**Incidence of Uterine infection and their Antimicrobial Resistant Pattern in Camel (*Camelus dromedaries*) Slaughtered at Maiduguri Central Abattoir**

**ABSTRACT**

Uterine bacterial infections are a significant reproductive health issue in camels, leading to reduced conception rates, increased risk of pregnancy loss, and infertility. This study aimed to investigate the prevalence and antimicrobial susceptibility pattern of uterine bacterial infections in camels slaughtered at Maiduguri Central Abattoir. Swab samples were collected from the uterine tract of 82 camels and cultured on Blood agar plates containing 5% defibrinated sheep blood and MacConkey agar plates. The inoculated plates were then incubated aerobically at 37 °C for 24 hours. Following incubation, bacterial growth was subjected to biochemical tests for species identification. The identified bacteria were then subjected to antimicrobial susceptibility testing using the Kirby-Bauer disk diffusion method. A total of 76 bacterial isolates were identified, comprising 19 (23.2%) Escherichia coli, 18 (22.0%) Staphylococcus aureus, 15 (18.3%) Klebsiella spp, 11 (13.4%) Salmonella spp, and 13 (15.9%) Streptococcus spp. Notably, these bacteria exhibited high-level resistance to commonly used antibiotics. Specifically, 100% resistance to Gentamycin, Streptomycin, Amoxicillin, and Ciprofloxacin was observed in Klebsiella spp and Salmonella spp isolates. However, Gentamycin, Ciprofloxacin, and Amoxicillin were the most effective antimicrobials, with 81.1%, 70.3%, and 70.3% susceptibility rates, respectively. The study's findings emphasize the importance of antibiotic susceptibility testing before treatment, thus ensuring effective therapy and minimizing the development of antibiotic resistance.

**Keywords: Bacteria, Culture, Isolates, Resistant, Antibiotics**

**INTRODUCTION**

Uterine bacterial infection is a pervasive and debilitating reproductive health issue in camels, leading to a plethora of complications including infertility, abortion, stillbirth, and reduced milk production [1]. The uterus of camels is particularly susceptible to bacterial colonization, especially by opportunistic pathogens such as non-pathogenic Escherichia coli (E. coli) and Staphylococcus aureus (S. aureus) [2].These infections can have far-reaching consequences on camel productivity and fertility, culminating in significant economic losses for camel breeders and owners [3].The prevalence of uterine infections in camels ranges from 20% to 40% in different regions, with E. coli and S. aureus being the most commonly isolated pathogens [4, 5]. Risk factors for uterine infections in camels include poor reproductive tract hygiene, inappropriate use of antimicrobials, and stress [6]. The clinical signs of uterine infections in camels include vaginal discharge, abdominal pain, and fever [7]. Antimicrobial resistance is a growing concern globally [8]. Uterine infections in camels are complicated by the emergence of multidrug-resistant bacterial isolates, including E. coli and S. aureus [1].

The development of effective treatment strategies for uterine infections in camels requires a comprehensive understanding of the antimicrobial susceptibility patterns of the causative pathogens [1]. Despite their importance in the livestock industry, camels are prone to uterine bacterial infections, which can lead to infertility, abortion, and reduced milk production, resulting in significant economic losses for camel breeders and owners. The emergence of antimicrobial resistance among bacterial isolates from camel uterine infections has further complicated the treatment and management of these infections, highlighting the need for a comprehensive understanding of the antimicrobial susceptibility patterns of the causative pathogens. However, there is a dearth of studies on the antimicrobial susceptibility patterns of bacterial isolates from camel uterine tracts in Maiduguri, Borno State. Moreover, the gross abuse and irrational use of antimicrobials has necessitated the investigations into the prevalence and antimicrobial susceptibility patterns of bacteria commonly isolated from the reproductive tract of camel to inform evidence-based treatment strategies and improve reproductive health in camels.

