BACTERIAL BOVINE MASTITIS IN IRAQ: A REVIEW

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ABSTRACT

Bacterial mastitis is one of the most important diseases in high-production dairy cows which causing high economic losses however it effect on the dairy industry, resulting in the decline Dairy industry and quality, furthermore the cost of treatment. The annual losses due to mastitis are approximately 184 U.S $ for each animal. Usually during milking, infectious microorganisms are the major source of infection between healthy and infected udder quarters. Environmental pathogens are found in the enclosing area of the cow, such as the bedding of housing cows, soil and the waste product of the animals which contain Streptococcal strains other than *S. agalactiae*, *Enterococcus faecalis* and *Enterococcus faecium* and coliforms. Bacteria which involved in the udder inflammation process show high resistance to antibiotics. The aim of this review article was to establish the bacterial causes of clinical and subclinical mastitis in Iraq, and recognize its sensitivity to antibiotics, then find proper solutions for the treatment and control of mastitis.

INTRODUCTION

The term mastitis derived from the Greek word for masto- which means mammary gland and -itis means inflammation (1). Mastitis in cow is most important economic diseases impacting to the dairy industry, leading to economic losses, which due to reduction of milk yield, a change in the quality of milk, loss of milking days, a decrease in price of milk, in addition to an increase in the cost of treatment as well as an impact on dairy quality (2,3). Several estimates indicate that the affected quarter reduced productivity by 30% and the affected cow reduced 15% of its milk production for lactation (4).

Mastitis means inflammation of the parenchyma of mammary gland, due to physiological and metabolic alterations, trauma and chemical irritants. Inflammation is categorized by physical and chemical alterations in the milk with the presence of large numbers of different types of bacteria in it, in addition to the pathological changes of the mammary glands themselves, resulting from changes in the properties and components of natural milk in terms of taste, color, smell, and increasing in somatic cells especially leukocytes in milk (5).

Microbes causing mastitis are differ according to the host and invasive pathogen factors, in general, the distinctive appearance of the inflammatory response, udder swelling, hotness pain and loss of functions, which include milk shortage, and inflammation as a result of the invasion the udder by microorganisms that enter through the teat, circulation or through the skin after penetrating the natural barriers inside the teat canal (6,7).

The microorganisms multiply after interring the mammary gland causing inflammation that determines the type of bovine mastitis. According to clinical feature mastitis can classify to two forms: subclinical and clinical of mastitis.

1- Clinical mastitis are classify according to the stage of the disease to per acute, acute, subacute and chronic.

- Per acute mastitis: sever inflammation with swelling, heat and pain of the quarter, with a marked systemic reaction, which may be fatal (6).

-Acute mastitis: severe udder inflammation without a marked systemic reaction (8).

-Sub-acute mastitis: mild udder inflammation with persistent abnormality of the milk, appearance of flakes in it, and may become painful on palpation (6).

-Chronic mastitis: indurations of the gland, atrophy with no systemic reaction or continuous changes in the physical features of milk that contain pus, flakes, clots, or aqueous appearance were considered a most typical features of this type of mastitis (9).

Generally, Clinical mastitis is illustrated by occurs suddenly, redness, swelling of udder with high temperature and pain, a decrease in milk production in affected quarters and

watery milk, or it may contain clots or flakes in consistency and accompanied by fever, anorexia and depression (6).

2- Subclinical mastitis does not show any obvious signs in the udder and milk (10), although it is related with decreased milk yield and an increase in the Somatic cell count (SCC). First lactation heifers appear less impact than in older lactating animals. Generally, there is a negative relationship occur between Somatic cell count and milk production (11).

Milk from normal quarters usually contains about 200,000 somatic cells/ml. But the value of Somatic cell count exceeding 300,000 is considered abnormal and indicated to the udder inflammation (mastitis). The losses caused by mastitis in the dairy industry reached 526 million U.S $, of which the subclinical form was exposed to 70% of these losses (12).

