Journal of Fish Health
Volume 4, Issue 3, August 2024
https://doi.org/10.29303/jfh.v4i3.5791

Feed Retention of Silver Pompano (*Trachinotus blochii*) on Commercial Feeding with The Addition of Turmeric Extract (*Curcuma domestica*)

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Received : 05-24-2024
Accepted : 06-24-2024

Keywords:
Fat Retention, Protein Retention, Silver Pompano, Turmeric

ABSTRACT

Silver pompano is a high-value fish, yet the cost of commercial feed is a major challenge for fish farmers. This study explores the addition of turmeric extract to commercial feed as a potential strategy to improve feeding efficiency and reduce production costs. Conducted at the Lombok Marine Aquaculture Center, the 50-day experiment used a Completely Randomized Design (CRD) with four treatment levels (control, 10 ml, 15 ml, and 20 ml of turmeric extract per kg feed) and three replications, totaling 12 experimental units. Parameters measured included growth performance indicators like specific growth rate (SGR), feed conversion ratio (FCR), protein and fat retention, and water quality. Data was analyzed using ANOVA and Duncan tests to assess treatment effects. Results showed that turmeric extract significantly improved SGR, FCR, protein retention, and fat retention, although it had no significant impact on absolute weight, length, survival rate, or feeding efficiency. The optimal treatment was 20 ml/kg of turmeric extract, yielding an SGR of 4.92%, FCR of 2.48, protein retention of 18.64%, and fat retention of 22.37%, likely due to the presence of bioactive compounds such as flavonoids, alkaloids, tannins, terpenoids, and phenols.

INTRODUCTION

Silver pompano (*Trachinotus blochii*) is a species that is still relatively new to be cultivated in Indonesia. Even though it is relatively new, the silver pompano has attracted cultivators' attention to carry out pompano cultivation activities. This is because the silver pompano has fast growth, is resistant to disease, is quite easy to maintain, and has quite high market demand from local to international markets such as Singapore, Japan, Canada, Taiwan, and Hong Kong (Retnani & Nurlita, 2013). Sarwono *et al*. (2016) stated that the large market demand for silver pompano is offset by its high price, namely around IDR 60,000-70,000/kg for live fish; meanwhile, fresh fish costs around IDR 45,000-50,000/kg. Seeing promising opportunities in the pompano cultivation business has caused it to become one of the leading aquaculture commodities in Indonesia.

The selection of silver pompano feed must be based on its needs, quality, nutrition, and economic value. Silver pompanos can be given artificial feed that can be adjusted to the fish's

mouth opening. Commercial feed usually given to silver pompano contains 37% protein and 9% fat (Reanando, 2019). For cultivators, feed is the largest production cost in cultivation activities. The costs used for feeding fish reach 60-70% of total production costs. Ardita *et al*. (2015) stated that the high price of commercial feed is one of the obstacles most frequently complained about by fish farmers. Therefore, it is necessary to have an effective feeding strategy to reduce production costs. One way for fish to utilize feed optimally is by increasing the digestibility of the feed. Sugih (2005) in Ahmadi *et al*. (2012) stated that the presence of digestive enzymes in the fish's body can increase the fish's feed digestibility and stimulate fish growth. Therefore, one alternative that can be done is to add turmeric extract (*Curcuma domestica*).

Turmeric is an abundant herbal ingredient that is easy to find, and the price is very affordable. Turmeric prices range from IDR 2,500 to IDR 15,000 per kg (Hakim, 2013). According to Syarifah (2006), turmeric contains several groups of organic compounds such as flavonoids, glycosides, triterpenoids, steroids, alkaloids, and several other organic compounds that contain nitrogen, which have a role in stimulating the body's immune system or as an immunostimulatory so that it supports fish growth.

Research by Santika *et al*. (2020) showed that adding turmeric extract significantly affected absolute growth, SGR, feeding efficiency, and FCR. The best concentration is the addition of 20 ml turmeric extract, which can have an optimum growth effect on white snapper (*L. calcarifer*). The research results of Ulum *et al*. (2018) in Andesra (2019) show that adding turmeric supplements at a concentration of 4%/kg feed can increase the feeding efficiency of catfish (*Clarias* sp.).

Based on previous research, turmeric has been proven to increase growth and feeding efficiency in freshwater fish. However, few studies have focused on using turmeric extract in feed retention. Meanwhile, research has never used turmeric as an appetite enhancer and feed digestibility in seawater fish, especially silver pompano. Therefore, this research was conducted to analyze the retention of commercial feed by adding turmeric extract to cultivate silver pompano.

METHODS

This research was carried out for 50 days, from April 1 to May 20, 2022, at the Lombok Marine Aquaculture Center (BPBL), Ministry of Fisheries and Maritime Affairs of the Republic of Indonesia, Sekotong, West Nusa Tenggara. The retention test was conducted at the Animal Nutrition and Forage Science Laboratory, Faculty of Animal Husbandry, University of Mataram. The design used was a Completely Randomized Design (CRD). The factors tested were differences in the concentration of turmeric extract in the feed with four treatment levels, each repeated three times. Thus, it results in 12 experimental units. The treatments tested in this study were P1: Control (without adding turmeric extract), P2: Turmeric extract 10 ml/kg feed, P3: Turmeric extract 15 ml/kg feed, and P4: Turmeric extract 20 ml/kg feed.

Making turmeric extract

The turmeric to be extracted is first cleaned, then cut into small pieces and dried. Once completely dry, the turmeric is ground into powder. This turmeric powder is then extracted to obtain the active ingredients. The turmeric powder was then shifted and macerated by soaking using 96% ethanol as a solvent for 2x24 hours until homogeneous (Rojtinnakorn *et al*., 2012). The results of the maceration of turmeric powder were filtered using Whatman paper

No. 42. The filtration obtained was then evaporated using a Rotary Vacuum Evaporator at a temperature of ±40°C with a speed of 120 rpm (Harini *et al*., 2012). The results are in the form of thick turmeric extract put into a spray bottle/jar (Arifin *et al*., 2015).

The turmeric extract is put into a syringe according to the treatment and then sprayed on the pellets until evenly distributed. The pellets are aired until dry, after which the feed is ready. Food is stored tightly in plastic containers so that air does not enter the feed and hormones do not decompose.

Fish culture

The test fish used in this research were silver pompano seeds obtained from rearing activities at the Lombok Marine Aquaculture Center (BPBL) hatchery, Sekotong, West Nusa Tenggara. One hundred eighty fish measured ±4 cm with a weight of around 0.4-1.25 grams and a length of 3-3.5 cm, which were first acclimatized for 15-30 minutes in a holding tank. The test fish used were divided randomly into four treatments and three replications, where each container was filled with 15 fish with a stocking density of 1 fish/1.5 l.

