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Effects of chromium-contained feed on growth and its deposition in meat of cantang grouper (*Epinephelus Fuscoguttatus-Lanceolatus*)

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Abstract
This study aims to look at how chromium-organic fish feed affects the growth performance of the grouper fish and its deposition on the flesh of the grouper fish. According to experts, organic chromium affects the performance of the hormone insulin which plays a role in carbohydrate metabolism. Fish maintenance has been carried out in the Brackish Aquaculture Fisheries Center (BPBAP) Situbondo, East Java. The content test on the grouper bush meat was conducted at the Central Laboratory of Padjadjaran University, Jatinangor. The Situbondo Research Institute for Sea Fish Cultivation in January 2020-March 2020, this research was conducted experimentally using the Completely Randomized Design (RAL) research method. This study consisted of four different chromium dosage treatments and each treatment was repeated three times. There are 15 fish used in each aquarium with 42 days of maintenance time. The treatments used are as follows: Feed with the addition of chromium-yeast 0.0 mg / kg (control = A). Feed with the addition of chromium-yeast 3.1 mg/kg (B). Feed with the addition of chromium-yeast 3.9 mg/kg (C). The addition of chromium-yeast by 3.9 mg/kg of feed produced a survival rate (100%), daily growth rate (0.31 g/day), and the best utilization of feed (68.65%) among all treatments.

Keywords: carbohydrate metabolism, chromium content in fish meat, grouper juvenile, organic chromium

1. Introduction
Grouper fish is Indonesia's leading export fishery commodity and has high economic value in the local and international markets. Grouper fish has several species including the duck grouper or mouse grouper, tiger grouper, tiger grouper, kertang grouper, and hybridized grouper (Hijriyati 2012). One of the most popular hybrid groupers is the catfish (*Epinephelus fuscoguttatus-lanceolatus*). Cantang grouper is a hybrid grouper produced from a cross between tiger grouper (*Epinephelus fuscoguttatus*) and kertang grouper (*Epinephelus lanceolatus*) [1]
Cantang grouper fish is a type of fish that has a high enough selling price. The price of a living grouper living in The Pangandaran Regency in 2019 consumes IDR 95,000 / kg. The development of the grouper market encourages the community to meet the demand for the grouper fish abstruse through aquaculture. This makes the grouper fish farming continue to increase and become a promising business opportunity.
Groupers are carnivorous and like feed with high protein content. Grouper feed containing 40% - 50% protein will provide maximum growth to the development of fish life but protein is a fairly expensive feed nutrient [2]. For protein efficiency, it is necessary to look for cheap energy sources such as carbohydrates [3].
The use of carbohydrates as an energy source can support the maximum use of protein for growth [4]. In general, fish are less able to utilize carbohydrates in feed. The ability to utilize carbohydrates in the feed of each fish species is different. Omnivorous and herbivorous fish can utilize carbohydrates by 30 - 40%, while carnivorous fish such as abstraction groupers can only use carbohydrates by 10 - 20%. This difference is caused by the ability of fish digestive organs to digest feed carbohydrates, insulin performance capacity, and the number of insulin active receptors in different fish [5].
Insulin in the fish's body functions to transfer glucose into cells. The cells will convert glucose into energy. Potential for insulin performance can be increased by chromodulin through increased insulin receptor sensitivity. Chromodulin is an oligopeptide that is important in the normal metabolism of carbohydrates and lipids, containing trivalent chromium (Cr + 3) [5]. Economical sources of chromium are chromium chloride, chromium-yeast, chromium nicotinic, and chromium picolinate [6]**.** Found that the addition of chromium-yeast in feed can increase the growth and immune response of Humpback grouper (Cromileptes altivelis) [7].
The aim of this study was to see how the chromium-organic fish feed affected the growth performance of the grouper fish and its deposition on the flesh of the grouper fish.

