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Ethoveterinary: Traditional Medicine in Treating Mastitis – A Review

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Abstract: Ethnoveterinary medicine is considered a sub- field of ethnobotany that deals with the study of traditional medicines. Ethnoveterinary practices concern to animal healthcare is as old as the domestication of various livestock species. They comprise belief, knowledge, practices, and skills pertaining to healthcare and management of livestock. It serves as an alternative method to treat and prevent various diseases in livestock. The plant has shown to exhibit antibacterial, antifungal, insecticidal and antioxidant activity. Without being treated this infection can lead to major economic lost in diary industry. Thus, this review will summarize on the different medicinal plant varieties commonly used to treat mastitis, bacterial infection on the mammary gland and udder tissue of cattle.

Keywords: Ethnoveterinary medicine, Medicinal Plant, Mastitis, Livestock, Treatment.

INTRODUCTION

Mastitis is an endemic disease and a potentially fatal mammary gland infection worldwide, which caused an inflammation at the udder tissue and mammary gland. Mastitis is caused by bacteria where invading process takes place in the mammary gland cell. The disease is commonly accompanied with swelling and hot udders, loss of appetite and fever (Cho *et al.*, 2015). Mastitis is caused by various pathogens and, epidemiology divided in two major groups which are contagious and environmental mastitis. Contagious mastitis occurs when there are bacteria detected inside the udder and skin of the four teats. They primarily transmit from one cow to another during milking process. *Streptococcus agalactiae, Staphylococcus aureus, Corynebacterium bovis and Mycoplasma spp.* are examples of contagious pathogens. Apart from that, bacteria or pathogens that live in the cows farm environment are also the caused of environment mastitis which includes *Escherichia coli, Streptococcus uberis, Streptococcus dysgalactiae, and Klebsiella spp* (Abebe *et al.*, 2016). Mastitis are categorized in sub-clinical, clinical, and chronic forms, depends on the severe level of the inflammation, also depending on the animal's etiology, age, breed, and their immune system (Pasca *et al.*, 2017). Bradley (2002) stated the risk factors of the disease are particularly related to cow management and practices on farm, milking process, and the management of the house (Bradley *et al.*, 2002). The most common treatments in treating this disease are the intramammary therapy, which is applied into the infected udder, and intramuscular antibiotic injection (Pasca *et al.*, 2017). Prevention and control strategies are foremost very crucial to reduce the infection. This disease can be prevented with a good udder health management practices, as well as mastitis treatment strategies, mastitis control programs. Kasna *et al.*, (2018), argued that mastitis shows high occurrence during the late lactation than early lactation (Kasna *et al.*, 2018; Lalouckova *et al.*, 2019). Moreover, Oliver and Murinda (2012), claimed that mastitis is known as one of the most economically devastating problems in cattle and a difficult disease to control because a wide variety of pathogens can infect the udder. These infections alter milk composition and reduce milk yield thus affects the dairy industry worldwide (Keyvan and Tutun, 2019).

Antibiotic and Antimicrobial Resistance: Emerging Mastitis Threats

It is known worldwide that mastitis causing many undesirable effects on the industry of dairy cow. Which define the common use of antibacterial in the infected herd worldwide (Lalouckova *et al.*, 2019). The practices of intramammary therapy are usual in the dairy cows. Barkema *et al.*, (2006) stated that the common used drugs for mastitis include betalactams, macrolides and lincosamides. Additionally, there is various udder and teat disinfection procedures have been carried out on the farm especially during the milking process. Iodine-based and chlorhexidine-based are example of applied treatment on the cows during post-milking (Lalouckova *et al.*, 2019).