Before the seeds are stocked, seed selection is carried out with a predetermined size, and then acclimatization is carried out for 15-30 minutes in a holding tank. Acclimatization is done by placing the fish in a holding tank using a basket and then leaving it for 15-30 minutes. After acclimatization, the seeds are spread in each container. Fish rearing is carried out for 50 days by feeding 5% of the fish's total weight. Feeding is carried out three times a day: in the morning (8 am), midday (noon), and afternoon (4 pm) Central Indonesian Time (WITA).

Research parameters

The research parameters measured were absolute weight growth, absolute length growth, specific growth rate, feeding efficiency, feed conversion ratio (FCR), survival rate (SR), retention test, and water quality.

Results and Phytochemical Test of Turmeric Extract (Artini *et al*., 2013):

$$\%Yield = \frac{Weight\ of\ extract}{Weight\ of\ simplicia} x\ 100\%$$

Absolute Weight (Windarto et al., 2019):

$$W = Wt - W0$$

Note:
W = Growth weight (g)
Wt = Weight of fish at final time (g)
W0 = Weight of fish at initial time (g)

Absolute Length (Effendi, 1997 in Windarto *et al*., 2019):

$$L = Lt - L0$$

Note:
L = Length growth (cm)
Lt = Length of fish at final time (cm)
L0 = Length of fish at initial time (cm)

Specific Growth Rate (Dedi *et al*., 2018):

$$SGR = \frac{Ln\ Wt - Ln\ W0}{t}\ x\ 100_{\%}$$

Note:
SGR = Daily Growth Rate (%/day)
Ln Wt = Weight of fish at final time
Ln Wo = Weight of fish at initial time
t = time (days)

Feeding Efficiency (Saputra *et al*., 2018):

$$FE = \frac{(Wt + D) - W0}{F}\ x\ 100\%$$

Note:
FE = Feeding efficiency (%)
Wt = Average Weight of fish at the end of the study (g)
W0 = Average Weight of fish at the start of the study (g)
F = Total amount of fish feed given (g)
D = Weight of fish that died during the study (g)

FCR (Feed Conversion Ratio) (Saputra *et al*., 2018):

$$FCR = \frac{F}{(Wt + D) - W0}\ x\ 100\%$$

Note:
FCR = Feed Conversion Ratio
F = Total Amount of feed given (g)
Wt = Total Weight of fish at the end of the study (g)
W0 = Total Weight of fish at the start of the study (g)
D = Weight of fish that died during the study (g)

Survival Rate (SR) (Windarto *et al.*, 2019):

$$SR = \frac{Nt}{N0}\ x\ 100\%$$

Note:
SR = Survival (%)
Nt = Number of fish alive at the end of the study (tails)
N0 = Number of fish at the start of the study (tails)

Protein Retention (Winaldi, 2017):

$$RP = \frac{Fp - Ip}{P}\ x\ 100\%$$

Note:
PR = Protein Retention (%)
Fp = Amount of fish body protein at the end of rearing (g)
Ip = Amount of fish body protein at the start of rearing (g)
P = Amount of protein consumed by fish during rearing (g)

Fat Retention (Winaldi, 2017):

$$FR = \frac{Fl - Il}{L} x\ 100\%$$

Note:
Fl = Amount of fish body fat at the end of rearing (g)
Il = Amount of fish body fat at the start of rearing (g)
L = Amount of fat consumed by fish during rearing (g)

Water Quality
Water quality parameters are measured once every 10 days of maintenance. The water quality parameters measured are temperature, salinity, pH, and DO.

Data analysis
Data was analyzed using analysis of variance (ANOVA) with SPSS at a significant level of 5% to determine the effect of treatment in the study. Data showing a real effect was further analyzed using the Duncan test.

RESULTS

The results of research during the 50-day rearing period showed that the extract yield value was 9.14% (Table 1), the average absolute weight of pompano ranged from 5.85-7.11 g, the absolute length ranged from 4.0-4.35 cm, and the specific growth rate ranged from 4.51-4.92%/day (Figure 1). Meanwhile, the feeding efficiency value ranges from 37.61-40.39% and survival (SR) ranges from 93-100% (Figure 2). Feed conversion ratio (FCR) ranges from 2.48-2.87 (Figure 3), protein retention ranges from 14.27-18.64, and fat retention ranges from 22.37-36.39 (Figure 4). The average salinity value during maintenance ranges from 32-33 ppt, temperature from 27-28.1 °C, pH from 7.1-7.4, and DO from 5.3-5.7 mg/l (Table 2).

Table 1. Turmeric extracts yield value

Powder weight (g)	Extract weight (g)	Yield (%)	Characteristic		
			Shape	Color	Smell
1,000	91.392	9.14	Thick	Yellow	Stings

Based on the results of the ANOVA test and Duncan's further test results show that the addition of turmeric extract to commercial feed can affect specific growth rate (SGR), feed conversion ratio (FCR), protein retention, and fat retention in silver pompano ($P<0.05$); however, it does not affect the absolute weight, absolute length, feeding efficiency and survival (SR) of the silver pompano ($P>0.05$). Duncan's further test results showed that the highest increase in absolute weight, absolute length, specific growth rate, feed conversion

ratio, feeding efficiency, protein retention, fat retention, and survival was found in the treatment with the addition of 20 ml turmeric extract/kg feed.

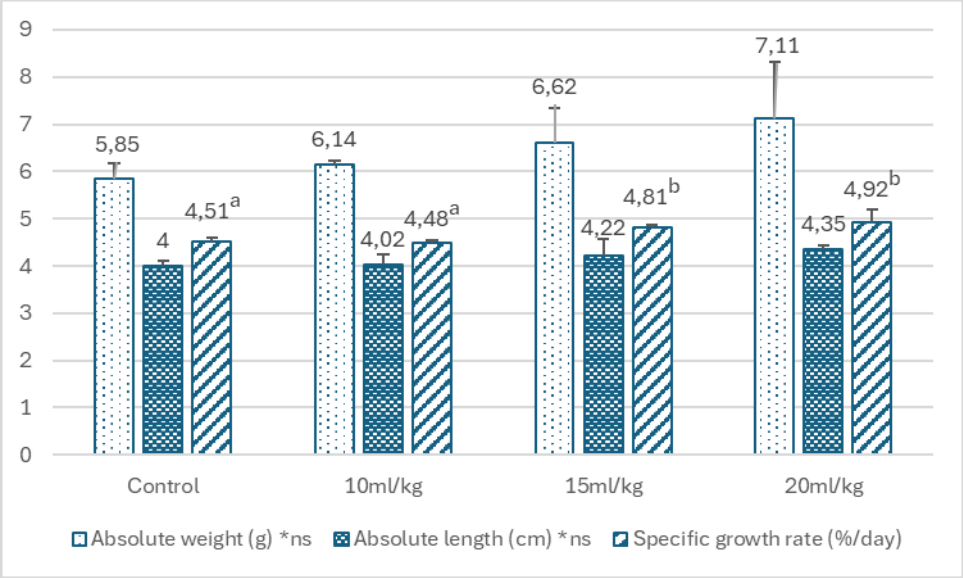

Figure 1. Absolute weight, absolute length, and specific growth of silver pompano. Note: different superscript letters indicate significant differences between treatments, and *ns indicate no differences between treatments.

