Journal of Fish Health
Volume 4, Issue 2, May 2024
https://doi.org/10.29303/jfh.v4i2.4945

Effect of Adding Calcium Dolomite ($CaMg(CO_3)$) and Tohor (CaO) in Cultivation Media to Increase Moulting of *Litopenaeus vannamei*

Septia Tri Wahyuni[1], Dewi Putri Lestari[1], Damai Diniariwisan[1*]

[1]Aquaculture Study Program, Faculty of Agriculture, University of Mataram
Pendidikan Street No. 37 Mataram, Indonesia

***Correspondence**:
damaidiniari@unram.ac.id

Received : 04-15-2024
Accepted : 05-25-2024

Keywords:
Calcium, *Litopenaeus vannamei*, Moulting, Shrimp

ABSTRACT

Vaname shrimp (*Litopenaeus vannamei*) is a fishery commodity that is the largest contributor to exports compared to other commodities. The success of shrimp survival and growth cannot be separated from the molting process, which requires calcium. The calcium that absorbed from the cultivation media can play a greater role in the process of exoskeleton formation. Dolomite lime ($CaMg(CO_3)$) and tohor (CaO) can be sources of calcium that can be added to cultivation media. The research method used in this study was a completely randomized design (CRD) consisting of 5 different treatments (A: without additional lime, B: 0.8 gr dolomite, C: 0.8 gr tohor, D: 0.3 gr dolomite + 0.5 gr of tohor, E: 0.5 gr of dolomite + 0.3 gr of tohor) with 3 repetitions. The results showed that the addition of lime at different doses provided a molting frequency ranging from 2.07 – 3.23 times during the 60 days rearing period, where treatment E was the optimum treatment. The absolute weight growth obtained ranged from 2.52 gr – 5.03 gr, with an absolute length of 5.25 cm – 9.11 cm. The highest survival rate during maintenance in treatment E reached 72%. The water quality conditions measured during the activity were alkalinity 135 – 146 ppm, Ca hardness 132.74 – 172.39 ppm, temperature 29.9 – 30.3°C, DO 6.3 – 6.5 mg/l, pH 7 .9 – 8.3 and salinity 32 -34 ppt.

INTRODUCTION

Vaname shrimp (*Litopenaeus vannamei*) is a fishery commodity that is the largest contributor to exports compared to other commodities. In a short period of time the white shrimp commodity has a high production level compared to other types such as tiger shrimp, white shrimp and other shrimp (Ramadhani *et al.*, 2019). In general the success factor for survival and growth in shrimp is the process of moulting activities and an increase in somatic biomass that occurs in crustaceans (Nurhasanah *et al.*, 2021). The shrimp will make adjustments by shedding the old shell and will re-form a new shell with the help of calcium (Astifa *et al.,* 2022). The production of vaname shrimp is widely carried out because this vaname shrimp has the advantage of being more resistant to disease, resistant to drastic changes in temperature, fast growth and this shrimp likes bottom areas of water so that when stocked it can be stocked in large quantities (Anam *et al*., 2016).

Calcium is a macro mineral that influences the metabolic process and shell hardening process in vaname shrimp. Low levels of calcium and magnesium can cause the exoskeleton hardening process during cultivation activities to be hampered. Calcium needs can be obtained from food, but calcium obtained from cultivation media can play a greater role in the exoskeleton process (Astifa *et al.,* 2022). Yunus *et al.* 2020, stated that dolomite ($CaMg(CO_3)$) and tohor or quicklime (CaO) are raw materials that contain high levels of calcium and magnesium and are also easy to obtain so they can be used as a source of calcium and magnesium in shrimp growth.

In order to support the success of vaname shrimp cultivation activities, research on the effect of giving lime in the form of dolomite ($CaMg(CO_3)$) and tohor (CaO) at different doses on the moulting rate and survival of vaname shrimp needs to be carried out in order to know the right dose to support moulting process and survival of vaname shrimp.

