

## Comparison of microbial isolates isolated from external ear canal of sheep and their susceptibility to antibiotics

Sahar Mahdi Hayyawi

Department of Microbiology, College of Veterinary Medicine University of Baghdad,  
Baghdad, Iraq

### Summary

One hundred sheep with bilateral otitis externa were studied one year and a half .The exudates of both external ears obtained using sterile swabs, and microorganisms were isolated according to standard microbiological techniques. There was bacterial and fungal growth in many of the samples. The total numbers of isolates from right ear was 104 , and the most common pathogens isolated in right ear were *Staphylococcus aureus* 30.76 % , then *Staphylococcus epidermidis* 9.61% and *Pseudomonas aeruginosa* 9.61 % while *E.coli* , *Proteus mirabilis* and *Streptococcus pyogenes* were 7.69% for each of them , *Candida albicans* 5.76% , *Klebsiella pneumonia* 3.84% , *Nocardia spp* 3.84% , *Pasteurella multucida* 3.84% , *Mannheimia haemolytica* 3.84% , *Aspergillus spp.* 3.84 % and *Streptomyces spp.* 1.23% . The total number of isolates from left ear was 96 ,the most pathogens were *Staphylococcus aureus* 27.08% while *Pseudomonas aeruginosa* 12.5% and *Streptococcus pyogenes* were 12.5% , *Klebsiella pneumonia* 8.33 % and *Proteus mirabilis* 8.33 % , *Staphylococcus epidermidis* , *Nocardia spp* 6.25 % , then *Streptomyces spp* , *Pasteurella multucida* and *Mannheimia haemolytica* were 4.16% , the last *E.coli* , *Aspergillus spp* and *Candida albicans* were 2.08 % for each of them . The result were showed significant differences at level  $P < 0.05$  between bacteria and fungi isolates, and have no significant differences at level  $P > 0.05$  between right and left ear . High susceptible rates of gram positive *Staphylococcus aureus* to (Amoxicillin + Clavulaunic acid) and Chloramphenicol were 100 % , while high susceptible rates of gram negative *Pseudomonas aeruginosa* was 90.90 % to Ciprofloxacin, (Amoxicillin+ Clavulaunic acid) and Chloramphenicol .

### مقارنة العزلات الجرثومية المعزولة من التهاب الأذن الخارجية في الأغنام وحساسيتها تجاه المضادات الحيوية

سحر مهدي حياوي

فرع الاحياء المجهرية ، كلية الطب البيطري ، جامعة بغداد ، بغداد ، العراق

#### الخلاصة

تم في هذه الدراسة عزل وتشخيص الاجناس البكتيرية والفطرية من الاذن الخارجية اليمنى واليسرى المصابة بالتهابات خمجية في الاغنام ومدى حساسيتها للمضادات الحيوية . تم اخذ العينات من الاذن المصابة وفحصها وتشخيص انواع الجراثيم باستخدام الاختبارات الكيموحيوية ثم دراسة حساسيتها للمضادات الحيوية . اظهرت النتائج ان عدد العزلات الجرثومية الكلي في الاذن اليمنى هو 104 عزلة واكثرها اهمية هي المكورات العنقودية الذهبية 30.76 % ثم تليها المكورات العنقودية البشرية والزوائف الزنجارية 9.61 % لكل منها ، تليها الاشريشيا القولونية والمتقلبات و المسبقيات القيجية 7.69 % لكل منها اما نسبة العزلات الجرثومية في الاذن اليسرى كان اهمها العنقوديات الذهبية بنسبة 27.8 % وتليها الزوائف الزنجارية والمسبقيات القيجية بنسبة 12.5 % . وتبين انه توجد فروق معنوية بين العزلات البكتيرية والعزلات الفطرية بمستوى  $P < 0.05$  ، بينما لا توجد فروق معنوية بين العزلات الجرثومية في الاذن اليمنى والاذن اليسرى بمستوى  $P > 0.05$  . واطهرت النتائج ان حساسية بكتريا العنقوديات الذهبية تجاه (الاموكسسلين+حامض الكلافولونك اسد والكلورامفينيكول كان بنسبة 100 % بينما الزوائف الزنجارية تجاه (الاموكسسلين+حامض الكلافولونك) والسبروفلوكساسين والكلورامفينيكول كان بنسبة 90.90 % .

