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Evaluation of Buffalo Health and Prevalence of Metabolic Disorders in Pulivendula: A Urine Analysis Approach

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The study aims to evaluate the health status of buffaloes in selected villages of Pulivendula, detect potential metabolic disorders, and assess the prevalence of common health issues using urine analysis via the dipstick method.

Objectives: The main aim of this study is to identify abnormalities, correlates the findings with nutrition and health data and emphasizes student participation in community-based animal health programs.

Materials and Methods: A total of 25 buffaloes from five villages in the Pulivendula region were randomly checked as part of the study. The dipstick method was chosen for urine sample collection and analysis because of its ease of use, affordabilitys and speedy findings. Tests were conducted on parameters including **Blood, Bilirubin, Nitrite, Leucocytes, Sp. Gravity Glucose, Protein, pH, Urea, RBC and Ketones.** Students also completed surveys that yielded information about the diet, living circumstances, and overall health of the buffaloes.

Results and Discussion: The investigation found that a less number of buffaloes had aberrant urine parameters, indicating subclinical illnesses. Proteinuria and ketonuria were more common in buffaloes from settlements with limited access to quality feed and water. The study results revealed a link between dietary behaviours and observed urine abnormalities, highlighting the need for better nutritional management and health monitoring in these locations. This study highlights the importance of the dipstick method in routine veterinary health checks, as well as the need for focused interventions to improve buffalo health and productivity in the Pulivendula region.

Keywords: Abnormalities; dipstick method; urine analysis; nutrition management; health programmes.

1. INTRODUCTION

The urinary system regulates and conserves body fluid components, as well as removes harmful waste from the body (Elghany et al., 2013, Abe et al., 2022). A urinary tract infection (UTI) that compromises system integrity might impair the operation of other systems (Elghany et al., 2013). The term "UTI" refers to microbial colonization of the urinary system or any urinary tract organ, with the exception of the distal urethra, which has a normal bacterial flora. Several microorganisms have been implicated in the etiology of UTI in cattle, with bacteria being mostly responsible for disease pathogenesis. E. coli is most commonly related with UTI in cattle (Ahmed et al., 2013). *Streptococcus spp.*, Staphylococcus spp., and Pseudomonas spp. are some of the other bacteria that are frequently isolated. Susceptibility testing and microbiological culture are the mainstays of UTI diagnosis and treatment in buffaloes (Cordin et al., 2021). Drug therapy decisions are made easier by routinely tracking infections isolated from the urinary system and their patterns of susceptibility. This approach can also be used to track the presence of resistant bacteria (Blowey and Weaver, 2011). The existence of many forms of parameters, their normal and abnormal values, and leads resulting from diseases have all been discussed in this work (Bohn, 2014). Pathogenic bacteria causing UTI in a well-managed buffalo pasture. Additionally, for a better understanding of the drug sensitivity of these organisms and to design a therapeutic regimen to prevent the clinical infection, the antimicrobial sensitivity, the susceptibility of pathogenic bacteria to different classes of antibiotics, and the multidrug resistant pattern are described **(**Braun et al.,2008, El-Naser et al., 2011).

2. MATERIALS AND METHODS

2.1 Sample Collection and Preparation

Fresh urine samples were obtained in clean, dry containers to ensure the dipstick analysis was accurate. It is critical that samples were not centrifuged and were fully mixed prior to testing. To ensure test reliability, samples were analyzed within one hour of collection. To avoid contamination, all specimens were handled in strictly hygienic settings. Water should not be used as a negative control liquid because certain preservatives are unsuccessful at preserving ketones, bilirubin, or urobilinogen stability, and bacterial development in long-term storage specimens can affect glucose, pH, nitrite, and blood test results.

2.2 Points for Attention

Protein and Microalbumin (10V Only): The dipstick test is extremely sensitive to albumin, but

less so to Bence-Jones proteins, immunoglobulins, and haemoglobin. A negative result does not always reflect a complete lack of protein in the urine.

