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Short communication

Evaluating the impact of polypropylene-based cat litter on urinalysis reliability in feline patients

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Abstract

Urinalysis is a key diagnostic tool in veterinary medicine, aiding in the detection of urinary diseases and systemic conditions such as diabetes mellitus and chronic kidney disease. This study investigates the impact of polypropylene-based urine collection litter on the reliability of urinalysis results in feline patients.

Urine samples were collected from 50 cats and divided into native and litter-treated aliquots. Parameters such as leukocytes, ketones, glucose, protein and pH were analyzed using dipsticks, refractometry and sediment examination.

Significant differences were observed in leukocyte counts, which decreased after exposure to litter ($p = 0.0054$), and inconsistencies were noted in ketone and glucose results. While protein, pH and red blood cell counts remained unaffected, sediment analysis revealed more contaminated backgrounds in litter-treated samples.

These findings highlight that while urine collection litter is a practical solution for sample acquisition, it may introduce variability in certain parameters. Therefore, it is best suited for preliminary assessments and should guide further diagnostics rather than serve as a definitive basis for treatment or prognosis. Further research is needed to refine its application in clinical settings.

Keywords: urine, feline, urine litter, urinalysis

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Introduction

Urinalysis is a useful tool in identifying urinary diseases, and also a variety of underlying pathologies, including *diabetes melitus* (Piech and Wycislo 2019). It can also be an effective tool for diagnostic evaluation for stadium assessment of chronic kidney disease with UPC (urinary protein:creatinine ratio) and USG (urine specific gravity) (Mortier et al. 2023). A complete urinalysis should be provided as a routine examination and, due to basic equipment such as centrifuge, refractometer, microscope and urine strips, may be done in most veterinary practices (Piyarungsri et al. 2020). Chemical evaluation of urine can be conducted using test strips, which are typically graded according to a color scale provided with the strips. The results from these dipstrips can be interpreted either visually or through automated methods, most commonly using reflectance photometry, in accordance with the manufacturer's instructions (Tomasik et al. 2012). Urine dipsticks are considered reliable for measuring pH, glucose, bilirubin, and occult blood levels (Piech and Wycislo 2019). Dipstick measurements of urine specific gravity (USG) and leukocytes have been shown to be unreliable. However, USG can be accurately assessed using refractometry, and leukocytes can be reliably verified through microscopic examination of urine sediment (Piech and Wycislo 2019). In veterinary medicine, urinalysis, including the use of test strips, is a fundamental diagnostic tool for assessing urinary system disorders. Urine samples can be collected by catheterisation, cystocentesis and free capture (Reppas and Foster 2016) such as micturition and manual urinary bladder compression, each having its benefits and disadvantages (Yadav et al. 2020). Catheterisation requires trained staff and is done under general anesthesia to secure the catheter in place, while creating risks of trauma, iatrogenic infection and blood contamination (Pelligand et al. 2011; Yadav et al. 2020). Cystocentesis is the best way to eliminate the risk of bacterial contamination from the urethra, genital tract, skin and hair, but this procedure also requires trained staff and is invasive, causes stress, and may be associated with transient hematuria. It also is not suitable for some cats due to their behavior or poor bladder filling, forcing owners to collect samples at home (Mortier et al. 2023). Cat owners can collect voided urine using an empty shallow plastic container, plastic wrap placed on top of regular cat litter, or cat litter substrates – polypropylene beads or hydrophobic sand (Delport and Fourie 2005, Kennils et al. 2022). For urine sampling, polypropylene beads are poured onto the litter box, where the cat urinates. The owner then collects a sample by using a pipette provided and a fluid collection vial. Collecting urine from a cat using non-absorbent litter is the least stressful method and thus it is often the preferred choice for pet owners. Polypropylene beads do not affect feline urine tests (Kennils et al. 2022). They also do not emit or absorb calcium, magnesium and phosphate. Moreover, human studies indicate no impact on pH, protein concentrations and white or red blood cell counts (Delport and Fourie 2005). However, manufacturers, although they confirm that the litter can be used for diagnostic purposes, do not provide research results, which leads to uncertainty among veterinarians when interpreting the results obtained using this method. Therefore, in our study, we aimed to evaluate how the use of diagnostic litter affects the parameters obtained from dipstick tests in cats.

Materials and Methods

Urine samples (minimum 4 ml) were obtained from 50 cats via ultrasound-guided cystocentesis during routine medical procedures at a veterinary clinic. Cats were included in the study based on clinical indications for urinalysis, without exclusions related to age, sex, neuter status or health condition (20 females, 19 males; mean age ~4 years, range: 8 months to 14 years). Ethical committee approval was not required, as the urinalysis was part of standard diagnostic procedures, a fact confirmed by the Ethics Committee's decision (number: NR P2/2023). Urine samples were processed within 60 minutes of collection at the clinic's in-house laboratory. For each cat, a single urine sample was obtained through cystocentesis and subsequently divided into two aliquots, creating paired samples for analysis. One 2 ml aliquot served as the control and was placed in an eppendorf tube containing only urine, while the second was placed into a 2 ml eppendorf tube, half-filled with UriGrit urine collection litter (COVETRUS).

