BioEdge™ Defend: Impacts on Gut Health

By Joshua A. Jendza, PhD – Sr Research and Technical Services Manager, QualiTech, LLC

Heat Stress and Gut Health

Heat stress exists whenever animals are exposed to prolonged periods of elevated temperatures, which impair their ability to maintain a normal body temperature. This is typified by worsening of gut health as evidenced by increased scouring, increased need to treat for intestinal infections, and reduced feed efficiency.

Neuroimmune regulation

Fennel oil is rich in *trans*-Anethole (Figure 1), a potent regulator of the immune system by way of interactions with ion channels on the surface of somatosensory neurons. These neurons are responsible for neural control of immune tissues. Fennel oil preferentially activates non-peptidergic IB4$^+$ neurons instead of peptidergic CGRP$^+$ neurons[1]. The net effects of this differential excitation are:

- Soothing sensation
- Reduced intensity of pain perception
- Increased production of IL-10
- Reduction in inflammation

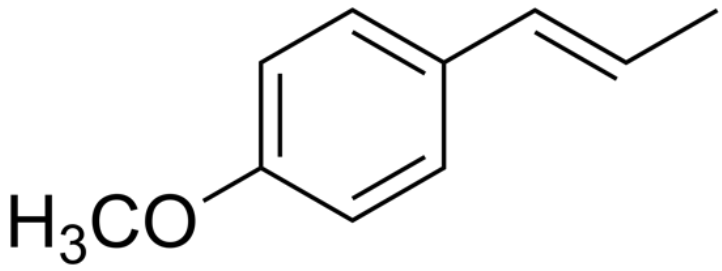

Figure 1. Chemical structre of trans-Anthole from Fennel Oil.

Inflammation and Gut Health

Inflammation in the gut is associated with reduced efficiency of nutrient digestion and absorption, increased in situ utilization of nutrients for immune activities, and reduced feed efficiency and overall performance. Selective activation of the neuroimmune system by fennel oil drives changes in expression of pro- and anti-inflammatory cytokines in the intestine (Figure 2)[2].

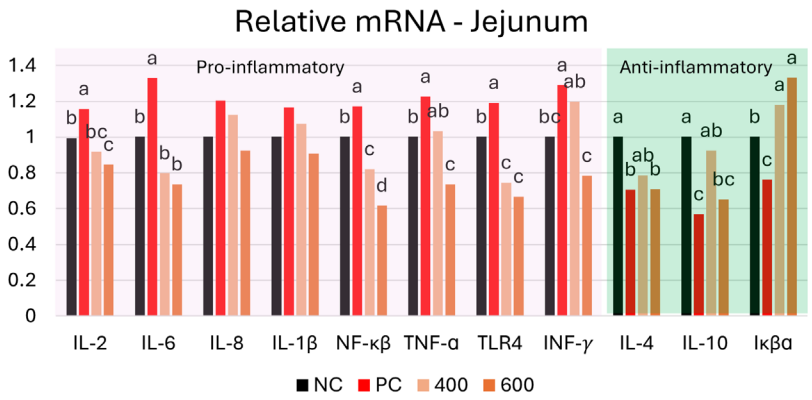

Figure 2. Relative mRNA expression in the jejunum of broilers challenged with LPS (PC) and supplemented with 400 or 600 mg fennel essential oil per kg of diet. Columns without the same letter are significantly different ($P < 0.05$). Adapted from Tong et al. (2023).

A non-inflamed gut favors the establishment of an intestine more focused on digestion and absorption, as measured by increased absorptive surface area (villus height, and villus area) and reduced rate of enterocyte replenishment (reduced crypt depth and VH:CD ratio; Figure 3)[3]. This shift is enabled, in part, by an increase in tight junction proteins, which are a key indicator of the success of gut barrier function (Figure 4)[4].