Glucose: The reagent is solely intended to detect glucose. Other urine components do not produce a good result. In some situations, a sample containing 2.2 mmol/L glucose and 0.28 mmol/L ascorbic acid may produce a colour change that is similar to a positive result. However, ascorbic acid concentrations as low as 0.28 mmol/L and/or acetoacetic acid concentrations as high as 1.1 mmol/L are unlikely to interfere with the test. Typically, the kidney removes a small, inconsequential amount of glucose, which is usually below the reagent's detection threshold.

Bilirubin: Detecting bilirubin in urine is difficult even with the most sensitive technologies. Bilirubin levels as low as this necessitate a thorough evaluation. Substances that colour acidic media red, such as phenazopyridine or some pharmaceuticals, can impair test accuracy, potentially resulting in false negatives if the sample contains significant quantities of ascorbic acid.

Ketone: The dipstick reacts to acetoacetic acid but not acetone or ß-hydroxybutyric acid. Normal urine should normally produce negative results. In some cases, strongly pigmented urine or urine containing high quantities of levodopa metabolites can give false positives.

Specific Gravity: The reagent strip can assess urine specific gravity between 1.000 and 1.030 with a mean error margin of 0.005. pH changes, the presence of non-ionic solutes, highly buffered alkaline urine, and moderate protein levels can all affect findings. Automated instruments correct strip measurements for greater precision.

Blood: The reagent strip is especially sensitive to haemoglobin and myoglobin, making it a useful addition to microscopic investigation. Within 60 seconds of contact, the appearance of green specks (intact erythrocytes) or a green tint (hemoglobin/myoglobin) on the reagent region may indicate blood in the urine, prompting further diagnostic testing. False positives can be caused by oxidising chemicals such as hypochlorite or the microbial peroxidase activity associated with UTIs. Menstrual blood contamination may cause false positives for female.

pH: The dipstick detects urine pH levels between 5.0 and 9.0 instrumentally and 5.0 to 8.5 visually. This measure is critical for determining the acidity or alkalinity of urine, which can vary during infections or other pathological circumstances.

Urobilinogen: Urobilinogen is detectable at concentrations as low as 3 µmol/L (0.02 Ehrlich units/dL). Results of 33 µmol/L or greater indicate a shift from normal to potentially abnormal conditions, requiring additional research. Negative results do not completely rule out the existence of urobilinogen.

Nitrite: Nitrite detection is connected to the presence of gram-negative bacteria, which convert dietary nitrate to nitrite. A constant pink colouration on the dipstick, regardless of intensity, is considered a favorable result; however, there is no clear association between colour depth and bacterial load. False negatives may occur if dietary nitrate levels are low or if urine has a high specific gravity, which reduces test sensitivity.

Leukocytes: Leukocyte esterase interacts with granulocytic leukocytes in urine. Normal samples are normally negative, whereas clinically relevant values yield a positive result. 'Trace' readings may not be important until they persist. High specific gravity and glucose levels (more than 160 mmol/L) can reduce test sensitivity, and contamination with vaginal discharge may result in false positives in female samples.

Protein: The test region is especially sensitive to albumin, but a negative result does not rule out the existence of other proteins such as globulins, haemoglobin, Bence-Jones proteins, or mucoproteins. False positive results may occur in highly buffered alkaline urine.

Test Strip Technology: Advances in test strip technology have greatly improved the analytical sensitivity of urine dipsticks. Electronic detection innovations have allowed for the quantitative measurement of critical components such as red and white blood cells, glucose, and urine proteins. Furthermore, current strips can quantitatively test albumin and calculate the albumin-to-creatinine ratio, particularly in the microalbuminuria range (20-200 mg/L). Creatinine-specific test pads now account for urine dilution, and CMOS technology improves sensitivity to leukocyte esterase and peroxidase activity. The incorporation of smart technology has enabled smartphone applications to read and interpret dipstick findings, increasing ease and accuracy.

