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Research Article

ORGANIC CHROMIUM SUPPLEMENTATION THROUGH FEEDING TO INCREASE INFLUX OF BLOOD GLUCOSE, GROWTH AND SURVIVAL RATE OF SNAKEHEAD FISH (*CHANNASTRIATA*)

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ABSTRACT

The research aims to: 1) Evaluate the optimal carbohydrate protein contents to increase growth performance of snakehead fish, 2) Evaluate the optimal organic chrome concentration as feed supplement that can increase insulin performance in accelerating the blood glucose rate of *influx*, to increase growth and survival rate of snakehead fish. The results showed that blood glucose *influx* in snakehead fish seeds was best in the treatment of carbohydrate 35%, protein 40%, chrome 5 ppm and was lowest in the treatment of carbohydrate 40%, protein 35%, chrome 3 ppm. It was indicated that treatment of chrome concentration and carbohydrate-protein content and interaction between both of them gave real effects (P<0,05) on the growth of snakehead fish seeds *(Channa striata)*. For Duncan further test results, a treatment that gave the highest growth was obtained, in the feeding with carbohydrate content 35%, protein 40%, chrome 5ppm. The treatment producing the lowest growth was obtained in carbohydrate content 40%, protein 35% chrome 3ppm. Next, results of various analysis in the treatment of chrome concentration and carbohydrate-protein content and the interaction between both of them did not affect the survival rate of snakehead fish. It can be concluded that blood glucose *influx* and growth of snakehead fish seeds was highest in treatment of carbohydrate 30%, protein 45%, chrome 5ppm, and was lowest in treatment of carbohydrate 40%, protein 35%, chrome 3 ppm. While survival rate of snakehead fish seeds reached 100% for all treatments.

INTRODUCTION

Snakehead fish (*Channastriata*) is one of the types of freshwater fish having a high economic value whose utilization today is not only limited to becoming fresh food material. This is along with the fact that snakehead fish has been made as one of albumin source food materials [1]. For those who suffer from hypoalbuminemia and several other diseases, so from the marketing side, this albumin product has a clear market target. Snakehead fish is also the type of freshwater fish that is easy to culture because it has wide ability to tolerate water quality parameter. Nevertheless, the obstacle that the culturists have is the high cost of the feed, related to the traits of snakehead fish as carnivorous organism that needs feed protein *ranging* from 45 to 60 % [2] and the feed is one of the important components that really determines the success of the aquaculture efforts. Almost 60 – 70% of the total cost of production is used to buy the feed [3].

Protein is an expensive source of feed energy, especially the protein coming from fish flour. Protein is the essential substance of all nutrition substances needed by fish because protein is the structuring substance and main source of energy for fish[4]. In fish, protein is more effective to be used as an energy source that is carbohydrate[5]. This is because of the low ability to regulate plasma glucose concentration which is thought to be caused by the occurrence of insulin hormone deficiency [6].

The low ability of fish to utilize blood glucose for metabolism energy is related to bioactivity and insulin performance capacity, where at the level of cellular glucose needs transport facility, namely glucose transporter (GLUT) in order to go pass cell membrane and enter cytosol before being metabolized further to become energy. Therefore, it is necessary to make some efforts to increase the activity of glucose transporter (GLUT) so the utilization of protein as an energy source can be

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minimized and the utilization of carbohydrate as an energy source can be increased. Protein is hoped to be utilized for the growth and replacement of broken tissues, not as an energy source. The utilization of carbohydrate by fish is expected to be able to increase carbohydrate content and minimized protein content in artificial decomposition, that can decrease the cost of feed [7].

