

ROLE OF TRUEPERELLA PYOGENES (ARCANOBACTERIUM PYOGENES) IN GENITAL INFECTION IN DROMEDARY SHE-CAMELS WITH SPECIAL REFERENCE TO ITS HISTOPATHOLOGICAL LESION

By

Mona, A. El Shehedi¹; Thanaa, K. Hassanien²; and Madboli, M.M.³

¹Serology Unit and bacterial Strains Bank, Animal Health Research Institute, Dokki

²Pathology Department-Animal Reproduction Research Institute

³Camel Research Department-Animal Production Research Institute

E-mail: monashehedi@gmail.com

ABSTRACT

The present work was aimed to isolate and clarify the pathogenesis of *Trueperella pyogenes* (*T. pyogenes*) in pregnant she camels particularly its effect on the reproductive performance causing abortion. Pathological data available in the current literature regarding pyometra in dromedary camels due to *T. pyogenes* infection. 196 blood, nasal swab and tissue samples were collected aseptically from 176 she-camels for bacterial culture, serological identification and study the histopathological alterations and fluorescent technique. The samples were collected from dromedary she camels in three Egyptian governorates (Mattrouh, El-Sharkia and Giza). The bacteriological examinations revealed that *T. pyogenes* which isolated by percentage of (13.27%) were mainly responsible for the abortion. The experimental infection with the isolated bacterial strain were applied on pregnant New Zealand rabbit does to compare and confirm that, the abortion resulted in she camels were due to the natural infection with *T. pyogenes*. Antibiogram pattern was applied and the most effective drugs against the pathogen were Amoxicillin/clavulanic acid (100%), Cefotaxime (96.2%), Ampicillin (92.3%), and Ciprofloxacin (80.8%). The histopathological examination of the uterus and placenta of the aborted she camels revealed purulent endometritis and placentitis. Necrosis of hepatic tissues and interstitial bronchopneumonia with suppuration in the lung and intestine of aborted foeti were observed. Nearly similar lesions in the experimentally infected does were evident.

Keywords:

She-camels-*Trueperella pyogenes* (*Arcanobacterium pyogenes*) - Abortion - Bacteriological isolation -Antibiogram-Histopathology and fluorescent.

INTRODUCTION

Trueperella pyogenes formerly *Arcanobacterium pyogenes* (Addo and Dennis, 1977) are genus of 'Actinomyces pyogenes' (Reddy et al., 1982 and Ramos et al., 1997).

It is a gram positive, rod-shaped, β -hemolytic, no motile, no spore forming bacterium (Collins et al., 2006) cause a variety of pyogenic infections (Moore et al., 2010).

T. pyogenes is a group of bacteria which have been implicated in a range of infections in cattle including mastitis (suppurative mastitis called summer mastitis), suppurative metritis (Jost et al., 2002) and abortion (Zastempowska and Lassa 2012). As summarized by (Jost and Billington, 2005) it is able to cause diseases in various animal species, including camels. In one-humped camels *T. pyogenes* was isolated together with various other bacterial species from lung abscesses, liver and from arthritic joints, both mostly from juvenile camels (Al-Tarazi, 2001; Bani Ismail et al., 2007; Al-Tarazi et al., 2012 and Zuhair, 2017). *T. pyogenes* is a commensal and an opportunistic pathogen of economically important livestock where the infections are local or generalized depending on the immune status of the animal, their individual susceptibility and environmental factors, also, found in many reproductive diseases including vulvitis, vaginitis, metritis, placentitis and abortion so causes substantial economic losses in breeding and rearing. (Yassin et al., 2011 and Abd-Elrahman, 2013). Abortions can occur at any stage of gestation, but are most often observed during the last trimester (Jarosz et al., 2014). In addition, it may contaminate farm utensils or to be transmitted by biting flies (Radostits et al. 2007). The organism possesses a number of adherence mechanisms, including two neuraminidases, the action of which are required for full adhesion to epithelial cells, and several extracellular matrix-binding proteins, including a collagen-binding protein, which may be required for adhesion to collagen-rich tissue (winery, 1991). *T. pyogenes* also invades and survives within epithelial cells and can survive within macrophages for up to 72 hr (Riseti et al., 2017). That suggested the important role for *T. pyogenes* interaction with the host cells during pathogenesis (Jost and Billington, 2005). *T. pyogenes* is the most common one to be isolated from she camels with chronic and purulent endometritis (El-Sayed et al., 2008). *T. pyogenes* is not often present as a contaminant or commensal in tissues of aborted fetuses or their placentas, and thus, its presence is usually of significance. *T. pyogenes* is believed to reach the pregnant uterus by a hematogenous route and produces suppurative endometrial lesions; the fetus may become septicemic by transplacental transmission. Fetal death may be caused by hypoxia following placental destruction

(Nagib *et al.*, 2014 and Wareth *et al.*, 2014). Diagnosis of abortion induced by *T. pyogenes* is based on typical lesions and the isolation of the organism, preferably from the placenta, lung, abomasa and intestinal contents (Tzora *et al.*, 2001 and Levy *et al.*, 2009). The aim of the present study is to highlight the diversity of clinical manifestations caused by *T. pyogenes* infections in camel livestock and describe the main pathological alterations in three important governorates of Egypt (Mattrouh, El-Sharkia and Giza), as well as the antimicrobial sensitivity pattern of *T. pyogenes* cases in aborted she-camels, also, reinforces the importance of isolation and the performance of in vitro susceptibility testing to improve antimicrobial therapy approaches.

