



## **Small Ruminants Abscesses: Bacterial Etiology, Antibiogram and Haematological Study in the East of Saudi Arabia**

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### **Authors' contributions**

This work was carried out in collaboration between all authors. Author FMTH designed the study, wrote the protocol and interpreted the data. Author BAT carried out the field work. Author KAAS gathered the initial data and performed clinical studies. Authors AF and MAS managed laboratory and statistical analysis. All authors read and approved the final manuscript.

### **Article Information**

DOI: 10.9734/MRJI/2017/38366

#### Editor(s):

(1) Giuseppe Blaiotta, Professor, Department of Agriculture, Division of "Grape and Wine Sciences", University of Naples Federico II, Via Universita' 100 – Palazzo Mascabruno 80055 Portici, Italy.

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Complete Peer review History: <http://www.sciencedomain.org/review-history/22719>

**Original Research Article**

**Received 23<sup>rd</sup> October 2017**  
**Accepted 28<sup>th</sup> December 2017**  
**Published 12<sup>th</sup> January 2018**

### **ABSTRACT**

Health and productivity of sheep and goats are affected greatly by superficial and deep abscesses. This study aimed to investigate the bacterial causative agents and their antibiogram of local and foreign breeds of sheep and goats abscesses in Alhasa and Dammam areas of Kingdom of Saudi Arabia (KSA). A total of 37 and 29 species of were isolated from local and foreign breed sheep and goats abscess respectively. In local breed, *Kocuria varians* isolation rate was 11.67%, then *K. rosea* (7.42%), *K. kristinae* (6.99%), *Streptococcus uberis*, *Corynebacterium pseudotuberculosis*,

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*Sphingomonas paucimobilis* (6.55%), *C. pyogenes* (3.93%), *Staph. aureus* subsp. *anaerobius* (3.49%). In foreign breed, *K. varians* and *K. rosea* of (11.67 %), *Acineto. Iwoffii* (7.35%), *Sp H. paucimobilis*, *Strept. uberis* (5.88 %), *Staph. aureus* subsp. *anaerobius* (4.41%). This is the first report for isolation of *Kocuria* spp. from sheep and goats abscesses as reports of this species from animals are meagre. The prevalent isolates showed high degree of resistance to commonly-used antibiotics. Haematological analysis showed significant increase of granulocytes count ( $P = < .05$ ) in the affected sheep and goats ( $50.3 \pm 2.7\%$  &  $47.5 \pm 5.8\%$ ) compared to control ones ( $40.6 \pm 2.5\%$  &  $44 \pm 5.4\%$ ). In leucocytes, significant increase ( $P = < .05$ ) in the affected sheep than normal animals but goats showed no difference. Contrary, the lymphocyte percentage significantly decreased ( $P = < .05$ ) in diseased sheep and goats abscesses ( $45.07 \pm 1.17\%$ ) as compared with control group ( $52.6 \pm 1.8\%$ ). The study indicated that abscesses in sheep and goats did not affect erythrocytes count or haemoglobin content.

**Keywords:** Pyogenic bacteria; *Kocuria* spp; sheep; goats; abscesses; Saudi Arabia.

## 1. INTRODUCTION

Abscess formation in different parts of the body of sheep and goats is a common infection which affect animal health and productivity. It was observed that abscesses often result after a subcutaneous infection by a variety of bacteria including: *Staphylococcus aureus*, *Staph. epidermidis*, *Pseudomonas aeruginosa*, *Actinomyces pyogenes*, *Rhodococcus equi*, *Moraxella species*, and *C. pseudotuberculosis* [1]. Microorganisms associated with abscesses of sheep and goats in the south of Iran where total of 86 abscesses of sheep and goats, respectively were examined for their causal agents. Species of the genera *Corynebacterium*, *Staphylococcus*, and *Streptococcus* and *Pasteurella*, *Escherichia coli*, and other gram negative rods were reported. *Peptostreptococcus anaerobius* and *Eubacterium tortuosum* were isolated in pure culture from one abscess each in goats [2]. [3] in (2002) examined 337 liver abscesses of Awassi sheep in different slaughterhouses in Jordan for their causal agents. *Fusobacterium necrophorum* biovar B were isolated from 195 abscesses. *Arcanobacterium pyogenes*, *F. necrophorum* biovar A, *E. coli* and *Clostridium perfringens* were also isolated. In a retrospective study, *A. pyogenes* which was recently renamed *Trueperella pyogenes*, was reported from different pyogenic infections with a rate of 18.0% in abscesses and 9.0% in lymphadenitis [4]. [5] (2012) isolated *Serratia*, *Arcanobacterium* and *Burkholderia* species from visceral and cutaneous abscesses in four emaciated ewes.

