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Growth Performance of Silver Arowana Fed with *Gryllus mitratus* (Local Cricket) and *Blaptica Dubia* (Dubia Roach)

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Abstract

This research aimed to determine the feed types for Brazilian silver Arowana *(Osteoglossum bicirrhosum)*, consisting of *Poecilia reticulata* (guppy fish), *Gryllus mitratus* (local cricket) and *Blaptica Dubia* (Dubia roach). The best feed ratios were compared to improve the performance growth of Arowana. The research was conducted in October - November 2022 at the ornamental fish farm named Badai Arwana Tasikmalaya, West Java. This research used an experimental method with a completely randomized design through five treatments and four repetitions. The treatments consisted of (A) guppy fish as the control feed (100%); (B) local cricket as the tested feed (100%); (C) Dubia roach as the tested feed (100%), (D) combination of guppy fish (50%) with local cricket (50%); and (E) combination of guppy fish (50%) with Dubia roach (50%). The treatments were given for 40 days, and the growth parameters of those Arowana seeds were then observed every 10 days. The observed parameters covered Survival Rate (SR), Absolute Length Growth (L), Absolute Weight Growth (W), Feed Conversion ratio (FCR), and Water Quality. SR, W, L, and FCR data were analyzed using ANOVA with a significant level of 95% and if there is a significant difference, the Duncan test will be further conducted. Meanwhile, water quality was descriptively analyzed. The research results showed that the feed combination of guppy fish (50%) with local cricket (50%) could improve the SR and growth performance of Arowana seeds. The given feed combination with the ratio of guppy fish (50%) with local cricket (50%) resulted in SR (100%), L (9.07 cm), W (10.53 g), and FCR (2.36). Meanwhile, the water quality during the research was in appropriate and stable conditions.

***Keywords**:* Growth, Silver Arowana, Feed Combination, Cricket, Roach

1. Introduction

Arowanas are very popular because of their beautiful color and shape; making them much sought after by fish hobbyists. Along with its existence in nature which is increasingly rare and high market demand, the selling price of Arowanas are also becoming more expensive. Many believe that Arowanas bring good luck and fortune, as a result, the demand for these fish is rocketing (Yamazaki, 1996). The most sought-after Arowanas are Brazilian silver Arowana *(Osteoglossum bicirrhosum).*

Arowanas have different growth rates in various phases. According to Tjakrawidjaja (2006) at the age of seeds to juveniles, the body length growth of Arowanas occurs more rapidly. This growth is thought to be due to bone development which has a direct effect on the rapid increase in length. Conversely, in the adult stage, the speed of growth in body length (including bones) is getting slower. This is caused by the primarily use of energy for the growth of other organs or for the maintenance of the body so that the speed of bone development slows down.

Feed is one of the factors that affect the growth of Arowanas. It acts as a provider of protein and energy for the continuity of the body repairing damaged or used body tissue. It also regulates the sustainability and environmental conditions in the body. Feed containing higher protein tends to provide higher body weight gain, while feed containing low protein and are consumed in small amounts can cause deficiencies or imbalances of amino acids that inhibit growth (Martens et al, 2014) . According to Gultom (2014), high protein consumption will also affect protein intake in meat and sufficient amino acids in the body so that the metabolism of cells in the body takes place normally.

The common feed given to Arowanas is live fish. However, a variety of food is one thing that must be considered in feeding Arowanas. The provision of varied feed aims to prevent Arowanas from experiencing digestive disorders. Yahya *et al*. (2016) stated that differences in food variations in Arowana fish seeds had a significant effect on the survival of Arowana fish. Susanto (2008) said that basically the types of food for Arowanas can be grouped into 2, namely animals native to water and other animals that do not come from water.

Feeding Arowanas with local crickets and Dubia roaches (Figure 1), can be used as an alternative to add nutritional value to Arowanas. Therefore, it is necessary to carry out further research regarding the effect of feeding on the growth and development of Arowanas

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Figure 1. Dubia Roaches

2. Material and Methods

2.1. Research Purpose

This research aimed to analyze and determine the effect of local cricket (*Gryllus mitratus*) and Dubia roaches (*Blaptica Dubia*) feed given on the growth of Brazilian Silver Arowana (*Osteoglossum bicirrhosum*).

2.2. Research Design

The research method used experimental method with a completely randomized design (CRD) model consisting of 5 treatments and 4 replications with a variation of feeding as much as 7% of the biomass, consisting of: A (guppies), B (local crickets), C (Dubia roaches), D (50% guppies: 50% local crickets), and E (50% guppies: 50% Dubia roaches).

