanition when the body catabolises fat reserves. Ketosis therefore develops in cases of clinical states of deficient carbohydrate metabolism, since optimum carbohydrate metabolism inhibits ketosis. This metabolic disturbance was not anticipated in the present study since the ostriches were on a good plane of nutrition and the birds were fed *ad libitum.* Absence of ketones and biliverdin therefore ruled out hepatic compromise.

Finding occult blood in the urine may be indicative of bleeding in the upper urinary tract[3]. It may also indicate the presence of myoglobin. However, in this study, only 3 ostrich urine samples were positive for blood assumed to have originated from the urinary tract, suggesting haematuria. The clinical significance of this finding is not known, since no extra tests were performed to differentiate myoglobinuria and haematuria. This probably warrants a separate investigation.

White blood cells, mainly heterophils, were demonstrated microscopically in 5.7 % of the urine sediment samples using the standard wet preparation technique and Giemsa-stained smears. Epithelial casts were evident in only about 6 % of the total number of urine samples. The latter usually originate from the renal tubular epithelium. Erythrocytes and white blood cells have been reported in the urine of racing pigeons with *Salmonella*-induced polyuria[6]. Since normal urine usually contains little sediment it was concluded that the urine analysed in this study was relatively normal.

The mean uric acid value obtained from the supernatant of the urine analysed in this study was comparable to the levels recorded by authors from Israel but lower than that previously reported by workers from southern Africa[11,16]. This discrepancy could have in part been due to the fact that the supernatant in this study had more of the dissolved uric acid from the sediment. The state of hydration and the diet probably influenced the results. Birds are urecotelic, excreting 60–80 % of the total excreted nitrogen in the form of uric acid[10,16]. Two-thirds of the nitrogenous waste in birds is therefore in the form of uric acid. Hydration and nutritional status of birds have been shown to have profound effects on the production and elimination of these waste products through the kidneys[2,15,19]. The quantity of undissolved uric acid varies in hydrated ostriches from 0.7–1.2 %, under drought conditions this can rise 40-fold[16]. The high hydration status of the birds could partly have accounted for the relatively lower uric acid level.

Very low values of urinary creatinine and urea were obtained in the present study, contrasting greatly with levels previously recorded[16]. Reduced creatinine clearance may therefore be indicative of pre-renal azotaemia resulting from water deprivation, which was not the case in the present study[14]. There is documentary evidence to the effect that blood urea and creatinine may be the only variables elevated in dehydration, a finding that could account for the discrepancies between our results and those of other authors[14,16]. This is contrary to common belief that creatinine is of questionable value for evaluating renal function in birds, probably because urea is converted into creatine before it has been converted to creatinine[12].

The mean urinary phosphorus and calcium levels obtained in the present study were lower than those reported in southern Africa[16]. The serum calcium level was slightly above the renal threshold for domestic animals, which ruled out defective calcium metabolism. Since renal clearance of phosphorus is often used as an index of renal function, it was evident in this study that there was no kidney compromise[3].

The electrolyte sodium was at variance with the values previously reported by other workers[11,13,16]. Similarly, the level of chloride obtained in this study was lower than that given by workers in southern Africa, but almost 50 % higher than the levels quoted by investigators from Israel[11,16]. The disparity between the serum levels of electrolytes namely potassium, sodium and chloride, could have been a reflection of climatic influences. In the hotter and more arid climates, urine would contain less salt as a water-conserving mechanism.

An intriguing observation was the excessive excretion of copper by ostriches used in this study compared to the low values obtained by other workers. No plausible explanation could be advanced for this. Probably, dietary influences partly contributed to the high copper levels obtained in this investigation[16]. Further studies may be warranted if the mechanisms involved are to be elucidated.

The findings in this preliminary study of urine from apparently healthy and physiologically normal ostriches indicated that the biochemical parameters measured in this study could be used to monitor renal integrity and the general health of ostriches in this country.

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