MATERIAL AND METHODS

1-Bacteriological examination:

Isolation and identification of isolates:

A total 196 samples (140 blood and nasal swabs, 56 tissue samples) were obtained from (176) she-camels (clinically normal, sick and aborted animals) were examined for isolation of *Trueperella pyogenes* where (56) tissue samples consisted of (36) from uterus and placenta of aborted she-camels after slaughtering and (20) from internal organs of aborted foeti (lung, liver and intestine). The samples were obtained from camel farms in Mattrouh and Sharkia governorates, also, slaughtered houses in Giza governorate. Each sample was obtained by using sterile cotton swabs, inserted in a sterile glass tube. Samples were taken directly for bacteriological examination. All nasal, whole blood samples, uterus and placenta of aborted she-camels and lung, liver and intestine of the aborted foeti were separated into 2 parts; first one was inoculated directly into nutrient broth for 24 hours at 37°C then sub cultured onto MacConkey's agar, blood agar. The inoculated plates were incubated at 37°C for 24-48 hours for isolation of *Trueperella pyogenes* and other part for other examinations.

Swabs from the uterine discharge and placenta were streaked on plates containing blood agar enriched with 5 - 6% sheep blood and incubated at 37°C for 24 h with further re-incubation for 36 - 72 h, if no growth was observed after 24 h. Single colonies of different types were picked on plates containing blood and on MacConkey's agar. The pure cultures were Gram-stained. Identification of bacterial agents was through cultural, morphological and in some cases biochemical characteristics according to (Finegold and Martin, 1982).

Positive Samples for bacteria other than *T. pyogenes* were excluded.

The diagnosis was later confirmed using Suspected colonies were tested biochemically using API 20 Coryne (Bio Merieux).

Antibiogram pattern:

Antibiogram was applied on the 26 isolated strains of *T. pyogenes* isolated from the suspected samples using in vitro disc diffusion technique according to (Quinn et al., 2011). It was performed on Mueller Hinton agar plates and 11 Discs of chemotherapeutic agents.

The used antibiotics included Amoxicillin/clavulanic acid (30 µg), Streptomycin (10µg), Trimethoprim/sulphamethazole(25µg),Norfloxacin (10 µg), Danofloxacin (5 µg), Cefotaxime (30 µg), Ciprofloxacin (5 µg), Enrofloxacin (5 µg), Gentamicin (10 µg), Oxytetracyclin (30 µg), and Ampicillin (10 µg). Measuring the diameter of inhibition zone produced and the results were interpreted according to (EUCAST, 2016).

2-Pathological Study:

Animals and samples:

The present work was carried out on dromedary she camels from Matrouh, Sharkiaand Giza governorates. The detailed data are recorded in (Table 1).

Tissue samples from the uterus and placenta were taken from the aborted she camels after slaughtering, also the internal organs of the aborted foeti (lung, liver and intestine). All tissues were washed, dehydrated by alcohol, cleared in xylene and embedded in paraffin. Tissues were sectioned at 3µ thickness and stained with H&E for microscopical examination according to (Bancroft and Stevens, 1990).

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Table (1): Number and Types of samples of camels collected from the target areas for detection of *T. pyogenes*.

Target area	Animal status		No. Of the camels	Type and No. of Samples			Total samples	Positive samples	
				Nasal swab and heparinized blood	Lung liver Intestine of aborted foeti	Uterus and placentas		No. of Positive samples	%* of Positive samples
Matruh Camel Center (APRD) Stations (28 animals)	Suspected cases	Clinically sick	22	22	-	-	22	5	22.7%
		Aborted she camel	14	14	-	-	14	2	14.3%
		Slaughtered she camel	9	-	-	9	9	1	11.1%
	Aborted foeti		-	-	11	-	11	2	18.2%
	Clinically normal		28	28	-	-	28	2	7.1%
	Total							12	14.3%**
Sharbia private camel farms in Bahig, Al-Sahele, Al-Adia	Suspected cases	Clinically sick	20	20	-	-	20	3	15%
		Aborted she camel	10	10	-	-	10	2	20%
		Slaughtered she camel	7	-	-	7	7	1	14.3%
	Aborted foeti		-	-	9	-	9	2	22.2%
	Clinically normal		26	26	-	-	26	2	7.7%
	total							10	11.8%**
Giza slaughtered houses	Suspected cases	Clinically sick	10	10	-	-	10	2	20%
		Slaughtered she camel	20	-	-	20	20	1	5%
	Aborted foeti		-	-	-	-	-	-	-
	Clinically normal		10	10	-	-	10	1	10%
	Total							4	10%**
Total numbers			176	140	20	36	196	26	13.27%***

*The percentage calculated according to the total no. of each type of samples.