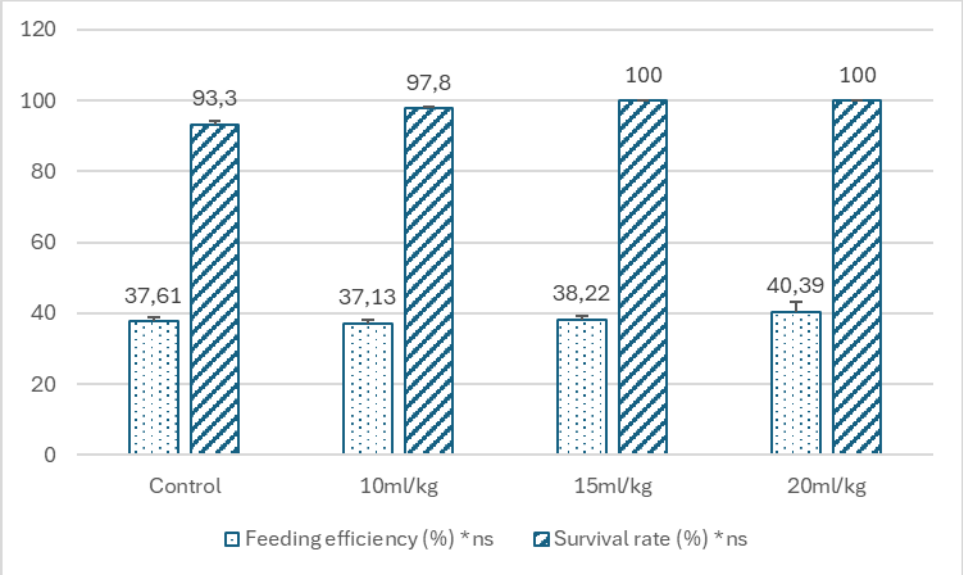

Figure 2. Feeding efficiency and survival rate of silver pompano. Note: *ns indicate no differences between treatments.

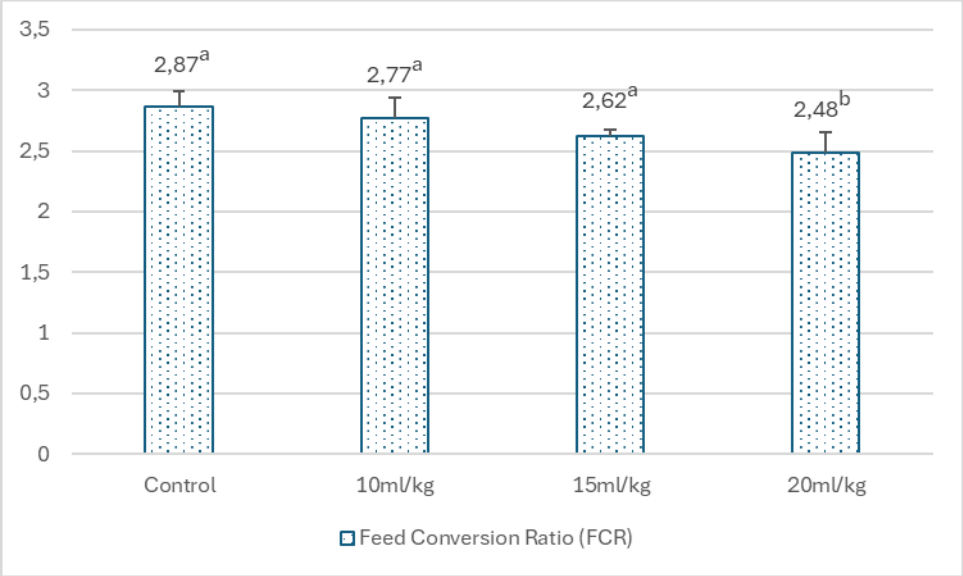

Figure 3. Feed conversion ratio of silver pompano. Note: different superscript letters indicate significant differences between treatments.

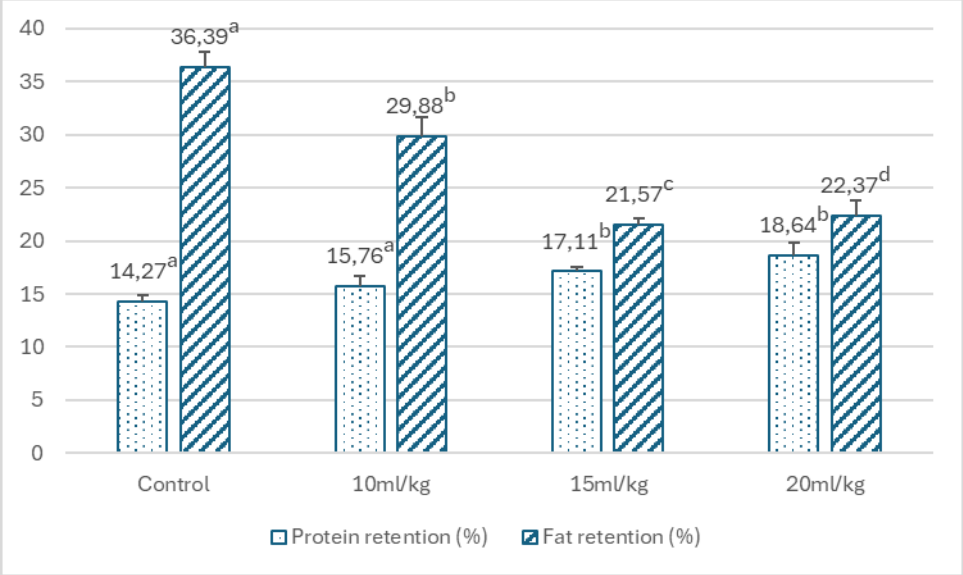

Figure 4. Protein retention and fat retention. Note: different superscript letters indicate significant differences between treatments.