Caseous lymphadenitis is a contagious bacterial disease that affects sheep and goats. It is characterized by abscess formation in the skin, internal and external lymph nodes, and internal

organs. The causative agent is *Corynebacterium pseudotuberculosis* [6]. [7] recorded that caseous lymphadenitis was a chronic and subclinical disease of sheep and goat of worldwide distribution, presenting high animal and flock prevalence. *C. pseudotuberculosis* affects sheep and goats, though it can also infect cattle and horses, and rarely, humans; thus, it is considered an occupational zoonosis. Recently, a PCR assay was developed to discriminate between *C. pseudotuberculosis* biovar Ovis and Equi strains as innovative diagnostic tool [8]. All abscesses on goats are not necessarily caseous lymphadenitis abscesses. *Actino. pyogenes* also produces a fast-growing nodule, but it contains a smelly, greenish pus. [9] examined 1406 imported and 969 native sheep clinically for the presence of external abscesses at different localities in Makkah El-Mokarrama during the Hajj season of 1426 H. *C. pseudotuberculosis* was widely prevalent in the native (26%) rather than in imported breeds (0.5%).

Morel's or abscess disease is clinically similar to caseous lymphadenitis caused by *Staph aureus* subsp *anaerobius*. Abscess disease is a specific lymphadenitis of sheep and goats which affects mainly young animals up to about 6 months of age. The disease leads to formation of abscesses located mainly in close association with superficial lymph nodes mostly in the head region [10]. In Poland, two outbreaks of Morel's disease in sheep and goats indicated that most of the strains isolated were identical to the type strain of *S. aureus* subsp. *anaerobius* ATCC 35844 [11].

Alhendi et al. [12] recorded an outbreak of abscess disease in goats in Saudi Arabia, 61 out of 165 goats showed abscesses in various body lymph nodes, mainly in the head, neck and

shoulder region. The specimens cultured revealed the growth of *Staph. aureus* subsp. *anaerobius*. The prevalence of abscesses in slaughtered sheep in Al-Ahasa and Jeddah regions was reported as 3.8% and 2.8% for local and imported breeds of sheep, respectively. The prevalence rate of abscesses was higher in Al-Ahasa area than Jeddah area. Najdi sheep are more susceptible to diseases than other breeds. Young animals generally had lower infection rate compared to adults [13]. High sero-prevalence of CLA in sheep farms was reported in a state in Brazil to be due to lack of good management measures and vaccination [14].

The economic impact of abscesses on the small ruminant industry is through decreased meat yield, damaged wool and leather, decreased reproductive efficiency, culling of affected animals, and mortality. Economic losses due to the disease are most severe in the disseminated visceral form which can result in loss of the animal's value by wasting, death or carcass condemnation due to the extensive internal abscesses.

*C. pseudotuberculosis* is Gram-positive, non-encapsulated, non-spore, fimbriated, coccoid, non-motile, facultative aerobic and anaerobic, with metachromatic granules in the bacillary form. It is facultative intracellular parasite that multiplies inside the macrophages [15,6].