**The percentage calculated according to the total no. of positive samples of each governorate.

***The percentage calculated according to the total no. of all examined samples.

Experimental Design:

Six pregnant New Zealand White does (3 - 4kg b.wt.) were used for the experimental infection of the isolated strain of *T. pyogenes* (*A. pyogenes*) to insure that, the pathological alterations of the affected tissues in the aborted she camels and aborted foetiis due to the natural infection with *T. pyogenes* and this by comparing the lesions in aborted she camels due to naturally infection with *T. pyogenes* and the lesions in experimentally infected pregnant does with the isolated bacterial strain of *T. pyogenes*. Rabbit does were divided into two Groups : Group (I) included 6 Does were anesthetized and inoculated with 1ml of isolated bacterial strain of *T. pyogenes* intrauterine (in both horns of uterus) by (the isolated strain, 10

TCID₅₀/ml) after 8 days of insemination. Group (II) consisted of 3 does which kept none infected along the whole period of experimental work and served as control according to (Archbald and Chen, 1985).

Direct immunofluorescent antibody technique (FAT):

It was used as a rapid confirmatory method to detect the presence of *T.pyogenes* in freezing cryostat sections of the placenta of infected she camels and lung of aborted foeti. It was done according to (Ghoniem *et al.*, 2011) using Staphylococcal protein- A conjugated with flourescein isothionate, where Staphylococcal protein-A is less expensive and more available.

RESULTS

1-Bacteriological results:

Our results revealed that (26) samples by percentage of (13.27%) were positive to *T.pyogenes* out of (196) whole samples which collected under investigation.

Antibiogram:

The most effective drugs against the pathogen were Amoxicillin/clavulanic acid (100%), Cefotaxime (96.2%), Ampicillin (92.3%), and Ciprofloxacin (80.8%). High resistance rates were observed against Oxytetracyclin (92.3%), followed by Danofloxacin (73.1%) and Norfloxacin (46.2%) as mentioned in (Table 2).

Table (2): Antimicrobial resistance of *Arcanobacterium pyogenes* isolates.

<i>Chemotherapeutic agent</i>	Antibiotic (concentration)	Sensitive isolates		Resistant isolates	
		No	%	No	%
Ampicillin	(10 µg)	24	92.3	2	7.7
Amoxicillin/clavulanic acid	(30 µg)	26	100	0	0
Ciprofloxacin	(5 µg)	21	80.8	5	19.2
Cefotaxime	(30 µg)	25	96.2	1	3.8
Gentamicin	(10 µg)	18	69.2	8	30.8
Enrofloxacin	(5 µg)	16	61.5	10	38.5
Norfloxacin	(10 µg)	14	53.8	12	46.2
Oxytetracyclin	(30 µg)	2	7.7	24	92.3
Trimethoprim /sulphamethazole	(25 µg)	16	61.5	10	38.5
Danofloxacin	(5 µg)	7	26.9	19	73.1
Streptomycin	(10µg)	18	69.2	8	30.8

2-Histopathological results:

Clinical Symptoms :clinically, the affected animals showed signs of illness such as fever, mucoid nasal discharge, increased respiratory and pulse rates, depression, dyspnea, anorexia with cases of abortion at fourth, sixth and tenth month of gestation among dromedary she camels in the governorates under investigations. From the whole observed animals in the examined selected farms there were subsequently 24 dromedaries she camels (10 animals in Sharkia farms) had pregnancy loss at fourth and sixth month of gestation and 14 animals in Matroh farms at sixth and tenth month of gestation.

Pathological examination of the uterus and placenta of aborted she- camels:

A-The uterus of aborted she camels infected with *T.pyogenes* showed edema and filled with pus. Microscopically the uterine tissue showed suppurative endometritis characterized by severe infiltration of live, dead neutrophils mostly subepithelialy. Some glands appeared shrunk, degenerated and surrounded by fibroblastic proliferations (Fig. 2). By higher magnification, the tissue of uterus showed liquefactive area of necrosis in the lamina propria and congestion with inflammatory cell infiltrations mainly neutrophils and lymphocytes in the endometrial stroma (Fig.3).

B-Placenta of aborted she camel infected with *T. pyogenes* showing the trophoblastic cells are detached from the surface of the fetal placenta and placental villi.

The inter villus space contains abundant necrotic cellular debris, some macrophages and neutrophils. The villous connective tissues are thickened and hyalinized (Fig. 4). By applying the fluorescent technique on the placental tissue of aborted she camel it showed positive fluorescence against *T. pyogenes* in the covering epithelium of the placental villi and the trophoblastic cells (Fig. 5).

C-Pathological examination of the internal organs of the aborted foeti:

Grossly: the aborted camel foeti infected with *T. pyogenes* at sixth and tenth month of gestation showed edema and congestion of the body surface. Other aborted camel fetus at fourth month of gestation appeared with its umbilical cord, fetal membranes and detached placenta (Fig.6).

Macroscopical examination of the lung of aborted foeti showed emphysema; congestion and containing multiple small abscesses inside the lung tissue appeared by cut section (Fig.7).

Microscopically, the lung showed broncho interstitial pneumonia; bronchitis and thickening of interstitial tissue due to mononuclear inflammatory cell infiltrations and activation of

bronchus associated lymphocytic infiltration (BALT) (Fig.8). the area of multiple small suppuration showed degenerated bronchiolar epithelium and the alveolus lined by degenerated epithelial cells (vacuolar) and surrounded by a fibrous tissue proliferation. Cellular exudates consist of cell debris, lymphocytes and neutrophils appeared in the lumen of the alveoli and surrounded with fibrous connective tissue (Fig.9). Microscopical examination of the liver of aborted camel fetus revealed severe edema and autolyzed dark brownish organ. Microscopically: the liver showed necrosis of hepatocytes with intensive inflammatory cell aggregations in and around the portal area (Fig.10).

