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THE ABUNDANCE OF *Chlorella* Sp. AND *Chlamydomonas* Sp.: WATER QUALITY, GROWTH, AND FEED CONVERSION RATIO OF WHITELEG SHRIMP (*Litopenaeus vannamei*)

Kelimpahan *Chlorella* Sp. Dan *Clamydomonas* Sp.: Kualitas Air, Pertumbuhan Dan *Feed Convertion Ratio* Udang Vaname (*Litopenaeus vannamei*)

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ABSTRACT

Chlorophyceae groups, such as Chlorella sp. and Chlamydomonas sp., are a stable group of phytoplankton with the highest abundance in Litopenaneus vannamei ponds. These two types can be used as determinant factors for water quality, growth, and Feed Conversion Ratio (FCR) in L. vannamei farming. This study aims to determine the correlation of Chlorella sp. and Chlamydomonas sp. on the water quality, growth, and FCR in L. vannamei farming. This study was conducted by survey and identification of plankton, water quality, growth, and FCR. The identified plankton was conducted using Principal Component Analysis (PCA) on water quality, growth, and FCR. The results of the study obtained a total abundance of Chlorella sp. and Chlamydomonas sp. of 91.93%. The water quality was found that most parameters comply with standards for L. vannamei farming activities, except for the parameters phosphate, nitrate, nitrite, Total Organic Matter (TOM), and ammonia. The abundance of Chlorella sp. and Chlamydomonas sp. has a strong correlation with a parameter of water quality in all ponds. The growth rate of Mean Body Weight in ponds is 0.4 – 24.43 grams/shrimp and has a strong correlation with the abundance of Chlorella sp. and Chlamydomonas sp. according to the significance value (p-value) of approximately 0.004 – 0.636. FCR value is 0.3-2.23 and has a strong correlation with the abundance of Chlorella sp. and Chlamydomonas sp. according to the eigenvalue of 1.032-1.670. The eigenvalue of the pond represents approximately 54.364% (pond 1), 55.658% (pond 2), 1.236, and 1.032 (pond 3) of the variable diversity. The results of the study showed that the abundance of Chlorella sp. and Chlamydomonas sp. is an indicator that influences the environment quality, growth, and Feed Conversion Ratio.

Keywords: Chlorella sp., Chlamydomonas sp., Water Quality, Growth and Feed Conversion Ratio, Litopenaeus vannamei

ABSTRAK

Kelompok *Chlorophyceae* seperti *Chlorella* sp. dan *Chlamydomonas* sp. merupakan kelompok fitoplankton yang stabil dengan kelimpahan tertinggi pada tambak *Litopenaeus vannamei*. Kedua jenis tersebut dapat dijadikan faktor penentu kualitas air, pertumbuhan dan Feed Convertion Ratio (FCR) pada budidaya *L. vannamei.* Penelitian ini bertujuan untuk mengetahui hubungan kelimpahan *Chlorella* sp. dan *Chlamydomonas* sp. terhadap kualitas air, pertumbuhan dan FCR pada budidaya *L. vannamei.* Penelitian dilakukan dengan cara *survey* dan identifikasi terhadap plankton dan kualitas air, pertumbuhan dan FCR. Plankton yang teridentifikasi dilakukan analisis Principal Component Analysis (PCA) terhadap kualitas air, pertumbuhan dan FCR. Hasil penelitian diperoleh total kelimpahan Chlorella sp. dan Chlamydomonas sp. sebesar 91.93%. Kualitas air diperoleh bahwa sebagian besar parameter sesuai dengan standar untuk kegiatan budidaya *L. vannamei,* kecuali parameter fosfat, nitrat, nitrit, Total Organic Matter (TOM) dan amoniak. Kelimpahan *Chlorella* sp. dan *Clamydomonas* sp. memiliki hubungan kuat terhadap parameter kualitas air pada keseluruhan tambak. Tingkat pertumbuhan *Mean Body Weight* tambak berkisar 0.4 – 24.43 gram/ekor serta memiliki hubungan kuat terhadap kelimpahan *Chlorella* sp dan *Clamydomonas* sp berdasarkan nilai signifikansi (*p value*) sekitar 0.004 – 0.636. Nilai FCR berkisar 0.3-2.23 serta memiliki hubungan kuat terhadap kelimpahan *Chlorella* sp dan *Clamydomonas* sp berdasarkan nilai eigenvalue 1.032–1.670. Nilai eigenvalue tambak mewakili sekitar 54.364% (tambak 1), 55.658% (tambak 2), 1.236 dan 1.032 (tambak 3) dari keragaman variable. Hasil penelitian menunjukan bahwa kelimpahan *Chlorella* sp dan *Clamydomonas* sp merupakan indikator berpengarug terhadap kualitas lingkungan, pertumbuhan dan Feed Convertion Ratio.