2.3. Time and Venue

The research was conducted for forty days in October - November 2022 at the ornamental fish farm named Badai Arwana on Jalan Siliwangi No. 97 A/B District of Tawang, Tasikmalaya, West Java.

2.4. Tools and Materials

The tools used to support this research were divided into two, including the following: glass aquarium with a size of 100cm x 40cm x 40cm, water pump, plastic box, heater, and aerator for test fish.

The tools used to analyze the performance of fish growth in the study were as follows: digital pH meter, digital DO meter, digital thermometer, digital scales, ruler, drain, camera, and stationery. The materials used in this study were: 75 Brazilian silver Arowanas with a length of 12 cm and a weight of 12 grams, 2 liters of guppies as control feed for Arowanas, 2 kg of local crickets, 2000 Dubia roaches.

2.5. Parameters

2.5.1. Absolute Length Growth (L)

This parameter aimed to measure the length growth by comparing the initial length before and after the test treatment.

2.5.2. Absolute Weight Growth (W)

This parameter aimed to measure the weight growth by comparing the initial weight before and after the test treatment.

2.5.3. Food Conversion Ratio (FCR)

During the research, the FCR was measured by using the Effendie & Ichsan (1997)

2.5.4. Feed Efficiency (FE)

During the research, the FE was measured by using the Effendie & Ichsan (1997)

2.5.5. Survival Rate (SR)

The parameter of Survival Rate was calculated from the initial of the research treatment until the end of the research, which was for 40 days.

2.5.6. Water Quality

Water quality parameter observation was used as supporting data in determining the optimum conditions for the maintenance of test fish.

3. Results and Discussion

3.1. Survival Rate

The research result conducted by Sukarman *et al*. (2023) reported that the feeding of crickets, crickets with enrichment, and combination

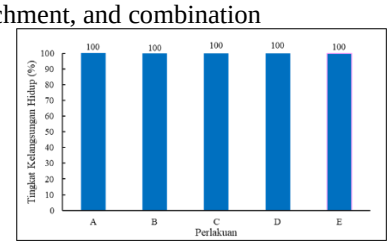

Figure 4. The Survival Rate of Brazilian Silver Arowana (*Osteoglossum bicirrhosum*) in different treatments.

The survival rate is the percentage ratio of the number of fish that live at the end of the rearing period to the number of fish that live at the beginning of the rearing period (Mulyani *et al*. 2014). The results of the analysis of variance (ANOVA) showed that feeding Arowanas with local crickets (*Gryllus mitratus*), Dubia roaches (*Blaptica Dubia*), and combination diets did not have a significant effect on the survival rate of the Brazilian silver Arowana (*Osteoglossum bicirrhosum*) ($P>0.05$). These results are in accordance with previous research which reported that the feed given in the form of crickets, caterpillars and shrimp did not have a significantly different effect on the survival rate of Arowanas and resulted in a survival rate of 100% in each treatment.

Mulyani *et al.* (2014) stated that if the Survival Rate (SR) is more than 50%, it is classified as good category, the percentage of fish survival ranges from 30-50% is classified as medium category and if the survival rate of fish is less than 30% then it is classified as not good category. The survival rate of Brazilian silver Arowana in all treatments was 100%. These results are much higher when compared to research results conducted by Armando *et al.* (2018)

with 20-78% survival rate of Brazilian silver Arowana and research by Santanurmurti *et al*. (2021) with the survival rate of Brazilian Silver Arowana fed with Tubifex sp., Chironomus sp., and a combination of Tubifex sp. and Chironomus sp. were 60%, 100%, and 70%, respectively.

3.2. Absolute Length Growth

Absolute length is the growth of the total length of the fish which represents the final length of the fish during the rearing period and is expressed in cm (Nurhariati *et al*., 2021). Length growth is a growth parameter observed in ornamental fish (Said *et al.* 2005).

