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Post Larvae Tolerance of Vaname Shrimp Under Salinity Stress With *Spirullina* Sp. Extract Supplementation: A Meta-Analysis Approach

Toleransi Post Larva Udang Vaname Terhadap Cekaman Salinitas Lingkungan Tumbuh Dengan Suplementasi Ekstrak *Spirullina* Sp. : Sebuah Pendekatan Meta Analisis

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ABSTRACT

Vaname shrimp (*Litopenaeus vannamei*) is one of Indonesia's fishery commodities with high economic value. In order to successfully cultivate vaname shrimp, it is important to consider the survival of shrimp during the post larval phase because it is one of the most crucial phases in shrimp survival. This article aims to determine the feeding of Spirulina sp. extract during the post larval period of vaname shrimp to increase the tolerance potential of salinity stress. This research uses a meta-analysis method by searching previous journals that are relevant with the topic of discussion. Furthermore, the articles that have been obtained are analyzed to form a discussion and conclusion. The results of the analysis shows the utilization of Spirulina sp. extract as an additional feed has a positive and significant effect on the weight gain and survival rate of vaname shrimp due the salinity stress. Significant results began to appear at 0.4% concentration of *Spirulina* and progressively increased as its concentration increased. However, the use of concentrations of Spirulina too much or too low showed a decreasing trend. These results indicate that Spirulina sp. can potentially be used as an additional feed for vaname shrimp.

ABSTRAK

Udang vaname *(Litopenaeus vannamei)* merupakan salah satu komoditas perikanan di Indonesia yang bernilai ekonomis tinggi. Dalam keberhasilan budidaya udang vaname hal-hal yang perlu diperhatikan selain lingkungan tumbuh adalah kelangsungan hidup udang selama fase post larva, sebab fase ini merupakan satu fase yang cukup krusial dalam keberlangsungan hidup udang. Artikel ini bertujuan untuk mengetahui pemberian ekstrak *Spirulina* sp. selama masa post larva udang vaname untuk meningkatkan potensi toleransi dari cekaman salinitas. Metode yang digunakan dalam penulisan artikel ini adalah metode meta-analisis dengan melakukan pencarian terhadap jurnal-jurnal terdahulu yang relevan dengan topik bahasan. Selanjutnya, analisis dilakukan terhadap artikel yang telah didapatkan untuk membentuk suatu bahasan dan kesimpulan. Hasil analisis menunjukkan bahwa penggunaan ekstrak *Spirulina* sp. sebagai bahan pakan tambahan berpengaruh positif signifikan terhadap penambahan bobot dan persentase keberlangsungan hidup udang vaname akibat cekaman salinitas. Hasil signifikan mulai

terlihat pada konsentrasi 0,4% dan semakin meningkat seiring pertambahan konsentrasi. Namun, penggunaan konsentrasi Spirulina terlalu banyak atau terlalu sedikit hasil menunjukkan tren penurunan. Hasil ini menunjukkan bahwa *Spirulina* sp. memiliki potensi untuk dapat digunakan sebagai sumber pakan tambahan bagi udang vaname.

Kata Kunci	*Embriogenesis, Daya Tetas, Ikan Lele Mutiara, Pemijahan*
Keywords	*Embryogenesis, Hatching Rate, Pearl Catfish, Spawning*
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INTRODUCTION

The vaname shrimp (*Litopenaeus vannamei*) is a group of shrimps that are euryhaline, which is capable of surviving under salinity conditions in a wide range of between 0.5 - 40 ppt. (Supono et al., 2022). Vaname shrimp becomes an aquaculture commodity with high economic value (Verdian et al., 2020). The cultivation activity of this vaname shrimp itself can be said to be not optimal (Scabra et al., 2023b). There has been an increase in the productivity of white shrimp from 2013 to 2019 and will be further increased by 2024 (Scabra et al., 2023). (Amelia et al., 2021).

