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# The use of liquid vermicompost microcapsules as a complement in food for juvenile white shrimp

## Abstract

Organic acids, worms, and other high protein substances, containing most of the essential amino acids, have been proven to bean excellent food additive for fish and in aquaculture, especially for shrimp culture. The worm *Eisenia foetida* and vermicompost sub products have been used as a protein source because of their high protein content, between 50 and 67%; they have been included in experimental aquatic feeds, but their use is less known in shrimp culture and has not been tested as a food complement for shrimps. In this study, we added microcapsules with liquid vermicompost as a natural immune enhancer to stimulate disease resistance in shrimp, but they were used also as a complement in shrimp food to observe their survival and growth. Ground commercial shrimp food (CSF) with 40% protein was added to each of eight treatments as follows: A2:CSF+2% of cow manure microencapsulated liquid vermicompost (CMMLV); A3:CSF+3% of CMMLV; A5:CSF+5% of CMMLV; V2:CSF+2% cafeteria wastes microencapsulated liquid vermicompost (CWMLV); V3: CSF+3% CWMLV; V5: CSF+5% CWMLV; CNE:CSF + microencapsulated distilled water, and CN: CSF alone. Initial and average weight gain did not depict statistically significant differences among treatments, but there were significant differences in the specific growth rate and survival. The use of liquid vermicompost resulted in a plausible option to enhance shrimp nutrition. Further studies must be done to test how much shrimps can grow in a longer period and whether this additive can be an option to prevent shrimp diseases.

**Keywords:** shrimp, liquid vermicompost, microencapsulation, growth, survival

Volume 8 Issue 6 - 2019

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**Received:** October 23, 2019 | **Published:** November 27, 2019

## Introduction

World fishing to produce fish flour has reached the maximum sustainable yield with high consequences in the price and the nutritional level of products. But, one of their major challenges is to reduce food production costs.[1] Until now, the aquaculture food industry depends only on fish flour consumption, which constitutes the highest value ingredient of shrimp food due to its protein quality, essential amino acids, and polyunsaturated fatty acids content.[2] Mexico demands balanced aquaculture food for trout, tilapia, carp, catfish, and shrimp cultures.

Some organic acids, worms, and other high protein substances, containing most of the essential amino acids, and a predominance of polyunsaturated fatty acids with significant amounts of linoleic and linolenic acid have been proven to bean excellent food additive for fish, poultry, pigs, or domestic animals,[3,4] as well as to measure growth and as antimicrobial agents in aquaculture, especially for shrimp culture.[5] It has been shown that they have a better performance in growth and survival than control treatments in low quantities,[6,7] making them a potential food additive for shrimps.[5]

Much research has been focused on finding alternatives to substitute fish protein in food for aquatic species, like fishes[8] and crustaceans.[9] Several studies have been done to substitute partially or totally fish protein with natural and lower cost ingredients.[10] The worm *Eisenia foetida* has been used as a protein source in pets and little ruminants food, because of its high protein content, between 50 a 67%, and has been included in experimental aquatic feed,[8] but its use is less known in shrimp culture,[11] the use of vermicompost sub products has not been tested as food complement.

On the other hand, microparticulated and microencapsulated diets as partial substitute of animal food have yielded survival and development rates similar to those obtained with live food but with lower growth.[11,12] Thus, we can consider that the use of liquid vermicompost in microcapsules as an additive in shrimp feed could have some influence in the crustacean's behavior.

The purpose of this research was to add microcapsules with liquid vermicompost as a natural immune enhancer to stimulate disease resistance in shrimp, but they were also used as a complement in shrimp food to observe shrimp survival and growth. Different doses of these microcapsules from two different vermicompost wastes were proven as important sources of protein.

## Materials and methods

The experiment was done in the laboratory with controlled parameters of temperature, salinity, and oxygen. Worms were added to two different organic waste beds: one with cow manure and the other with cow manure and cafeteria wastes. The vermicompost beds were moisturized during three months and, at the end of the third month, the vermicompost liquid from the two beds was collected. Three liters of each liquid were filtered to separate all suspended solids and to be microencapsulated in a Spray Dryer ADL311S (Yamato Scientific America, Japan) for three hours.

Ground Purina©[1]commercial shrimp food (CSF) with 40% protein was added to each of the eight treatments, as follows: A2: CSF+2% of microencapsulated vermicompost liquid from cow manure (CMMLV) + alginate + maltodextrin[2] + fish oil; A3: CSF+3% of CMMLV +

[1]Purina©:12.00% maximum humidity, 40.00% minimum protein, 7.70% minimum fat, 3.50% maximum crude fiber, 11.20% maximum ashes.
[2]Maltodextrin is a mixture of glucose polymers that appear as a result of starch hydrolysis.

alginate + maltodextrin+ fish oil; A5: CSF+5% of CMMLV + alginate + maltodextrin+ fish oil; V2: CSF+2% microencapsulated vermicompost liquid from cafeteria wastes(CWMLV)+alginate + maltodextrin+ fish oil; V3: CSF+3% CWMLV+ alginate + maltodextrin+ fish oil; V5: CSF + 5% CWMLV + alginate + maltodextrin+ fish oil; CNE: CSF + microencapsulated distilled water + alginate + maltodextrin + fish oil; and CN: CSF alone.

