

## Cytokine and Oxidative Stress, Indicator of Mastitis

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Mastitis can be illustrated as inflammation of mammary glands, characterized by pathological changes in udder, increased leukocytes, chemical and organoleptic changes in milk of infected animals. In mastitis, immune cells of the body identify invading pathogens which upon activation discharge inflammatory mediators like cytokines, prostaglandins and nitric oxide to produce inflammation. Following parameters (Malondialdehyde (MDA), reduced glutathione (GSH) and Super oxide dismutase (SOD) act as biomarkers to diagnose mastitis [1]. Cytokine and oxidative stress are not only considered better indicators of mastitis but also serve as a useful prophylactic and therapeutic measure to minimize the productivity losses taking place owing to mastitis [2]. Cytokines include tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), interleukin-1 $\beta$  (IL-1 $\beta$ ), interleukin-6 (IL-6) and interleukin-12 (IL-12), responsible for inflammation of mammary glands by priming of leukocytes to induce increased response to microbial pathogens. Activation of systemic inflammatory response cause increase in body temperature, increased heart rate, reduced feed intake and produce clinical signs of disease [3].

Oxidative stress occurs due to imbalance between cellular oxidation-reduction reactions involving increased production of reactive oxygen species (ROS) and reduced elimination of it by antioxidants in the body [4]. Factors responsible for oxidative stress may include either higher production of ROS, reduced antioxidant protection or failure of repairing induced tissue injuries. Reactive oxygen species particularly damage immune cells, consequently reduce response of immune system to invading pathogens. In clinical mastitis, greater lipid peroxidation and reduction in amounts of some antioxidant molecules lead to increased oxidative stress [5]. During inflammatory reaction, some inflammatory cells like neutrophils and macrophages produce ROS to kill pathogens. So, ROS accumulation can also produce oxidative stress. Accumulation of ROS and other products of oxidative stress, like lipid hydro peroxides can cause greater cell and tissue damage [6]. Furthermore, greater production of ROS is responsible for reduced milk quality due to disruption of its organoleptic properties [7]. Mastitis increases blood vessels permeability, so various constituents of blood like leukocytes can pass directly from blood vessels into milk. As a result, different enzymes can change milk composition by causing disruption of milk casein and fats. Amount of casein decreases while the quantities of some unwanted protein constituents like serum albumin, immunoglobulins and transferrin are increased due to enhanced permeability of blood vessels [8]. It is suggested that oxidant and antioxidant imbalance occurs in clinical mastitis, accompanying promotion of pro-inflammatory cytokines resulting in potent oxidative stress, hence it can be used as potential biomarker to diagnose mastitis and screening of udder health status in animals.

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