Efforts to increase the export value of this vaname shrimp should be made in conjunction with increased productivity and quality of the shrimps that are definitely affected by the maintenance process including in the post larvae period (PL). Because the post larvae is one of the most risky phases of the shrimp's life because its vital organs are not well developed, so the shrimp will be very vulnerable to changes in environmental conditions and increased mortality (Lestari et al., 2024). So as long as the shrimp is in this phase, the conditions of the shrimp farmers must really keep the environment growing the shrew, one of which is salinity (Lestari et al., 2024) because the main habitat of the vaname shrews is in the waters of the brackish waters (Ahmad et al., 2023).

In general, the optimal water quality parameters for the cultivation of vaname shrimp larvae are at temperatures between 26-32°C, the pH of the water between 7.0 - 8.5 (Pebrianto et al., 2023), and the oxygen levels are soluble between 5.04-5.64 (Ahmad et al., 2023). Although the vaname shrimp has the advantage of being able to adapt well to its plant environment, the cultivation of shrimps in conditions of low salinity must have a barrier, i.e. the presence of an obstacle in the process of skin change and shrub growth. (Supono et al., 2022).

The shrimp growth process is a combination of the moulting process and an increase in somatic bipmass. Moulting is an important physiological process in the growth process of shrimp and other crustacean groups. Moulting will go hand in hand with increasing age and depends on environmental conditions and nutritional availability (Roshaliza & Suwartiningsih, 2020). Meanwhile, the osmoregulation process is a system that regulates the body of living creatures to balance ion and water between the body and its growing environment. In unfavorable conditions, for example isoosmotic conditions, shrimp require large amounts of energy to osmoregulate their bodies (Salsabiela, 2020). Such conditions will cause the shrimp to spend most of their energy only on the process of

osmoregulation and adaptation, this will cause the shrimp's risk of contracting disease to increase (Lestari et al., 2024).

Indonesia is a country with a tropical climate which tends to experience rapid changes in salinity due to rainfall (Erfanda & Supriyanto, 2020). The relatively high intensity of rainfall in tropical areas can reduce the salinity level of water areas. This relatively rapid change in salinity can influence the osmoregulation process in aquatic biota. Apart from that, this situation will cause a repeat molting process in the shrimp organism (Salsabiela, 2020). In fact, several studies show that vaname mamu shrimp live well in freshwater media treated with the addition of minerals such as phosphorus (P) (Scabra et al., 2021), calcium (Scabra et al., 2022), as well as magnesium (Scabra et al., 2021).

Efforts to minimize mortality rates and increase productivity in vaname shrimp cultivation activities can also be done by paying attention to shrimp nutritional intake (Perdana et al., 2021). Food sources that come from nature are considered more capable of providing nutrition for shrimp when they are in their early life, one of which is *Spirulina* sp. (Adella et al., 2023). *Spirulina* sp. is a type of microorganism in the form of algae that belongs to the group of cyanobacteria or blue green algae (Ragaza et al., 2020). Spirulina is known to be rich in nutrients and potential compounds that can have therapeutic effects. The nutrients contained in spirulina include carbohydrates, fats, proteins, vitamins and minerals. The protein content in spirulina itself is relatively high, namely around 55-70% (Yudiati et al., 2021).

This high protein content makes spirulina potential to be used as additional feed in fish or crustacean farming activities. In several studies, spirulina has been reported to be able to replace fish and shrimp pellets by up to 75%. The use of spirulina as feed is also known to increase the immune response of shrimp by increasing granular cells and increasing shrimp growth (Lestari et al., 2024). More than that, Spirulina contains the pigment phycocyanobilin which consists of the compounds alloficocyanin, phycocyanin, and phycoerythrin which are very useful as a source of antioxidants and an antidote to free radicals that can damage the body (Sedjati et al., 2022). This research was conducted to determine the physiological response of vaname shrimp larvae supplemented with spirulina.

