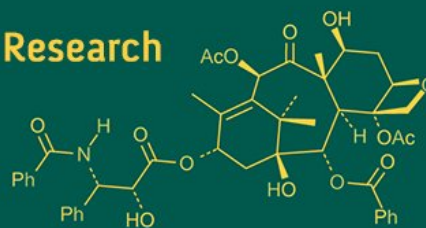


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An insight of clinico-haemato-cytokine and milk alterations in clinical mastitis in goats

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Abstract

It is crucial to identify mastitis early in order to minimize the financial damage to dairy farmers and dairy industry. The study was conducted to determine the effect of clinical mastitis on clinico-haemato-cytokine & milk parameters of goats. The clinical mastitis cases were diagnosed on the basis of characteristic swollen, hard, inflamed, painful udder & abnormal milk. Thirty goats from Anand district of Gujarat, India and six healthy goats as a control were included in the study. Milk samples were evaluated for pH & Electrical conductivity & blood samples were analyzed for haematological & biochemical parameters. Milk pH of mastitis affected goats was higher towards alkaline as compared to healthy goats which decreased highly significantly ($p < 0.01$) post treatment. Whereas, Electrical conductivity of milk of mastitis affected goats was higher than healthy goats & found to be decreased highly significantly ($p < 0.01$) post treatment. In hematological study, significant decrease was observed in the hemoglobin g/dl, PCV%, $TEC \times 10^6/\mu l$ and monocyte% whereas, higher values of $TLC \times 10^3/\mu l$ & neutrophils% were observed in mastitis affected goats. The lymphocyte% was found to be decreased in mastitis affected goats as compared to that of healthy goats. Cytokine analysis revealed higher value of IL-6 (pro-inflammatory cytokine) in mastitis affected goats as compared to healthy goats which decreased highly significantly ($p < 0.01$) post treatment. Whereas, the value of IL-10 (anti-inflammatory cytokine) was found to be lower in mastitis affected goats than healthy goats however, it was increased highly significantly ($p < 0.01$) post treatment, proving both IL-6 & IL-10 as an important indicators of mastitis in goats.

Keywords: Mastitis, goat, pH, electrical conductivity, hematology, cytokine, interleukin

1. Introduction

Mastitis is a complex, multi-etiological illness characterized by inflammation of the parenchyma of the mammary glands along with pathological abnormalities in glandular tissues as well as physical, chemical, and typically bacterial changes in milk (Constable *et al.*, 2017) [5]. The most prevalent and infectious ailment in dairy animals is mastitis. It has been estimated that mastitis is currently costing India Rs. 7165 crores in damages (Bansal and Gupta, 2009) [3]. Dairy industries suffer enormous financial losses as a result of the disease's effects on milk yield and milk quality, animal fatalities and culling, and associated treatment costs (Singh, 2021) [38]. Mastitis causes global profitable losses of USD 35 billion for the world's dairy industry and Rs. 6000 crores for India's dairy industry. It is crucial to identify mastitis early in order to minimise the financial damage to dairy farmers and dairy assiduity (Sathiyabarathi M. *et al.*, 2016) [29].

Mastitis is more common in meat goats that have been grown using intense and semi-intensive management techniques. Mastitis may cause producers to earn less money, depending on the disease's severity. Mastitis is typically linked to poor hygiene habits and brought on by the bruising of breast tissue or teats as a result of injuries, nursing, fly bites, or other skin wounds that compromise a vital infection barrier. Mastitis is also linked to toxins produced by bacteria, fungi, or viruses. A doe's immune system is weakened and struggles to defend against the invasion of foreign things that cause diseases like mastitis under stressful circumstances like severe temperatures, muddy and damp living conditions, or a sudden change in nutrition.

Damage to the udder tissue causes altered concentrations of milk constituents and increased concentrations of sodium and chloride ions which raises the pH and electric conductivity of

the milk. The blood-milk barrier is damaged as a result of inflammation, allowing serum electrolytes to enter the milk (mostly salt and chlorine), increasing electrical conductivity and decreasing electrical impedance. The high concentration of alkaline blood components like sodium and bicarbonate ions, which are caused by inflammation of the mammary gland and enhance the permeability of the blood capillaries, may be responsible for the elevated milk pH in subclinical mastitis (Guha *et al.* 2010 & Sinha *et al.* 2018) [31, 39]. Moreover, lower acidity, which is linked to reduced lactose concentrations in mastitic milk, may be the cause of the higher milk pH during mastitis. The electrical conductivity of milk is altered as a result of mammary gland inflammation in goats. Mastitic milk in goats has a higher electrical conductivity, especially when both mammary glands are affected. Examining the haematological and biochemical parameters of animals is a key factor in determining how accurate a diagnosis is. Deviation from normal hemato-biochemical indices is indicative of ill health, and they aid in diagnosis and evaluation of the severity and prognosis of the disease condition, as evident in the white blood cell accumulation in mastitic udder. The investigation of basic hematological and biochemical indicators contributes to the knowledge of metabolic profile and their possible disorder, whether of a latent or clinical nature (Mohammed 2016) [40].