Based on the results of the analysis of variance (ANOVA), it was shown that feeding Arowanas with local crickets (Gryllus mitratus), Dubia roaches (Blaptica Dubia), guppies and combination feeds gave significant results on the absolute length gain of Brazilian silver Arowana (Osteoglossum bicirrhosum). Based on the Duncan test results, treatment A (100% guppies) was significantly different ($P<0.05$) to treatment C (100% Dubia roaches) and showed results that were not significantly different ($P>0.05$) to treatment B (100% local crickets). D (50% guppies : 50% local crickets) and treatment E (50% guppies : 50% Dubia roaches). The highest absolute length gain of Brazilian silver Arowana fish (Osteoglossum bicirrhosum) was produced in treatment D (50% guppies : 50% local crickets) of 9.07 ± 0.21 cm and the lowest yield was in treatment C (100% Dubia roaches) of 7.37 ± 0.32 cm.

However, even though 50% guppies: 50% local crickets feeding in treatment D gave the highest absolute length growth in Brazilian silver Arowana, these results were not significantly different from treatment A with feeding 100% guppies, which means there was no significant effect between the treatments (Figure 5).

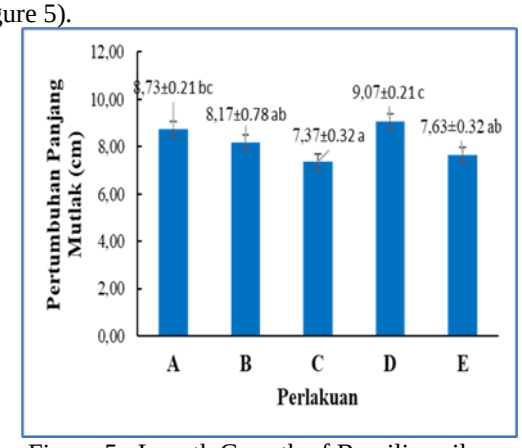

Figure 5. Length Growth of Brazilian silver Arowana (*Osteoglossum bicirrhosum*) with different treatment.

The results of observing the absolute length growth of Brazilian silver Arowana showed that in this experiment the absolute length increase of Brazilian Arowana fed with local crickets, both 100% local crickets and a combination of local crickets and guppies resulted in a better absolute length gain compared to fed with Dubia roaches as well as a combination of Dubia roaches and guppy fish. These results provided an indication that local crickets can be used as live food for Arowana fish and was able to provide better absolute length growth than Dubia roaches. This is in line with research results conducted by Hasrah *et al.* (2022) which stated that feeding Arowanas with crickets resulted in the highest absolute length gain compared to feeding them with caterpillars and shrimp.

The absolute growth length of the Brazilian silver Arowana in this study ranged from 7.37 ± 0.32-9.07 ± 0.21 cm. These results are still far greater than the research results conducted by Hasrah et al. (2022) in which feeding super red Arowana with crickets resulted in the best absolute length growth of 6.67 ± 0.47 cm, while feeding them with caterpillar and shrimp resulted in absolute length growth of 3.83 ± 0.85 cm and 3.17 ± 0.24 cm respectively. In addition, research by Sukarman et al. (2022) feeding Arowanas with crickets, cricket astaxanthin enrichment and a combination feed consisting of crickets, fish feed, sand crabs, and marigold petal meal although they did not show significantly different results between treatments, feeding Arowanas with crickets produced the highest significant growth in absolute length, which was 10.98 ± 1.65 cm.

According to Anggraeni and Abdulgani (2013) the factor that influences fish growth is feed. In addition, the amount and quality of feed given to fish are factors that can affect fish growth. Protein and fat are components of nutrients needed to achieve optimum growth. According to Yahya et al. (2013) the protein requirement for Arowana fish is no different from the protein requirement for carnivorous fish such as catfish or others, therefore using crickets as natural food for Arowana fish is the right choice because crickets have a high protein content. This is in accordance with the statement of Pastell et al. (2021) crickets contain more than 50% protein content and contain high levels of lysine and methionine.

3.3. Absolute Weight Growth

Absolute weight is the growth of fish weight as measured at the end of rearing and is expressed in grams (Rizzo and Bazzoli, 2020). This is in accordance with the opinion of Suparlan et al. (2020) which stated that absolute weight is the total growth rate of fish during rearing.

Based on the results of the analysis of variance (ANOVA) it was shown that feeding Arowanas with local crickets, Dubia roaches, guppies and combination feed had a significant effect on the absolute weight gain of Brazilian silver Arowana. Based on the Duncan test results, treatment A (100%

guppies) was significantly different (P<0.05) to treatment C (100% Dubia roaches), treatment D (50% guppies: 50% local crickets), and treatment E (50% fish guppies : 50% Dubia roaches) and showed results that were not significantly different (P>0.05) to treatment B (100% local crickets). The highest absolute weight gain for Brazilian silver Arowana was in treatment D (50% guppies : 50% local crickets) of 10.53 ± 0.23 grams and the lowest yield was in treatment E (50% Dubia roaches : 50% guppies) of 76.90 ± 0.35 cm (Figure 6).