Different environmental and pathogenic microorganisms cause mastitis, including both of gram positive and negative bacteria, Mycoplasmas, Prototheca and Fungi (13). The most common causative agent of mastitis are bacteria, which transmitted from infected mammary glands to healthy glands in several ways, including milking hands, contaminated milking machines and infant calves (14).The main bacterial causes of this inflammation are *Staphylococcus aureus*, *Streptococcus agalactiae*, *Streptococcus dysagalactiae*, *Corynebacterium bovis* and *Mycoplasma spp*. Infectious etiology is more prevalent than other bacterial etiology and causes clinical mastitis (15).

There are some types of bacteria that colonize the teat canal and cause sub-clinical infections or mild clinical diseases called secondary causes, including Coagulase-Negative Staphylococci (CNS) and *Corynybacterium bovis* (6). The causative agent of mastitis are divided into two parts according to the source of infection:

CONTAGIOUS PATHOGENS:

Usually adhering to the epithelial cells of mammary tissue or become intracellular, to prevent themselves from the mechanisms of intramammary host defense. Contagious pathogens which comprise *Staphylococcus aureus*, *Streptococcus agalactia*, *Streptococcus dysgalactia*, *Corynebacterium bovis*, and *Mycoplasma bovis*. These microorganisms cause an

epidemic disease that spreads rapidly in the herd and consider as most common causes of clinical mastitis and can transmit from an infected animal to healthy one (6,16).

ENVIRONMENTAL PATHOGENS:

About 90% of the pathogens responsible for mastitis are environmental (17), which is found around the udder and reach the udder through the teat, and increased when predisposing factor where available, such as humidity, stress and crowded animals. The environmental pathogens for bovine mastitis were included Gram-positive bacteria, *S. uberis*, *Enterococcus faecalis*, *E. faecium* , *Staph. equinus* ,Mycobacterium and Gram-negative bacteria, *Escherichia coli*, Serratia, Klebsiella, *Pseudomonas aeruginosa* and Enterobacter (18).

1- GRAM POSITIVE BACTERIAL MASTITIS:

a. *Staphylococcus* spp.

In Iraq many studies indicated that *Staphylococcus aureus* was the predominant organism on clinical bovine mastitis, in one of these studies (19) showed that 18/20 (90%) of his isolates was *S. aureus*. Some studies were in agreement results which isolated it in proportion (55%-57.5%) (20,21,22,23,24), whereas other studies isolated it in different percentage (45.9%, 42.45%, 35.7%, 33.33%, 32.5%, 32%, 23%, 23.2%, 16.9%) (25,26,27,28,29,30, 31,32,33). Most of these isolates having some of the virulence factors, including, capsules, production of coagulase enzyme and enterotoxin (20, 25), *S. aureus* also isolated from subclinical mastitis in cow in varying proportions (45.33%, 44%, 38.9%, 33.87%, 32.5%, 10.12%), as studies of (34,35,36,37,38, 31) respectively.

These variations may be referred to differences in breeds, seasonal variation and geographical distribution from south to north of Iraq . All of these incidences indicate to the substantial value concerning the economic losses and public health prominence of the disease in different regions of Iraq.

Coagulase-negative Staphylococci (CNS), also isolated in some studies from clinical mastitis, as (33, 39,40,41) showed in varying proportions (8.9%, 22.2%, 21.5%, 20%) respectively, which included: *S. scuiri*, *S. lentus*, *S. gallinerum*, *S. warneri*, *S. xylosus*, *S. lugdunesis*, *S. heamolytica*, *S. chonii*, *S. hyicus*, *S. saprophyticus*, *S. intermedius* and *S. epidermidis*.

Although CNS bacteria are considered secondary causes of mastitis, some publication have been proven the ability of CNS to stay for a long time in mammary glands without unchanged in its microbial state during the period of milking, and they indicated that the bacteria *S. haemolyticus*, *S. intermedius* and *S. chromogenes* have the ability to escape from Immune system and stay in the glands for a long time, causing chronic mastitis (42), in addition to the finding of (40) they showed that some isolates of CNS bacteria have the ability to produce some virulence factors such as DNase, Urease, Protease, Lecithinase, Lipase, Gelatinase, β- Lactamase and Haemolysin ,this study agree with (43).