One of the alternatives that can be developed to overcome the above problem is by giving organic chromium supplement into the feed as a micronutrient that has the major role in accelerating insulin activities to transport glucose into cells and then will change glucose into energy. Research on chromium supplementation in the feed has been largely conducted especially on herbivorous fish such as [7], the addition of Cr can increase the transport of blood glucose in carp fish (Cyprinuscarpio), [8], [9] in gouramy fish, [10] the role of yeast chromium supplement in the utilization of carbohydrate in gouramy. [11] Effects of chrome on the growth performance of baung fish. Nevertheless, information about chrome supplement incorporated through mushroom of Rhyzopusoryzae which is then applied on snakehead fish has not yet been found, so research about the role of organic chrome as a feed supplement to increase the effectiveness of the utilization of carbohydrate on snakehead fish needs to be done. The aim of this research is to evaluate the combinations of carbohydrate-protein content with organic chrome concentration producing glucose Influx, growth and the best survival rate of snakehead fish seeds.

MATERIALS AND METHODS

Time and Place of Research; This research was conducted in the months of September 2016 – September 2017. Incorporation of organic chrome on mushroom Rhyzopusoryzae through the fermentation process was conducted in Laboratorium Bio-Technology PKP Hasanuddin University in Makassar. While atom analysis absorption to find out the total amount of organic chrome produced through mushrooms was conducted in Laboratorium BalaiPenelitianPertanianMaros Regency. The making of feed and the analysis of test feed nutrition content was conducted in Laboratorium Nutrisi BALITKANTA Maros Regency. Application of feed on snakehead fish seeds was conducted in BalaiBenihIkan (BBI) BantimurungMaros Regency.

TOOL AND MATERIAL

Test fish used were snakehead fish seeds transported from the special province of Yogyakarta. The body length of test fish was 3-4 cm with the weight of 0.8-0.85g, the spreading density of 20 fish/waring. The fish made sample was first acclimated to the environment for 1 hour and then adapted for 1 week before given test feed according to treatments. The feed used was in the form of a pellet with the chemical composition of feed raw material as seen in Table 1. Fish were given feed in adlibitum way 3 times per day namely at 7 a.m. 12 noon, and 5 p.m.

Research Design. This research used a factorial pattern with Complete Random Basic Design or Rancangan Dasar Acak Lengkap (RAL). The first factor was different carbohydrate contents in the feed, and the second factor was chrome supplementation in the feed with different concentrations. The treatments were as follows:

Determination of carbohydrate and protein content for each treatment was done based on the need for optimal protein and carbohydrate of snakehead fish according to the results of previous research;
Feed carbohydrate content of 40 %, protein 35 %
Feed carbohydrate content of 35 %, protein 40 %
Feed carbohydrate content of 30 %, protein 45 %
Feed carbohydrate content of 25 %, protein 50 %
Each content of carbohydrate/protein was given 3 repeats. The second factor was the addition of chrome into the feed with different concentrations.
The treatments were as follows:
Concentration of chrome 3ppm
Concentration of chrome 5ppm
Concentration of chrome 7ppm

Each treatment of chrome concentration in the feed was given 3 repeats, so 12 treatment combinations and 36 test units were obtained.

The Observed Variable

1. Blood Glucose Content in the Period of one and two months of observation was analyzed descriptively.
2. Relative Growth Rate

$$SGR = \frac{\ln W_t - \ln W_0}{t} x\ 100\%$$

Remarks:
SGR=Relative Growth Rate
W_t=Average weight of test fish at the end of research
W_0=Average weight of test fish at the beginning of research

Table 1 The chemical composition of test feed raw material given for every treatment during research

No	TREATMENT	COMPOSITION (%)				
		ASH (%)	PROTEIN (%)	FAT (%)	FIBER (%)	BETN (%)
1	(K.40%, P.35%, Cr. 3ppm)	18.19	35.33	6.91	5.79	33.78
2	(K.40%, P.35%, Cr. 5ppm)	18.14	35.35	6.93	5.74	33.84
3	(K.40%, P.35%, Cr. 7ppm)	18.16	35.33	6.92	5.75	33.84
4	(K,35%, P.40%, Cr. 3ppm)	18.20	39.90	6.67	5.46	29.77
5	(K,35%, P.40%, Cr. 5ppm)	18.17	39.97	6.62	5.45	29.79
6	(K,35%, P.40%, Cr. 7ppm)	18.22	39.80	6.73	5.52	29.73
7	(K.30%, P.45%, Cr. 3ppm)	17.85	45.06	6.81	3.05	27.23
8	(K.30%, P.45%, Cr. 5ppm)	17.87	45.02	6.81	3.05	27.25
9	(K.30%, P.45%, Cr. 7ppm)	17.85	45.06	6.84	3.01	27.24
10	(K.25%, P.50%, Cr. 3ppm)	18.51	49.95	6.30	4.02	21.22
11	(K.25%, P.50%, Cr. 5ppm)	19.10	49.75	6.03	4.01	21.11
12	(K.25%, P.50%, Cr. 7ppm)	18.55	49.90	6.32	4.01	21.22