Macroscopical examination of the intestine of aborted camel fetus showed congestion, edema and cut section showed oozing of whitish exudation (Fig.11). Microscopically the intestine showed degeneration and necrosis of the intestinal villi and glands with diffuse aggregation of inflammatory cells mainly neutrophils and lymphocytes (Fig.12).

D-Pathological Findings in the experimentally infected does with isolated strain of *T.pyogenes*:

The appeared clinical signs in the inoculated does included abortion at 22nd day and 26th day of gestation with dead, autolysis and incomplete growth of the foeti (Fig.13). Moreover, there was a rise in body temperature with signs of nasal discharge, inappetence and loss of weight.

Microscopical examination of the aborted doe uterus showed purulent endometritis with wide spread area of liquefactive necrosis with severe infiltration of mononuclear cells and neutrophils in the stratum compactum with degenerated endometrial glands Fig. (14). Higher magnification of the purulent exudation showed severe infiltration of mononuclear cells and neutrophils in the uterine tissue Fig. (15). The placenta of aborted rabbit- doe showed diffuse necrosis of the placental tissue and chorioallantoic villi associated with abundant cellular debris and inflammatory cell infiltrations (Fig. 16). The pathological alterations in the lung included bronchointerstitial pneumonia and the found lesions were similar to those observed in aborted camel calf.

DISCUSSION

Reproductive losses in camelids are due to infertility, pregnancy loss and neonatal mortality caused by a variety of infectious diseases (Tibary *et al.*, 2006). In the present study the animals showed reproductive tract infections, reinforcing the involvement of *T. pyogenes* as a causative agent of abortion in dromedary she camels. In the present study the authors will describe the main pathological alterations and clinical aspects in three important Egyptian

governorates, as well as the antimicrobial sensitivity pattern of *T.pyogenes* cases in the aborted she-camels. Clinically affected animals showed signs of illness such as fever, mucoid nasal discharge, increased respiratory and pulse rates, depression, dyspnea and anorexia. The same signs were also recorded in other investigation carried by **Al-Tarazi, (2001) and Songer and Post (2005)**.

Tibary, 2006 and Moore et al., 2010 mentioned that *T. pyogenes* gains entry to the bloodstream causing endometritis and placentitis. The authors recorded also diffuse reddish brown to brown color. The fetus was usually autolyzed with fibrinous pericarditis; pleuritis and bronchopneumonia that may be evident on histopathology. However, it is better to culture from the placenta or abomasum contents. The present results were parallel with the previously mentioned ones. Abscesses at the internal organs are among the most prominent emerging problems of camels causing considerable losses in production and varying mortality rates. Those findings were only detected after the affected animals were slaughtered (**Bekele, 2014**). In addition, the pyogenic infections in animals are also important from the point of view of the economics of production. The most common consequence of those infections in farming is the culling of animals, as a result of the development of a generalized purulent process and in connection with reproductive disorders, leading to a reduction in reproductive rates, and thus a decline in profitability (**Silva et al. 2008**) and the present study insures those opinions. Due to opportunistic behavior of the micro-organism, several routes of transmission are possible and the virulence of *T. pyogenes* is attributed to several mechanisms related to tissue damage. Moreover, neuraminidases, fimbriae and collagen-binding protein are also involved in the pathogenicity and associated to mucosal adherence and colonization (**Jost and Billington 2004**). Thus, the problems associated with infection of *T.pyogenes* infections during pregnancy are complex. When pregnant camels are at risk of acquiring *T.pyogenes* infections resulting in abortion. There were at least two factors associated with the bacteria and two associated with the pregnant animal that contribute to the vulnerability of the host to infection and disease. The two bacterial factors are immunosuppression and strain variation while the two host factors are the immune status of she camel entering pregnancy and the physiologic immunosuppression which occurs during pregnancy. Relatively few studies have focused on the localization of the bacteria in the genital organs from infected animals such as uterus, placenta (**Winery and Ruger, 2002**). In our study, by comparison the natural isolated strain in infected she-camel and experimentally infected does similar gross and microscopic

lesions induced such as purulent endometritis to necrotic placentitis also the suppurative inflammation in the intestine of aborted fetuses of naturally infected she camels and the experimentally infected does with the isolated strain, our results come in agreement with **Brodzki et al., 2014**). The present study showed that *T. pyogenes* cause neutrophilic and mononuclear cell infiltrations in the superficial lamina propria of mucosa of uterus with congestion of most blood vessels of the mucosa of uterus. Those findings were previously recorded on *T.pyogenes* in cases with mastitis in sheep (**Abd-Elrahman, 2013**), in purulent enteritis in swine (**Jarosz et al., 2014**) and postpartum uerine infections in cow (**Ruder et al., 1981 and Nagib et al., 2014**). The histopathological examination of aborted placenta in current work revealed necrosis of epithelial cell covering of chorioallantoic villi in addition to accumulation of cellular debris and inflammatory cell infiltrations, these results were in agreement with previous recorded findings by (**Powers et al., 1990; Semambo et al., 1991 and Zubair et al., 2004**). These authors concluded that fetal death was due to loss of intimate contact between the fetal and maternal placental layers due to thrombosis of blood capillaries leading to hemorrhage, necrosis and inflammatory changes within the villi with subsequent degenerative changes in the trophoblast cells and loss of chorionic epithelium. Moreover, the intestine with necrosis of intestinal glands were recorded in the present work were also reported by (**Levy et al., 2009 and Moore et al., 2010**). *T. pyogenes* was often isolated from the abscesses in the lungs of ruminants, pigs and sometimes people and with Klebsiella spp. and Pseudomonas aerogenosa in nodular-like suppurative pneumonia (**Zubair et al., 2004**). However, (**El-Tigani et al., 2004; Zubair et al., 2004 and Tibary, 2006**) stated that in cases of stress, poor sanitation, and immunosuppression pneumonia in camels such symptoms may be involved. Such results are in agreement with the present study. The knowledge on *T. pyogenes* infections among domestic animals is fragmented and restricted to the report of cases or outbreaks by **Moore et al., (2010)**. Thus several studies were focused on bacterial pathogens as possible causative agents of abscesses in camels (**Zubair et al.,2004 and Aljameel et al., 2014**). Such results agree with the present result.