METHODS

This research was carried out in January - March 2024. The maintenance stages took place at the Fish Production and Reproduction Laboratory, and water quality checks took place at the Fish Health Laboratory, Faculty of Agriculture, University of Mataram. The research design used was a completely randomized design (CRD) with 5 treatments and 3 replications. In this study, there were 15 experimental units using 40 L capacity containers where each container was filled with 20 L of treatment water. The test animals used were vaname shrimp larvae with PL 32. The treatments given were different doses of lime in the cultivation media as follows:

A: Without adding / control
B: Addition of dolomite 0.8 gr
C: Addition of tohor 0.8 gr
D: Addition of 0.3 gr dolomite + 0.5 gr tohor
E: Addition of 0.5 gr dolomite + 0.3 gr tohor

The parameters tested consisted of molting rate, weight growth (absolute & specific), length growth (absolute & specific), survival rate, alkalinity and Ca hardness. The data obtained was analyzed using ANNOVA with a confidence level of 95%, then significant data was further tested using the Duncan test. The molting rate is calculated using the number of molting shrimp which can be calculated by calculating the number of molting shrimp during the study divided by the total number of test shrimp and multiplying by 100%. To determine absolute weight growth, it is calculated using the formula proposed by (Rakhfid *et al.,* 2019) as follows:

$$Wm = Wt - Wo$$

Information:
Wm = Absolute weight growth (gr)
Wt = Shrimp weight at the end of the study (gr)
W0 = Shrimp weight at the start of the study (gr)

Absolute length growth is obtained by measuring the length of the shrimp at the start of stocking and at the end of rearing. Length growth is calculated using the following formula (Nasir & Khalil, 2016):

$$L = L_t - L_o$$

Information:

L : Increase in length (cm)
Lt : Final length (cm)
Lo : Initial length (cm)

Survival of vaname shrimp (*Litopenaeus vannamei*) was obtained by comparing the total number of shrimp larvae stocked at the start of the study with the total number of shrimp that survived until the end of the study multiplied by 100%. The survival rate is calculated using the formula (Rakhfid *et al.,*2019) below as follows:

$$SR = \frac{Nt}{No} \, x \; 100 \; \%$$

Information:
SR = Survival Rate (%)
Nt = Vaname shrimp live at the end of rearing (individual)
No = Vaname shrimp live in the at the start of rearing (individual)

RESULTS

Moulting Rate

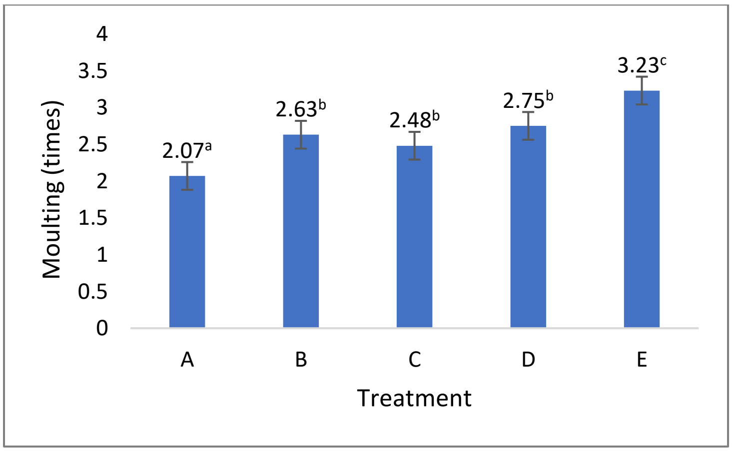

Figure 1. Moulting Rate Graph

The average value of the molting rate is presented in Figure 1. It ranges between 2.07 – 3.23 times. The results of the ANNOVA test show that treatment with different doses of lime had a significantly different effect (P<0.05) on the molting rate of vaname shrimp. Duncan's further test results showed that treatment E was the best molting value and was significantly different from all treatments.

