

Building Resilience from the Start: How Early Nutrition Shapes Immune Development in Young Animals

Pauline Rovers-Paap and Jolien van Soest

Young animals grow at an exceptional rate, yet their biological defense systems are still developing. Piglets, calves and chicks all face multiple early-life challenges, including abrupt dietary transitions, social and environmental stressors, high pathogen exposure and the gradual transition from passive to active immunity. Across species, three shared biological characteristics define this stage: an immature immune system, limited antioxidant capacity, and high metabolic activity. Combined, these create a natural vulnerability to oxidative stress and inflammatory dysregulation.

During key events such as weaning, vaccination and early gut colonization, reactive oxygen species increase, while immune pathways are still maturing in their ability to distinguish between genuine threats and harmless stimuli. When this balance is disrupted, valuable energy is diverted away from growth, gut integrity may be compromised and disease susceptibility increases. Nutrition therefore plays a crucial regulatory role, not by overstimulating immunity, but by ensuring an appropriate and balanced response.

Modern nutritional strategies increasingly recognize that supporting early-life immune self-protection is essential. The focus is shifting from simply maximizing growth towards actively building resilience, thereby preserving energy for growth under healthy conditions. Two complementary nutritional approaches are central to this concept: enhancing selenium-dependent antioxidant protection and guiding immune development through targeted modulation. Together, specific selenium sources (e.g. Excential Selenium 4000; Orffa Additives BV) and immune-modulating β -1,3/1,6-glucans (Excential Resilia; Orffa Additives BV) illustrate how nutrition can shape robustness from the very beginning of life.

Bridging the immunity gap starts before life begins

One of the most critical challenges in early-life nutrition is the so-called ‘immunity gap’, a short but decisive window during which young animals are particularly vulnerable (*Figure 1*). At hatch or birth, chicks, piglets and calves depend heavily on maternal immunity provided via egg, colostrum or milk. While this passive protection is essential, it declines over time. Meanwhile, the young animal’s own immune system is still immature and only gradually develops towards full functionality.

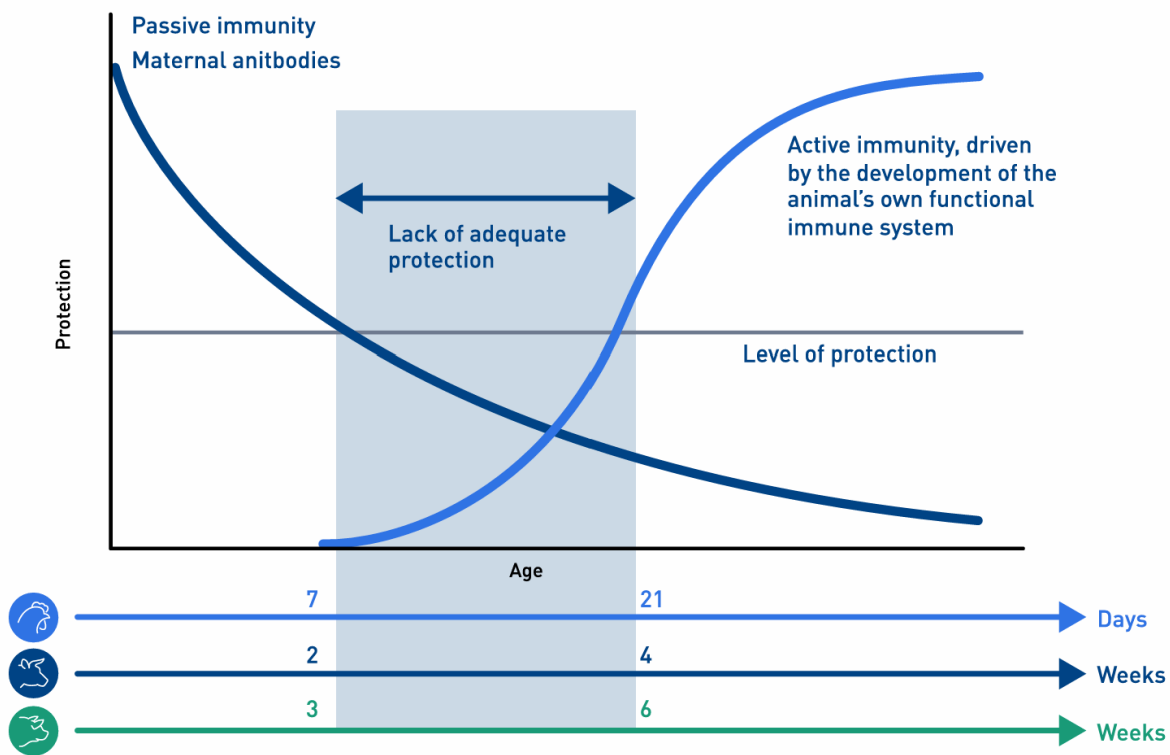


Figure 1: Young animals face an immunity gap when maternal immunity declines before their own immune system develops fully. Appropriate nutrition for both mothers and young animals can help reduce this gap.

This creates a temporary mismatch between declining maternal protection and increasing exposure to environmental challenges. As a result, animals are more susceptible to infections and performance setbacks. Effectively supporting immunity during this phase requires a strategy that begins with the mother and continues in the offspring, ensuring both strong passive protection and a well-prepared active immune response.

