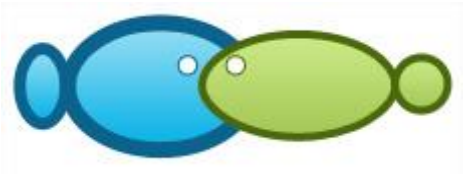

The quality of artificial feed test by adding thyroxine hormones on the growth of selais fish *Kryptopterus lais* (Bleeker, 1851)

[1]Efrizal, [1]Sri Rahmi Andre, [1]Amelia Sriwahyuni Lubis, [2]Mas Eriza

[1] Department of Biology, Faculty of Math and Science, Andalas University, Kampus Unand Limau Manis, Padang, 25163, West Sumatera, Indonesia; [2] Department of Aquaculture, Faculty of Fisheries and Marine Science, Bung Hatta University, Padang, 25133, West Sumatera, Indonesia. Corresponding author: Efrizal, efrizal@sci.unand.ac.id

Abstract. Selais fish (*Kryptopterus lais*) is a freshwater fish that has high economic value and a high market demand. This species production comes from fishing, and this can cause a decrease in stocks in natural habitats. Artificial feed usage in selais cultivation is still an obstacle and also there is a lack of information in relation to the nutritonal needs of the species. Dedicated feed for selais fish is not yet available on the market, because the information about the feeding habits of the species is limited. The hormonal manipulation techniques are used to improve the quality of production for some freshwater fish. Hormones that are known to have a positive effect on fish growth are thyroxine (T4) and growth hormone. The aim of this research is to study the quality of feed in increasing fish growth by adding thyroxine hormone. The method of this research is experimental with Completely Randomized Design (CRD), 4 treatments and 4 replications. Four dosses of thyroxine hormone are used as control (A), 0,04 mg/kg (B), 0,06 mg/kg (C), and 0,08 mg/kg (D). The organoleptic test showed that the addition of thyroxine hormone with different doses resulted in the same feed quality and physical test showed that the addition of thyroxine hormone to artificial feed with different doses resulted in different feed quality. The results of the proximate analysis showed that the nutritional content of the test feed was within the range of the requirement of selais fish. The addition of the thyroxine hormone with various doses in artificial feed did not significantly affect the growth in weight and length of the selais fish.
Key Words: biology test, chemical, feed, organoleptic, physical.

Introduction. Selais fish (*Kryptopterus lais*) is a freshwater fish that has high economic value. Selais fish is a very popular fish and is much sought after by fishermen because besides being consumed, this fish also has ornamental value. High demand is accompanied by increased fishing activity for these fish (Nurmayani et al 2020; Thamrin 2020). This situation is feared to cause the fish population to decrease and become extinct. One of the efforts to maintain this fish population is cultivation, in addition to reducing the intensity of fishing in natural waters, aquaculture activities can also increase the production of fish with good quality (Arisuryanti et al 2020; Leksono et al 2020).

The only means for selais production is fishing the species natural habitats and this can affect the existing stocks. It is necessary to carry out fish farming activities in order for the species natural stocks to be preserved (Larasati et al 2018; Zhou et al 2015). Cultivation activities for selais fish are still around the stage of fish rearing. The more these activities are carried out, it is necessary to make some efforts to increase the production in the fish farming sector. The use of hormonal manipulation techniques is one of the efforts in aquaculture to improve the quality of production for some freshwater fish, including selais fish. Hormones that are known to have a positive effect on fish growth are thyroxine (T4) and growth hormone (Hoga et al 2018; Mylonas et al 2017). According to Deal and Volkoff (2020), thyroxine hormone can increase fish growth rate by increasing metabolic rate, feed efficiency and protein retention.

The problems that are often encountered in cultivation are the high mortality rate in eggs, larvae and seeds phase which are around 50-70%, and the slow growth rate. Nowdays, selais fish cultivation started to develop, however, the application of giving artificial feed in selais cultivation fish still becomes an obstacles in selais fish cultivation and also available information is lacking in relation to nutritonal need of fish (Sukendi et al 2021; Zakaria et al 2022b). Meanwhile, the increases in production can be achieved by increasing the growth of fish and fish feed efficiency, and in this case a feed with the nutritional content that suits the nutritional needs of the species is required (Efrizal 2017; Lubis et al 2021). The nutritional value of fish feed is generally seen from the nutritional content such as protein, fat, carbohydrates, vitamins, and minerals (Efrizal et al 2019; Efrizal et al 2019; Lubis et al 2021). Based on this, it is necessary to study the quality of feed in increasing fish growth by adding thyroxine hormone based on organoleptic, physical, chemical, and biological tests.

