Gut health management of young piglets with macroalgal extracts

The gastrointestinal tract of young piglets raised in commercial conditions is being challenged and the subtle balance gut health relies on can be impaired, resulting in enteric infections which trigger diarrhoea, impacting animal welfare with important economic losses.

by María García Suárez,
For Feed Product Manager,
Olmix Group,
www.olmix.com

Consequently, the implementation of strategies targeting a functional barrier of the intestinal mucosa and an efficient immune response in early stages of life are essential and will determine the health status and technical performance in later productive stages.

Recent research and trials in commercial conditions have indicated the potential of in-feed marine macroalgal polysaccharides as reliable agents for immune modulation and gut integrity promotion in young animals via direct use in the feed during the transition period and indirectly by adding these macroalgal bioactive compounds to maternal feeds leading to an increase transfer of immune components and ultimately to an improved health outcome and performance after weaning.

Special structural traits of marine macroalgal polysaccharides

The polysaccharides found in the cell wall of seaweeds present a complex structure and a unique composition that confer them high reactivity and define their bioactivities when used in animals.

The complexity and biological reactivity of seaweed polysaccharides stem from the nature of the sugar units, which are diverse and sometimes rare, such as uronic acids, xylose and rhamnose; the variety of glycosidic bonds leading to their branched structure and the presence of sulphate groups (Fig. 1). Additionally, their polyanionic structure and solubility increases their reactivity and enables their recognition by host cells. Sulphated polysaccharides are distinctive of macroalgae (they are not present in terrestrial plants, nor freshwater microalgae or yeast cell wall).

Olmix Group marine bioactive ingredient extraction know-how has led to the development of an in-feed product, Algimun, which is based on the combination of two bioactive macroalgal extracts:

- MSP BARRIER, a red algal extract, which promotes and maintains the gut barrier function.
- MSP IMMUNITY, a green algal extract, that modulates innate and adaptive immune responses.

Algimun bioactive molecules proved to be resistant to feed processing, especially to heat treatment and extrusion.

Gut health promoting properties of macroalgal extracts

The effects of MSP BARRIER on intestinal barrier function were demonstrated in an in vivo scientific study.

MSP BARRIER reduced the paracellular passage of FITC-dextran (gut permeability biomarker) to the bloodstream in an animal model known to trigger a strong proinflammatory response in the gut mucosa and consequently a loss of integrity.

Other studies have proven, in vitro, that MSP BARRIER upregulates the expression of genes encoding transmembrane and scaffolding proteins which are required for an optimal functioning of the tight junction complexes; and the expression of genes encoding for major mucus proteins which prevents pathogen attachment and colonisation of the gut epithelium.

New scientific evidence has corroborated the role of MSP BARRIER on the strengthening of the gut mucosa as observed in two in vitro assays, using differentiated and polarised intestinal porcine epithelial cells (IPEC-1) isolated from the intestine of newborn piglets.

In the first assay, IPEC-1 cells were incubated in the culture medium alone (negative control) or with MSP BARRIER prior to inoculation with the enteropathogenic strain E. coli K88 1305.

Results showed that the transepithelial electrical resistance (TEER) which is a marker of the epithelium integrity was stable in the negative control (non-infected) in the first 10 hours of monitoring, while it rapidly decreased (within four hours) in the positive control.

When the IPEC-1 cell line was in contact with MSP BARRIER prior to being inoculated with E. coli K88 1305, TEER was maintained at a higher level than in the positive control in the first 10 hours post-infection.

This fact indicates that MSP BARRIER preserves the epithelium integrity and barrier function in the first 10 hours post-infection (Fig. 2).

In the second assay, IPEC-1 cells were firstly incubated in the culture medium alone (negative control) or with MSP BARRIER at three different concentrations (tests: 1, 1/10 and 1/100). Secondly, the cell cultures were inoculated with E. coli K88 968. The percentage of adhesion of bacteria to the cells was obtained by dividing the number of bacteria that adhered to the cells by the total number of bacteria brought into contact with the cells (inoculate).

The results showed that MSP BARRIER reduced the percentage of adhesion of E. coli K88 968 to the IPEC-1 cell line at the three concentrations tested (-64%, -56% and -50%) compared to the negative

