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Application of Feed Supplements to Improve the Growth Performance of Pacific Whiteleg Shrimp *Litopenaeus vannamei* with Clinical Symptoms of Acute Hepatopancreatic Necrosis Disease

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Abstract

Pacific whiteleg shrimp *Litopenaeus vannamei* is a type of shrimp species with high economic value and is one of major fisheries export commodities in Indonesia. High market demand encourages farmers continosly increase production; however, these efforts are often constrained by various problems, such as outbreaks of Acute Hepatopancreatic Necrosis Disease (AHPND). This study aimed to determine to evaluate the effects of feed supplementation on the growth and survival rate of whiteleg shrimp and compare its performance in two different growing media (soil ponds and HDPE-lined ponds). Feed supplementation was applied from day 54 of the culture period in two ponds with stocking densities of 66 and 97 postlarvae m^{-2}. The feed supplement underwent a water-dissolution and 11-hour fermentation process prior to application. Shrimp growth performance (ABW, ADG, FCR, SR, and productivity) and water quality parameters (salinity, pH, temperature, and dissolved oxygen) were monitored and analyzed descriptively. The results showed an increase in shrimp growth and survival rate. The survival rate in the soil pond was 26,9%, which lower than that in the HDPE- lined pond (70,6%). Changes in weather and water quality in were identified as crucial factors affecting the results. Feed supplementation improved shrimp growth and survival; however, despite faster growth in Pond A, Pond B demonstrated higher survival, better feed efficiency, and superior overall productivity.

Keywords: AHPND, feed supplement, pacific whiteleg shrimp, pond type

I. INTRODUCTION

Indonesia ranks fourth among the world's largest shrimp producers. One of the shrimp species with high economic value and serving as a major export commodity is the Pacific white shrimp *Litopenaeus vannamei*. This species possesses several advantages, including tolerance to poor environmental conditions, the ability to thrive at high stocking densities, euryhaline characteristics (tolerance to a wide range of salinity levels), and fast growth with a culture cycle of approximately 90–100 days (Renanda *et al.,* 2019).

Market demand for *L. vannamei* continues to increase, encouraging farmers to adopt and develop aquaculture techniques aimed at boosting production. However, efforts to enhance shrimp productivity are often constrained by various challenges, particularly outbreaks of Acute Hepatopancreatic Necrosis Disease (AHPND), which is caused by Vibrio parahaemolyticus. Clinical symptoms of AHPND include an empty gut, a pale hepatopancreas, and reduced appetite that leads to stunted growth. These symptomps are typically followed by mass mortalities, characterized by erratic spiral swimming near the water surface before shrimp gradually sink due to weakness (Tran *et al.,* 2013; Joshi *et al.,* 2014).

Similar symptoms were observed at the study site (H. Khumaedi's ponds) during the previous culture cycle in several ponds. In the currently observed culture cycle, AHPND-like symptoms appeared on day 35 in Pond A and day 41 in Pond B. As a mitigation effort, a feed supplementation strategy was evaluated by applying a feed supplement starting on day 55 of the culture period. The supplement was administered orally by mixing Boster Amino Liquid, Aquavita premix, and Grotop into the feed. This study aimed to evaluate the effects of feed supplementation on the growth performance and survival rate of *L. vannamei* exhibiting clinical symptoms of AHPND under two different pond systems.

II. MATERIALS AND METHODS

This research was carried out over a period of 107 days. Two types of ponds were designated as rearing media. Pond A (1800 m^2) was an earthen pond with High-Density Polyethylene (HDPE) tarpaulin lining applied only to the pond walls, whereas Pond B (1750 m2) was fully lined with HDPE tarpaulin, including the pond bottom. Both ponds are located at a shrimp farm in Berundung Village, Ketapang Subdistrict, South Lampung Regency, at coordinates 05°52'30"–05°37'30" S and 105°40'0"–105°52'30" E.

2.1. Material

The equipment required in this research included rearing ponds, paddlewheels, anco nets, submersible pumps, manual and digital scales, buckets, dippers, transparent plastic bags, feed sacks, a refractometer, a pH meter, and a dissolved oxygen (DO) meter. The materials used consisted of L. vannamei, feed supplement (Boster Amino Liquid, Boster Premix Aquavita and Boster Grotop).