Absolute Growth of Biomass

PB = Wt – Wo

Remarks:

PB = Biomass growth
Wt = Biomass of fish at the end of fish keeping (g)
Wo = Biomass of fish at the beginning of fish keeping (g)

Survival Rate

The survival rate of snakefish seeds during fish keeping was calculated using the formula of [12], as follows:

$SR = N_t / N_0 \times 100\ \%$

Remarks:

SR = Survival of test fish
N_t= Total number of test fish at the end of research (fish)
N_o= Total number of test fish at the beginning of research (fish)

Data Analysis: The data obtained in this research were analyzed using variance analysis. and if the treatment gave a real effect, then Duncan further test was conducted, while blood glucose content pattern was analyzed descriptively.

RESULTS AND DISCUSSION

Blood Glucose Content in the Period of One and Two Months of Fish keeping. Based on the results of measurement of blood glucose content on snakehead fish seeds in the period of one and two months of keeping, the results can be seen in the following Figure 1.

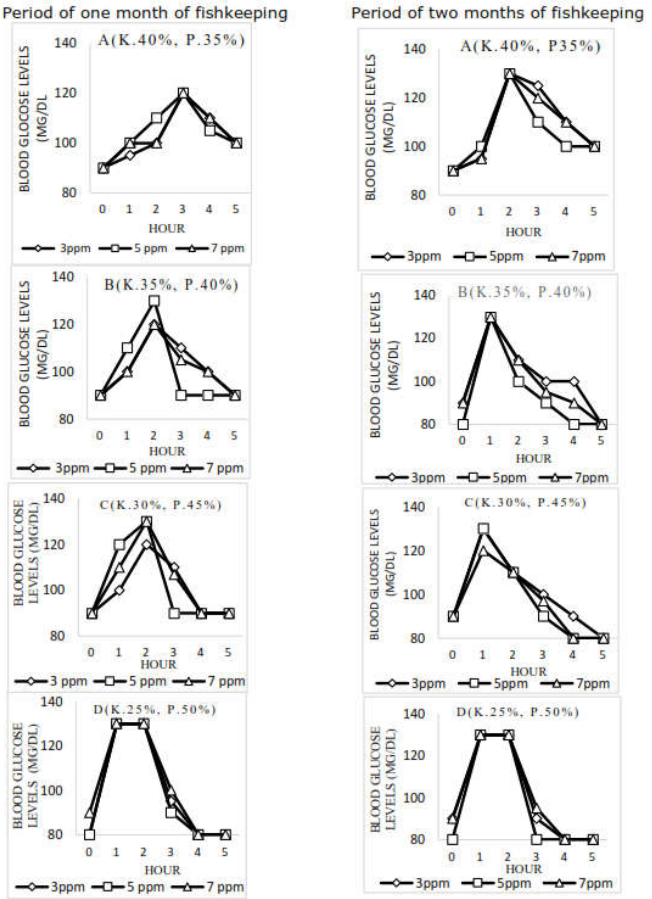

Figure 1 Blood Glucose Content of Snakehead Fish supplemented with chrome at different concentrations in the period of one monthand two months of fishkeeping.

