



Role of Gut Health in managing challenging environment in Shrimp

Optimum nutrient utilization is the key for accelerating the growth of shrimp and augmenting the production potential. Consumer preference for the antibiotic-free [shrimp](#) and fish products attracted the scientists to find out natural growth promoter, as an alternative to antibiotic growth promoters in aquafeed. Dietary supplementation of organic acids and their salts as growth promoter has been proven in animal feed and well documented. Aquafeed sector has equally benefitted with this novel additive though it was lately introduced. However, unlike [animal feed additives](#) the use of acidifier in [aquafeed](#) needs a different approach due to diversified feeding habit and wide variation in structure of the digestive system and physiological function. Dietary organic acids can stimulate secretion of pancreatic enzymes, lower gastric pH, inhibit pathogens, act as a source of energy, improve mineral utilization and enhance nutrient digestibility, which could lead to enhanced growth performance of [shrimp](#). It is envisaged that intensive aquaculture will be the major focus in coming decades to supply the quality protein to the burgeoning population with the limited water, land and feed resources.

Mechanism of [Shrimp Gut acidifiers](#)

Mechanisms of action In shrimp, the dietary acidifiers exhibit their effects in gastrointestinal tract (GIT) as antimicrobial agent against and provide acidic environment for the better action of enzymes. Similarly, it can support the energy production through directly entering in metabolic pathway. However, in feeds the addition of organic acid can act an antimicrobial agent and can extend the storage of feeds. [Gut health acidifiers](#) can improve gut morphology along with stimulation, secretion and activation of the digestive enzymes by lowering the pH of the digesta of stomach and foregut of many aquatic species. Short chain organic acids can provide acidic pH in the GIT which can stimulate the activation of enzymes like pepsin and other pancreatic enzymes and enhance digestion.

Action on metabolism Organic acids have considerable amount of energy stored in the form of chemical bonds and hence, they can act as a good energy source. The SCFAs absorbed through intestinal epithelia by passive diffusion can directly enter into the citric acid cycle and undergo for ATP generation.

How it works?

Palatability

- Acidifiers enhances the feed palatability as well as intake.
- Mold inhibition due to presence of organic acids increases longevity.
- Controls Bacterial growth in feeds due to environmental conditions.

Nutrient Digestibility

The effects of short chain organic acids go beyond modification of gut microflora, and other benefits such as improved digestive enzyme activity, increased pancreatic secretion, enhanced development of intestinal epithelium and intestinal barrier integrity and enhances the absorption of minerals including phosphorous, magnesium, sodium and calcium. Enhances the bioavailability of minerals. Dietary supplementation of organic acids, their salts or mixtures of those, could improve growth, feed utilization, disease resistance and survival.

Effect in Gut

The morphological feature of the gut is an important factor which determines the mode of action of the acidifier. Both gastric and gastric fishes are benefitted from the organic acid. Therefore, the diversity in the fish gut morphology complicates to generalize the effective dietary [Gut acidifiers](#) and their optimum doses for all cultivable fish species rather it varies from species to species. Organic acids and their salts exert their growth inhibiting effects on stomach and gut microbes through pH reduction and anion and proton effects in the microbial cell. Moreover, small acids are lipophilic and can diffuse across the cell membrane of gram-negative bacteria. In the more alkaline cytoplasm, they dissociate, and the released protons will subsequently lower the internal pH. pH reduction alters cell metabolism and enzyme activity thus inhibiting growth of intraluminal microbes, especially pathogens.

Immunity

Acidifier can improve the general health status of cultured fish by its stronger antimicrobial effect towards acid-labile gram-negative bacteria, such as *E. coli* and *Salmonella* sps, *Vibrio* sps. than acid tolerant *Lactobacilli* sps. Anti-inflammatory properties have been described and attributed to likely causes of enhanced performance when supplementing some of these organic acids particularly sodium or potassium salt of organic acids, especially potassium format or diformate. At low pH, the un-dissociated form of an organic acid is lipophilic and can passively diffuse through the cell wall of pathogenic bacteria and mould. In the more alkaline (higher pH) cytoplasm of bacteria, organic acid dissociates and causes the internal pH to decrease. This inhibits bacterial nutrient transport, cell metabolism and enzyme activity. Thus, inhibiting the growth and propagation of pathogens especially

gram-negative bacteria in the fish gut but acid tolerant bacteria like *Lactobacillus* spp. etc. remained unchanged or may even be enhanced in numbers through propagation. The molecule of organic acid also attacks the DNA of gram-negative bacteria causing its death. Though medium chain fatty acids (MCFA) like capric, caprylic and lauric acid exhibit strong antimicrobial effect both on gram negative and gram-positive pathogens

Commonly used Acidifiers in Aquaculture

1. Formic acid or calcium formate and potassium formate as their most important salts.
2. Acetic acid or its sodium salt sodium acetate
3. Propionic acid or calcium propionate; butyric acid or sodium butyrate
4. Lactic acid and citric acid, Malic acid, fumaric acid

Effect of acidifiers in feed

1. Higher growth rate
2. Increases protein digestibility.
3. Better feed conversion
4. Improved immune response.
5. Better Feed conversion ratio

Effect of Acidifiers in Gastrointestinal Tract

1. Reduce the pH of the gut.
2. Improve the action of digestive enzymes.
3. Improves nutrient absorption.
4. Support the growth of beneficial bacteria so it promotes higher production of metabolites.

Summary

The concept of using dietary acidifiers in aquaculture has been successfully established since a decade ago. Acidifiers can be supplemented in the feed either as free organic acids or as their salts singly or in a blend (mixtures) of two or more than two organic acid salts with the combination of other functional [feed additives](#). But dietary supplemented organic acids or their salts can hardly reach to the distal part of the gut to exhibit their mode of action.

Through stimulating secretion of pancreatic enzymes, lowering gastric pH, inhibiting pathogens, acting as an energy source, improving mineral utilization and enhancing nutrient digestibility dietary organic acids can lead to enhanced growth performance for augmenting fish production. Though, the concept of using acidifier started since 1960 as

addition of individual organic acid or their salts, but 2nd generation acidifier came with blending of different organic acids in different proportion to harness the maximum benefit.

About Skretting Aquaculture

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