The study of (44) indicate that there is a great similarity between the external proteins produced by *S. aureus* and those of the *S. haemolyticus*, *S. epidermidis* and *S. saprophyticus* and they suggest that they can be important virulent factors in human and animal infections, thus CNS can be considered as a pathogenic bacteria, and this has been confirmed by numerous studies indicated that these external enzymes combined have a role in the pathogenicity of these bacteria (44).

In one studies were done at Basrah city(45) showed the effect of lysostaphin extracted from *S. simulans* isolated from bovine mastitis against *S. aureus*, the effect of lysostaphin as antibacterial against *S. aureus* in vitro, which gave good zone of inhibition on solid media. The effect of lysostaphin against *S. aureus* in vivo also studied by experimental infection in cow mammary glands, the lysostaphin presented important effect as an antibacterial agent, the histological studies exhibited the significant effect of lysostaphin to prevent the growth of *S. aureus* in mammary glands (45).

b. *Micrococcus* spp.

The studies of (43) indicated to isolate *Micrococcus* spp. from sub clinical mastitis in (3.1%), in addition to isolated it in another study from bovine mastitis (46).

c. *Streptococcus* spp.

The present study showed that streptococcal bacteria as important pathogens in both, clinical and subclinical mastitis. *Streptococcus agalactiae* is classified as one of the most important pathogens caused mastitis in cows, it was formed (22.2%, 18.6%) from clinical and subclinical mastitis respectively in study of (27). The finding of (33,38) indicates that (17.74%, 18.3%) of her isolates were *Strept. agalactiae* from clinical and subclinical mastitis respectively. In addition to the study of (47) indicated that *Strept. agalactiae* formed (13.2%) from bovine mastitis (73.3% sub clinically and 26.6 clinically).

Strept. agalactiae is the predominant species than other streptococcal bacteria in cases of bovine mastitis because they are commensals on the skin and causes frequent colonization of teats. Then they can easily transmitted to the teat canal during suckling or milking and transmit from cow to cow during milking. They resistant to antibiotic because of their ability to remain intra cellular and localize within micro abscessation in the mammary gland (48).

The finding of (22, 31,23**)** were isolated *Streptococcus* spp. from clinical mastitis in percentage (45%, 16.56%, 5.5%) respectively. Whereas it formed (11.42%, 8.28%) from the cases of subclinical mastitis (29,32). Another type of streptococcus included: *Streptococcus. dysgalactiae* which formed (9.2%, 4.84%) from bovine mastitis (49,37), and *Streptococcus. uberis* formed (5.1%, 2.4%, 1.6%) from clinical mastitis (49,32,33) but formed (11.29%) from subclinical mastitis (37).

d. *Enterococcus* spp.

This type of bacteria is found in the intestine naturally and is excreted into the environment with feces, thus contaminating the udder and can enter through teat orifice and lead to mastitis (50). Two types of Enterococcus were isolated at a first time in Iraq included: *E. columbae* and *E. cloac dissolvent* which isolated by (51)at Al-Qadisiyah province , his study indicates that mastitis has new causative agents due the progress of the bacterial

variations through the last decades especially as a result of mutations and antibiotic resistance.

e. *Granulicatella elegans*

G. elegans is gram-positive bacteria also isolated at first time in Iraq (51). Was first described in 1998 as oxidase-negative, catalase-negative, facultative anaerobic, non-motile, gram-positive bacteria, pleomorphism with Gram staining. Forms range from bacilli in simple media to short chains cocci in enriched media (52).

f. *Arcanobacterium pyogenes*

Some publication indicated that *A. pyogenes* is a causative agent of clinical mastitis and its formed (14.3%, 5.95%, 9.3%) in studies of (27, 22,41) respectively. Another finding indicated to the existence a relationship between mastitis and metritis in cows resulting from *A. pyogenes* as shown in studies of (53,23). On the other hand, some studies showed mixed infection between *A. pyogenes* with other bacteria on cases of bovine mastitis (46). These bacteria are considered the causative agent of summer mastitis, the pathogenicity of these bacteria belong to possess some of the virulence factors such as heamolytic exotoxin, neuraminidase, protease and dermonecrotic exotoxin (8,54).

g. *Bacillus cereus*

Few studies indicated that *B. cereus* as a causative agent of clinical and subclinical mastitis it is formed (1.4%, 12.1%) from clinical mastitis (41, 22), and formed (2.2%) from subclinical mastitis (41).