**MATERIALS AND METHODS**

***Study Area***

The study was conducted at Maiduguri Central Abattoir, situated in Maiduguri, the capital city of Borno State. The abattoir is geographically located between longitude 013.10719°E and latitude 11.51519°N. Maiduguri city lies at an elevation of 300 meters above sea level, within the coordinates 11.46°N - 11.54°N and 13.04°E - 13.14°E. With a population of approximately 844,747 residents and covering an area of 72,609 square kilometers, Maiduguri is the largest city in Borno State [9].

***Sample collection and microbiological examinations***

Sample was collected and processed according to methods described by [1], and identification of bacterial colonies were carried out in line with [10].

***Antibacterial susceptibility testing***

Antibiotic susceptibility testing carried out in line with methods described by [11] and zone of inhibition was determined as described by [12].

**RESULTS**

A total of 74 bacterial isolates, belonging to 5 different genera, were identified from the positive swab samples, with *Escherichia coli* (23.2%), *Staphylococcus aureus* (22.0%), and *Klebsiella spp* (18.3%) being the most prevalent, and 21 samples showing mixed bacterial growth (Table 1). Table 2 showed that out of 21 samples with mixed growth, 16 showed growth of 2 bacterial species and 5 showed growth of 3 bacterial species. The most common combinations included S. aureus, *E. coli*, Salmonella, and *Klebsiella spp.* No samples showed growth of all 4 bacterial species.

The antimicrobial susceptibility testing revealed a varied landscape of antimicrobial resistance. *Staphylococcus* species and *E. coli* had the highest resistance (100%) to Gentamycin, streptomycin, Amoxicillin, and Ciprofloxacin. *Salmonella spp* isolates were 100% resistant to ampicillin, while *Klebsiella spp* had 9 (64.3%) resistant to chloramphenicol and amoxicillin.

*Staphylococcus* species showed low resistant to chloramphenicol (16.7%) and co-trimoxazole (27.8) respectively. Generally, *Streptococcus* species isolated in this study showed the lowest resistant to the antimicrobials tested (Table 3).

**Table 1: Bacterial isolates from the uterus of camels** **Slaughter at Maiduguri Central Abattoir**

|  |  |  |  |
| --- | --- | --- | --- |
| **Bacterial Isolate** | **No. Tested** | **No. Positive** | **Prevalence (%)** |
| ***Staphylococcus aureus*** | 82 | 18 | 22.0 |
| ***Streptococcus spp*** | 82 | 13 | 15.9 |
| ***Escherichia coli*** | 82 | 19 | 23.2 |
| ***Salmonella spp*** | 82 | 11 | 13.4 |
| *Klebsiella spp* | 82 | 15 | 18.3 |

**Table 2: Mixed Bacterial Growth in Swab Samples of Camels Slaughter at Maiduguri Central Abattoir**

|  |  |  |
| --- | --- | --- |
| **No. of Bacterial Spp.** | **Specific Combinations** | **No. of Samples** |
| 2 | *S. aureus* + *E. coli* | 4 |
| 2 | *S. asureus* + *Klebsiella spp*  | 2 |
| 2 | *Salmonella spp* + *E. coli* | 3 |
| 2 | *Salmonella spp* + *Klebsiella spp*  | 2 |
| 2 | *E. coli* + *Klebsiella spp*  | 2 |
| 2 | Total | 16 |
| 3 | *S. aureus* + *Salmonella spp* + *E. coli* | 2 |
| 3 | *S. aureus* + *Salmonella spp* + *Klebsiella spp*  | 1 |
| 3 | *S. aureus* + *E. coli* + *Klebsiella spp*  | 1 |
| 3 | *Salmonella spp* + *E. coli* + *Klebsiella spp*  | 1 |
| 3 | Total | 5 |
| 4 | *S. aureus* + *Salmonella spp* + *E. coli + Klebsiella spp*  | 0 |