β -1,3/1,6-glucans: strengthening maternal protection and immune readiness

One way to bridge the immunity gap is by supporting immune function already at the level of the mother, whether in breeders, sows or cows, including both dairy and beef systems. Research shows that highly purified β -1,3/1,6-glucans, derived from yeast cell walls, have the ability to modulate the immune system through activation of innate immune cells. When included in maternal diets, they contribute to a stronger and more responsive immune status of the animal itself, but their impact extends beyond the dam.

In poultry, this can translate into improved immunoprotection transferred via the egg, while in swine and ruminants it supports the quality of colostrum and early milk, enhancing the transfer of immune factors such as immunoglobulins to the offspring. For example, in sows, dietary inclusion of β -1,3/1,6-glucans has been shown to increase vaccine-specific

immunoglobulin levels in milk by 7.6%. This strengthened maternal protection ensures that chicks, piglets and calves start life with a more consistent and robust passive immunity. At the same time, β -1,3/1,6-glucans continue to support young animals after birth by modulating innate and adaptive immune pathways, promoting a faster and more balanced response to early-life challenges. The work of Stuyven et al. (2009) illustrates this effect, demonstrating reduced severity and shorter duration of diarrhoea following *E. coli* infection in weaned piglets. This improved resilience was associated with enhanced local intestinal immunity, reflected by increased *E. coli*-specific immunoglobulin responses in the gut-associated lymphoid tissue. Supporting the animal's own immune development also explains why purified β -1,3/1,6-glucans are widely used in calf milk replacers for veal and beef production, where they are associated with improved growth performance, reduced mortality and lower medication costs.

Through this dual action, supporting maternal transfer and directly modulating the offspring's immune system, purified β -1,3/1,6-glucans help reduce the depth and duration of the immunity gap. The result is a smoother transition towards an effective and resilient immune system, contributing to robust animals and reduced reliance on medical interventions.

L-selenomethionine: strengthening antioxidant defense from the start

Complementary to immune modulation, antioxidant protection is essential to ensure effective immune function. This also begins at the level of the mother. While inorganic selenium sources such as sodium selenite primarily meet immediate requirements, they offer limited capacity for building body reserves. In contrast, L-selenomethionine behaves as a natural amino acid that can be incorporated into body proteins, creating a selenium reserve that can be mobilized when needed.

This difference is particularly important in the context of maternal protection. When the mother is supplied with dietary L-selenomethionine, selenium is more effectively transferred via eggs, colostrum and milk, allowing chicks, piglets and calves to start life with a stronger and more consistent selenium status. This early advantage is critical, as the young animal is immediately exposed to oxidative stress associated with rapid growth, pathogenic pressure, environmental changes and immune activation. By supporting the formation of selenoproteins involved in antioxidant defense, L-selenomethionine helps protect immune cells and maintain their functionality during these demanding phases.

Trial data shows that L-selenomethionine instead of sodium selenite in broiler breeder diets can increase selenium deposition in eggs by 40%, resulting in a 48% increase in glutathione peroxidase levels and in turn allowing for a 9% higher body weight 3 weeks post hatch. Same trends can be found for dairy cows where L-selenomethionine can significantly increase selenium deposition in milk by 68% compared to sodium selenite (Vandaele et al. 2014). Similarly, Falk et al. (2019, 2020) showed that in sows, L-selenomethionine can increase selenium deposition in colostrum up to 81%, which results in 61% higher plasma selenium levels in suckling piglets.

In this way, by adding L-selenomethionine to both mother and offspring diets, it does more than simply provide selenium, it ensures that this essential micronutrient is available where and when it matters most. By strengthening maternal protection and improving the antioxidant status of the young animal, it supports the development of a balanced and responsive active immune system, helping young animals to better cope with challenges during and beyond the immunity gap.

Complementary roles: linking immune modulation and antioxidant protection

Supporting animals through the immunity gap requires more than a single intervention. It is about combining strategies that act at different, yet interconnected, levels of the immune system. In this context, β -1,3/1,6-glucans and L-selenomethionine offer a highly complementary approach, linking immune modulation with antioxidant protection.

While β -glucans primarily support the modulation and training of the immune system, L-selenomethionine focuses on safeguarding immune cells by strengthening the antioxidant defense system. Together, they ensure that the immune system is not only ready to respond but also protected during periods of challenge (*Table 1*).

Function	β -1,3/1,6-Glucans	L-Selenomethionine
Primary target	Innate and adaptive immune cells	Oxidative stress and cellular protection
Key mechanism	Immune modulation and training	Selenoprotein-mediated antioxidant defense
Impact	Faster and more effective immune response	Protection and maintenance of immune cell function
Relevance	Bridging the early-life immunity gap	Supporting resilience during early-life

Table 1: The complementary roles of β -1,3/1,6-glucans and L-selenomethionine to support immune development in young animals

Turning Early Nutrition into Long-Term Resilience

Early-life nutrition extends far beyond supporting immediate growth. It establishes the foundation for long-term health, resilience and performance. L-selenomethionine supports cellular protection against oxidative stress, while β -1,3/1,6-glucans guide the immune system towards appropriate and efficient responses.

As production systems continue to evolve towards higher efficiency and reduced reliance on medical interventions, nutritional strategies that promote balance rather than overstimulation will become increasingly important. In practice, this means combining

sources such as L-selenomethionine and β -1,3/1,6-glucans in both maternal and early-life diets to reduce the immunity gap and support consistent performance and health outcomes.