2- Gram negative bacteria

There are many genus of Gram negative bacteria may cause mastitis in cows in both forms clinical and subclinical mastitis, most of them are considered as environmental

pathogens such as *Escherichia coli*, *Serratia* spp., *Klebsiella* spp., *Pseudomonas aeruginosa* and *Enterobacter* spp.

a. *Escherichia coli*

E. coli is a permanent part of the normal flora of the gastrointestinal tract in all mammals, and some strains of *E. coli* associated with disease in humans and animals when predisposing factors were available (16,8). Environmental mastitis caused by *E. coli* has been increased in Iraq and many countries at the same time as other types of mastitis has been successfully controlled, the severity of infection with *E. coli* mastitis is variation between the cows in the same herd, and in the same animal during different stages of lactation (55,56).

Multiple studies of mastitis was conducted at the general governorates of Iraq from Al-Sulaimania to Al- Basrah province , which indicated to variation incidence of *E. coli* isolates, the percentage of *E. coli* isolated from clinical mastitis formed (37.8%, 20%, 17.12%, 9.2%, 3.88%,) as noted by (32,57,58, 31,59) respectively.

From subclinical mastitis *E. coli* also isolated in varied proportions (24.19%, 16.7%, 15.5%, 8.3%, 2.77% in the studies for (37,27,60,58,59) respectively. Other studies (61,62,63,64,65,66,67), also indicated to isolate *E. coli* of different cases of bovine mastitis in different parts of Iraq.

Environmental bovine mastitis which caused by *E. coli* is difficult to control because the organisms are found in the soil and surrounding area in nature (68). *E. coli* which causes mastitis considered as one of highest expensive disease in farm animal, also this disease affected many high producing cows in dairy herds and may lead to several cases of death per year in most severe cases with economic losses to the dairy industry (68).

b. *Klebsiella pneumonia*

Some studies indicate to the isolation of *Klebsiella pneumonia* in different region of Iraq from bovine mastitis in (24%, 8.2%, 7.7%) as showed each in (30,22,33) respectively. Other

studies isolated it from clinical mastitis (4.79%, 4.3%, 1.84%) (15,6,21). However, (27) isolated *Klebsiella pneumonia* from subclinical mastitis in percentage of (7.15%).In addition to isolated it with other bacteria as mixed infection (46).

Escherichia coli and *Klebsiella* spp. are the most prevalent in clinical mastitis as it's one of the normal flora in the gastrointestinal tract in mammals, and can be transferred to the udder easily by contamination the teat by milky hands or from contaminated barns (34)

c. *Salmonella* spp.

S. typhimurium are the most being isolated from bovine milk ,it is an important bacteria that cause food borne disease when transmitted from milk to human causing food poisoning (69) . Some studies indicated to isolation *Salmonella* spp. from clinical mastitis as we have shown in the publication of (26,35,22,31) which isolated it in proportion (4.49%, 1.33%, 1.27%, 0.92%) respectively.

d. *Pseudomonas aeruginosa*

Mastitis is possibly the most important health syndromes on dairy farms. Pseudomonas mastitis is a sporadic disease, but from time to time it may be caused a serious herd problem, udder antibiotics have been participated in the development and distribution of Pseudomonas mastitis (70).

In Iraq, some studies indicated that (6%, 4.4%, 3.8%, 3.7%) of isolates were *P. aeruginosa* from clinical mastitis as it recorded by (71,60,22,31) respectively. On the other hand, the study of (72) showed that *P. aeruginosa* formed 26.6% in AL-Diwaniya province from bovine mastitis milk, and in agreement with (73) which isolated from bovine raw milk.