2.2. Application of Feed Supplement Using the Oral Method

Feed supplementation was applied from day 55 of the culture period in both ponds. Boster Amino Liquid was administered at a dose of 10 mL kg^{-1} feed, Boster Premix Aquavita at 5 g kg^{-1} feed, and Boster Grotop at 3 g kg^{-1} feed, based on the daily feed requirement. The stocking density of postlarvae in Pond A was 66 individuals m^{-2}, while Pond B had a stocking density of 97 individuals m^{-2}. The feed supplement was prepared by dissolving the supplements in a bucket containing 0.25 kg of pond water per kilogram of feed and stirring until all components were fully dissolved. The solution was then mixed with the feed, which had been weighed according to the daily feeding requirement, and stirred until evenly coated. After thorough mixing, the supplemented feed was placed into a feed sack and allowed to ferment (rest) for approximately 11 hours to achieve optimal results. Feeding in the culture ponds was conducted the following day using the supplemented feed. Daily feeding rates were adjusted based on estimated shrimp biomass and feeding response in each pond.

2.3 Observation Parameters

The parameters observed in this study included shrimp growth performance and water quality. Shrimp growth performance parameters comprised Average Body Weight (ABW), Average Daily Growth (ADG), Feed Conversion Ratio (FCR), Survival Rate (SR), and productivity. Water quality parameters measured included salinity, pH, temperature, and dissolved oxygen (DO).

2.3.1 Shrimp Growth Performance

Shrimp growth performance was assessed through weekly sampling. Prior to sampling, shrimp were collected from the culture pond using a 1-meter-diameter cast net. A total of 30 shrimp was then taken and weighed using a digital scale. The collected data were used to calculate the following parameters:

Average Body Weight (ABW): the mean body weight of shrimp from the sample. Average Daily Growth (ADG): the average daily weight gain of shrimp over a specific period, used to determine the growth rate. The observation parameters are calculated using the following equation:

ABW = Total weight of sampled shrimp (g)/Number of sampled shrimp (individuals)

ADG = (ABWt-ABWo)/t

FCR = F /Biomassa

Productivity = Number of production/(Land area)

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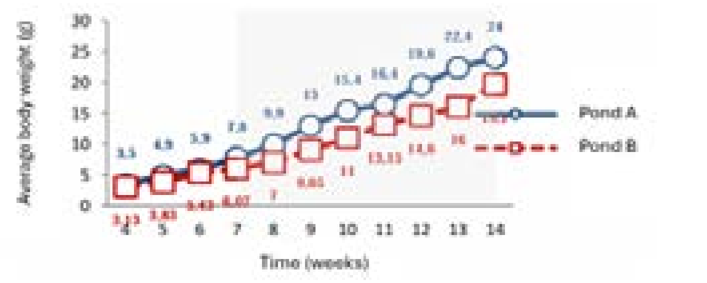

Figure 1. Weekly Average Body Weight (ABW) at the research site.

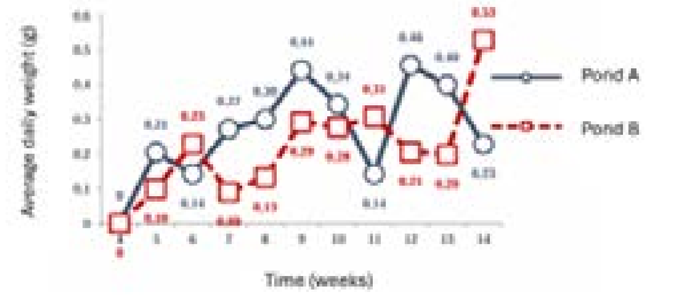

Figure 2. Average Daily Growth (ADG) at the research site.

Description:
ABW= Average Body Weight (g).
ABWt= ABW at the latest sampling (g).
ABWo= ABW at the previous sampling (g).
ADG = Average Daily Growth (g day^{-1})
FCR = Feed Convertion Ratio
SR = Survival Rate (%)
t= time interval between samplings (days)

Furthermore, population sampling was conducted during the culture period. From population sampling data, the FCR was calculated, representing the ratio between shrimp weight gain and the amount of feed administered. The SR was also determined, representing the percentage of shrimp that survived until the end of the culture cycle. In addition, shrimp culture productivity was calculated at the end of the rearing period.