Members of the genus *Kocuria* (family Micrococcaceae, order Actinomycetales, class Actinobacteria) are Gram-positive cocci found as tetrads or irregular clusters that are catalase-positive and coagulase-negative. They are responsible for different types of infection, mostly in immunocompromised hosts with serious underlying conditions [16,17]. However, the prevalence of human and animal infections caused by *Kocuria* species is underestimated, as commonly used phenotypic techniques are known to misidentify *Kocuria* isolates as *Staphylococci*. A variety of presumed *Kocuria* infections might have actually been due to coagulase-negative *Staphylococci* (CNS). *Kocuria* is ubiquitous in nature and is frequently encountered as normal skin flora in humans and other animals. Only five of the 18 species in this genus are known to be opportunistic pathogens [17].

### 1.1 Anti-microbial Sensitivity Test

Caseous lymphadenitis was extremely resistant to antibiotic therapy because the thick caseous

pus is contained in a tough fibrous capsule which antibiotics cannot penetrate.

The objectives of this work were to identify bacterial species causing sheep and goat abscesses and to describe the antibiogram and haematological characteristics in local and foreign breeds in Alhasa and Dammam areas of KSA.

## 2. MATERIALS AND METHODS

Pus samples were collected from sheep and goats according to the formula:

$$n = \frac{t^2 \times p(1-p)}{m^2}$$

where n = required sample size; t = confidence level at 95% (standard value of 1.96); p = estimated prevalence of disease; m = margin of error at 5% (standard value of 0.05).

A total of 300 pus samples were collected from Eastern region (Alhasa and Dammam) of the Kingdom of Saudi Arabia. Samples were obtained from suppurating lymph nodes, open abscesses and closed abscesses of sheep and goats presented to AL-Hasa slaughter house, Dammam slaughter house and from many Private Veterinary Clinics in AL-Hasa. Open abscesses were squeezed until pus flew out and a sterile bacteriological swab or sterile syringe was inserted deeply collecting sample from the capsule of the abscess. In case of closed abscesses, hairs or wool on the lesions were first clipped using a curved scissors and then the lesions were thoroughly disinfected with cotton swabs soaked in 70% ethyl alcohol. A small incision about 1 cm in length was made at the bottom of each lesion which was gently squeezed to be evacuated from pus and then a sterile cotton swab or sucking with sterile syringe was inserted to collect sample as described above. The collected samples were either sent immediately to the bacteriological laboratory or kept on ice in a special thermos until being submitted to the laboratory according to the location or the place at which the samples were collected. In all instances were brought to the laboratory within 24 hours.

### 2.1 Haematological Analysis

Blood samples were collected from 300 sheep and goats showing superficial abscess and from 50 sheep and goats free of abscess (control) using heparinized Vacutainer tubes (BD).

## 2.2 Microbiological Analysis

Abscess specimens were streaked onto blood agar (Oxoid, Basingstoke, UK) and MacConkey agar plates (Oxoid). The plates were incubated at 37°C for 24 h. Culture characteristics and microscopic features were observed and recorded for presumptive identification, as described by [18]. Biochemical confirmation of isolates was done by VITEK 2 system (bioMerieux, Marcy l'Étoile France).

## 2.3 Antimicrobial Susceptibility Testing

The standard agar disc diffusion test (Bauer-Kirby technique) was adopted as described by [18]. Interpretation of results was done according to the standards of the National Committee for Clinical Laboratory Standards.

A total of 39 bacterial isolates, from abscesses of sheep and goat from the different investigated region, were tested to determine their antibiogram patterns.

## 2.4 Statistical Analysis

Results were expressed as means±SD. Values of blood parameters were compared between groups of infected versus control sheep and goats by a student's t test for independent samples and groups having unequal sample size.

## 3. RESULTS

### 3.1 Bacteriological Investigations

A total of 37 species were isolated from local breed sheep and goats abscess in Alhasa and Dammam regions (Table 1). The most prevalent bacterial species was by *Kocuria varians*, identified from 27 cases representing (11.67%) of the total number. It was followed by *Kocuria rosea* isolated from 17 cases (7.42%), *Kocuria kristinae* 16 isolated (6.99%), *Strep. Uberis*, *C. pseudotuberculosis* 15, *Sphingomonas paucimobilis* were 15 isolates (6.55%), *C. pyogenes* 9 isolates (3.93%), *Staph. aureus* subsp. *anaerobius* 8 isolates (3.49%).