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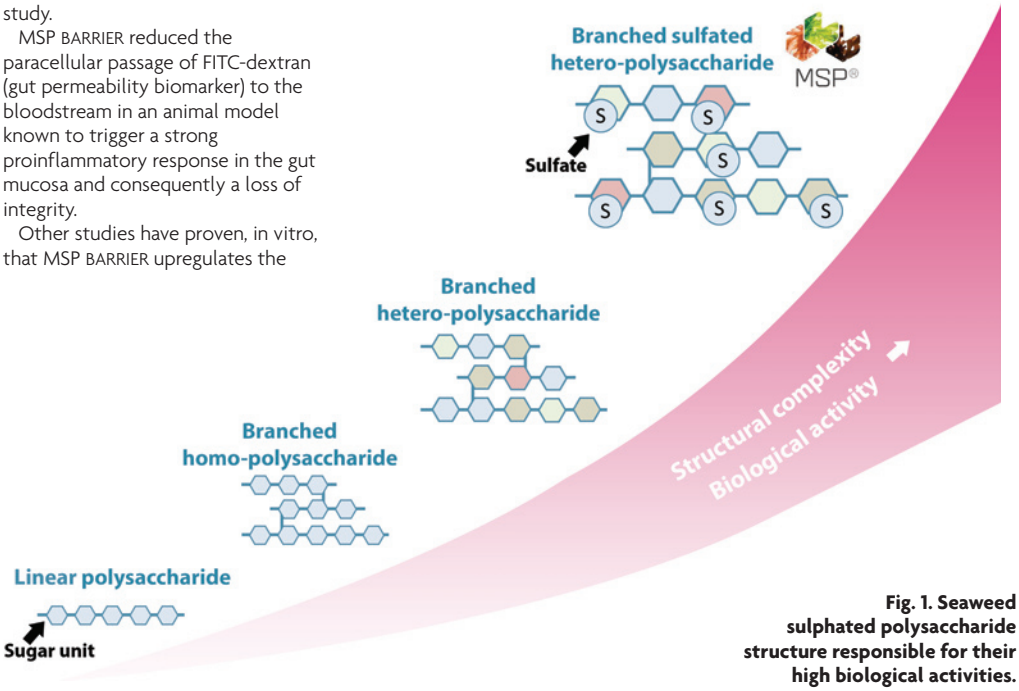

Fig. 1. Seaweed sulphated polysaccharide structure responsible for their high biological activities.

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control, thus highlighting the capacity of this red algal extract to inhibit pathogenic bacteria adhesion to the epithelial cells.

Further research has shown that MSP IMMUNITY, a green algal extract from Ulva sp, has the capacity to modulate the synthesis of immune mediators involved in defence mechanisms within the innate and the adaptive immune response, among others, the recruitment and activation of antigen-presenting cells, the differentiation and proliferation of different immune cell populations, while inducing immune tolerance thanks to its anti-inflammatory properties.

In vivo scientific studies confirmed the immunomodulating properties of MSP IMMUNITY in swine, namely by favouring the synthesis and transfer of passive immune components such as immuno-globulins G and A through colostrum and milk respectively.

Effect of Algimun on gut health and performance

Supporting the integrity of the intestinal mucosa and modulating the immune system is essential to ensure a high degree of gut health in piglets during the transition period.

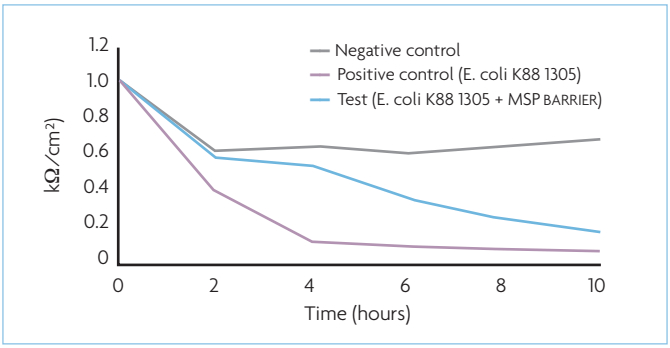

Fig. 2. TEER of IPEC-1 cell line incubated with E. coli K88 1305 with or without MSP BARRIER (kΩ/cm²)

Understanding the role of the sow on piglet health performance and therefore setting up nutritional strategies accordingly are paramount.

Litters from sows that received Algimun in the lactating feed (from seven days prior to farrow to weaning day) needed fewer veterinary treatments related to enteric disturbances (-25%, P<0.01), the body weight of these piglets at weaning was higher when compared to piglets from control sows (+360g, P=0.056) and they had a better ADG (+18g/day, P<0.05).

Thus, sows supplemented with Algimun presented a higher passive immune transfer (+25% of IgG levels in colostrum when compared to control animals) that favourably affected the health and performance of their litters, generating a 10% higher net benefit (+€7.75/sow).

The effects of Algimun on gradually balancing the global health status of herds in a high sanitary pressure context have been observed in both sow and suckling piglets.

For example, the use of Algimun in gestating and lactating feed in a 5,500-sow commercial farm resulted in an increased number of piglets born alive along with a decreased pre-weaning mortality over time, leading to a substantial increase in profit obtained by sow herds. In this case a gain of 1.8 piglets weaned per sow per year in the Algimun period (May-October 2021) compared to the control period (November 2020-April 2021).

Moreover, Algimun use in the transition period in piglets (duration of 43 days) resulted in an improved health performance as shown by a lower inflammatory status (-16% haptoglobin level at 26 days of age), better faecal consistency during the first two weeks post-weaning and a lower number of animals needing a veterinary treatment (-57%, P<0.01).

The nursery piglets were better prepared for this stressful period and showed improved performance (+300g at 64 days, -1pt FCR). Algimun use renders a high profitability: ROI = 3:1.

In short, Algimun can be used as a natural alternative in-feed strategy to promote health and growth performance by reinforcing the gut barrier function and by supporting the development of the immune system in young animals and increasing the transfer of passive immunity from the mother to the progeny. By doing so, it can play an important role within the reduction of antibiotics and high dosing zinc oxide use in farms. ■

References are available frm the author on request