Kata Kunci: *Chlorella sp., Chlamydomonas sp., Kualitas Air, Pertumbuhan dan Feed Conversion Ratio, Litopenaeus vannamei*

INTRODUCTION

Phytoplankton are aquatic organisms that have an important role in the ecosystem of *vannamei* shrimp farming (*Litopenaneus vannamei*). Phytoplankton has a role in the absorption of organic materials from farming activities, so it can be used to evaluate the environmental quality and growth rate of *L. vannamei* and function as natural food in the pond ecosystem. The environmental condition of *L. vannamei* farming is influenced by the abundance of phytoplankton, while the condition of farmed shrimp can be reviewed based on the observation of pond phytoplankton (Yang *et al*., 2020). Phytoplankton groups often found in *L. vannamei* ponds are *Chlorophyceae, Cyanophyceae, Bacillariophyceae,* and *Dinoflagelata. The Chlorophyceae* group is a dominant type in *L. vannamei* ponds. This is because this group is easy to adapt and reproduce very quickly, so the population is found in a high number of 99.67% (Akbarurrasyid *et al.,* 2023; Inayah *et al*., 2023; Ni *et al*., 2018). *The Chlorophyceae* group has an important role in farming activities, especially related to environmental factors and the availability of natural food that supports the growth of *L. vannamei*.

The Chlorophyceae group affects the maintenance of pond water quality caused by farming activities with an intensive system. *Chlorophyceae* in an intensive farming system are able to increase dissolved oxygen value, utilize nutrition from shrimp waste, and function as natural food (Sani *et al*., 2022). Several types of *Chlorophyceae* become the natural food for *L. vannamei*. The types of *Chlorophyceae* that support the growth of *L. vannamei* are *Chlorella* sp. and *Chlamydomonas* sp. (Inayah *et al*., 2023). Certain types of *Chlorophyceae* affect the availability of natural food in the pond and feed conversion for *L. vannamei* farming. Natural food is the main alternative in the post-lava stage, so it minimizes the use of artificial feed that affects the low value of the Feed Conversion Ratio (Ariadi *et al*., 2020; Fricke *et al*., 2023).

The presence of natural food in ponds functions as a provider of important nutrients for the metabolic and growth needs of *L. vannamei* (Soeprapto *et al*., 2023). The presence of *Chlorophyceae* in a pond environment has a positive impact on the environment quality and Feed Conversion Ratio, which has a direct effect on the growth of *L. vannamei*. Generally, the domination of *Chlorophyceae* groups in *L. vannamei* ponds has an important role in *L. vannamei* farming activities.

The abundance of *the Chlorophyceae* group in the pond is influenced by the high level of brightness, nitrate, pH, dissolved oxygen, and organic materials, as well as the low level of temperature, salinity, and orthophosphate (Mahmudi *et al*., 2018). *The Chlorophyceae* group often found in *L. vannamei* pond environment is the genus *Chlamydomonas* sp. and *Chlorella* sp. Genus *Chlamydomonas* sp. and *Chlorella* sp. are cosmopolitan and easily grow in various conditions of the environment, have abundant amounts, and can be used as biological indicators to maintain the balance of the pond ecosystem (Ramanan *et al*., 2010; Yaobin *et al*., 2019). The abundance of *Chlamydomonas* sp. and *Chlorella* sp. in the pond can increase the performance of shrimp growth by 3% (Sukri *et al*., 2016; Takarina *et al*., 2020). *Chlorella* sp. has a significant effect on the growth and survival rate of *L. vannamei* by 89% (Nasir *et al*., 2023). *Chlorella* sp. can be used as a natural food that affects the growth of *L. vannamei. Chlorella* sp. is really important to the availability of natural food in the seed stage (Zhang *et al*., 2022). Feeding *Chlorella vulgaris* with a concentration of 30 g/kg feed shows a high level of resistance to the pathogen, thus affecting the performance of growth and feed utilization in *L. vannamei* farming activities (Eissa *et al*., 2023).

The presence of *Chlorella* sp. in the farming pond is always accompanied by the presence of the genus *Chlamydomonas* sp. This shows that nutrients contained in the farming pond are also needed by certain genera in the same group. *Chlamydomonas* sp. can replace the abundance of *Chlorella* sp. due to environmental factors, such as salinity changes (Cremen *et al*., 2007). The abundance of *Chlamydomonas* sp. occurs after the abundance of *Chlorella* sp. in the first seven days of farming and increases until the twenty-first day (Takarina *et al*., 2020). The stable abundance of *the Chlorophyceae* group in the pond shows a normal thing in *L. vannamei* farming activities. *Chlorophyceae* is a group that can thrive in the aquaculture ecosystem (Xie *et al*., 2022). A study regarding the abundance of phytoplankton in farming ponds has been widely conducted and is interesting to observe. However, a study conducted was partial and not comprehensive regarding the presence of *Chlorophyceae* group phytoplankton in the pond on *L. vannamei* farming activities. This study aims to determine the correlation of the abundance of *Chlorella* sp. and *Chlamydomonas* sp. on the environment quality, growth, and FCR in *L. vannamei*.