Fig. 1. Collection and testing of urine sample

Fig. 2. The image showing sample testing and result observation

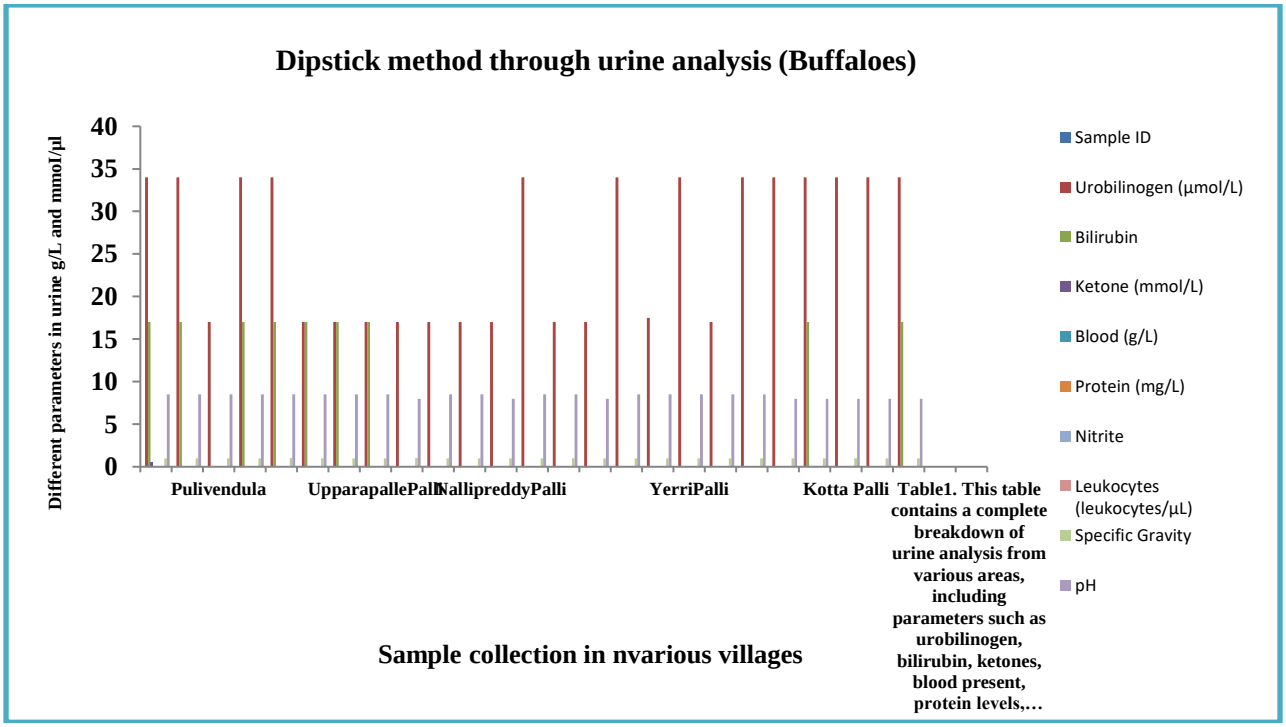

Fig. 3. Urine assay graph demonstrating the detection of multiple parameters in urine using the dipstick method (Buffaloes)

Table 1. Detection of several parameters in urine using the dipstick method through urine analysis (Buffaloes)

