



International Journal of Veterinary Sciences and Animal Husbandry



ISSN: 2456-2912

NAAS Rating (2025): 4.61

VET 2025; 10(12): 14-16

© 2025 VET

www.veterinarypaper.com

Received: 18-10-2025

Accepted: 19-11-2025

R Selva Rani

Assistant Professor, Department of
Veterinary Physiology and
Biochemistry, VCRI, Orathanadu,
Tamil Nadu, India

Understanding acute phase proteins: Key players in *E. coli* and *S. aureus* mastitis in Sahiwal and Karan fries COWS

R Selva Rani

DOI: <https://www.doi.org/10.22271/veterinary.2025.v10.i12a.2782>

Abstract

Mastitis is the most common and economically harmful health issue impacting dairy cattle globally. Severity of mastitis varies with the causative pathogen, and this variation is reflected in the concentrations of key inflammatory biomarkers in milk. This study investigated the concentrations of key APPs, Serum Amyloid A (SAA) and Haptoglobin (HP) in both plasma and milk of Sahiwal and Karan Fries cows naturally infected with *Escherichia coli* and *Staphylococcus aureus*. Mastitis screening in 165 cows identified 24 Sahiwal and 24 Karan Fries animals, comprising both clinical and subclinical cases. Bacteriological examination revealed *S. aureus* as the predominant pathogen in both breeds, followed by *E. coli*. Quantification of APPs demonstrated consistently higher concentrations of SAA and Hp in *E. coli* infected cows compared to those infected with *S. aureus*, in both serum and milk. Overall, the results highlight the diagnostic and prognostic value of APPs as sensitive biomarkers capable of differentiating pathogen-specific inflammatory responses in mastitis. Their integration into routine screening could enhance early detection and severity assessment in dairy herds.

Keywords: *Escherichia coli*, *Staphylococcus aureus*, dairy herds, understanding, phase proteins, severity assessment

Introduction

A group of proteins known as "acute phase proteins" show changes in their blood plasma levels during inflammatory reactions; some of these proteins increase (referred to as positive acute phase proteins) while others decrease (referred to as negative acute phase proteins). The term "acute phase response" describes a collection of nonspecific host reactions to different stimuli that are typified by variations in the concentrations of certain acute phase proteins, which are plasma proteins produced by the liver (Baumann and Gauldie, 1994) [2]. The degree of tissue damage or infection is closely correlated with the amount of APP in the blood (Murata *et al.*, 2004) [11]. It is crucial for preserving or regaining homeostasis and preventing microbial growth in animals prior to the host producing antibodies following trauma, inflammation, or infection (Murata *et al.*, 2004) [11].

The importance of haptoglobin and serum amyloid A in the diagnosis and prognosis of mastitis, endometritis, enteritis, peritonitis, pneumonia, and endocarditis was emphasized by Eckersall and Bell (2010). Additionally, the infected mammary gland secretes SAA and Hp (Eckersall *et al.*, 2006) [5]. Eckersall and Bell (2006) [5] demonstrated and cited APP in serum and milk samples as potential markers of mastitis under both natural and experimental circumstances. Their low concentration in healthy animals, their quick rise during the acute phase of inflammation, and their quick fall as the illness resolves make them potentially helpful as disease markers (Gruys *et al.*, 1994) [10].

The two most significant acute phase proteins in cattle are serum amyloid A and haptoglobin, which are either absent or produced in relatively small amounts in healthy cows but in large quantities in bacterial or viral diseases (Murata *et al.*, 2004) [11]. Although these biomarkers lack specificity, they are very sensitive indicators of inflammation.

Corresponding Author:

R Selva Rani

Assistant Professor, Department of
Veterinary Physiology and
Biochemistry, VCRI, Orathanadu,
Tamil Nadu, India

Pedersen *et al.* (2003) [12] and Gronlund *et al.* (2005) [8] investigated APP concentrations in milk with various infections. The quantities of Hp were highest in mastitis produced by *A. pyogenes*, and SAA was highest in mastitis induced by *E. coli*. The concentrations of APPs were low in cases of CNS-induced mastitis. In general, the streptococcal groupings had higher APP concentrations than the *S. aureus* group.

Materials and Methods

Initial screening of infected cows for clinical or subclinical mastitis was carried out on 92 KF and 73 Sahiwal cows at the Livestock Research Centre (LRC) of NDRI in Karnal, Haryana. The milk of these cows was tested by modified California Mastitis Test (mCMT) for identification of sub-clinical mastitis. Cows suffering from clinical mastitis were diagnosed on the basis of clinical symptoms. Out of 165 animals, we randomly selected 24 Sahiwal and 24 KF which included 12 clinical and 12 subclinical cases. Blood samples (~10ml) were drawn in sterile heparinised vacutainer from each cow by jugular vein puncture. The plasma was separated by centrifugation at 3000 rpm for 15 minutes. The samples of composite milk (representing all four quarters) were collected from SCM and CM-affected cows. A part of whole milk and skimmed milk (obtained after centrifugation at 3000 rpm for 20 minutes at 4 °C) were stored at -20 °C for analysis of acute phase proteins. Bacteriological analyses were performed as per the standard procedures. Plasma and milk SAA was determined by "Bovine SAA ELISA kit" (catalogue No: E0023Bo) obtained from Bioassay Technology Laboratory. Plasma and milk Haptoglobin was determined by "Bovine Hp ELISA kit" (Catalogue No E0022Bo) obtained from Bioassay Technology Laboratory. For microbiological assessments, EMB agar was utilized for the isolation of *E. coli*, while MSA (Mannitol salt agar) was used for isolating *Staphylococcus aureus*, with both products obtained from Hi-Media and TM Media Company, respectively. Data were analysed by unpaired t-test utilizing the GraphPad Prism software package.