Following an incubation period of 15 min, both urine samples were subjected to further analysis. Both samples were applied onto VetScan UA10 (Zoetis) urinalysis strips and readed with VETSCAN® UA Urine Analyzer. Parameters assessed included leukocytes, ketones, nitrates, urobilinogen, bilirubin, protein, glucose, blood cell count and pH. Additionally, urine specific gravity was assessed using refractometry. In cases where abnormalities were detected in the general urinalysis, sediment examination was also performed. In total, 50 paired chemical analyses were performed, providing data for subsequent statistical evaluation.

Statistical analysis

Statistical analysis was conducted using GraphPad

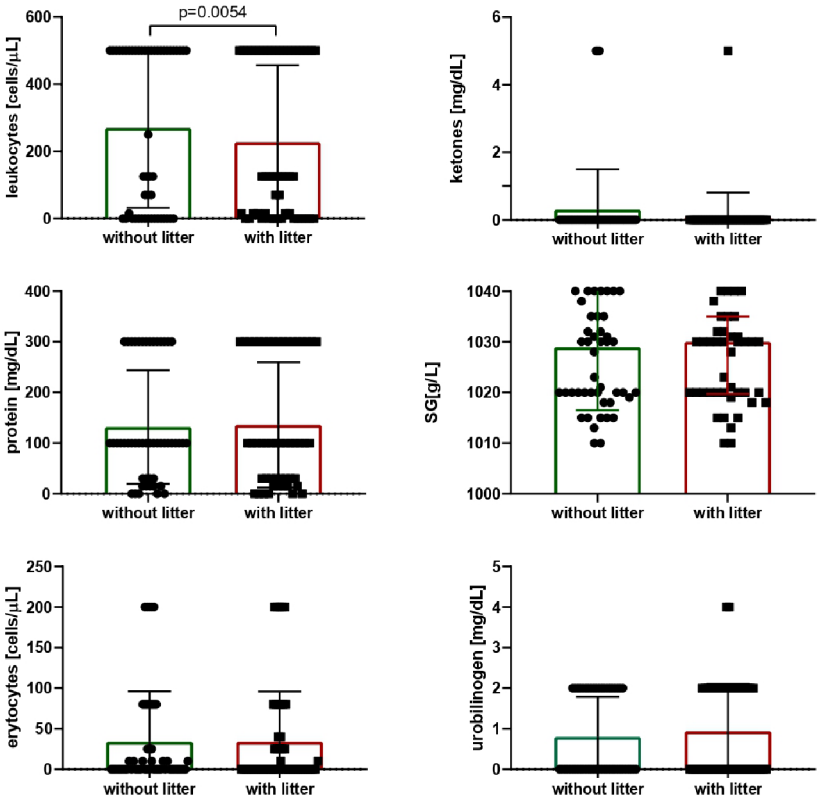

Fig. 1. Comparison of urinalysis parameters in feline samples with and without the use of litter.

Prism version 6 (GraphPad Software Inc., San Diego, CA, USA). The normality of the differences between paired samples was assessed using the Shapiro-Wilk test, which revealed a non-normal distribution. Therefore, the Wilcoxon signed-rank test – a non-parametric alternative – was used to compare control and litter-treated samples. Results were presented as median and interquartile range (IQR). A p-value < 0.05 was considered statistically significant.

Results and Discussion

Using commercial cat litter for urine collection provides practical advantages but also comes with notable limitations. Cats often resist urinating in unfamiliar environments, leading to missed opportunities for urinalysis despite its critical diagnostic importance. Urine collection litter addresses this challenge, enhancing the practicality of urine sampling for both veterinarians and pet owners. However, our study highlights certain drawbacks, including potential contamination of sediment and minor alterations in chemical parameters that may impact the accuracy of results.

Previous studies have been conducted using hydrophobic sand, where no significant differences were observed after its use. However, there is a lack of such studies for polypropylene litter, which we provide in our research (Kennils et al. 2022).

Among the parameters assessed, leukocytes, ketones, nitrates, urobilinogen, bilirubin, protein, glucose, red blood cell count, and pH-significant differences were observed primarily in leukocyte counts. A notable decrease in leukocytes was detected following the addition of litter ($p = 0.0054$), together with alongside a slight reduction in urine specific gravity. The remaining parameters showed no differences (Fig. 1).

For nitrates, only one sample yielded a positive result in the native urine, which reverted to negative in the litter-treated sample. Ketone analysis revealed inconsistencies: of the three native samples that tested positive, only one corresponded with a positive result in the litter-treated sample, while two were negative. Conversely, another native sample was negative, while the litter-treated sample tested positive (Fig. 2A). Glucose levels were positive in only six urine samples. Among these, three showed a reduction in glucose concentration after exposure to the beads (Fig. 2B).

No significant differences were observed in the urine sediment analysis, except for subjectively more contaminated backgrounds in samples collected using the commercial litter, a smaller number of lipid droplets was observed after use of litter. This observation is illustrated by two representative images of the same urine sample: (Fig. 2A, C) native sediment and (Fig. 2B, D) sediment after contact with the litter.

