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Review

# Acute phase proteins in ruminants☆

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ABSTRACT

The physiological response to infections and injuries involves local inflammation and the initiation of events leading to a systemic response, also called acute phase reaction (APR). This multiplicity of changes is distant from the site of injury, and includes fever, leukocytosis and quantitative and qualitative modification of a group of non-structurally related proteins present in blood and other biological fluids, collectively named Acute Phase Proteins (APP). Proteomic investigations of serum or plasma following natural or experimental infection frequently reveal substantial alterations in the APP, several of which are high abundance proteins in these fluids. The present review will focus on the results of recent research on ruminant APP. Highlight points will include:

- The structure and the functions of the main APPs in ruminants, as well as the regulatory mechanisms that trigger their systemic and local expression in both physiological and pathological conditions.
- The clinical aspects of APPs in ruminants, including the current and future application to veterinary diagnosis and animal production.
- The APP in small and wildlife ruminants.
- Alteration in APP detected by proteomic investigations.

This article is part of a Special Issue entitled: “Farm animal proteomics”.


## Contents



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## 1. The systemic reaction during inflammation

Local inflammation is the first response of the immune system to noxious stimuli. When infections and tissue injuries overwhelm local defenses, the organism responds by activating a wide ranging systemic response [1]. These events are collectively referred to as "the acute phase reaction". More properly, the right definition should be "systemic reaction to inflammation", because they may accompany both acute and chronic inflammation. These changes, distant from the site of inflammation, involve many organs and include a large number of behavioral, physiologic, biochemical and nutritional changes. The most evident phenomena include fever, leukocytosis, and the over- or under-expression of a large family of structurally un-related proteins (Table 1), the acute phase proteins (APP) [2,3]. It is a highly coordinated process where several cell types and a network of proteins initiate, amplify, sustain, control and eventually resolve the inflammatory reaction.

### 1.1. *The triggering and regulation of the systemic reaction to inflammation*

The systemic reaction to inflammation is triggered by external (pathogen associated molecular patterns—PAMP) and internal (damaged associated molecular pattern—DAMP) stimuli. Pathogen associated molecular patterns are microbial structures recognized by blood and cell associated proteins. These molecules, that include exo- and endo-toxins, polysaccharides and mannans, are shared by pathogens such as Gram$^+$ and Gram$^-$ bacteria, as well as some fungi and viruses [4]. Damaged associated molecular patterns are derived from mitochondria, nucleus, endoplasmic reticulum and other intracellular compartments [5]. DAMP are released after cell death or injury, and are recognized by the innate immune system by pattern recognition receptors that, in many cases, are the same that recognize PAMP.

A family of membrane-bound molecules, the Toll Like Receptors (TLR), plays a central role in distinguishing different