Sample Collection Site	Sample ID	Urobilinogen (µmol/L)	Bilirubin	Ketone (mmol/L)	Blood (g/L)	Protein (mg/L)	Nitrite	Leukocytes (leukocytes/µL)	Specific Gravity	pH
Pulivendula	Sample 1	34	+17	0.5	**Trace**	+	-	-	1.000	8.5
	Sample 2	34	+17	-	-	0.3+	-	0-15	1.000	8.5
	Sample 3	17	Neg	-	-	-	-	0-70	1.005	8.5
	Sample 4	34	17	-	-	-	-	-	1.000	8.5
	Sample 5	34	17	-	-	3.0+	-	-	1.010	8.5
Upparapalle Palli	Sample 1	17	17	0.5+	-	3.0+++	-	-	1.000	8.5
	Sample 2	17	17	0.5+	1.0+	0.3+	**Trace**	0-15	1.000	8.5
	Sample 3	17	17	-	-	-	-	0-70	1.000	8.5
	Sample 4	17	17+	-	-	-	-	-	1.010	8.0
	Sample 5	17	Neg	0.5+	-	0.3+	-	-	1.005	8.5
Nallipreddy Palli	Sample 1	17	17+	-	-	0.3+	-	-	1.000	8.5
	Sample 2	17	17+	-	-	0.3+	-	0-70	1.000	8.0
	Sample 3	34	Neg	-	1.0+	0.3+	-	-	1.000	8.5
	Sample 4	17	17+	-	-	-	-	-	1.005	8.5
	Sample 5	17	17+	0.5+	-	-	-	-	1.005	8.0
Yerri Palli	Sample 1	34	17+	-	-	**Trace**	-	-	1.000	8.5
	Sample 2	17.5	Neg	-	-	0.3+	-	-	1.000	8.5
	Sample 3	34	17+	-	-	Trace	-	-	1.000	8.5
	Sample 4	17	17+	-	Non	0.3+	-	-	1.000	8.5
	Sample 5	34	Neg	-	-	-	-	0-15	1.000	8.5
Kotta Palli	Sample 1	34	17+	-	-	-	-	-	1.000	8.0
	Sample 2	34	17	-	-	-	-	-	1.000	8.0
	Sample 3	34	Neg	-	-	-	-	-	1.000	8.0
	Sample 4	34	17+	-	-	-	-	-	1.000	8.0
	Sample 5	34	17	-	-	-	-	-	1.000	8.0

This table contains A complete breakdown of urine analysis from various areas, including parameters such as urobilinogen, bilirubin, ketones, blood present, protein levels, nitrite, leukocyte count, specific gravity, and pH. The data was acquired from samples in Pulivendula, Upparapalle Palli, Nallipreddy Palli, Yerri Palli and Kotta Palli and provides insights into the urinary health of local buffalo herds

3. RESULTS

Urine analysis from five regions—Pulivendula, Upparapalle Palli, Nallipreddy Palli, Yerri Palli, and Kotta Palli—provides a comprehensive picture of urinary health in buffalo populations. Urobilinogen was detected in 87% of the samples (17 or 34 µmol/L), which is a significant finding. Pulivendula had the greatest concentration (34 µmol/L), accounting for 80% of its samples, while Kotta Palli had 100% of its samples at this level. This study indicates a broad presence of bile pigments in the buffaloes, implying potential liver or bile duct problems. In terms of bilirubin, 62% of the samples tested positive, with the majority at +17, indicating probable liver impairment. This was particularly notable in Pulivendula and Kotta Palli, where 80% of the samples had elevated bilirubin levels.

Ketone levels were low across the locations, with only 14% of samples testing positive, mostly from Pulivendula and Upparapalle Palli, and the maximum found amount being 0.5 mmol/L. Trace amounts of blood were found in 12% of the samples, indicating potential moderate urinary tract damage, whereas one sample from Nallipreddy Palli had a higher blood level of 1.0 g/L, indicating more severe bleeding. Protein presence was more prominent, with 60% of samples containing measurable amounts, implying renal failure or urine infections. Pulivendula and Upparapalle Palli had the highest protein levels, with one sample measuring 3.0+++. Nitrite was detected in just 5% of the samples, indicating a low frequency of gram-negative bacterial infections in the community. Leukocytes were also present in just 14% of samples with mild inflammatory or infection reactions, mostly from Pulivendula and Upparapalle Palli. The specific gravity of the urine was consistent, ranging from 1.000 to 1.010, showing that the buffaloes were well-hydrated with no significant difference in urine content. The pH levels demonstrated a substantial tendency towards alkalinity, with 78% of the samples having a pH of 8.5. Certain samples from Upparapalle Palli and Kotta Palli had a slightly lower pH of 8.0, indicating potential nutritional or metabolic impacts.