2. Materials and Methods
2.1 Time and Place of Research
This research was conducted from February to June 2020. Maintenance of fish and chromium-yeast feed production was carried out at the Brackish Aquaculture Fisheries Center (BPBAP) Situbondo, East Java. The content test on the fish of the grouper abstraction was carried out at the Central Laboratory of Universitas Padjadjaran, Jatinangor

2.2. Materials
Containers for fish maintenance amounted to 12 boxes, analytical scales, aeration hose, aeration stone, and ballast,

water hose, thermometer, DO, pH meter, refractometer, plastic. Plastic, stationery, documentation tools, Atomic Absorption Spectrophotometric.

The materials being studied is a Cantang Grouper juvenile from BPBAP Situbondo, measuring 6 cm as many as 180 individuals. The test feed used was "O" EP-3, chromium-yeast used was "C GTF", feed adhesive.

This research was conducted experimentally using a Completely Randomized Design (CRD). This study consisted of four chromium dose treatments and three replications. There were 15 fish used in each aquarium for 42 days. The treatments used are as follows:

a. Feed with the addition of chromium-yeast 00 mg/kg (control)
b. Feed with the addition of chromium-yeast 3, 1 mg/kg
c. Feed with the addition of chromium-yeast 39 mg/kg
d. Feed with the addition of chromium-yeast 46 mg/kg

The parameters observed were survival rate, daily growth rate, and feed utilization efficiency, chromium content in fish meat, and water quality.

Testing the effect of each treatment data was tested using Analysis of Variance (ANOVA). If there are differences between treatments, further tests are performed using Duncan's multiple range test with a confidence level of 95% [8].

3. Results and Discussion

3.1 Survival Rate

Survival rate (SR) is one of the parameters to determine the ability of an organism to maintain its life during a certain maintenance period in a culture container. The value of the survival rate of the grouper fish during maintenance showed the same results in each treatment with a value of 100%. The graph of the value of the survival rate of grouper fish during the study can be seen in Figure 4.

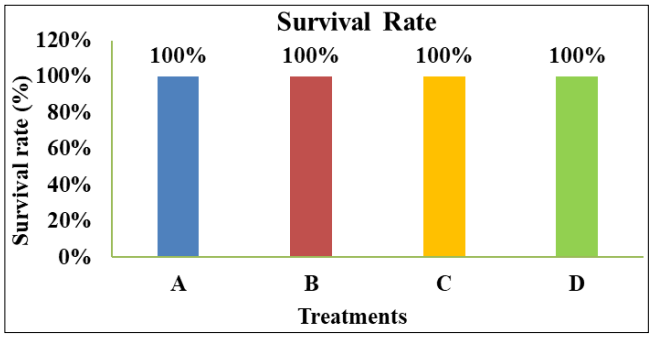

Fig 4: The Value of Survival rate

The value of the survival rate of the cantang grouper fish does not indicate a difference between treatments. This is due to chromium content in feed during the study in a range that can still be tolerated by fish. The high value of the survival rate of the grouper fish juvenile is thought to be due to the influence of chromium content in the feed which can increase the body's resistance of the fish grouper. This is in line with the research of Suprayudi *et al*. (2006) where the administration of chromium-yeast as much as 1.5 ppm in the test feed gives the best results in increasing the immunity response of Humpback grouper (Cromileptes altivelis) [7].

One of the hallmarks of the Cantang grouper is the ability of fish to adapt to their environment [9]. States that hybridization can cause heterozygosity that can strengthen the endurance of an individual [10]. This causes the grouper fish to be resistant to disease and environmental changes, so that it can produce high survival rates [11].