METHODS

This study was conducted on *L. vannamei* farming ponds with an intensive system in Pandeglang, Banten, Indonesia. There were three ponds observed with a size of 2500 m^2/pond, respectively. This study was conducted using observation methods and direct data collection in *L. vannamei* ponds. Direct data collection in the field is the concept method of *ex post facto causal design* (Linayati *et al*., 2024). Data collection on plankton, water quality, Feed Conversion Ratio (FCR), and growth was conducted using random sampling. FCR data were processed by comparing cumulative feed with biomass. Parameters observed included the abundance of phytoplankton (*Chlorella* sp. and *Chlamydomonas* sp.), water quality (temperature, salinity, dissolved oxygen, power of Hydrogen, brightness, phosphate, ammonia, nitrate, nitrite, alkalinity, and Total Organic Matter), FCR, and growth of L. vannamei (Mean Body Weight).

Observation parameters were analyzed using a quantitative statistical correlation and *Principal Component Analysis* (PCA). Data analysis was divided into three: the abundance of phytoplankton (identified phytoplankton group and genus with the highest abundance), the quality of the aquatic environment, Feed Conversion Rate, growth and correlation of the abundance of plankton on the observation parameters. Analysis of plankton diversity was grouped by taxon, group and type of plankton using a microscope, and key to identifying plankton in waters (Al-Yamani *et al*., 2011). The analysis of water quality, FCR, and growth used the correlation statistical method and PCA to determine the level of correlation between each observed parameter on the abundance of phytoplankton (Akbarurrasyid *et al*., 2023; Akbarurrasyid *et al*., 2024).

RESULT

The Abundance of Phytoplankton

The number of plankton identified in three *L. vannamei* farming ponds consisted of three groups (Table. 1): *chlorophyceae* (2 genera), *cyanophyceae* (1 genus), dan *Bacillariophyceae* (2 genera).

Table 1. Phytoplankton groups and genera

Groups	Genera		
	Pond 1	**Pond 2**	**Pond 3**
Chlorophyceae	*Chlorella* sp. *Chlamydomonas* sp.	*Chlorella* sp. *Chlamydomonas* sp.	*Chlorella* sp. *Chlamydomonas* sp.
Cyanophycea,	*Mycrocistis* sp.	*Mycrocistis* sp.	*Mycrocistis* sp.
Bacillaryophyceae	*Amphora* sp. *Pinularia* sp.	*Amphora* sp.	*Amphora* sp. *Pinularia* sp.

The phytoplankton identified in the three ponds is in the same genus, except in pond 2, where there was a slight difference. Phytoplankton genera identified in the three ponds are *Chlorella* sp., *Chlamydomonas* sp., *Mycrocistis* sp., *Amphora* sp., and *Pinularia* sp., while in pond 2, the genus *Pinularia* sp was not found. The highest percentage of phytoplankton abundance was identified in the *Chlorophyceae* group in all ponds. The percentage for the abundance of phytoplankton can be seen in Figure 1.

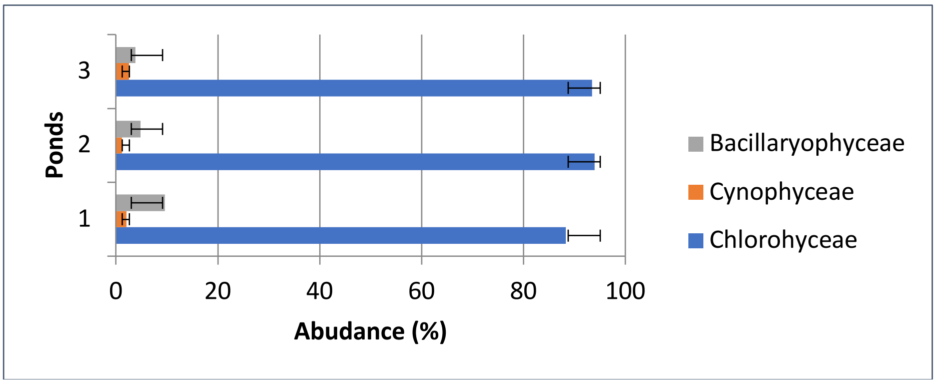


Figure 1. Abundance of phytoplankton group

The highest genus abundance in all ponds was identified in the genus *Chlorella* sp. of 31.48 – 37.03% (340,000 – 400,000 cell/ml) and *Chlamydomonas* sp. of 29.92 – 35.43%

(380,000 – 450,000 cell/ml). The lowest percentage was in genus *Pinularia* sp. of 20 - 80% (2,500 – 10,000 cells/ml). The abundance of phytoplankton genera can be seen in Figure 2.