As well, 29 species of bacteria isolated from foreign breeds sheep and goats are shown on (Table 2). The highest rate was observed in *K. varians* and *K. rosea* isolated from 8 cases (11.67%), and followed by *Acineto. Iwoffii* 5 isolates (7.35%), *Sphingomonas paucimobilis*,

*Strep. uberis* were 4 isolates (5.88 %), *Staph. aureus* s. *S. anaerobius*, were 3 isolates (4.41%).

### 3.2 Haematological Findings

Result of haematological investigation is shown on Table 4. Only the granulocytes showed significant increase ( $P = < .05$ ) in the affected sheep and goats ( $50.3 \pm 2.7\%$  &  $47.5 \pm 5.8\%$ ) compared to control ones ( $40.6 \pm 2.5\%$  &  $44 \pm 5.4\%$ ). Contrary, the lymphocyte percentage significantly decreased ( $P = < .05$ ) in diseased sheep and goats abscesses ( $45.07 \pm 1.17\%$ ) as compared with non-abscess group ( $52.6 \pm 1.8\%$ ). WBC there is significant increase ( $P = < .05$ ) in the affected sheep than normal animals (Reference Interval:  $4 - 13 \times 10^3 / \mu\text{L}$ ) but goats showed no difference.

A non-significant increase in the HCT (PCV%) values was noticed in sheep and goats affected with abscesses corresponding control group.

Only slightly differences were detected between sheep and goats affected with or without abscesses for RBCs counts, HGB and monocytes percentage.

### 3.3 Antimicrobial Sensitivity Test

The results of sensitivity test are illustrated on Table 3.

## 4. DISCUSSION

The results obtained during bacteriological examination of abscesses from the study area revealed 40 bacterial species isolated from 300 abscess cases. *K. varians* was found to be the predominant organism in sheep and goat with 35 isolates followed by *K. rosea* representing 25 isolates, *Strep. uberis*, *Shingomonas spp*, and *Paucimobilis spp* were 19 isolates, *K. kristinae* 18 isolates, *C. pseudotuberculosis* 15 isolates, *Acineto. lowffii* and *Staph. aureus* subsp. *anaerobius* 11 isolates, *Dermacoccus nishinomiyaensis* and *C. pyogenes* 10 isolates. Most frequently isolated species were similar to those reported by other workers [19,3,20,21]. In the present study, it is interesting to point out the predominance of *Kocuria spp* as causative agents of abscesses in sheep and goats. Use of Vitek2 system with its wide range of species data base could explain this. However, bacteriological research on sheep and goats abscess revealed that *C. pseudotuberculosis* was the pathogen most frequently isolated, followed by *Staph. aureus* subsp *anaerobius*. *C. pseudotuberculosis* is easily disseminated throughout the herd by

normal management practices and by environmental contamination [22]. Further studies are needed to confirm findings of the present study.

During the present investigation, other bacterial species were isolated in lower ratios, which included *Strept. pluranimalium* (9), *Coryn*

*tenuis*, *Staph. epidermidis*, *Staph. warneri*, *Kytococcus sedentarius*, *proteus mirabilis* were (8). This is the first report of some species from cases of abscess in sheep and goats. *Coryn tenuis* was reported from Trichomycosis axillaris, a superficial bacterial infection, in man. The adherent concretions on the hair shaft may be yellow, black, or red, and there is typically

