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Utilization of Papaya Sap Extract (*Carica papaya* L.) on Feed to Increase Growth of White Shrimp (*Litopenaeus vannamei)*

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Abstract

Shadiqa Malahayati, Erni Marlina, Mugi Mulyono, Suharyadi dan Mochamad Farhan. Utilization of Papaya Sap Extract (*Carica papaya* L.) on Feed to Increase Growth of White Shrimp (*Litopenaeus vannamei*. 2022. The aim of this research to analyze the effect of adding papaya sap extract to feed on growth of white shrimp (*Litopenaeus vannamei*). Research activities for adding papaya sap extract to white shrimp feed include preparation of containers and media, stocking of shrimp fry, preparation of feed, and conducting research. The research was conducted experimentally with a completely randomized design. The treatment was carried out with four treatments and three replications including the addition of papaya sap extract 0% (as a control), 2%, 4%, and 6%, by observing the growth of white shrimp. The best value was produced by the addition of 2% papaya sap extract where the absolute weight gain was 23.34 g ± 3.05 g, specific growth rate was 17.10% ± 1.72%, food conversion ratio with a yield of 1.44 ± 0.11, and feed utilization efficiency with a yield of 69.94% ± 5.69%. Whereas the survival rate the best value was produced by the addition of papaya sap extract 2% and 6% (76.00% ± 4.00%) with the same value.

KEYWORDS: *Litopenaeus vannamei*, *Carica papaya L.*, growth, survival rate, feed conversion ratio

Introduction

White shrimp (*Litopenaeus vannamei*) is a species of shrimp that is currently being developed by shrimp farmers in Indonesia (Maghfiroh, *et al.* 2019). According to Agus and Mardiana, (2017) white shrimp are euryhaline shrimp, namely shrimp that are able to adapt to a wide salinity range, which means that rearing can be carried out in low salinity media. One of the reasons for the shift of tiger prawns to white shrimp, among others, is the better performance and growth rate of white tiger prawns and higher resistance to disease than tiger prawns. (Mahasri *et al.*, 2017). White shrimp cultivation has promising profits and prospects, so it is one of the most commonly cultivated commodities (Arsad *et al.*, 2017).

The value of Indonesian shrimp exports in 2014-2018 showed a good growth trend. Within these 4 years, Indonesia was in the 4th position of the largest frozen shrimp exporter in the world where from 2014 - 2018 there was an increase in production of 11.69% starting from 131,149.9 tons to 148,507.6 tons (UN Comtrade, 2019 *in* Furqon, 2021). In 2019, 207 thousand tons of shrimp were exported to the global market with an export value of US$ 1.7 billion. Furthermore, Central Bureau of Statistics in Indonesia (2021) also noted that this shrimp export experienced an increase in 2020 to 239 thousand tons with an export value of US$ 2 billion, and currently Indonesia is in the 5th largest shrimp exporter after Ecuador, India, Vietnam and Argentina (Central Bureau of Statistics in Indonesia, 2021 *in* Yulisti and Mulyawan, 2021). The presence of this white shrimp variety is able to support the revival of shrimp farming in Indonesia and make investments in shrimp farming have good potential to be developed. (Anjasmara *et al.*, 2018).

One of the absolute requirements in carrying out white shrimp cultivation activities is the availability of the appropriate feed, both in quality and quantity to support its growth, so that it is hoped that in the end it can increase production. Excessive feeding can increase production costs and waste and cause a lot of feed residue to accumulate at the bottom of the rearing container which will result in a decrease in water quality so that in the end the growth and survival of shrimp decreases. In shrimp farming, feed absorbs 50% of the total cost of shrimp production (Tahe and Suwoyo, 2011). High feed prices encourage the use of local ingredients to be used in fish feed (Zuliyan *et al.*, 2017).

Enzymes have unique properties, among others, very large catalytic power, specific reactions, mild reaction conditions and can be regulated because enzymes are biocatalysts that are very important in metabolic and biological processes. (Ferdinal, 2005). Protease enzymes are enzymes that play a role in the breakdown of proteins in the body. Protease functions to hydrolyze peptide bonds into oligopeptides and amino acids (Jannah *et al.*, 2021). Enzymes are added to feed so that protein can be utilized optimally and more optimally in the biota that are kept. The presence of enzymes in the feed is expected to help and speed up the digestive process, thus the nutrients must be available enough for the growth and survival of biota.

