The challenge of controlling intestinal inflammation at weaning

The process of weaning is one of the most stressful events in the pig's life. The piglet will experience different physiological, environmental, and social challenges when separated from the sow. One of the organs that is severely stressed during that period is the intestine, particularly during the first week after weaning. For example the sudden change in dietary regimens at weaning places a heavy burden on the immature digestive system of the piglet, resulting in intestinal damage and inflammation.

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The gut is not only critical for nutrient digestion and absorption, but it is also the largest immune organ in the body.

It is clear that when the intestinal immune system is out of control, severe consequences are noticed. Inflammation will result in intestinal mucosal injury and dysfunction, and will consequently result in reduced health status and poor growth.

From a nutritional perspective, controlling early intestinal inflammation is certainly a challenge in managing postweaning gut disorders in piglets.

Recent research shows that adequate nutrition and the use of certain feed additives can modulate the intestinal inflammation level.

Intestinal inflammation

Gut inflammation is a cascade reaction of different signal molecules secreted by different cells in response to a stressor, like a pathogen, a toxin or intestinal damage. Cytokines are signal molecules that are important mediators in the regulation of the immune and inflammatory responses.

Although they are mostly derived from lymphocytes and macrophages, it is now clear that cytokines are also produced by other cells not traditionally considered to be part of the immune system like epithelial cells.

In general, when an antigen (bacteria, virus, toxin) is present, for example in the intestinal environment, the response of the body can be described as follows.

There are two immune systems present in the body, the non-specific (innate) immunity (inflammation) and the specific (acquired) immunity with antibody production targeting a specific antigen. In both innate and acquired immunity, a phagocytotic cell like a macrophage will capture an antigen.

In response, the macrophage will produce cytokines and induce a specific and/or non-specific immune reaction.

In case of activation of the non-specific immunity interleukin-12 (IL-12), amongst others, will be secreted by the phagocytotic cell. IL-12 will activate the T-helper 1 cells, those will again produce other signal molecules like tumor necrosis factor, IL-1, IL-2 and interferon.

This will lead to a further cascade reaction in which the cell mediated immunity (for example the cytotoxic T-cells) will also be activated resulting in an inflammation reaction.

An inflammation reaction is a general reaction of the immune system resulting in destruction of the antigen, but it also involves a cost.

It consumes a lot of energy that could be used for growth and reproduction, as well as resulting in intestinal damage and dysfunction, whereas the specific immune reaction is less energy consuming and more targeted to an antigen.

There is no need to explain that the inflammation reaction needs to be kept under control, and the specific immune system needs to be stimulated.

A lot of research has been performed on the nutritional side of piglet management in order to investigate which molecules or feed ingredients could perform an anti-inflammatory reaction in the gut.

One of these molecules is butyric acid. This short chain fatty acid has a biological role in the gut, as it is naturally produced by the beneficial intestinal microbiota.

The natural functions of butyric acid can be described as balancing the intestinal microbiota, promoting the intestinal barrier, stimulation of nutrient digestion and absorption as well as the modulation of the immune system characterised by an anti-inflammatory effect.

The anti-inflammatory effect of butyrate through IL-12 and subsequently Th1-cell inhibition in the gut is well documented.

Th1 could be defined as being a pro-inflammatory T-cell producing TNFα in response to an activation by IL-12 produced by a macrophage in reaction to an antigen.

It is clear that this short chain fatty acid is the subject of much research in order to control early post weaning intestinal inflamma-

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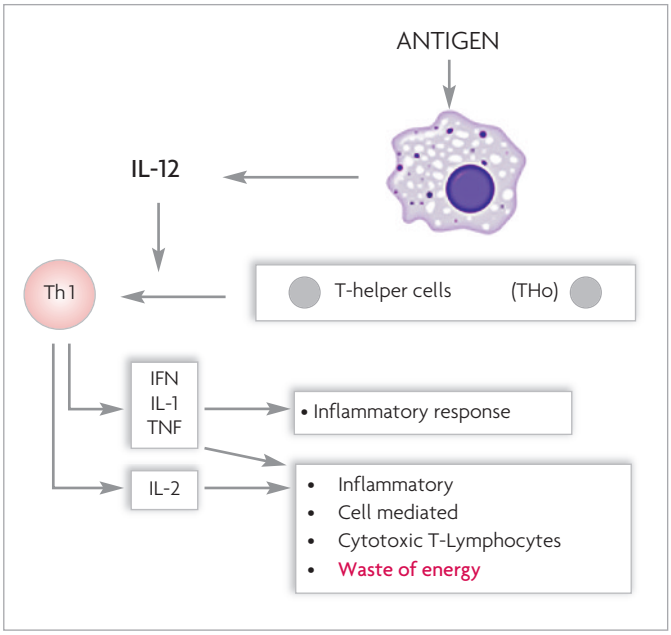
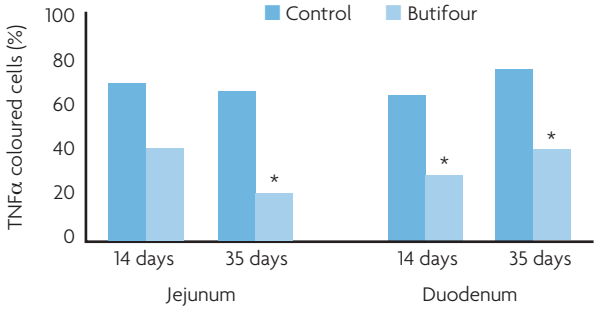