2. Aim/Objective of study

The present study was designed to evaluate the relationship of mastitis with clinical signs, milk & udder parameters, pH, Electrical Conductivity, Hematological Parameters & Cytokine Estimation in goats affected with mastitis, as due to inadequate study on inter-relationship of mastitis with hematological, cytokine & milk parameters in goats.

3. Materials & Methods

3.1 Selection of Goats based on Clinical Signs indicative of Mastitis

Goats presented to the Veterinary Clinical Complex, Anand, Gujarat, India with clinical signs like reduced milk yield, painful, hot, hard and swollen udders, abnormal milk were suspected for mastitis. Out of these, 30 positive cases were included in the therapeutic study. Healthy goats from Instructional Livestock Farm Complex of College of Veterinary Science & A. H. Anand, were selected as a control group.

3.2 pH & Electrical Conductivity of Milk

Milk samples were collected aseptically from the mastitis affected goats. The mid-stream milk was collected using

sterile container. pH & Electrical conductivity of milk samples were recorded by Digital pH & Conductivity Meter (LAQUA Benchtop pH & Electrical Conductivity Analyzer). pH electrode was calibrated to 7.0 whereas EC electrode was calibrated to 10.1. Readings were taken on 'day 0' & 'day 5' of treatment. The results of electrical conductivity were expressed in milli Siemens per cm (mS/cm)

3.3 Hematological Parameters

Blood was collected aseptically in heparinized tubes from jugular veins of goats showing signs of mastitis & healthy goats as healthy control. Blood samples collected from the goats were used for hematological examination and blood parameters like Hemoglobin (g/dl), Packed cell volume (%), Total Erythrocyte Count (TEC) ($\times 10^6$ l), Total Leucocyte Count (TLC) ($\times 10^3/\mu$ l), μ Differential Leucocyte Count (DLC) (%) like Lymphocyte%, Monocyte% and Neutrophil% were recorded.

3.4 Cytokine Analysis

Blood was collected in serum clot activator tubes for separation of serum. Serum samples were separated by using centrifugation machine @ 3000 RPM for 10 minutes. These separated serum samples were aspirated with sterile pipette & collected in serum collecting vials which were stored at -20° centigrade till further use for serum cytokine estimation. Cytokines analysis was done by Sandwich ELISA (Fine test) Enzyme Linked Immuno Sorbent Assay using serum samples of goats positive for mastitis. IL-6 (Interlukin 6) as Pro-inflammatory cytokine & IL-10 as an Anti- Inflammatory Cytokine found in serum samples of goats were studied by Goat IL-6 ELISA Kit & Goat IL-10 ELISA Kit respectively.

4. Result & Discussions

4.1 General Clinical signs of Goats Affected with Mastitis

In present study, 30 goats showing clinical signs of mastitis regarding milk abnormalities like color & consistency of milk, udder abnormalities like unilateral or bilateral affection of udder, consistency of udder, signs of inflammation of udder like swollen, hot, painful, hyperemic), general signs like fever, depression, weakness, anorexia, reduced milk yield were recorded as per table no 1 & figure 1.

Table 1: General Clinical signs of Goats Affected with Mastitis

Sr. No.	General Clinical Signs	No. of Goats (n=30)	Percentage
1	Fever	28	93.33
2	Abnormal Milk	28	93.33
3	Anorexia	26	86.67
4	Reduced Milk Yield	25	83.33
5	Depression	20	66.67
6	Unilateral Udder Affection	20	66.67
7	Bilateral Udder Affection	10	33.33
8	Weakness	10	33.33
9	Recumbency	05	16.67

