On-farm strategies demonstrating the efficacy of a functional feed additive to reduce the impact of white faeces syndrome

These trials at a farm in Lampung, Indonesia, cover a large number of ponds with shrimp fed preventive and corrective application levels of the feed additive

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Feeding at Tambak Udang Babarafi, Indonesia

The rapid growth and intensification of the shrimp farming industry have resulted in the emergence of devastating shrimp diseases. Among them, white faeces syndrome (WFS) is a major cause of crop failures of *Penaeus vannamei* shrimp farming in Southeast Asian countries, India and China. WFS affects the digestive system of shrimp resulting in production losses due to smaller harvest size from stunted growth and decreased survival rates.

WFS arises because of a series of complex interactions involving the host, pathogen and environment. Outbreaks are associated with changes in environmental conditions and water quality leading to physiological stress and a compromised ability of shrimp to resist infection (Alfiansah et al. 2020). Although the causative agent of infection remains inconclusive, it has generally been associated with pathogenic *Vibrio* bacteria and the microsporidian *Enterocytozoon hepatopenaei* (EHP).

Prevention is important to reduce the impact of WFS. A first strategy is pond management measures to maintain water and sediment quality and to reduce the presence of EHP and *Vibrio* (Tang et al. 2016; Aldama-Cano et al. 2018). A second strategy is to adopt functional nutrition to promote a stable bacterial community within the digestive tract of shrimp. Since shrimp are highly exposed to exchanges of microbiota between the pond environment and the digestive system, functional nutrition contributes to counteract the development of pathogens favoured by the destabilising effect of environmental stressors.

SANACORE®GM (Adisseo) is a functional feed additive which comprises a synergetic blend of phytobiotic extracts with a broad antimicrobial spectrum, antiparasitic activity, and immunomodulating properties (Coutteau and Goossens, 2014). It can be incorporated into feed during feed manufacturing or via top-coating at the farm; both ways will deliver antimicrobial activity that has been proven to promote a more diverse and stable microbial community in the digestive tract in marine fish (Robles et al. 2017).

The efficacy of this functional additive to reduce the impact of WFS has been demonstrated under field conditions (Nuez-Ortín and Isern-Subich, 2019). This article brings new evidence of its efficacy under different application strategies in an Indonesian farm which has had a previous history of WFS outbreaks. This farm trial was conducted under a high degree of replication and demonstrates the effectiveness of the product under farming conditions.

Stocking date	Jul 30, 2020	July 3, 2020
Density (shrimp/m²)	100	100
Number of pond replicates (1,000 m² per pond)	10 (1 block)	10 (1 block)
Application strategy	Corrective	Preventive + corrective
Dosage	High	Low (preventive) + high (corrective)
Application period	10-14 days after DOC 30-40 when infection symptoms appeared	Preventive: DOC 7 until harvest Corrective: 10-14 days after DOC 30-40 when infection symptom appeared

Table 1. Stocking information and application strategies of SANACORE®GM

Farm experimental set-up

A shrimp farm located in Bratasena Lampung, Indonesia with 110 ponds was selected for this trial. The 110 ponds were distributed in 11 blocks of 10 ponds each. Each block is one ha. Historical farm data of two of the blocks and during the last four crops showed water *Vibrio* load over 10^2 CFU/mL and positive PCR to EHP. The same two blocks and 20 ponds were used in the present trial in order to evaluate the efficacy of corrective and preventive application strategies of Sanacore.

The stocking information and application strategies are described in Table 1. Historical farm data were used only for comparison purposes and were not included in the statistical analysis. Independent t-test was used to assess the difference in efficacy between the two application strategies using 10 pond replicates per strategy. Performance parameters reported here correspond to the average values of the two blocks and four crops for the farm historical data (where the additive was not used), and of the same two blocks with one crop each for the two application strategies. Each crop has an approximate duration of 110 days of culture (DOC).

Results and discussion

Supplementation of Sanacore under corrective application and under the combination of preventive and corrective applications improved average daily growth (ADG) and survival when compared to previous crops. The target ADG for the present farm was 0.3g, while lower values of 0.21g were observed in previous crops with reported WFS outbreaks. The corrective approach increased the ADG to 0.25g, while the combined preventive and corrective approach reached an ADG of 0.33g. Survival improved by 58% and 169% by the corrective and the combined strategies, respectively, when compared to previous crops (Figure 1A). The use of a preventive dosage from DOC 7 until harvest resulted in an additional and numerical improvement of 48% when compared to only the corrective application.

Improvements in ADG and survival with supplementation of the functional additive were reflected in better pond productivity (Figure 1B). The corrective strategy improved pond production by 105% when compared to previous crops, while the combination of preventive and corrective strategies achieved a 219% improvement. Likewise, the preventive dosage showed an additional and significant improvement of 50% when compared to only the corrective application.