Despite the extensive use of antibiotic in mastitis treatment, it had showed numerous disadvantages which include high occurrence drug-resistance, antibiotic residues in human consumption, and low rate of curing (Lalouckova *et al.,* 2019). In a study by Ameen and colleague reported that *S. aureus* showed high resistance (90%) towards penicillin while 10% of the pathogens are resistance to oxacillin (Ameen *et al.,* 2019). *P. aeruginosa* showed resistance to enrofloxacin, levofloxacin and centriaxone while *E. coli* (40%) is resistance towards streptomycin. The occurrence of antibiotic resistance had been reported in many previous studies. The common cause of mastitis, *S. aureus* showed high resistance level in many antimicrobials. Therefore, White and McDermott (2001) claimed that new approach to alternative treatment are crucial to combat the antibiotic resistance in mastitis, and the fact that this caused harmful in humans health as there are reported of many antibiotic residues present in human consumption. Hence, alternative treatments are essential and severely needed for in order to control emergence of mastitis resistance. Recently, an insight of plant as new alternative approach is widely study [11]. Researchers have proposed using plant extracts containing antimicrobial compounds to fight the high resistance level of bacteria which caused numerous infectious diseases (Harjanti *et al.,* 2019; Yang *et al.,* 2019).

Used of Natural Products against Mastitis

Antibiotic resistance development in mastitis has caused public concern worldwide. Therefore, it is necessary to address an innovative approach towards the emergence of drug-resistant bacteria of mastitis in current research. Plant based products are serve as a new foundation for alternative mastitis treatment in veterinary medicines. This is due to low cost of manufacturing as well as zero report of resistance in antimicrobial (Pasca *et al.,* 2017). Recently, many research efforts have been conducted to study the alternative treatment to treat mastitis. Natural products have successfully played a crucial role in the discovery of drugs of numerous scopes including veterinary medicine. Natural product originated in nature and derived from natural organism sources which can be developed either in naturally, semi-synthesis or total synthesis process. It comes from plant, animal and as well as microbes' sources. Biological activities of the natural product play as an important tool in discovery of new drug. Natural products are promising therapeutics in treating mastitis. The development of therapeutic agents from natural products has been chosen in consideration as many multiple factors are discovered. The effectiveness of natural product reported display wide range of successful outcomes due to its biological properties. Other than its potential biological activities, inexpensive cost and simple preparation also contribute to the factors of development natural products as alternative approach in curing mastitis (Melander *et al.,* 2020). Discovery of many previous studies of the effectiveness of wide range of natural products have pointed out as a promising role to prevent bacteria resistance in the future (Harjanti *et al.,* 2019; Ibrahim *et al.,* 2016). It is also considered as beneficial, safe, low cost material, and shows no harmful in humans and animals health.

Potential Natural Product as Alternative in Mastitis Treatment

The concept of medicinal plants-based products in treating mastitis has been introduced in veterinary medicine by many research. This strongly indicates the potential treatment of natural products against mastitis. Hence, most current research supports the use of natural products as alternative strategies to cure mastitis. The selection of the natural product to treat mastitis further discussed below.

Palm Oil - Medium-chain fatty acids

Organic acids serve as the foundation of a new target in mastitis alternative treatment. They could control bacterial contamination and boosting the production of animal Polycarpo *et al.,* 2017). Next, fatty acids show activity against numerous pathogens including incorporated into membrane of bacteria, increased the membrane fluidity, and caused internal cells loss (Chamberlain *et al.,* 1991). A medium – chain fatty acids (MCFAs) prevail in native palm of oils present in tropical and subtropical climates (Van der Cossen *et al.,* 2001). The effect of antibacterial within palm oils that rich in MCFAs has been proven in previous studies including coconut (*Cocos nucifera),* Babassu *(Attalea speciose)* and palm kernel *(Elaeis guineensis)* oil after the cleavage. Total content of MCFA and saturated fatty acids both are higher in all tested oils with 50% and 80% respectively (Hovorkova *et al.,* 2018). Palm oil is a complex substance with lower prices and enriched sensory properties. Lalouckova and colleague have carried out the research to evaluate the possible implementation of rich MCFAs present within palm such as palm kernel, tucuma oil and coconut with the objective to reduce the colonization of udders prior to milking in dairy cows (Lalouckova *et al.,* 2019). The research observed in vitro on eight mastitis pathogens in palm oils, showed an effective result of MCFA against mastitis [6]. These include no skin irritation (Oyedeji and Okeke, 2010), and the efficient of activity in antibacterial properties. Hence it is proven an alternative approach of MCFAs in palm oils in treating mastitis are beneficial during milking period in the preparation and treatment of teat.

