RESEARCH ARTICLE

Sokoto Journal of Veterinary Sciences

(P-ISSN 1595-093X: E-ISSN 2315-6201)

http://dx.doi.org/10.4314/sokjvs.v24i2.6

Abdulsalam *et al.*/*Sokoto Journal of Veterinary Sciences*, **24**(2): 143 - 152.

Urinalysis findings in cattle slaughtered at Maiduguri central abattoir

H Abdulsalam*, UA Girei & HI Gambo

Department of Veterinary Pathology, Faculty of Veterinary Medicine, University of Maiduguri, Nigeria

*Correspondence: Tel.: +2348039266736; E-mail: abdulsalamjnr@gmail.com

Publication History:
Received: 17-01-2026
Revised: 25-02-2026
Accepted: 03-03-2026

Abstract

The study evaluates urine abnormalities from cattle slaughtered at Maiduguri central abattoir. A total of 35 urine samples were collected directly from the bladder immediately after slaughter into clean urine sample bottles. The samples were transported in an ice pack to the laboratory for gross, chemical, and microscopic evaluation using standard procedures. Results showed abnormal colour of urine samples in 11(31.4%) cattle. Male and adult cattle had 6(31.6%) and 8(30.8%) abnormal coloured urine samples, respectively. Chemically, the urine sample had traces of leukocytes 2(5.7%), urobilinogen 24(68.5%), proteinuria ++ 22(62.9%), acidic 13(37.1%), ketonuria 21(60.0%), glycosuria 7(20.0%), bilirubin 17(48.6%). Microscopically, the urine sample had pus cells 2(5.8%), epithelial cells 4(11.4%), numerous red blood cells 3(8.6%) crenated red cell ++ 2(5.7%), casts ++ 2(5.7%), crystals +++ 3(8.6), bacterial cells ++ 1(2.9%), numerous sperm cells 13(37.1%), yeast cells + 1(2.9%), hyaline cast + 4(11.4%), calcium oxalate ++ 4(11.4%), crystal cells + 3(8.6%), ammonium magnesium phosphate ++ 2(5.7%), granular cast + 2(5.7%), amorphous crystals ++ 2(5.7%), cystine crystals ++ 1(2.9%), and crystal oxalate ++ 1(2.9%), In conclusion urine sample from apparently healthy cattle had gross, chemical and microscopic abnormalities which suggest the possibility of renal or metabolic disorder.

Keywords: Cattle, Leukocytes, Maiduguri, Microscopic, Urinalysis

Introduction

Urinalysis is a common clinical procedure used to assess the health status of the urinary system (Bardsley, 2015), that is often underutilized in veterinary practice (Parrah *et al.,* 2013). It is an important diagnostic tool for many common disease states (Ihedioha *et al.,* 2019). It can provide useful information related to screening and diagnosis of other conditions such as diabetes (Tripathi *et al.,* 2011; Bates, 2013). It is a priceless test in both healthy and sick animals and should be part of extensive but systemic clinical evaluation (Bates, 2013; Delanghe & Speeckaert, 2014). Examination of urine (urinalysis) is a very helpful procedure to evaluate renal function but it can also reveal a variety of systemic disease processes such as inflammation, haemorrhage, and intravascular hemolysis (Abirami & Tiwari, 2001). Urinalysis involves physical, chemical, and microscopic examination of urine sample to

determine the health status of the renal system (Daniel *et al.,* 2023). Important analytes commonly evaluated in urine specimens include leukocytes, nitrite, urobilinogen, protein, specific gravity, ketone, bilirubin, glucose, and pH (Adamu *et al.,* 2007).

Cattle and goats play a huge role in rural life, especially in regions like sub-Saharan Africa, where they provide food, income, and cultural value to many rural families (Peacock, 2005; FAO, 2012). Despite the importance of these animals in economic growth, their health status is seldom hindered by several conditions, such as urinary tract infections, kidney problems, and even metabolic disorders (Smith, 2014). Also, diagnostic procedures like urine analysis are not commonly used on them, especially in smallholder or rural settings. This might be due to a lack of awareness, a lack of diagnostic tools, or the perception that such tests are unnecessary (Endacott *et al*., 2021).

Chronic kidney disease has been described as a global public problem (Levey *et al.,* 2007). Considering the high incidence of kidney-related diseases in humans, the interaction of nutrition and kidney diseases, and the fact that there is scanty information available in the literature on the comprehensive urinalysis of Nigerian cattle, hence the need for this study.

Materials and Methods

Study location

This study was conducted in Maiduguri, the capital of Borno State, located in north-eastern Nigeria. Urine samples were collected from cattle at the Maiduguri Central abattoir, which serves as a major slaughter facility for livestock in the region. The abattoir is a central point for meat processing and animal health inspection, making it an ideal site for sample collection due to the availability of diverse animal species and routine veterinary oversight.

Study design

The study was a cross-sectional survey of cattle presented for slaughter at the Maiduguri central abattoir, Borno State.

The animals for the study

The study population comprised cattle slaughtered at the Maiduguri Central abattoir in the month of May, 2025. Visits to the abattoir was done twice a week. A total of 35 cattle (male and female) urine samples were collected for physical, chemical and microscopic examinations.

Age and sex determination

The age of the animals was estimated using dentition patterns, specifically by observing the eruption and wear of incisor teeth, which is a widely accepted method in small ruminants and cattle (Ozung *et al.,* 2011). Sex determination was carried out through visual inspection of external genitalia, a standard and reliable method commonly employed in both field and abattoir settings for distinguishing male and female animals (Khan *et al.,* 2014).