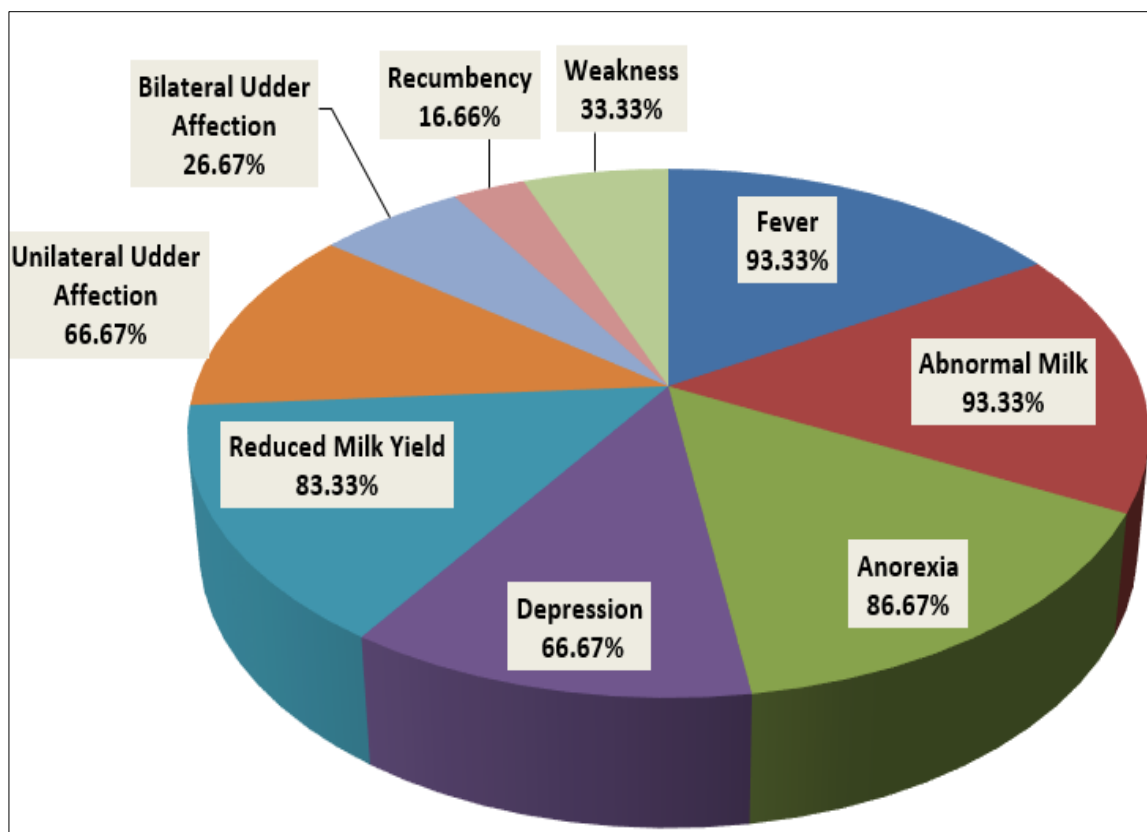


Fig 1: General Clinical signs of Goats Affected with Mastitis

In this study, clinical signs like Fever (93.33%), Abnormal milk (93.33%), Anorexia (86.67%), Reduced Milk Yield (83.33%), Depression (66.67%), Unilateral Udder Affection (66.67%), Bilateral Udder Affection (33.33%), Weakness (33.33%), and Recumbency (16.66%) were observed on 'day 0' in goats (n=30) affected with mastitis. Similar findings were recorded by Diaz *et. al.*, (2012) ^[7] in prevalence & incidence of bacteriological mastitis in goats in which they found six multiparous goats infected unilaterally & three bilaterally in which unilateral gland infection was caused by *Staphylococcus* sp., *Streptococcus* sp. & one gram negative organism. Bilateral infection was caused by *Staphylococcus* sp. Danmallam *et. al.*, (2019) ^[6] reported depression (65%), lack of appetite (75%), increase in body temperature (fever) of 40 °C and above (100%), PR >90 beats/min (80%), respiratory rate above 25 breaths/min (85%) and 40% recumbency. Gabli *et. al.*, (2019) ^[11] studied

prevalence of mastitis in dairy goats in which clinical examination of mammary glands showed 3.55% goats with clinical mastitis, 20% primiparous, 80% multiparous. 98.34% goats with half udder affected, 6.66% goats with both teats affected.

4.2 Milk & Udder Parameters in Goats affected with Mastitis

Physical parameters of milk recorded as color of milk, consistency of milk, udder parameters as consistency of udder & Signs of inflammation of udder in goats suffering with mastitis. Abnormal Color of milk was recorded as Yellowish (16.67%), blood in milk (33.33%), Colorless Milk (23.33%), Consistency of milk was recorded as Watery Milk (26.66%), Flakes in milk (33.33%), Clots in milk (30%), Curdy Milk (10.00%), as per table & figure no 2.

Table 2: Milk & Udder Parameters in Goats affected with Mastitis

Sr. No.	Clinical signs	Goats affected with Mastitis (n=30)	
1	Yellowish Milk	05	16.67%
2	Blood in Milk	10	33.33%
3	Colorless Milk	07	23.33%
4	Watery Milk	08	26.66%
5	Flakes in milk	10	33.33%
6	Clots in milk	09	30.00%
7	Curdy Milk	03	10.00%
8	Swollen Udder	24	80.00%
9	Hot & Painful udder	25	83.33%
10	Hyperemic Udder	20	66.67%
11	Hard Udder	16	53.33%
12	Firm Udder	12	40.00%
13	Reduced Milk Yield	28	93.33%