Absolute Weight

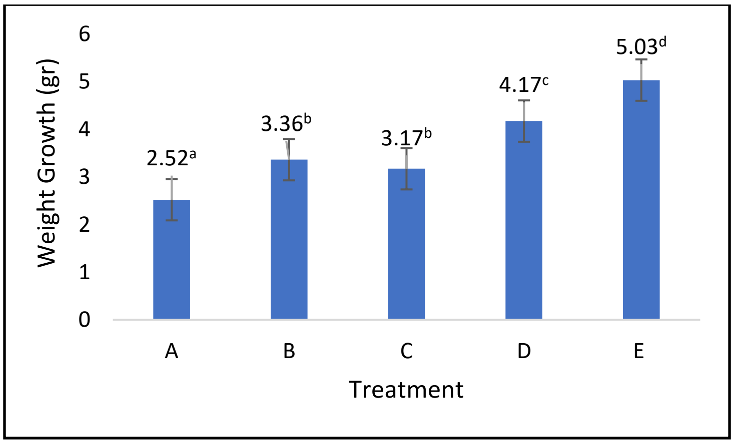

Figure 2. Absolute Weight Graph

Average value the average absolute weight is presented in Figure 2. It ranges from 2.52 grams – 5.03 grams. The results of the ANNOVA test showed that administration of lime at different doses had a significantly different effect ($P<0.05$) on the absolute weight of vaname shrimp. Duncan's further test results showed that giving lime to treatment E had the highest value and was significantly different from all treatments.

Absolute Length

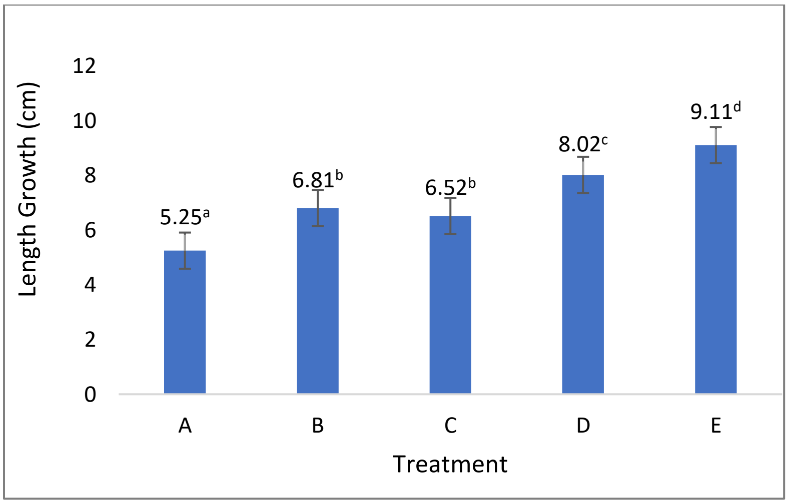

Figure 3. Absolute Length Graph

Average valueThe average absolute length is presented in Figure 3. It ranges from 5.25 cm – 9.11 cm. The results of the ANNOVA test showed that administration of different lime doses showed a significantly different effect ($P<0.05$) on the absolute length of white vaname shrimp. Duncan's further test results showed that giving lime to treatment E had the highest value and was significantly different from all treatments.

Survival Rate

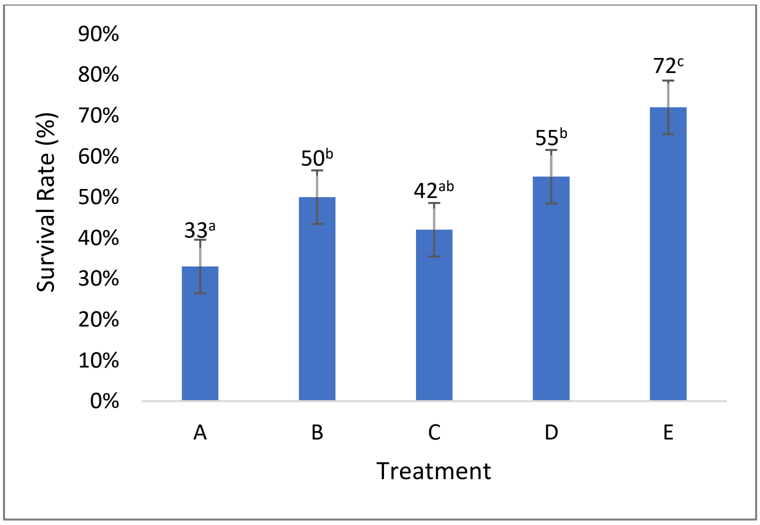

Figure 4. Survival Rate Graph

The average survival rate is presented in Figure 4. It ranges from 33% - 72%. The results of the ANNOVA test showed that administration of lime at different doses had a significantly different effect (P<0.05) on the survival rate of vaname shrimp at the end of rearing. Duncan's further test results showed that treatment E had the highest survival rate and was significantly different from all treatments.

