

Butyrate-based concepts offer nutritional support for early gut development

As the gastrointestinal tract is a complex system, it is no secret that the newly hatched chick's digestive tract is underdeveloped and needs to mature during the first weeks of life. Due to the short lifespan of a broiler a speed-up of the intestinal development process is required as quick growth, preferably with huge efficiency, is demanded. Nutritional support of this early gut development is thus significant for young growing animals; a domain the industry is focusing on during the development of new nutritional products.

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At hatch, there is a significant and immediate demand on the gut to digest and absorb nutrients efficiently in order to maintain a high growth rate, as the gut is the main organ converting feed into meat.

The sooner the intestine achieves its functional capacity the earlier the young chick can use dietary nutrients and grow according to its genetic potential.

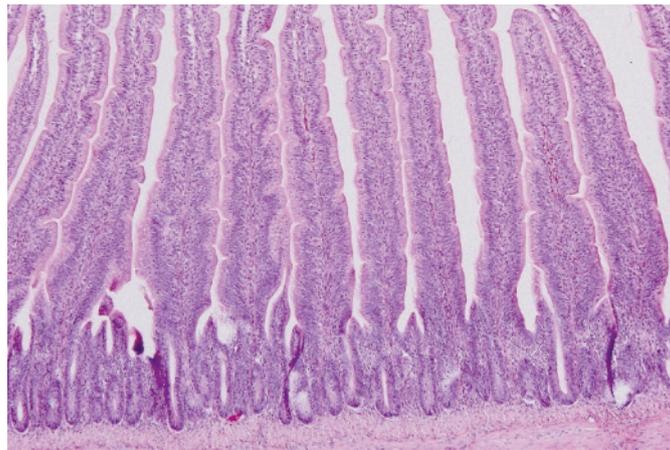
Luckily, the intake of exogenous feed is accompanied by a rapid development of the gastrointestinal tract (GIT). But still, we need to take into account that the uptake of exogenous feed is a first hurdle because a major change occurs in the source of nutrients as the yolk is replaced by an exogenous diet.

Intestinal epithelial cell integrity is of prime importance considering that this epithelium is responsible for absorption of water, electrolytes, and nutrients.

In addition, this layer of cells must provide a selective barrier against the complex and potentially harmful environment of the gut lumen.

Research has shown that duodenal villus growth could almost be completed by day seven, whereas in the jejunum and ileum, villus development continues beyond day 14.

The first weeks after hatch are thus critical for development of the GIT and it is logical that the bird can



Haematoxylin and eosin staining of a jejunum sample (10x) of a 14-day-old Ross 308 broiler supplemented with a butyrate based product, Butifour F, showing long slender villi.

use some support in this critical period in order to obtain a good and efficient growth curve at a later stage. Nutritional support of gut development is thus significant for young growing animals.

Not only is the morphologic development of the gut important, but the colonisation of the gut with the beneficial microbiota and the maturation of the immune system (GALT) is also crucial, as 70-80% of the immune system is located in the gut.

Microbial colonisation starts right after hatch and proceeds during the life of the bird. The chick's gut associated lymphoid (GALT) tissue is

only to be considered as mature starting from day 14-21 of age.

Actually, in newly hatched broiler chicks, B- and T-lymphocytes need to migrate from the Bursa of Fabricius to the peripheral tissues, in order to create effective mucosal associated lymphoid tissues.

This migration process is time consuming, making the young bird very sensitive to environmental challenges, as B- and T- cell population of the intestinal mucosa is primordial to establish an effective GALT. It goes without saying that we need to support the young bird in this process.

Research has discovered that one

molecule, called butyric acid (C4), which is consistently present in the intestinal ecosystem, as it is naturally produced by fermentation by the intestinal microbiota, is primordial in the intestinal development.

Butyric acid plays a major role in enhancing gut health by promotion of the intestinal barrier, modulation of the immune system, balancing the intestinal flora and improving digestion and absorption of nutrients, leading to enhanced performance.

In young animals, butyric acid is known to promote the maturation of the intestinal mucosal immune system and to stimulate the intestinal mucosal development.

Therefore it is the ideal molecule to be supplied to young animals and to focus on in research.

Practical research

As positive effects of butyrate have been proven in vitro and in vivo, butyrate based products are widely used in animal production worldwide.

Butyric acid, as such, cannot be supplemented to animal feed due to its volatility and pungent odour. Solutions were developed by the industry: supplementation of coated salts of butyric acid – butyrate – became a standard.

In addition, other ingredients, for example specific acid salts and natural extracts, have proven to interact synergistically with butyrate and are thus enhancing butyrate's action.

