

Endotoxins: Why aquaculturists must not turn a blind eye

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Endotoxins are the proverbial Sword of Damocles when it comes to aquaculture. While livestock producers are beginning to recognize the serious risks endotoxins pose to animals and farms, they are still widely ignored in fish and shrimp production. This neglect could prove very costly.

Due to the intensification of feeding methods, the impact of endotoxins increases in all major livestock species. Why? Because high-performing animals are fed energy- and protein-rich diets to meet their requirements. These diets result in a shift towards gram-negative bacteria in the microflora of the gastrointestinal tract and, ultimately, in the accumulation of endotoxins. Subsequently, endotoxins are absorbed through the intestinal wall and transported to the liver. If the level of endotoxins exceeds the liver's capacity to detoxify them, endotoxins trigger heavy immune reactions in the animals (Mani *et al.*, 2012). Consequently, feed efficiency declines significantly, by up to 27% (Pastorelli *et al.*, 2012). This is because the immune reactions triggered by endotoxins cost a lot of energy - energy that is no longer available for growth and performance. Furthermore, endotoxins are a risk

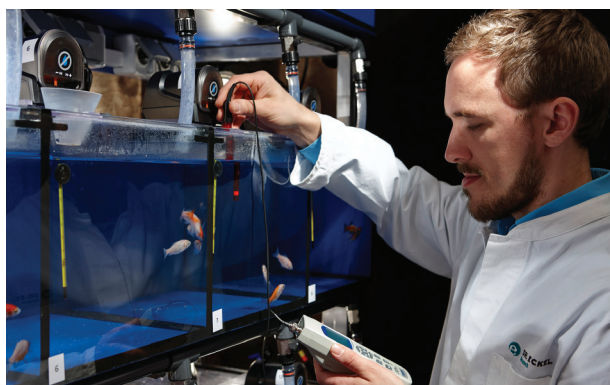


Figure 1. The risks of endotoxins in aquatic species are still largely ignored. Photo credit: Dr. Eckel.

factor for periparturient diseases, necrosis and increase the susceptibility of animals to pathogens.

In livestock, awareness of the detrimental effects of endotoxins has increased significantly of late. In

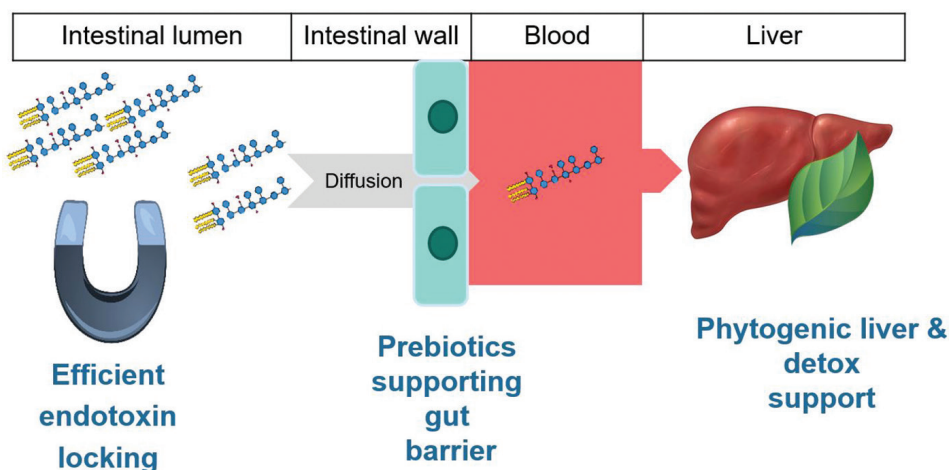


Figure 2. Anta®Catch, the effective triple mode of action against detrimental effects of endotoxins.

Table 1. Feeding groups in the trial.