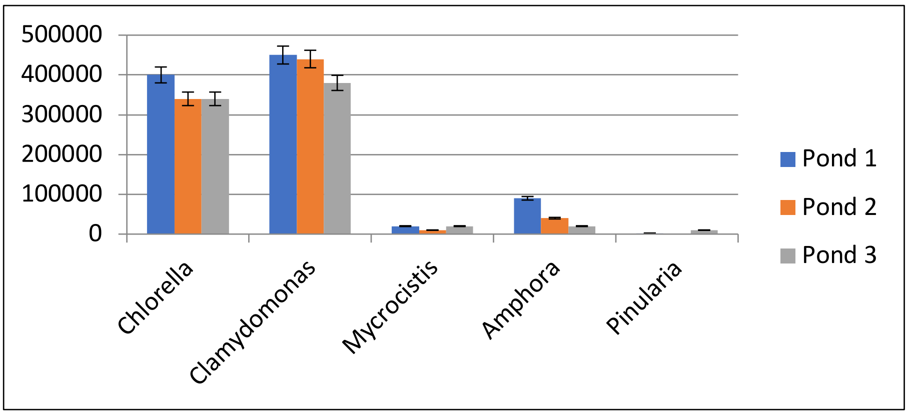


Figure 2. Abundance of phytoplankton genera

Water Quality

The quality of the pond environment can be observed according to the quality of farming water. The quality of farming water can be traced according to the physical, chemical, and biological conditions. The observation of water quality for farming activities is important to carry out because it has a direct effect on the growth and condition of phytoplankton as natural food, so it has a direct effect on the production and Feed Conversion Ratio. The results of the water quality observation can be seen in Table 2.

Table 2. Water quality of *L. vannamei* ponds

Parameters	Ponds			Optimum Value*
	Pond 1 (Min – Max) (Mean ± std)	**Pond 2 (Min – Max) (Mean ± std)**	**Pond 3 (Min – Max) (Mean ± std)**	
Temperature (ºC)	26.1 – 30.2 28.38 ± 1.16	26.5 – 30.4 28.54 ± 1.07	20 – 30.8 29.50 ± 2.25	25 – 32
Salinity (ppt)	29 – 36 33 ± 1.87	30 – 39 33.57 ± 2.87	25 – 39 33.85 ± 3.53	15 – 35
Disolved Oxygen (mg/L)	3.68 – 7.83 5.03 ± 0,95	3.27 – 6.65 4.63 – 0.82	4.23 – 5.99 5.07 ± 0.61	> 4
Power of Hydrogen	7.7 – 8.6 8.18 ± 0.29	7.8 – 8.8 8.11 ± 0.27	7.8 – 8.9 8.34 ± 0.30	7.5 – 8.5
Transparancy (%)	30 – 90 47.85 ±14.71	30 – 90 48.80 ± 13.40	30 – 80 55.47 ± 16.42	20 – 100
Phosphate (mg/L)	0.1 – 2 0.8 ± 0.60	0.1 – 2.3 0.361 ± 0.484	0.1 – 2 0.369 ± 0.423	< 0.1
Ammonia (mg/L)	0.012 – 0.198 0.060 ± 0.048	0.006 – 0.379 0.070 ± 0.082	0.011 – 0.112 0.035 ± 0.026	< 0.1
Nitrate (mg/L)	15 – 30 22.38 ± 5.32	35 – 40 23.47 ± 7.79	2 – 28 19.33 ± 6.48	3.9 – 15.5
Nitrite (mg/L)	0.01 – 1.8 0.439 ± 0.636	0.01 – 5.5 0.78 ± 1.36	0.01 – 0.15 0.039 ± 0.048	< 0.1
Total Organic Matter (mg/L)	45.5 – 121.34 100.57 ± 17.13	87.74 – 123.87 103.91 ± 10.46	73.31 – 115.02 95.76 ± 12.54	< 90

Parameters	Ponds			Optimum Value*
	Pond 1 (Min – Max) (Mean ± std)	**Pond 2 (Min – Max) (Mean ± std)**	**Pond 3 (Min – Max) (Mean ± std)**	
Alkalinity (mg/L)	120 – 216 165.57 ± 23.51	124 – 188 156.28 ± 15.85	132 – 220 163.04 ± 24.15	> 120

* Wafi *et al*., (2021)

The results of Principal Component Analysis (PCS) showed that the abundance of *the Chlorophyceae* group, such as *Chlorella* sp. and *Chlamydomonas* sp., had a strong correlation with the water quality parameter in all ponds. The biplot results of the abundance of *Chlorella* sp. and *Chlamydomonas* sp. on water quality can be seen in Figure 3.