CONCLUSION

Camels harbor potentially pathogenic agents in their lower respiratory tract that can pose threat to camels, other domestic animals and livestock or even human population. Therefore, there may exist a need to control trans-border movements of camel to ensure camel health in Egypt so this study highlights the diversity of clinical manifestations caused by *T. pyogenes*

infections in camel livestock, and reinforces the importance of isolation and the performance of in vitro susceptibility testing to improve antimicrobial therapy approaches. Finally we could be concluded that the dromedary she camels are susceptible to natural infection with *T. pyogenes* causing abortion and rabbit does are susceptible to experimental infection with the isolated strain, also, uterine infection of she camels should examine periodically to determine the causative bacterial agents and do their antibiogram pattern for isolated microorganisms which will facilitate applying the suitable treatment.

REFERENCES

- Abd-Elrahman, A.H. (2013):** Mastitis in housed dairy buffaloes and sheep: incidence, etiology, clinical finding, antimicrobial sensitivity and different medical treatment. *Life Sci. J.*, 10 (1): 532-538.
- Addo, P.B. and Dennis, S.M. (1977):** Corynebacteria associated with diseases of cattle, sheep and goats in northern Nigeria. *Br. Vet. J.*, 133: 334 -339.
- Aljameel, M.A.; Halima, M.O.; El-Tigani, A.E.; Abdalla, A.S. and Abdellatif, M.M. (2014):** Liver abscesses in dromedary camels: Pathological characteristics and aerobic bacterial etiology. *Open Veterinary Journal*, Vol. 4 (2): 118-123
- Al-Tarazi, Y.;Hijazin, M.;Alber, J.;Lammler, Ch.; Ahmed, H.A.;Timke, M.;Kostrzewa, M.; Prenger-Berninghoff, E.and Zschock,M.(2012):** Phenotypic and genotypic characteristics of *Trueperella* (*Arcanobacterium*) *pyogenes* isolated from lung abscesses of one-humped camels (*Camelusdromedarius*). *Clin. Microbiol. News* 28: 163 -167.
- Al-Tarazi Y. (2001):** Bacteriological and pathological study on pneumonia in the one-humped camel (*Camelusdromedarius*) in Jordan. *Rev. Elev. Med. Vet. Pays. Trop.*, 54, 93-97.
- Andrea, T. F.; Stefan, S.Z.; Frank, M.A.; Jianzhong, S. and Lina, C. (2017):** Antimicrobial Resistance in *Corynebacterium* spp., *Arcanobacterium* spp., and *Trueperella pyogenes*. *Microbiolspec* Vol. 5 no. 6 .
- Archibald, L.F. and Chen, C.L. (1985):** Effect of some bacteria and viruses on genital and digestive system of New Zealand rabbits. *Theriogenology*, 23 (5):787-93.
- Bancroft, J. D. and Stevens, A. (1990):** *Theory and Practice of histological Techniques*.3rd edition, New York.
- Bani Ismail, Z.; Al-Rukibat, R.; Al-TaraziY. and Al-Zghoul, M.B. (2007):** Synovial fluid analysis and bacterial findings in arthritic joints of juvenile male camel (*Camelusdromedarius*) calves. *Physiol. Pathol. Clint. Med.*, 54, 66-69.
- Bekele, M. (2014):** Major Diseases of Camel Calves in Barona of Southern Ethiopia. *African Journal of Basic and Applied Sciences* (6): 159 -165.