Therefore, a protein-breaking enzyme is needed, namely the papain enzyme (Hutabarat and Rachmawati, 2015). Papain enzyme is a proteolytic enzyme that can be obtained from the sap of the papaya plant (*Carica papaya*) and young papaya. The enzyme is used for the perfect breakdown or breakdown of peptide bonds in proteins so that proteins break down into simpler peptide bonds because papain is able to catalyze hydrolysis reactions of a substrate (Khodijah and Rachmawati, 2015). Papaya plant (*Carica papaya L.*) is a plant that can grow in the tropics and originally comes from Central America and is widespread in the South Pacific and other tropical areas. Tropical areas with adequate rainfall and temperatures ranging from 21-23°C are very suitable places for papaya growth. California papaya has the characteristics of a fruit size that weighs between 0.8 – 2 $kg.fruit^{-1}$ when ripe, thick and smooth skin, oval in shape, chewy flesh, and yellow ripe fruit. (Al Rivan and Sung, 2021).

The addition of papain enzymes in feed has been carried out on several biota, including the use of papain enzymes to increase the efficiency of feed utilization and the growth of freshwater crayfish (*Cherax quadricarinatus*) (Hutabarat and Rachmawati, 2015), utilization of papain enzymes to improve feed utilization efficiency, protein ratio efficiency and growth of catfish fry (*Clarias gariepinus*) (Khodijah and Rachmawati, 2015), utilization of papain enzymes to improve nutrient digestibility, feed utilization efficiency, and growth of catfish (*Pangasius hypophthalmus*) (Ananda *et al.*, 2015), and utilization of papain enzymes on the growth of keurling fish (*Tor tambra*) (Muchlisin *et al.*, 2016). The addition of papain as an exogenous enzyme into the feed was able to increase the hydrolysis of feed to refer to growth. The papain enzyme is relatively resistant to temperature when compared to other proteolytic enzymes such as bromelain and ficin. (Tulung *et al.*, 2018). Thus, this study aims to obtain the effect of adding papaya sap extract to feed with a certain dose on the growth of white shrimp

Materials And Methods

Research Time and Place

This research was carried out from March 2021 to July 2021. White shrimp rearing was carried out at the Feed Laboratory of the Ujung Batee Brackish Aquaculture Fisheries Center. Water quality analysis was carried out at the

Fish Health and Environmental Laboratory of the Ujung Batee Brackish Water Aquaculture Center.

Research Design

The study was conducted experimentally with a completely randomized design. The study was conducted with four treatments and three replications, by observing the growth of white shrimp. The layout of the test container was carried out based on a Completely Randomized Design experiment which was processed using Microsoft Excel Software. The research treatments carried out include:

Treatment A : The addition of papaya sap extract 0% (as a control)

Treatment B : The addition of papaya sap extract 2%

Treatment C : The addition of papaya sap extract 4%

Treatment D : The addition of papaya sap extract 6%

Research Procedure

a. Preparation of containers and media

Preparation of the container is done by preparing a container in the form of a plastic container by measuring the dimensions of the container first. The dimensions of the container used have a length of 54.3 cm, a width of 38 cm and a height of 31.5 cm so that the container used has a capacity of 65 liters. The containers used were 12 pieces which were cleaned using detergent to remove dirt on the container which was then dried. Furthermore, the containers are arranged based on the layout of the containers that have been determined and labeled according to the treatment that has been designed. Then the container is equipped with an aerator, hose and aeration stone that have been sterilized first. Each container is equipped with 2 aeration points to supply oxygen to the maintenance medium.

Media preparation is done by channeling media water into a container taken from a reservoir as a reservoir of 50 liters of seawater. Next, check the temperature, salinity, pH, and DO before stocking white shrimp.

b. Preparation of experimental animals

White shrimp that will be used as a test biota comes from the white shrimp rearing unit at the Center for Brackish Water Aquaculture Ujung Batee Location 2. White shrimp is stocked in the morning to avoid the temperature being too high. Prior to stocking, the temperature and salinity were checked in the previous rearing container. The temperature of the media in the previous container was 28.3^{0}C and the salinity was 30 g.l^{-1}. Meanwhile, the temperature of the media in the research container was in the range of 27.6^{0}C and the salinity was in the range of 29 g.l^{-1}. The shrimp were then acclimatized to temperature and salinity.

