

Antimicrobial susceptibility profiling of *Staphylococcus aureus* of camel (*Camelus dromedarius*) skin origin

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Abstract. Camel (*Camelus dromedarius*) is an important desert animal species contributing greatly to the desert economy in many ways. The skin abscesses and wounds caused by *Staphylococcus aureus* reduces working efficiency of the animal and most of the times it is very difficult to manage and treat the wounds and abscess due to certain factors related to this organism together with its ability to acquire antibiotic resistance very quickly. The present study was undertaken with the view to determine efficacy of 25 different antibiotics against 15 *S. aureus* organisms isolated from camel skin wounds. The study revealed that the most effective antibiotic was linizolid against which all the isolates were sensitive followed by azithromycin and gentamicin against which 93.33% of the isolates were sensitive; 80.00% isolates were sensitive to methicillin, levofloxacin, rifampicin, ofloxacin and vancomycin, 73.33% to azlocillin, 60.00% to bacitracin and norfloxacin and other antibiotics were still less effective. Four of the antibiotics *viz.* ampicillin, cefexime, metronidazole and nalidixic acid were found completely ineffective as resistance to these antibiotics was shown by all the isolates.

Key Words: antibiogram, camel, skin, *Staphylococcus aureus*, wounds.

Introduction. The camel (*Camelus dromedarius*), belonging to class Mammalia, order Artiodactyla, family Camelidae, tribe Camelini and genus *Camelus*, is an integral component of desert ecosystem which is uniquely adapted to hot, cold and arid environments and it is most suitable mammal for uses in climatic extremes (Wilson 1984; Yagil 1985). It is used for riding, load carrying, traction work, short distance transport and agricultural operations in desert areas. The camel dairying is also gaining popularity in camel raising countries. The economical significance of camel had been realized during recurring droughts in past in our state where huge losses of livestock was recorded especially of cattle and to lesser extent of sheep and goat whereas camel was marginally affected.

Though the camel has low susceptibility to diseases but the skin infections due to staphylococci causing contagious skin necrosis, dermatitis, wounds, abscesses or similar lesions are a constant problem in all the ages of this species. The infection is chronic and difficult to treat medically depending on among other factors the pathogenic qualities of the staphylococcal strain present (Wernery 2000).

The literature regarding microbiology of the skin wounds and abscesses in camel is scarce (Qureshi et al 2002). The disease caused by *Staphylococcus aureus* (belonging to class Bacilli, order Bacillales, family Staphylococcaceae and genus *Staphylococcus*) is not fatal but due to reduced working efficiency causes great economical losses. Sometimes the animal becomes of no use because of widespread abscesses or wounds over the whole body, which are difficult to manage and even the antibiotic therapy does not work satisfactorily as this organism acquires antibiotic resistance with remarkable proficiency (Booth et al 2001). This paper reports profiling of antibiotic susceptibility of *S. aureus* isolates obtained from wounds in camel skin.

Material and Method

Isolation and identification of *S. aureus*. A total of 22 pus samples from skin wounds at various body parts in camel were collected aseptically with sterile absorbent swabs soaked in nutrient broth. The sampling was done in and around Bikaner city during June-July 2011. After collection the samples were immediately taken to laboratory at Bikaner over ice for further processing. The samples were inoculated on nutrient agar plates and then processed for isolation and identification of *S. aureus* (Cowan & Steel 1974; Quinn et al 1994). Of the 22 samples 15 isolates of *S. aureus* were obtained which were further confirmed genotypically by ribotyping for 23S rRNA (Straub et al 1999) using the following sequences for the two primers, Primer 1 – 5' ACGGAGTTACAAAGGACGAC 3' and Primer 2 – 5' AGCTCAGCCTTAACGAGTAC 3'.

Antibiotic sensitivity test. The method of Bauer et al (1966) was followed to determine the antibiogram of the isolates against 25 different antibiotics (Table 1). In brief, the isolates were inoculated in sterile 5 ml nutrient broth tubes, incubated for 18 h at 37°C and then the opacity was adjusted to 0.5 McFarland opacity standard (Quinn et al 1994). The inoculum was well spread over the agar surface with the help of sterilized swab. Plates were allowed to dry for 10 min at 37°C and then antibiotic discs were carefully placed on the surface with enough space around each disc for diffusion of the antibiotic. Plates were incubated for 24 h at 37°C and the zone of inhibition of growth of the organism around each disc was measured in millimeters.