Alkalinity

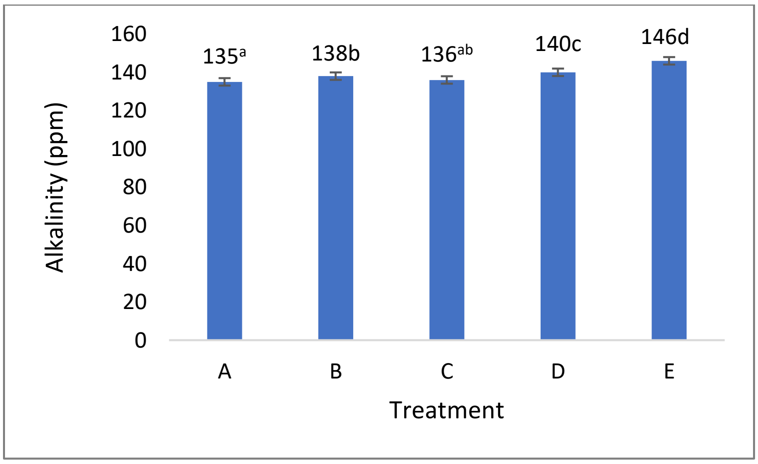

Figure 5. Alkalinity Graph

Average value the average alkalinity is presented in Figure 5. Ranges between 135 – 146 ppm. The results of the ANNOVA test showed that administration of lime at different doses had a significantly different effect (P<0.05) on the alkalinity value of the vaname shrimp cultivation media. Duncan's further test results showed that increasing the dose for treatment E was the highest and best value.

Calcium Levels

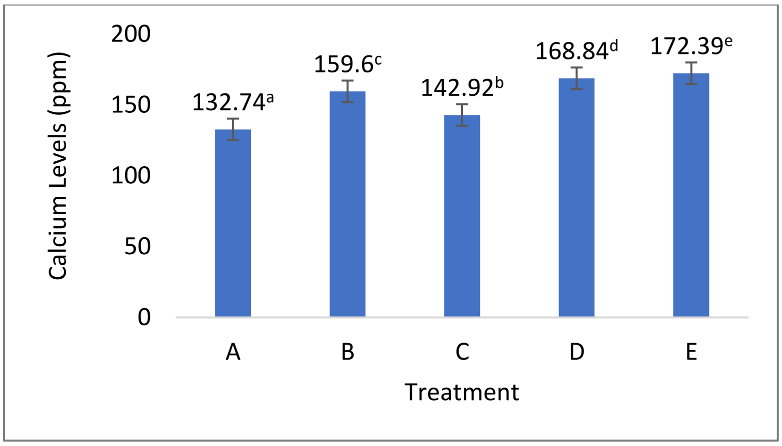

Figure 6. Calcium Levels Graph

The average value of calcium levels is presented in Figure 6. It ranges from 132.74 – 172.39 ppm. The results of the ANNOVA test showed that administration of lime at different doses had a significantly different effect (P<0.05) on the calcium content of the vaname shrimp cultivation media. Duncan's further test results showed that treatment E gave the highest calcium levels and was significantly different from the treatment.

Water Quality

Table 1. Water Quality Data

No	Parameter	A	B	C	D	E
1.	Temperature (°C)	29.9	30.0	30.3	30.1	30.0
2.	DO (mg/L)	6.3	6.4	6.5	6.4	6.5
3.	pH	7.9	8.0	8.3	8.2	8.2
4.	Salinity (ppt)	32	33	33	34	33

