ALLIANCE™
(https://www.globalseafood.org)

Responsible Seafood ADVOCATE

Health & Welfare

Evaluation of a commercial polyphenol compound for Pacific white shrimp diets

2 December 2024

By Dr. Eduardo Luis Cupertino Ballester

ELIFE® improved growth, survival and antioxidant defenses of *P. vannamei* juveniles

The study evaluated the effect of the commercial polyphenol compound ELIFE® on the performance and antioxidant status of *P. vannamei*. Results showed that dietary supplementation with these grape polyphenols promoted shrimp growth, survival, final biomass and feed conversion, and positively modulated the antioxidant defense system, with a recommended inclusion level of 1 gram per kg feed. Photo by Francisco Miranda.

Oxidative stress may result from the imbalance between the levels of pro-oxidant agents and the antioxidant defense system of shrimp. During the process, the formation of subcomponents harmful to animals also occurs. Reactive oxygen species (ROS) are molecules capable of oxidizing and damaging biomolecules such as lipids, proteins, and nucleic acids. ROS may appear in different tissues as a product resulting from the incomplete **reduction of oxygen molecules** (https://doi.org/10.1016/j.fsi.2016.05.009) or as a byproduct of energy metabolism.

To avoid the damage caused by the excess of reactive species, aerobic organisms have developed complex antioxidant defense mechanisms, including enzymatic and non-enzymatic ones. For farmed aquatic organisms like Pacific white shrimp (*Penaeus vannamei*), there is increasing interest in adopting natural compounds with antioxidant, antimicrobial, and anti-inflammatory activities as alternatives to improve their farmed production, rather than using antibiotics or synthetic compounds. Natural polyphenol compounds are an alternative; these are organic compounds generally found in vegetables (e.g., herbs, fruits, and legumes). They have several **bioactive functions** (https://doi.org/10.1016/j.foodchem.2020.127535) such as antioxidant, anti-inflammatory, and antimicrobial actions.

Several studies have reported on the inhibitory potential of pathogenic agents through the use of **polyphenols** (https://doi.org/10.3390/ijms11020622), promoting the improvement of enzymatic activity and nutrient absorption, and enhancing the development of aquatic organisms. Some dietary polyphenols have positive effects on the performance of farmed shrimp, resulting in increased

immunostimulant and immunomodulating capacities in the fight against **oxidative stress** (https://doi.org/10.1016/j.fsi.2017.11.043), improvement in growth, and for *P. vannamei*, an increase in survival rates.

This article – **summarized** (https://creativecommons.org/licenses/by/4.0/) from the **original publication** (https://doi.org/10.3390/fishes9100410) (Colares, H.D.F. et al. 2024. Effect of a Commercial Polyphenol Compound on the Performance and Antioxidant Status of *Penaeus vannamei*. Fishes 2024, 9(10), 410) – reports on research to evaluate the effect of a commercial polyphenol compound (ELIFE®) on the performance and antioxidant status of *P. vannamei*.

(https://link.chtbl.com/aquapod)

Study setup

This study consisted of two 28-day phases. In the first phase (Phase 1), the use of ELIFE® was assessed during shrimp growth from approximately 2 to 6 grams, while in the second phase (Phase 2), growth was assessed from approximately 6 to 10 grams. Different groups of animals were used for each test phase, sourced from a commercial hatchery (Aquatec®, Canguaretama, Rio Grande do Norte, Brazil). The study design was a completely randomized design, with twenty-four 40-liter tanks within a recirculating system and individual tank aeration.

Controlled environmental conditions for the test included a photoperiod of 12:12 h (light/dark) using artificial light and water temperatures maintained at 27 to 30 degrees-C. Artificial water was used (Red Sea, Houston, TX, USA) and salinity maintained at 15 grams per liter. There was no water renewal during the trial period, but about 5 percent of the volume was replaced during the study to compensate for losses due to evaporation or the syphoning of residues.

In each trial phase, five shrimp were stocked in each experimental unit, totaling 120 *P. vannamei* juveniles. In the first phase, the initial shrimp weight was 1.76 ± 0.16 grams (mean ± SD); in the second phase, the initial shrimp weight was 5.58 ± 0.41 grams. The animals underwent a 24-hour acclimation period to the test environment, and then the test diets were offered.

The amount of feed offered was calculated based on the expected growth of one gram per week and a feed conversion ratio of 1.5:1 Feed was monitored daily and adjusted in case of death and/or decrease or increase in food consumption. For greater control of food consumption, each tank was visually inspected once a day, to identify the consumption of each unit; for this purpose, the syphoning of excreta and surplus pellets was carried out in the morning of each day and the leftovers were counted.