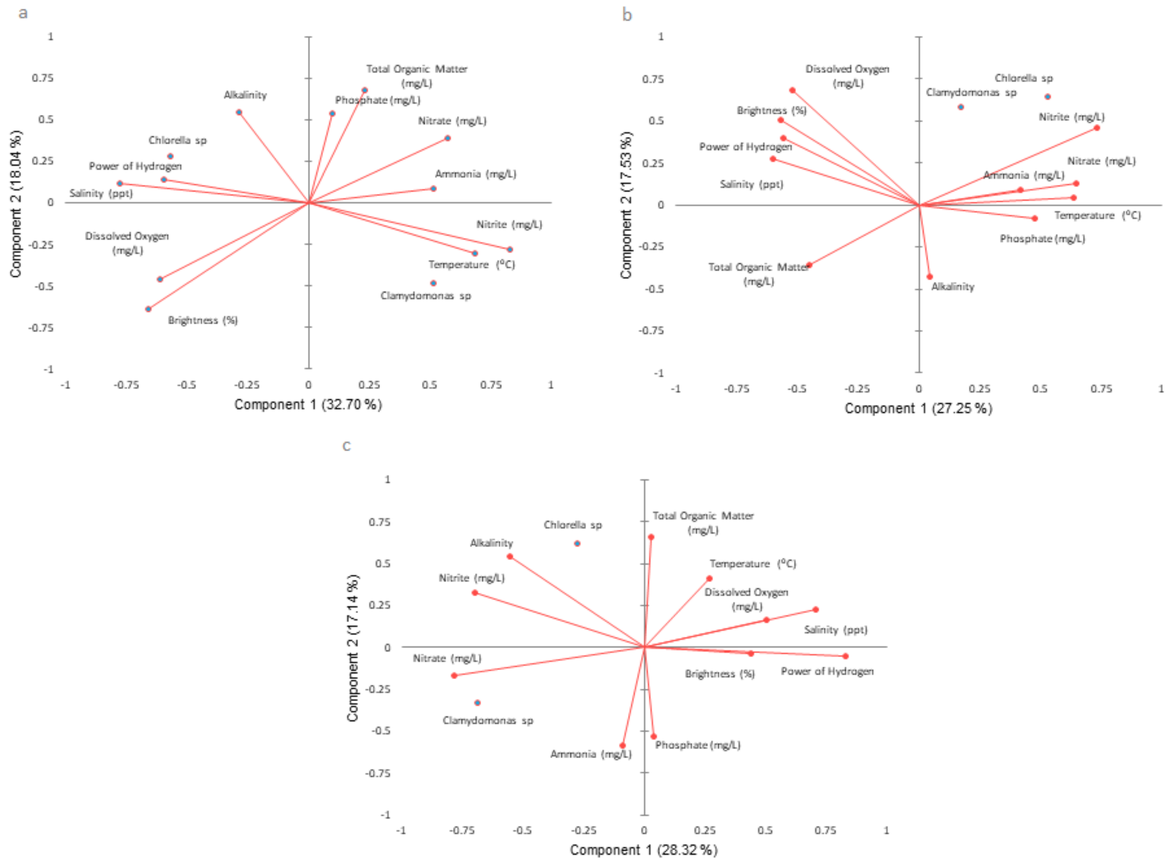


Figure 3. Biplot of the abundance of *Chlorella* sp. and *Chlamydomonas* sp. on water quality, (a) pond 1, (b) pond 2, (c) pond 3

Growth *Litopenaneus vannamei*

The growth of *L. vannamei* is influenced by environmental factors and the availability of natural food. The growth rate can be tracked based on Mean Body Weight (MBW). The MBW observation was carried out every seven days during the farming period. The results of MBW observation (Figure. 2) showed that *L. vannamei* experienced weight gain during the farming period.

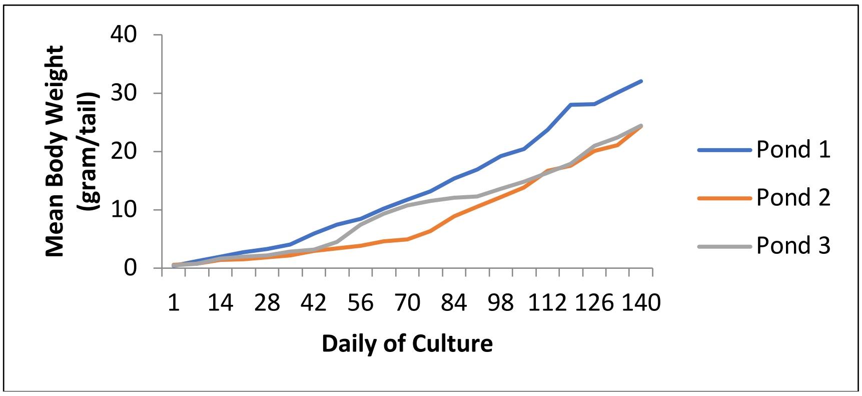


Figure 4. Mean Body Weight

Kaiser-Meyer-Olkin (KMO) value or sampling adequacy test of the three ponds was 0.558 – 0.580. This showed that Principal Component Analysis (PCA) could be carried out related to the abundance of *Chlorella* sp. and *Chlamydomonas* sp. on the MBW value, which has been fulfilled. The results of PCA regarding phytoplankton abundance on MBW can be seen in Table 3.