2.4 Data Analysis

The collected data were entered and processed using Microsoft Excel 365 and analyzed descriptively. The results are presented in tables and graphs.

III. RESULT

The average body weight (ABW) of *Litopenaeus vannamei* increased steadily in both ponds throughout the 14-week culture period, with consistently higher values observed in Pond A compared to Pond B (Figure 1). Average daily growth (ADG) fluctuated in both ponds; however, Pond A generally exhibited higher and more stable ADG during the mid-culture period, whereas Pond B showed greater variability, with a notable increase in week 14 (Figure 2). These trends indicate superior individual growth performance in Pond A compared to Pond B.

Despite faster growth observed in Pond A, the final production results demonstrated that Pond B achieved superior overall production performance. This finding suggests that higher individual growth rates do not necessarily translate into greater production efficiency. Pond B recorded a higher harvest yield (1,515 kg), survival rate (70.6%), feed conversion ratio (1.62), and overall productivity compared to Pond A. These results indicate that management practices and stocking density likely played a critical role in determining final production outcomes (Table 1).

IV. DISCUSION

Average Body Weight (ABW) represents the mean weight per shrimp during a cultivation cycle and is obtained through periodic sampling. This parameter is used to monitor shrimp biomass growth at weekly intervals (every 7 days). The first sampling was conducted on Day of Culture 34 (DOC 34), corresponding to 34 days after postlarvae were stocked in the ponds. A total of 30 shrimp were randomly sampled from each pond,

Table 1. Performance indicators for Pacific whiteleg shrimp production.

Parameter	Pond A	Pond B
Rearing age (days)	107	107
Harvest (kg)	648	1.515
Pond area (m^2)	1.800	1.750
Number of Fish Stocked (shrimps)	118.080	170.560
Stocking Density (shrimps m^{-2})	65,6	97,46
Survival Rate (%)	26,9	70,6
FCR	1,87	1,62
Size (shrimps kg^{-1})	49	80
Productivity (kg ha^{-1})	3.600	8.657,14

weighed, and averaged to determine ABW. The results showed that ABW increased consistently in both ponds following the application of feed supplementation. Overall, shrimp reared in Pond A exhibited higher weight gain compared to those in Pond B, indicating better individual growth performance in Pond A.

Average Daily Growth (ADG) reflects the average daily increase in shrimp body weight and is used to evaluate growth rate over a specific period. ADG values fluctuated in both ponds throughout the culture period. The highest ADG in Pond A was 0.46 g day^{-1}, recorded during the ninth week of sampling (day 90 of culture), whereas the highest ADG in Pond B reached 0.53 g day^{-1} during the eleventh week of sampling (day 104 of culture). The lowest ADG in Pond A occurred during the sixth and eleventh weeks (0.14 g day^{-1}), while Pond B recorded its lowest ADG during the seventh week (0.09 g day^{-1}). These fluctuations may reflect variations in environmental conditions, feeding efficiency, and shrimp health status during the culture cycle.

Although both ponds had the same culture duration of 107 days, stocking density differed between the two systems. Pond A was stocked at a lower density than Pond B. The higher stocking density in Pond B was associated with greater harvest biomass, higher survival rate (SR), improved feed conversion ratio (FCR), and increased overall productivity. This result suggests that, under appropriate management and environmental conditions, higher stocking densities can enhance production performance of L. vannamei. However, faster individual growth, as observed in Pond A, did not necessarily result in superior production outcomes.

The differences in growth performance and survival rate of *Litopenaeus vannamei* observed between Pond A and Pond B indicate that shrimp production was influenced not only by feed supplementation but also by environmental and physicochemical water quality conditions. Variations in ABW, ADG, and SR suggest differential environmental stress and pond management effects. Previous studies have shown that wastewater inputs from fish-processing activities can significantly alter physicochemical properties of waters surrounding aquaculture areas, increasing organic load and potentially affecting shrimp metabolism, feed utilization, and disease resistance (Kusumanti *et al.,* 2021).

Degraded water quality has been shown to increase shrimp susceptibility to bacterial infections, including Acute Hepatopancreatic Necrosis Disease (AHPND) (Tran *et al.,* 2013). Therefore, the delayed onset of AHPND symptoms and the higher survival rate observed in Pond B likely reflect more stable environmental conditions, underscoring the importance of integrating water quality management with nutritional strategies to support sustainable shrimp production.