**Table 1. Bacterial species isolated from local breed of sheep and goats in Al-Ahsa and Dammam areas of KSA**

Serial	Bacterial species	Number	Percentage
1	<i>Kocuria varians</i>	27	11.79
2	<i>Kocuria rosea</i>	17	7.42
3	<i>Kocuria kristinae</i>	16	6.99
4	<i>Streptococcus uberis</i>	15	6.55
5	<i>Coryn. Pseudotuberculosis</i>	15	6.55
6	<i>Sphingomonas paucimobilis</i>	15	6.55
7	<i>Coryn. pyogenes</i>	9	3.93
8	<i>Staph. aureus</i> subsp. <i>anaerobius</i>	8	3.49
9	<i>Leuconostoc mesenteroides</i>	7	3.06
10	<i>Dermacoccus nishinomiyaensis</i>	7	3.06
11	<i>Coryn. tenuis</i>	7	3.06
12	<i>Acinetobacter lwoffii</i>	6	2.62
13	<i>Kytococcus sedentarius</i>	6	2.62
14	<i>Streptococcus pluranimalium</i>	6	2.62
15	<i>Proteus mirabilis</i>	5	2.18
16	<i>Staphylococcus warneri</i>	5	2.18
17	<i>Escherichia coli</i>	5	2.18
18	<i>Staphylococcus epidermidis</i>	5	2.18
19	<i>Staphylococcus hominis</i>	5	2.18
20	<i>Micrococcus luteus</i>	4	1.75
21	<i>Aeromonas sorbia</i>	4	1.75
22	<i>Moraxella lacunata</i>	4	1.75
23	<i>Moraxella osloensis</i>	4	1.75
24	<i>Pasteurella pneumotropica</i>	3	1.31
25	<i>Micrococcus lylae</i>	3	1.31
26	<i>Pasteurella canis</i>	3	1.31
27	<i>Moraxella nonliquefaciens</i>	3	1.31
28	<i>Buttiauxella agrestis</i>	3	1.31
29	<i>Acinetobacter calcoaceticus</i>	2	0.87
30	<i>Pediococcus acidilactici</i>	2	0.87
31	<i>Neisseria animaloris</i>	2	0.87
32	<i>Pediococcus pentosaceus</i>	1	0.44
33	<i>Chryseobacterium glem</i>	1	0.44
34	<i>Acinetobacter genomospecies</i>	1	0.44
35	<i>Acinetobacter haemolyticus</i>	1	0.44
36	<i>Morganella morganii ssp</i>	1	0.44
37	<i>Pantoea ssp.</i>	1	0.44
	Total	229	100.00

**Table 2. Bacterial species isolated from sheep and goats foreign breeds in Al-Ahsa and Dammam areas of KSA**

Serial	Bacterial Species	Number	Percentage
1	<i>Kocuria varians</i>	8	11.76
2	<i>Kocuria rosea</i>	8	11.76
3	<i>Acinetobacter lwoffii</i>	5	7.35
4	<i>Streptococcus uberis</i>	4	5.88
5	<i>Sphingomonas paucimobilis</i>	4	5.88
6	<i>Proteus mirabilis</i>	3	4.41
7	<i>Staphylococcus warneri</i>	3	4.41
8	<i>Staphylococcus epidermidis</i>	3	4.41
9	<i>Demacoccus nishinomiyaensis</i>	3	4.41
10	<i>Streptococcus pluranimalium</i>	3	4.41
11	<i>Staph. aureus</i> subsp. <i>anaerobius</i>	3	4.41
12	<i>Kocuria kristinae</i>	2	2.94
13	<i>Francisella tularensis</i>	2	2.94
14	<i>Moraxella lacunata</i>	2	2.94
15	<i>Moraxella nonliquefaciens</i>	2	2.94
16	<i>Kytococcus sedentarius</i>	2	2.94
17	<i>Staphylococcus hominis</i>	2	2.94
18	<i>Pediococcus pentosaceus</i>	1	1.47
19	<i>Pasteurella pneumotropica</i>	1	1.47
20	<i>Micrococcus lylae</i>	1	1.47
21	<i>Chryseobacterium glem</i>	1	1.47
22	<i>Acinetobacter baumannii</i>	1	1.47
23	<i>Acinetobacter haemolyticus</i>	1	1.47
24	<i>Coryn. pyogenes</i>	1	1.47
25	<i>Aeromonas sobria</i>	1	1.47
26	<i>Pasteurella canis</i>	1	1.47
27	<i>Moraxella osloensis</i>	1	1.47
28	<i>Coryn. tenuis</i>	1	1.47
29	<i>Neisseria animaloris</i>	1	1.47
	Total	71	100.00

an associated rancid, acidic odor, which is due in part to the bacteria [23].