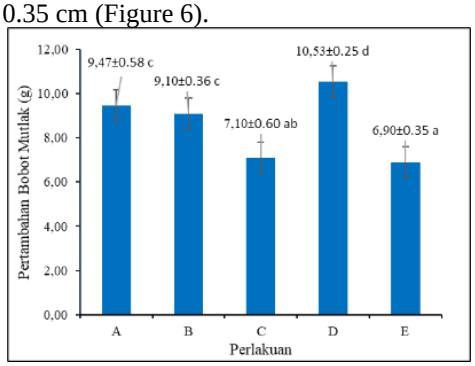

Figure 6. Absolute Weight Growth

The results of observations in this experiment showed that the combination feed of crickets and guppies gave the best results on absolute weight gain of Brazilian silver Arowana followed by treatment A (100% guppies) and treatment B (100% local crickets) with each weight gain value of 10.53 ± 0.23 gram, 9.47 ± 0.58 gram and 9.10 ± 0.36 gram.

Based on the results of the analysis of variance (ANOVA) it was shown that feeding Arowanas with local crickets, Dubia roaches, guppies and combination feed, had a significant effect on the absolute weight gain of Brazilian silver Arowana. Based on the Duncan test results, treatment A (100% guppies) was significantly different (P<0.05) to treatment C (100% Dubia roaches), treatment D (50% guppies: 50% local crickets), and treatment E (50% fish guppies : 50% Dubia roaches) and showed results that were not significantly different (P>0.05) to treatment B (100% local crickets). The absolute weight gain in this research is higher than that of Santanumurti et al. (2021) absolute weight gain of Brazilian silver Arowana fed Chironomus sp. which resulted in an absolute weight gain of 3.36 grams.

The high absolute weight gain in feeding in the form of guppies, crickets and a combination of both, is thought to be due to the combination feed between local crickets and guppies meeting the nutritional needs of Brazilian silver Arowana due to a variety of feeds. This is in line with the statement of Yahya et al. (2013) that the fish's need for protein can be fulfilled properly through varied administration. Pastel et al. (2021) crickets contain more than 50% protein content and contain high levels of lysine and methionine. Based on the research results of Yang et al. (2010) that lysine and methionine were able to increase the final weight of the grass carp *Ctenopharyngodon idella*.

In addition, feed that has a better appeal will be able to stimulate the fish appetite. This indicates that although local crickets and Dubia roaches have high protein content, local crickets and guppies have better attractiveness than Dubia roaches so that Brazilian silver Arowanas were more attracted to this feed. This is in accordance with the opinion of Petrell and Ang (2001). that apart from the protein content in the food eaten by fish, the attractiveness of the feed is a factor that plays an important role in the growth and survival of fish. Feed that has a better appeal can stimulate the fish appetite.

3.4. Feed Conversion Ratio (FCR)

Based on the results of the analysis of variance (ANOVA) it was shown that feeding Arowanas with local crickets, Dubia roaches, guppies and combination feed had a significant effect on the absolute weight gain of Brazilian silver Arowana. Based on the Duncan test results, treatment A (100% guppies) was significantly different (P<0.05) to treatment C (100% Dubia roaches), treatment D (50% guppies: 50% local crickets), and treatment E (50% fish guppies : 50% Dubia roaches) and showed results that were not significantly different (P>0.05) to treatment B (100% local crickets). The absolute weight gain in this research is higher than that of Santanumurti et al. (2021) absolute weight gain of Brazilian silver Arowana fed with *Chironomus* sp. which resulted in an absolute weight gain of 3.36 grams.

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In addition, feed that has better attractiveness will be able to stimulate FCR or feed conversion, which is a conversion of feed in terms of how much feed is needed to produce 1 kg of fish meat (Marie et al. 2018). Based on the results of the analysis of variance (ANOVA) it showed that the feeding of Arowanas with local crickets, Dubia roaches, guppies and combination feed had a significant effect on the feed conversion of Brazilian silver Arowana, which means there were significant differences between treatments (Figure 7).