## Introduction

Otitis externa is similar to skin and soft tissue infection elsewhere. Two major type of external Otitis: acute and chronic; acute external otitis may be localized or diffuse .Acute localized disease occurs in the form of a pustule or furuncle and typically result from *Staphylococcus aureus*. Erysipelas caused by group A *streptococci* may involve the external ear canal and the soft tissue of the ear itself (1). The normal flora of external ear are rather sparse, similar to flora of the conjunctival sac qualitatively except *pneumococci*, *Staphylococcus aureus* and *Enterobacteriaceae*, *Pseudomonas aeruginosa* and non-*Candida albicans* (2). Many factors can predispose sheep and goat to Otitis externa, the first is the anatomic orientation of the ear canal itself and cause an inflammation of the outer ear and ear canal (3). Otitis externa has multifactorial etiology and bacteria play an important role in otic diseases (3, 4) lesions on ear pain, balance alterations, itch, hemorrhagic lesions, ear orifice surrounding mucous discharge yellowish in color (5). These are clinical signs of significance in most cases and may indicate the presence of pathogenic infections (6, 7). Many studies have used samples collected from only one ear per animal (8), others have used samples collected from 1 or both ears and considered them as different samples (9).The purpose of this study was bacterial and fungal isolation patterns of samples collected from both ears to study the antimicrobial susceptibility pattern on the prevalent strains.

## Material and Methods

Hundred samples were taken from infected ear of sheep ,right and left ears from the Veterinary Clinic farms around veterinary college in Baghdad , the age between 6 months – 2 years old , in this study both numbers of female and male were 50 . Both ears swabbed by sterile cotton swabs then inoculated in nutrient broth as a primary bacterial isolation and incubated at 37 °C for 24 hours after that cultured by streaking method on MacConkey agar then incubated aerobically at 37( 10)+ , while blood agar under CO<sub>2</sub> condition for 24 hours (11). Routine bacterial culture was performed in all samples , then made the biochemical test to identified bacterial species , also the fungus were isolated by Sabaourod dextrose agar (12). For sensitivity test we have prepared Sterile Muller Hinton agar media then poured in sterile petri plates under aseptic condition used for susceptibility of antibiotic sensitivity disc. (13, 14) included; *Ampicillin*, Amikacin, Clarithromycin, Gentamycin , Amoxicillin, Ciprofloxacin, Cefotaxime, Augmentin, Trimethoprim + Sulfamethoxazol and Chloramphenicol.

The values were considered statistically significant ANOVA (Analysis of variance) for least significant differences (15).

## Results

The result were showed that there was significant differences at level  $P < 0.05$  between bacterial and fungal isolates, the total number of bacterial and fungal species isolated from right external ear canal was 104 included : *Staphylococcus aureus* the most prevalent 30.76 % ,followed by *Staphylococcus epidermidis* and , *Pseudomonas aeruginosa*, 9.61 % for each of them , but *E.coli*, *Proteus mirabilis*, *Streptococcus pyogenes* were 7.69 % for each of them , while *Candida albicans* 5.76 % , then *Klebsiella pneumonia* ,*Nocardia spp.* *Pasteurella multucida*, *Mannheimia haemolytica* *Aspergillus spp* were 3, 84 % for each of them , the last *Streptomyces spp* was 1.23 % . The total number of isolates from left ear was 96 included : *Staphylococcus aureus* 27.8 % , *Pseudomonas aeruginosa*, *Streptococcus pyogenes* 12.5 % per each ,while *Klebsiella pneumonia*, and *Proteus mirabilis* 8,33 % , then *Staphylococcus epidermidis* , *Nocardia spp* 6.25%, *Streptomyces spp*, *Pasteurella multucida* and *Mannheimia haemolytica* were 4.16%, the last *E.coli*, *Aspergillus spp* and *Candida albicans* were 2.08 % per each (table 1 ,2). There were no significant differences at  $P > 0.05$  between right and left infected ear.

The results of antibiotic sensitivity test to bacterial isolates from otitis externa in sheep showed that *Mannheimia haemolytica* have been a significant differences at level  $P < 0.05$

among different antibiotics , the highest were Amikacin , Gentamycin, ciprofloxacin, Augmentin and Chloramphenicol have 100% and the lowest was Ampicillin (table -8) .