For detailed information on the experimental design, animal husbandry and diet preparation; data collection and analyses, refer to the original publication.

Effect of dietary piperine supplementation on production and health of Pacific white shrimp postlarvae

Piperine at doses of 0.1–0.4 percent can be a valuable feed additive to improve the growth, feed utilization, immunity, digestibility and disease resistance of L. vannamei.

Global Seafood Alliance

Results and discussion

Polyphenols are plant-derived compounds with beneficial biological activities, promoting improvement in growth performance parameters, body composition, and digestive enzyme activities. Polyphenols also mitigate oxidative stress, increase the antioxidant status of fish, improve immune responses, and increase resistance against infectious diseases. In recent years, a growing number of studies have explored the use of polyphenols and polyphenol-rich additives in aquaculture as functional feed additives. However, the use of commercially available polyphenols, such as the one used in this study, is more advantageous because commercially available extracts are standardized according to **polyphenol concentration** (https://doi.org/10.1016/j.aquaculture.2022.737955), allowing a precise assessment of the inclusion level and allowing reproducible results to be obtained.

Regarding growth performance and the zootechnical performance of the experimental shrimp at the end of Phase 1, significant differences were observed between the treatments with supplementation and the control group for final average weight, final average length, and specific growth rate (SGR). The SGR, final weight, and final average length of *P. vannamei* were higher in both treatments with supplementation. For the final biomass and feed conversion rate (FCR) variables, the treatment with 1.0 grams per kg supplementation was better than the control group (no supplementation).

At the end of Phase 2, significant differences were observed in supplemented treatments for survival, final biomass, SGR, and feed conversion rate (FCR). The treatment with the addition of 1.0 grams per kg of the commercial product resulted in significantly higher shrimp survival than the treatment with just 0.5 grams per kg of supplementation, and both treatments were significantly higher than survival in

the control group (no supplementation). The final biomass and SGR were significantly higher in the treatment with 1.0 grams per kg than in the treatment with 0.5 grams per kg supplementation and the control group. For FCR, both treatments with the commercial polyphenol product were significantly higher than the control group and similar to each other.