These bacteria are considered as environmental causes of mastitis and they reach the udder by drinking water, contaminated milking tools and wounds. It can also enter the teat by injecting antibiotics inside the udder, as it is an opportunistic bacterium and causing infection in animals that suffer from deficiency diseases, immunity, usually the infection rate with these bacteria as in Household breeding caw is higher than in cow fields and pastures due to Indoor breeding conditions, crowded homes, and polluted with animal feces (68,74).

e. *Serratia marcescens*

Serratia spp. are able of living in various environments, such as water, soil and the digestive tracts of different animals. Some species of Serratia consider as a cause of mastitis, including *S. marcescens*, *S. liquefaciens* and *S. rubidaea* (74).

In Iraq *Serratia marcescens* were isolated from bovine mastitis into two governorates firstly in Mosul by AL-Dabbagh, 2012 in percentage (2.2%) (60), secondly in Baghdad (4%) by (75). The infection with *Serratia marcescens* is effected with seasonal variation (76,77), that increase in the dry period of years, the lactation phase it is also effected in it (78).

Serratia mastitis have been appearing as a resulting to growing of this bacteria in a teat dip cup and in the animal bedding. In addition to bad hygiene and harm teat ends are thought to increase the rate of mastitis (79).

f. *Enterobacter aerogenes*

In one study of Iraq that indicate to isolation of *E. aerogenes* from bovine mastitis which is formed (3.3%) (60), it is considered as environmental pathogens, because it belong to the coliform bacteria group which transmitted into the udder by contaminating it with animal feces or by contaminated drinking water (80**)**.

g. *Proteus* spp.

Proteus spp. belong to Enterobacteriacea group. These bacteria were isolated in one of studies in Iraq from bovine mastitis in percentage (1.4%, 2.2%) from clinical and subclinical mastitis respectively (27).

h. *Aeromonas hydrophila*

A. hydrophila formed (1.1%) in studies of (60) which done in Al- Mosul city. Naturally, it is found in water and can be transferred to the udder through contaminated drinking water and caused inflammation as it is one of the bacteria producing exogenous toxins and Hemolycin (81).

i. *Pasteurella multocida*

P. multocida formed (1.1%, 3.8%) in studies for each (60,22) respectively. These bacteria are commensals in the mucous membranes of cows and cause many medical conditions, including mastitis. When predisposing factors of infection were available because it has many virulence factors, including: adhesives to the host's membranes that protect it from phagocytosis (57). Also the studies of (22, 82) indicated to isolation of *P. heamolytica* from the cases of bovine mastitis in percentage 10/157(6.3%), (1.4%) respectively.

DEFENSE MECHANISMS IN THE MAMMARY GLAND

Although the udder possesses many defensive mechanisms, such as the presence of the sphincter and the keratin layer covering the epithelium natural squamous lining of the teat channel as well as the presence of defensive immunoassay factors in normal milk, which increases in the cases of infections such as lactobroxides, lactoferrin and lysis enzymes Immunoglobulins and complement components (81,83), but many types of bacteria can overcome to the defense mechanisms and cause infection due to some of the virulence factors, the most important factors that Gram-negative having are the adhesives factors, enzymes, and endotoxins that is released from the bacterium after its death or as a result of its destruction by Inflammatory reactions leading to acute septicemia (74,79).

Studies have indicated the possibility of experimental inflammation by injection of endotoxin of *Escherichia coli* and others type of Coliform bacteria, the degree of inflammation often effects on a number of white blood cells and serum albumin level in milk as endotoxin injection causes acute mastitis like infections in cases of experimental injections with pathogens of the lactating gland. When measuring the level of several prostaglandins, were showed the level was increased in cases of *Escherichia coli* bacterial endotoxin injection through the teat while experimental injection of *Klebsiella pneumonia* endotoxin, which cause increasing in the level of histamine and serotonin after injection with it (84), usually the infection with coliform bacteria occur before and after birth in a few days, as a result of the animal's debility before birth and reduction of immunity, during labor and in the first days of breastfeeding (85,86).

THE ANTIBIOTIC SENSITIVITY TEST

Antibiotics have been used as mastitis treatment more than fifty years ago, but the consensus about using the most safely, competence and economical drug is still deficient. Furthermore the effect on public health should be taken into regarded as dairy cows produce high amount of milk for human consumption (87).