c. Feed preparation

Feed preparation was carried out before starting the study. The prepared papaya was cleaned with a sterile wet cloth and the sap was taken by tapping the papaya fruit from top to bottom to a depth of 2 mm and as many as 5 scratches in 1 fruit. The papaya sap that comes out is collected into a container (Rachmania *et al.*, 2017). 150 ml of papaya sap was collected. Furthermore, a solution of 0.7% Na-metabisulfite was added as much as 600 ml with a ratio of papaya sap and Na-metabisulfite that is 1: 4. Then the papaya sap and Na-metabisulfite were mixed with a mixer to form a milky white emulsion a bit thick. Finally, the results of the mixing are poured into a baking sheet and in an oven at 65^{0}C to dry for 5 hours (Permata *et al.*, 2016). After drying, papaya extract is ground and sieved. In 150 ml of papaya sap used to produce 62.25 g of papaya sap extract. During the study, the papaya sap extract used was 47.00 g.

The papaya sap extract that has been produced and the feed are weighed according to the dose to be given. Papaya sap extract was dissolved in 3 ml of pure water for 100 g of feed and added progol as an adhesive, then put into a container. The papaya sap extract solution is mixed into the feed by spraying evenly throughout the feed and aerating so that the feed is not too moist. Then the feed is stored in containers to avoid rapid mold growth.

The maintenance of white shrimp was carried out for 55 days or 8 weeks and observations were made every day. Feeding was carried out with a frequency of 4 times a day at 07.00 WIB, 11.00 WIB, 16.00 WIB, and 21.00 WIB. Feeding is done by demand feeding which is determined based on the results of sampling which is done once every 7 days and weighed according to the calculation results obtained. Feed is given as much as 5% of the total weight of shrimp (biomass). Water quality checks are carried out every day at 06.30 WIB and 18.00 WIB to check temperature, salinity, pH, and dissolved oxygen, while ammonia and nitrite are measured once a week.

Research Variables and Indicators

The variable used in this study is the difference in the application of the dose given to the feed for each treatment. The indicators used in this study were the growth of white shrimp including absolute weight growth, Survival Rate (SR), Food Conversion Ratio (FCR), Specific Growth Rate (SGR) and feed utilization efficiency. The sampling data that has been obtained are then processed using each formula to obtain the results of absolute weight growth, Survival Rate (SR), Food Conversion Ratio (FCR), Specific growth Rate (SGR), and feed utilization efficiency. Furthermore, the data was processed using SPSS software to determine whether there was an effect on each treatment.

Statistic Analysis

The data obtained were tabulated using Ms. Excel 2016 and analyzed using SPSS (Statistical Product and Service Solutions) software. The data were tested for normality and homogeneity test. Normal and homogeneous data continued with analysis of variance in the form of ANOVA test with 5% degree of freedom. If the results of the ANOVA analysis show that there is a significant difference between the treatments (sig. < 0.05), then it is continued with a significant difference test.

The hypotheses used in the real difference test are as follows:

H_0 : There was no effect of the addition of papaya sap extract (*Carica papaya* L.) on growth of white shrimp (*Litopenaeus vannamei*).

H_1 : There was an effect of adding papaya sap extract (*Carica papaya* L.) to growth of white shrimp (*Litopenaeus vannamei*).

RESULTS AND DISCUSSION

Production Performance

In absolute weight growth, the addition of 2% papaya sap extract was significantly different from other treatments where the highest value was obtained by the addition of 2% papaya sap extract (23.34 g ± 3.05 g). In Survival Rate (SR), there was no significant difference between all treatments but the highest value was obtained by the addition of 2% papaya sap extract (76.00% ± 4.00%) and the addition of 6% papaya sap extract (76.00% ± 4.00%). In the Feed Conversion Ratio (FCR), the addition of 2% papaya sap extract was significantly different from other treatments where the smallest value was produced by the addition of 2% papaya sap extract (1.44 ± 0.11). At the Specific Growth Rate

(SGR) there was a significant difference between the treatment of adding 2% papaya sap extract with other treatments where the highest value was produced by the addition of 2% papaya sap extract (17.10% ± 1.72%). In feed utilization efficiency, there was a significant difference between the treatment with the addition of 2% papaya sap extract with other treatments where the highest value was produced by the addition of 2% papaya sap extract (69.94% ± 5.69%). The results of data processing can be seen in table 1.