*Leuconostoc mesenteroides* ssp *cremoris*, *Staph. hominis* subsp. *hominis*, were (7), *Moraxella lacunata* (6), *E. coli*, *Aeromonas sobria*, *Moraxella nonliquefaciens*, *Moraxella osloensis* were (5), *Pasteurella canis*, *Pasteurella pneumotropica*, *Micro. lutus*, *Micro. lylae* were (4), *Buttiauxella agrestis* (3), *Neisseria animaloris*, *pediococcus acidilactici*, *Acineto. haemolyticus*, *Francisella tularensis*, *Chryseobacterium gleum*, *Acineto. calcoaceticus*, *Pediococcus pentosaceus* were (2), *Acineto. baumannii*, *Acineto. genomo s.*, *Morganella morganii* subsp. *morganii*, *Neisseria zoodegmatis*, *Pantoes* ssp were (1), respectively. These causative agent in the present study are almost similar to finding in other studies of abscesses disease [24,25,26].

The result of the haematological analysis suggests that animals with abscesses have normal HCT %, RBCs and HGB with no evidence of anaemia.

On the other hand, the high WBC counts were due mainly to increase in leukocytes indicating active infection. GRA % there is significant increase in sheep but not goats, WBC there is significant increase in sheep but not goats. Such changes have been observed in bacterial diseases in sheep and other animals. Generally pyogenic infections may be accompanied by leukocytosis and elevation in PMN leukocytes with left shift. Other workers demonstrated that leukocytes from sheep with caseous lymphadenitis chronic abscesses produced higher IFN- $\gamma$  levels than seropositive animals without clinical signs and concluded that IFN- $\gamma$  is a potential marker to detect infection [27].

**Table 3. Anti-microbial susceptibility pattern of the most prevalent bacterial isolates obtained from sheep and goats abscesses in Al-Ahsa and Dammam areas of KSA**

Serial	Antibacterial/bacterial species	E15	NV5	CN10	OB5	OT30	K30	C30	AMP10	N10	Aml10	S10	SXT25	F300	UB30
1	<i>P. pentosaceus</i>	S	IR	IR	IR	S	S	S	IR	IR	IR	IR	S	S	IR
2	<i>Kocuria varians</i>	IR	R	S	IR	IR	IR	IR	R	IR	R	S	R	S	R
3	<i>Derm nishinomiyaensis</i>	R	IR	IR	IR	S	IR	S	S	R	S	R	R	S	IR
4	<i>Kyt sedentarius</i>	R	IR	IR	IR	S	IR	S	S	R	S	R	R	S	IR
5	<i>K. rosea</i>	R	R	IR	IR	S	IR	S	R	IR	S	R	R	R	S
6	<i>C. pseudo</i>	S	IR	R	IR	S	IR	S	S	S	S	IR	R	R	IR
7	<i>Micro luten</i>	S	IR	IR	IR	S	R	S	S	R	S	R	R	R	R
8	<i>Micro. lylae</i>	S	IR	IR	IR	S	R	S	S	R	S	R	R	R	R
9	<i>K. kristinae</i>	S	R	IR	R	IR	IR	R	IR	S	S	S	R	R	R
10	<i>L. mesenteroides</i>	S	IR	IR	IR	IR	S	S	S	IR	IR	S	R	R	R
11	<i>C. tenuis</i>	S	IR	S	IR	S	IR	S	S	IR	IR	IR	R	S	S
12	<i>Staph hominis</i>	IR	IR	IR	R	S	IR	S	S	IR	S	IR	R	R	S
13	<i>S. warneri</i>	IR	R	IR	R	S	S	IR	S	R	S	R	R	R	IR
14	<i>Strep uberis</i>	R	R	R	R	R	R	R	R	R	R	R	R	R	R
15	<i>C. pyogenese</i>	IR	IR	S	R	S	IR	S	S	S	IR	IR	S	R	R
16	<i>Staph anaerobius</i>	S	S	R	S	S	R	IR	S	R	S	R	IR	IR	R
17	<i>E coli</i>	R	R	S	R	R	S	S	R	IR	R	R	IR	S	IR
18	<i>S. paucimobilis</i>	R	S	IR	S	IR	R	R	IR	R	S	R	R	R	R
19	<i>Acin. lwoffii</i>	IR	R	S	R	R	S	S	R	IR	R	R	R	IR	S
20	<i>Mor. lacunata</i>	S	R	IR	IR	S	IR	IR	S	S	R	S	R	IR	R
21	<i>Aero sorbia</i>	S	R	S	R	R	S	S	R	IR	R	IR	R	IR	S
22	<i>M. nonliquefaciens</i>	IR	R	S	R	IR	S	S	R	S	R	IR	R	R	R
23	<i>Past. pneumotropica</i>	R	S	IR	R	S	IR	IR	S	S	S	R	IR	R	R
24	<i>M. osloensis</i>	IR	R	IR	IR	S	S	S	R	IR	R	R	R	S	IR
25	<i>Chry. glem</i>	S	R	IR	S	IR	R	IR	R	S	R	S	IR	IR	S
26	<i>Past. canis</i>	R	S	IR	R	S	R	IR	S	S	IR	S	IR	R	R
27	<i>Prot. mirabilis</i>	R	R	IR	R	R	IR	S	R	R	R	R	R	R	S