Table 2. Water quality parameters

Parameters		Control	10ml/kg	15ml/kg	20ml/kg	Ideal	References
Salinity	ppt	32-33	32-33	32-33	32-33	29-32	
Temperature	°C	27-28.1	27.3-28.1	27.1-28	27.4-28.1	27-32	
pH	-	7.1-7.4	7.1-7.3	7.1-7.4	7.1-7.3	6.8-8.4	
Dissolve Oxygen (DO)	mg/l	5.3-5.5	5.3-5.6	5.3-5.7	5.3-5.5	5.0-7.0	

DISCUSSION

Phytochemical test results of turmeric extract

The turmeric extract yield was determined by weighing the extracted turmeric powder,

and the extract yield was obtained to obtain a turmeric extract yield of 9.14%. This yield value is lower when compared to previous research using an ethanol solvent extraction method, which produced a yield of 14.90% (Wahyuningtyas & Sri, 2017). The level of cell wall thickness and differences in turmeric rhizome harvest influence this difference. Zhang *et al*. (2018) stated that the thickness of the cell walls and cell membranes largely determines the extraction results in plants using the maceration method. This is because the maceration method is carried out by soaking plant material in a certain solvent, which causes different pressures inside and outside the cells, which will cause the dissolution of secondary metabolites from the cytoplasm. This pressure difference then results in the cell walls and membranes rupturing. This affects the size of the yield produced in a maceration extraction process. The genetic factors of the sample greatly influence cell wall thickness. Other factors that influence the extract yield are the harvest age of the yellow and white turmeric rhizomes and the type of solvent used in the extraction process. Popuri (2013) in Wahyuningtyas & Sri (2017) stated that ethanol is the best solvent compared to other hydrocarbon solvents. This is because secondary metabolites are extracted, and all metabolites are attracted during extraction. The active compounds in each turmeric have different specifications for dissolving the active ingredients.

Anggitha (2012) further stated that the effectiveness of extraction of a compound by a solvent is very dependent on the solubility of the compound in the solvent, by the principle that a compound will dissolve in a solvent with the same polarity. The type of solvent used is related to the solvent's polarity, so it influences the phytochemical compounds produced. The thing that needs to be considered in the extraction process is that compounds with the same polarity will dissolve more easily. Polar solvents include ethanol, methanol, acetone, water, and isopropanol (Sudarmaji *et al*., 1997 in Wahyuningtyas & Sri, 2017).

Growth and retention

Fish growth is influenced by the quality of the feed provided and the nutritional needs of the fish. Some nutrients that are very important and must be available in fish feed include protein, fat, carbohydrates, vitamins, and minerals. Lack of one of these nutrients can reduce the growth rate of fish. Likewise, excess nutrition can hamper the growth rate (Marzuqi, 2012).

The results of this study show that the addition of turmeric extract with different concentrations in feed does not affect the growth in absolute weight and absolute length but can increase the specific growth rate (SGR) of silver pompano (Figure 1). This shows that the turmeric extract used does not interfere with or harm the metabolism of silver pompano. The higher the turmeric extract is given in the feed, the higher the specific growth rate of the silver pompano.

The addition of 15 ml/kg (P3) and 20 ml/kg (P4) turmeric extract to artificial feed provides the same ability to increase the specific growth rate of silver pompano better, namely 4.81 - 4.92%/day (Figure 1). This shows that turmeric extract mixed in artificial feed with a concentration of up to 20 ml/kg (P4) in this study is still optimal in increasing appetite, increasing body weight, and increasing the speed of food absorption in silver pompano and has not had any negative effects on the biology of the silver pompano. The specific growth rate value for silver pompano obtained in this study is better when compared to the results of research by Santika *et al*. (2020), which obtained a specific growth rate for silver pompano of only 3.57%/day in the turmeric extract concentration treatment of 20 ml/ kg feed.

The increase in better growth of silver pompano by adding turmeric extract to the feed is thought to be due to secondary metabolite compounds in turmeric rhizomes. This is supported by the results of phytochemical tests, which show that the turmeric extract mixed

with feed contains alkaloids, flavonoids, polyphenols, terpenoids, and tannins (Table 5). These results align with previous research conducted by Hariyati *et al*. (2015), which found that turmeric rhizomes contain flavonoid compounds, tannins, alkaloids, essential oils, and curcumin.

Flavonoids are secondary metabolite compounds that provide biological effects on growth, endurance, anti-stress, antibacterial, anti-viral, and anti-fungal (Handayani, 2017). Flavonoids are a secondary metabolite that also acts as an antioxidant. Antioxidants are compounds that can protect the body from attacks by toxic free radicals. The phenolic group contained in flavonoid compounds can cause these compounds to have biological activity as antioxidants and antidepressants and can be a stimulant for the heart and capillaries (Sirait, 2007). Turmeric also contains secondary metabolites of flavonoids, alkaloids, and tannins, so it is an antioxidant, antidepressant, and anticancer (Sidiq & Wardani, 2014). According to Syarifah (2006), several groups of organic compounds such as flavonoids, glycosides, triterpenoids, steroids, alkaloids, and several other organic compounds that contain nitrogen have a role in stimulating the body's immune system or as an immunostimulatory.

Robinson (1995) states that tannin compounds are secondary metabolite compounds with antibacterial capabilities, including denaturing proteins. Denatured proteins will inhibit the way enzymes work. If the enzyme's work is hampered, it will cause the metabolic process to be hampered. By hampering the metabolic process, the growth and development of bacteria will also be hampered. Other active compounds contained in turmeric are alkaloids. The mechanism of alkaloids as antibacterials can disrupt the peptidoglycan (cell wall constituent) in bacteria. The cell wall layer does not form completely and causes the bacteria to die.

The increase in the growth rate of silver pompano, which was better in the treatment with the addition of 15 ml/kg (P3) and 20 ml/kg (P4) turmeric extract to the feed because of this research, was also supported by an increase in the protein retention value in the same treatment of 17.11- 18.64%. The increase in protein retention value and the increase in turmeric extract concentration in commercial feed is likely due to the role of phytochemical compounds in protein synthesis through mRNA activity. Optimum concentrations in young experimental animals can increase growth by increasing protein deposition and retention (Susanti *et al*., 2016). Furthermore, Susanti *et al*. (2016) stated that protein retention shows the large contribution of protein consumed in feed to increased body protein. Apart from describing the presence of protein deposits in the fish's body, the protein retention value also describes the protein-sparing effect of fats and carbohydrates as energy providers for daily activities. In some fish species, energy derived from fat acts as an effective sparing agent for protein.