Shrimp growth performance is governed by complex interactions among environmental conditions, nutrition, culture management, and shrimp health. Water quality parameters, particularly temperature, salinity, dissolved oxygen, and pH directly influence shrimp metabolism and feed utilization efficiency (Boyd, 2020). Sediment quality and redox conditions further affect nutrient availability and the accumulation of toxic metabolites that may suppress growth and reduce pond productivity (Wiyoto *et al.,* 2017). Nutritional factors, including dietary protein–energy balance and functional feed supplementation, play a critical role in determining growth rate and feed efficiency (Davis & Arnold, 2022). Moreover, stocking density and feeding management strongly influence growth performance, survival rate, and overall production efficiency in shrimp farming systems (Avnimelech, 2015).

V. CONCLUSION

Feed supplementation positively enhanced the growth and survival performance of *Litopenaeus vannamei*. Although shrimp reared in Pond A exhibited faster individual growth, Pond B achieved higher harvest yield, survival rate, feed efficiency, and overall productivity. These findings highlight the importance of pond type, stocking density, and management practices in determining production outcomes in Pacific white shrimp cultivation.

CONFLICT OF INTEREST

We certify that there is no conflict of interest with any financial, personal, or other relationships with other people or organization related to the material discussed in the manuscript.

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REFERENCES

Alfizar, H., Naufal, A., Ridwan, T. 2021. Kelayakan usaha dan produksi budidaya udang vaname (*Litopenaeus vannamei*) tambak intensif farm Mahyuddin Desa Deah Raya, Kecamatan Syiah Kuala, Kota Banda Aceh. Jurnal Abulyatama.

Amri, K., Kanna. I. 2008. Budidaya udang vaname secara intensif, semi intensif, dan tradisional. Jakarta (ID): PT. Gramedia Pustaka Utama.

Ariadi, H., Wafi, A., Supriatna. 2020. Hubungan kualitas air dengan nilai FCR pada budidaya intensif udang vanname (*Litopenaeus vannamei*). Samakia: Jurnal Ilmu Perikanan. 11(1):44-50.

Arsad, S., Afandy, A., Purwadhi, A. P., Saputra, D. K., Buwono, N. R. 2017. Studi kegiatan budidaya pembesaran udang vaname (*Litopenaeus vannamei*) dengan penerapan sistem pemeliharaan berbeda [Study of vaname shrimp culture (*Litopenaeus vannamei*) in different rearing system]. Jurnal Ilmiah Perikanan dan Kelautan. 9(1): 1–14.

Assidiq, F. G. 2022. Pembesaran udang vaname (*Litopenaeus vannamei*) dengan padat tebar berbeda di PT. Paramyde Paramount Indonesia. Diploma thesis. Politeknik Negeri Lampung.

Avnimelech, Y. 2015. Biofloc technology: A practical guide book (3rd ed.). World Aquaculture Society.

Awanis, A. A., Prayitno, S. B., Herawati, V. E. 2017. Kajian kesesuaian lahan tambak udang vaname dengan menggunakan system informasi geografis di Desa Wonorejo, Kecamatan Kaliwungu, Kendal, Jawa Tengah. Buletin Oseanografi Marina. 6(2): 102–109.

Boyd, C. E. 2020. Water quality: An introduction. Springer. https://doi.org/10.1007/978-3-030-23335-8.

Budiman C., Yani A. 2022. Penerapan biteknologi pakan ternak dengan penambahan silikat cair (SIO2) plus sebagai Feed supplement untuk meningkatkan produktivitas kambing peranakan ettawa. Jurnal Agrioteknologi Universitas Samawa. 2(2): 55–65.

Davis, D. A., Arnold, C. R. 2022. Nutritional strategies for improving shrimp growth performance. Aquaculture, 546, 737350. https://doi.org/10.1016/j.aquaculture.2021.737350

Fahrur, M., Undu, M. C., Syah, R. 2016. Performa instalasi pengolah air limbah (IPAL) tambak udang vaname superintensif. Prosiding Forum Teknologi Akuakultur. 285-293.

Han, J. E., Tang, K. F. J., Piamsomboon, P., Pantoja, C. R. 2017. Evaluation of a reliable non-invasive molecular test for the diagnosis of the causative agent of acute hepatopancreatic necrosis disease of shrimp. Aquaculture Reports. 5:58 61.