***Angelica dahurica* and *Rheum Officinale* extracts**

Bovien mastitis treatment in Traditional Chinese Medicine (TCM) is obtained from numerous herbs, *Angelica dahurica and Rheum officinale* are the

example of herb used. This is due to their detocifying, antibacterial properties, anti-inflammatory as well as their heat-clearing which are administered orally help to clear internal heat, thus marked to be successful in treating inflammatory infection due to their antimicrobial and anti-inflammatory effective activity Muluye *et al.,* 2014). It was showed that the designated herbs Yi-Xiong-Tang (YXT), derived from the extracts of *A. dahurica* and *R. officinale* are proven to have wound healing effect, anti-inflammatory and antimicrobial. The analyzed the potency of YXT against bovine mastitis was done by Yang and colleague (2019). As a result, decrease of bacteria in mastitis milk showed YXT have active potent of antibacterial properties. Level of inflammatory in mastitis milk drop to average level after the YXT treatment, this indicates YXT contain anti-inflammatory activities (Yang *et al.,* 2019). Similarly, study conducted by Kim and colleague, *A. dahurica* and *R. officinale* reduces macrophages production, regulate inflammatory in macrophages (Kim *et al.,* 2013). Advantages of YXT treatment include inexpensive preparation materials, simple administration, and shorter period of course than common antibiotic therapy.

Plant endophytic actinobacteria

Endophytic is a potential medicinal plant, acts as effective biocontrol agents for alternatives in chemical antibiotic (Elbendary *et al.,* 2018). The antimicrobial activities of medicinal plant had been reported by many previous studies. Recently, two medicinal plant, *Allium sativum* and *Bunium persicum* was found to be effective in mastitis treatment (Amber *et al.,* 2018). Ameen and colleague evaluated the effectiveness of metabolic extracts from plant endophytic actinobacteria (*Pulicaria undulata, Mentha longifolia, Malva parviflora*) in mastitis treatment towards cows [10]. Three endophytic actinobacterial isolates showed wide range of potential actonobacterial activities. The inhibitory concentration depends on the wide raging of pathogens and species in plant. The pathogens are subtle minimum one of the actinobacterial extracts. It was supported by Han and colleagues (2018), where the mixture of actinobacterial metabolite was found efficient against several pathogens. Micromonospora or Streptomyces genera are known to have strong actinobacterial activities. Similarly, with other studies, Streptomyces and Micromonospora genera offer great strategy in treating drug-resistant bacteria.

Honey

Honey (Family: Apidae) made by bees is the most used to treat wound due its effective antimicrobial activities (Cooper, 2016). Due to its wide variety of antimicrobial activity, honey was known to be efficient substitute for topical antibiotics. Rajweswari and colleague (2010), confirmed the effectiveness of honey against a range of bacteria include *S. aureus, P. aeruginosa, E. coli and A. calcoaceticus* which also appear resistance to honey. Lu and colleague (2019) also discussed the effectiveness of honey as inhibitor and eliminate the biofilm produced by *P. aeruginosa.* In this study, Manuka –type honey eliminates biofilms produced by the pathogen, *P. aeruginosa* as well as inhibiting the pathogen planktonic cell growth. Several studies were found to have similar result (Bardy *et al.,* 2011). Study conducted by Cooper and colleague also agreed where Manuka honey can eliminate biofilms and prevent biofilm's formation towards various pathogens which *Streptococcus* species, *E. coli*, and *P. aeruginosa* (Cooper, 2014).