Feeding groups	Endotoxins	Anta®Catch (g/t)
No endotoxins 0 g/t	0 µg/L	-
No endotoxins 100 g/t	0 µg/L	100
No endotoxins 1 kg/t	0 µg/L	1000
Endotoxins 0 g/t	100 µg/L	-
Endotoxins 100 g/t	100 µg/L	100
Endotoxins 1 kg/t	100 µg/L	1000

aquaculture, however, the topic of endotoxins is discussed in more diverse ways. While the harmful effects of various toxins following algae blooming are well-noted (Merel *et al.*, 2013), the impact of endotoxins originating from gram-negative bacteria in the digestive tract of aquatic species is still largely ignored. This might be due to the contradicting results about the impact of endotoxins in aquaculture that have been published in recent years. While some authors claim that aquatic species are not as susceptible to endotoxins as higher vertebrates (Iliev *et al.*, 2005), others even recommend the use of endotoxins as immunostimulants in aquaculture to increase the resilience of fish to pathogens (Selvaraj *et al.*, 2009). This is a risky procedure, as some results in aquatic species are in line with the damaging effects of endotoxins in all livestock species and show that endotoxins have immunological and pathological effects

in aquatic species (Swain *et al.*, 2008). In conclusion, despite the sufficiently well-known adverse impacts of endotoxins on the health, welfare and performance of livestock, the impact of endotoxins in aquatic species appears to be highly underestimated.

Endotoxins in aquaculture

In order to better understand the effects of endotoxins in aquaculture,

the multidisciplinary R&D team of Dr. Eckel Animal Nutrition has spent more than two years on intensive research on this topic. In this project, fundamental research confirmed the detrimental effects of endotoxins in fish and shrimp. In addition, an innovative solution supporting livestock and aquatic animals against the negative effects of endotoxins was developed. The product by the name of Anta®Catch reduces the amount of free endotoxins in the gastrointestinal tract, supports the gut barrier by its prebiotic components and supports the liver with phytogetic compounds (Fig. 2).

To determine the effects of endotoxins on survival rate and performance and reveal if Anta®Catch could reduce the performance-limiting effects of endotoxins in aquaculture, a trial in fish was performed in collaboration with the Faculty of Fisheries at Kasetsart University, Thailand.

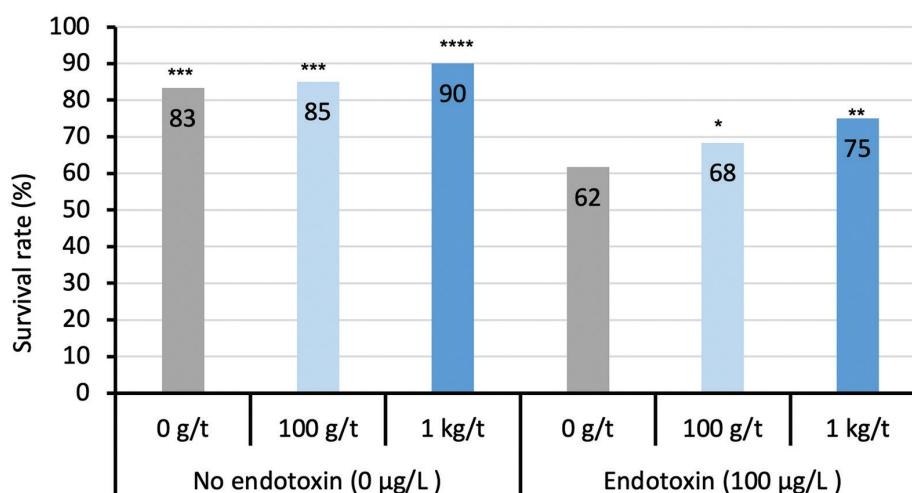


Figure 3. Effects of endotoxins and Anta®Catch on the survival rate of tilapia. *p<0.05.