Urine collection

A convenience sampling technique was used during the research. Urine samples were obtained after slaughter of cattle at the Maiduguri abattoir. Rather than using conventional methods like free-catch or catheterization, the urinary bladder was carefully excised after the slaughter process. Urine was then directly collected by pouring it from the removed bladder, without relying on syringes or other collection tools. This technique guaranteed that the samples remained uncontaminated and transported to the laboratory in an ice pack, and it was examined physically, chemically and microscopically.

Urine evaluation

Physical examination of urine: The urine was examined physically for changes in colour, odour and transparency using the naked eye, and findings were recorded according to Sadoon (2021).

Chemical examination of urine: The urine samples were chemically analyzed using urine strips from (Plasmatec Laboratory Products Limited, Unit 29 Dreadnought Trading Estate, Bridport, Dorset DT6 5BU. UK.). The Combi-11 urinalysis strips were used to examine the urine chemically for leukocytes, nitrites, urobilinogen, protein, pH, specific gravity, ascorbic acid, occult blood, ketone, bilirubin and glucose (Sadoon, 2021).

Microscopic examination of urine: The urine was examined microscopically according to Constable *et al.* (2017). Briefly, 12 mL of well-mixed urine was poured in a centrifuge tube and centrifuged at 450 gravity (1500-2000 rpm) for five minutes. Then 11 mL of the centrifuged urine were decanted without disturbing the sediment, leaving 1 mL in the tube. Gently, the sediment was re-suspended, and one drop was delivered on a slide and covered with a cover slip. The slide was examined using low power (×10) objective. The light intensity was reduced to minimum and several fields were scanned for casts,

and a number of casts per low power field were reported. Using high power objective with slightly increased light intensity, leukocytes, crystals, spermatozoa and renal epithelial cells were identified and reported as cells/hpf.

Statistical analysis

The data generated were calculated using simple percentages and presented on the tables. The results obtained were compared among variables (sex and age).

Results

Urine colour of cattle

The frequency of occurrence of abnormal urine colour in cattle is presented on Table 1. Of the 35 cattle urine samples grossly examined, 24(68.6%) had normal urine colour, while 11(31.4%) showed abnormal urine colour (cloudy, reddish and brownish). Among those with abnormal urine colour, male 6(31.6%) and adult 8(30.8%) had the highest number of occurrences compared to female and young, respectively.

Urine chemical composition of cattle

The chemical composition of cattle urine is presented on Table 2. In cattle, traces of leukocytes were found in young 2(22.7%) and female cattle 2(12.5%). Urobilinogen was abnormal in 24(68.5%) of cattle, with higher proportions in adult 18(69.2%) and female 11(68.7%) compared to young 6(66.7%) and male 13(68.4%). Proteinuria was observed in ++ 22(62.9%), predominantly among adults 19(73.0%) and male 12(63.2%). Alkaline urine 22(62.9%) was more frequent than acidic 13(37.1%), with females 11(68.7%) and young 6(66.7%) having the highest numbers compared to male 11(57.9%) and adult 16(61.5%). Occult blood was present in 20(57.1%) of the cattle, with adult 15(57.6%) and male cattle 13(68.4%) more frequently affected compared to young 5(55.5%) and female 7(43.9%). Specific gravity ≥1.020 was recorded in 17(48.6%) of animals, more common in adults 13(50.0%) and male 11(57.8%) compared to young 4(44.4%) and female 6(37.5%). Traces to large ketones were observed in 21(60.0%) of samples, more in males 13(68.4%) and adults 18(69.1%) compared to female 8(50.0) and young 3(33.3%). Bilirubin was positive in 17(48.6%) of animals, with females 8(50.0%) and adults 14(53.8%) having the highest rate compared to male 9(47.4%) and young 3(33.3%). Glucose was positive in 7(20%) of cattle, more frequent in males 3(15.8%) than females 4(25.0%). Ascorbic acid was detected in 25(71.4%) cattle urine samples, with concentrations between 0.5–1.4 mmol/l more common in young 7(77.7%) and females 12(75.0%) compared to adult 18(69.2%) and male 13(68.4%).

Urine microscopic constituents of cattle

The occurrence of urinary microscopic constituents in cattle is shown in Table 3. In cattle, only few urine samples 2(5.8%) were positive for pus cells, with only young 2(22.2%) and female 1(6.3%) showing higher positivity. Epithelial cells (Plate I) were present in 4(11.4%) of cases, with 3–5 cells occurring only in males 4(21.1%) and adults 4(15.4%). Numerous red blood cells (Plate II) were present in 3(8.6%) cattle, with female 2(12.5%) and adult 3(11.5%) having higher occurrence, compared to male 1(5.3%, respectively). Crenated red blood cells (Plate III) ++ were only present in 2(5.7%), distributed as male 2(10.5%) and adult 2(22.2%). Cellular casts (Plate III) ++ were present in 2(5.7%) of the samples, with male 1(5.3%) and female 1(6.3%); adult 1(23.8%) and young 1(11.1), prevalence. Crystals (Plate IV) +++ were recorded in 3(8.6%) of the samples, with higher frequency in male 2(10.5%) and young 1(11.1%); compared to female 1(6.2%) and adult 2(7.7%); respectively. Bacterial cells (Plate V) were positive in 3(8.6%) of samples, more common in females 2(12.5%) and young 1(11.1%); compared to male 1(5.3%) and adult 2(7.6%). Numerous sperm cells (Plate VI) were detected in 13(37.1%) of the cattle, predominately in male 11(57.9%) and adults 10(31.5%); compared to female 2(12.5%) and young 3(33.3%). Hyaline casts (Plate VII) were positive + in 4(11.4%) cattle, with slightly higher proportion in male 3(15.8%) and young 1(11.1%) compared to female1(6.3%) and adult 3(8.6%). Calcium oxalate