**Table 1: Numbers of bacteria and fungus species isolates from infected right ear in sheep**

| Bacterial isolation from right ear | Number of isolates from right ear | Percentage % |
|------------------------------------|-----------------------------------|--------------|
| <i>Staphylococcus aureus</i>       | 32                                | 30.76        |
| <i>Staphylococcus epidermidis</i>  | 10                                | 9.61         |
| <i>Pseudomonas aeruginosa</i>      | 10                                | 9.61         |
| <i>Escherichia coli</i>            | 8                                 | 7.69         |
| <i>Proteus mirabilis</i>           | 8                                 | 7.69         |
| <i>Streptococcus pyogenes</i>      | 8                                 | 7.69         |
| <i>Candida albicans</i>            | 6                                 | 5.76         |
| <i>Klebsiella pneumonia</i>        | 4                                 | 3.84         |
| <i>Nocardia spp.</i>               | 4                                 | 3.84         |
| <i>Pasteurella multucida</i>       | 4                                 | 3.84         |
| <i>Mannheimia haemolytica</i>      | 4                                 | 3.84         |
| <i>Aspergillus spp.</i>            | 4                                 | 3.84         |
| <i>Streptomyces spp.</i>           | 2                                 | 1.23         |
|                                    | 104 total                         |              |

**Table 2: Numbers of bacteria and fungus species isolates from infected Left ear in sheep**

| Bacterial isolation from left ear infected | Number of isolates from left ear | Percentage % |
|--|----------------------------------|--------------|
| <i>Staphylococcus aureus</i>               | 26                               | 27.08        |
| <i>Pseudomonas aeruginosa</i>              | 12                               | 12.5         |
| <i>Streptococcus pyogenes</i>              | 12                               | 12.5         |
| <i>Klebsiella pneumonia</i>                | 8                                | 8.33         |
| <i>Proteus mirabilis</i>                   | 8                                | 8.33         |
| <i>Staphylococcus epidermidis</i>          | 6                                | 6.25         |
| <i>Nocardia spp</i>                        | 6                                | 6.25         |
| <i>Streptomyces spp.</i>                   | 4                                | 4.16         |
| <i>Pasteurella multucida</i>               | 4                                | 4.16         |
| <i>Mannheimia haemolytica</i>              | 4                                | 4.16         |
| <i>Escherichia coli</i>                    | 2                                | 2.08         |
| <i>Aspergillus spp.</i>                    | 2                                | 2.08         |
| <i>Candida albicans</i>                    | 2                                | 2.08         |
|  | 96 total                         |              |

The high percentage of gram positive bacterial isolates from right ear was *Staphylococcus aureus* 61.5 % (table-3).

**Table 3: Numbers of gram positive bacteria from infected right ear in sheep**

| Gram- Positive Bacteria           | Number of isolates from right ear | Percentage % |
|-----------------------------------|-----------------------------------|--------------|
| <i>Staphylococcus aureus</i>      | 32                                | 61.5         |
| <i>Staphylococcus epidermidis</i> | 10                                | 19.2         |
| <i>Streptococcus pyogenes</i>     | 8                                 | 15.38        |
| <i>Streptomyces spp.</i>          | 2                                 | 3.84         |
|                                   | 52 total                          |              |

**Table 4: Numbers of gram positive bacteria from infected left ear in sheep**

| Gram- Positive Bacteria           | Number of isolates from left ear | Percentage % |
|-----------------------------------|----------------------------------|--------------|
| <i>Staphylococcus aureus</i>      | 26                               | 54.16        |
| <i>Streptococcus pyogenes</i>     | 12                               | 25           |
| <i>Staphylococcus epidermidis</i> | 6                                | 12.5         |
| <i>Streptomyces spp.</i>          | 4                                | 8.33         |
|                                   | 48 total                         |              |

The most gram negative bacteria isolated from right ear was *Pseudomonas aeruginosa* 26.315 % (table -5), while in the left ear was 26.315 % (table- 6).

**Table 5: Numbers of gram negative bacteria from infected right ear in sheep**

| Gram- negative bacteria       | Number of isolates from right ear | Percentage % |
|-------------------------------|-----------------------------------|--------------|
| <i>Pseudomonas aeruginosa</i> | 10                                | 26.3         |
| <i>Escherichia coli</i>       | 8                                 | 21.05        |
| <i>Proteus mirabilis</i>      | 8                                 | 21.05        |
| <i>Klebsiella pneumonia</i>   | 4                                 | 10.5         |
| <i>Pasteurella multucida</i>  | 4                                 | 10.5         |
| <i>Mannheimia haemolytica</i> | 4                                 | 10.5         |
|                               | 38 total                          |              |