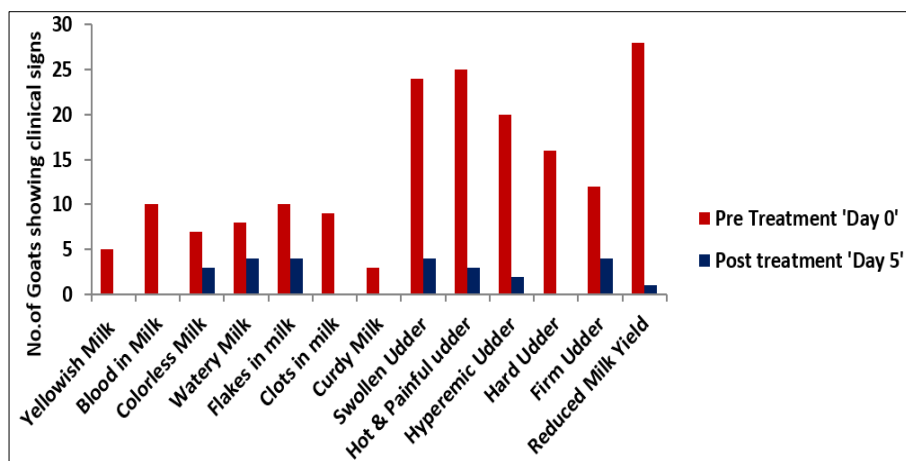


Fig 2: Milk & Udder Parameters in Goats affected with Mastitis

Consistency of udder was found as hard (53.33%) & firm udder (40.00%). Signs of inflammation of udder were recorded as swollen udder (80.00%), hot & painful udder (83.33%), Hyperemic udder (66.67%) & reduced milk yield (93.33%) as shown in table 2 & figure 2. Similar clinical signs were observed by Ganguly (2014) [12], Ya'u (2014) [36], Peter (2015) [23], Krishnappa (2016) [18] as Warm, swollen, hard, hyperemic, painful and hot affected udders with a grossly enlarged teat, palpation udder showed hard to touch, response to pain and the absence of milk from the affected quarter. Merz (2016) [20], Singh (2018) [32] reported sudden onset of swelling and redness of udder, pain, and reduced and altered milk secretion from the affected quarters, clots, flakes, watery consistency of milk. Danmallam *et. al.*,

(2019) [6], Garba (2019) [13], Shaheen *et. al.*, (2020) [30] and Poonia (2022) [24] recorded pain, heat, swelling, redness of udder with abnormal secretion of milk such as clots, flakes, or watery milk, Bluish-reddish tinge and spotty hemorrhages on udder, abnormalities of the milk like thick with foul-smelling yellow-green pus secretion, no milk letdown.

4.3 Milk pH & Electrical Conductivity of Milk

In present study, the mean $\pm$ S.E. value of milk pH of mastitis affected goats was found to be higher (7.02 ± 0.03) towards alkaline as compared to healthy goats (6.18 ± 0.07) which was found to be decreased to 6.56 ± 0.03 highly significantly ($p < 0.01$) post treatment as shown in table & figure no. 3.

Table 3: Milk pH & Electrical Conductivity of Healthy & Mastitis Affected Goats

Sr. No.	Parameters	Comparison of Mastitis affected Goats Pre-treatment (Day 0) and Post-treatment (Day 5)			
		Normal Ranges in Healthy Goats	Mastitis Affected Goats (n=30); Day 0 (Pre-treatment)	Goats treated (n=30); Day 5 (Post-treatment)	Test of Significance
1	Milk pH	Healthy Goats N=06 Day 0 6.18 ± 0.07	7.16 ± 0.05	6.55 ± 0.03	**
2	Electrical Conductivity of Milk (mS/cm)	6.55 ± 0.08	7.96 ± 0.12	7.06 ± 0.11	**

** ($p < 0.01$): Highly Significant

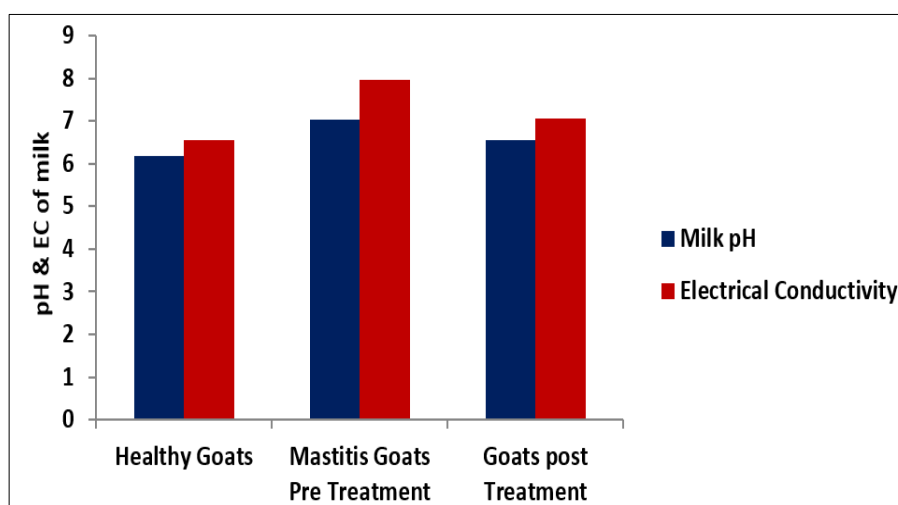


Fig 3: Milk pH & Electrical Conductivity of Healthy & Mastitis Affected Goats

The present research findings are in accordance with Fandialan and Davide (2001) [10], Ghosh (2004) [15], Samanta

(2006) [28], Sharma (2007) [41], Garg and Singh (2008) [14], Bagri (2018) [1]. A significant increase were recorded in pH

and acidity of subclinical mastitis milk samples as compared to normal milk samples was recorded by Modh (2018) [42] & Sinha (2018) [31] also recorded elevation in milk pH value in Subclinical Mastitis (SCM) cows (7.1 ± 0.01) as compared to the healthy cows (6.65 ± 0.01). Poonia (2022) [24] recorded significantly ($p < 0.01$) higher pH in mastitis animals towards alkalinity. Elevated milk pH during mastitis may be due to lower acidity which is associated with reduced lactose contents in mastitis milk. Increased milk pH in the mastitis may be related with high concentration of alkaline blood constituents such as sodium and bicarbonate ions which, due to inflammation of the mammary gland, increases permeability of the blood capillaries.

