

Gut health and barrier in weanling piglets fed with a blend composed of carvacrol, tannic acid, and medium chain fatty acids; a nutritional strategy to shape the gastrointestinal tracts

Aidos L¹, Pallaoro M, Mirra G, Sbritz M, Marchetti L¹, Rebucci R¹, Bontempo V¹, Modina S, Di Giancamillo A²

¹ Department of Veterinary Medicine and Animal Science, Università degli Studi di Milano, Lodi - Italy.

² Department of Biomedical Sciences for Health, Università degli Studi di Milano, Milan - Italy.

During the weaning of piglets, the intestine undergoes changes, such as morphometry and digestive enzyme production which may lead to chronic and acute inflammatory status [1]. Active compounds from natural extracts could prevent inflammation and oxidative stress demonstrating positive effects on gut morphology and function. The intestinal epithelium is a single layer of absorptive enterocytes that are bound together by junctional complexes that regulate cellular permeability and are crucial for the integrity of the epithelial barrier. Two of the most important junctional complexes consist of the Tight Junctions (TJ) and, adherens junctions, [2]. TJ includes a series of transmembrane proteins, such as Occludin and Zonulin, while adherens junctions, like E-cadherin, are located beneath the TJ and are involved in cell-cell adhesion, and all together they regulate the gut barrier.

This study aimed to assess the dietary administration of a blend composed of essential oils from natural extracts (carvacrol), tannic acid (TA), and medium chain fatty acids (MCFAs) on post-weanling piglets' growth, gut morphology, and tight junctions' expression.

A total of 210 weanling piglets were randomly assigned to two experimental treatments, with 7 replicates each. The control group (CTR) was fed the basal diet, and the treated group (T) was fed the basal diet mixed with a dosage of blend, corresponding to 1.5 kg/ton of complete feed. Growth performances were registered on days 0, 14, and 35. At day 35, 7 animals per group were slaughtered and duodenum and jejunum were sampled to evaluate the small intestine morphology as well as the expression of E-Cadherin, Zonulin 1, and Occludin. Small intestine samples were fixed in buffered formalin until further analyses, according to [3]. Even if there was no significant interaction between treatment and time, body weight and average daily gain of T piglets were positively influenced by the treatment (16.67 ± 3.13 kg vs 15.82 ± 2.79 , $P < 0.05$ and 0.25 ± 0.087 kg vs 0.23 ± 0.078 , $P < 0.01$, respectively). The increased fecal score was outlined in T compared to CTR at 6, 7, and 8 d after weaning ($P < 0.05$) thus revealing a positive influence on PWD. Histometry of the duodenum and jejunum of piglets of the T group showed higher villi ($P < 0.05$), deeper crypts ($P < 0.01$), and increased V/C ratio ($P < 0.01$), indicating a higher absorptive and surface area. Regarding the gut barrier, CTR animals exhibited a higher expression of duodenal Occludin ($P < 0.05$). Jejunal E-cadherin and Occludin were more expressed in the T-animals jejunum sections ($P < 0.05$). In conclusion, the administration of a blend containing carvacrol, tannic acid, and MCFAs produced a positive effect on the gut health of weaned piglets, even if, further research is needed to elucidate the synergistic effect of these blended substances when applied in commercial farm conditions.

- [1] Modina et al. Stages of Gut Development as a Useful Tool to Prevent Gut Alterations in Piglets, *Animals*, 2021.
- [2] Krug et al. Special Issue on "The Tight Junction and Its Proteins: More than Just a Barrier", *Int. J. Mol. Sci.*, 2020.
- [3] Di Giancamillo et al., Copper sulphate forms in piglet diets: Microbiota, intestinal morphology and enteric nervous system glial cells, *Anim. Sci. J.*, 2018.