Table 1: Frequency of occurrence of urine colour among cattle slaughtered at Maiduguri Central Abattoir, Nigeria

Colour	Number of occurrences (%)				
	Sex		Age		
	Male (n=19)	Female (n=16)	Adult (≥3years) n=26	Young (<3 years) n=9	Total (%) (n=35)
Normal colour	13 (68.4)	11 (68.7)	18 (69.2)	6 (66.7)	24 (68.6)
Abnormal colour	6 (31.6)	5 (31.3)	8 (30.8)	3 (33.3)	11 (31.4)

Table 2: Chemical composition of Cattle urine slaughtered at Maiduguri, Central Abattoir, Nigeria

Parameters		Sex		Age		
		Male (n=19)	Female (=16)	Adult (≥3 years) n=26	Young (<6 years) n=9	Total n=35
Leucocytes	Negative	19 (100)	14 (87.5)	26(100)	7 (77.8)	34 (97.1)
	Trace± ()	-	2 (12.5)	-	2 (22.2)	2 (5.7)
	Small+ ()	-	-	-	-	-
Urobilinogen (µmol/l)	Normal	6 (31.5)	5 (31.3)	8 (30.8)	3 (33.3)	11 (31.4)
	16	13 (68.4)	11(68.7)	18 (69.2)	6 (66.7)	24 (68.5)
	32	-	-	-	-	-
Nitrite	Negative	19 (100)	16 (100)	26 (100)	9 (100)	35 (100)
	Positive	-	-	-	-	-
Protein (g/l)	Negative	-	-	-	-	-
	Trace (±)	3 (15.8)	2 (12.5)	5 (19.2)	-	5 (14.2)
	30(+)	4 (21.0)	4 (25)	2 (7.7)	6 (66.7)	8 (22.9)
	100 (++)	12 (63.2)	10 (62.5)	19 (73)	3 (33.3)	22 (62.9)
pH	Acidic (5-6.5)	8 (42.1)	5(31.3)	10 (38.5)	3 (33.3)	13 (37.1)
	Alkaline (7.5-8.5)	11(57.9)	11(68.7)	16 (61.5)	6 (66.7)	22 (62.9)
Occult Blood (cells/µl)	Negative	6 (31.6)	9 (56.2)	11 (42.3)	4 (44.4)	15 (42.9)
	Non-haemolyzed	2 (10.5)	2 (12.5)	2 (7.7)	2 (22.2)	4 (11.4)
	Hemolyzed	2 (10.5)	1 (6.3)	2 (7.7)	1 (11.1)	3 (8.6)
	Small-moderate	5 (26.3)	3(18.8)	6 (23.0)	2 (22.2)	8 (22.8)
	Large	4 (21.1)	1 (6.3)	5 (19.2)	-	5 (14.3)
Specific gravity	≤1.010	4 (21.1)	6 (37.5)	6 (23.1)	4 (44.4)	10 (28.6)
	1.015	4 (21.1)	4 (25.0)	7 (26.9)	1 (11.1)	8 (22.8)
	≥1.020	11 (57.8)	6 (37.5)	13 (50.0)	4 (44.4)	17 (48.6)
Ketones (mmol/l)	Negative	6 (31.6)	8 (50.0)	8 (30.8)	6 (66.7)	14 (40.0)
	Trace – large (5-80)	13 (68.4)	8 (50.0	18 (69.1)	3 (33.3)	21(60.0)
Bilirubin (µmol/l)	Negative	10(52.6)	8 (50)	12 (46.2)	6 (66.7)	18 (51.4)
	Small +	9 (47.4)	8 (50)	14 (53.8)	3 (33.3)	17 (48.6)
Glucose (mmol/l)	Negative	16 (84.2)	12 (75.0)	20 (76.9)	8 (88.9)	28 (80)
	100-250 (±)	3 (15.8)	4 (25.0)	6 (23.0)	1 (11.1)	7 (20.0)
Ascorbic Acid (mmol/l)	Negative	6 (31.6)	4 (25)	8 (30.8)	2 (22.2)	10 (28.6)
	0.5	7 (36.8)	6 (37.5)	10 (38.4)	3 (33.3)	13 (37.1)
	1.4	6 (31.6)	6 (37.5)	8 (30.8)	4 (44.4)	12 (34.3)

(Plate VIII) ++ occurred in 4(11.4%) of samples, more common in females 3(18.8%) and adult 4(15.4%); compared to male 1(5.3%) and young 0(0.0%). Other crystals, such as cysteine (Plate IX), ammonium magnesium phosphate (Plate X), and amorphous crystals (Plate XI), occurred at low frequencies (2.9–8.6%). Crystal oxalate was present in only 1(2.9%) urine sample, represented by male 1(5.3%) and adult 1(5.3%) Plate XII

Discussion

Some of the abnormal urine colours observed in this study appeared cloudy, reddish and brownish, which was earlier reported by Aliyu *et al.* (2017) and Ihedioha *et al.* (2019). Freshly voided urine from healthy animals is usually clear, except in horses, where it may be thick and cloudy due to the presence of calcium carbonate crystals and mucus (Fenton, 2009; Thrall *et al.,* 2013). Abnormal urine colouration could also be due to a decrease in the volume of voided urine resulting from bacterial infections of the urinary tract. The finding in this study is in agreement with Fazilie *et al.* (2010) and Jawalekar *et al.* (2010). Cloudiness in freshly voided urine is usually associated with the presence of mucus, bacteria, white blood cells or red blood cells (Ochei &

Table 3: Occurrence of urinary microscopic constituents of cattle slaughtered at Maiduguri, Central abattoir, Nigeria

