

The Arc of Balanced Immunity, guided by beta-1,3/1,6-glucans

By Pauline Rovers-Paap, Principal Relations Manager, Orffa Additives, the Netherlands

A wellfunctioning immune system is a cornerstone of health and productivity in livestock. Shaped by millions of years of evolution, the immune system continuously protects animals by recognizing threats, neutralizing pathogens, and restoring physiological balance after stress or injury. In modern livestock production, however, animals are exposed to an increasing number of immune challenges that can place significant pressure on this finely tuned system.

From early life through peak production and into later stages, poultry, pigs and ruminants encounter multiple stressors such as vaccination programmes, dietary transitions, high stocking densities, environmental fluctuations, pathogen exposure and physiological demands related to growth, reproduction and lactation. These challenges are often first reflected in immune function. When immune balance is disrupted, animals may become more susceptible to infections, experience prolonged inflammatory responses, or show inconsistent performance across a production cycle.

The visible consequences of immune imbalance in livestock may include reduced growth rate, impaired feed efficiency, increased morbidity, higher medication use, delayed recovery after disease or stress events, and variability in production results. Underlying these effects are two fundamental biological extremes: an immune system that is insufficiently responsive and one that reacts excessively.

Optimal immune function lies within the arc of balanced immunity (figure 1), between insufficient and excessive activation. While inadequate immune responsiveness increases susceptibility to (pathogenic) infections and weak vaccine responses, excessive immune activation drives chronic inflammation, tissue damage and elevated metabolic costs, redirecting energy and nutrients (e.g. amino acids, micronutrients) away from growth, reproduction and production towards prolonged immune processes. Supporting the immune system towards this balanced state is therefore essential for sustainable animal performance.



Figure 1: Optimal immune function lies within the 'Arc of balanced immunity'

UNDERSTANDING THE IMMUNE SYSTEM

All livestock species rely on three core immune principles: recognition of threats, processing of immune signals and effective elimination of pathogens. These processes are organized into three interconnected defense layers. Physical barriers such as the skin, respiratory epithelium and intestinal lining form the first line of defense. Innate immunity provides rapid, nonspecific protection, while adaptive immunity supplies targeted and longlasting responses through immunological memory.

A central role is played by the gastrointestinal tract. More than 70%

of immune cells are located in gut-associated lymphoid tissue, where the immune system continuously interacts with dietary components, commensal microbiota, and environmental antigens. As a result, immune competence in livestock is closely linked to intestinal health and nutrition.

When immune balance is disturbed—either through insufficient activation or excessive responsiveness—production animals may show increased sensitivity to enteric and respiratory pathogens, prolonged inflammatory challenges following infections, and reduced resilience during periods of stress. Nutritional strategies that support balanced immunity therefore contribute directly to health stability, robustness and consistency of performance in commercial production systems.

WHAT ARE BETA1,3/1,6GLUCANS?

Beta1,3/1,6glucans are among the most extensively studied natural molecules with a demonstrated positive influence on immune function across multiple animal species. Their ability to interact directly with the immune system and modulate host defense responses has been documented in a broad range of experimental and field studies.

Glucans are carbohydrate polymers composed solely of glucose units. Their biological activity is determined entirely by the type and orientation (figure 2) of the chemical bonds between these glucose molecules. Common glucans such as starch (alpha1,4 linkages) or cellulose (beta1,4 linkages) serve as energy or structural components but do not exert immunomodulating effects.

In contrast, yeast-derived beta1,3/1,6glucans possess a unique molecular structure that is recognized by the immune system. These glucans consist of a beta1,3linked backbone with beta1,6linked side branches, a structure naturally present in the cell wall of *Saccharomyces cerevisiae*.

The immunomodulating efficacy of beta1,3/1,6glucans depends on several critical structural parameters, including backbone length, degree of branching and, importantly, purity. When these characteristics are preserved, beta1,3/1,6glucans enhance the responsiveness of innate immune cells and improve communication with the adaptive immune system, enabling animals to respond more efficiently to immune challenges and restore balance more rapidly.

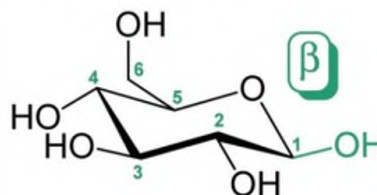


Figure 2: Structure of a glucose molecule illustrating beta-oriented linkages

THE IMPORTANCE OF REMOVING THE MANNAN-PROTEIN LAYER

Not all yeast-derived products deliver the same biological effects. In whole yeast cell wall materials (Figure 3), beta1,3/1,6glucans are naturally covered by an outer mannan-protein layer rich in mannanoligosaccharides

(MOS). This layer can bind certain pathogenic bacteria and toxins in the gut, contributing to intestinal hygiene, but it also masks the betaglukan structure from immune recognition.

As a result, MOSrich yeast products predominantly act through pathogen binding rather than direct immune modulation. Their bioactivity therefore differs fundamentally from that of purified beta1,3/1,6glucans.

