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Exploring antibiotic resistance profiles in *Escherichia coli* strains isolated from canine wound infections: A comprehensive antibiogram analysis

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Abstract
The primary objective of this study was to investigate the antimicrobial resistance patterns of *Escherichia coli* (*E. coli*) isolated from wound infections in animals, particularly focusing on samples obtained from dogs. The confirmation of *E. coli* was carried out through comprehensive cultural and biochemical characterization of both pus and wound samples. A total of 20 samples, encompassing various wound and skin afflictions, were collected from dogs, irrespective of gender and age. Upon isolation, 20 distinct *E. coli* isolates were identified and subjected to antibiotic sensitivity testing using a panel of nine commonly used antibiotics. The results of the sensitivity tests revealed varying degrees of susceptibility among the isolates. Notably, the isolates exhibited maximum sensitivity to Amoxicillin, with a rate of 70%. Following closely, Ciprofloxacin demonstrated a sensitivity rate of 65%, while Erythromycin displayed the least sensitivity at 25%. In contrast, the isolates demonstrated heightened resistance to certain antibiotics. Specifically, Penicillin and Gentamicin elicited the highest resistance rates, both standing at 70% and 65%, respectively. Conversely, the isolates displayed minimal resistance to Ciprofloxacin and Co-Trimoxazole, each registering a low resistance rate of 4%. These findings provide valuable insights into the antibiotic resistance landscape of *E. coli* strains isolated from canine wound infections, emphasizing the importance of understanding and monitoring antimicrobial resistance in the context of veterinary medicine.

Keywords: Antibiotic resistance, *Escherichia coli*, canine wound infections, antibiogram

Introduction

Pus formation, a frequent outcome in bacterial infections, is usually a result of systemic inflammation. The process of pus formation, also known as purulence, is primarily induced by bacterial pathogens classified as pyogenic bacteria. In turn, infections characterized by pus formation are referred to as pyogenic infections. Notably, gram-positive pyogenic bacteria, including Staphylococcus aureus, Streptococcus, and Enterococci, are prevalent contributors to this inflammatory response. Additionally, gram-negative pyogenic bacteria such as Escherichia coli, Klebsiella species, Proteus, and Pseudomonas species also play a significant role in the development of purulent conditions associated with bacterial infections. This underscores the diverse microbial involvement in the manifestation of purulence and highlights the importance of understanding these pathogens in the context of infectious processes and their clinical implications (Kalita *et al*., 2021) [1].

Antibiotic therapy serves as a crucial component in the successful treatment of infections characterized by pus formation. Several studies highlight a consistent bacteriological composition in pus samples, but there are significant variations in the antibiotic resistance profiles of pyogenic pathogens. The emergence of multi-drug resistant microorganisms is a concerning trend attributed to inaccurate prescriptions and inappropriate antibiotic usage.

The persistent rise in multi-drug resistant strains is a consequence of selective pressure exerted by improper antibiotic treatments. This phenomenon is further exacerbated by the overuse or misuse of antibiotics, contributing to the development and spread of resistance mechanisms among bacterial populations. As a result, the effectiveness of conventional antibiotic therapies is compromised, leading to prolonged illness durations and an elevated risk of spreading these resistant strains within communities and healthcare settings.

Understanding and addressing the intricacies of antibiotic resistance in the context of pyogenic infections are essential for formulating informed treatment strategies and mitigating the adverse consequences associated with the proliferation of antibiotic-resistant microorganisms. This underscores the importance of judicious antibiotic prescribing practices and the need for ongoing research to develop alternative therapeutic approaches to combat emerging antibiotic resistance (Breijyeh *et al*., 2020) [2]. The primary objective of this study is to delineate the bacteriological profile of pyogenic organism *E. coli* and assess its antibiotic sensitivity in isolates obtained from pus samples.

Materials and Method

The isolates were cultured on MacConkey agar and incubated at 37 °C for 24 hours. Lactose-fermenting colonies from each MacConkey agar plate were then inoculated onto Eosin Methylene Blue (EMB) agar and incubated overnight at 37 °C for preliminary identification. Colonies on EMB agar displaying a greenish metallic sheen were provisionally considered as *E. coli*. Subsequently, all 20 *E. coli* isolates underwent confirmation using PCR for specific genes.