Research, both in vitro and in vivo, has proven that turmeric's active ingredients are anti-inflammatory and antioxidant compounds (Tung et al., 2019). Research conducted by Mahmoud *et al*. (2014) showed that giving 0.50% turmeric increased body protein and protected tilapia from Pseudomonas fluorescens bacteria. Turmeric can also increase the growth of catfish (Dewi *et al*., 2017) and inhibit the lipid peroxidation process in mice (Shukla *et al*., 2003).

The opposite happens in fat retention, where the higher the concentration of turmeric extract, the lower the fat retention value (Figure 4). This is thought to be caused by fat retention, indicating the amount of fat originating from feed stored in the body during the rearing period (Samsudin, 2010 in Yandra *et al*., 2020). The fish's body needs fat to be stored as structural fat. To meet its fat needs, the fish synthesizes (bio converts) fat from non-fat

nutrients, such as carbohydrates, into fatty acids and triglycerides, which occur in the liver and fat tissue (Linder, 1992 in Susanti et al., 2016). The fat in fish functions to maintain stamina and is a storage medium for fat-soluble vitamins. It is recommended that the fat in fish feed is not too high because it can cause liver damage (Arleston & Manik, 2021).

In this study, turmeric extract was proven to reduce fish fat retention. This is also supported by research by Rahmadani *et al*. (2020), which shows that adding turmeric to feed can reduce the fat content of catfish. Geijer *et al*. (2002) stated that turmeric is one of the ingredients that can be used because it has many antioxidant compounds that can increase the immune response and antioxidant activity in the body.

Providing food with appropriate nutrition can increase the body weight of fish. This is because fish can store food nutrients in the body, which are processed and processed as energy for forming body tissue, increasing biomass, and fish growth and development. Saputra *et al*. (2017) stated that fish growth is closely related to protein availability in feed because protein is a source of energy for fish, and protein is a nutrient that fish need for growth. So, feed that contains high nutrients is very influential for fish growth and development. Fish growth is influenced by the energy that enters the fish's body. The more food consumed, the more energy enters the fish's body, so the fish use this energy to grow. According to Effendie (1979) in Hardianti (2016), individual growth can occur if excess energy and protein originate from food that the body has used for basic metabolism, movement, body maintenance, and replacing damaged body cells.

Turmeric extract contains active compounds such as alkaloids, flavonoids, tannins, saponins, glycosides, and steroids or triterpenoids, which can function as antibacterials, antibiotics, anti-inflammatories, and antioxidants (Nurussakinah, 2010). Meanwhile, according to Syarifah (2006), several groups of organic compounds such as flavonoids, glycosides, triterpenoids, steroids, alkaloids, and several other organic compounds containing nitrogen have a role in stimulating the body's immune system or as immunostimulatory, thereby supporting fish growth.

Feeding efficiency and feed conversion ratio

The results of this study indicate that adding turmeric extract with different concentrations in feed does not significantly affect the efficiency of feed utilization but has a significant effect on the feed conversion ratio. This shows that the administration of turmeric extract does not interfere with the absorption of the nutritional components contained in the silver pompano feed, so the feed with the addition of turmeric extract provides the same ability to increase the growth of the silver pompano as the treatment without the administration of turmeric extract (control). This assumption is very much in line with the data on the growth results of the silver pompano, which was explained in the previous section, where the administration of turmeric extract only affected the specific growth rate of the silver pompano. Based on the results obtained, the feeding efficiency value of silver pompano in this study increased in line with the increasing concentration of turmeric extract added to the feed.

Feeding efficiency is the ability of fish to utilize feed optimally. Marzuqi *et al*. (2012) stated that feed utilization efficiency shows how much feed can be utilized by fish. The efficiency of feed utilization is related to the fish's ability to digest the feed provided so that the fish can grow and develop well. According to Kim *et al*. (2005) in Putranti *et al*. (2015), the ability of fish to digest feed will affect the protein efficiency ratio value. The ability of fish to digest this feed is influenced by several factors, namely the composition of the feed, where the higher the protein utilized by the body, the more efficient the protein utilized by the fish.

According to Craig and Helfrich (2002) in Putranti *et al*. (2015), energy levels greatly influence feeding efficiency. High energy levels will cause the fish to become full quickly and immediately stop feeding. Increasing non-protein levels in feed will increase total energy so that it exceeds fish needs

The results of this study show that the average feeding efficiency value of commercial silver pompano feed with the addition of different turmeric extracts gives an average value ranging between 37.13% - 40.39%. The range of feeding efficiency values in this study is still quite good. According to Febriansyah *et al*. (2020), a good feeding efficiency value is more than 25%. High feeding efficiency indicates efficient use of feed so that it can be used for growth. The research results of Santika *et al*. (2020) show that adding turmeric extract provides an efficiency value for feed utilization in fish, ranging from 51.91%-66.63%). Meanwhile, the research results of Putri *et al*. (2016) showed that giving turmeric flour at a concentration of 2% to goldfish (Cyprinus carpio) feed increased the amylase enzyme by 7.012 U/mg, protease by 0.032 U/mg and goldfish growth performance by 2.22%.

The increase in the feeding efficiency value of silver pompano in this study also aligned with the decrease in the feed conversion ratio value. According to Iskandar et al. (2017), the feed conversion ratio is the feed needed to produce 1 kg of cultured fish meat. Ardit et al. (2015) stated that a lower FCR value indicates that the feed is more efficient and is used well by the fish. The feed conversion value in this study ranged between 2.48 - 2.87 (Figure 3). The range of FCR values is still good. Nurulaisyah *et al*. (2021) stated that the feed conversion value is still considered good if it is less than 3.

Adding 20 ml of turmeric extract to pompano, fish feed gave the best conversion value (FCR), namely 2.48. This result is also supported by specific growth rate analysis, where adding 20 ml of turmeric extract to the feed gives the best results. Melianawati & Sewirya (2010) in Anriyono *et al*. (2018) stated that a lower feed conversion rate indicates that the feed given is more effective for fish growth. Conversely, a higher feed conversion rate indicates that the feed is less effective for growth. The increase in the feeding efficiency value of silver pompano in this study also aligned with the decrease in the feed conversion ratio value. According to Iskandar *et al*. (2017), the feed conversion ratio is the feed needed to produce 1 kg of cultured fish meat. Ardit *et al*. (2015) stated that a lower FCR value indicates that the feed is more efficient and is used well by the fish. The feed conversion value in this study ranged between 2.48 - 2.87 (Figure 3). The range of FCR values is still good. Nurulaisyah *et al*. (2021) stated that the feed conversion value is still considered good if it is less than 3.