Ten shrimps were placed in 3-L fish bowls with three replicates for each treatment. Shrimp juveniles had an average weight of 0.585±0.101248g at the beginning of the experiment. The experiment lasted 15days and the water of the fish bowls was changed every 2days to prevent nitrification by shrimp excreta and food surpluses.

We measured survival, specific growth rate (SGR), and weight gain at the end of the experiment. All data were analyzed with one-way ANOVA and Tukey test.

## Results

Salinity, pH, and oxygen were the same for all treatments during the experiment. All treatments were fed at the same hour and the water was cleaned on the next day. Initial average weight was not statistically significant different among treatments. There were no significant differences among treatments, but A2 had the highest weight gain with 0.0978g (Figure1) followed by CN with 0.963g, which had no liquid vermicompost.

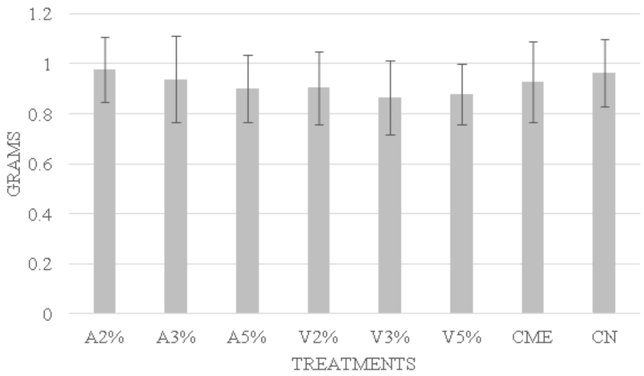


**Figure 1** Weight after 15 days of experiment.

SGRdepicted significant differences among treatments. Treatment A2 had the best performance with 0.368g (p=0.000042), followed by CME with 0.365g (p=0.000051). The treatment with the lowest value was V5 with 0.277g (p=0.314123; Figure 2). Since the first measure, this treatment had this behavior throughout the whole experiment.

There were statistical differences among treatments in survival. Treatments A2 and CN presented 100% of survival. The lowest survival was for A3 with 70% (Figure 3).

## Discussion and conclusion

Recent studies on the effect of organic acid supplementations in aquaculture diets have focused on their used as growth promoters and bacterial prophylaxis.[13]

In our study, low amounts of liquid animal vermicompost as a supplement in shrimp food yield eda good response in shrimp growth and survival.[13,14] Febrianti et al.[15] reported that dietary symbiotic microcapsules could improve the absorption of nutrients and growth performance, this statement can be applied to the vermicompost that can be absorbed by bacterial metabolism in the gut.[5,16] Yao et al.[17] mention that crude protein can be improved significantly with these diets of additives supplementation; some studies have reported that organic acids, such as liquid vermicompost, can improve growth, feed utilization, gut health, and disease resistance in aquatic animals, and will benefit shrimp farming in water reservoirs and closed recirculating water culture systems.[18]

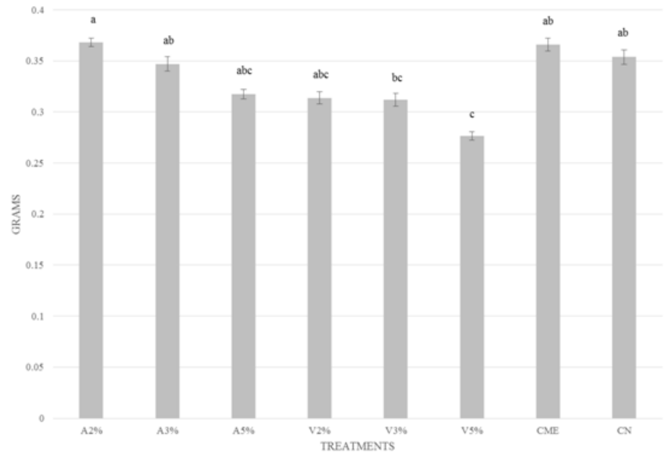


**Figure 2** Weight gained according to treatment during the 15 days of the experiment.

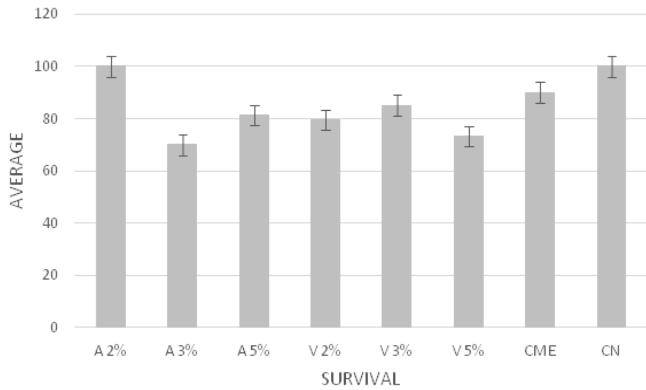


**Figure 3** Survival throughout the experiment.

The use of liquid vermicompost can be a possibility to enhance shrimp nutrition. Further studies must be done to test how much shrimps can grow in a longer period and whether the liquid vermicompost supplementation can be an option to prevent shrimp diseases.

## Acknowledgment and funding

To the Instituto Politécnico Nacional for the administrative and financial support to our research (Grant SIP20170522).

## Conflicts of interest

The authors declare that there are no conflicts of interest.

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