- Brodzki, A.; Bochniarz, P.M.; Wrona, Z. and Wawron, W. (2014):** Trueperella pyogenes and Escherichia coli as an etiological factor of endometritis in cows and the susceptibility of these bacteria to selected antibiotics. Pol J Vet Sci.; 17 (4):657 - 64.
- Collins, M. D.; Jones, D.M. and Schleifer, K. H. (2006):** proposal for Trueperella gen. Nov. and emended description of the genus Arcanobacterium. Int. J. Syst. Evol.Microbiol,61:1265 - 1274.
- El-Tigani, A.Abdulkhalig, B. and Adam, A. (2004):**Studies on Pathological changes of condemned lungs of One-humped camels (Camelusdromedarius). Rural Poverty Reduction through Research for Development, Deutscher Tropentag, October 5-7, Berlin.
- EL-Sayed, A.; Ahmed, S. and Awed, W. (2008):** Do camelus (camelus dromedaries) play an epidemiological role in the spread of shiga toxin producing Escherichia coli (STEC) associated with Arcanobacterium pyogenes infection.Trop.Anim.Health.Prod.Aug. 40 (6):469 - 473.
- EUCAST (2016):** The European committee on Antimicrobial susceptibility testing, European Society of clinical microbiology and infectious diseases Breakpoint tables for interpretation of MICs and Zone diameter Version 6.
- Finegold, S.M. and Martin, W.J. (1982):** “In Diagnostic Microbiology” 6th Ed. The C.V. Mosby Company, U.S.A.
- Ghoniem, H.A., Saad, A. M., Hala, A. S., Ibrahim, A. A. (2011):** Staphylococcus aureus protein-A as a rapid and sensitive test in comparative with other serological tests for detection of Rift valley fever antibodies in vaccinated camels. B.S. Vet. Med. J. 21:67-72.
- Jarosz, Z.; Gładzki, M. and Kalinowski, F. (2014):** Trueperella pyogenes infections in swine: clinical course and pathology. Polish Journal of Veterinary Sciences Vol. 17, No. 2,395 - 404.
- Jost, B. H. and Billington, S. J. (2004):** Corynebacterium and Arcanobacterium. In Pathogenesis of Bacterial Infection in Animals, 3 rdedn, pp. 77- 86. Edited by C. L. Gyles, J. F. Prescott, J. G. Songer and C. O. Thoen. Ames, IA: Blackwell Publishing.
- Jost, B. H. and Billington, S. J. (2005):** Arcanobacterium pyogenes: molecular pathogenesis of an animal opportunist. Antony Van Leeuwenhoek 88, 87-102.
- Jost, B.H., Songer, J.G. and Billington, S.J. (2002):** Identification of a second Arcanobacterium pyogenes Neuraminidase and Involvement of Neuraminidase Activity in Host Cell Adhesion. Infect. Immun.106:112.
- Levy, C.E.; Pedro, R.J.; Nowakonski, A.V.; Holanda, L.M.; Brocchi, M. and Ramo, M.C. (2009):** Arcanobacterium pyogenes Sepsis in Farmer, Brazil. J. Emerg. Infect. Dis., 15: 1131-1132.
- Moore, R.; Miyoshi, A.; Pacheco, L.G.; Seyffert, N. and Azevedo, V. (2010):** Corynebacterium and Arcanobacterium. In: Pathogenesis of Bacterial Infections in Animals. C.L. Gyles, J.F. Prescott, G. Songer and C.O.Thoen. Wiley-Blackwell publ., Oxford, United Kingdom, 133 - 147.