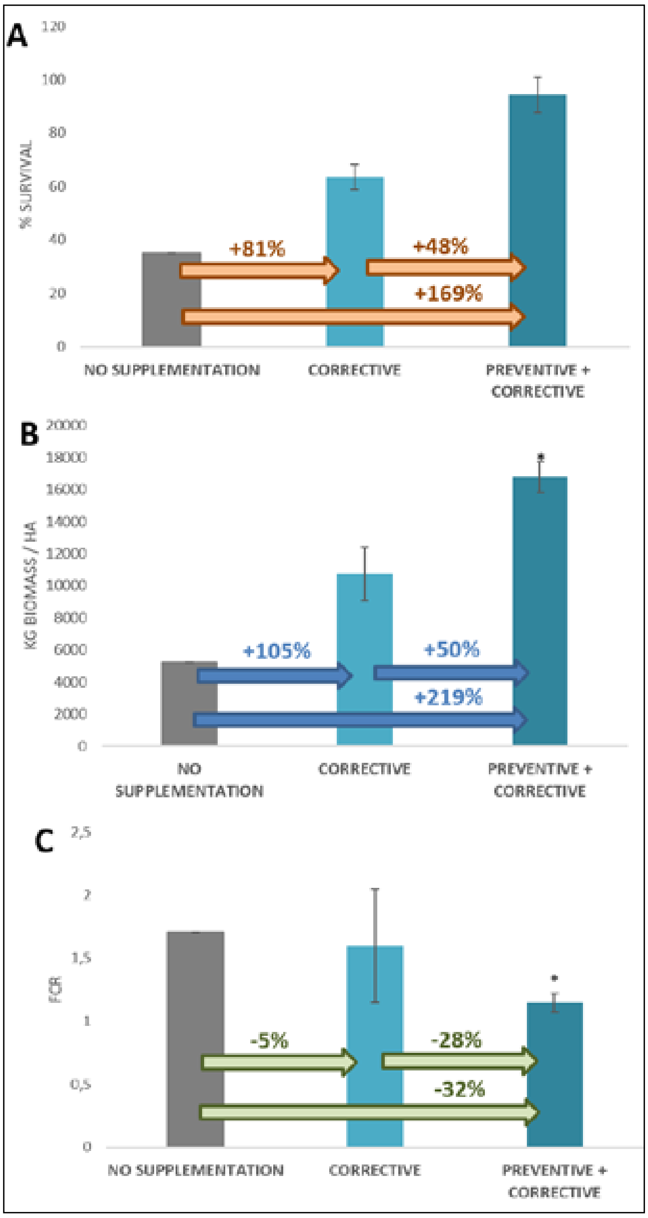


Figure 1. Efficacy of supplementation strategies of SANACORE®GM on shrimp performance and survival over two crops. A) % survival. B) Biomass per ha. C) Feed conversion efficiency (FCR). A total of 10 ponds were used per application strategy (n=10).

* Denotes significant differences between corrective and preventive + corrective application strategies.

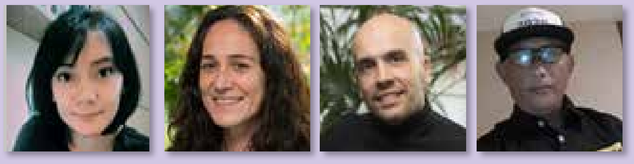
Feed conversion efficiencies were also positively affected by supplementation (Figure 1C). The corrective application showed an improvement of 5%, while the combined strategy significantly resulted in an additional 24% improvement.

Pale hepatopancreas was observed at DOC 30-40; however, the application of the functional additive under both strategies prevented further symptoms such as white faecal strings at the water surface.

Altogether, these results are consistent with previous farm trials showing that while the corrective application is sufficient to mitigate signs of infection and improved survival, the combination of preventive and corrective applications is a more successful approach to maintain or increase growth rates and survival to pre-WFS levels (Nuez-Ortín and Isern-Subich, 2019). The efficacy of Sanacore against WFS is firstly attributed to the counteracting effect against pathogen development. The inhibitory activity against *Vibrio* spp. and EHP isolated from WFS infected shrimp has been proven and attributed to the combination of bactericide/bacteriostatic properties, quorum sensing inhibition, and antiparasitic properties (Nuez-Ortín and Isern-Subich, 2019). The additive also supplies antioxidant and immune-stimulant activities that support shrimp in dealing with the stress associated with changes in water quality and the subsequent increased susceptibility to infection.

The return on investment (ROI) can be defined as the ratio between the money gained from an investment relative to the amount of money invested. ROI was calculated based on the costs of post larvae, feed, additive, improved biomass gain and selling price per kg of shrimp. The functional additive increased feed cost per ha when compared to the farm's historical data, but this investment was well paid off by the biomass gain and economic returns. The ROI calculation indicated that for each US dollar invested in the additive application; USD18 and USD40 were additionally gained for the corrective and combined preventive and corrective strategies, respectively.

In conclusion, the present trial brings new evidence on the efficacy of Sanacore to prevent WFS under farming conditions. The high level of pond replication used in this study is not easily achieved at farm level and increases the reliability of the results. The corrective application of the additive positively impacts performance and survival, but only the preventive dose from stocking onwards successfully recovers farm standard growth rates and pond productivity. Under risk of disease outbreak, the net returns from additive applications exceed the net investment.



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