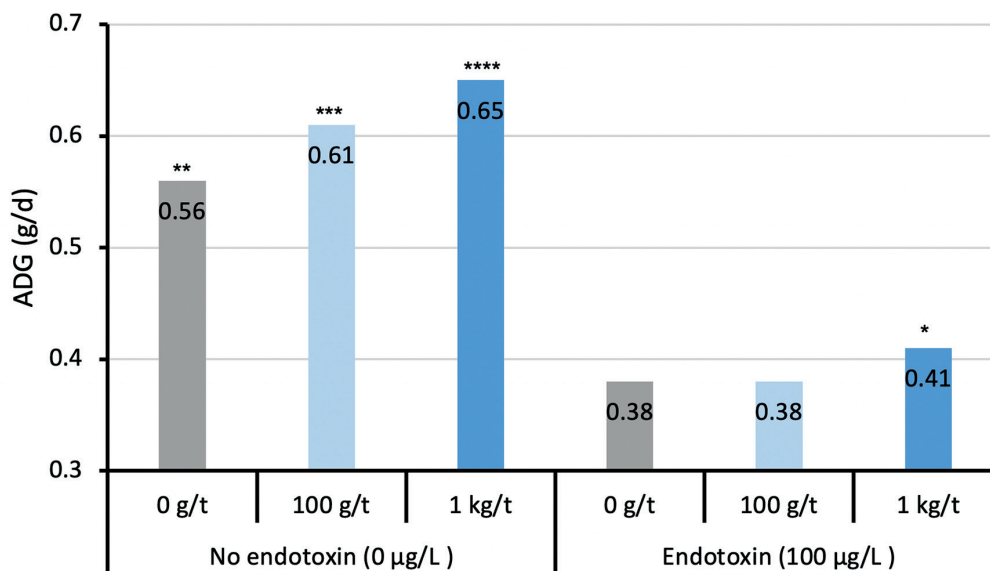


Figure 4. Effects of endotoxins and Anta®Catch on the ADG of tilapia. * $p < 0.05$.

Damaging impact of endotoxins on performance and survival rate

A trial with 1,000 Nile tilapia (initial size 2–2.5 cm) was conducted for 45 days. Fish in the control groups received no endotoxins (control; 0 µg/L), while tilapia in the treatment groups received an endotoxin dosage of 100 µg endotoxins/L in the feed. Diets of control and endotoxin groups were fed 0, 100 or 1000 g/t Anta®Catch. The treatments of different groups are shown in Table 1. Survival rate was determined every 10 days. At the end of the trial, data on survival rate and average daily gain (ADG) were statistically compared using a t-test.

Results showed that endotoxins decreased the survival rate of tilapia by 21 % on average (Fig. 3). Furthermore, the endotoxin challenge reduced the ADG of tilapia by up to 0.24 g/d ($p < 0.05$; Fig. 4). This shows that endotoxins have major detrimental effects on survival rate and performance in tilapia.

In addition, trial results revealed beneficial effects of Anta®Catch on survival rate and performance. Without artificial endotoxin challenge, the feeding of Anta®Catch improved the survival rate of tilapia by up to 8.4% ($p < 0.05$; Fig. 3). When tilapia were challenged with endotoxins, the effect of Anta®Catch on survival rate became even more visible and the survival rate was increased by up to 21% ($p < 0.05$; Fig. 3). This underlines the potential of Anta®Catch to protect fish from endotoxin-related mortality.

Furthermore, results showed that Anta®Catch increased ADG in tilapia. Thus, the ADG of the Anta®Catch group was increased by up to 0.09 g/d under natural conditions and by up to 0.03 g/d during artificial endotoxin challenge ($p < 0.05$; Fig. 4). This shows that Anta®Catch can visibly improve the performance of fish under natural conditions and in environments contaminated with endotoxins.

Conclusion

As the results of this trial confirm, endotoxins are an important risk factor for low performance and survival rate in aquaculture. Aquaculturists would be well advised to take up measures to safeguard their production and businesses against this risk. Innovative solutions like the feed additive Anta®Catch are a powerful aid in protecting aquatic species from endotoxin-related mortality and reduced performance.

References available on request.

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