DISCUSSION

The moulting rate is the number of shrimp that molt from the start of rearing to the end of rearing. The moulting rate of *Litopenaeus vannamei* was obtained by counting the number of shrimp that had moulting for each experimental unit from the beginning to the end of the study. Yunus *et al.* (2020), the number of moulting shrimp was calculated by adding up the shrimp that moulting during the study divided by the total number of test shrimp. Treatment E has the highest moulting level value, presumably because the lime dose given to the cultivation media contains sufficient minerals. The mineral content in the water is absorbed by the shrimp so that white shrimp utilize these minerals in the process of hardening their shells after moulting, because when moulting the shrimp's skin will be soft so it is susceptible to cannibalism or being preyed upon by other predators which will cause the shrimp to die. This is in line with opinion Aisya *et al*. (2017), calcium can be found in food and the environment. Adding lime to the cultivation media functions in the shell hardening process. The old shell will be replaced with a new shell. At the post-moulting stage, the vaname shrimp will absorb calcium from the environment so that adding lime can speed up the process of shell hardening in the shrimp. According to the statement Astifa *et al*. (2022), moulting is a phase where the flesh on the shrimp's body increases in size but the shell does not increase in size so the old shell is removed and replaced with a new shell with the help of calcium. In the post-moulting stage, the skin will harden due to calcium deposits on the skin.

Growth in shrimp occurs due to moulting so that the weight of the shrimp will increase. Growth in shrimp occurs through somatic biomass where weight growth is accompanied by growth in length. The growth that occurs in shrimp always goes hand in hand with the moulting process, the faster and more frequent the moulting process, the higher the growth. The high growth in treatment E (0.5 gr dolomite and 0.3 gr tohor) indicates the optimal dose of lime given so that it can help provide one of the minerals needed by shrimp during the moulting process. This is in line with opinion Arumsari *et al.* (2019), If the presence of lime in cultivation activities is not sufficient, the hardening process of new shrimp shells will be slow, which will affect the growth of vaname shrimp. Nurhasanah *et al.* (2021), states that the calcium given to the cultivation media functions in hardening the skin or exoskeleton thereby speeding up the process of forming new shells, apart from that the calcium given also functions in the osmoregulation process. The low growth in treatment A (Control) is thought to be due to the low levels of minerals in the cultivation media which can slow down the moulting process and slow shrimp growth. Growth occurs due to the moulting process or the process of replacing the old carapace with a new carapace. Minerals are an important part needed in the growth process of vaname shrimp. In line with the opinion of Lante *et al.* (2015), minerals such as calcium and phosphorus are elements needed in metabolic processes, regulators of metabolic processes in the body and sources of energy when energy needs are not met.

The increase in body length of shrimp is supported by the intensity of moulting, moulting is the process of growth in length and weight of white shrimp. Apart from that, the increased length growth is thought to be due to the complete mineral content and normal metabolic processes. This is in line with opinion Maghfiroh *et al.* (2019), that the relationship between weight and body length is considered as a function of length. Growth will be good if the fish's body approaches an isoosmotic state, cell function and metabolism will run normally if it approaches an isoosmotic state. Treatment E was the most optimal treatment, allegedly because the addition of calcium dolomite ($CaMg(CO_3)$) and tohor (CaO) helped the moulting process. The growth of shrimp body length is supported by the shrimp's insensitivity to moulting. When the size of the meat increases, the shrimp will release the old exoskeleton and replace it with a new exoskeleton. The low growth in treatment A (control) and the decrease in length growth in treatments B and C are thought to be due to the lack of calcium levels in the cultivation media which causes the moulting process to be hampered. In line with opinion Zufadhillah *et al.* (2018), calcium deficiency causes the skin hardening process after moulting to be slow. The lower the dose of calcium carbonate given, the smaller the number of shrimp moulting.

The survival rate (SR) of vaname shrimp is the number of shrimp that lived from the beginning to the end of the study, then calculated for each experimental unit manually and expressed in percent units. The low survival rate is due to the mineral content in the cultivation media being relatively low, which causes vaname shrimp to have difficulty in the process of forming new shells so that the shrimp will be attacked by another shrimp. The presence of optimal calcium magnesium will certainly influence the level of absorption in the vaname shrimp's body. Scabra (2023), states that the survival rate of shrimp can be influenced by ions in the shrimp's body fluids. Low doses of $CaCO_3$ mineral addition cause the amount of minerals needed by shrimp to not be met, which can cause death due to molting failure. This is supported by opinion Dwiono *et al.* (2018), which states that the optimal level of mineral content in the cultivation media must be taken into account because it will affect the growth rate and survival rate of vaname shrimp.