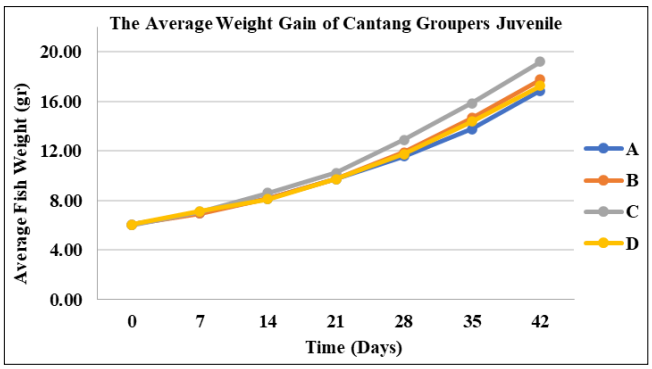

Fig 5: Average Weight Gain of Cantang Grouper Juvenile

Cantang grouper juvenile have increased weight during the maintenance period. The average weight of individual juvenile grouper at the beginning of the maintenance period ranged from 6.03 to 6.08 grams, while at the end of the study ranged from 16.53 to 19.27 grams (Appendix 3). The results of the observation showed that the weight of the cantang grouper fish in treatment C, namely feed with the addition of chromium-yeast by 3.9 mg/kg produced the highest average weight of 19.27 grams.

The average daily growth rate of each treatment is treatment A (chromium-yeast 0.0 mg/kg or control) of 0.26 g / day, treatment B (chromium-yeast 3.1 mg/kg) of 0.28 g / day, treatment C (chromium-yeast 3.9 mg/kg) of 0.31 g/day, and treatment D (kromium-yeast 4.6 mg / kg) of 0.27 g/day.

The results of the daily growth rate calculation were then analyzed using analysis of variance and showed that the addition of chromium-yeast to the feed gave a significant difference to the daily growth rate of the grouper juvenile. These results are followed by Duncan's multiple range test. Based on Duncan's multiple range test results the addition of chromium-yeast treatment of 3.9 mg/kg produces the highest daily growth rate, where the treatment is significantly different from other treatments. Daily growth rate values of treatment B and D were not significantly different from the control treatment.

Table 2: Growth rate of each treatment

Treatment	Average Daily Growth Rate (g / day)
A (control)	0.26^{a}
B (chromium-yeast 3.1 mg/kg)	0.28^{b}
C (chromium-yeast 3.9 mg/kg)	0.31^{c}
D (chromium-yeast 4.6 mg/kg)	0.27^{b}

Information: The value followed by a lowercase letter same shows different based on Duncan's Multiple Range Test at the level of trust is 95%.

Based on Table 2 the addition of chromium-yeast in feed produced a better daily growth rate of the humpback grouper juvenile compared to the treatment without the addition of chromium-yeast (control). The content of organic chromium (Cr + 3) in feed gives different results to the average daily growth rate. This phenomenon is related to the ability of Cr + 3, especially in the form of chromium-yeast, in increasing the potential for insulin performance [12]. Chromium contained in feed increases insulin performance

through GTF. Increased insulin activity in the blood accelerates the introduction of blood glucose into target cells. Glucose in the blood can be immediately used as an energy source to meet the energy needs of metabolism, resulting in savings in protein feed. Feed protein will be used for body protein synthesis,

The results showed the highest daily growth rate was generated by treatment C, which is 032 g / day (Appendix 5). The high value of daily growth rate in treatment C is due to the influence of the chromium content found in feed. Chromium in treatment C is in the right amount range so that it can function optimally. This is in line with the statement of Subandiyono *et al*. (2004) that chromium supplementation in the form of chromium-yeast into the feed to a certain optimal level, can increase feed efficiency and daily growth rate of fish [13]. Wahyudi's research (2013) shows that the treatment of adding Cr + 3 of 3.9 ppm to feed gives the best growth rate results for tiger grouper fish [14].

Fish in treatment C (chromium-yeast 3)9 mg/kg) yields a better daily growth rate than control and other treatments. A high daily growth rate is influenced by optimal chromium levels in feed [15]. Chromium in feed at a certain amount plays an important role in regulating insulin activity. States that the presence of chromium insulin activity through GTF becomes more effective. Increased insulin activity causes blood glucose to be more quickly utilized by cells as an energy source. An increase in the energy supply from carbohydrates results in increased energy allocation for growth, so that the growth of the grouper fish juvenile in C treatment is faster than the control treatment or other treatments [13].