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According to Fahrizal & Nasir (2018), the greater the FCR value, the more feed is needed to produce 1 kg of fish meat. In line with the opinion of Fran & Akbar (2013), if the feed conversion rate is low, it means the feed is more efficient, whereas if the feed conversion rate is high, the efficiency of the feed is lower. Feed conversion is closely related to feed quality, so the lower the value, the better the feed quality, and the more efficient the fish use the feed they consume for growth.

The better quality of feed with the addition of turmeric extract further strengthens the suspicion that the increase in fish appetite is triggered by the presence of active substances in

turmeric extract so that it can stimulate the performance of digestive enzymes in absorbing nutrients or food substances so that it can influence fish growth.

Survival rate and water quality

This study's results show that adding turmeric extract to artificial feed with different concentrations does not affect the survival rate (SR) of silver pompano, where the survival rate obtained ranges from 93.33%-100% and is classified as good (Figure 2). According to Simanullang *et al*. (2017), a survival rate of >50% is considered good, and survival of 30-50% while survival of less than 30% is not good

This high survival rate is thought to be supported by the active compounds in the turmeric extract given to the silver pompano feed, such as flavonoids, alkaloids, tannins, terpenoids, and phenols, which function as immunostimulants in fish so that they can increase the fish's endurance during maintenance and can increase appetite and increase fish immunity. According to Suhirman & Winarti (2013), secondary metabolite compounds found in plants have the potential to act as immunostimulants, such as flavonoid compounds, which play a role in improving the body's immune system and can ward off attacks by bacteria, viruses, or other microorganisms. The results of research by Santika *et al.* (2020) show that the addition of turmeric extract showed different results from rearing without any addition, allegedly because the chemical compounds in turmeric extract reacted positively to fish and the fish's immune system increased and fish survival was higher compared to maintenance without treatment.

Therefore, giving turmeric extract up to a turmeric extract concentration of 20 ml/kg feed (P4) in the feed is still considered safe because it does not show symptoms of toxicity to the pompano test animals during maintenance. According to Supriyono *et al*. (2015), signs that fish have died due to toxic forces are characterized by the operculum being wide open and red, the dorsal fin standing straight, bleeding from the gills, gasping (irregular swimming), and when the fish dies, the mouth is wide open (stiff). Prasad *et al*. (2017) stated that the LC50 (Lethal Concentration) value of turmeric rhizome ethanol in Channa punctatus fish was 7.89 mg/l, where this concentration resulted in stunted fish growth and the death of 50% of the total fish population.

Another factor thought to cause the high survival rate of silver pompano in all treatments is the water quality factor during rearing. Heru (2011) stated that water quality is an important factor in fish cultivation and greatly influences survival, reproduction, and growth. The high quality of life shows that the quality and quantity of feed provided is sufficient to meet the basic needs of the star silver pompano seeds. Apart from that, high survival shows that the water quality of the rearing media supports the survival of fish.

The results of water quality measurements during 50 days of raising silver pompano were obtained on average, namely for pH ranging between 7.1-7.4, temperature values ranging between 27-28.2ºC, DO values ranging between 5.5-5.7 mg/l, and salinity values ranging between 32-33 ppt. According to Adekayasa *et al*. (2015), the optimal ranges of pH, temperature, DO, and salinity are, respectively, pH 6.8-8, temperature 27-32˚C, DO 5.0-7.0 mg/l, salinity 32-42 ppt. Thus, the water quality of the silver pompano during rearing in this study was still in the appropriate range for cultivation.

CONCLUSION

The addition of turmeric extract to commercial feed can affect specific growth rate (SGR), feed conversion ratio (FCR), protein retention, and fat retention in silver pompano but

does not affect absolute weight, absolute length, feeding efficiency, and survival (SR) of silver pompano. The addition of 20 ml/kg turmeric extract to commercial silver pompano feed is the best treatment because it can provide a specific growth rate (SGR) of 4.92%, feed conversion ratio (FCR) of 2.48, protein retention of 18.64% and fat retention of 22.37%. This is supported by the content of phenolic compounds in turmeric extract in flavonoids, alkaloids, tannins, terpenoids, and polyphenols.

ACKNOWLEDGEMENT

We want to thank the Lombok Marine Aquaculture Center, Sekotong, West Nusa Tenggara, who have helped provide research facilities and infrastructure. Thanks to the Laboratory of Animal Nutrition and Forage Science, Faculty of Animal Husbandry, Mataram University, as a retention test site.

REFERENCES

Anggitha, I. (2012). Performa Flokulasi Bioflokulan DYT pada Beragam Keasaman dan Kekuatan Ion terhadap Turbiditas Larutan Kaolin. Unpublish. Skripsi. Jakarta: Universitas Pendidikan Indonesia.

Andesra. (2019). Penambahan Ekstrak Kurkumin Kunyit dalam Pakan untuk Meningkatkan Kekebalan Non Spesifik Ikan Jambal Siam (*Pangasius hypopthalmus*) yang Dipelihara dalam Keramba. *Jurnal Perikanan Indonesia*. 3(1), 34-45.

Anriyono, Henky, I., & Wiwin, K.A.P. (2018). Pertumbuhan Benih Ikan Kakap Putih (*Lates calcarifer*) dengan Pemberian Konsentrasi Pakan yang Berbeda. *Jurnal Akuakultur Indonesia*. 2(3), 2-19.

Ardita, N., Agung B., & Siti L.A.S (2015). Pertumbuhan dan Rasio Konversi Pakan Ikan Nila Oreochromis niloticus dengan Penambahan Prebiotik. Bioteknologi. Vol.12 (1): 16-21.

Arifin, P. P., Setiawati, M., Bambang, N., & Utomo, P. (2015). Evaluasi Pemberian Ekstrak Kunyit *Curcuma Longa* Linn. pada Pakan terhadap Biokimia Darah dan Kinerja Pertumbuhan Ikan Gurame Osphronemus gouramy Lacepède, 1801 [Evaluation of The Addition of Turmeric *Curcuma Longa* Linn. Extract In Diet for Biochemical. 16(1), 1–10.

Artini, P., Astuti, K., & Warditiani, N. (2013). Uji Fitokimia Ekstrak Etil Asetat Rimpang Bangle (*Zingiber purpureum* Roxb.). Jurusan Farmasi Fakultas Matematika dan Ilmu Pengetahuan Alam Universitas Udayana, 2(4), 1–7.

Arleston, J., & Manik, R.R.D.S. 2021. Nutrisi dan Pakan Ikan. Widina Bhakti Persada.

Dedi, Hengki, I & Wiwin, K. A., P. (2018). Pengaruh Pemberian Hormon Tiroksin Pada Pakan Pellet Megami terhadap Pertumbuhan Benih Ikan Kerapu Cantang *Epinephelus fuscoguttatus-Lanceolats*. *Intek Akuakultur,* 2 (2), 33-48.