**Table 4. Blood picture of infected and control sheep and goats**

Blood parameters		Goats		Sheep	
	Condition	No.	Mean $\pm$ SE	No.	Mean $\pm$ SE
HCT %	Control	10	30.50 $\pm$ 1.75	40	32.43 $\pm$ 0.76
	Infected	79	34.37 $\pm$ 1.37	221	35.58 $\pm$ 0.78
RBCs x 10 <sup>6</sup> / $\mu$ L	Control	10	13.10 $\pm$ 1.18	40	13.43 $\pm$ 0.56
	Infected	79	12.55 $\pm$ 0.48	221	13.05 $\pm$ 0.31
LYM %	Control	10	52.50 $\pm$ 3.19	40	52.65 $\pm$ 1.89
	Infected	79	46.89 $\pm$ 2.11	221	45.07 $\pm$ 1.17
GRA %	Control	10	44.00 $\pm$ 5.41	40	40.60 $\pm$ 2.50
	Infected	79	47.57 $\pm$ 5.88	221	50.30 $\pm$ 2.75
HGB g/dl	Control	10	11.00 $\pm$ 0.39	40	10.30 $\pm$ 0.23
	Infected	79	10.83 $\pm$ 0.38	221	10.41 $\pm$ 0.21
WBC x 10 <sup>3</sup> / $\mu$ L	Control	10	10.70 $\pm$ 1.33	40	8.99 $\pm$ 0.51
	Infected	79	11.27 $\pm$ 1.86	221	11.34 $\pm$ 0.53
MON %	Control	10	5.00 $\pm$ 0.45	40	6.02 $\pm$ 1.27
	Infected	79	4.25 $\pm$ 0.36	221	5.99 $\pm$ 0.20

Key: HCT (PCV) % = Packed cell volume, HGB = Haemoglobin, GRA = Granulocyte, MON = Monocytes LYM = Lymphocytes, WBC = White blood cell, RBCs = Red blood cells, SE = Standard errors

In LYM % there is significant decrease in infected animals( lymphopenia) while in MON % there is non- significant decrease in both sheep & goats. Conversely, infected animals had lower values of lymphocyte counts (lymphopenia) than the control or the reference values. Other workers demonstrated that in chronic cases lymphocytes and monocytes may increase together with development of moderate normochromic anaemia and mild proteinuria [28,22].