Table 1
Antibiogram obtained for *S. saureus* isolates from camel skin wounds

S. No.	Antibiotic Disc (conc, mcg/disc)	Percent (%)		
		Sensitive	Intermediate	Resistant
1	Linizolid (30)	100.00	0.00	0.00
2	Azithromycin (30)	93.33	6.63	0.00
3	Gentamicin (30)	93.33	6.63	0.00
4	Methicillin (5)	80.00	6.67	13.33
5	Levofloxacin (5)	80.00	6.67	13.33
6	Rifampicin (5)	80.00	6.67	13.33
7	Ofloxacin (5)	80.00	13.33	6.67
8	Netilimicin (10)	80.00	20.00	0.00
9	Co-trimoxazole (10)	80.00	13.33	6.67
10	Vancomycin (30)	80.00	0.00	0.00
11	Azlocillin (75)	73.33	0.00	26.66
12	Norfloxacin (10)	60.00	20.00	20.00
13	Bacitracin (8 units)	60.00	40.00	0.00
14	Ceftriaxone (30)	53.34	33.33	13.33
15	Sparfloxacin (5)	40.00	20.00	40.00
16	Trimethoprim (5)	33.34	66.66	0.00
17	Cephotaxime (30)	33.33	60.00	6.67
18	Polymyxin B (300 units)	26.67	53.33	20.00
19	Chloramphenicol (30)	20.00	46.67	33.33
20	Neomycin (30)	20.00	73.33	6.67
21	Novobiocin (30)	6.67	6.67	86.66
22	Ampicillin (25)	0.00	0.00	100.00
23	Cefixime (5)	0.00	0.00	100.00
24	Metronidazole (5)	0.00	0.00	100.00
25	Nalidixic Acid (30)	0.00	0.00	100.00

Results and Discussion. There is increased public and scientific interest regarding the administration of antimicrobials to animals due primarily to zoonotic bacterial pathogens (White & McDermott 2001). The emergence of antibacterial resistance among pathogens that affect animal health is of growing concern in veterinary medicine as these resistant pathogens in animals have been incriminated as a potential health risk for humans (Moon et al 2007).

In the present investigation all the 15 isolates confirmed by ribotyping as all produced a species specific amplicon of 1250 bp (Figure 1) were subjected to antibiogram susceptibility testing against 25 different antibiotics. The antibiogram revealed that the most effective antibiotic was linizolid against which all the isolates were sensitive followed by azithromycin and gentamicin against which 93.33% of the isolates were sensitive, 80.00% isolates were sensitive to methicillin, levofloxacin, rifampicin, ofloxacin, netilmicin, cotrimoxazole and vancomycin, 73.33% to azlocillin, 60.00% to bacitracin and norfloxacin and other antibiotics were still less effective. Four of the antibiotics viz. ampicillin, cefixime, metronidazole and nalidixic acid were found completely ineffective where resistance to these antibiotics was shown by all the isolates.

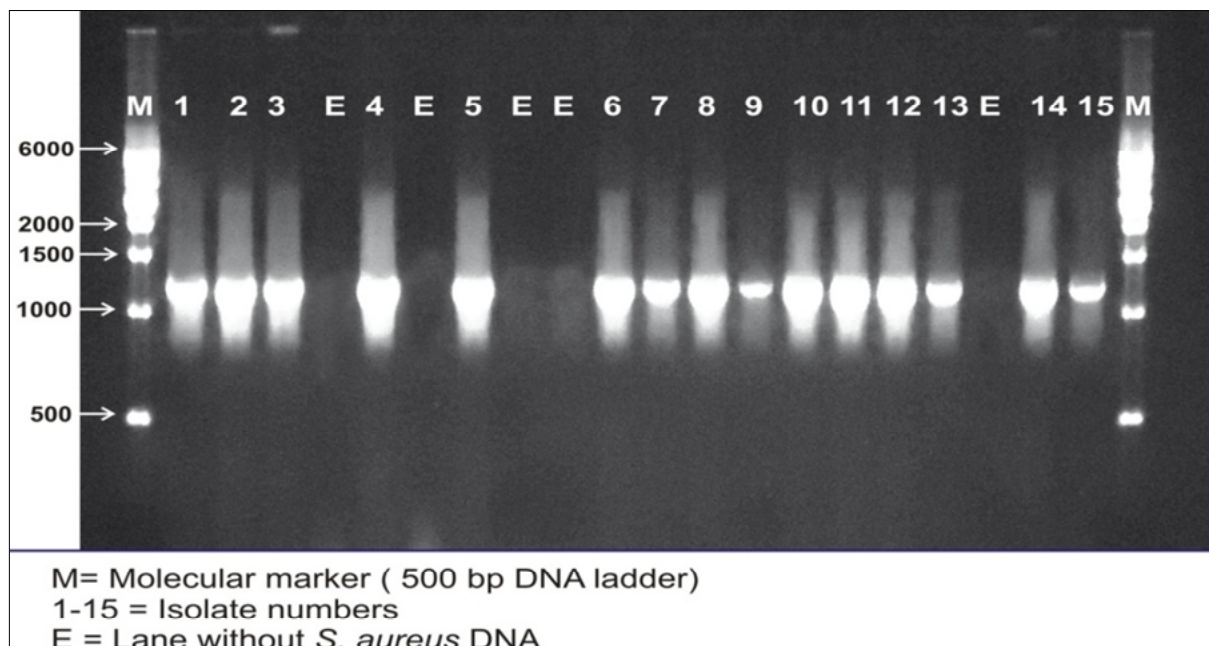


Figure 1. 23S rRNA ribotyping of *S. aureus* from camel wound.