Carefully purified betaglucans undergo controlled processing steps that remove the mannan–protein layer while preserving the integrity of the native beta1,3/1,6glucan structure. This purification exposes the biologically active molecule, allowing immune cells to recognize and respond to it effectively.



Figure 3: The mannanoligosaccharide layer covers the beta1,3/1,6glucan layer in whole yeast cell wall products

HOW BETA1,3/1,6GLUCANS ARE RECOGNIZED BY THE IMMUNE SYSTEM

Innate immune cells such as macrophages, neutrophils and dendritic cells form the body's early warning system. These cells are equipped with specialized receptors designed to detect conserved carbohydrate structures found in microbes, including purified beta1,3/1,6glucans (Figure 4).

When these glucan structures are recognized, innate immune cells enter a heightened state of preparedness. Phagocytic activity increases, antimicrobial mechanisms are activated more efficiently and cytokine signaling helps coordinate subsequent immune responses. At the same time, antigenpresenting cells improve communication with the adaptive immune system, strengthening the overall quality of immune responses.

This process is often described as immune training or modulation. Importantly, it enhances immune readiness without triggering excessive inflammatory reactions. In production animals, such balanced immune activation supports effective disease defense while minimizing unnecessary energy and nutrient costs associated with chronic inflammation.

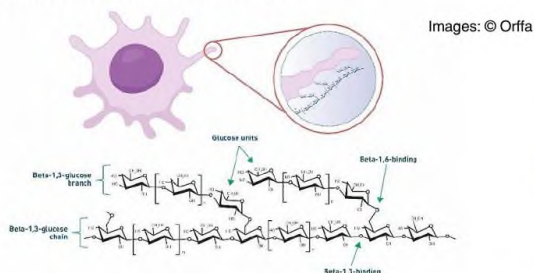


Figure 4: Recognition of the specific beta1,3/1,6glucan structure by immune cells

EXCENTIAL RESILIA: MODERN, SCIENCEBASED IMMUNE SUPPORT FOR LIVESTOCK

Excential Resilia represents a next generation of beta1,3/1,6glucanbased immune support ingredients. Its advanced

purification process ensures that the beta1,3/1,6glucan retains its native structure. Building on decades of scientific research, it combines controlled purification, high consistency and preserved molecular structure to deliver reliable biological performance in animal nutrition.

By supporting immune systems towards a balanced state, Excential Resilia helps production animals respond more efficiently to health challenges, maintain controlled inflammatory processes, and recover more rapidly after stressful events such as transport, dietary transitions or environmental changes. Below, selected examples are presented to illustrate the effects of purified beta1,3/1,6glucans on immune function and performance in poultry, swine and ruminants.

Poultry

In poultry, balanced immune modulation supports animal robustness, vaccine responses, and consistency of performance during periods of elevated infection pressure. Studies in laying hens have shown that dietary inclusion of beta1,3/1,6glucans improves intestinal integrity, reduces inflammatory cell infiltration, and helps stabilize production in birds affected by chronic enteritis. By supporting a more controlled immune response at the gut level, immune modulation contributes to maintaining productivity and resilience under chronic, low-grade inflammatory challenges.

Swine

In swine, balanced immune support is particularly important during early life stages and around weaning, when the gastrointestinal tract is highly susceptible to disruption. Experimental challenges with enterotoxigenic *Escherichia coli* (ETEC) in weaned piglets demonstrated that beta1,3/1,6glucan supplementation reduces pathogen excretion, shortens the duration and severity of diarrhoea, and supports the development of local intestinal immunity. These effects contribute to improved gut stability, faster recovery, and greater resilience across critical production phases.

Ruminants

In ruminants, immune modulation is essential for maintaining health during metabolically demanding periods such as the dry period and the first weeks after calving in dairy cattle, as well as calves, exposed to stressors like transport and group reallocation. Field trials in fattening calves under commercial conditions characterized by respiratory and enteric challenges showed that supplementation with beta1,3/1,6glucans markedly reduced mortality, and medication use while supporting overall robustness. By helping to stabilize immune function during early life and other highstress periods, immune modulation contributes to more consistent health outcomes and improved production resilience.

As previously mentioned, achieving a balanced immune system decreases the background inflammatory load. This approach conserves energy, enabling nutrients to be allocated more efficiently toward growth, reproduction, and productivity instead of sustaining extended immune responses.

CONCLUSION

Beta1,3/1,6glucans are among the most extensively researched natural immunesupport ingredients in animal nutrition. Their unique molecular structure enables direct interaction with innate immune cells, strengthening immune readiness while supporting controlled, balanced inflammatory responses.

Excential Resilia demonstrates how refined purification and structural integrity transform yeastderived betaglucans into a precise nutritional tool for modern livestock production. By supporting the arc of balanced immunity, Excential Resilia contributes to robustness, consistency and sustainable performance across poultry, swine, and ruminant production systems.