Dewi, R. R. S. P. S. & Thapari. V. (2017). Pemanfaatan Probiotik Komersial pada Pembesaran Ikan Lele (*Clarias gariepinus*). *Jurnal Riset Akuakultur*, 12 (3).

Fahrizal, A., & Nasir, M. (2018). Pengaruh Penambahan Probiotik dengan Konsentrasi Berbeda pada Pakan Terhadap Pertumbuhan dan Rasio Konversi Pakan (FCR) Ikan Nila (*Oreochromis niloticus*). *Median: Jurnal Ilmu Ilmu Eksakta*, 9(1), 69. https://doi.org/10.33506/md.v9i1.310.

Fran, S., & Akbar, J. (2013). Pengaruh Perbedaan Tingkat Protein dan Rasio Protein Pakan terhadap Pertumbuhan Ikan Sepat (*Trichogaster pectoralis*). *Fish Scientiae*, 3(1), 53–63. https://doi.org/10.20527/fs.v3i5.1137.

Febriansyah, R. (2020). Pengaruh Penambahan Serbuk Daun Pepaya (*Carica papaya* L.) pada Pakan untuk Meningkatkan Pertumbuhan Ikan Mas (*Cyprinus carpio*). Universitas Mataram.

Geijer A, Kim SK, Gerloff T, Dietrich CG, Lammert F, & Karpen SJ. 2002. Hepatobiliary organic anion transporters are differentially regulated in acute toxic liver injury induced by carbon tetrachloride. *Journal of Hepatology*, 37(2) 198-205.

Hakim, L. (2013). Rempah dan Herba Kebun Pekarangan Rumah Masyarakat: Keragaman, Sumber Fitofarmaka dan Wisata Kesehatan-Kebugaran. Yogyakarta: Diandra Creative.

Handayani, L. 2017. Penggunaan Esktrak Akar Jeruju Untuk Meningkatkan Laju Pertumbuhan Dan Survival Rate Pada Ikan Patin Djambal (*Pangasius Djambal*). *Sebatik*, 2(1410–3737): 153–157.

Hardianti, Q., Rusliadi, & Mulyadi. (2016). Effect of Feeding Made with Different Composition on Growth and Survival Seeds of Barramundi (*Lates calcarifer*, Bloch). *Jurnal Ilmu Kelautan dan Perikanan*. 2(1), 35-42.

Hartati, S.Y., & Balittro. (2013). Kasiat Kunyit Sebagai Obat Tradisional Dan Manfaat Lainnya. *Jurnal Puslitbang Perkebunan*. 3(19), 5-9.

Harini, B.W., Dwiastuti, R & Wijayanti, C. (2012). Aplikasi Metode Spektrofotometri Visibel untuk Mengukur Kadar Kurkuminoid pada Rimpang Kunyit (*Curcuma domestica*). Prosiding Seminar Nasional Aplikasi Sains & Teknologi (SNAST) Periode III: Yogyakarta. Universitas Sanata Dharma.

Handayani. 2017. Skrining Fitokimia dan Aktivitas Antioksidan Beberapa Fraksi Dari Kulit Batang Jarak (*Ricinus Communis* L.). *Alotrop Jurnal Pendidikan dan Kimia*, 2(1):117-122.

Hariyati, T., Jekti, D. S., & Andayani, Y. 2015. Pengaruh Ekstrak Etanol Daun Jambu Air (*Syzygium Aqueum*) terhadap Bakteri Isolat Klinis. *e-journal Penelitian Pendidikan IPA*. Vol. 1, No. 2, 31 - 38.

Hermawan. T. 2007. Keberhasilan Pembenihan Bawal Bintang Secara Masal. Balai Budidaya Laut Batam. Batam.

Iskandar., Ayu, M., Ibnu, D, B., & Yuli, A. 2017. Suplementasi Probiotik Komersil Pada Pakan Buatan Untuk Induksi Pertumbuhan Ikan Lele Sangkuriang (*Clarias gariepinus*). *Jurnal Perikanan dan Kelautan*, 8: 133-139.

Kadari, M.A. 2005. Pengembangan Usaha Budidaya Bawal Bintang Di Keramba Jaring Apung Melalui Pemberian Pakan Buatan. Balai Budidaya Laut Batam.

Mahmoud MMA, El-Lamie MMM, Dessouki AA, & Yusuf MS. 2014. Effect of turmeric (*Curcuma longa*) supplementation on growth performance, feed utilization, and resistance of nile tilapia (*Oreochromis niloticus*) to *Pseudomonas fluorescens* challenge. *Global Research Journal of Fishery Science and Aquaculture*, 1(12): 26-33.

Marzuqi, M., Astuti, W., & Suwirya, K. (2012). Pengaruh Kadar Protein dan Rasio Pemberian Pakan terhadap Pertumbuhan Ikan Kerapu Macan (*Epinephelus fuscoguttatus*). *Jurnal Ilmu dan Teknologi Kelautan Tropis*. 4(1), 55-65.

Nurulaisyah, A., Dewi, N. S., & Baiq, H. A. (2021). Potensi Pemanfaatan Daun Singkong (*Manihot utilissima*) Terfermentasi sebagai Bahan Baku Pakan untuk Meningkatkan Perttumbuhan Ikan Mas (*Cyprinus carpio*). *Jurnal Perikanan* 11: 13-25.

Nurussakinah. 2010. Skrining Fitokimia dan Uji Aktivitas Antibakteri Ekstrak Kulit Buah Tumbuhan Jengkol (*Pithecellobium jiringa* (Jack) Prain) terhadap Bakteri *Streptococcus mutans*, *Staphylococcus aureus*, dan *Escherichia coli*. Skripsi. Fakultas Farmasi Universitas Sumatera Utara.

Prasad, R., Manoj, K., & Sunil, P.T. (2017). Antigenotoxic Effect of Turmeric Powder Extract Curcumin Against Chromium Trioxide Induced Genotoxicity in Fish *Channa punctatus*. *Journal of Entomology and Zoology Studies*. 5(1), 89-94.

Putri, Ika W, Setiawati, Mia, Jasadi dan Dedi. 2016. Evaluasi pemanfaatan tepung kunyit *Curcuma longa* linn. dalam pakan terhadap enzim pencernaan dan kinerja pertumbuhan ikan mas. Institut Pertanian Bogor.