Parameters		Number of occurrences (%)				
		Age		Sex		
		Male n=19	Female n=16	Adult (≥3 years) n=26	Young (<3 years) n=9	Total n=35
Pus cells (cells/hpf)	Nil	18 (94.7)	15 (93.7)	26 (100.0)	7 (77.8)	33 (94.3)
	+	-	1 (6.3)	-	1 (11.1)	1 (2.9)
	++	1 (5.3)	-	-	1 (11.1)	1 (2.9)
Epithelial cells	0-2	15 (78.9)	16 (100)	22 (84.6)	9 (100)	31 (88.6)
	3-5	4 (21.1)	-	4 (15.4)	-	4 (11.4)
Red blood cells (cells/hpf)	Nil	16 (84.2)	11 (68,8)	20 (76.9)	7 (77.8)	27 (77.1)
	+	2 (10.5)	2 (12.5)	2 (7.7)	2 (22.2)	4 (11.4)
	++	-	1 (6.2)	1 (3.8)	-	1 (2.9)
	Numerous	1 (5.3)	2 (12.5)	3 (11.5)	-	3 (8.6)
Crenated red cells	Nil	16 (84.2)	15 (93.8)	24 (92.3)	7 (77.8)	31 (88.6)
	+	1 (5.3)	1 (6.2)	-	2 (22.2)	2 (5.7)
	++	2 (10.5)	-	2 (7.7)	-	2 (5.7)
Casts	Nil	13 (68.4)	13 (81.3)	19 (73.1)	7 (77.8)	26 (74.3)
	+	5 (26.3)	2 (12.5)	6 (23.1)	1 (11.1)	7 (20.0)
	++	1 (5.3)	1 (6.25)	1 (23.8)	1 (11.1)	2 (5.7)
Crystals	Nil	10 (52.6)	7 (43.8)	15 (57.7)	2 (22.2)	17 (48.6)
	+	6 (31.6)	7 (43.8)	8 (30.7)	5 (55.5)	13 (37.1)
	++	1 (5.3)	1 (6.2)	1 (3.8)	1 (11.1)	2 (5.7)
	+++	2 (10.5)	1(6.2)	2 (7.7)	1 (11.1)	3 (8.6)
Bacterial cells	Nil	18 (94.7)	14 (87.5)	24 (92.3)	8 (88.9)	32 (91.4)
	+	1 (5.3)	1 (6.3)	1 (3.8)	1 (11.1)	2 (5.7)
	++	-	1 (6.2)	1 (3.8)	-	1 (2.9)
Sperm cells	Nil	5 (26.3)	14 (87.5)	13 (50.0)	6 (66.7)	19 (54.3)
	+	1 (5.3)	-	1 (3.8)	-	1 (2.9)
	++	2 (10.5)	-	2 (7.7)	-	2 (5.7)
	Numerous	11 (57.9)	2 (12.5)	10 (38.5)	3 (33.3)	13 (37.1)
Yeast cells	Nil	19 (100)	15 (93.8)	26 (100)	8 (88.9)	34 (97.1)
	+	-	1 (6.2)	-	1 (11.1)	1 (2.9)
Hyaline cast	Nil	16 (84.2)	15 (93.8)	23 (88.5)	8 (88.9)	31 (88.6)
	+	3 (15.8)	1 (6.3)	3 (8.6)	1 (11.1)	4 (11.4)
Calcium oxalate	Nil	16 (84.2)	12 (75.0)	19 (73.1)	9 (100)	28 (80.0)
	+	2 (10.5)	1 (6.2)	3 (11.5)	-	3 (8.6)
	++	1 (5.3)	3 (18.8)	4 (15.4)	-	4 (11.4)
Crystal cells	Nil	17 (89.5)	15 (93.8)	24(92.3)	8 (88.9)	32 (91.4)
	+	2 (10.5)	1 (6.2)	2 (7.7)	1 (11.1)	3 (8.6)
Ammonium magnesium phosphate	Nil	17 (89.5)	16 (100)	24 (92.3)	9 (100)	33 (94.2)
	++	2 (10.5)	-	2 (7.7)	-	2 (5.7)
Granular cast	Nil	17 (89.5)	16 (100)	24 (92.3)	9 (100)	33 (94.2)
	+	2 (10.5)	-	2 (7.7)	-	2 (5.7)
Amorphous crystals	Nil	17 (89.5)	16 (100)	24 (92.3)	9 (100)	33 (94.2)
	++	2 (10.5)	-	2 (7.7)	-	2 (5.7)
Cystine crystals	Nil	18 (94.7)	16 (100)	25 (96.1)	9 (100)	34 (97.1)
	++	1 (5.3)	-	1 (3.9)	-	1 (2.9)
Crystal oxalate	Nil	18 (94.7)	16 (100)	25 (96.1)	9 (100)	34 (97.1)
	++	1 (5.3)	-	1 (3.9)	-	1 (2.9)