Material and Method

Research location and period. This research was carried out from June to October 2021. Physical and organoleptic tests were carried out at the Bungus Fish Seed Center, Bungus Timur Village, Bungus Teluk Kabung District, Padang, West Sumatra, Indonesia. Feed chemistry data was analyzed at the Chemical Basic Laboratory of Bung Hatta University, Padang, West Sumatra, Indonesia.

Research design. This study used an experimental method with Completely Randomized Design (CRD), which consisted of 4 treatments with 4 replications. The four treatments used are: A = artificial feed without thyroxine hormone (control), B = artificial feed with thyroxine hormone 0.04 mg/kg feed, C = artificial feed with thyroxine hormone 0.06 mg/kg feed and D = artificial feed with thyroxine hormone 0.08 mg/kg feed.

Research procedure. The manufacture of fish feed in this study refers to the method used by Aslamyah and Karim (2013), Efrizal et al (2019) and Lubis et al (2021). The composition of feed raw materials is fish meal, soybean meal, wheat flour, corn flour, fish oil, coconut oil, vitamin and mineral mix. The composition of the feed was made based on a modified study by Adelina et al (2012). The composition of the raw materials is complemented with thyroxine hormone and mixed until homogeneous. The thyroxine hormone used is the commercial thyroid hormone thyroxine, Thyrax Thyroxine, with a content of 100 mcg or the equivalent of 0.1 mg of thyroxine.

Sixteen tanks of 1x1x1 m per tank were used. The fish were first acclimatized and fasted for 24 hours. Before carrying out the experiment, the fish were weighed and their length was measured. Feed was given 2 times a day in the morning at 08.00 AM and in the afternoon at 06.00 PM. Feed was administred using a dose of 5% of the biomass.

Research parameters. Organoleptic testing was conducted for the texture, aroma, and color of the feed. Feed texture can be seen from the surface of the feed which is smooth, fibrous or hollow. The aroma of the feed is determined by categorising as not stinging, quite stinging, stinging, and very stinging. The color of the feed depends on the type of raw material used (Lubis et al 2021).

Feed chemistry test includes determining the quantity and quality of nutrients in the feed. These nutrients were obtained by the proximate method to measure protein, fat, ash, water, crude fiber and NFE in the test feed (Aslamyah & Karim 2013).

Physical testing includes the stability of the feed in water, the level of hardness, sinking speed, allure and deliciousness of the feed. This test refers to the experiment of Efrizal et al (2019). The stability test in water is a test of the level of resistance of the feed in the water or the time it takes for the feed to become soft and crumble. Feed stability in water also includes breaking speed and solid dispersion. The hardness test of the feed is measured to determine the hardness level of the test feed. Sinking speed test is to observe the time it takes the feed to reach the bottom of the water column. This is needed to determine whether the feed is in the sinking or floating category. The allure

test was carried out to determine the time required for fish to approach or consume the test feed. The feed delicacy test was carried out by measuring the amount of feed consumed in relation to the body weight of the fish.

Feed biology test was conducted to observe the feed on the biological growth of fish. Parameters measured to determine the biological value of feed were absolute length, relative length, absolute weight and relative weight (Lozano et al 2017).

Statistical analysis. Organoleptic and chemical feed data were analyzed descriptively based on the results of observations and laboratory tests. The results are described using the related references. The physical and biological values of the feed were analyzed using one way ANOVA with a significance level of 0.05 to analyze the effect of treatment on the test parameters. If the treatment has a significant effect, then we proceeded with the Duncan test to determine the differences between the treatments.

Results. The results of the organoleptic test of each treatment had the same criteria for feed texture. This feed has a good texture in all treatments (Table 1). This indicates that the addition of the thyroxine hormone to the artificial feed did not affect the appearance of the texture of the test feed. The aroma parameter in the organoleptic test of feed also showed the same criteria in the feed test. This feed has quite a pungent aroma and has a distinctive odor. Color test on the organoleptic feed showed the same results between all feed tests, which showed the brown color. Based on the color criteria, the feed showed that the use of thyroxine hormone with different doses between treatments did not have a different effect on the color of the artificial feed produced (Table 1).

Table 1

Organoleptic data of feed test by adding thyroxine hormones on the growth of selais fish (*Kryptopterus lais*)

Parameters of the test	*Treatments*			
	A	*B*	*C*	*D*
Texture	Smooth	Smooth	Smooth	Smooth
Aroma	Quite pungent	Quite pungent	Quite pungent	Quite pungent
Color	Brown	Brown	Brown	Brown

The results of chemical testing using the proximate method on the test feed is presented in Table 2. The results show that the nutritional composition of the test feed contains a percentage that is quite balanced with the needs of the fish. The value of water content in the test feed was 8.16%, the ash content value was 17.20%, the fat content value was 9.05%, the protein content obtained was 34.31%, the crude fiber test obtained were 7.80% and carbohydrate values were 23.48%.