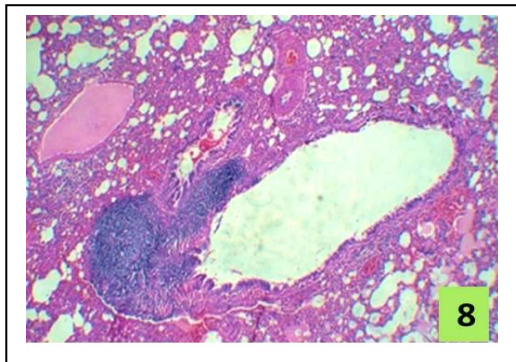
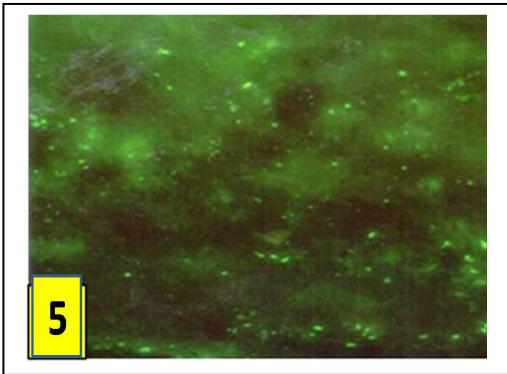
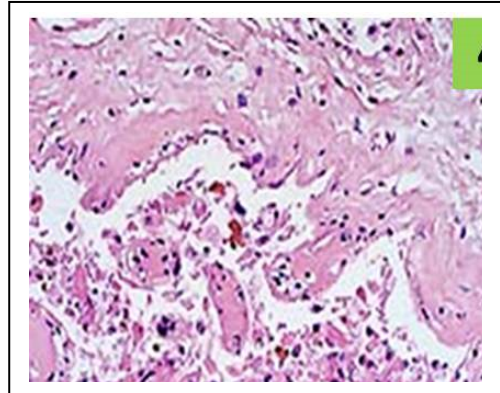
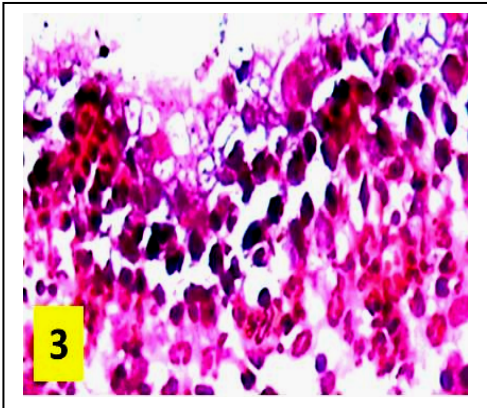
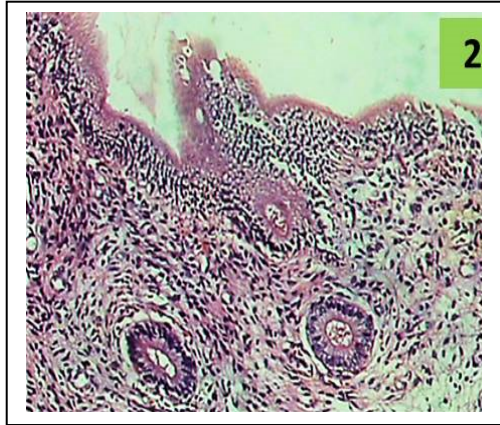
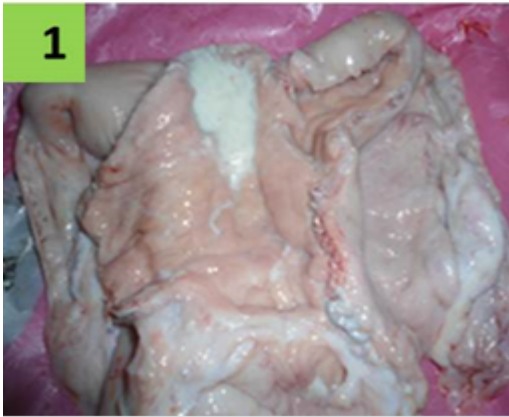
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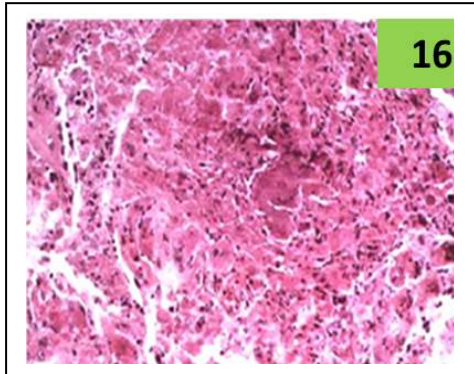
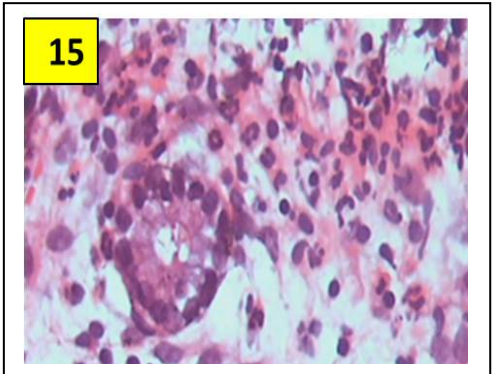
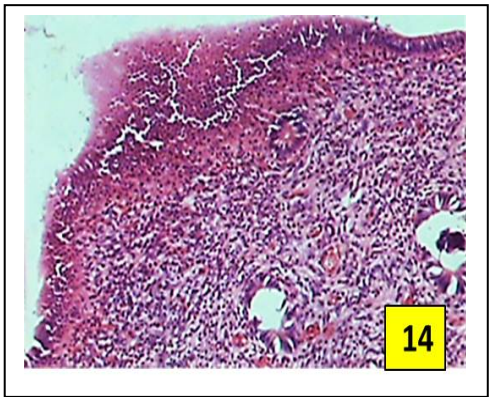
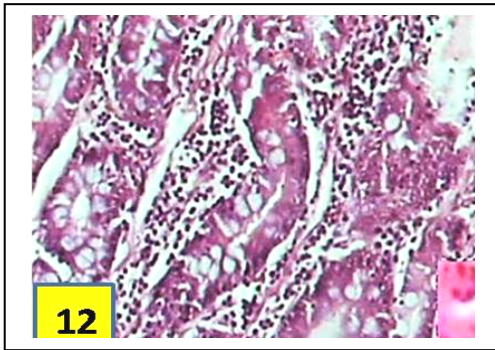
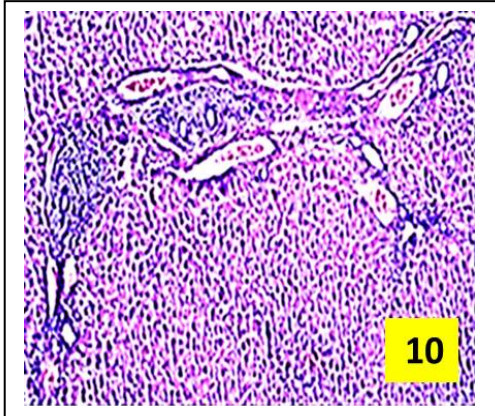
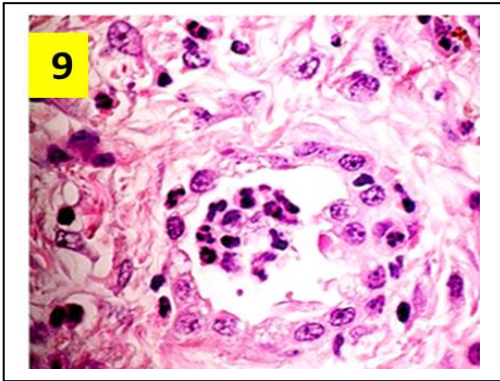
- Nagib, S.; Rau, J.; Sammra, O.; Lammler, C.; Schlez, K.; Zschock, M.; Prenger-Berninghoff, E.; Klein, G. and Abdulmawjood, A. (2014):** Identification of *Trueperella pyogenes* isolated from bovine mastitis by fourier transform infrared spectroscopy. PLoS ONE 9 (8): e104654. Doi: 10.1371 / journal. Pone. 0104654.
- Powers, B.E.; Johnson, L.W.; Linton, L.B.; Garry, F. and Smith, J. (1990):** Endometrial biopsy technique and uterine pathologic findings in llamas. J. Am. Vet. Med. Assoc. 197, 1157-1162.
- Quinn, P.J.; Markey, B.K.; Leonard, F.C.; Fitzpatrick, E.S.; and Fanning, S. (2011):** Veterinary microbiology and microbial disease. UK: Wiley-Blackwell; p. 245 - 257.
- Radostits, O.M.; Gay, C.C.; Hinchcliff, K. W. and Constable, P.D. (2007):** Veterinary medicine: a textbook of the diseases of cattle, horses, sheep, pi Songer and Post 2005. p. 84 - 91.
- Ramos, C. P.; Foster, G. and Collins, M. D. (1997):** Phylogenetic analysis of the genus *Actinomyces* based on 16S rRNA gene asequences: description of *Arcanobacterium phocae* sp. Nov., *Arcanobacterium bernardiae* comb. Nov., and *Arcanobacterium pyogenes* comb. Nov. Int.JSystBacteriol 47, 46 -53.
- Reddy, C.A.; Cornell, C. P. and Fraga, A. M. (1982):** Transfer of *Corynebacterium pyogenes* (Glage) Ebersson to the genus *Actinomyces* as *Actinomyces pyogenes*. Int. J. Syst. Bacteriol. 32:419 - 429.
- Risseti, R. M; Zastempowska, E. and Twarużek, M.(2017):**Virulence markers associated with *Trueperella pyogenes* infections in livestock and companion animals,” Letters in Applied Microbiology, Vol. 65, No. 2, pp. 125 - 132.
- Ruder, C.A.; Sasser, R.G.; Williams, R.J.; Ely, J.K.; Bull, R.C. and Butler, J.E. (1981):** Uterine infections in the postpartum cow. II. Possible synergistic effect of *Fusobacterium necrophorum* and *Corynebacterium pyogenes*. Theriogenology; 15: 573-580
- Semambo, D.K.; Ayliffe, T.R.; Boyd, J.S. and Taylor, D.J. (1991):** Early abortion in cattle induced by experimental intrauterine infection with pure cultures of *Actinomyces pyogenes*. Vet. Rec.; 129: 12-16.
- Silva, E.; Gaivao, M.; Leitao, S.; Jost, B.H.; Carneiro, C.; Vilela, C.L.; Lopes , L. and Mateus, L. (2008):** Genomic characterization of *Arcanobacterium pyogenes* isolates recovered from the uterus of dairy cows with normal puerperium or clinical metritis. Vet. Microbiol 132: 111-118.
- Songer, J.G. and Post, K.W. (2005):** Veterinary microbiology. Bacterial and fungal agents of animal disease. St Louis: Elsevier Saunders; p. 84 -91 .
- Tibary, A.; Fite, C.; Anouassi, A. and Sghiri, A. (2006):** Infectious causes of reproductive loss in camelids. Theriogenology August; 66 (3): 633 - 47.