Alkalinity is a water quality parameter that can show changes in pH in cultivation media. The optimal alkalinity value will act as a buffer against acidity so that the pH value becomes stable, which is indirectly good for the growth of vaname shrimp. Excess or deficiency of alkalinity value will affect the pH of the cultivation media. An unstable pH will make shrimp have no appetite, slow growth and be susceptible to disease. Sitanggang & Pahala (2019), believes that low alkalinity values can cause shrimp to molt their shells abnormally, while high alkalinity will cause shrimp to experience difficulties during the molting process.

Calcium levels is a value used to determine the number of mineral ions contained in the cultivation medium. Based on the results obtained, it is known that treatment E is the optimal value because the value obtained is not too high and not too low in cultivating vaname shrimp, then the lowest value in treatment A is because there is no additional lime which can increase minerals in the cultivation media so that can cause shrimp difficulty in shelling and will affect the growth of vaname shrimp. This is in line with Supono *et al.* (2022), stated that in the activity of white vaname shrimp, calcium plays an important role in accelerating the moulting process, thereby influencing the growth and survival of white shrimp. The level of hardness generally required in shrimp cultivation activities is in the range of 20 – 300 ppm (Sitanggang & Pahala, 2019). The optimum value in treatment E, the Ca hardness value, is thought to be due to the balanced amount of quicklime and dolomite lime which can support the growth and survival of vaname shrimp so that it is directly proportional to the growth of vaname shrimp. The mineral calcium functions as a form of skin and carapace. In line with opinion Yulihartini *et al*. (2016), that giving optimal doses of calcium helps white vaname shrimp molt well, besides that giving calcium Ca (OH)2 at different doses can have a significantly different effect ($P<0.05$) on the molting rate and growth rate of *Litopenaeus vannamei*.

The average temperature obtained during the research ranged from 29.9 -30.3^oC. This is in line with opinion Rafiqie (2021), temperature affects dissolved oxygen, at low temperatures the shrimp's metabolism will also be low and this will affect the shrimp's appetite. The optimal temperature for cultivating shrimp is 26-30^oC. Low temperatures can cause shrimp's immunity to become low and they are susceptible to disease. Temperature changes that occur during cultivation activities can affect shrimp growth because shrimp will not have an appetite.

The average value of dissolved oxygen (DO) during research activities was 6.3 – 6.5 mg/l. Dissolved oxygen functions to carry food substances along with the blood cells in the shrimp and distribute it throughout the body so that the shrimp will produce energy for its activities. If an organism has a high metabolism, more oxygen is needed compared to organisms with a slow metabolism (Wahyun*i et al*., 2022). Bahri *et al*. (2020), states that the optimum value of dissolved oxygen in waters ranges from 4-8 mg/l. To avoid the occurrence of low dissolved oxygen, this can be done by adding a wheel or aerator.

The pH value obtained during the research is still considered optimal for cultivation activities, namely ranging from 7.4 – 8.3. Supriatna (2020), states that the range of pH values to support shrimp cultivation activities is between 7.0 – 8.5. The pH in the water greatly influences the shrimp's appetite. A pH value that is below the optimal value can cause difficulties in the moulting process because the skin will become soft and will cause low survival. If the pH value is high, it can be overcome by changing the water. Roy & Henry (2006), believes that the presence of lime in water will cause an increase in the pH of the cultivation media because liming neutralizes acidity. This is proven by the comparison of the pH obtained in the control treatment with the pH obtained in the lime treatment.

White vaname shrimp have euryhaline zero, which means they can live with different levels of salinity. The salinity value obtained during research activities is still considered optimal in white vaname shrimp cultivation activities, namely 32 - 34 ppt. Witoko *et al.* (2018) that vaname shrimp have the ability to adapt to changes in salinity (euryhaline) which is quite in the range of 3 – 45 ppt. This is confirmed by opinion Yulihartini *et al.* (2016), stated that cultivating white vaname shrimp is generally carried out in media with high salinity because white vaname shrimp have ueryhaline properties, the salinity value that can be tolerated in cultivating vaname shrimp is in the range of 2 – 40 ppt.