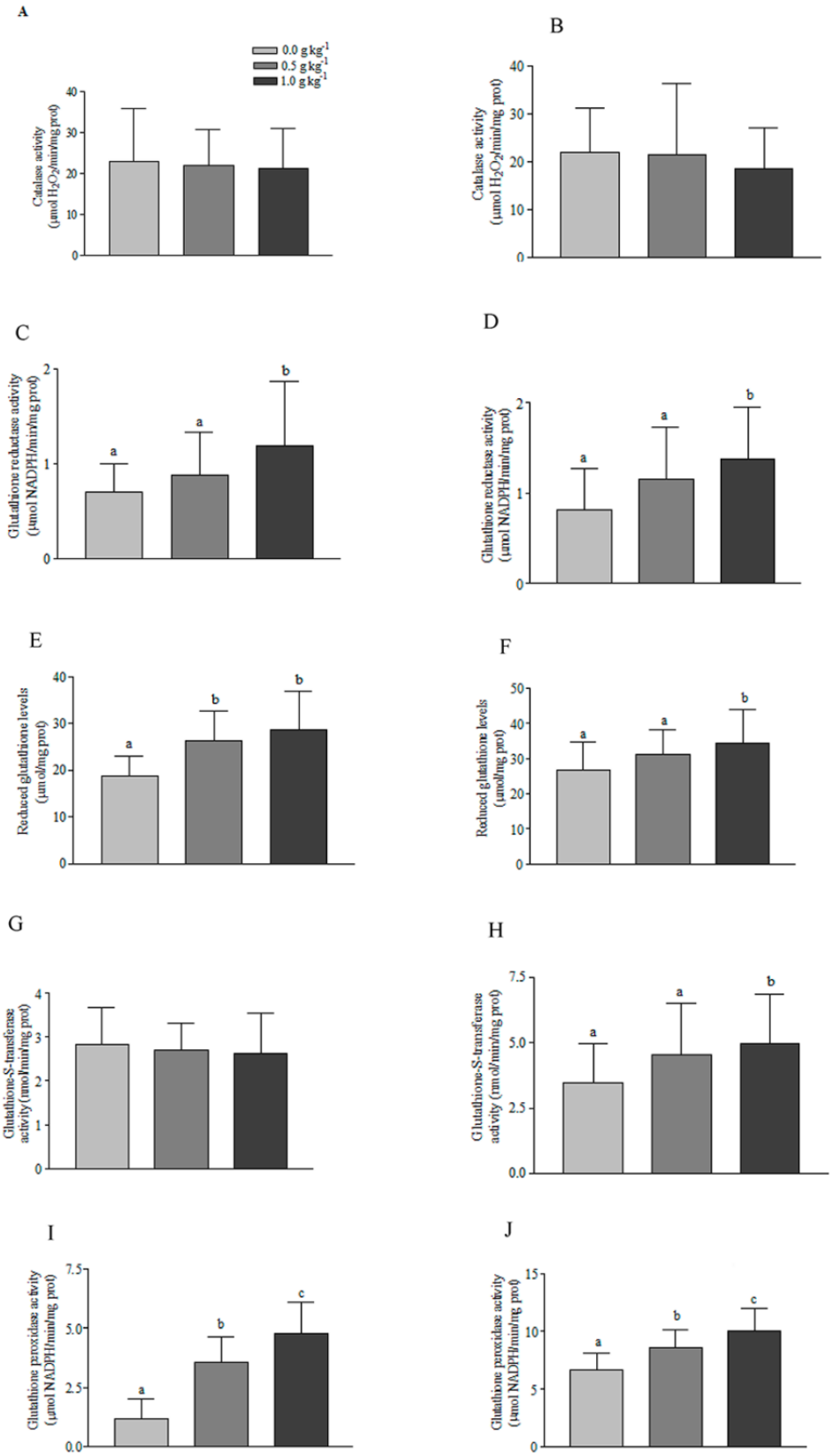

Fig. 1: Antioxidant activity in the hepatopancreas of *P. vannamei* juveniles fed without and with two inclusion levels of a commercial polyphenol compound, ELIFE®, in two trial phases. (A): Catalase (Phase 1). (B): Catalase (Phase 2). (C): Glutathione reductase (Phase 1). (D): Glutathione reductase (Phase 2). (E): Reduced glutathione (Phase 1). (F): Reduced glutathione (Phase 2). (G): Glutathione S-transferase (Phase 1). (H): Glutathione S-transferase (Phase 2). (I): Glutathione peroxidase (Phase 1). (J): Glutathione peroxidase (Phase 2). (K): Lipid peroxidation (phase 1). (L): Lipid peroxidation (Phase 2). Different letters above bars indicate significant difference between experimental groups ($p < 0.05$).

Our results are directly related to the properties of phytogenic compounds that can benefit the activity of digestive enzymes and the absorption of nutrients, improving FCR and contributing to shrimp growth performance and activity profitability. Considering that the product we tested is based on polyphenolic compounds, the growth performance results observed in this study may be due to the influence of these compounds on the digestive process, increasing the activity of digestive enzymes and improving nutrient absorption.

In addition to the potential effect of phenolic compounds as metabolism modulators, another noteworthy advantage of their application in aquafeeds is the potential antioxidant effect of this group of compounds. The antioxidant properties of polyphenols are related to their ability to neutralize reactive oxygen species. In this study, the polyphenol supplementation to shrimp diets improved the antioxidant status of the animals, observed by the increases in the content and activities of various enzymes.

Phenolic compounds can abduct or even inhibit ROS, enabling animals to metabolize xenobiotics more efficiently, reducing the potential damage of these chemical substances, and favoring detoxification. They are of great importance since ROS are **highly toxic** (https://doi.org/10.1111/jpn.12579) and with the potential to damage proteins, lipids, and nucleic acids, resulting in cellular lesions such as mutations and lipid peroxidation.

Overall, the supplementation of the polyphenol-containing commercial product ELIFE® in the experimental diets we tested with *P. vannamei* benefited the animals' activity of various enzymes that improve the antioxidant status of the animals. It also improved nutrient absorption and consequently FCR, resulting in greater production of final biomass and improving profitability.

Perspectives

Supplementation with grape polyphenols from the commercial compound ELIFE® in Pacific white shrimp diets had a modulating role in the animals' antioxidant defense system, promoting an improvement in their antioxidant status and resulting in better FCR and SGR and increased survival and final biomass. Based on these results, we can recommend the dietary supplementation of 1.0 grams per kg of the commercial polyphenols evaluated.

Further studies could assess the potentially wider pharmacodynamic effects of these polyphenols, such as any antiviral and antimicrobial effects and the promotion of gut microbiota health. And the key mechanisms of bioactivity and bioavailability along the shrimp's liver and intestinal tract could also be further investigated.

Author

DR. EDUARDO LUIS CUPERTINO BALLESTER

Corresponding author
Shrimp Culture Laboratory, Federal University of Paraná—Palotina Sector, Rua Pioneiro, 2153, Jardim Dallas, Palotina 85953-128, Paraná, Brazil

elcballester@ufpr.br (mailto:elcballester@ufpr.br)