Table 6: Numbers of gram negative bacteria from infected left ear in sheep

| Gram- negative bacteria       | Number of isolates from left ear | Percentage % |
|-------------------------------|----------------------------------|--------------|
| <i>Pseudomonas aeruginosa</i> | 12                               | 31.5         |
| <i>Klebsiella pneumonia</i>   | 8                                | 21.05        |
| <i>Proteus mirabilis</i>      | 8                                | 21.05        |
| <i>Pasteurella multucida</i>  | 4                                | 10.5         |
| <i>Mannheimia haemolytica</i> | 4                                | 10.5         |
| <i>Escherichia coli</i>       | 2                                | 5.26         |
|                               | 38 total                         |              |

Table:7 Biochemical tests were include: Biochemical test for bacterial species isolates from otitis externa in sheep

| Bacterial species                 | SIM  | catalase | oxidase | Coagulase | pigments                       | MR | VP | SC | Urea hydrolysis | TSI            |
|-----------------------------------|------|----------|---------|-----------|--------------------------------|----|----|----|-----------------|----------------|
| <i>Staphylococcus aureus</i>      | ---  | +        | -       | +         | Yellow                         |    | +  | /  | +               | /              |
| <i>Staphylococcus epidermidis</i> | ---  | +        | -       | -         | White                          |    | +  | /  | +               | /              |
| <i>Pseudomonas aeruginosa</i>     | ---+ | +        | +       | /         | Green                          |    |    | +  | +               | K / K          |
| <i>Escherichia coli</i>           | ---+ | +        | -       | /         | /                              | +  | -  | -  | -               | Y / Y<br>gas+  |
| <i>Proteus mirabilis</i>          | +++  | +        | -       | /         | /                              | +  | -  | +  | +               | K / A<br>H2S+  |
| <i>Streptococcus pyogenes</i>     | ---  | -        | -       | /         | /                              | /  | /  | /  | /               | /              |
| <i>Klebsiella pneumonia</i>       | ---  | +        | -       | /         | muroid                         | -  | +  | +  | +               | A / A<br>gas + |
| <i>Pasteurella multucida</i>      | /+ / | +        | +       | /         | /                              |    |    |    | -               | /              |
| <i>Mannheimia haemolytica</i>     | /- / | +        | +       | /         | /                              |    |    |    | -               | /              |
| <i>Streptomyces spp.</i>          |      | -        |         | /         | branching<br>Arial<br>filament | /  | /  |    | ±               | /              |

SIM= sulfur Indole Motility, MR=methyl red, VP = vogues proskaour, SC=Simmoncitrate, TSI= Triple sugar iron

**Table :8 Numbers and the percentages of bacterial isolation affected agents antibiotic sensitivity from otitis externa in sheep**