Similarly, the mean $\pm$ S.E. value of Electrical Conductivity (EC) of milk of mastitis affected goats was found to be higher (7.96 ± 0.12) as compared to healthy goats (6.55 ± 0.08) which was found to be decreased (7.06 ± 0.11) highly significantly ($p < 0.01$) post treatment as shown in table & figure no. 3. Similar findings were recorded by Diaz (2012) [7] that, EC increased with infection in Saanen goats (from 5.6 mS/cm in healthy animals to 5.8 mS/cm in infected ones), whereas EC decreased with infection in Alpine goats (from 6.1 mS/cm for healthy goats to 5.4 mS/cm in infected ones). Romero (2012) [7] observed the higher milk electric conductivity value in the SCM affected animals as compared to healthy animals. Sinha (2018) [31], Poonia *et al.*,

(2022) [24] demonstrated statistically significant ($p < 0.01$) increase in electric conductivity & pH. Gupta (2010) [43] reported a significant reduction in EC and pH values post treatment in subclinical mastitis affected animals. In present study, the electrical conductivity of milk is altered as a result of mammary gland inflammation in goats causing damage to the blood-milk barrier, allowing serum electrolytes to enter the milk (mostly salt and chlorine), increasing electrical conductivity.

4.4 Hematological Parameters

In the present hematological study, the mean $\pm$ SE value of hemoglobin (g/dl), PCV (%), TEC ($\times 10^6/\mu\text{l}$) and monocyte (%) in healthy goats were recorded as 9.28 ± 0.30 , 28.11 ± 0.95 , 14.47 ± 0.72 & 2.08 ± 0.52 respectively, which were found to be decreased in mastitis affected goats ($n=30$) as 6.53 ± 0.17 , 19.59 ± 0.49 , 10.42 ± 0.72 & 1.28 ± 0.16 respectively. Higher mean values of TLC & neutrophils were observed in mastitis affected goats (20.63 ± 1.46 & 70.19 ± 1.79) as compared to healthy goats (10.33 ± 1.15 & 41.53 ± 2.46 respectively), The mean $\pm$ SE value of lymphocyte% was found to be decreased in mastitis affected goats as compared to that of healthy goats (28.34 ± 1.68 vs. $55.72 \pm 2.32\%$), as per table & figure no 4.

Table 4: Hematological Parameters of Healthy & Mastitis Affected Goats

Sr. No.	Parameters	Healthy Goats N=06 Day 0	Mastitis Affected Goats (n=30) Day 0 (Pre-treatment)	Goats treated (n=30) Day 5 (Post-treatment)	Test of Significance
1	Hemoglobin (g/dl)	9.28 ± 0.30	6.53 ± 0.17	8.67 ± 0.26	**
2	Packed Cell Volume%	28.11 ± 0.95	19.59 ± 0.49	27.50 ± 0.67	**
3	Total Erythrocyte Count ($\times 10^6$)	14.47 ± 0.72	10.42 ± 0.72	12.76 ± 0.73	**
4	Total Leucocyte Count ($\times 10^3$)	10.33 ± 1.15	20.63 ± 1.46	18.20 ± 1.75	**
5	Lymphocyte%	55.72 ± 2.33	28.34 ± 2.43	29.70 ± 2.33	*
6	Monocytes%	2.08 ± 0.52	1.28 ± 0.16	1.51 ± 0.18	NS
7	Neutrophil%	41.53 ± 2.46	70.19 ± 2.52	68.31 ± 2.49	**