Organic chromium provides a different biological response to the daily growth rate of each treatment. This difference occurs due to the addition of different chromium content in the feed given is related to the role of chromium in optimizing the use of carbohydrates as an energy source. As with other essential microminerals, the disadvantages or advantages of organic chromium beyond their optimal requirements will reduce the biological function of insulin [13]. This is evidenced by the results of the daily growth rate of fish in treatment B (chromium-yeast 3.1 mg/kg) and treatment D (chromium-yeast 4.6 mg/kg) which is lower than the treatment C (chromium-yeast 3, 9 mg/kg).

The fish in treatment B had a higher daily growth rate value compared to the control treatment but were lower compared with treatment C. This is suspected because the chromium content in the feed is quite low, so the biological function of chromium decreases which causes the low activity of insulin. Low levels of chromium in feed can cause the flow of glucose into target cells to be disrupted, so that the availability of energy and carbohydrates to meet metabolic needs becomes inadequate [15]. The reduced availability of energy from carbohydrates causes the growth rate of fish is low.

In addition to treatment B, fish in treatment D also have low growth rate values. The greater chromium content compared to other treatments does not produce a better daily growth rate. High levels of chromium make insulin performance capacity reach maximum levels. Increased absorption of glucose supply into the bloodstream is not matched by its utilization in cells. This resulted in a decrease in the function of chromium biology. Provision of high chromium content in feed can cause interference with the metabolic system of the fish's body [16]. In addition, chromium content in feed that is too high can also suppress the function of various other minerals in the digestive tract, so that protein synthesis and growth rates are low [15]. Chromium (Cr) is classified in essential micro minerals. Physiologically the main role of Cr is related to glucose metabolism, which is to increase the potential for insulin activity. Chromium is an important component of GTF (Glucose Tolerance Factor) [17]. GTF is a water-soluble component of liver, blood plasma, brewer's yeast, and several biological and cell extracts. GTF containing Cr has the potential to increase insulin bioactivity by two times in transferring glucose to cells, glycogenesis, lipogenesis, transport, and amino acid intake [6].

3.2 Chromium in Fish Meat

The chromium content in the feed consumed by grouper juvenile accumulates in the body of the fish. Heavy metals such as chromium accumulate in fish body tissues, namely the gills, liver, and fish flesh [18]. The body tissues of the fish that were tested for chromium content in this study were part of the meat. The results of testing the chromium content in fish meat is used to determine whether or not the research fish is suitable for consumption by humans. Fish that contain heavy metals exceed the human consumption threshold when consumed will potentially cause various diseases both in the short and long term [19]. The results of chromium content in fish meat for each treatment can be seen in Table 4.

Table 4: Chromium content in fish meat per treatment

Treatment	Chromium (mg/kg)
B (Yeast Cr 3.1 mg/kg)	0.2871
C (Yeast Cr 3.9 mg/kg)	0.3694
D (Yeast Cr 4,6 mg/kg)	0.3694

Based on Table 4 it can be seen that the amount of chromium accumulation in fish meat increases with the increasing amount of chromium contained in fish feed. The lowest chromium content in fish meat was in treatment B that was 0.2871 mg/kg and the highest in treatment D was 0.4412 mg/kg. The higher the amount of chromium added to the feed, the higher the amount of chromium that accumulates in fish meat. This is in line with the research of Yanto *et al*. (2017), which is that the chromium content in the flesh of blackfish continues to increase along with the increasing amount of chromium added to the feed given [15].

The maximum limit of metal contamination in food is based on the Directorate General of POM No. 03725 / B / SK / 89 is 2.5 mg/kg. The amount of chromium content in fish meat has not exceeded the threshold for human consumption. This is also similar to the Food and Drug Administration provisions regarding metal contamination in food where the maximum permissible level of chromium metal content is 1 mg/kg. Based on the two provisions, it can be concluded that the fish produced in each treatment are still below the threshold and are safe for human consumption. The chromium contained in the feed is already in an organic form so it is safe for consumption by humans. States that chromium with a three-dimensional (Cr + 3) is not toxic if consumed within reasonable limits [17].