| Antibiotics /µg                 | Bacterial species                            |   |  |                                 |   |  |   |  |   |  |  |
|---------------------------------|--|---|--|---------------------------------|---|--|---|--|---|--|--|
|                                 | <i>S.aur</i><br><i>eus</i><br>58<br>isolates | <i>S.epider</i><br><i>midis</i><br>16<br>isolates | <i>P.aerugi</i><br><i>nosa</i><br>22<br>isolates | <i>E.coli</i><br>10<br>isolates | <i>P.mira</i><br><i>bilis</i><br>16<br>isolates | <i>S.</i><br><i>pyogenes</i><br>20<br>isolates | <i>K.pneum</i><br><i>onia</i><br>12<br>isolates | <i>P.multa</i><br><i>cida</i><br>8<br>isolates | <i>M.haemoly</i><br><i>ticus</i><br>8<br>isolates | <i>Streptom</i><br><i>yces</i> spp.<br>6<br>isolates |  |
|                                 | N.<br>%                                      | N<br>%  | N.<br>%  | N.<br>%                         | N.<br>%   | N.<br>%  | N.<br>%   | N.<br>%  | N.<br>%   | N.<br>%  |  |
| Ampicillin 10                   | 6<br>27.58                                   | 10<br>62.5  | 3<br>13.6  | 8<br>80                         | 14<br>87.5                                      | 14<br>70                                       | 2<br>16.6                                       | 5<br>62.5                                      | 4<br>50   | 4<br>66.6  |  |
| Amikacin 30                     | 50<br>86.2                                   | 13<br>81.2  | 18<br>81.8                                       | 8<br>80                         | 14<br>87.5                                      | 18<br>90                                       | 8<br>66.6                                       | 8<br>100                                       | 8<br>100  | 5<br>83.3  |  |
| Clarithromycin 15               | 50<br>86.2                                   | 16<br>100   | 9<br>40.90                                       | 8<br>80                         | 12<br>75  | 15<br>75                                       | 9<br>75   | 7<br>87.5                                      | 5<br>62.5   | 5<br>83.3  |  |
| Gentamycin 10                   | 54<br>93.1                                   | 14<br>87.5  | 18<br>81.8                                       | 9<br>90                         | 15<br>93.7                                      | 14<br>70                                       | 8<br>66.6                                       | 8<br>100                                       | 8<br>100  | 4<br>66.6  |  |
| Amoxicillin 25                  | 16<br>27.58                                  | 10<br>62.5  | 8<br>36.36                                       | 7<br>70                         | 12<br>75  | 16<br>80                                       | 4<br>33.3                                       | 5<br>62.5                                      | 5<br>62.5   | 5<br>83.3  |  |
| Ciprofloxacin 5                 | 54<br>93.1                                   | 14<br>87.5  | 20<br>90.90                                      | 10<br>100                       | 16<br>100                                       | 20<br>100                                      | 8<br>66.6                                       | 8<br>100                                       | 8<br>100  | 6<br>100   |  |
| Cefotaxime 30                   | 24<br>41.37                                  | 14<br>87.5  | 18<br>81.8                                       | 10<br>100                       | 15<br>93.7                                      | 20<br>100                                      | 11<br>91.6                                      | 7<br>87.5                                      | 7<br>87.5   | 5<br>83.3  |  |
| Augmentin 30                    | 58<br>100                                    | 16<br>100   | 20<br>90.9                                       | 9<br>90                         | 16<br>100                                       | 20<br>100                                      | 11<br>91.6                                      | 7<br>87.5                                      | 8<br>100  | 6<br>100   |  |
| Trimethoprim+Sulfamethoxazol 25 | 57<br>98.2                                   | 16<br>100   | 4<br>18.18                                       | 10<br>100                       | 15<br>93.7                                      | 18<br>90                                       | 11<br>91.6                                      | 8<br>100                                       | 7<br>87.5   | 5<br>83.3  |  |
| Chloramphenicol 30              | 58<br>100                                    | 13<br>81.5  | 20<br>90.90                                      | 10<br>100                       | 15<br>93.7                                      | 20<br>100                                      | 12<br>100                                       | 7<br>87.5                                      | 8<br>100  | 5<br>83.3  |  |

## Discussion

The purpose of this study to determine the isolation and identification of bacterial and fungal species and antibacterial susceptibility test then compare this isolation pattern from both ears in bilateral otitis externa in sheep. Ear infection in calves and lambs has been associated with concurrent respiratory diseases, also the otitis in goat and sheep compared with the information on cattle and horses (16). the skin lining of the external ear canal has a large numbers of gland, these include modified porcine gland which produce large amounts of secretions which provide good suitable media for irritation and infection (1).The result appears that the total numbers in right infected ears were 104 isolates, while in left ears were 96 isolates, the result have no significant differences at  $P > 0.05$  between right and left infected ears. Many microbial infections commonly inhabit the ear canal and can become secondary opportunistic invaders when conditions are favorable (5). And it probably ascended from the pharynx through the auditive tube into the tympanic cavities (17). The most importance gram positive pathogenic bacteria was *Staphylococcus aureus* that isolated from both ears, while the most one of gram negative bacteria was *pseudomonas aeruginosa* (5) . As expected, low level of sensitive to Ampicillin 27.58 % was observed because of the  $\beta$ - lactamase enzyme produced by *Staphylococcus aureus* similar to that described in the literature (18, 19, and 20). *Pseudomonas aeruginosa* is this study sensitive to Ciprofloxacin, Augmentin and Chloramphenicol 90.90 %. Also polymyxin B ticarcillin ,or enrofloxacin , polymyxin B is inactivated by purulent debris and must be applied only in clean ears (21) , either acetic acid 2% is effective against *Pseudomonas* after 1 minute of contact time , higher concentrations of acetic acid may be irritating ,aluminum acetate is also effective against *Pseudomonas* when used topically(22). Ear medications are applied after cleaning and drying ,and is usually in form of ointment applied daily or twice daily for one or two weeks and the type of infection must be identified by the veterinarian by examining a sample of ear exudates under a microscope, since bacterial infection will only respond to antibiotics, fungal infection to a fungicide (23).

Management of chronic recurrent otitis externa requires diagnosis and control of predisposing factors with oral and topical antimicrobials.