Hadie, W., Hadie, L. E., Supangat, A. 2017. Teknik Budidaya Ikan. Jakarta (ID): Bharata Karya Aksara.

Hidayat, Suwarno, G., Mahasri. 2017. Evaluasi pemberian crude protein Zoomthamnium panaei terhadap laju pertumbuhan, respon imun dan kelulus hidupan udang vaname di tambak. Jurnal Paskasarjana.19 (2). Biosains

Hidayah, Z., Nike, I. N., Wiyanto, D. B. 2020. Analisa keberlanjutan pengelolaan sumber daya Perikanan Di Perairan Selat Madura Jawa Timur. Jurnal Perikanan Universitas Gadjah Mada. 22(2): 101.

Joshi, J., Srisala, J., Truong, V. H., Chen, I. T., Nuangsaeng, B., Suthienkul, O., Lo, C. F. (2014). Variation in Vibrio parahaemolyticus isolates from a single Thai shrimp farm experiencing an outbreak of acute hepatopancreatic necrosis disease (AHPND). Applied and Environmental Microbiology, 80(19), 6033–6042.
https://doi.org/10.1128/AEM.01120-14.

Karthikeyan, K., Sudhakaran, R. 2018. Experimental horizontal transmission of Enterocytozoon hepatopenaei in post-larvae of whiteleg shrimp, *Litopenaeus vannamei*. J Fish Dis. doi: 10.1111/jfd.12945.

[KKP] Kementrian Kelautan dan Perikanan. 2018. Produktivitas Indonesia. Jakarta.

[KKP] Kementerian Kelautan dan Perikanan. 2020. Keputusan Dirjen Perikanan Budidaya Nomor 184/KEP-DJPB/2020 tentang Pembentukan Pengendalian Nasional. Jakarta. Gugus Penyakit Tugas Ikan

Lubis, F. N. L., Alfianty R, Sahara E. 2015. Pengaruh suplementasi selenium organik (se) dan vitamin e terhadap performa itik pegagan. Jurnal Peternakan Sriwijaya. 4(1): 28–34.

Morales-Covarrubias, M. S., Cuellar-Anjel, J., Varela-Mejias, A., Elizondo-Ovares, C. 2018. Shrimp bacterial infections in Latin America: a review. Asian. Fish. Sci. 31: 76 – 87.

Mustafa, A. 2012. Kriteria kesesuaian lahan untuk berbagai komoditas di tambak. Media Akuakultur. 7(2):108-118 Nababan E, Iskandar P, Rusliadi. 2015. Pemeliharaan udang Litopenaeus vaname vannamei dengan persentase pemberian pakan yang berbeda. [Skripsi]. Pekanbaru (ID): Universitas Riau.

Nainggolan, R. K. S., Yuhana, M., Sukenda, S., Sariati W. N. E. 2020. Deteksi vibrio parahaemolyticus menggunakan marka Gen Pir A pada udang vaname *Litopenaeus vannamei* dengan Real Time PCR. Jurnal riset akuakultur. 15(2): 111-119.

Prama, E. A., Akbarurrasyid, M., Astiyani, W. P., Prajayanti, V. T., Anjarsari, M. 2023. Penaruh pemberianmerk pakan yang berbeda pada budidaya udang vaname (*Litopenaeus vannamei*) di PT. Biru Laut nusantara di Kabupaten Pangandaran, Provinsi Jawa Barat. Marine and Fisheries Technology Journal. Science.

Tran, L., Nunan, L., Redman, R. M., Mohney, L. L., Pantoja, C. R., Fitzsimmons, K., Lightner, D. V. (2013). Determination of the infectious nature of acute hepatopancreatic necrosis syndrome affecting penaeid shrimp. Diseases of Aquatic Organisms, 105(1), 45–55. https://doi.org/10.3354/dao02621.

Wiyoto, W., Sukenda, S., Harris, E., Nirmala, K., Djokosetiyanto, D., & Ekasari, J. 2017. The effects of sediment redox potential and stocking density on Pacific white shrimp *Litopenaeus vannamei* production performance and white spot syndrome virus resistance. Aquaculture Research, 48(6), 2741-2751.