3.3 Water quality

Water quality of aquaculture media influences the process of grouper metabolic activities [20]. Water quality parameters

measured in this study include temperature, degree of acidity (pH), Dissolve Oxygen (DO), and salinity. Water quality parameter measurements were carried out 6 times in a span of 7 days in 42 days of rearing fish. The results of the measurement of water quality parameters can be seen in Table.

Table 5: Parameters of Water Quality

Treatment	Parameters			
	Temperature (oC)	pH	DO (mg / L)	Salinity (ppt)
A (Yeast Cr- 0.0 mg / kg)	30 - 31	7.7 - 8.1	5.2 - 5.8	32-33
B (Yeast Cr 3.1 mg / kg)	29 - 31	7.7 - 8.1	5.2 - 5.8	32-33
C (Yeast Cr 3.9 mg / kg)	29-30	7.7 - 8.1	5.2 - 5.6	31-33
D (Yeast Cr 4,6 mg / kg)	29 - 31	7.5 - 8.1	5,3 - 5,8	31-33
Normal range	28 - 32	7.5 - 8.5	$\geq$ 4	28 - 33

Water temperature during the study ranged from 29 - 31ºC. The temperature value of each treatment is in the normal range for the grouper bush cultivation. This is in accordance with SNI 8036.2: 2014. which sets the optimal temperature requirements for the production of grouper juvenile in a tub that ranges from 28 - 32ºC. Water temperature plays an important role in regulating activity, growth, and influencing the digestion process of fish food [21]. High and low temperatures will affect the response of fish to feed [22]. The optimum temperature of maintenance media will cause active fish to eat their food. The temperature of the maintenance media also affects the metabolism of fish. Metabolism in fish bodies will increase with increasing environmental temperature [23].

Temperature value is related to dissolved oxygen value in water maintenance media. The higher the temperature of the water, the lower the value of dissolved oxygen in water, and conversely the lower the temperature of the water, the higher the value of dissolved oxygen in water [24]. Dissolved oxygen plays a role in the metabolic process of fish's body; therefore, the lack of dissolved oxygen will threaten fish's life. Dissolved oxygen values in the study ranged from 5.2 to 5.8 mg / L which is in the normal range for the cultivation of grouper fish. This is in accordance with SNI 8036.2: 2014. which sets the optimal dissolved oxygen requirements for the production of grouper juvenile in the basin, which is> 4 mg / L.

A low pH value can result in decreased growth activity or weakened fish. Fish that live in low pH waters are more susceptible to disease and are usually accompanied by high rates of fish mortality [25]. The pH values obtained during the study ranged from 7.5 - 8.1. The pH value during the study was in the normal range in accordance with SNI 8036.2: 2014.

In addition to temperature, dissolved oxygen, and pH, salinity is also one of the parameters of water quality that supports fish growth. States that salinity has a direct effect on fish metabolism. The optimum salinity value will cause more energy to be used for growth and not much is spent on osmoregulation. Salinity values obtained during the study ranged from 31 - 33 ppt. Salinity values during the study were in the normal range in accordance with SNI 8036.2: 2014. which sets the optimal salinity requirements for the production of the grouper juvenile in the basin, which is 28 - 33 ppt [26].

Chromium (Cr) is classified in essential micro minerals. Physiologically the main role of Cr is related to glucose metabolism, which is to increase the potential for insulin activity. Chromium is an important component of GTF (Glucose Tolerance Factor) [17]. GTF is a water-soluble component of liver, blood plasma, brewer's yeast, and several biological and cell extracts. GTF containing Cr has the potential to increase insulin bioactivity by two times in transferring glucose to cells, glycogenesis, lipogenesis, and transport and amino acid uptake [6].

Yeast (Saccharomyces cerevisiae) is a source of GTF (Glucose Tolerance Factor) which plays a role in increasing the potential for insulin performance. Yeast is also able to synthesize one type of B vitamin, namely niacin (nicotinic acid) which is an important part of GTF. The formation of organic Cr can be carried out by incorporating Cr into fungi. This is done through a bio-fermentation process that uses fungi as a producer with substrates enriched with inorganic Cr minerals [17]. States that the incorporation of trivalent chromium into yeast forms chromium-yeast which is one form of organic chromium complex. Insulin is a polypeptide that contains two amino acid chains [4].