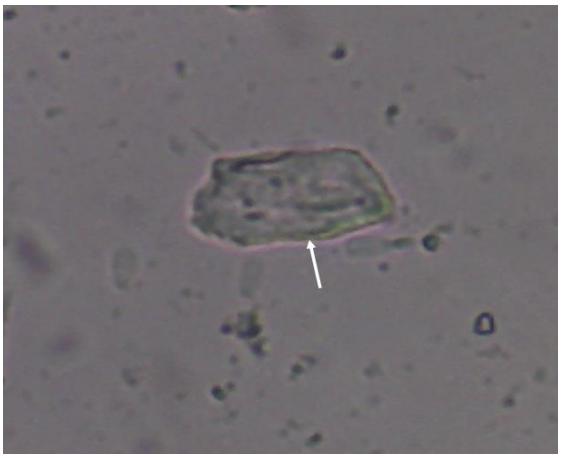

Plate I: Photomicrograph from urine sample of cattle showing epithelial cell x40

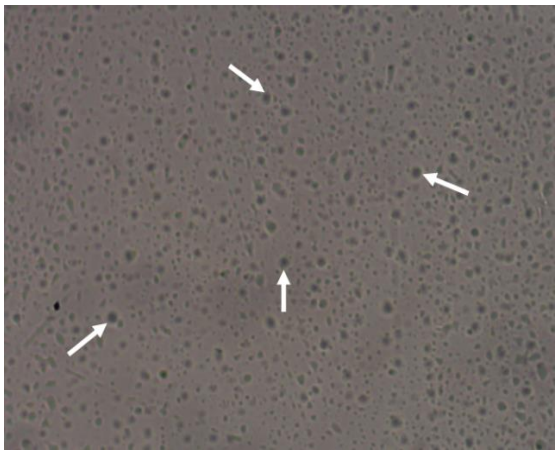

Plate II: Photomicrograph from urine sample of cattle showing red blood cell x40

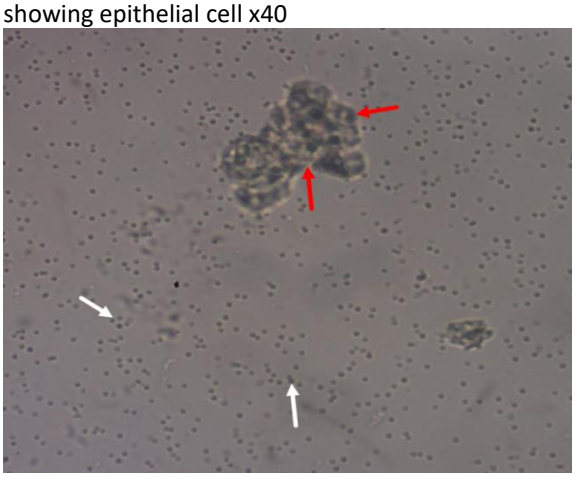

Plate III: Photomicrograph from urine sample of cattle showing crenated red blood cell (white arrow) and cellular cast (red arrow) x40