Table 1. The average of absolute weight gain, survival rate, food conversion ratio, specific growth rate, and feed utilization efficiency of white shrimp during the research

Parameters	Treatments			
	Control	**Papaya sap extract 2%**	**Papaya sap extract 4%**	**Papaya sap extract 6%**
Weight (g)	15,15 ± 3,11[a]	23,34 ± 3,05[b]	12,32 ± 0,90[a]	15,59 ± 2,19[a]
SR (%)	72,00 ± 4,00[a]	76,00 ± 4,00[a]	72,00 ± 4,00[a]	76,00 ± 4,00[a]
FCR	1,66 ± 0,10[a]	1,44 ± 0,11[b]	1,74 ± 0,10[a]	1,84 ± 0,10[a]
SGR (%)	12,43± 2,65[a]	17,10 ± 1,72[b]	9,52 ± 0,44[a]	11,81 ± 2,00[a]
FUE (%)	60,51 ± 3,46[a]	69,94 ± 5,69[b]	57,83 ± 3,41[a]	54,10 ± 2,35[a]

Note: The same letter notation ([ab]) on the same line indicates that there is no significant difference between treatments.

The best weight growth in white white shrimp was obtained by the addition of 2% papaya sap extract (23.34 g ± 3.05 g) and followed by the addition of 6% papaya sap extract (15.59 g ± 2.19 g). Papain is an enzyme obtained from papaya sap which contains protein-breaking enzymes or proteolytic enzymes. When these enzymes are mixed into the feed, the protein in the feed will be broken down into peptides and broken down again into simpler elements called amino acids making it easier for the digestive process and the absorption of feed nutrients in the body so as to increase growth (Hutabarat and Rachmawati, 2015). In the treatment with the addition of 4% papaya sap extract (12.32 g ± 0.90 g) the weight growth data of white shrimp obtained during the study showed lower growth compared to other treatments. This is because the amount of leftover feed is wasted in the rearing container due to a lack of appetite in white shrimp in consuming feed that is added with 4% papaya sap extract so that it has an impact on absolute weight growth results. Khodijah and Rachmawati, (2015) stated that the addition of enzymes in the feed was able to increase the growth of fish. The addition of excessive enzymes in the feed is not good for fish growth. Riyanti *et al.,* 2014 states that if the papain enzyme is given too much, the enzyme will not work optimally. The absolute weight growth graph can be seen in Figure 1.

The best Food Conversion Ratio (FCR) value in white white shrimp was obtained by the addition of 2% papaya sap extract (1.44 ± 0.11) and followed by the control treatment (1.66 ± 0.10). In the treatment of adding 4% papaya sap extract (1.74 ± 0.10) and the addition of 6% papaya sap extract (1.84 ± 0.10) Food Conversion Ratio (FCR) data obtained during the study showed lower results than with other treatments. Rachmawati *et al.,* (2019) stated that a smaller FCR value indicates that the feed consumed by shrimp is more efficiently used for growth, whereas a larger FCR value indicates that the feed consumed is less efficient. Xu *et al.,* (2018) states that the FCR value is said to be good if it ranges from 1.2 to 1.7 where the smaller the FCR value produced, the more efficient the use of the feed. Syah *et al.,* (2017) stated that the FCR value indicated the ability of shrimp to utilize feed rations. Zainuddin *et al.,* (2014) stated that the FCR value indicates how much shrimp can utilize the given feed to form 1 kg of meat. The smaller the FCR value, the better the feed quality, the higher the digestibility of the feed. The Food Conversion Ratio (FCR) graph can be seen in Figure 1.

The best Survival Rate (SR) results in white shrimp were obtained by the addition of 2% papaya sap extract (76.00% ± 4.00%) and the addition of 6% papaya sap extract (76.00% ± 4.00%). In the treatment of adding 4% papaya sap extract (72.00% ± 4.00%) and the control treatment (72.00% ± 4.00%) the Survival Rate (SR) data for white shrimp obtained during the study showed lower results compared to other treatments. One that affects the survival rate of white shrimp is the cannibalism that cannot be eliminated even though the feed supply is sufficient for the growth and survival of the shrimp (Safitrah *dkk.,* 2020). Appelbaum and Arockiaraj, (2010) stated that the nature of cannibalism is prone to occur when the shrimp is moulting because at the time of moulting the shrimp experience a weak body condition due to a lot of energy loss and at the same time the availability of feed is not available, the shrimp that are not moulting will eat the moulting shrimp. Rachmawati and Samidjan, (2015) stated that moulting white shrimp can be eaten by other shrimp because the aroma of shrimp is more stimulating than the aroma of artificial feed so that it can increase mortality. The graph of Survival Rate (SR) can be seen in Figure 1.