Insulin is a hormone that activates the transfer of blood glucose from the outside into cells so that it can be used by cells. Insulin plays a role in carbohydrate metabolism that is driving the process of glycogenesis and lipogenesis. Glycogenesis is a process of forming glycogen as a reserve energy that comes from excess glucose as a metabolic energy source. Lipogenesis is the process of forming fat, especially in the liver and adipose tissue-derived from dietary fat [27].

Carnivorous fish generally have lower blood insulin levels compared to omnivorous and herbivorous fish. GTF (Glucose Tolerance Factor) is known as chromodulin which is an oligopeptide that binds chromium and has low molecular weight. Chromium trivalence, especially as chromodulin oligopeptides, is important in the normal metabolism of carbohydrates and lipids.

Chromodulin has the role of increasing the potential for insulin performance by increasing the sensitivity of the insulin receptor site [4]. Increased insulin activity will accelerate the entry of glucose into cells for immediate use [5]. The presence of chromium in the blood causes glucose to be immediately used as a source of energy in the fish's body. The energy is used for metabolism so that certain amounts of protein can be utilized as an energy source for growth [4].

4. Conclusion and Suggestion

4.1 Conclusion

Based on the results of the study, it can be concluded that the addition of chromium-yeast to the feed gives significantly different results on the survival rate, daily growth rate, and efficiency of the utilization of the grouper seed feed. The addition of chromium-yeast by 3.9 mg / kg of feed produced a survival rate (100%), daily growth rate (0.31 g / day), and the best utilization of feed (68.65%) among all treatments.

4.2 Suggestion

Suggestion that can be given based on this research is that it is necessary to evaluate the administration of chromium-yeast in feed for field scale and further testing regarding the possible toxic effects of chromium material used on the aquaculture environment.