Results and Discussion

The findings of microbiological analysis indicated that two types of bacteria were predominantly identified in the milk samples of both breeds: *Staphylococcus aureus* and *Escherichia coli* (Surya *et al.*, 2021) [19].

Distribution of mastitogens in NDRI farm

	Sahiwal	Karan Fries
<i>S. aureus</i>	83.33%	91.66%
<i>E. coli</i>	16.67%	8.33%

A prevalent type of bovine mastitis in the world is staphylococcal mastitis, which is typically brought on by *Staphylococcus aureus*. *Staphylococcus aureus* was found to be responsible for around 90% of new udder infections, including both clinical and subclinical mastitis. *Staphylococcus aureus* was identified by Fox and Gay (1993) [6] as a primary cause of infectious cow mastitis. Sentitula *et al.* (2012) [16] discovered that 43.3% of mastitic milk samples from the NDRI herd tested positive for *Staphylococcus* utilizing biochemical and PCR-based techniques.

Variations in plasma and milk acute phase proteins of sahiwal and Karan Fries cows infected with different

mastitogens

Breed	Mastitogen	N	Plasma		Milk	
			SAA (µg/ml)	Hpt (mg/ml)	SAA (µg/ml)	Hpt (mg/ml)
Sahiwal	<i>S. aureus</i>	20	25.23±1.77	0.87±0.12	0.48±0.02	5.23±0.85
	<i>E. coli</i>	4	33.52±2.20	1.52±0.26	0.54±0.04	9.46±2.60
Karan Fries	<i>S. aureus</i>	22	26.30±1.28	1.02±0.14	0.53±0.01	5.37±0.69
	<i>E. coli</i>	2	33.39±2.29	1.72±0.70	0.59±0.09	13.71±2.53

The aforementioned table clearly shows that cows infected with *E. coli* had numerically larger levels of acute phase proteins in both milk and plasma. Coliform mastitis is the most dangerous type of mastitis, according to the levels. One of the main causes of acute mastitis in dairy cows is *E. coli* (Suriyasathaporn *et al.*, 2000) [18]. The findings of Suriyasathaporn *et al.* (2000) [18] and Pyorala and Taponen (2009) [13] are consistent with our data. Hpt and SAA levels differed according to the type of pathogen in the current study. Our findings concur with the Pyorala *et al.* (2011) research. These authors also showed how the type of pathogen isolated affected the Hp and SAA concentrations in the milk. SAA concentrations were substantially greater ($p<0.05$) in *E. coli*-caused mastitis samples than in *S. aureus*, *A. pyogenes*, and CNS samples. Compared to *S. aureus* and CNS, *E. coli* mastitis had considerably higher ($p<0.05$) Hpt concentrations. According to Pyorala *et al.*, (2011), instances of mastitis brought on by a *pyogenes* and *E. coli* had the greatest quantities of Hpt. Clinically severe forms of mastitis are known to be caused by these infections. The concentrations of a number of indicators, such as Hpt, LBP, and lactate dehydrogenase activity in milk, were considerably greater in samples of spontaneous clinical mastitis caused by Gram-negative bacteria than in samples produced by Gram-positive bacteria (Wenz 2010) [20]. The mean peak concentrations of Hp and SAA in the milk increased in a *S. aureus* subclinical mastitis, peaking with a mean of 115 mg/l and 540 mg/l, respectively (Eckersall *et al.*, 2006) [5]. In experimental mastitis caused by *E. coli*, mean peak concentrations of Hpt and SAA in the milk were as high as 600 mg/l and 1315 mg/l, respectively (Suojala *et al.*, 2008) [17].

Conclusion

The current study shows that in both Sahiwal and Karan Fries cows, acute phase proteins specifically, Serum Amyloid A (SAA) and Haptoglobin (HP) serve as extremely sensitive markers of mastitis severity and pathogen type. Compared to *Staphylococcus aureus*, *Escherichia coli* infections produced noticeably larger amounts of these biomarkers in milk and plasma, supporting the more severe inflammatory response linked to coliform mastitis. The results are consistent with previous studies that demonstrate Gram-negative pathogens elicit a more potent acute-phase response than Gram-positive organisms. The distinct differences in APP levels among pathogens demonstrate their usefulness in identifying clinical severity, facilitating early diagnosis, tracking the course of disease, and directing more focused therapeutic measures. Therefore, by enabling prompt and pathogen-specific responses to mastitis outbreaks, integrating APP profiling into routine mastitis surveillance may improve herd health management.