Remarks: K = Carbohydrate P = Protein

Based on Figure 1. It can be seen that in the period of one month and two months of fish keeping the patterns of blood glucose contents are almost the same, namely, at hour 0 (before the feeding), the research result on the feed with the level of 40% Carbohydrate-35% Protein showed that theblood glucose influx was slow, both in one-monthand two-months periods of treatments. It was because 40% Carbohydrate - 35 %Protein level hadhigh percentage eof carbohydrate beyond the digest ability of the snakehead fish as carnivores, sothat the glucoseinflux into thebloodwas slow. [13] report that carnivorous fish has limited ability in making use of carbohydrate than omnivorous and herbivorous fish.

In the treatments with the levels of 40% Carbohydrate-35% Protein, 30% Carbohydrate-45% Protein, as wellas 25% Carbohydrate-50% Protein which were supplemented with 5 ppm of organic chromium, the result showed that theblood glucose influx wasfaster (went up and down fast). It apparently occured because there was supplementation of organic chromium incorporated through the permentation process of *R.oryzae* fungus.

In its permentation, *R.oryzae* fungus can produce digestive enzyme so that the feed with the levels of 35% Carbohydrate-40% Protein as well as 30% Carbohydrate-45% Protein can be digested by the snakehead fish completely, and ithasan implication on the speed rate of glucoseinflux fromthe digestive ductsintothe blood flow. Further more, the presence of the 5 ppm of chromium asthe feed supplement speeded upthe blood glucose *influx* into cells. [14] report that there is a linkage between chromium and the increased insulin level in blood. The increased insulin in blood will speed upthe blood glucoseinflux into cells, thus it fastensthe decreased level of the blood glucose.[7] also state that chromium can level up the blood glucose flow into cells and it enables glucoseto be utilized soon as a source of energyto fulfill the energy metabolism, hence the protein can be utilized more efficientlyfor the growth without changing it to the source of energy.

The delay of blood glucose decline in the supplementation of organic chromium treatment with 7 ppm concentration a tall levels of carbohydrate showed that giving chromium that went beyond limit tolerance caused the delay of blood glucose decline. It indicates that the reduction of bioactivity *(GTF)* occurs when the optimum range of the chromium function has been exceeded (towards the saturated point).

The low blood glucose *influx* in 3 ppm of organic chromium supplementation for all carbohydrate levels showed that the chromium concentration supplemented into the feed was unable to increase the blood glucose *influx* as well as the glucose transportation toward slow cells, so the glucose inthe blood could not be utilized soon by cells as a source of energy metabolism. It corresponds to the statement of [15] and [16] in[17] adds that chromium as the micro minerals oneither low or high concentrations as well as either under or above the optimum range canlowerthe biological functionandcan inhibitthe blood glucose flow into cells. It shows that chromium in the feedwith certain levelsplays an important role in setting thestabilityofblood glucose levels.

Relative Survival Rate. Based on the results of variance analysis, treatment of the feed with different carbohydrate-

protein content and concentration and the interaction between both of them gave real effects (P<0.05) on the growth rate of snakehead fish seeds. Results of Duncan further test indicated that relative growth rate in the treatment of feeding with carbohydrate content of 30%, protein 45%, chrome 5ppm was higher yet was not really different from the feed with carbohydrate content of 35%, protein 40%, chrome 5ppm, and carbohydrate content of 25%, protein 50%, chromium 5ppm yet it was really different from other treatments. While treatment of the feed with carbohydrate content of 40%, protein 35%, chrome 3ppm was lower yet was not really different from treatment of feed with carbohydrate content of 35%, Protein 45%, chrome 3ppm and feed with carbohydrate content of 25%, protein 50%, chrome 3ppm bur it was really different from other treatments.