The best value of Specific Growth Rate (SGR) in white shrimp was obtained by adding 2% papaya sap extract (17.10% ± 1.72%) and followed by control treatment (12.43% ± 2.65%). In the treatment of adding 4% papaya sap extract (9.52% ± 0.44%) and the addition of 6% papaya sap extract (11.81% ± 2.00%) the Specific Growth Rate (SGR) data obtained during the study showed results lower than the other treatments. Protein is needed by the body of biota both to produce energy and for growth for biota (Gunadi and Febrianti, 2010). The feed given to the biota is not only seen from the chemical composition of the nutrients it contains, but also how much of the nutrients contained in the feed can be absorbed and utilized by the biota. Absorption of nutrients by the body is influenced by various things such as the ratio of protein efficiency and feed utilization efficiency. The efficiency of good feed utilization shows that the nutrients from the feed can be utilized properly by white shrimp for growth. A good feed efficiency ratio also shows that the protein contained in the feed is utilized properly for the growth of white shrimp (Mudjiman, 2004). Hutabarat and Rachmawati, (2015) states that a high feed utilization efficiency value is associated with a high growth rate. A high feed utilization efficiency value indicates that few feed nutrients are broken down to meet energy needs and the rest are for growth. Specific Growth Rate (SGR) diagram can be seen in Figure 1.

The best value of feed utilization efficiency on white shrimp was obtained by the addition of 2% papaya sap extract (69.94% ± 5.69%) and followed by control treatment (60.61% ± 3.46%). In the treatment of adding 4% papaya sap extract (57.83% ± 3.41%) and the addition of 6% papaya sap extract (54.10% ± 2.35%) the feed utilization efficiency data obtained during the study showed lower results compared to other treatments. This indicates that the addition of papaya sap extract to feed affects the efficiency of feed utilization. The increase in digestibility of feed containing the papain enzyme is due to the availability of proteolytic enzymes in the feed that are able to assist the process of protein hydrolysis in digestion (Patil and Singh, 2014). The feed utilization efficiency value of white shrimp fed with papain enzyme supplementation was stated to be quite good because it had a value above 50%. Feed can be said to be good if the efficiency value of feed utilization is more than 50% or even close to 100%. (Craig *et al.*, 2017). Rachmawati *et al.*, (2020) stated that the high value of feed utilization efficiency is also supported by the low value of FCR, where the higher the FCR value, the lower the feed utilization efficiency value, on the contrary, the lower the FCR value, the higher the feed utilization efficiency value produced. Li *et al.*, (2013) stated that a high feed utilization efficiency value can be interpreted by the high ability of shrimp to utilize feed and protein content in the feed so that it can produce high feed utilization efficiency values, low FCR values, and high SGR values. The graph of feed utilization efficiency can be seen in Figure 1.

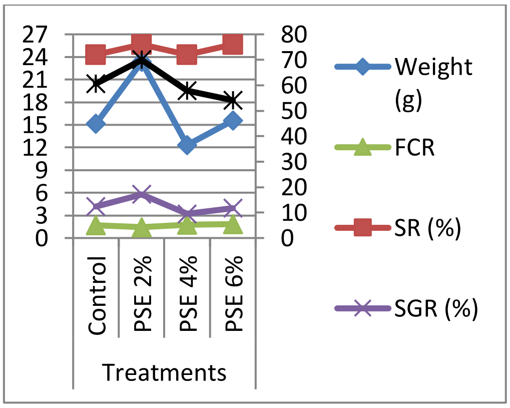

Figure 1. Graph of absolute weight growth, food convertion ratio, survival rate, specific growth rate, and feed utilization efficiency of white shrimp in treatments A (control), B (addition papaya sap extract 2%), C (addition papaya sap extract 4%), and D (addition papaya sap extract 6%).

*PSE (papaya Sap Extract)

Water Quality

Temperature is very influential on oxygen consumption, growth, survival of shrimp in aquaculture environment. The temperature value obtained in the rearing must be in accordance with the optimal category for shrimp growth and survival (Sahrijanna, 2017). Water temperature also has a direct effect on shrimp life through its metabolic rate (affecting shrimp feeding metabolism) and also affects the solubility of gases including O_2 and various other chemical reactions in water. The higher the water temperature, the greater the consumption of O_2 (Manan and Putra, 2014).