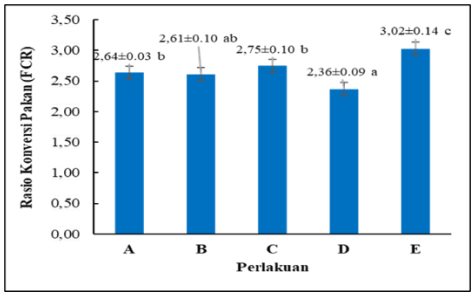

Figure 7. Feed Conversion Ratio (FCR) Graph

Based on the results of Duncan's test, treatment A (100% guppies) was significantly different (P<0.05) to treatment D (50% guppies: 50% local crickets) and treatment E (50% guppies: 50% Dubia roaches) and showed the results which was not significantly different (P>0.05) to treatment B (100% local crickets) and treatment C (100% Dubia roaches). The best or lowest Feed Conversion Ratio (FCR) for Brazilian silver Arowana was obtained in treatment D (50% guppies : 50% local crickets) of 2.36 ± 0.09 and the highest FCR value was in treatment E (50% Dubia roaches : 50% guppies) of 3.02±0.14. These results have a better FCR value compared to rice field eels which are fed crickets with an FCR value of 3.55 ± 0.54.

The results of observations in this experiment showed that the combination feed of crickets and guppies gave the best results on the Food conversion ratio (FCR) of Brazilian silver Arowana.

According to Abidin et al. (2015) the lower the feed conversion value, the higher the feed efficiency value, the higher the feed conversion value indicates that the feed efficiency value is low. This is thought to be caused by the amount of fat contained in the feed according to the nutritional needs of Brazilian silver Arowana fish in research activities so that the feed can be digested and utilized properly by Brazilian silver Arowana fish. This is indicated by a good specific growth rate as well. This is in accordance with the statement of Dawood et al. (2021) that increasing nutrient digestibility allows for high feed utilization and intake and results in high growth performance.

Feeding Arowanas with a combination of 50% guppies: 50% local crickets and feeding only 100% local crickets produces a better FCR value than feeding 100% Dubia roaches or a combination of 50% guppies: 50% Dubia roaches, this is due to the fat content in crickets and guppies local much lower than the Dubia roaches. Guppies are small fish, according to Bachtiar et al. (2003) types of small fish have a fat content of 2.2%, crickets as much as 5.6% (Turex et al., 2020) and Dubia roaches 35.51% male and female 35.49% (Yee et al. 2018). The high fat content in the Dubia cockroac allows the Brazilian silver Arowana fish to be unable to digest the feed so that feed utilization becomes lower. This is reinforced by the opinion Tawwab et *al.* (2007) if the fat content in the feed exceeds the needs of the fish, it can cause disturbances in the fish's body metabolism such as decreased appetite and suboptimal absorption of nutrients. According to Dawood et al. (2021) that increasing nutrient digestibility allows for high feed utilization and intake and results in high growth performance.

3.5. Water Quality

Water is the most important variable because water is a medium for fish to live. According to (Braga *et al.*, 2017) unstable environmental conditions can affect either directly or indirectly on aquatic organisms. The water quality of a waters is an important factor affecting the development, growth, survival, and level of fish production (Table 1).

Table 1. Water Quality Parameter

treatments	Water Quality Parameter		
	Temperature(^{0}C)	pH	DO (mg/l)
100% Cricket	26,1 – 30,1	6,86 – 8,15	5,2 – 6,7
100% Dubia Roach	26,5 – 30,1	6,89 – 8,15	4,7 – 7,2
100% Guppy	26,2 – 30,1	6,90 – 8,15	5,1 – 7,1
50% Cricket and 50% Guppy	26,0 – 30,1	6,88 – 8,15	5,3 – 6,9
50% Dubia Roach and 50% Guppy	26,0 – 30,0	6,88 – 8,15	4,5 – 7,1

Parameters that affect water quality consist of DO, pH, CO_2, brightness, salinity, and hardness (Fauzia and Suseno, 2020). Based on the results of observations of water temperature during research activities ranged from 29°C - 30.1°C. This temperature was still within the normal temperature range for the life of Brazilian silver Arowana (Table 4). According to Froese (2000), a good temperature range for Brazilian silver Arowana is 24°C-30°C. This is reinforced by the opinion of Tjakrawidjaja (2006) that fish in their natural habitat are able to tolerate temperatures ranging from 26°C -30.2°C. In addition, according to Shilman et al. (2021) stated that the water quality standard for keeping super red Arowana ranged from 29°C -30°C. The temperature range in research showed that during rearing the temperature was still in a condition capable of supporting the life of Brazilian silver Arowana fish (*Osteoglossum bicirrhosum*), because of the use of a heater to keep the temperature in the aquarium within the appropriate range to support the life of silver Arowana fish Brazil. Water temperature has a major influence on fish survival because it indirectly affects metabolic work in the fish's body (Taufik et al., 2016).