METHODS

This research is a type of quantitative research with a meta-analysis approach, namely by searching and linking related journals and articles sourced from previous research and carried out systematically to obtain a new conclusion. This research was conducted in April 2024. The systematics of this research is to search and collect journals and articles related to the research topic via the Google Scholar article search site, PubMed, Science Direct, and so on with relevant keywords. Next, a selection process is carried out on articles deemed to be the most relevant. The type of data used is secondary data obtained from selected journals. Finally, analysis of the data obtained is carried out using statistical analysis so that it can produce a conclusion to answer the research objectives. Apart from statistical analysis, effect size calculations were also carried out to determine the size of the effect of each article used in this research. The effect size calculation is carried out using the Glass formula:

$$ES = \frac{\bar{X}e - \bar{X}c}{Sc}$$

Information:
ES = Effect Size
$\bar{X}e$ = Average value of the experimental group
$\bar{X}c$ = Mean value of the control group
Sc = Standard Deviation

Based on the measurement results, the effect size values are then categorized based on criteria, namely:

Table 1. Table of effect size criteria (Glass, McGraw, & Smith, 1981)

Effect Size	Description
Effect size ≤ 0,15	Effects are negligible
0,15 < effect size ≤ 0,40	Low effect
0,40 < effect size ≤ 0,75	Medium effect
0,75 < effect size ≤ 1,10	High effect
1,10 < effect size ≤ 1,45	Very high effect
1,45 < effect size	Very high influence

RESULT AND DISCUSSION

Vaname Shrimp

Vaname shrimp (*Litopenaeus vannamei*) is a member of the Penaeid shrimp group, namely a group of shrimp that are able to adapt to their environment (Taqwa et al., 2021). Vaname shrimp is a species of shrimp that comes from Pacific waters. This shrimp was first discovered on the west coast of Mexico to Peru. Furthermore, the process of cultivating vaname shrimp in the Asian region began in 1996 in Taiwan, then spread to China, Myanmar, Indonesia and several other Southeast Asian countries (KKP Situbondo, 2021). Vannamei shrimp itself entered Indonesia in 2001 (Ahmad et al., 2023) and is then one of the dominant fishery products, especially in tropical areas (Kurniawan et al., 2021) which has become a leading commodity in Indonesia because of its high economic value (Nurhasanah et al., 2021) and is an alternative type of shrimp that can be cultivated in Indonesia besides cultivating tiger prawns and giant prawns (Anisa et al., 2021).

Vaname shrimp have a savory taste with a high protein content of up to 70% and a low fat content of 2.99%, so they are very popular with consumers (Scabra et al., 2023a). Vaname shrimp also have many advantages when kept, such as having better immune system (Putri et al., 2020), easy to cultivate with high productivity (Scabra et al., 2023b), having a high appetite, having time relatively short maintenance, namely between 90-100 days per cycle (Anisa et al., 2021), and a low level of risk of loss (Nguyen et al., 2021). Vaname shrimp are also able to grow quickly, live in the water column so they can be stocked in high densities (Yunus et al., 2020) and can adapt to saline environments (Anisa et al., 2021).

Vaname shrimp are a group of shrimp that are able to act as osmoregulators. However, this can only be done under optimal salinity conditions. When extreme changes in salinity occur, vaname shrimp will only use most of their energy to carry out internal homeostasis to maintain fluid balance in the body (Jaffer et al., 2020). However, despite this, the vaname shrimp cultivation activity itself can be said to be not optimal. This can be seen based on the amount of land use which is only 20% of the total land and the level of consumption fulfillment which only meets 7% of needs (Scabra et al., 2023b). In 2013, the total productivity of vaname shrimp was 500,000 tons, then increased in 2019 to 717,094 tons (KKP, 2019 in Scabra et al., 2023). Furthermore, the Ministry of Maritime Affairs and Fisheries (KKP) is trying to continue to increase the target value of white shrimp exports in 2024 to around 250% or around 2 million tons (KKP, 2021).