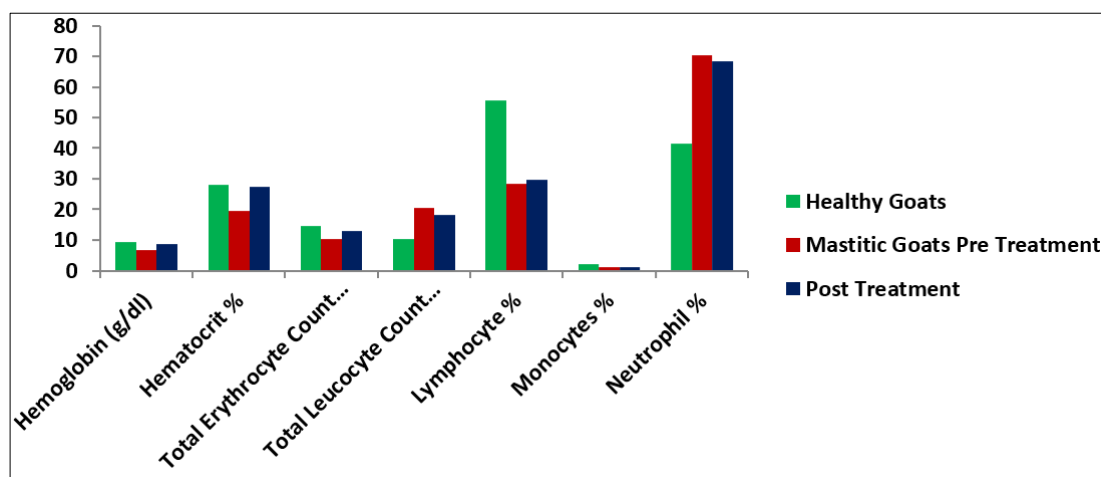


Fig 4: Hematological Parameters of Healthy & Mastitis Affected Goats

In present study, there was a significant decrease in the mean $\pm$ SE value of hemoglobin in mastitis affected goats than healthy goats. This decrease in hemoglobin level may be due to the defensive mechanism of mononuclear phagocyte system which increases iron trapping & storage, and reduces iron availability to microorganism causing mastitis which results in decrease in hemoglobin synthesis.

Decrease in packed cell volume of goats affected with mastitis in this study could be due to the decreased production of RBCs indicating microcytic hypochromic anaemia which is common in inflammatory disorders like mastitis. Total Erythrocyte Count ($\text{TEC} \times 10^6/\mu\text{l}$) decreased in mastitis affected goats as compared to the healthy goats. The substantial decrease in TEC of goats affected with

mastitis is due to inflammatory condition and influence of inflammatory cytokines responsible for mastitis, which causes iron trapping & storage leading less availability of iron to bacteria ultimately results into decrease in production of RBCs, i.e., decrease in TEC. Findings of present study are in accordance with El-Latif *et al.* (2010) [8], Yusuf *et al.* (2013) [37], Sadek *et al.* (2017) [44], Garba *et al.* (2019) [13] and Saleh *et al.* (2022) [27] who reported significant decrease ($p<0.05$) in hemoglobin%, packed cell volume%, significant decrease ($p<0.05$) in TEC of goats affected with mastitis of goats affected with mastitis. However, Garba *et al.* (2019) [13] recorded non-significant ($p>0.05$) effect on PCV ($27.96\pm1.31\%$) in mastitis affected goats as compared to healthy goats ($29.59\pm0.68\%$).

The TLC value of mastitis affected goats in all 30 goats was found to be higher as compared to healthy goats. Similarly, Garba *et al.*, (2019) [13] reported significant increase ($p<0.05$) in TLC values of goats affected with mastitis. Increased level of total leucocyte count in present study is due to migration of inflammatory cells which is usually associated with acute inflammatory reaction like mastitis. The mean ($\pm$ SE) value of lymphocytes (%) was decreased in mastitis affected goats as compared to the healthy goats. Significant decrease in lymphocyte% found in mastitis affected goats in present study i.e. lymphopenia is most likely the result of degree of inflammatory response at the systemic level, and stress induced increase in blood cortisol level, which have a secondary role in redistribution of re-circulating lymphocytes. The mean $\pm$ SE value of monocytes (%) was found to be decreased in mastitis

affected goats as compared to the healthy goats. However, El-Latif *et al.* (2010) [8], recorded significant increase in monocyte count in goats affected with clinical mastitis. The lack of significant differences in monocyte count could be attributed to phase & progression of disease as mastitis. The mean value of neutrophils (%) was found to be increased in mastitis affected goats as compared to the healthy goats. The results of present hematological investigations were in accordance with Radostits *et al.* (2007) [25], who stated marked leucopenia, neutropenia and degenerative shift to left in mastitis. El-Latif *et al.* (2010) [8], Yusuf *et al.* (2013) [37] & Koop *et al.* (2016) [17] reported neutrophilia and lymphopenia in mastitis goat. Similar findings were recorded by Krishnappa *et al.* (2016) [18], Tripathy (2018) [34], Gabli *et al.* (2019) [11], Garba *et al.* (2019) [13], and Saleh *et al.* (2022) [27], who observed significant increase ($p<0.05$) in neutrophil count. In present study, increased level of neutrophils found may be caused by various immunomodulatory effects due to increased demand of leucocyte in infected udder. Neutrophilia & degenerative shift to left occurs due to migration of large number of neutrophils into the affected udder. Stress associated condition could have also played role in development of neutrophilia. In this study, neutrophilia could be due to degree of inflammatory responses at the systemic levels shown by goats infected with mastitis.

4.5 Cytokine Analysis

The mean $\pm$ S.E. value of IL-6 & IL-10 of healthy & mastitis affected goats are recorded in table & figure no 5.