Analysis of antibiogram (Table 3) showed that *C. pseudotuberculosis* was highly sensitive to erythromycin, oxytetracyclin, chloramphenicol, ampicillin, neomycin and amoxicillin, while, novobiocin, cloxacillin, kanamycin, streptomycin and nitrofurantion had moderate effect and gentamicin, sulpham- trimethoprim and flumequine had weak effect. Similar finding were reported by [1], [29]. Another study showed that *C. pseudotuberculosis* strains were sensitive to norfloxacin , cephalothin, methicillin, kanamycin and furazolidine [30]. *Staph. aureus* subsp. *anaerobius* (abscesses) was highly sensitive to erythromycin, oxytetracyclin, novobiocin, ampicillin, cloxacillin and amoxicillin, while, chloramphenicol, sulph. trimethoprim, kanamycin and flumequine had moderate effect and gentamicin, kanamycin, nitrofurantion and neomycin had weak effect and resistant to streptomycin. Similar finding were reported by [31] that Gram positive bacteria causing abscess were found to be sensitive to amoxicillin, trimethoprim, neomycin, cloxacillin, furozolidone and kanamycin. Analysis of antibiogram revealed that a majority of the Gram positive organism

were sensitive to ampicillin followed by oxytetracycline, chloramphenicol and amoxicillin. The predominant Gram positive bacteria isolated from abscess such as *Staphylococcus*, *Koccuria* and *granula* ssp., were sensitive to oxytetracycline and ampicillin. The majority of Gram negative bacteria were sensitive to chloramphenicol. However the most predominant bacteria such as *Sphingomonas*, *Aeromonas* and *Acinetobacter* spp., were sensitive to chloromphenicol and kanamycine. *Sphingomonas* was sensitive to Amoxicillin and cloxacillin. In a similar situation *Enterobacteriaceae* were found sensitive to ampicillin, cephaloxin, chloramphenicol, kanamycin and gentamycin [31]. *E. coli* strains were found sensitive to gentamycine and kanamycine [32]. The antibiograms revealed that most effective drug for both Gram positive and Gram negative was chloramphenicol. [33] studied the bacteria isolated from abscess and concluded that erythromycin was the most effective. While another study by [31], found gentamycin, chloramphenicol, ciprofloxacin and trimethoprium to be most effective against Gram positive and Gram negative bacterial isolated from abscess. In the present study, antimicrobial resistance pattern of bacterial pathogens isolated from abscess indicated that Gram positive isolates were resistant to sulphamethoxazole-trimethoprim, erythromycin and flumequine. In other studies Gram positive bacteria causing abscess were resistant to sulphadiazine, cephalixin, ampicillin and penicillin [33], [31]. In the present study, antimicrobial resistance pattern of predominant Gram negative bacteria



indicated that they were resistant to sulphamethoxazole- trimethoprium, flumequine, kanamycin, nitrofurans, ampicillin and novobiocin. *Enterobacteriaceae* were found resistant to sulphadiazine, tetracycline and streptomycin [32]. The disagreement between antimicrobial application and prevalence of antimicrobial resistant bacteria among animals has been reported in some previous studies [34], [35]. In general, the choice of an antimicrobial agent is dictated by antibiotic sensitivity. Too often sensitivity patterns are expressed in qualitative terms such as sensitive, intermediate or resistant to antibiotics.

## 5. CONCLUSION

A host of bacterial species were identified from abscesses of local and foreign breeds of sheep and goats in the Eastern Region, KSA. The predominant isolates were *Kocuria varians*, *K. rosea*, *K. kristinae*, *Streptococcus uberis*, *Corynebacterium pseudotuberculosis*, *Sphingomonas paucimobilis*, *C. pyogenes*, *Staph. aureus* subsp. *Anaerobius*. This is the first report for isolation of *Kocuria* spp. from sheep and goats abscesses. Isolated species showed high degree of resistance to commonly-used antibiotics. Haematological analysis showed significant increase of granulocytes and leucocytes counts in the affected sheep and goats. However, sheep and goats abscesses did not affect erythrocytes count or haemoglobin content. The role of automated identification systems in defining precisely new isolates which were misidentified in previous works elsewhere, is stressed.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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