CONCLUSION

Providing dolomite and tohor at different doses can affect the molting rate, absolute and specific weight growth, absolute and specific length growth, as well as the survival rate of vaname shrimp. Giving lime to treatment E, namely with a dose of 0.5 gr of dolomite and 0.3 gr of tohor, is the best treatment because it provides a molting rate of 3.23 times during maintenance, absolute weight of 5.03 grams, absolute length of 9.11 cm and survival rate. 72%, alkalinity 135 – 146 ppm, Ca hardness 132.74 – 172.39 ppm, temperature 29.9 – 30.3°C, DO 6.3– 6.5 mg/l, pH 7, 9 – 8.3 and salinity 32 -34 ppt.

ACKNOWLEDGEMENT

Thanks are expressed to the University of Mataram, especially for Aquaculture Study Program, Faculty of Agriculture for facilitating assistance during research activities

REFERENCES

Arumsari, C., Rusliadi, & Mulyadi. (2019). Pengaruh Penambahan Kapur Dolomit (CaMg(CO3)2) dalam pakan terhadap intensitas Moulting, Pertumbuhan dan Kelulushidupan Udang Vannamei (Litopenaeus vannamei). *Jurnal Jom Faperika Unri*, *1*(1), 1–9.

Astifa, A., Rajamuddin, M. A. L., & Yuliadi, Y. (2022). Akselerasi moulting larva udang Vaname (*Litopenaeus vannamei*) dengan pemberian kalsium hidroksida Ca(OH)2. *Agrokompleks*, *22*(2), 7–17. https://doi.org/10.51978/japp.v22i2.401

Bahri, S., Mardhia, D., & Saputra, O. (2020). Growth and Graduation of Vannamei Shell Life (*Litopenaeus Vannamei*) with Feeding Tray (ANCO) System in AV 8 Lim Shrimp Organization (LSO) in Sumbawa District. *Jurnal Biologi Tropis*, *20*(2), 279–289. https://doi.org/10.29303/jbt.v20i2.1812

Dwiono, A., Widigdo, B., & Soewardi, K. (2018). Pengaruh Komposisi Mineral Air Tanah Terhadap Fisiologi Dan Histologi Udang Vaname Litopenaeus vannamei. *Jurnal Ilmu Dan Teknologi Kelautan Tropis*, *10*(3), 535–546. https://doi.org/10.29244/jitkt.v10i3.21049

Lante, S., Usman, U., & Laining, A. (2015). Pengaruh Kadar Protein Pakan Terhadap Pertumbuhan Dan Sintasan Udang Windu, Penaeus Monodon Fab.Transveksi. *Jurnal Perikanan*, *17*(1), 10–17.

Maghfiroh, A., Anggoro, S., & Purnomo, P. W. (2019). Osmoregulation Patterns and Factors of Vaname Shrimp Conditions (*Litopenaeus vannamei*) Cultivated in Intensive Mojo Ulujami . *Management of Aquatic Resources Journal (MAQUARES)*, *8*(3), 177–184. https://doi.org/10.14710/marj.v8i3.24253

Nasir, M., & Khalil, M. (2016). Pengaruh penggunaan beberapa jenis filter alami terhadap pertumbuhan, sintasan dan kualitas air dalam pemeliharaan ikan mas (*Cyprinus carpio*). *Acta Aquatica*, *3*(1), 33–39.

Nurhasanah, N., Junaidi, M., & Azhar, F. (2021). Survival Rate and Growth of Shirmp Vaname (*Litopanaeus vannamei*) at Salinity 0 ppt With Multilevel Acclimatization Method Using Calsium CACO3. *Jurnal Perikanan Unram*, *11*(2), 166–177. https://doi.org/10.29303/jp.v11i2.241

Rafiqie, M. (2021). Analisa Kualitas Air Budidaya Udang Vaname (*Litopenaeus vannamei*) di Tambak Rakyat Kontruksi Dinding Semen Dan Dasar Tambak Semen Di Pantai Konang, Kecamatan Panggul Kabupaten Trenggalek. *Samakia : Jurnal Ilmu Perikanan*, *12*(1), 80–85. https://doi.org/10.35316/jsapi.v12i1.838

Rakhfid, A., Baya, N., Bakri, M., & Fendi, F. (2019). Growth And Survival Rate Of White Shrimp (Litopenaeus Vannamei) At Different Density. *Jurnal Akuakultur, Pesisir Dan Pulau-Pulau Kecil*, *3*(1), 23–29.