Table 5: Cytokine Study of Healthy & Mastitis Affected Goats

Sr. No.	Normal Ranges in Healthy Goats		Comparison of Mastitis affected Goats Pre-treatment (Day 0) and Post-treatment (Day 5)		
	Parameters	Healthy Goats N=06 Day 0	Mastitis Affected Goats (n=30) Day 0 (Pre-treatment)	Goats treated (n=30) Day 5 (Post-treatment)	Test of Significance
1	Interlukin-6 (pg/ml)	349.18 $\pm$ 7.77	611.35 $\pm$ 8.71	474.82 $\pm$ 9.29	**
2	Interlukin-10(pg/ml)	773.06 $\pm$ 19.60	556.17 $\pm$ 8.23	643.54 $\pm$ 7.63	**

** ($p<0.01$): Highly Significant

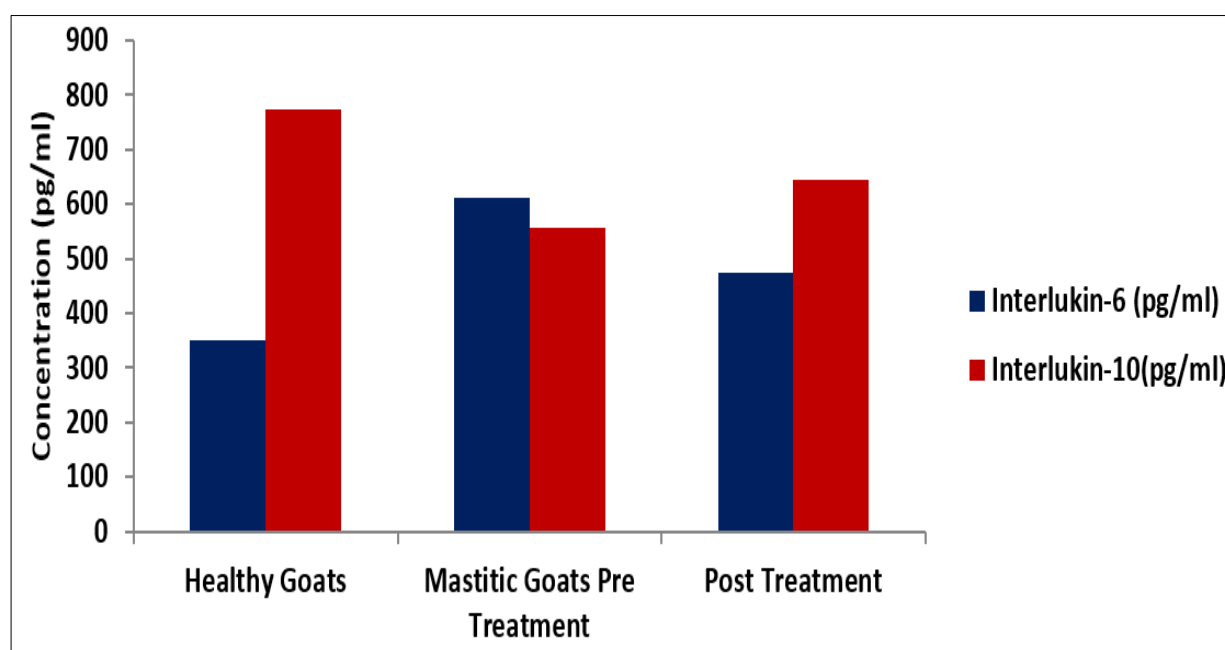


Fig 5: Cytokine Study of Healthy & Mastitis Affected Goats



Fig 1: Unilateral inflammation of udder

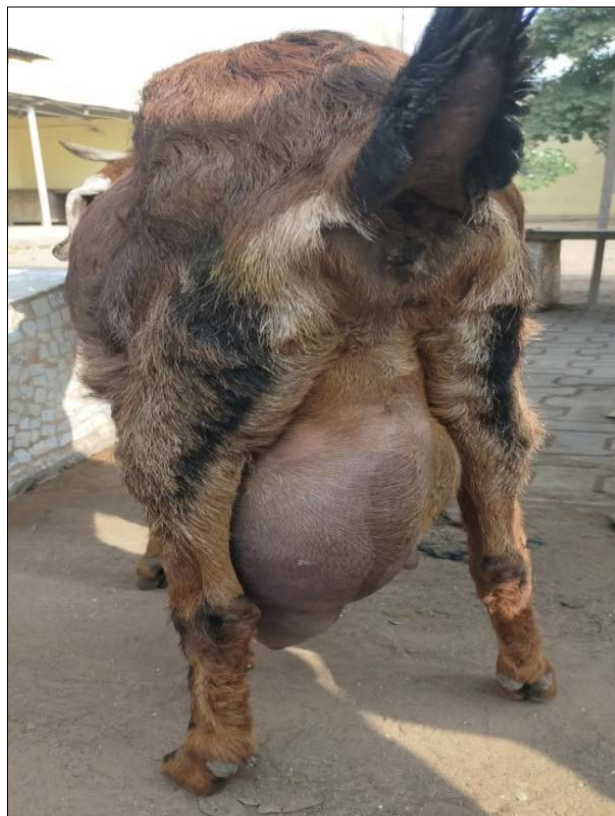


Fig 2: Bilateral inflammation of udder



Fig 3: Examination of Udder Consistency of goat



Fig 4: Examination of Inflammatory Udder of Goat



Fig 5: Collection of infected milk from goat affected with mastitis

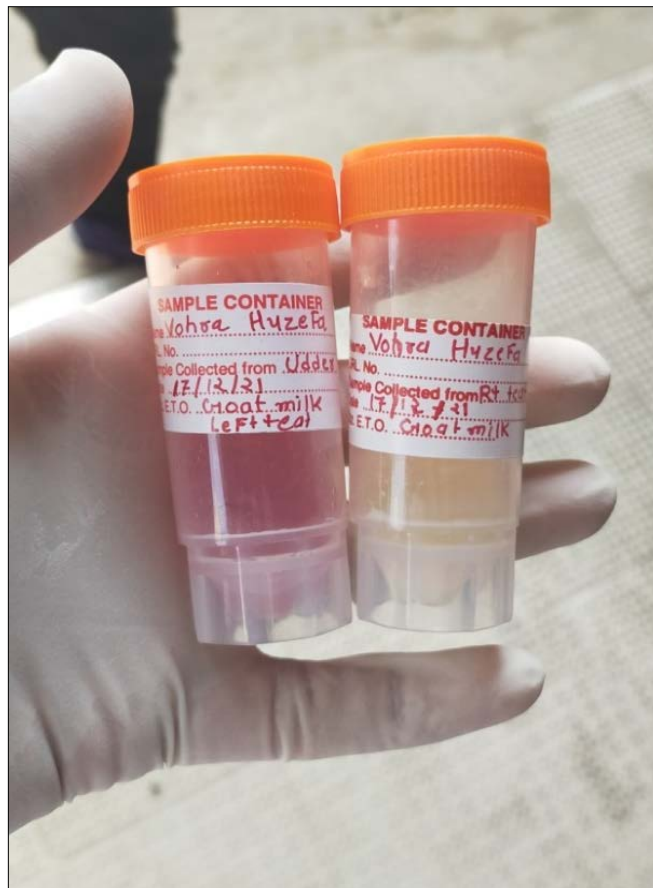


Fig 6: Abnormal color of milk in mastitis



Fig 7: Measurement of pH of milk



Fig 8: Measurement of electrical conductivity of milk

**Fig 9:** Blood Collection from goat affected with mastitis**Fig 10:** Serum separation in Centrifuge machine**Fig 11:** Reagents & Kits required for Sandwich ELISA IL-6 & IL-10**Fig 12:** ELISA Microplate Reader

The mean $\pm$ S.E. value of IL-6 found to be higher in mastitis affected goats (611.35 ± 12.44) as compared to the mean $\pm$ S.E. value of IL-6 in healthy goats (349.19 ± 7.77) which was decreased highly significantly ($p < 0.01$) post treatment as per table & figure no 5. Present findings correlates with the findings of Sakemi *et. al.*, (2011)^[26], El-Deeb (2013)^[45], Bayoumi *et. al.*, (2016)^[4], Nayan (2012)^[22], Saleh (2022)^[27], Vitenberga *et. al.*, (2022)^[35] who also observed significant ($p \leq 0.05$) increase in the levels of IL-6 in mastitis affected animals. Significant rise in the level of IL-6 in the serum samples of goats affected with mastitis in the present study established the presence of the inflammatory cytokine IL-6 to be immediately associated with inflamed mammary glands at the onset of mastitis.