Salinity is one of the environmental parameters that affect biological processes and will directly affect the life of organisms, among others, affecting the rate of growth, the amount of food consumed, the value of food conversion, and survival (Utami, 2016). Salinity has a close relationship with the osmoregulation of aquatic animals, if there is a sudden decrease in salinity and in a large enough range, it will make it difficult for the animal to regulate its body osmoregulation so that it can cause death (Anggoro, 2000 *in* Umiliana, 2016). Salinity describes the total concentration of ions contained in both organic and inorganic waters. The salinity of sea water is caused by 7 main ions, namely Sodium (Na^+), Potassium (K^+), Calsium (Ca^{2+}), Chloride (Cl^-), Sulfate (SO_4^{2-}), and Bicarbonat (HCO_3^-) (Yudiati *et al.*, 2009).

Oxygen is a water quality parameter that plays a direct role in the metabolic process of aquatic biota, especially shrimp. The availability of dissolved oxygen in water bodies as a factor in supporting the growth, development and life of shrimp (Fuady and Nitisupardjo, 2013). The respiration process in shrimp and cell physiology that plays a role in energy formation during the process of nutrient metabolism in feed requires oxygen, the low oxygen content causes the ability to metabolize feed to be limited thereby reducing the ability to convert feed (Adipu, 2019).

The value of the degree of acidity (pH) is one of the indicators used to determine the freshness of shrimp chemically (Qumairoh *et al.*, 2021). Changes in the pH value of waters to aquatic organisms have certain limits with varying pH values, depending on seawater temperature, dissolved oxygen concentration, and the presence of anions and cations (Pankaj *et al.*, 2012). pH or the degree of acidity of water can affect growth. A low water pH will result in death, while a water pH that is too alkaline can cause the shrimp growth rate to be hampered (Anita *et al.*, 2018). The degree of acidity (pH) describes the potential activity of hydrogen ions in solution which is expressed as the concentration of hydrogen ions ($mol.l^{-1}$) at a certain temperature, or pH = -log (H_+). Pure water has a pH value of 7 and is said to be neutral, whereas in brackish water the normal pH ranges from 7 – 9 (Boyd and Hanson, 2010). Acidic waters tend to cause death in fish as well as at pH values that are too alkaline. When the pH of the waters is too low or too high, it can cause stress to the shrimp and the softness of the shrimp shell and the low survival of the shrimp (Chakravarty *et al.*, 2016).

Ammonia is excreted by the shrimp, and can also accumulate in the water due to the decomposition of solid organic matter (Schuler *et al.*, 2010). Ammonia is the most common toxin resulting from the excretion of farmed animals and the mineralization of organic detritus such as uneaten feed and feces. Accumulation of ammonia in water can reduce water quality, reduce growth, increase oxygen consumption and excretion of ammonia-N, change hemolymph protein concentration and free amino acid levels, and even cause high mortality. (Lin and Chen, 2001). Excess ammonia can increase the use of oxygen in the tissues, damage the gills, and reduce the ability of the blood to carry oxygen (Hidayat *et al.,* 2019).

Nitrite exists in two forms, ionized nitrite (NO_2^-) and nitric acid (HNO_2). These forms exist in equilibrium mainly controlled by pH. The total nitrite present in the water at a pH greater than 6, where most of the aquatic organisms kept are ionized (NO_2^-) (Tomasso, 2012). There is an inverse relationship between salinity and nitrite, such that nitrite increases with decreasing salinity, this makes vaname shrimp more susceptible to nitrite when under hypoosmotic conditions (Furtado *et al.,* 2016). Nitrite in water can enter the bloodstream of aquatic biota. The presence of nitrite in the blood of white shrimp results in the formation of methemoglobin instead of normal hemoglobin, which is an oxygen-carrying blood protein (Gross *et al.,* 2004). Water quality measurement standards based on SNI can be seen in table 2.

Table 2. Water quality measurement standards

Parameter	Standard	Reference
Temperature (^0C)	29 – 32	SNI 7311:2009
Salinity ($g.l^{-1}$)	29 – 34	SNI 7311:2009
DO ($mg.l^{-1}$)	> 4,0	SNI 8037.1:2014
pH	7,5 – 8,5	SNI 8037.1:2014
Ammonia ($mg.l^{-1}$)	< 0,1	SNI 8037.1:2014
Nitrite ($mg.l^{-1}$)	< 0,1	SNI 7311:2009

Conclusion

Based on the results obtained between the four treatments, the addition of papaya sap extract as much as 2% to the feed gave a significant effect on the growth of white shrimp with an absolute weight gain value of 23.34 g ± 3.05 g, a food conversion ratio of 1.44 ± 0.11, a specific growth rate of 17.10% ± 1.72%, and feed utilization efficiency of 69.94% ± 5.69%.

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