**Table 3:** **Prevalence of Antimicrobial resistance among bacteria isolated from the interne tract of camels in Maiduguri, Borno State**

|  |  |  |
| --- | --- | --- |
| **Type of isolates** | **Number****of isolates tested** | **Antimicrobial tested** |
|  |  | T10μg | Ch30μg | G10μg | St10μg | Am20μg | AMP25μg | Cip | SXT |
| ***S. aureus*** | 18 | 5 (27.8) | 3 (16.7) | 18 (100) | 5 (27.8) | 18 (100) | 10 (55.6) | 18 (100) | 5(27.8) |
| ***Streptococcus spp*** | 13 | 4 (30.8) | 2 (15.4) | 5 (38.5) | 7 (53.9) | 9 (69.2) | 5 (38.5) | 8 (61.5) | 5 (38.5) |
| ***Escherichia coli*** | 19 | 7 (36.8) | 5 (26.3) | 19 (100) | 7 (36.8) | 19 (100) | 12 (63.2) | 19 (100)  | 5 (26.3) |
| ***Salmonella spp***  | 10 | 5 (50.0) | 5 (50) | 3 (30) | 5 (50) | 5 (50.0)  | 10 (100) | 3 (30.0) | 3 (30) |
| *Klebsiella spp* | 14 | 7 (50.0) | 9 (64.3) | 7 (50) | 2 (14.3) | 9 (64.3) | 3 (21.4) | 7 (50.0) | 2 (14.3) |
| TOTAL  | 74 | 38 (51.4) | 24 (32.4) | 52 (70.3) | 26 (35.1) | 60 (81.1) | 40 (51.3) | 54 (70.3) | 20 (25.6) |

**Key: T = Tetracycline; Ch = Chloramphenicol; G = Gentamycin; St = Streptomycin; Am = Amoxicillin; AMP = Ampicillin; Cip = Ciprofloxacin; SXT = Trimethoprim/sulfamethoxazole (co-trimoxazole)**

**DISCUSSION**

This study identified 78 bacterial isolates across five genera, with *E. coli* and S. aureus being the most common (23.2% and 22.0%). This finding is significant, as previous research has demonstrated that these pathogens, particularly *Staphylococcus aureus* and *Escherichia coli*, are associated with uterine inflammatory and degenerative changes, leading to reduced conception rates, increased risk of pregnancy loss, and infertility (Mshelia *et al*., 2014). Moreover, the development of uterine infections is influenced by the bacterial load and the host's immune response [13]. When the immune system is compromised, pathogens can colonize the endometrium, leading to inflammation and tissue damage. Furthermore, bacterial toxins can induce uterine diseases with varied pathological manifestations [14].

The uterine bacterial isolates observed in camels in the present study are similar to the findings of [14]and [1] who reported S. aureus, *E. coli*, *Klebsiella spp spp*, *Proteus spp*, *Corynebacterium spp* and *Streptococcus spp* as the main bacterial isolates from several cases of uterine infections in camels. In addition to these similarities, the reproductive biology of camels also plays a crucial role in their susceptibility to uterine infections. Camels have a unique mating process, involving deep penile insertion into the uterus, which may increase the risk of uterine infections [7]. Furthermore, the common practice of repeated breeding attempts in camelids can lead to recurrent insults to the reproductive tract, thereby predisposing the uterus to a heightened risk of microbial contamination [15].

The presence of *Klebsiella spp*. (18.3%) and *Salmonella spp*. (13.4%) is particularly concerning, as these bacteria have been linked to endometritis [14,15] and repeat breeding [16] indicating their potential to cause uterine infections. In contrast, a lower prevalence rate of these bacteria was reported by [17]

The presence of mixed bacterial growth in 21 samples suggests that uterine infections in camels can be polymicrobial in nature, involving multiple bacterial species. These species, including *S. aureus*, *E. coli*, Salmonella, and *Klebsiella spp*, are known to be pathogenic in camels and can cause a range of diseases, including uterine infections.