Spirulina to Increase Productivity and Tolerance

The use of supplementary feed as an additional feed ingredient in improving survival status and productivity shows good results. The following is a table of analysis results of relevant journals:

Table 2. Vaname Shrimp Productivity Table

	Treatment	IBW (g)	FBW (g)	WG (g)	WGR (%)	SR (%)
Novriadi, et al., 2022	Control = 0%	0,71	7,83	7,12	2868,3	-
	P1 = 0,2%	0,71	8,37	7,66	3192,77	-
	P2 = 0,4%	0,71	8,57	7,86	3228,29	-
	P3 = 0,8%	0,71	8,73	9,03	3025,57	-
Lestari, et al., 2024	Control = 0%	0,002	0,025	0,023	-	87,5
	P1 = 0,3%	0,002	0,026	0,024	-	83,0
	P2 = 0,6%	0,002	0,020	0,018	-	83,0
	P3 = 0,9%	0,002	0,020	0,018	-	81,0
Said, et al., 2023	Control = 0%	6,0	16,77	10,77	10,77	86,67
	P1 = 0,250 %	6,03	18,13	12,10	12,10	90,00
	P2 = 0,50	6,13	19,13	13,00	13,00	96,67
	P3 = 1 %	6,03	19,90	13,87	13,87	96,67
Mansour, et al., 2022	Control = 0%	0,19	21,87	21,68	-	82,22
	P1 = 2%	0,19	22,03	21,84	-	76,67
	P2 = 4%	0,19	24,61	24,42	-	77,78
	P3 = 6%	0,19	25,75	25,56	-	74,44
Zidan, et al., 2021	Control = 0%	0,02	7,86	7,84	-	78,4
	P1 = 5%	0,02	8,57	8,55	-	85,5
	P2 = 10%	0,02	8,65	8,63	-	86,3
	P3 = 15%	0,02	8,33	8,31	-	83,1
	P4 = 20%	0,02	7,32	7,30	-	73,0
Yuan, et al., 2023	P1 = 32%	0,83	5,96	5,13	618,21	97,5
	P2 = 36%	0,83	6,54	5,71	687,29	99,17
	P3 = 40%	0,83	6,48	5,65	681,90	97,5
	P4 = 44%	0,83	6,46	5,63	677,67	98,33
	P5 = 48%	0,83	6,23	5,40	650,46	98,33

Information:
IBW = Initial Body Weight;
FBW = Final Body Weight;
WG = Weight Gain;
WGR = Weight Gain Rate/Weight Gain Rate;
SR = Survival Rate/Life Ability Level

In general, the use of additional spirulina feed showed significantly different results from the control treatment. However, different things happened in the data presented by Lestari et al., (2024) which showed that the control treatment provided the highest survival value compared to the treatment with additional spirulina feed, namely 87.5%. This can be caused by the water change process during the maintenance period (Lestari et al., 2024). This is supported by the statement that the water change process can increase biosecurity risks and the possibility of spreading pathogens (Hasan et al., 2020). Apart from that, high mortality can also be caused by the ability to adapt and the process of collecting and counting post larvae (Usman et al., 2022). Meanwhile, the less significant increase in shrimp weight could be due to a shorter rearing period, so that the maximum increase in shrimp weight cannot yet be known (Lestari et al., 2024).

The use of Spirulina as additional feed for vaname shrimp has a real influence on weight gain, percentage of weight gain and survival percentage of white vaname shrimp. The results presented show that significant results begin to appear at a concentration of 0.4% and increase as the concentration increases. However, when using too much or too little Spirulina concentration the results show a decreasing trend. This may be due to the use of too much spirulina causing a decrease in phosphorus content and feed palatability (Zidan et al., 2024).