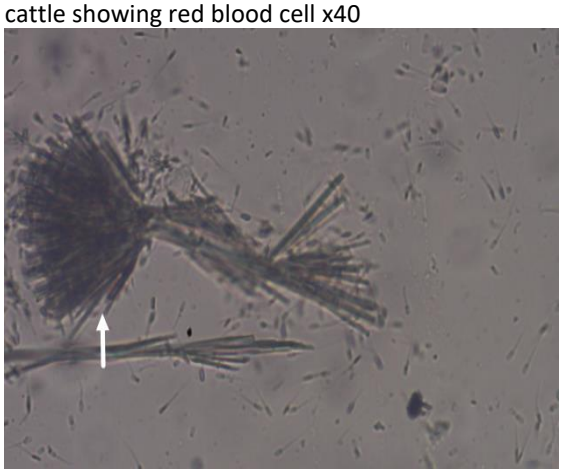

Plate IV: Photomicrograph from urine sample of cattle showing crystal x40

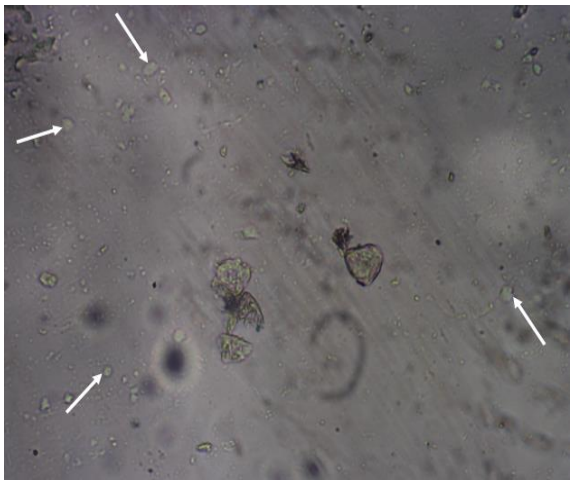

Plate V: Photomicrograph from urine sample of cattle showing bacterial cells x40

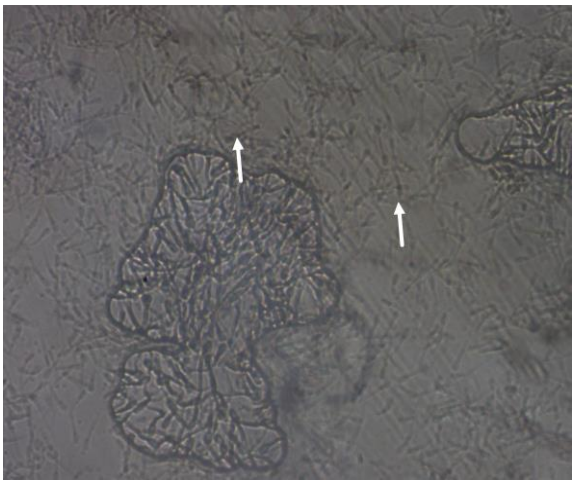

Plate VI: Photomicrograph from urine sample of cattle showing sperm cells x40

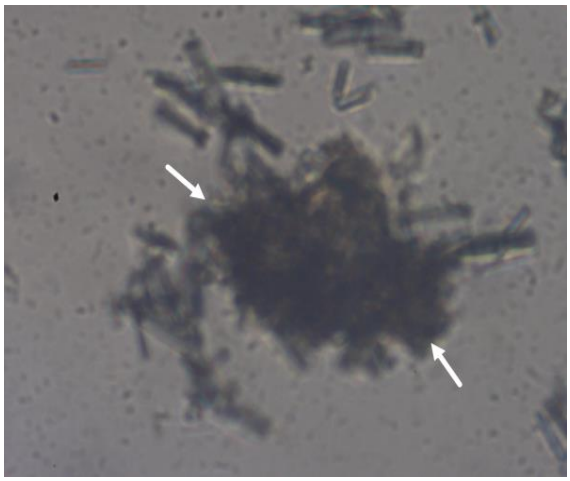

Plate VII: Photomicrograph from urine sample of cattle showing hyaline cast x40

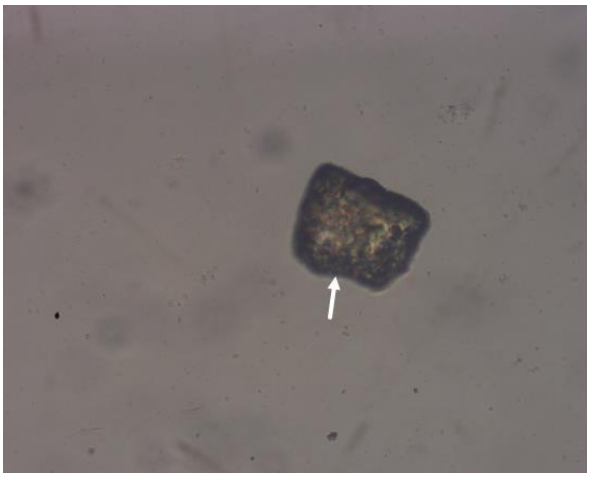

Plate VIII: Photomicrograph from urine sample of cattle showing calcium oxalate x40

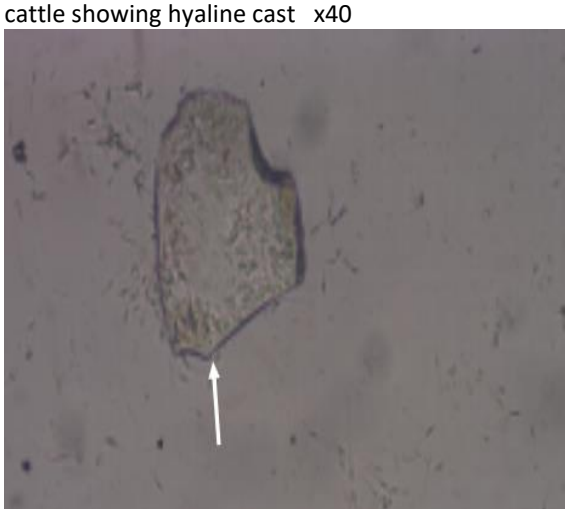

Plate IX: Photomicrograph from urine sample of cattle showing cysteine cell x40

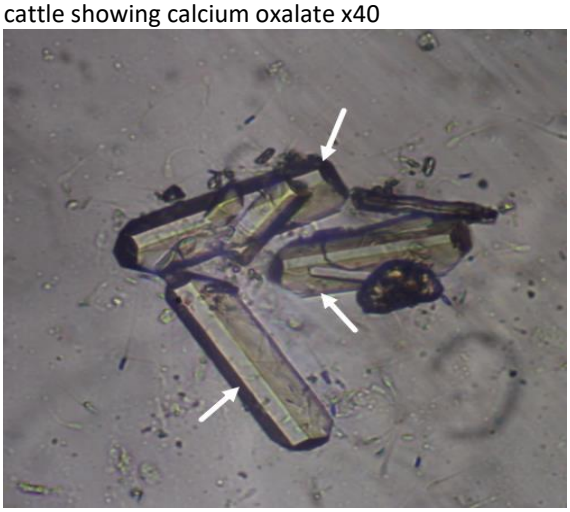

Plate X: Photomicrograph from urine sample of cattle showing amorphous magnesium phosphate x40

Plate XI: Photomicrograph from a urine sample of cattle showing an amorphous crystal x40

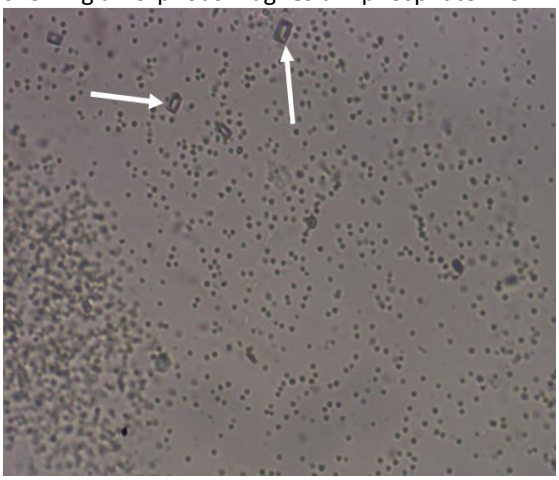

Plate XII: Photomicrograph from urine sample of cattle showing crystal oxalate x40

Kolhatkar, 2000). Brownish colouration of urine is indicative of mixing of blood in the urine, which could be due to nephritis. Reddish discolouration of urine is suggestive of haematuria (Kannan & Lawrence, 2010).

Urinary specific gravity observed in this study were within the normal range (1.020 - 1.040) for cattle (Parrah *et al.,* 2013). A lower or higher specific gravity may suggest an alteration of the urine concentration by the renal tubules. Isosthenuric urine (1.007 - 1.013) with azotaemia suggests the occurrence of renal failure. However, if the animal is dehydrated, some of the azotaemia may be due to hypovolaemia (Thrall *et al.,* 2013). The majority of the urine sampled were alkaline, which is associated with herbivorous animals, including goats (Sadoon, 2021). However, the finding of slightly acidic urine samples in the present study could be attributed to trekking long distances and exercise in search of pasture, which is in agreement with Amer & Alhendi (1996) and Ihedioha *et al.* (2019) in camels and cattle, respectively.