Table 2

Chemical data of feed test by adding thyroxine hormones on the growth of selais fish (*Kryptopterus lais*)

Composition (%)	*Content (%)*
Water	8.16
Ash	17.20
Fat	9.05
Protein	34.31
Crude Fiber	7.80
Carbohydrate	23.48

After being reared for 30 days, data on the average weight and length gain of selais fish were obtained for feeds with different doses of the thyroxine hormone (Table 3). The addition of thyroxine hormone with different doses in artificial feed can increase the

growth of selais fish body weight. However, the statistical results of the ANOVA test showed that the growth in weight and length had no significant effect.

Table 3

Physical and biological data of feed test by adding thyroxine hormones on the growth of selais fish (*Kryptopterus lais*)

Parameters of the test	*Treatments*			
	A	*B*	*C*	*D*
Physical test				
Stability of the feed				
Breaking speed (minutes)	70.60±3.72^{a}	68.80±4.85^{a}	66.60±2.14^{a}	64.60±1.82^{a}
Solid dispersion (%)	17.02±1.37^{a}	17.60±0.95^{a}	19.32±1.77^{ab}	22.02±0.39^{b}
Level of hardness (%)	94.96±0.44^{b}	94.02±0.39^{ab}	93.72±0.22^{a}	93.28±0.52^{a}
Sinking speed (cm^{-s})	1.64±0.12^{a}	1.93±0.12^{a}	1.81±0.03^{a}	1.79±0.16^{a}
Allure (cm^{-s})	0.39±0.02^{a}	0.55±0.06^{b}	0.58±0.03^{b}	0.62±0.05^{b}
Deliciousness (g/weight/days)	0.452±0.098^{a}	0.235±0.049^{a}	0.450±0.234^{a}	0.330±0.078^{a}
Biological test				
Absolute length	2.14±0.30^{a}	0.25±0.04^{a}	0.38±0.09^{a}	0.033±0.01^{a}
Relative length	4.13±1.36^{a}	0.44±0.15^{a}	0.55±0.18^{a}	0.047±0.02^{a}
Absolute weight	3.99±0.37^{a}	0.41±0.07^{a}	0.63±0.18^{a}	0.056±0.02^{a}
Relative weight	3.82±0,33^{a}	0.40±0.06^{a}	0.33±0.05^{a}	0.028±0.01^{a}

Discussion. Fine-textured feed indicates good feed raw materials in good levels, so that the feed is mixed evenly. Sørensen (2012) stated that the level of fineness of raw materials will affect the compactness and evenness at the time of mixing. Good feed pellets have a compact texture and are fine and similar in particle size of raw materials. There was no difference in aroma in each test feed in this treatment, and it was suspected that the thyroxine hormone had no effect on the composition of the feed. The type and amount of attractant added to the feed manufacturing process will affect the aroma produced. Aroma affects the quality of synthetic feed because it is closely related to fish acceptance. Distinctive aroma such as natural feed in artificial feed is very liked by fish and can increase fish appetite (Gao et al 2020; Ogunkalu 2020). The color of the feed is very dependent on the type of raw material used. High protein in the raw material used will produce a brown color in the material. This is called the Maillard reaction or non-enzymatic browning, lipid oxidation and the interaction between amino acids and lipid oxidation products (Gao et al 2020; Saleela et al 2015).

Excessive water content in the feed will reduce the durability of the feed. Feed will be affected quickly due to overgrown fungus and the nutritional content decreases (Verma et al 2020; Yu et al 2017). Ash content is produced from completely dry raw materials. The ash content in the feed is an indicator of the magnitude of the mineral content in the feed. The ash content value will indicate the inorganic material content in the feed. Inorganic materials in the material vary greatly in both type and amount. The content of inorganic materials contained in a material include calcium, potassium, phosphorus, iron, magnesium, and others (Bulbul et al 2015; Lubis et al 2021).