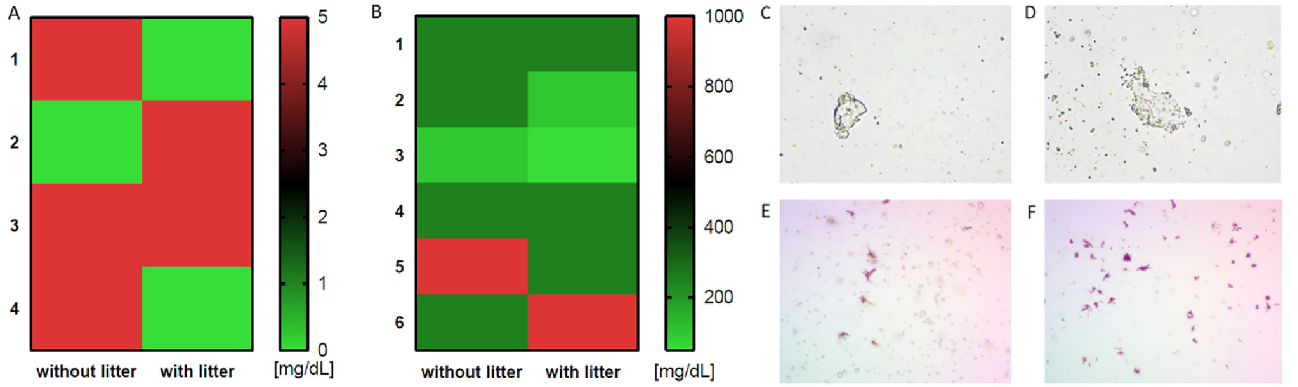

Fig. 2. Heatmap showing the distribution of positive ketone test results in four samples (A), and glucose in six samples (B). Representative images of the two urine samples: native sediment (C, D) and sediment after contact with the litter (E, F), with magnification of 400x.

Our result showed that, if pathological changes are present, they are likely to be detected even with the use of litter. While microbiological analysis is compromised, litter can serve as a preliminary assessment tool when other options are unavailable particularly for the rapid assessment of pH, protein, ketones, and glucose. Since urine test strips are not reliable for evaluating leukocytes, significant differences in leukocyte results between samples with and without litter are not a cause for concern. Moreover, even litter is not a good solution for microbiological use; human studies have shown that the urine dipstick test alone is useful to exclude the presence of infection if both nitrite and leukocyte esterase results are negative (Devillé et al. 2004). However, an interesting observation can be made regarding ketones, which in four positive cases showed almost completely different results. This may suggest that a parameter considered very sensitive (Mitchell et al. 2013) under normal assessment becomes unreliable when using litter-based methods. It should be emphasized that a urinary dipstick measures only acetoacetate but not 3-beta-hydroxybutyrate (3-β-OHB) or acetone (Brewster et al. 2017). The observed differences may result from the reaction of ketones with plastic (National Research Council (US) Committee on Toxicology 1984). A similar observation was noted in the case of glucose where half of the results obtained using litter were lower, though it remains unclear whether this is due to glucose adhering to the litter or other factors.

Thus it is essential to recognize that the results obtained may differ from those of native urine samples and should not form the basis for definitive treatment or prognosis. Instead, they should guide further diagnostic investigations.

The subjective observation of more contaminated backgrounds in sediment analysis after the use of litter underscores the need for careful interpretation of results. While this does not appear to significantly affect the diagnostic value, it may introduce artifacts that can complicate the assessment. Additionally, it is crucial to analyze the urine within 30 minutes of collection to obtain the most accurate results, and a urinalysis after 6 hours gives significantly altered results (Parikh et al. 2025). It is also important that the urine sample collected is passed into a freshly prepared litter tray, as the cat's mere entry into the litter tray may cause some contamination, for example in children it is advisable to change the urine bag every 30 minutes (Kouri et al. 2024). The use of urine collection litter can delay this process, increasing the risk of missing critical changes in the sample. This emphasizes the importance of timely processing and the need for standardized protocols to minimize variability.

In summary, the findings of this study indicate that polypropylene-based diagnostic litter can serve as a practical tool for preliminary urine assessment in feline patients, particularly in home settings where standard collection methods may be challenging. However, discrepancies in leukocyte, ketone, and glucose levels, together with subjectively more contaminated sediment backgrounds, suggest that results from litter-treated samples may not be as reliable as those from native specimens. Therefore, such samples should not form the sole basis for therapeutic decisions, but rather serve as an indication for further diagnostic evaluation.

Importantly, our study highlights the lack of reliable data provided by manufacturers of diagnostic litter products and underscores the need for standardized procedures for urine collection and analysis when synthetic substrates are used. Although it has certain limitations, urine collection litter remains a useful aid in sample acquisition, particularly in the feline patient. Further research involving larger cohorts, microbiological testing, and automated sediment analysis is warranted to better understand the extent and causes of deviations observed when using litter and to develop evidence-based recommendations for veterinary practitioners.

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