Table 3. Principal Component Analysis of phytoplankton abundance on MBW

Principal Component Analysis	**Pond**		
	Pond 1	**Pond 2**	**Pond 3**
Kaiser-Meyer-Olkin			
Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy	0.619	0.558	0.580
Approx. Chi-Square	13.372	11.579	7.815
Bartlett's sphericity test			
df	3	3	3
Sig.	0.004	0.009	0.636
Eigenvalues			
Variability (%)	65.553	61.898	45.563
Cumulative (%)	65.553	61.898	45.563

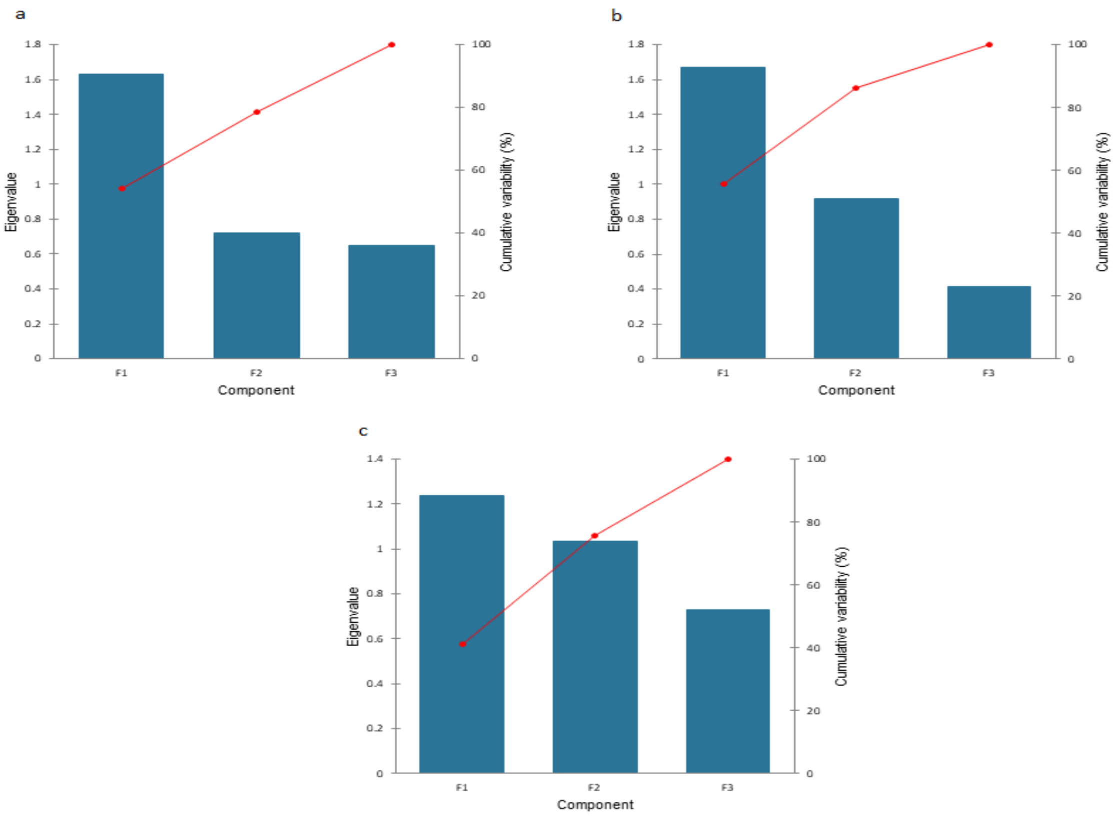
Feed Conversion Ratio

Feed Conversion Ratio (FCR) is the conversion rate of feed provided during the farming period to the shrimp biomass obtained. FCR value during the farming period (Table. 4) was 0.3-2.23. The lowest FCR value was obtained in all ponds, while the highest FCR value was obtained in pond 2.

Table 4. Feed Conversion Rate

Pond	**FCR Value**			**Optimum Value***
	Minimul	**Maximum**	**mean ± std**	
Pond 1	0.3	1.97	1.48 ± 0.49	1.25 – 1.52
Pond 2	0.3	2.23	1.56 ± 0.47	(Akbarurrasyid
Pond 3	0.3	1.74	1.31 ± 0.38	*et al*., 2023)

The results of Principal Component Analysis (PCA) show that the FCR value in *L. vannamei* farming has a strong correlation with the abundance of *Chlorella* sp. and *Chlamydomonas* sp. A scree plot of PCA can be seen in Figure 5.



DISCUSSION

The plankton identified is a group of phytoplankton. The number of phytoplankton genera identified was three genera. The highest number of genera identified in all ponds was obtained by *the Chlorophycease* group: *Chlorella* sp. and *Chlamydomonas* sp. The highest number of genera in the *Chlorophyceae* group affects the abundance value of observed phytoplankton. This shows that the diversity of phytoplankton was quite high and stable during the *L. vannamei* farming activities. *Chlorophyceae* in the aquatic environment show a high level of fertility, so they are widely used as alternative natural food in aquaculture activities (Fučíková *et al*., 2016; Tulsankar *et al*., 2021). The percentage value of *Chlorophyceae* abundance for pond 1 was 88.31% (850,000 cells/ml), pond 2 of 93.97% (780,000 cells/ml), and pond 3 of 93.50% (720,000 cells/ml). The lowest abundance percentage was in the *Bacillaryophyceae* group of 3.89 - 9.61% (770,000 - 962,500 cells/ml). This shows that the identified phytoplankton is required in *L. vannamei* farming activities.