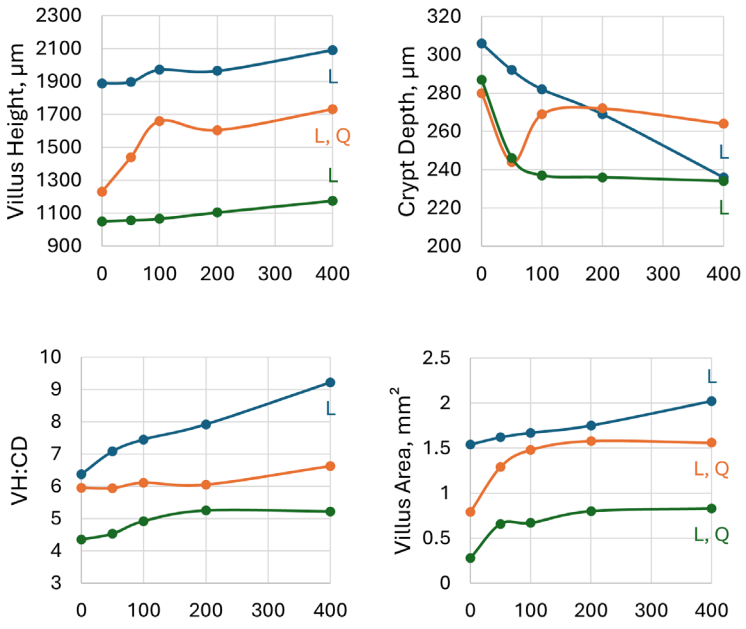

Figure 3. Intestinal morphology of broilers consuming encapsulated fennel seed oil in the duodenum (blue), jejunum (orange), and ileum (green). L,Q = linear and quadratic effects, respectively, of fennel oil ($P < 0.05$). Adapted from Ipcak et al., 2024.

To learn more about the benefits of BioEdge Defend®, contact QualiTech at 800-328-5870 or qualitechco.com.

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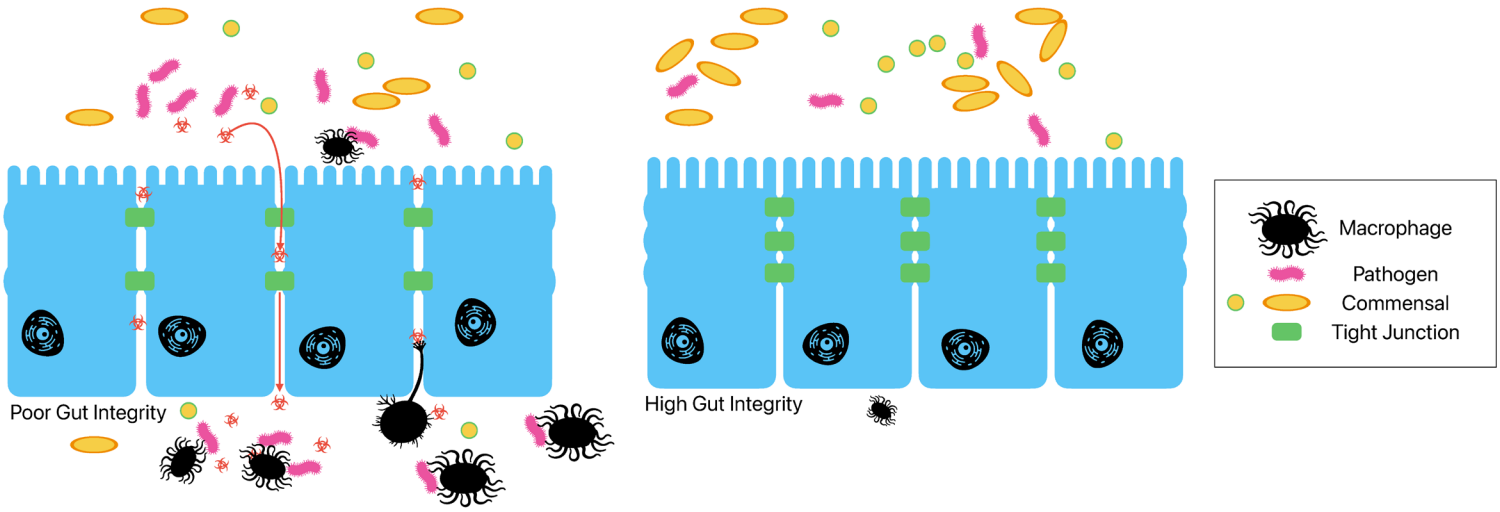

Figure 4. Fennel essential oil increases the abundance of tight junction proteins, which can improve gut integrity.

Conclusions

Heat stress favors the development of an inflamed intestine, which wastes nutrients and energy on immune tissue proliferation and activation at the expense of growth/production. The Fennel in BioEdge Defend counteracts this effect by reducing metabolic heat production, reducing tissue inflammation, and improving the ability of the gut to serve as a barrier to intestinal pathogens and as an absorptive surface for nutrients.

References
1. DOI: 10.1124/mol.118.114561
2. DOI: 10.1016/j.psj.2022.102397
3. DOI: 10.1093/jas/skae035
4. DOI: 10.1371/journal.pone.0271045

BioEdge Defend Dry

USE DIRECTIONS: Use 1.0 – 2.0 pounds per ton of complete feed for flavor enhancement.

For other applications, please contact your QualiTech representative.

BioEdge Defend Dispersible

USE DIRECTIONS: Add 2 lb per ton of dry mix (target daily intake of 1 lb of milk replacer per day to achieve target intake of 450 mg per calf per day).

For other applications, please contact your QualiTech representative.

BioEdge™ Defend combines Fennel with Garlic to create a flavor-based additive that helps defend your beef cattle from flies, ticks, lice, worms and from environmental stressors like heat and humidity.

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