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Study location: **Shanghai Ocean University, China**

August 1, 2024 Report on file

Title: Celmanax improved growth, antioxidant ability, immunity and gut morphology of white leg shrimp (*Litopenaeus vannamei* sp.)

Celmanax is a multicomponent, all-natural postbiotic and prebiotic feed supplement that has Generally Recognized as Safe (GRAS) status as a feed ingredient.

Study Overview

- The objective of this study was to evaluate the effects of Celmanax supplementation to shrimp diets on growth performance, serum antioxidant status, immunity and gut morphology of Pacific white shrimp (*Litopenaeus vannamei*).
- White leg shrimp with starting BW 1.3 g were stocked in fresh-water ponds. There were sixty shrimp/replicate and four replicates per treatment group.
- Shrimp were fed isonitrogenous and isolipidic diets supplemented with 0, 100 ppm, and 200 ppm of Celmanax SCP for eight weeks.
- Growth performance, mortality, serum biochemistry, and function and morphology of hepatopancreas were measured.
- Data were analyzed using the software SPSS 26.0 with statistical significance noted at $P < 0.05$ and a tendency at $P < 0.1$.

Results

Performance

- Performance data are summarized in table 1. There was a dose dependent increase in final BW, rate of weight gain and percent survival in Celmanax supplemented shrimp compared to control treatment ($P < 0.05$). There was also a dose dependent decrease in feed conversion ratio (FCR) in Celmanax supplemented shrimp compared to control treatment ($P < 0.05$) with Celmanax 200 ppm showing the best FCR.
- The crude protein content of whole shrimp was significantly higher in Celmanax than the control group ($P < 0.05$) (data not shown).

Table 1. Effect of Celmanax supplementation on shrimp growth performance

Parameter	Control	CELMANAX 100 PPM	CELMANAX 200 PPM
Initial BW, g	1.20 ± 0.05	1.20 ± 0.05	1.20 ± 0.05
Final BW, g	9.24 ± 0.18 ^c	10.51 ± 0.08 ^b	11.14 ± 0.23 ^a
Weight gain rate, %	611.1 ± 14.2 ^c	708.1 ± 6.0 ^b	756.8 ± 17.5 ^a
Survival, %	80.0 ± 2.5 ^b	90.0 ± 8.7 ^{ab}	98.0 ± 3.5 ^a
FCR FI/BW	1.72 ± 0.07 ^a	1.35 ± 0.03 ^b	1.31 ± 0.12 ^b

Superscripts within a row ^{abc} $P \leq 0.05$ indicate significant differences between treatments.



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Physiology and immunity

- Oxidative stress: Shrimp supplemented with Celmanax had higher level of catalase (CAT) and total superoxidase dismutase (T-SOD) and lower levels of malondialdehyde (MDA) (oxidative stress indicator) (100 ppm), indicating better ability to manage oxidative stress compared to shrimp fed the control diet (Table 2).
- Innate Immune markers: Serum Total protein (TP), Phenoloxidase (PO), Lysozyme (LZM), acid protease (ACP), and alkaline protease (AKP) are key immune markers that form part of the innate immune responses in shrimps. Shrimp fed Celmanax had higher AKP, TP, LZM (200 ppm), ACP (200 ppm), NOS, and PO (100 ppm) activity compared to shrimp fed the control diet (Table 2).
- Activity of digestive enzymes protease, amylase and lipase as well as villus height and villus width were higher in Celmanax compared to control treatment (data not shown) and could be a factor in improved growth rate seen in Celmanax supplemented shrimp.

Table 2. Effects of Celmanax supplementation on serum antioxidant and immune markers

Parameter	Control	CELMANAX 100 PPM	CELMANAX 200 PPM
CAT, U/ml	13.32 ± 1.58 ^c	24.05 ± 1.01 ^a	19.76 ± 1.24 ^b
MDA, nmol/ml	5.92 ± 0.85 ^a	1.97 ± 0.28 ^b	4.79 ± 0.85 ^a
T-SOD, U/ml	133.96 ± 8.24 ^b	161.47 ± 8.72 ^a	178.11 ± 12.17 ^a
Lysozyme, U/ml	812.50 ± 62.50 ^b	828.13 ± 46.88 ^b	979.17 ± 47.74 ^a
Alkaline Protease, King unit/100 ml	10.90 ± 0.32 ^b	14.41 ± 1.26 ^a	14.03 ± 1.07 ^a
ACP, U/ml	12.33 ± 0.19 ^b	12.15 ± 0.5 ^b	15.62 ± 1.24 ^a
TP, g prot/L	26.25 ± 1.01 ^b	29.03 ± 0.69 ^a	28.64 ± 0.91 ^a
AlB, g prot/L	10.38 ± 0.35 ^b	12.47 ± 0.5 ^a	12.55 ± 0.71 ^a
NOS, U/ml	36.38 ± 1.37 ^c	43.79 ± 0.92 ^a	39.92 ± 1.85 ^b
PO, ng/ml	9.19 ± 0.44 ^b	12.92 ± 0.95 ^a	9.39 ± 0.47 ^b

Superscripts within a row ^{abc} P ≤ 0.05 indicate significant differences between treatments.

Conclusion

In conclusion, the addition of 100 mg/kg or 200 mg/kg of Celmanax to the diet could improve the growth performance, antioxidant capacity and intestinal health of Pacific white shrimp.