Temperature can also have an effect on fish growth because temperature is related to fish metabolic activities (Fadillah *et al.*, 2022). In conditions of

temperature above the optimum condition, the metabolic rate of fish will increase. This metabolic process can cause low oxygen levels in water (Gunawan et al., 2019). According to Boyd (1990) the ideal temperature for maintaining tropical ornamental fish ranges from 25°C-32°C. Temperatures that are too low can cause fish to be attacked by fungi, while temperatures that are too high can cause fish stress and growth disorders (Said and Supyawati, 2005).

The temperature in this study was within the normal range for Brazilian silver arowana fish to live so it did not have a negative effect on the appetite of Brazilian silver Arowana. According to Stickney (2020),fish can carry out their metabolism optimally if the water temperature is also in optimal conditions so that it has a positive impact on growth and increases in fish body weight. This is in line with the opinion of Hazel (1974) that in warmer temperatures conditions can increase enzyme activity and increase protein deposits in the body because the metabolic process becomes faster in breaking down nutrients, protein deposits have benefits in the growth process so as to increase absolute length gain.

According to Anas *et al.* (2017) water temperature has a significant impact on the process of exchange of substances, temperature also affects the level of dissolved oxygen in water, also affects the growth and appetite of fish. Fish can grow well in a temperature range of 25°C-32ºC, but sudden changes in temperature can make the fish become stress.

Based on the observations, the pH of the water during this research activity ranged from 6.86 to 8.15 (Table 4). The pH range in the research was still within mihby7the normal pH range for the growth of Brazilian silver Arowana (*Osteoglossum bicirrhosum*). According to Huet (1971) the degree of acidity or optimal water pH for fish ranges from 6.5-9.0. Meanwhile, according to Shiman et al. (2021) and Yahya et al. (2005) a good range of pH values for the maintenance of Arowana fish is 7-8.11.

The pH value in a water will affect the content of organic and inorganic materials so that it can affect the growth of aquatic organisms in these waters according to Silitonga et al. (2018). According to Siegers et al. (2019), pH is very important in the field of aquaculture because it relates to the ability of fish to grow and reproduce. pH values that are not optimal can cause fish to stress, disease susceptible, and low fish productivity and growth. According to Romadhona et al. (2016) too high pH values cause ammonia in the water to also be in high amounts. DO levels in this study ranged from 4.6-7.2 mg/L. This range of dissolved oxygen levels was still within the normal range for the growth and survival of Brazil (*Osteoglossum bicirrhosum*).

This is in accordance with Yahya et al. (2005) stated that dissolved oxygen levels are good for maintaining Arowana fish in the range 4.6-7.8 mg/L. Meanwhile, according to Shilman et al. (2021) the water quality standard for super red Arowana fish is 6 mg/L. This is reinforced by the statement of Apiyandi et al. (2021) the dissolved oxygen (DO) content in silver Arowana fish rearing containers, which ranges from 4.9-5.7 mg/L, is quite good.

According to Dahril *et al.* (2017) the value of dissolved oxygen content that is not optimal can cause fish to be unable to get an adequate supply of oxygen and fish will be stressed so that the fish's body tissues experience a lack of oxygen and cause fish to be unable to bind oxygen in the blood. According to Lestari and Dewantoro (2018) if the availability of oxygen cannot meet the needs of fish, it can cause fish to become weak and can even cause death in fish.

4. Conclusion

Based on the results of research and discussion it can be concluded that:

1. The provision of natural feed to Brazilian silver Arowana with local crickets, Dubia roaches, and guppies, as well as a combination feed, namely 50% guppies: 50% local crickets, and 50% guppies: 50% Dubia roaches for 40 days, resulting in 100% survival rate.
2. The different types of natural feed given to Brazilian silver Arowana seeds resulted in different weight gain and daily growth rates. The highest weight gain of 10.53 ± 0.23 gram and the highest growth rate of 9.07 ± 0.21 cm was obtained by feeding Brazilian silver Arowana with 50% guppies: 50% local crickets

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