Conflict of Interest: Not available

Financial Support: Not available

Reference

- Ahmad J, Hussain I, Mahmood N, Munir R. Lactose determination as an aid to subclinical mastitis diagnosis. Pak Vet J. 1988;8:25-28.
- Baumann H, Gauldie J. The acute phase response. Immunol Today. 1994;15(2):74-80.
- Eckersall PD, Bell R. Acute phase proteins: biomarkers of infection and inflammation in veterinary medicine. Vet J. 2010;185(1):23-27.
- Eckersall PD, Young FJ, McComb C, Hogarth CJ, Safi S, Weber A, *et al.* Acute phase proteins in serum and milk from dairy cows with clinical mastitis. Vet Rec. 2001;148(2):35-41.
- Eckersall PD, Young FJ, Nolan AM, Knight CH, McComb C, Waterston MM, *et al.* Acute phase proteins in bovine milk in an experimental model of *Staphylococcus aureus* subclinical mastitis. J Dairy Sci. 2006;89(5):1488-1501.
- Fox LK, Gay JM. Contagious mastitis. Vet Clin North Am Food Anim Pract. 1993;9(3):475-187.
- Gånheim C, Alenius S, Waller KP. Acute phase proteins as indicators of calf herd health. Vet J. 2007;173(3):645-651.
- Gronlund U, Hulten C, Eckersall PD, Hogarth C, Persson Waller K. Haptoglobin and serum amyloid A in milk and serum during acute and chronic experimentally induced *Staphylococcus aureus* mastitis. J Dairy Res. 2003;70:379-86.
- Grönlund U, Sandgren CH, Waller KP. Haptoglobin and serum amyloid A in milk from dairy cows with chronic subclinical mastitis. Vet Res. 2005;36(2):191-198.
- Gruys E, Toussaint MJM, Niewold TA, Koopmans SJ. Acute phase reaction and acute phase proteins. J Zhejiang Univ Sci B. 2005;6(11):1045-1056.
- Murata H, Shimada N, Yoshioka M. Current research on acute phase proteins in veterinary diagnosis: An overview. Vet J. 2004;168(1):28-40.
- Pedersen LH, Aalbaek B, Røntved CM, Ingvarsen KL, Sorensen NS, Heegaard PM, *et al.* Early pathogenesis and inflammatory response in experimental bovine mastitis due to *Streptococcus uberis*. J Comp Pathol. 2003;128(2-3):156-64.
- Pyörälä S, Taponen S. Coagulase-negative staphylococci: emerging mastitis pathogens. Vet Microbiol. 2009;134(1-2):3-8.
- Pyörälä S, Hovinen M, Simojoki H, Fitzpatrick J, Eckersall PD, Orro T. Acute phase proteins in milk in naturally acquired bovine mastitis caused by different pathogens. Vet Rec. 2011;168(20):535.
- Radostits OM, Gay CC, Hinchcliff KW, Constable PD. Diseases associated with bacteria III. In: Veterinary Medicine: A Textbook of the Diseases of Cattle, Sheep, Pigs, Goats and Horses. 10th ed. Saunders; 2007, p. 847-919.
- Sentitula YR. Incidence of *Staphylococci* and *Streptococci* during winter in mastitic milk of Sahiwal cow and Murrah buffaloes. Indian J Microbiol. 2012;52:153-9.
- Suojala L, Orro T, Järvinen H, Saatsi J, Pyörälä S. Acute phase response in two consecutive experimentally induced *E. coli* intramammary infections in dairy cows. Acta Vet Scand. 2008;50(1):18.
- Suriyasathaporn W, Schukken YH, Nielsen M, Brand A. Low somatic cell count: A risk factor for subsequent clinical mastitis in a dairy herd. J Dairy Sci. 2000;83(6):1248-1255.
- Surya T, Selvarani R, Singh NP, Koloi S, Mohan M, Mohapatra SK. A pilot study on identification of infectious mastitogen responsible for mastitis in Sahiwal and Karan Fries. Pharma Innov J. 2021;SP10(7):846-848.
- Wenz JR, Fox LK, Muller FJ, Rinaldi M, Zeng R, Bannerman DD. Factors associated with concentrations of select cytokines and acute phase proteins in dairy cows with naturally occurring clinical mastitis. J Dairy Sci. 2010;93(6):2458-2470.

How to Cite This Article

Rani RS. Understanding acute phase proteins: Key players in *E. coli* and *S. aureus* mastitis in Sahiwal and Karan fries cows. International Journal of Veterinary Sciences and Animal Husbandry. 2025;10(12):14-16.

Creative Commons (CC) License

This is an open-access journal, and articles are distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 International (CC BY-NC-SA 4.0) License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.