The mean $\pm$ S.E. value of IL-10 was found to be lower in mastitis affected (556.17 ± 6.99) goats on 'day 0' as compared to the mean value of IL-10 in healthy goats (773.06 ± 19.60) which was found to be increased (643.54 ± 7.63) highly significantly ($p < 0.01$) post treatment on 'day 5'. The present findings are coincident with the results of Bannerman (2009) and Shaheen (2020)^[30] recorded marked reduction ($p < 0.001$) in IL-10 levels in clinical mastitis when compared to normal lactating cows however, Faaz and Abdullah (2022)^[9] recorded significantly higher ($p < 0.001$) expression of the IL-10 gene in mastitis-affected cows than non-infected animals in the investigation of IL-10 cytokine genes in mastitis originated from bacteria. Sulabh (2022)^[33] identified the interleukin 10 (IL-10) as an important cytokine for the control of immune response. In this study, IL-10 as an anti-inflammatory cytokine countered the effects of pro-inflammatory cytokines and caused their excessive release which resulted in giving protection to the tissues against harmful effects of pro-inflammatory cytokine release and thus helped in a more balanced regulation by shifting the immune response towards a more controlled outcome.

Conclusion

Mastitis is a life threatening disease in goats due to inflammatory processes in mammary glands which causes exudations & cellular infiltrations which results into the altered blood cellular count. There found a significant fluctuation in clinico-hemato-cytokine & milk parameters in goats affected with mastitis. The changes in hematological parameters can be used as important indicators of physiological or pathological state of mastitis in goats. Cytokine have role in both inflammation & leukocyte migration. Cytokine facilitates the alignment of leukocyte to inflammatory areas produced in response to bacterial infection. In this study, the concentration of both cytokine is positively correlated with the severity of inflammation. Hence, Detection of IL-6 & IL-10 could be the future prediction marker for mastitis. Hence, the changes in clinical signs, hematological, biochemical (Cytokine IL6 & IL10) & milk parameters (pH, EC) can be used as important indicators of physiological or pathological state of mastitis in goats.

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Conflict of Interest: None

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