The presence of *Chlorella* sp. has a role as a feed additive for shrimps because it contains important nutrients in high concentrations, such as vitamins, amino acids, and other components affecting growth (Ajiboye *et al*., 2012; Musa *et al*., 2024). The abundance of *Chlorella sp.* and *Chlamydomonas sp.* really depends on the availability of nutrients in farming ponds and phytoplankton succession. Nutrients in the ponds come from residual activities during farming activities, such as leftover feed and metabolic waste of shrimps, which are broken down into nutrients by bacteria; where these nutrients are used by phytoplankton, which affect the abundance and succession of phytoplankton abundance (Burford *et al*., 2003; Kumar *et al*., 2016; Yang *et al*., 2020).

The water quality during the farming activities was found to be in accordance with standards for *L. vannamei* farming activities, except for nutrient parameters, such as phosphate, nitrate, nitrite, Total Organic Matter (TOM), and ammonia. The increase in the ammonia value of *L. vannamei* ponds is caused by the accumulation of mud in the bottom of the pond, which is from the unused leftover feed, feces, dead plankton, air particles, soil erosion, and microorganisms (Musa *et al*., 2023). The value of water quality parameter that exceeds the required threshold tends to vary and increases along with increasing days of farming due to the increase in nutrients from farming activities (Ariadi *et al*., 2023). Nutrients in *L. vannamei* ponds are influenced by the availability of dissolved oxygen, brightness, salinity, temperature, nitrate, nitrite, phosphate, and ammonia (Utojo & Mustafa, 2016). The increase in nutrients has a direct effect on the increase of biogeochemical cycles and the population of microorganisms in the aquatic ecosystem (Kürten *et al*., 2019). The population that has a direct effect on the increase of nutrients in aquatic ecosystems is phytoplankton. The increase in phytoplankton population in *L. vannamei* pond waters has a direct effect on the growth, availability of natural food, and pond environment.

The presence of *Chlorophyceae* in aquatic environments can be used as an indicator of the quality of the aquatic environment (Ariadi *et al*., 2021). *Chlorella* sp. has a role as a buffer for water quality by increasing the amount of dissolved oxygen through the photosynthesis process and absorption of toxic substances, such as ammonia. The abundance of *Chlorella* sp. is directly related to the condition of water quality, such as nitrate, nitrite, and phosphate (Kamilia *et al*., 2021). The results of the biplot in three ponds show that parameters of ammonia, phosphate, nitrate, nitrite, and TOM have the highest contribution to the abundance of *Chlorella* sp. and *Chlamydomonas* sp.. The ammonia value has a positive correlation to the nitrite and nitrate values. Nitrite value in *L. vannamei* pond depends on the process or transition rate of ammonia and nitrate (Akbarurrasyid *et al*., 2023; Putri *et al*., 2019). The relatively high nitrate value is caused by the obstruction of the process of changing the forms of ammonia and nitrite, so it has a direct effect on the aquatic environment. Excessive nitrate will accelerate the eutrophication process of water and increase the phosphate content of water (Rustadi, 2009). Relatively high phosphate content causes an increase in the phytoplankton abundance through the photosynthesis process by utilizing the excessive availability of nitrate and phosphate elements in *L. vannamei* ponds. According to this, the abundance of phytoplankton, such as *Chlorella* sp. and *Chlamydomonas* sp*.,* is really determined by the availability of nutrients and transition rate of changes in the form of nutrients.

The growth rate of Mean Body Weight (MBW) in pond 1 was 0.4 – 24.04 grams/tail, pond 2 of 0.57 – 24.33 grams/tail, and pond 3 of 0.48 – 24.43 grams/tail. Generally, *L. vannamei* experienced quite good growth, which is influenced by various factors, including internal and external factors. Internal factors include the quality and origin of the fry, while external factors include farming treatment and farming environment. Environmental factors influence the shrimp growth process. *L. vannamei* can grow optimally in physical, chemical, and biological aquatic environments according to the growth requirements. Biological factors, such as phytoplankton, play an important role in farming activities. Phytoplankton acts as an indicator and natural food supplier in *L. vannamei* farming activities (Kamilia *et al*., 2021).