Limited fat can be used to replace the role of protein as a source of energy in the maintenance of the body. Thus, protein will be used more as a source of energy for growth. Fat has low carbohydrate enzyme activity in the digestive tract. Fat is also a source of essential fatty acids and a solvent for several micro-nutrients. Fat is also needed to maintain the shape and function of phospholipids, it assists the absorption of fat-soluble vitamins and maintains feed buoyancy (Efrizal et al 2019; Zakaria et al 2022a). Optimum protein levels in feed for fish growth ranged from 25-50%. Protein content can increase the growth of fish. Feeds with low protein content will reduce

growth rates, imperfect reproductive development and fish become susceptible to contracting diseases (Daniel 2017; Pattipeilohy et al 2020).

Crude fiber is needed in fish feed for the digestion of food. Feeds that have a high crude fiber content can experience a decrease in food absorption performance so that fish weight gain will decrease. Crude fiber can also provide a feeling of fullness because there is a composition of complex carbohydrates that stop appetite naturally (Ofosu et al 2015; Sun et al 2019). Fish can utilize carbohydrates as a source of metabolic energy, saving the use of protein and fat to support growth (Krogdahl et al 2005; Pandey 2013).

Increasing the dose of hormones does not cause weight gain to be high because hormones can not only accelerate growth but can also inhibit growth. The addition of hormones with high levels for a long time and continuously can affect the regulation of the body's metabolic rate which will cause a buildup of its concentration in the blood (Hoga et al 2018; Adiputra et al 2020; Sukendi et al 2021). From the four treatments, it was found that the addition of the dose of the thyroxine hormone did not have a significant effect on increasing growth, and it was suspected that the utilization of food that had been digested by the fish was used more for the metabolic purposes of its own cells than for the growth of the fish itself (Heraedi et al 2018; Alang et al 2020).

This caused the growth of fish treated with hormones to not differ from that of control fish. The use of the thyroxine hormone does not have a positive effect on fish growth due to metabolic abnormalities caused by high levels of thyroxine in the fish body, so that the utilization of food for growth is reduced (Abdollahpour et al 2018, 2019). The feed in treatment C (0.06 mg/kg) showed a higher length gain, it was suspected that the test fish could utilize feed containing the hormone thyroxine properly for growth and accelerate metabolic processes. Sukendi et al (2021), stated that the thyroxine hormone can stimulate the rate of oxidation of foodstuffs, increase the rate of oxygen consumption, increase growth, and accelerate the process of metamorphosis.

The growth of body weight is caused by the protein contained in the feed according to the needs of the fish. The balance of protein in the feed is not only used for the fishes activity, the excess is also used for growth (Lubis et al 2021; Zakaria et al 2022a). The food or energy needed by fish is used to maintain body function and movement, then the rest will be used for growth. This is in accordance with the statement of Abdalbakee and Mohammed (2019), that the protein in the feed will be used for combustion energy if the energy obtained from other sources than protein is insufficient.

The longer period of time in feeding of selais fish in each treatment during the study showed a fairly clear effect on increasing the average weight of the fish, this was due to one of the functions of the thyroxine hormone which had an effect on metabolic processes and increased the growth rate of the test fish (Abdollahpour et al 2018; Adiputra et al 2020). Thyroxine hormone can increase protease and lipase activity in the digestive tract, thus it can increase protein and fat metabolism in the body. Giving hormones added to feed can affect the body's metabolism, causing fish to be more active in taking feed. The higher the appetite, the growth rate will also increase (Abdollahpour et al 2019).

Conclusions. Based on organoleptic test, it was showed that the addition of thyroxine hormone with different doses resulted in the same feed quality and physical test showed that the addition of thyroxine hormone to artificial feed with different doses resulted in different feed quality. The results of the proximate analysis showed that the nutritional content of the test feed was within the range of the requirement of selais fish (*Kryptopterus lais*). The addition of the thyroxine hormone with various doses in artificial feed did not significantly affect the growth in weight and length of the selais fish.

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Conflict of interest. The authors declare that there is no conflict of interest.

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Authors:
Efrizal, Departement of Biology, Faculty of Math and Science, Andalas University, Kampus Unand Limau Manis, Padang, 25163, West Sumatera, Indonesia, e-mail: efrizal@sci.unand.ac.id
Sri Rahmi Andre, Departement of Biology, Faculty of Math and Science, Andalas University, Kampus Unand Limau Manis, Padang, 25163, West Sumatera, Indonesia, e-mail: andresri@gmail.com
Amelia Sriwahyuni Lubis, Departement of Biology, Faculty of Math and Science, Andalas University, Kampus Unand Limau Manis, Padang, 25163, West Sumatera, Indonesia, e-mail: amelialubis6@gmail.com
Mas Eriza, Department of Aquaculture, Faculty of Fisheries and Marine Science, Bung Hatta University, Padang, 25133, West Sumatera, Indonesia, e-mail: bdp@bunghatta.ac.id

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