## References

- 1- Thibodeau , G. A. and Patton, K.T. (1993).Anatomy and physiology. 2<sup>nd</sup> .St Louis, Mosby .
- 2-Betty, A.F.; Daniel, F.S. and Alice, S.W. (2007). Diagnostic Microbiology 12 ed Mosby Inc .,an affiliate of Elsevier Inc .56:837
- 3-Pugh, D.G. (2000). Sheep and Goat Medicine . 4<sup>th</sup> ed. Philadelphia : WB Saunders Com.
- 4-Ismail, S. F.(1994) . Studies on some surgical affections of the external ear in farm animals .Assuit Vet Med J 32:177-187 .
- 5-Harry , H.; Mada, C. and Rober, P. (2006). Update on antimicrobial susceptibilities bacterial isolates from canine and feline Otitis externa. Can Vet J 47:253-255.
- 6-Duarte, E.R. and Hamdan, J.G. (2004). Otitis in cattle, An etiology review .J.Vet. Med 5:1-7 .
- 7-Yeruham ,D. and Elad, M. L. (1999) . Clinical and Microbiological study of an Otitis Media outbreak in Calves in dairy herd J Vet Med 46:145-150
- 8-Lilenbaum, W.; Veras, M .; Blum, E. and Souza, G.N. (2000) . Antimicrobial susceptibility of *Staphylococci* isolated from Otitis in dogs Lett Appl Microbiology 31:42-45.
- 9 -Barrasa , J.L.M .; Gomez, P.L .; Lama, Z.G. and Junco, M.T. (2000) . Antibacterial susceptibility pattern of *Pseudomonas* strains isolated from chronic canine Otitis externa J Med Vet B 47:191-196 .

- 10- Cater, G.R. and Chengappa , M.M. (1993) . Microbial diseases. A Veterinarians Guide to laboratory diagnosis. Ames Iowa state University press 1 pp : 65-66 .
- 11-Quinn,P.J.; Carter, M.E.; Markey, B. and Carter, G.R. (1994) . Clinical Veterinary Microbiology .London :Wolfe , Mosby pp: 95-101 .
- 12-Koneman, E.W.; Stephan ,D.A. ; Dowell, J.R.and Somers, S.M. (1983). Color Atlas and textbook of Diagnostic Microbiology. Philadelphia: Lippincott .
- 13 -Jorgensen, J.H; Turnidge , J.D. and Washington, J.A.(1999) . Antibacterial Susceptibility test dilution and disk diffusion methods in manual of clinical Microbiology , 7 th . ed .ASM press, Washington.D.C.pp:152-1543 .
- 14- Baure, A.W.; Kirby,W.M. ; Sherris, J.C. and Turck, M.(1966).Antibiotic susceptibility testing by a standarized single disk method. Am.J.Chem. pathol.95 :493-49.
- 15 -Snedecor,G.W. and Cochran,W.G.(1968) . Statistical Methods .Iowa State Uni.Press .
- 16 -Opal ,S.; Cross, A. and Gemsk, I. P.K. (1982) . Antigen and serum sensitivity of rough Escherichia coli infect Immun 37;956-960 .
- 17 -Jensen, R.; Pierson, R.E. ; Weibel, J.L.;Tucker, J.O. and Swift, B.L. (1982) . Middle ear infection in feedlot lambs , J Am Vet Med Assoc 181; 805-807.
- 18-Lilenbaum, W.; Veras, M.; Blum ,E.and Souza, G.N.(2000). Antimicrobial susceptibility of Staphylococci isolated from otitis externa in dogs. Let Appl Microbiology.31; 42-45 .
- 19 – Hariharan, H.; Coles, M.; Poole, D.; Lund, I. and Page, R. (2006) Update on antimicrobial susceptibilities of bacterial isolates from canine and feline otitis externa . Can Vet J ,47:253-255.
- 20 -Farwachi, M. I. and Hassan, M .M. (2008) .Clinical and microbiological study of otitis externa in sheep .Iraqi journal of Vet Sci ,Vol. 22 ,No.1: 43-48.
- 21 -Logas, D.B. (1994) . Diseases of ear canal .Vet Clin North Am Small Anim Pract 24: 905-919.
- 22 – Teresa, C. and DeManuelle. (2001) .Advances in the treatment of Chronic Otitis Externa and Media in the dog. Bayer Selected Proceeding , TNAVC, January.
- 23-Shimizo, A.; Wakita ,Y.; Nagase, S. et al.(2001) .Antimicrobial susceptibility of Staphylococcus intermedius isolated from healthy and diseased dogs . J Vet. Med Sci ; 63 ;357-360.