The results of Principal Component Analysis (PCA) obtained that the growth of *L. vannamei* has a strong correlation to the abundance of *Chlorella* sp. and *Chlamydomonas* sp. according to a significance value (p-value) of approximately 0.004 – 0.636. P-value < 0.05 indicates that the level of influence between the observed factors can be further tested (Nahar & Hertini, 2020). Pond 3 had a p-value > 0.05. This indicates that the low abundance of *Chlorella sp* and *Chlamydomonas* sp has an effect on the growth of *L. vannamei* MBW. Moreover, the eigenvalues of factors influencing MBV value were 1.967 – 1.367. This indicates that the value can be used to calculate the number of factors formed. Eigenvalues > 0.50 can be used to determine the factors formed (Musa *et al*., 2023). Eigenvalues obtained represented approximately 45.653-65.553% of total variable diversity. Generally, the abundance of *Chlorella* sp. and *Chlamydomonas* sp. influences the growth rate of *L. vannamei*. This indicates that *Chlorella* sp. and *Chlamydomonas* sp. have an important role as a source of nutrition or natural food in farming activities, which affects growth performance.

Feed Conversion Ratio (FCR) value can be reduced by the availability of natural food in aquatic environments. Natural food is an important factor in *L. vannamei* farming. The presence of natural food can reduce the use of artificial feed without interrupting growth performance. Phytoplankton is an important type of natural food at the tropic level, and it is really required in *L. vannamei* farming activities. The abundance of certain plankton, such as *Chlorella* sp., *Oscillatoria* sp., *Amphidinuium* sp., and *Anabaena* sp., has a strong correlation with the trophic level of *L. vannamei* pond ecosystem (Akbarurrasyid *et al*., 2024). The results of the study showed that the types of plankton with the highest abundance in shrimp farming activities were *Chlorella* sp. and *Chlamydomonas* sp. Phytoplankton types *Chlorella* sp. and *Chlamydomonas* sp. can reduce the FCR value of farming. The use of *Chlorella vulgaris* powder in shrimp feed can increase the growth performance significantly (Eissa *et al*., 2023). Fish feed substituted with *Chlorella* sp. flour of 20.50% and 28.25% has the highest growth and lowest FCR value (Li *et al*., 2022). Generally, the FCR value obtained was still in the appropriate category for *L. vannamei* farming activities. A low FCR value does not have an effect on the growth rate of *L. vannamei*. This indicates that shrimp can convert pellets well and use natural food in the form of phytoplankton available in the aquatic environment. Phytoplankton in shrimp ponds can be used as natural food and maintain the balance of the pond system (Kamilia *et al*., 2021).

The results of the scree plot of PCA obtained an eigenvalue of the abundance of *Chlorella* sp. and *Chlamydomonas* sp. of 1.032–1.670. Eigenvalues of ponds 1 and 2 obtained by 1 factor were 1.631 and 1.670, respectively. Eigenvalues of Pond 1 and Pond 2 represented approximately 54.364% and 55.658% of variable diversity. This shows that 1 factor with a value > 50% represents the entire variable. Moreover, the eigenvalues of Pond 3 obtained 2 factors of 1.236 and 1.236, respectively. The eigenvalue obtained represented all the variables by approximately 34.416-41.216%. Generally, the abundance of *Chlorella* sp. and *Chlamydomonas* sp. has an effect on the FCR value of *L. vannamei* farming. This shows that *Chlorella sp* and *Chlamydomonas sp* are important factors as a source of nutrients or natural food in farming activities. Providing 40% *Chlorella sorokiniana* as the main protein can stimulate the growth of *L. vannamei* maximally (Yuan *et al*., 2023).

CONCLUSION

The diversity of phytoplankton identified in *L. vannamei* pond consists of groups *chlorophyceae* (2 genera), *cyanophyceae* (1 genera), and *Bacillariophyceae* (2 genera). The highest abundance of genera identified in all ponds was obtained by *the Chlorophycease* group (91.93%): *Chlorella* sp. and *Chlamydomonas* sp. The results of water quality identification showed that most of the water quality parameters comply with standards for *L. vannamei* farming activities, except for nutrient parameters, such as phosphate, nitrate, nitrite, Total Organic Matter (TOM), and ammonia. The results of Principal Component Analysis (PCA) showed that the abundance of *Chlorella* sp. and *Chlamydomonas* sp. has a strong correlation with the water quality parameter in all ponds. The growth rate of Mean Body Weight of ponds ranges from 0.4 – 24.43 grams/shrimp. The results of PCA showed that the growth of *L. vannamei* has a strong correlation to the abundance of *Chlorella* sp. and *Chlamydomonas* sp. according to a significance value (p-value) of approximately 0.004 – 0.636. Feed Conversion Ratio (FCR) value during the farming period is 0.3-2.23. The results of PCA showed that the FCR value in *L. vannamei* farming has a strong correlation with the abundance of *Chlorella* sp. and *Chlamydomonas* sp. according to the eigenvalue of 1.032-1.670. The eigenvalue of the pond represents approximately 54.364% (pound 1), 55.658% (pound 2), 1.236, and 1.032 (pound 3) of the variable diversity. The results of the study showed that the abundance of *Chlorella* sp. and *Chlamydomonas* sp. is an indicator that influences the environment quality, growth, and Feed Conversion Ratio.

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