Table 2 Average Relative Rate of Growth of Snakehead Fish Seed *(Channa striata)*given organic chromium supplementation feed at different doses

TREATMENT	AVERAGE
AP(K.40%,P.35%, Cr.3ppm)	3.13±0.003[f]
AQ(K.40%,P.35%, Cr.5ppm)	3.68±0.101[c]
AR(K.40%,P.35%, Cr.7ppm)	3.44±0.141[d]
BP(K.35%,P.40%, Cr.3ppm)	3.25±0.047[e]
BQ(K.35%,P.40%, Cr.5ppm)	4.82±0.015 [a]
BR(K.35%,P.40%, Cr.7ppm)	3.82±0.017[b]
CP(K.30%,P.45%, Cr.3ppm)	3.16±0.021[d]
CQ(K.30%,P.45%, Cr.5ppm)	4.82±0.017[a]
CR(K.30%,P.45%, Cr.7ppm)	3.52±0.067[d]
DP(K.25%,P.50%, Cr.3ppm)	3.09±0.057[f]
DQ(K.25%,P.50%, Cr.5ppm)	4.77±0.035[a]
DR(K.25%,P.50%, Cr.7ppm)	3.50±0.656[d]

Remarks: K = karbohidrat, P = Protein, Cr = Krom

Results of the research in Figure 2 indicate that the highest relative growth rate of snakehead fish seed during 2-month keeping was reached in the carbohydrate treatment of 35%, protein 40%, chrome 5ppm namely 4.82 g, and the carbohydrate content treatment of 30%, protein 45%, *acrome* 5 ppm namely 4.82 g, followed by carbohydrate treatment of 25%, Protein 50%, chrome 5 ppm with the value of 4.77g. While the lowest relative growth was reached in carbohydrate content treatment of 40%, protein 35%, chrome 3 ppm namely 3.13 g.

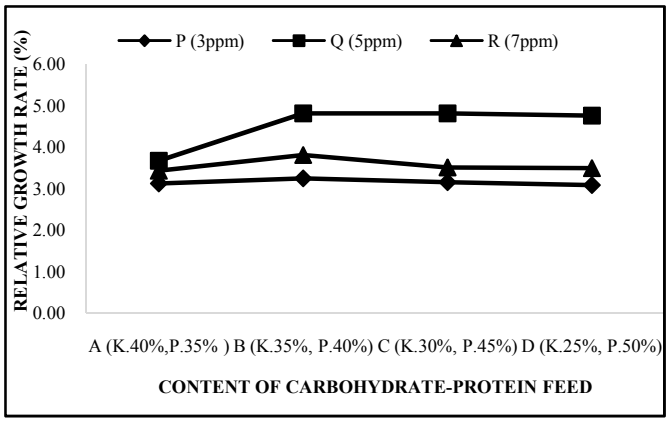

Figure 2 Interaction between carbohydrate-protein and confrontation of chrome supplementation toward relative growth rate of snakehead fish

The high values of relative growth rate in the treatment of carbohydrate content of 30%, protein 45%, chrome 5 ppm, and carbohydrate content of35%, protein 40%, chrome 5 ppm and carbohydrate content of 25%, protein 50%, chrome 5ppm, show that with the addition of chrome 5ppm to the feed, seeds of snake head fish which are carnivorous fish where their ability of consuming carbohydrate is no more than 20% (NRC, 1988) due to the low regulation of plasma glucose concentration (Bergot *in* [18] therefore insulin hormone deficiency occurred, in fact can utilize low carbohydrate to high carbohydrate (25% - 35%). because chrome 5ppm can increase insulin bioactivity marked with the increase in blood glucose*influx*. This is shown in the results of this research described in Figure 2. That treatment of chrome 5 ppm undergoes the peak of blood glucose decrease which is faster (3 hours after feeding) compared to chrome 3ppm and 7ppm (5 hours after feeding). It indicates that snakehead fish can utilize carbohydrates as a source of energy and protein is more retained for their need of growth. Related to this, then the utilization of feed protein snakehead fish is channelled for growth.

Absolute Growth. Results of variety analysis in Table 2 shows that differences of carbohydrate-protein contents in feed and chrome concentrations and interactions between both of them significantly affected the absolute growth of snakehead fish seeds (P<0.05).