Qureshi & Kataria (2004) also studied antibiogram for *S. aureus* from camel skin wounds and abscesses and found gentamicin effective which is in accordance to the present observations for this antibiotic.

Sanjiv & Kataria (2006), and Upadhyay & Kataria (2009) used some similar antibiotics as in this study against *S. aureus* isolates of milk origin from cattle and goats obtained from the same area and the analysis of results of these three consecutive studies revealed that the susceptibility of the organisms against the antibiotics has greatly reduced, the reason for which appears to be obvious. In this area the awareness of farmers towards animal care has increased tremendously and they seek veterinary help promptly as and when it is required. Younis et al (2000) recorded higher resistance to penicillin (96.6%) for *S. aureus* from bovine mastitis and suggested that the increasing penicillin resistance may be related to extensive use of this drug in mastitis treatment. In a retrospective study on antimicrobial sensitivity to *S. aureus* from bovine mastitis Gitau et al (2011) also recorded highest sensitivity for gentamicin while it was moderate to low for ampicillin and tetracycline.

In the present study the susceptibility of *S. aureus* to gentamicin is almost similar to that recorded by Ebrahimi & Akhavan Taheri (2009) who found 100% of the isolates susceptible to gentamicin but the results for cloxacillin in the present study (89.29%) are

opposed to the observations of these researchers where 100% resistance was shown towards this antibiotic.

In the present investigation two of the antibiotics *viz.* methicillin and ampicillin belonged to β -lactum antibiotic group but of these methicillin was found very effective whereas ampicillin was completely ineffective. The long standing and indiscriminate use of ampicillin would have been responsible for development of resistance towards this antibiotic (Sabour et al 2004; Moon et al 2007; Kumar et al 2011; Gitau et al 2011) whereas the other antibiotic is not being used in veterinary care.

Moon et al (2007) recorded antibiogram for *S. aureus* from bovine mastitis to nine antimicrobial agents. Their observations were similar to that observed in the present findings in regard to ampicillin and gentamicin.

The antibiogram obtained by Younis et al (2000) against *S. aureus* from bovine mastitis was in partial agreement to observations in the present study. They recorded all the isolates susceptible to novobiocin and methicillin but in present investigation no isolate was susceptible to novobiocin. However, susceptibility to methicillin was comparable. In contrast to the findings in the present investigation Viridis et al (2010) recorded that 88%, 92%, 92%, 100% and 100% of *S. aureus* isolates from goat were susceptible to ampicillin, ceftriaxone, ofloxacin, novobiocin and vancomycin, respectively.

In present investigation resistance towards methicillin was not recorded whereas El-Jakee et al (2010) recorded higher resistance (60%) by *S. aureus* isolates.

The resistance pattern of *S. aureus* in the present investigation was almost in agreement to that reported by Brinda et al (2010) where they observed highest resistance to ampicillin.

The *S. aureus* in the present study showed resistance to some of the antibiotics used in the study. The phenomenon of the multiple resistance to antibiotics in varying proportions has been noticed in *S. aureus* isolates by many researchers (Younis et al 2000; Brinda et al 2010; Kumar et al 2011; Gitau et al 2011)

In the present investigation the resistance towards cefixime was unexpected because this antibiotic is not being used in the veterinary care hence; chances of development of resistance towards this antibiotic by *S. aureus* are very rare. However, the recovery of cefixime resistant *S. aureus* from camel could be explained on the fact that the organism might have come from human sources. The 100% resistance towards cefixime is in complete agreement to the observations of Upadhyay & Kataria (2009). *S. aureus* is known for its ability to develop resistance towards frequently used antibiotics in a very short time and shows susceptibility to the same antibiotic if not used for longer durations. Blanc et al (2001) reported reemergence of gentamicin susceptible MRSA and suggested that these gentamicin susceptible strains emerged from gentamicin resistant *S. aureus* strains.

The extensive variability in the antibiogram patterns exhibited by *S. aureus* from different localities and at different time intervals suggests that this organism is changing its response to different antibiotics very frequently hence, it is imperative to use right antibiotic in control of *S. aureus* infections. Monitoring of antimicrobial susceptibility in pathogenic bacteria and in commensals in animals is also recommended by OIE (Acar & Rostel 2001).

Conclusions. The study revealed that the most effective antibiotic against *S. aureus* obtained from camel skin wounds was linizolid followed by azithromycin and gentamicin in decreasing order of their efficacy and all the isolates showed complete resistance towards four antibiotics *viz.* ampicillin, cefexime, metronidazole and nalidixic acid.

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