Polymicrobial infections are clinically significant due to their association with increased morbidity and mortality [1,4]. This highlights the importance of considering the complex microbial dynamics involved in uterine infections. The finding revealed that 7 samples showed double isolates, and 4 samples showed triple isolates, but notably, no samples showed growth of all four bacterial species, suggesting competition or inhibition between these species.

The study's results have implications for the diagnosis and treatment of uterine infections in camels. Specifically, they suggest that antimicrobial therapy should be broad-spectrum and effective against multiple bacterial species. Additionally, close monitoring of camels suspected of having uterine infections is crucial to prevent complications and promote optimal health outcomes.

The global concern about antimicrobial resistance (AMR) in livestock is escalating, yet there is a significant knowledge gap regarding the effectiveness of antimicrobials in treating camel reproductive tract and uterine infections. To address this, our study evaluated the efficacy of eight antimicrobials in camels. Our findings show that Gentamycin, Ciprofloxacin, and Amoxicillin were the most effective, demonstrating 100% efficacy against both Gram-positive and Gram-negative bacteria. Notably, these antibiotics are considered second-line treatments for livestock in the study region, highlighting the need for continued monitoring and responsible use to mitigate the risk of AMR.

The current study revealed that *E. coli* isolates exhibited high susceptibility (100%) to Amoxicillin, Gentamycin, and Ciprofloxacin. Our findings align with [1] regarding Amoxicillin, but diverge in regards to Ciprofloxacin, as they reported a susceptibility of only 10%. However, our results are consistent with those of [2,3], who also reported 100% susceptibility of *E. coli* to Ciprofloxacin. Given the high susceptibility of *E. coli* to Amoxicillin, Gentamycin, and Ciprofloxacin in this study, we recommend these antibiotics for the treatment of uterine infections in camels. Additionally, our findings show that *S. aureus* isolates were most susceptible to Gentamycin and Ciprofloxacin (100%), followed by Amoxicillin and SXT, which showed a resistance rate of 16.7%.

The study's overall findings indicate that Gentamicin was the most effective antimicrobial agent, with a remarkable 81.1% of all bacterial isolates exhibiting susceptibility. Ciprofloxacin and Amoxycillin followed closely, tied for second place, with 70.3% of isolates susceptible, making them equally effective as the second most effective drugs in combating bacterial infections in camels. This finding agreed with the findings of [18] who also reported gentamicin and amoxicillin to be effective against uterine infection. Contrary to our finding others scholars have reported resistance to gentamicin and amoxicillin in livestock with uterine infections [19, 20]. While gentamicin and amoxicillin have shown broad-spectrum efficacy against various bacterial isolates, it's crucial to consult with a veterinarian before using these antimicrobials. The effectiveness of antimicrobial agents can be influenced by factors like geographical location, bacterial resistance patterns, and individual animal health [21] conditions highlighting the need for tailored treatment decisions.

This study also revealed that tetracycline was the least effective antimicrobial agent, with only 51.4% (38) of the bacterial isolates showing susceptibility. The widespread use in veterinary practice in the study area, including treatment for uterine infections, the easy accessibility of tetracycline in local markets and its indiscriminate use by non-professionals may have contributed to the high resistance of the isolates to this antibiotic. The reliance on oxytetracycline bolus for uterine use, particularly among farmers, in the absence of intrauterine antibiotics, may also have accelerated the development of resistance, highlighting the need for more judicious use of antimicrobial agents and alternative treatment strategies.

**CONCLUSIONS**

The research identified 5 species of bacteria, both aerobic and anaerobic, that cause uterine infections, with *E. coli* and Staphylococcus species being the most frequently isolated bacteria from the uterine tract of camels in Maiduguri. The bacteria isolated also showed high level resistance to commonly used antibiotics.

**CONFLICT OF INTEREST**

The authors have no conflicts of interest to disclose.

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