The solubility of antibiotic in the lipid, ionization degree, and extent of binding to udder protein and serum in addition to, the antimicrobial treatment for bovine mastitis creates residues in milk, and avoidance of these residues is an important feature in the treatment of mastitis (88). On the other hand, milk components should not interfere with the antibacterial activity. Some studies showed the macrolides activity, trimethoprim, sulphonamides and tetracyclines may be reduced with milk (89,90).

It is better to choose substance with a low minimum inhibitory concentration (MIC) value for the pathogen, particularly when antibacterial is administered systemically and the antibacterial action should have bactericidal rather than bacteriostatic, because the phagocytosis is weakened in the mammary gland (91), the antimicrobial susceptibility test in vitro has been considered as an essential for treatment.

Antibiotics are used in animals for therapeutic purposes and as feed additives, this use lead to produce bacterial resistance to certain antibiotics, which in turn transmits resistant plasmids between the species of the genus of Staphylococcus and thus bacteria may be found in contaminated milk (92).

In Iraq, studies for antibiotic sensitivity test were subjected, according the method of Kirby-Bauer (disk diffusion assay). Most of these studies showed that agreement in some findings to susceptibility to *Staphylococcus* spp. isolates from bovine mastitis to ciprofloxacin and oxytetracycline and some for chloramphenicol but resistance to vancomycin, lincomyin, ampicillin and penicillin G (40,41,82,87,93,94,95). The resistance Staphylococci spp., especially, *Staph. aureus*, to penicillin G and ampicillin create a problem in widespread (92,96).

The study of Al-Edani at Basrah city showed that all isolates indicated previously, was sensitive to chloramphenicol, ciprofloxacin, gentamycin and vancomycin. However, the resistance to oxacillin and Penicillin exhibited by CNS and *Staph. aureus* were (76.9%, 84.6%, 62.5%, 68.75%) respectively (29).

In another study Al-Edani indicate the percentage of antibiotic resistance in the CNS was (97.7%) for ampicillin, (86.4%) for novbiocen, penicillin and (77.2%) for oxacillin. While recording (100%) of antibiotic sensitivity for each of ciprofloxacin, gentamycin and chloramphenicol (24). On the other hand, (21) indicate that (20%) of *Staph. aureus* isolates were resistant to methicillin.

Another finding indicates that *Staph. aureus* and *Streptococcus* spp. were more sensitive to, amikacin, kanamycin, tobramycin and showed intermediate sensitivity to rifampicin antibiotics. But gram negative bacteria including *Salmonella* spp., *E. coli* spp. and *klebsiella* spp. were high sensitive to amikacin, kanamycin and tobramycin but intermediate sensitive to ciprofloxacin antibiotics (26,63).

Most of Bovine mastitis isolates were highly sensitive to gentamycin, cloxacillin, amoxicillin and intermediately sensitive to oxytetracycline. However Streptococcus, Staphylococcus and Coliforms bacteria isolated were resistant to penicillin (28).

The results of (60) indicate that most of gram negative bacteria isolates were sensitive to ciprofloxacin, gentamycin and cotrimoxazole, while resistant to ampicillin, but the isolates showed a different proportion of sensitivity to tetracycline doxycycline, chloramphenicol and neomycin.

Study of (59) showed that all *E. coli* isolates were resistant (100%) to lincomycin, cloxacillin and cefuroxime, while showing (90.0%) resistance to novobiocin and ampicillin. Some isolates showed sensitivity (90.0%, 86.7%) to streptomycin and cephalothin respectively, but some of these isolates showed (83.3%, 46.7%, 33.3%) resistance to tetracycline, polymixin and neomycin.

Pseudomonas aeruginosa isolated from bovine mastitis showed high resistance (100%) to nalidixic acid and tetracycline, follow by gentamicin (50%), but less resistance percentage

(16.6%, 33.3%) to the ciprofloxacin and cephalothin respectively, and indicted that *P. aeruginosa* have been developed resistance against aminoglycosides through presence of aac (3)-Ib gene and suggest that ciprofloxacin and cephalothin can be used as good choice of treatment for bovine Pseudomonas mastitis (71).