Table 3. Table of Statistical Test Results

	p value	Std. Deviation
FBW	0,000	7,94121
WG	0,000	7,26837
WGR	0,011	1108,96339
SR	0,000	41,52006

Based on the results of statistical tests, it shows that each significance value in the research above shows a value of <0.05, indicating that there is a significant difference in the use of spirulina extract in each study. This shows that the use of spirulina has a real and significant effect on the tolerance of vaname shrimp subjected to salinity stress.

Table 4. Table of Effect Size Calculation Results

Articel	Effect Size	Category
Novriadi, et al., 2022	0,55	Medium effect
Lestari, et al., 2024	0,34	Low effect
Said, et al., 2023	0,46	Medium effect
Mansour, et al., 2022	0,64	Medium effect
Zidan, et al., 2021	0,53	Medium effect
Yuan, et al., 2023	0,71	Medium effect
Rata-rata	0,54	Medium effect

Based on the table of effect size calculation results (Table 4), it shows that 5 of the total 6 articles used showed a moderate effect. Meanwhile, 1 other article shows a low effect. The results of calculating the average effect size show that there is a moderate

effect. This shows that there is a moderate effect of Spirullina supplementation on the tolerance of vaname shrimp subjected to salinity stress.

Water salinity is one of the determining factors for the survival and productivity level of vaname shrimp. In shrimp growth, media salinity will influence the osmoregulation process and shrimp body resistance. Shrimp that are kept under conditions of extreme salinity stress will reduce their survival rate due to the difficulty of osmoregulation (Adella et al., 2023). Shrimp during the post larval period are more sensitive to salinity stress, so the maintenance of shrimp larvae is something that needs attention, especially when cultivated in media with low salinity. Media with low salinity will contain very few macro minerals that shrimp larvae need to support their survival (Taqwa et al., 2021).

Spirulina sp. is a type of blue green microalgae which is known to have many benefits and has been widely used as fish and shrimp feed, especially when it is still in the larval stage (Lubis & Lubis 2023). *Spirulina* has been widely reported in research to be able to eradicate pathogens (Yudiati, et al., 2021) and its antioxidant content is able to help shrimp overcome damage caused by oxidative stress (Abdel-Latif et al., 2022). Spirulina has a high protein content which is really needed by vaname shrimp to increase their body weight (Castaneda-Ruelas et al., 2022). This statement is supported by analysis data which shows that the use of Spirulina as shrimp feed is able to increase individual weight and increase the percentage of shrimp survival. However, the use of Spirulina concentration as feed also needs to be considered, because using too much spirulina will cause a decrease in phosphorus content and feed palatability (Zidan et al., 2021).

The protein content in *Spirulina* has a balanced content of amino acids, methionine, tryptophan, and several amino acids that are similar to casein. The composition of this protein will be very useful in meeting protein needs in fisheries cultivation (Zidan et al., 2021). *Spirulina* also has antimicrobial enzymes and peptides which are useful in helping vaname shrimp mediate defense against pathogens (Huang et al., 2020). This statement has been proven by research showing that using *Spirulina* as feed can reduce shrimp mortality due to the white spot syndrome virus (Novriadi et al., 2022).

CONCLUSSION AND SUGGESTION

Conclusion

Use of Spirulina sp. As an additional feed ingredient, vaname shrimp larvae have a significant positive impact on the value of shrimp weight gain and also the percentage of survival. This value is significantly different from the control treatment without the addition of Spirulina to shrimp feed. Spirulina is known to have a high protein content so it can be used as a feed ingredient to meet the protein needs of growing shrimp. In cultivating shrimp with low salinity, shrimp will be exposed to salinity stress which causes high mortality both as a result of salinity stress.

Suggestion

Shrimp cultivation activities in order to meet demand related to animal protein needs really need to be increased, especially because international shrimp requirements are still not met. One of the problems that often occurs is the weak immune system of shrimp when they are in the post larval stage. Therefore, it is necessary to carry out research related to a better approach to determine the impact of using additional supplements on the survival and productivity of post larval shrimp. Research should not only be carried out using one type of supplement but also several alternatives as comparison material.

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