Proteinuria observed in this study could be a result of glomerular leakage due to nephritis (Aliyu *et al.,* 2017 and Ihedioha *et al.,* 2019). Increased protein level in the urine might be due to inflammatory exudation resulting from pyelitis, urethritis, cystitis and urolithiasis (Nagy, 2009).

The ketonuria observed might be a result of exercise or starvation (Thrall *et al.,* 2013) when fats are burned for energy, while the non-ketonuric urine samples may be indicative of a positive energy balance. Although the reason for bilirubinuria in this study is not quite obvious, the causes of bilirubinuria in animals include bile duct obstruction, hepatic necrosis, infectious disease and haemolytic diseases (Jawalekar *et al.,* 2010). Negative to trace concentrations of urinary glucose is normal to all animals, but glucosuria results when there is hyperglycaemia and plasma glucose concentrations exceeds the renal threshold, and the glucose is excreted in urine. Glucosuria with or without hyperglycaemia may also be suggestive of a tubular resorption defect in animals, in which the renal tubules fail to reabsorb glucose from the glomerular filtrate (Thrall *et al.,* 2013).

The finding of calcium phosphate, calcium oxalate and triple phosphate in this study as the most common types of crystals was earlier reported by Aliyu *et al.* (2017); Ihedioha *et al.* (2019); Sadoon, (2021). The presence of calcium oxalate monohydrate in urine has been suggested to be normal, due to the fact that some vegetables contain oxalates and oxalic acid may be formed in the course of metabolism (Thrall *et al.,* 2013). The occurrence of crystals may be incidental or of diagnostic importance, as crystalluria may indicate possible plant poisoning. Crystalluria is associated with urolithiasis, acute uric acid nephropathy, ethylene glycol poisoning and drugs (sulphadiazine) (Thamilselvan & Khan, 1998; Ochei & Kolhatkar, 2000). The urinary casts observed in this study were white and red cell casts, waxy casts, hyaline casts and granular casts. These casts were also reported by another study (Amer & Alhendi, 1996; Aliyu *et al.,* 2017; Ihedioha *et al.,* 2019). White and red cell casts were probably due to inflammatory processes (Ochei and Kolhatkar, 2000). The presence of waxy casts could be due to chronic renal failure (Ochei & Kolhatkar, 2000). Occasionally, hyaline casts are seen in normal urine, but their number increases in renal disease (Amer & Alhendi, 1996; Ochei & Kolhatkar, 2000). Transient increase of hyaline casts has also been observed after exercise and fever (Ochei & Kolhatkar, 2000). Granular cell casts could be associated with the observed glomerular, tubular and interstitial lesions in this study (Ochei & Kolhatkar, 2000). Haematuria could be associated with the presence of glomerulonephritis with haemorrhage from glomerular capillary. Other causes of haematuria are calculi in urinary tract and cystitis (Ochei & Kolhatkar, 2000). Increased number of urinary neutrophils is usually associated with purulent urethritis, cystitis or pyelonephritis (Parrah *et al.,* 2013). The epithelial cell cast observed were differentiated from white cell casts from the nuclei of the cell. The epithelial cells observed in this study, were possibly as a result of acute tubular necrosis. Amer & Alhendi (1996) also reported epithelial cells in camel urine. Increased number of these cells from proximal or distal tubules could also be associated with toxic effects of drugs or metals. Pyuria observe in the urine of goats may indicates a purulent process at some point in the urinary tract, especially urethritis or cystitis (Sadoon, 2021).

In conclusion, this study has demonstrated that urinalysis may be used as a valuable diagnostic tool for screening of certain conditions such as assessing renal, hepatic, metabolic, and urinary tract health in cattle. Abnormal urine colours such as cloudiness, reddish, and brownish discolourations observed were associated with haematuria, nephritis, and urinary tract infections. The predominance of alkaline urine was consistent with the herbivorous nature of goats, while the occurrence of slightly acidic urine was attributed to physiological stress such as long-distance trekking in search of pasture. Proteinuria, ketonuria, bilirubinuria, and glucosuria observed in some samples indicated possible glomerular leakage, hepatic dysfunction, metabolic imbalance, or tubular resorption defects. The detection of calcium oxalate, calcium phosphate, and triple phosphate crystals, together with the presence of various casts, reflected dietary, metabolic, and renal influences. Overall,

these findings confirm that urinalysis provides significant diagnostic information in cattle and should be integrated into herd health monitoring and research.

Therefore, it is recommended that, further research to correlate the findings in urinalysis and other confirmatory diagnosis especially those that relate to renal, hepatic and metabolic disorders should be conducted. Since this study confirmed the diagnostic value of urinalysis in cattle, similar research should be expanded to larger populations, diverse breeds, and different ecological zones in order to develop baseline reference values for improved veterinary diagnosis and research application. Also, the observation of alkaline urine with occasional acidic samples suggests a management or stress influence; therefore, future studies should evaluate the effect of feed, water availability, and prolonged trekking on urine pH in. Finally, detailed studies combining urinalysis with biochemical and histopathological examinations are recommended.

Funding

No funding was received.

Conflict of Interest

The authors declare that there is no conflict of interest.

References

Abirami K & Tiwari SC (2001). Urinalysis in clinical practice (akin to liquid kidney biopsy). *Journal of Indian Academy of Clinical Medicine,* **2**(1&2): 39-50.

Adamu S, Adebayo IT, Useh NM, Bisalla M, Sambo SJ & Esievo KAN (2007). Chemical analysis of urinary constituents in cattle presented for slaughter at Zaria abattoir. *Medwell Journal of Veterinary Research,* **1**(3): 57-60.