The results of (75), showed that *Serratia marcescens* were resistant (100%) to Imipenem, Tetracycline and Ampicillin follow by cefotaxime (66.66%), but it's susceptible (100%, 83.33%, 66.66%, 50%) to Ciprofloxacin, gentamycin, chloramphenicol and nalidixic acid respectively.

One study was done in Al-Sulaimaniyah district indicated that the synchronized use of cephalexin, florophenicol and erythromycin may be beneficial for the treatment of subclinical mastitis cases in cow (37). Another study in the same area was indicated that cephalexin, florophenicol and gentamicin may be useful for the treatment of clinical bovine mastitis in cows (31).

The excessive use of antibiotics in the field of animal and agricultural production and the potential for transmission of many factors. The bacterial genetic resistance of these antigens from these animals to human intestinal flora through food consumption. Contaminated with these resistant bacteria negatively effects on human health and helps the emergence of more serious chronic human diseases, it will be difficult to control and treat it with known antibiotics (97).

MISCELLANEOUS STUDIES

Some studies in Iraq were deal with other aspects, such as physiological and immunological state of bovine mastitis (98,99,100,101,102).

MASTITIS CONTROL PROGRAMS

There are different control measures of bovine mastitis such as the hygienic management procedures, which include feeding practices, hygiene, animal husbandry and general health care can provide to decreasing the incidence of udder infections.

Treating infection with antibacterial, with good farming practices, help in this endeavor to, least reduction, the incidence of bacterial mastitis infection within a herd. However, the defect of using antibiotics creates residues in milk and when not administered properly give bacteria the chance to mutate and become resistant to that antibiotic (103). Moreover, in some cases, using antibiotics alone is not sufficient to destroy the pathogen is depending on the type of pathogens.

Vaccination program, although the most mastitis vaccines fail to give long term of immune responses, but vaccination idea, has been extensively studied in recent years. lysostaphin, is a bactericidal enzyme developed from transgenic mice which demonstrated the capability of preventing *S. aureus* infections successfully.

Selection of animals breed that are resistant to diseases and the incorporation of this feature in farm herds is a promising alternative to reduce the problems which caused by infectious diseases towards with applying sanitary conditions which reduces the need to use drugs, then decrease the levels of product contamination and the environment.

Incorporation of genes which impart the resistance by selection more resistant breed, is a good practice that should be encouraged. One of techniques were employed to select disease resistant animals by using molecular markers in programs of genetic improvement. These studies are created the knowledge about the genetic and biochemical mechanisms of resistance by clarifying the actions of the respective genes (104).

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التهاب الضرع الجرثومي في الابقار: مراجعة علمية

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يعد التهاب الضرع الجرثومي احد أهم الأمراض في الأبقار ذات الإنتاج العالي ويسبب خسائر اقتصادية عالية تؤثر في صناعة الألبان، مما يؤدي إلى انخفاض في تصنيع الحليب وجودته، بالإضافة إلى تكلفة العلاج. تبلغ الخسائر السنوية بسبب التهاب الضرع حوالي ١٨٤ دولارًا لكل حيوان. عادةً ما تكون الكائنات الحية الدقيقة المُعدية أثناء الحلب المصدر الرئيسي للعدوى بين أرباع الضرع السليمة والمُصابة. تم العثور على مسببات الأمراض البيئية في المناطق المحيطة بالابقار، مثل فراش الأبقار، والتربة ومخلفات الأبقار التي تحتوي على سلالات المكورات السبحية *Streptococcus agalactiae* و *Enterococcus faecalis* و *Enterococcus faecium* و coliform . تظهر الجراثيم التي تشارك في عملية التهاب الضرع مقاومة عالية للمضادات الحيوية. الهدف من هذه المراجعة هو تحديد الأسباب الجرثومية لالتهاب الضرع السريري وتحت السريري في العراق، والتعرف على حساسيتها للمضادات الحيوية، ثم إيجاد حلول فعالة لعلاج والسيطرة على التهاب الضرع.

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