Ramadhani, I., E, E., & Puspita Sari, R. A. (2019). Analisis Faktor – Faktor Yang Mempengaruhi Produksi Pada Budidaya Tambak Intensif Udang Vannamei Di Kecamatan Punduh Pedada Kabupaten Pesawaran Lampung. *Agribusiness Journal*, *12*(1), 61–75. https://doi.org/10.15408/aj.v12i1.11852

Roy, L. A., & Henry, R. P. (n.d.). *Physiological and nutritional requirements for the culture of the pacific white shrimp*.

Scabra, A. R. (2023). Pengaruh Pemberian Kalsium Hidroksida (Ca(OH)2) dan Fosfor (P) Terhadap Pertumbuhan Udang Vaname (Litopenaeus vannamei) Pada Media Air Tawar. *Jurnal Ruaya : Jurnal Penelitian Dan Kajian Ilmu Perikanan Dan Kelautan*, *11*(1), 39–51. https://doi.org/10.29406/jr.v11i1.4855

Sitanggang, L. A., & Pahala, L. (2019). Analisa Kualitas Air Alkalinitas dan Kesadahan (Hardness) pada Pembesaran Udang Putih (*Litopenaeus vannamei*) di Laboratorium. *Jurnal Penelitian Terapan Perikanan Dan Kelautan*, *1*(1), 54–60. https://stpsibolga.ac.id/ojs/index.php/TAPIAN_NAULI/article/view/19

Supono, S., Puspitasari, D., & Sarida, M. (2022). Pengaruh Penambahan Kalsium Pada Media Kultur Salinitas Rendah Terhadap Performa Udang Vaname *Litopenaeus vannamei. Journal of Tropical Marine Science*, *5*(2), 90–97. https://doi.org/10.33019/jour.trop.mar.sci.v5i2.3214

Supriatna, M. (2020). Model Ph Dan Hubungannya Dengan Parameter Kualitas Air Pada Tambak Intensif Udang Vaname (*Litopenaeus vannamei*) di Banyuwangi Jawa Timur. *JFMR-Journal of Fisheries and Marine Research*, *4*(3), 368–374. https://doi.org/10.21776/ub.jfmr.2020.004.03.8

Wahyuni, R. S., Rahmi, R., & Hamsah, H. (2022). Efektivitas Oksigen Terlarut Terhadap Pertumbuhan Dan Sintasan Udang Vaname (*Litopenaeus vannamei)*. *Jurnal Perikanan Unram*, *12*(4), 536–543. https://doi.org/10.29303/jp.v12i4.356

Witoko, P., Purbosari, N., Mahmudah Noor, N., Hartono, D. P., Barades, E., Rietje, D., & Bokau, J. (2018). Budidaya Udang Vaname (*Litopenaeus vannamei)* di Keramba Jaring Apung Laut. *Jurnal Polinela*, 410–418. http://jurnal.polinela.ac.id/index.php/PROSIDING

Yulihartini, W., Rusliadi2, & Alawi, H. (2016). Pengaruh Penambahan Calsium Hidrosida Ca(Oh)2 Terhadap Moulting, Pertumbuhan Dan Kelulushidupan Udang Vannamei *(Litopenaeus vannamei) Jurnal Perikanan,* (Vol. 1).

Yunus, R., Haris, A., & Hamsah. (2020). Pengaruh Penambahan Kapur Dolomite Dan Kapur Tohor Dalam Media Pemeliharaan Terhadap Moulting , Pertumbuhan Dan Sintasan Udang Vaname (*Litopenaeus vannamei*). *Jurnal Ilmu Perikanan*, *9*(1), 39–47.

Zufadhillah, S., Thaib, A., & Handayani, L. (2018). Efektivitas penambahan nano CaO cangkang kepiting bakau (Scylla serrata) kedalam pakan komersial terhadap pertumbuhan dan frekuensi molting udang galah (*Macrobrachium rosenbergii*). *Acta Aquatica: Aquatic Sciences Journal*, *2*, 69–74.