- Tzora, A.; Leontides, L.S.; Amiridis, G.S.; Manos, G. and Fthenakis, G.C. (2001):** Bacteriological and epidemiological findings during examination of the uterine content of ewes with the retention of fetal membranes. *Theriogenology*, 57: 1809 - 1817.
- Wareth, G.; Murugaiyan, J.; Khater, D. F. and Moustafa S. A. (2014):** Subclinical pulmonary pathogenic infection in camels slaughtered in Cairo, Egypt. *The Journal of Infection in Developing Countries*, Vol. 8, No. 7, pp. 909 - 913.
- Winery, J. (1991):** The barren camel with endometritis isolation of *Trichomonas Fetus* and different bacteria. *J. Vet. Med. B.* 38, 523-528.
- Winery, U. and Ruger, K. O. (2002):** *Infectious Diseases in Camelids*. 2 nd Ed., Blackwell Wissenechafts .Verlag, Berlin. Vienna.
- Yassin, A.F., Hupfer, H., Siering, C. and Schumann, P. (2011):** Comparative chemotaxonomic and phylogenetic studies on the genus *Arcanobacterium* Collins *et al.*1982 emend. Lehn *et al.* 2006: proposal for *Trueperella* gen. Nov. and emended description of the genus *Arcanobacterium*. *International Journal of Systematic and Evolutionary Microbiology*. 61, 1265 - 1274
- Zastempowska E and Lassa H. (2012):** Genotypic characterization and evaluation of an antibiotic resistance of *Trueperella pyogenes* (*Arcanobacterium pyogenes*) isolated from milk of dairy cows with clinical mastitis. *Vet Microbiol* .Jul. 20.
- Zubair, R.; Khan, A.M.Z. and Sabri, M.A. (2004):** Pathology of Camel Lungs. *J.Camel Sci.*, 1: 103-106.
- Zuhair, B.I. (2017):** Pneumonia in dromedary camels (*Camelusdromedarius*): a review of clinicpathological and etiological characteristics.vol.24 No 1, p 49-54.

ROLE OF TRUPEPERELLA PYOGENES

Figures:





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