Putranti G.P., Subandiyono., & Pinandoyo. 2015. Pengaruh Protein Dan Energi Yang Berbeda Pada Pakan Buatan Terhadap Efisiensi Pemanfaatan Pakan Dan Pertumbuhan Ikan Mas (*Cyprinus Carpio*). *Journal Of Aquaculture Management and Technology*, 4 (3): 38-45.

Rahmadani, T. B. C., Dedi J., Mia, S., & Yuni P.H. 2020. Evaluasi penambahan kunyit (*Curcuma longa*) dalam pakan sebagai antioksidan terhadap kinerja pertumbuhan ikan lele *Clarias gariepinus* Burchell 1822 yang dibudidaya tanpa pergantian air. *Jurnal Iktiologi Indonesia* 20(2): 105-115.

Retnani, H.T., & Nurlita. (2013). Pengaruh Salinitas Terhadap Kandungan Protein dan Pertumbuhan Ikan Bawal Bintang *Trachinotus blochii*. Jurnal Biologi. Fakultas Matematika dan Ilmu Pengetahuan Alam. Institut Teknologi Sepuluh November (ITS).

Reanando, R, M. (2019). Pengaruh Metionin Pada Pakan Terhadap Pertumbuhan Dan Kelangsungan Hidup Ikan Bawal Bintang (*Trachinotus Blochii*). Skripsi. Surabaya: Program Studi Budidaya Perairan Jurusan Perikanan Fakultas Pertanian Universitas Sriwijaya.

Robinson, T. 1995. Kandungan Organic Tumbuhan Tinggi. Edisi ke-4 Terjemahan Kosasih Padmawinata. ITB Press. Bandung.

Rojtinnakorn, J., Rittiplang, S, Tongsiri, S, & Chaibu, P. (2012). Turmeric Extract Inducing Growth Biomarker in Sand Goby (*Oxyeleotris mar* moratus). 2nd International Conferenceon Chemical, Biological and Environment Sciences. 7(2), 41-42.

Santika, L., Nanda D., & Baiq H.A. (2020). Pengaruh Penambahan Ekstrak Kunyit Pada Pakan Buatan Terhadap Pertumbuhan Dan Efisiensi Pemanfaatan Pakan Ikan Kakap Putih (*Lates calcarifer*) The Effect of Addition The Turmeric Extract On Pellet Feed To Growth And Feed Utilization Efficiency Of White B. 1–12.

Saputra, I., Wiwin, K. A. P. & Tri, Y. (2018). Tingkat Konversi Dan Efisiensi Pakan Benih Ikan Bawal Bintang (*Trachinotus Blochii*) Dengan Frekuensi Pemberian Berbeda. *Journal Of Aquaculture Science* Vol 3(2), 170-181.

Sarwono., H. Taufan., & M. Imron. (2016). Performa Pemijahan Bawal Bintang *Trachinotus blochii* dengan Perbedaan Perbandingan Jantan dan Betina. *Jurnal Perikanan*, Volume 8. No. 1: 1-7.

Suhirman, S. dan C. Winarti. 2013. Prospek dan Fungsi Tanaman Obat sebagai Imunomodulator. *Jurnal Penelitian*, 121- 122.

Tung BT, Nham DT, Hai NT, & Thu DK. 2019. *Curcuma longa*, the polyphenolic curcumin compound and pharmacological effects on liver (Chapter 3). Dietary Interventions in Liver Disease: Foods, Nutrients and Dietary Supplements. Academic Press. 428 p.

Sidiq, F., & Wardani, W. W. 2014. Aktivitas anti-oksidan dari curcumin dalam mengurangi dampak stres oksidatif pada unggas yang terpapar cekaman panas. *Journal Trouw Add Sci*, (3): 1-3.

Simanullang, D. F. P. (2017). Pengaruh Penambahan Sumber Karbon yang Berbeda Pada Sistem Bioflok terhadap Laju Pertumbuhan dan Kelulushidupan Ikan Nila Merah (*Oreochromis niloticus*). Skripsi. Jurusan Budidaya Perairan. Fakultas Perikanan dan Kelautan. Universitas Riau.

Sirait, M. 2007. Penuntun Fitokimia dalam Farmasi. Institut Teknologi Bandung: Bandung.

Susanti. N. M., Sukendi & Syafriadiman. (2016). Efektivitas Pemberian Hormon Tiroksin (T4) terhadap Pertumbuhan Ikan Pawas (*Osteochillus hasselti* CV). *Jurnal perikanan dan keluatan*. Vol. 21 (2).

Supriyono, E., Masak, P.R.P., Naiborhu, & P.E. (2015). Studi Toksisitas Insektisida Triklorfon terhadap Ikan Nila (*Oreochromis* sp.). *Jurnal Akuakultur Indonesia*. 4(2), 163-170.

Syarifah, Z.Z. 2006. Potensi Imunomodulator Bubuk Kakao Bebas Lemak Sebagai Produk Substandar Secara Invitro pada Sel Limfosit Manusia. Skripsi. Institut Pertanian Bogor.

Shukla PK, Khanna VK, Khan MY, & Srimal RC. 2003. Protective effect of curcumin against lead neurotoxicity in rat. *Human & Experimental Toxicology*, 22(12): 653-668.

Wahyuningtyas, S.E.P., & Sri, W. (2017). Pengaruh Jenis Pelarut T terhadap Kandungan Senyawa Kurkumin dan Aktivitas Antioksidan Ekstrak Kunyit (*Curcuma domestica* Val.). *Jurnal ITEPA*. 6(2), 61-70.

Winaldi, A. (2017). Tingkat Retensi Protein dan Lemak Udang Vannamei *Litopenaeus Vannamei* Yang Diberi Pakan Dengan Kadar Silase Limbah Sayur Yang Berbeda. Skripsi Makassar: Program Studi Budidaya Perairan Fakultas Pertanian Universitas Muhammadiyah Makassar.

Windarto, S., Hastuti, S., Subandiyono, S., Nugroho, R. A., & Sarjito, S. (2019). Performa Pertumbuhan Ikan Kakap Putih (*Lates Calcarifer* Bloch, 1790) Yang Dibudidayakan Dengan Sistem Keramba Jaring Apung (KJA). *Sains Akuakultur Tropis*, 3(1), 56–60. Https://Doi.Org/10.14710/Sat.V3i1.419.

Yandra, E., Usman, M., T., & Hennill, L., S. (2020) Elfektivitas pemberian hormon tiroksin (T4) dan photoperiode terhadap petumbuan ikan baung. *Jurnal Ruaya*. vol. 8 (2).

Zhang, Q.W., Lin, L.G., & Ye, W.C. 2018. Techniques for extraction and isolation of natural products: a comprehensive review. Chinese Medicine 13:20- 20. DOI:10.1186/s13020-018-0177-x.