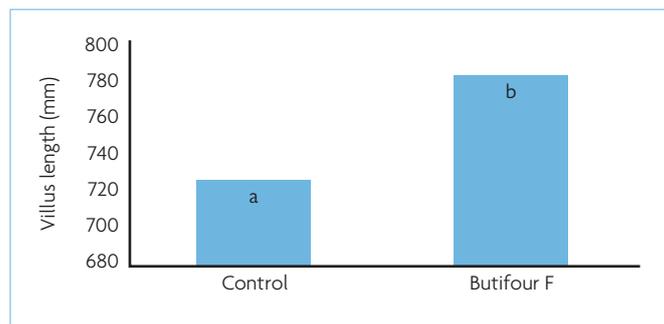
Impextraco has recently focused its research on gut health management through in vitro and in vivo trials in their own trial facilities in Brazil and in cooperation with Belgian and Brazilian research institutes and universities.

In one of its trials, Impextraco evaluated the effect of a commercially available synergistic butyrate based product in young chicks on two gut health parameters: the immune system and intestinal morphology.

Up to 21 days the intestine of a broiler chick is considered to be

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Fig. 1. Histological evaluation of jejunum of 14-day-old Ross 308 broilers supplemented with a butyrate based product, Butifour F, resulting in significantly longer villi (*p<0.05).



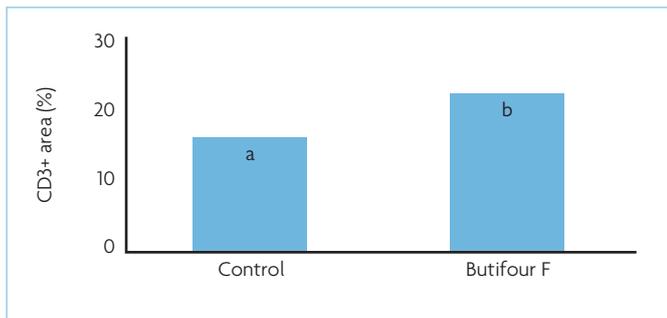
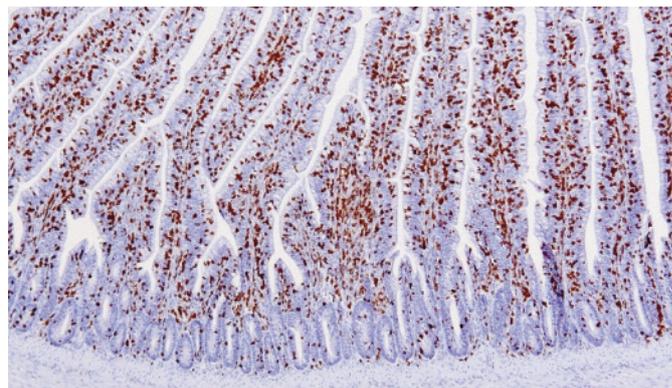


Fig. 2. Immunohistochemical evaluation of CD3+ T-lymphocytes of jejunum of 14-day-old Ross 308 broilers supplemented with a butyrate based product, Butifour F (*p<0.05), showing the early colonisation of the intestine by a significantly higher presence of CD3+ lymphocytes at young age compared to a non-supplemented group.



CD3+ T-lymphocyte staining (10x) of a jejunum sample of a 14-day-old Ross 308 broiler supplemented with a butyrate based product, Butifour F (*p<0.05), showing the early colonisation of the intestine by a high presence of CD3+ lymphocytes, marked by the brown areas.

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immature. Consequently, 20 day-old Ross 308 broiler chicks, individually identified by wing tag, were raised up to 14 days in 10 pens with five replicates each.

These animals, held at the research facilities of the Catholic University of Leuven, Belgium, were allocated to two treatments: a negative control group (wheat based diet without antibiotics or additives) and a butyrate based group (wheat based diet supplemented with 750g Butifour F per ton of feed).

At 14 days of age, all animals were

euthanised and samples of the jejunum were taken (1cm before Meckel's diverticle) for histological (villi length) and immunohistochemical evaluation (CD3+ T-lymphocytes) at the Faculty of Veterinary Medicine of the University of Ghent, Belgium.

Area % of CD3+ T-lymphocytes is a biomarker to evaluate mucosal immunity, while villi length is a biomarker for intestinal integrity and health.

The results are presented in Figs. 1 and 2.

Supplementation of a butyrate based product stimulated the

intestinal maturation of the young bird, clearly demonstrated by the significant higher villi and significant higher presence of CD3+ T-lymphocytes in the jejunum.

Conclusion

It is clear the gut needs to mature during the first weeks of life, and we need to support the young chick during this period. The positive effect of butyrate based products in young chicks is clear.

Research has proven that butyrate based supplementation is supporting an optimal maturation of the intestinal morphology and immunity in young chicks.

These effects are demonstrated by a healthy villi development and an increased population of the mucosa by CD3+ T-lymphocytes, leading to an early maturation of the GIT. ■

References are available from the author on request