The overall findings indicate a significant prevalence of increased protein and urobilinogen levels in buffalo herds, pointing to potential kidney or liver issues. Nitrite and leukocyte detection rates are low, indicating limited bacterial infections, while sporadic cases show mild urinary irritation. The alkaline composition of the urine samples could be attributed to nutritional variables, possible infections, or other metabolic abnormalities in buffaloes. These findings emphasise the significance of continuing to monitor for potential renal and hepatic health concerns, as well as taking into account dietary and environmental factors that may contribute to the observed trends.

4. DISCUSSION

Urine examination on buffalo herds from five regions gives important information about their kidney and liver health, as well as overall metabolic stability **(**Floeck, 2011,Meter, 2009).The high incidence of urobilinogen and bilirubin, particularly in areas such as Pulivendula and Kotta Palli, suggests liver dysfunction, possibly caused by bile duct obstructions or other hepatic disorders. This discovery is consistent with previous research showing that high bilirubin is frequently a sign for liver stress or inflammation in animals. Proteinuria, seen in 60% of the samples, is another major worry that indicates renal stress or malfunction. Protein in the urine, which is frequently associated with illnesses such as glomerular damage or nephritis, is a reliable sign of impaired kidney function (Junio et al., 2021,Hassan et al., 2008). The severity of proteinuria in Pulivendula and Upparapalle Palli, with some samples displaying protein levels as high as 3.0+++, emphasises the importance of targeted surveillance and intervention in preventing chronic kidney disease from developing. The presence of blood in 12% of the samples, with one sample containing up to 1.0 g/L in Nallipreddy Palli, implies that urinary tract trauma or infections pose a concern to these buffalo communities. According to studies, blood in urine, which is typically symptomatic of injuries or infections, requires immediate attention to avoid complications such as urinary tract infections (UTIs) **(**Hussein, 2011,Ibrahim et al., 2008). Unlike the worrisome biochemical indicators, the research found acceptable hydration among buffalo populations, with specific gravity values indicating sufficient water intake **(**Kushwaha et al., 2012). The pH of the urine, which is mostly alkaline, is compatible with the buffalo's dietary patterns, as they graze on plant-based forages, which boost urine alkalinity **(**Markey et al., 2013, Somvanshiet al.,2012). This conclusion is consistent with earlier research findings that show that dietary parameters particularly forage kinds, have a major influence on urine pH levels in animals **(**Meuten, 2012).

The overall health patterns identified in this study are consistent with larger livestock health trends, in which higher urobilinogen, bilirubin, and proteinuria are frequently associated with poor water quality, inadequate nutrition and environmental stress (Zaheh et al., 2010,Park et al.,2012). However, the low predominance of ketones in the urine shows that energy metabolism is balanced, which is good news for the buffalo's general metabolic health **(**Rhaymah et al.,2007, Sadiek et al., 2000). Furthermore, the low levels of nitrite and leukocytes suggest that, despite some minor illnesses, buffalo populations are not experiencing widespread bacterial infections, which can be a problem in less well-managed herds **(**Sadiek et al.,2000, Slauson and Cooper, 2002).The study emphasises the necessity of routine urine analysis in buffalo health management because it can detect concerns with renal and hepatic function. Additional diagnostic procedures, such as blood biochemistry and liver enzyme tests, are required. The study also emphasises the importance of nutrition and environmental factors in buffalo health.

5. CONCLUSION

This study advises for continuous monitoring of buffalo health using regular urine analysis. The findings indicate that, while buffalo populations have good hydration and energy balance, higher levels of bilirubin, protein, and urobilinogen require additional examination. Routine surveillance can assist detect early signs of liver and kidney failure, allowing for prompt interventions and enhancing buffalo herd health and production over time.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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