Aloe barbadensis

Aloe vera is widely used in both humans and animals by stimulate the immune system without any side effect reactions. Application of gel aloe vera speed up the process of healing at the wound site, on the other hand, oral application of aloe vera decreased the level of glucose in diabetic patient's blood (Vogler and Ernst, 1999). Thangadurai *et al.,* (2017), discussed the effectiveness in combination of herbal in curing mastitis. This purpose was taken to lower the cost of treatment among the cattle breeders. The study was carried out in combination of Aloe vera, lime and turmeric powder. The result obtained from the study was reported as effective practices in mastitis management. Somatic cell count, conductivity and pH of mastitis milk are high compared to common antibiotic control (Thangadurai *et al.,* 2017). The author concluded the mixture of these herbal are beneficial in treating mastitis, it also has short period of recovery compared to common antibiotic therapy.

Allium sativum cloves

The used of herbal medicine such as *Allium sativum* cloves (garlic) are widely approved in treating many diseases (Dishad *et al.,* 2008) due to its therapeutic properties (Khan *et al.,* 2012). Garlic is a plant in onion family and is knowingly famous used as a flavour in cooking and medicine throughout decades. 'Allicin', an effectual component of the antibacterial and antiseptic properties in garlic have been discovered in many previous studies (Dishad *et al.,* 2008). Ibrahim conducted a study to investigate the efficacy of herbal agent to treat subclinical mastitis among dairy cows. In the study, garlic was used in combination with Vitamin E+ Se and *Citrus limonum* (lemon) (Ibrahim *et al.,* 2016). Positive result was achieved as many cases as possible of mastitis found to be cured. The use of garlic in the study displayed many advantage such as raise in the number and percentage of lymphocyte, increasing composition of milk and the blood parameters as well as improving immune system due to the active ingredient 'allicin' in the garlic (Ibrahim *et al.,* 2016). Thus, it showed similar result as the study conducted by Dilshad and colleague (2008). The use of garlic in combination of Vitamin E + Se and lemon are proved to be effective in the treatment of subclinical mastitis.

Enthomedical plant – *Ageratum conyzoides, Muntinga calabura, Piper betle* and *Curcuma domestic*

Analysis of phytochemical for secondary metabolites in ethnomedical plants played an important role as a new therapeutics' agent. Fundamental research in human medicine, found that the presence of bioactive compounds in *Ageratum conyzoides, Muntinga calabura, Piper betle,* and *Curcuma domestica* contribute to many disease treatments such as gastric, injury inflammation, and fever [35]. Research has been carried out by harjanti and colleague to evaluate the effectiveness of antibacterial in *Ageratum conyzoides, Muntinga calabura, Piper betle*, and *Curcuma domestica* as a possible alternative in curing mastitis. The antimicrobial activities of *Ageratum conyzoides, Muntinga calabura, Piper betle*, and *Curcuma domestica* have been proved in various research studies [14]. The result shows abundant useful properties are found in *Ageratum Conyzoides* including anti-inflammatory and antimicrobial activity (Singh and Sharma, 2013). *Muntinga calabura* leaves were found to be effective against *Staphylococcus chromogenes, Streptococcus sanguinis, Staphylococcus simulans* and *Streptococcos dysagalactiae* prevented by ethanol extract. Based on the study conducted by Sani and colleague an aqueous extract from *Muntinga calabura* inhibited bacteria's penetration and growth in mammary gland (Sani *et al.,* 2012). Harjanti also reported antibacterial activity of *Piper betle* extract had the highest inhibitory zone result against mastitis. Similarly, with study by Agarwal *et al.,* (2012) and Valle *et al.,* (2016) pointed out the ethyl acetate, supercritical CO_2, ethanol, and methanol extract of *Piper betle* possess remarkable activities against mastitis disease.