Fig. 1. No specific immune reaction in response to an antigen.

Fig. 2. Percentage of TNFα coloured cells in the jejunum and duodenum at different time stages (*p<0.05)



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tion in the piglet, and it has already proven its efficacy in intensive production systems.

Research

As Impextraco is aware of the issues in managing the weaning period of piglets, the company has recently focused its research on gut health management through in vitro and in vivo trials in their own trial facilities in Brazil and in cooperation with Belgian and Brazilian research institutes and universities.

A new product, Butifour NF was designed: a synergistic butyrate and natural extract based additive.

This product was tested thoroughly in the above mentioned trial stations.

In one of its trials, Impextraco wanted to evaluate the effect of Butifour NF on intestinal inflammation in weaned piglets through evaluation of a biomarker, the percentage of TNFα coloured cells in intestinal samples.

This trial was performed in cooperation with the Pontifícia Universidade Católica do Paraná (PUCPR), Curitiba, Brazil.

Some 48 weaned piglets with an average body weight of 7kg were housed in nursery pens during 35 days and divided into two groups with eight replicates: a control group and the Butifour group.

Two corn and soybean meal based diets were formulated according to animals' age: prestarter (1-14 days of evaluation) and starter feed (15-35 days of evaluation).

Treatments consisted of a standard feed without inclusion of additives and the standard feed supplemented with Butifour NF at 0.15% in prestarter and 0.075% in the starter phase.

At 14 and 35 days of evaluation, eight animals of each group were euthanised to collect samples of duodenum and jejunum for immunohistochemistry by TNFα colouring, a biomarker for intestinal inflammation.

All parameters were analysed using a non-parametric test and all statements of difference were made considering P≤0,05. Animals of the Butifour NF group showed a significantly lower amount of TNFα positive cells in the duodenum at all time points compared to the control group animals, as well as at day 35 in the jejunum.

The animals supplemented with Butifour NF had a numerically lower amount of TNFα positive coloured cells in the jejunum at day 14 compared to the control group animals. This trial indicates that Butifour NF has an anti-inflammatory effect in the gut.

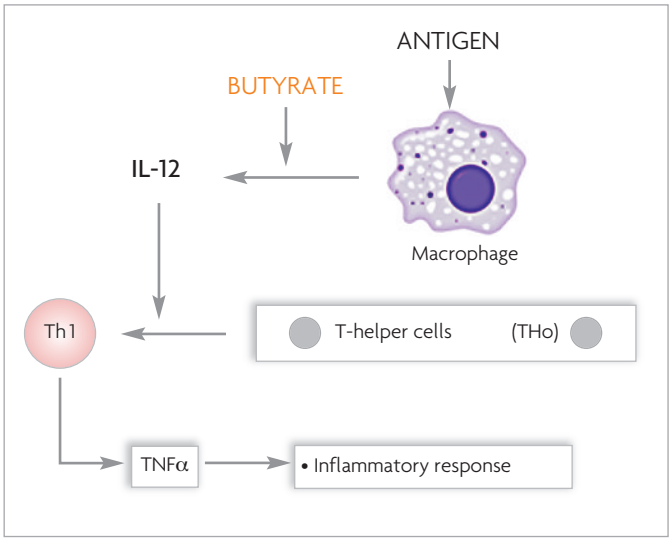

Fig. 3. Anti-inflammatory action of butyric acid.

Conclusion

It is clear that the process of weaning is one of the most stressful events in the pig's life.

We need to take into account that the sudden change in dietary regimens at weaning places a heavy burden on the immature digestive system of the piglet.

This could lead to intestinal inflammation and consequently to gut dysfunction and impaired growth.

Recent research shows that adequate nutrition and the use of certain feed additives, for example butyrate based products, are able to significantly reduce the intestinal inflammation level. ■