Aliyu A, Natala J, Adamu S, Igbokwe IO, Esievo KAN & Useh NM (2017). A Comparative Study on the Haematology, Biochemical Alterations in Serum Composition and Pathologic Changes in the Kidneys of Cachectic and Non-cachectic Cattle in Zaria, Nigeria. *International Journal of Biochemistry Research and Review,* **19**(4): 1-11,

Amer HA & Alhendi AB (1996). Physical, biochemical and microscopical analysis of camel urine. *Journal of Camel Practice and Research,* **3**(17): 21.

Bardsley A (2015). How to perform a urinalysis, *Nursing Standard*, **30**(2), 34-36.

Bates B (2013). Interpretation of urinalysis and urine culture for UTI treatment. *Pharmacist*, **38**(11): 65–68.

Constable PD, Hinchliff KW, Done SH & Grunberg W (2017). A Textbook of the Diseases of Cattle, Horses, Sheep, Pigs and Goats. Eleventh edition. Elsevier Limited, China. Pp 1095 – 1154.

Daniel A, Queremel M & Ishwarlal J (2023). Urinalysis, National Library of Medicine 8600 Rockville Pike Bethesda, MD 20894. https://www.ncbi.nlm.nih.gov/books/NBK557685/, 01-05-2023.

Delanghe J & Speeckaert M (2014). Preanalytical requirements of urinalysis. *Biochemia Medica (Zagreb),* **24**(1): 89-104.

Endacott I, Williams S, Byaruhanga J, Alafiatayo R, Mijten E, Tweyongyere R & Varga G (2021). A survey of priority livestock diseases and laboratory diagnostic needs of animal health professionals and farmers in Uganda. *Frontiers in Veterinary Science,* doi.10.3389/fvets.2021.721800.

Fazilie MR, Malik HU, Bhattacharyya HK, Bachoo Moulvi BA & Makhdoomi DM (2010). Minimally invasive tube cystotomy for treating obstructive urolithiasis in small ruminants with an intact urinary Bladder. *Veterinary Record,* **166**(17): 528-531.

Fenton TR (2009) Meta-analysis of the effect of the acid-ash hypothesis of osteoporosis on calcium balance. *Journal of Bone Mineral Research,* **24**(11): 1835-1840.

Fogazzi GB (1996). Crystalluria: A neglected aspect of urinary sediment analysis. *Nephrology Dialysis Transplantation,* **11**(2): 379-387.

FAO (2012). Invisible Guardians - Women manage livestock diversity. FAO Animal Production and Health Paper No. 174. Rome, Italy. Pp 34.

Ihedioha JI, Ukachukwu CV, Ugochukwu ICI & Anyogu DC (2019). Evaluation of kidney function and urinary analytes in Nigerian trade cattle. *Tropical Animal Health and Production,* **51**(7): 1867–1875.

Jawalekar S, Surve VT & Bhutey SA (2010). Twenty four hours urine and serum biochemical parameters in patients with urolithiasis. *Nepal Medical College Journal,* **12**(1):5-7.

Kannan KVA & Lawrence KE (2010). Obstructive urolithiasis in seaman goat in New Zealand, resulting from urinary bladder rupture. *New Zealand Veterinary Journal*, **58**(5): 269-271.

Khan CM, Line S & Aiello SE (2014). The Merck Veterinary Manual (eleventh edition). Merck & Co., Inc, Kenilworth NJ, USA Pp 345.

Levey AS, Andreoli SP, DuBose T, Provenzano R & Collins AJ (2007). CKD: common, harmful, and treatable World Kidney Day. *American Journal of Kidney Disease,* **49**(2): 175-179.

Nagy DW (2009). Urolithiasis in small ruminants: Proceedings on Animal feed Resources, CVC in Kansas City, Pp 59.

Ochei J & Kolhatkar A (2000). Medical Laboratory Science: Theory and Practice, First edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, India. Pp 110 – 151.

Ozung PO, Nsa EE, Ebegbulem VN & Ubua JA (2011). The potentials of small ruminant production in Cross River rainforest zone of Nigeria: A Review. *Continental Journal of Animal and Veterinary Research*, **3**(1): 33–47.

Parrah JD, Moulvi BA, Gazi MA, Makhdoomi DM, Athar H, Din MU, Dar S & Mir AQ (2013). Importance of urinalysis in veterinary practice. *Veterinary World,* **6**(9): 2231-0916.

Peacock C (2005). Goats – a pathway out of poverty. *Small Ruminant Research*, 60(1–2): 179–186

Sadoon AS (2021) Study of Bacterial Infections in the Urinary System of Goats in Mosul City. *Bazilian Journal of Veterinary Research,* **20**:(1): 172-191.

Smith BP (2014). Large Animal Internal Medicine, fiftth edition. Elsevier Health Sciences. London. Pp 256-259.

Thamilselvan S & Khan SR (1998). Oxalate and calcium oxalate crystals are injurious to renal epithelial cells : result of *in vivo* and *in vitro* studies. *Journal of Nephrology,* **11**(1): 66-69.

Thrall MA, Weiser G, Allison RW & Campbell TW (2013). Veterinary Hematology and Clinical Chemistry, second edition. Wiley-Blackwell. 2121 State Avenue, Ames, Iowa 50014-8300, USA Pp 34.

Tripathi NK, Gregory CR & Latimer KS (2011). Urinary system. In: *Duncan and Prasse Veterinary Laboratory Medicine*: *Clinical Pathology* (KS Latimer, editor)*,* fifth edition. Wiley Blackwell, WesSussex, UK. Pp 253-28.