Curcuma domestica

Curcuma domestica was found to possess an antibacterial activity which is useful against mastitis infection. The result was supported by previous study documented the effectiveness of antibacterial activity in *Curcuma domestica* against *Methicilin-resistant Staphylococcus aureus* (MRSA) Mun *et al.,* (2013) and *E. coli* de Oloveira *et al.,* (2018). It was concluded that *Ageratum conyzides, Muntinga calabura, Piper betle and Curcuma domestica* can be use as alternative approach in curing mastitis infection.

Origanum vulgare

Origanum vulgare (Oregano) is herb plants belong to mint family (Lamiaceae). Oregano is commonly used as natural remedies in treating various diseases Teixera *et al.,* (2013), which contain effective antimicrobial and antioxidant activity (Baratta *et al.,* 1998). Carvacrol and thyme are the example components of the oregano oil which play vital role contributes to antimicrobial and antibacterial activity (Burt, 2002). Cho and colleague (2015), conducted a study to evaluate the efficacy of therapeutic activity reaction of oregano essential oil (OEO) against clinical mastitis generate from *S. aureus* and *E. coli*. The advantages obtained from the result in combating mastitis infection with antibacterial activities of OEO are supported by many previous studies. These include improved membrane permeability (Lambert *et al.,* 2001), inhibited bacteria growth and increased the amount of the somatic cell account milk as well as the number of white blood cell blood (De Souza *er al.,* 2006). Other beneficial outcomes reported form this study is the improvement of udder condition physically and no detection of *S. aureus* and *E. coli* presence in milk (Sharma and Jeong, 2013). It is proved that the results from this study suggested OEO as alternative treatment against mastitis.

Mentha essential oil

Essential oils served as a new target, safe and a potential compound against numerous pathogens. Essential oils derived from plant are found to have efficient healed ability and effective antimicrobial activities (Grzesiak *et al.,* 2018). Mentha is a plant from mint family (Lamiaceae). The effectiveness of antibacterial properties from mint family had been documented by many previous studies (Golestan *et al.,* 2016; Ramos *et al.,* 2017). Harvoth and Koskova (2017), discussed the essential oil effect of antibacterial properties from three different mint species which are *Mentha spicata, Mentha piperita* and *Mentha arvensis* against *S. aureus.* The evaluation of this study reported that the 3 mentha essential oil had inhibiting the Staphylococcus strains effectively. The effectivity of all three mint family was confirmed in a study by Imai *et al.,* (2001). Different effect of various contents was reported from all the three essential oils.

Mentha Spicata

Highest resistance toward clinical *S. aureus* was reported by *M. spicta oil* due to its strongest effect than the other mentha. The result was supported by previous studies also found that *M. Spicata* oils produced the highest inhibitory activity against *S. aureus* and *Clostridium perfringers* (Golestan *et al.,* 2016).

Mentha piperita

In this study, *M. piperita* showed an effective antimicrobial activity against *S. aureus*. Previous study by Ramos *et al.,* (2017) confirmed the effectiveness of antibacterial and antimicrobial activity by *M. perita* oil against various mastitis pathogens.

Mentha Arvensis

As for *M. arvensis*, the study discovered essential oil of *M. arvensis* had the strongest effect exhibit biofilm inhibition against *S. aures.* As suggested by Horváth and Koščová (2017), mint essential oil as an alternative source of natural product against *S. aures*.

CONCLUSION

Ethnoveterinary practices or natural product is indeed on of the important subject to discuss and discover. There are broads' range of effective natural products in treating mastitis has been reported and discussed in previous studies. This alternative treatment has been widely documented throughout the literature. To better delineate the potent of the selection of natural products in treating mastitis, more structured and larger multicentre studies should be performed. Nevertheless, further consideration and more exploration towards mastitis alternative treatment need to be carried out to replace or substitute emerging drug-resistant bacteria with no adverse effects and harmful both human and animal health.

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