5. References

1. Folnuari S, Rahimi SAE, Rusydi I. Effect of different stocking densities on survival and growth of cantang grouper (Epinephelus fuscoguttatus-lanceolatus) in HDPE Cagenets. Jurnal Ilmiah Mahasiswa Kelautan dan Perikanan Unsyiah. 2017; 2(2):310-318.
2. Rahmaningsih S, Ari AI. Feed and growth of Grouper fish (Epinephellus fuscoguttatus-lanceolatus). Ekologia. 2013; 13(2):25-30.
3. Hadadi A. Effect of different feed carbohydrate levels on growth and efficiency of Gouramy fish (Osphronemus gouramy Lacepede) size 70-80g. [Thesis]. Post-Graduate School IPB, Bogor, 2002.
4. Subandiyono. The roles of chromium (Cr^{+3}) in relation to the sustainable fish culture. Jurnal Saintek Perikanan. 2005; 1(2):63-69.
5. Mokoginta I, Agustiani VS, Utomo UBP. The effect of dietary chromium level on the protein retention, growth and fish health of Tilapia (Oreochromis niloticus) Jurnal Ilmu-ilmu Perairan dan Perikanan Indonesia. 2005; 12(1):33-37.
6. Santika A. Effectiveness of dietary organic chromium response of common Carp (Cyprinus caprio) against herpes virus infection. Thesis, Post-Graduate School, IPB, Indonesia, 2007.
7. Suprayudi MA, Indriastuti l, Setiawati M. Effect of enriched feed by immunostimulant on immune response and growth of humpback grouper (Cromileptes altivelis). Jurnal Akuakultur Indonesia. 2007; 5(1):77-86.
8. Gaspersz V. Experimental Design Method. CVArmico, Bandung, Indonesia, 1991.
9. Directorate General of Aquaculture (DJPB-KKP). Assesment of Cantang Grouper in context of release to the community. 2011, www.djpb.kkp.go.id. 14 April, 2019.
10. Sutarmat T, Yudha HT. Performance analysis of seed grouper hybrid of cross breeding between tiger grouper Epinephelus fuscoguttatus with giant grouper Epinephelus lanceolatus and camouflage grouper Epinephelus microdon. Jurnal Riset Akuakultur. 2013; 8(3):363-371.
11. Lutfiyah L, Budi DS. Fluctuation of asymmetry of hybrid Cantang Grouper (Epinephelus fuscoguttatus x Epinephelus lanceolatus) orginating from Situbondo and Bali. Journal of Aquaculture Science. 20194; (1):21-26.
12. Guan X, Matte JJ, Ku PK, Snow JL, Burton JL, Trottier NL. High Chromium Yeast Supplementation Improves Glucose Tolerance in Pigs by Decreasing Hepatic of Insulin. Journal of Nutrition, 2000; 130(5): 1274–1279
13. Subandiyono, Mokoginta I, Harris E, Sutardi. Roles Yeast-Chromium Supplement on Dietary Carbohydrate Utilization and Growth of Giant Gouramy. Hayati. 2004; 11(1):29-33.
14. Wahyudi. Effect of Trivalent Chromium (Cr^{3+}) in Feed with the Different Dose on Growth of Tiger Grouper (Ephinephelus fuscoguttatus). Thesis, Airlangga University, Indonesia, 2013.
15. Yanto H, Junianto, Rostika R, Andriani Y. And Jusadi D.Different Levels on the Fermented Yellow Cornmeal in Diets for Jelawat, Leptobarbus hoevenii. Nusantara Bioscience. 2017; 9(4):378-384.
16. Underwood EJ, Shuttle NF. The Mineral Nutrition of Livestock. CABI Publishing, Third ed, London, England, 1999, 185-212.
17. Astuti WD, Sutardi T, Evvyernie D, Toharmat T. Chromium incorporation in yeast and fungi with cassava base substrate added by inorganic chromium. Jurnal Media Peternakan. 2006; 29(2):83-88.
18. Azis MN, Herawati T, Anna Z, Nurruhwati I. The effect of chromium (Cr) on histopathology of gill, liver, and meat of fish in Cimanuk River, Garut**.** Jurnal Perikanan dan Kelautan. 2018; 9(1):119-128.
19. Yudha P, Djamar T, Batu F, Sulistiono. Heavy Metal Contain Cu and Cd on the Mullet Fish in the estuary of Donan River, Cilacap, Central Java. JPHPI. 2017; 20(1):18-27.
20. Harikrishnan R, Balasundaran C, Heo MS. Review: Fish health aspects in grouper aquaculture. Aquaculture, 2011; 320:1-21.
21. Rahmawati APA, Hudaidah S, Maharani HW. The effect of light intensity during Tiger Grouper (Epinephelus Fuscoguttatus) juvenile culture. Journal of Aquaculture Engineering and Technology. 2016; 5(1):547-558.
22. Gusrina. Aquaculture. Directorate General of Primary and Secondary Education, Ministry of National Education, Jakarta, volume 2, 2008.
23. Hepher B. Nutrition on pond fish. Cambridge University Press, Cambridge, England, 1988, 388.
24. Ghufran M. Intensively maintenance of Tilapia. Akademia, Jakarta, Indonesia, 2011.
25. Haryanto P, Pinandoyo, Ariyati RW. The influence of different feeding dose on growth of juvenile Tiger Grouper (Epinephelus fuscogutattus). Journal of Aquaculture Management and Technology. 2014; 3(4):58-66.
26. Yurisma EH, Abdulgani N, Mahasri G. The effect of different salinity on oxygen consumption rate of Gouramy (Osprhonemus gouramy) laboratory scale. Journal of Science and Art. 2013; 1(1):1- 4.
27. Sari EP, Mokoginta I, Jusadi D. The effect of dietary chromium-yeast on the growth performance of Baung Fish (Hemibagrus nemurus Blkr). Jurnal Ilmu-ilmu Perairan dan Perikanan Indonesia. 2009; 16(1):17-23.