The antibiotic susceptibility pattern of the *Escherichia coli* (*E. coli*) isolate was determined using the Kirby-Bauer disc diffusion test, following the guidelines recommended by the Clinical and Laboratory Standards Institute (CLSI). To initiate the test for each bacterial isolate, an inoculum was prepared by adjusting turbidity to the 0.5 McFarland standard. This standardized inoculum was then spread evenly on Muller-Hinton agar plates. Subsequently, antibiotic discs were strategically placed on the agar plates, and the cultures were incubated at a temperature range of 35-37 °C for 24-48 hours. Following incubation, the zones of inhibition surrounding each antibiotic disc were measured in millimetres. These measurements were then compared and classified according to the interpretive criteria provided by the CLSI, allowing for the determination of the antibiotic susceptibility or resistance of the *E. coli* isolate. This standardized methodology ensures consistency and reliability in assessing the response of the bacterial isolate to various antibiotics, providing valuable information for effective treatment strategies.

Results and Discussion

Table 1: List of antibiotics used for the antibiotic susceptibility test

S. No.	Name of Antibiotic disc	Symbol	Concentration
1.	Penicillin	P	10 µg
2.	Amoxicillin	AMX	10 µg
3.	Gentamicin	GEN	10µg
4.	Ciprofloxacin	CIP	5µg
5.	Co- Trimaxazole	COT	25µg
6.	Tetracycline	TE	30µg
7.	Ceftriaxone	CTR	30µg
8.	Erythromycin	E	15µg
9.	Chloramphenicol	C	30µg

Table 2: Antibiotic sensitivity /resistance patterns of *E. coli*

	Name of Antibiotic disc	Sensitive	Intermediate	Resistant
1.	Penicillin (P 10 µg)	6(30%)	0	14(70%)
2.	Amoxicillin (AMX 10 µg)	14(70%)	2(10%)	4(20%)
3.	Gentamicin (GEN 10 µg)	7(35%)	0	13(65%)
4.	Ciprofloxacin (CIP 5 µg)	13(65%)	3(15%)	4(20%)
5.	Co- Trimaxazole (COT 25 µg)	11(55%)	5(25%)	4(20%)
6.	Tetracycline (TE 30 µg)	9(45%)	1(5%)	10(50%)
7.	Ceftriaxone (CTR 30 µg)	09(45%)	05(25%)	6(30%)
8.	Erythromycin (E 15 µg)	5(25%)	13(65%)	2(10%)
9.	Chloramphenicol (C 30 µg)	10(50%)	6(30%)	4(20%)

All 20 *Escherichia coli* (*E. coli*) isolates underwent an antibiotic sensitivity test, assessing their response to nine different antibiotics commonly used in veterinary medicine, as outlined in the provided table. The isolates exhibited varying degrees of sensitivity and resistance.

Maximum sensitivity was observed towards amoxicillin (70%), followed by ciprofloxacin (65%), co-trimazole (55%), chloramphenicol (50%), tetracycline (45%), ceftriaxone (45%), gentamicin (35%), penicillin (30%), and erythromycin (25%).

A notable percentage of isolates showed intermediate resistance, with higher figures for erythromycin (65%), chloramphenicol (30%), ceftriaxone (25%), co-trimazole (25%), ciprofloxacin (15%), tetracycline (5%), amoxicillin (2%), while gentamicin and penicillin showed 0% intermediate resistance.

The isolates demonstrated maximum resistance to penicillin (70%), followed by gentamicin (65%), tetracycline (50%), ceftriaxone (30%), ciprofloxacin (20%), co-trimazole (20%), amoxicillin (20%), chloramphenicol (20%), and erythromycin (10%). These findings highlight the diverse antibiotic susceptibility profiles among the *E. coli* isolates, providing crucial information for informed treatment decisions in veterinary medicine.

The results of resistance and sensitivity is also reported by Palma *et al*. (2020) [3], Kibret *et al*. (2011) [4] and Galarce *et al*. (2023) [5]. The results of the current study highlight the rapid emergence of bacterial isolates resistant to antimicrobials from animal wounds, underscoring the potential impact of antimicrobial resistance in organisms.

Conclusion

In conclusion, the antibiotic sensitivity test on 20 Escherichia coli isolates revealed diverse responses to veterinary antibiotics. Amoxicillin exhibited maximum sensitivity (70%), highlighting variability in resistance across isolates. Intermediate resistance was notable, particularly with erythromycin (65%). The isolates displayed maximum resistance to penicillin (70%), emphasizing the need for informed treatment decisions. These findings, consistent with previous studies, underscore the urgent concern of bacterial isolates developing antimicrobial resistance in veterinary settings, emphasizing the potential impact on organisms.

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