Table 3 Average Absolute Growth of snakehead fish seed *(Channa striata)*given organic chromium supplementation feed at different doses

TREATMENT Average Growth of Biomass

Snakehead Fish Seed

AP (K.40%,P.35%, Cr. 3ppm)	104,37±0,403[f]
AQ (K.40%,P.35%, Cr. 5ppm)	148,1±0,360[b]
AR (K.40%,P.35%, Cr. 7ppm)	132,83±0,985[d]
BP (K.35%,P.40%, Cr. 3ppm)	117,64±0,632[e]
BQ (K.35%,P.40%, Cr. 5ppm)	159,04±1,857[a]
BR (K.35%,P.40%, Cr. 7ppm)	137,3±0,968[c]
CP (K.30%,P.45%, Cr. 3ppm)	117,83±0,804[e]
CQ (K.30%,P.45%, Cr. 5ppm)	156,73±0,990[a]
CR (K.30%,P.45%, Cr. 7ppm)	136,4±1,178[c]
DP (K.25%,P.50%, Cr. 3ppm)	106,7±1,386[f]
DQ (K.25%,P.50%, Cr. 5ppm)	149,9±0,715[b]
DR (K.25%,P.50%, Cr. 7ppm)	130,7±0,105[d]

Remarks: K = Carbohydrate, P = Protein, Cr = Chrome

Duncan further test shows that treatment of feed with the carbohydrate content of 35%, protein 40%, chrome 5ppm is not different from carbohydrate content of 30%, protein 45%, chrome 5ppm. Yet, obviously higher and different from other treatments. This shows that carbohydrate content of 30%, protein 45% and carbohydrate content of 35%, protein 40% can be utilized better by snakehead fish, although it is known that snakehead fish are carnivorous organisms that need relatively high protein in their growth, yet that can be balanced with the utilization of carbohydrate through the process of *protein-sparring effect.* So, the energy received by fish from protein can be utilized maximally for growth, while the energy for metabolism and activities is obtained from carbohydrate. Results of this research are in accordance with the results of research done by [18] reporting that the giving of high carbohydrate in the keeping of *vannamei* shrimp proves to be able to be received well through the process of*protein-sparing effect by carbohydrates.* Therefore, chrom was able to replace

the role of protein as source of energy, replaced by carbohydrate as non protein source of energy.

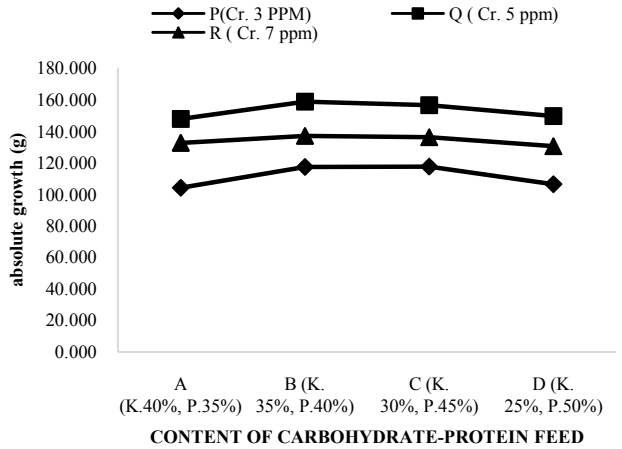

Figure 3 Interaction between carbohydrate-protein and confrontation of chrome supplementation toward Absolute Growth of Snakehead Fish (*Channastriata*)

Another thing related to the different growth caused by the different Cr concentration addition in the feed given was related to the role of Cr in optimizing the use of carbohydrate by fish as a source of energy. This was in accordance with the opinion of [19] who states that one of the important things of Cr is that it can increases the potential of insulin performance, i.e. the increases in insulin receptor site, through chromodile as a glucose tolerance factor that binds Cr so that it plays an important role in the metabolism of of carbohydrate and lipid. Results of this research were in line with the results of research done by [10] showing that the giving of Cr with different concentrations make effects on the growth of *gouramy* fish. Also, [20] reported that chromium supplementation in climbing *gouramy* feed with a concentration of 3 – 4.5 mg/kg gave optimal growth.

Survival Rate. The survival rate is the percentage value of fish that live during the fish keeping period (Effendie, 1997). Based on the results of research, it can be seen in Figure 4,

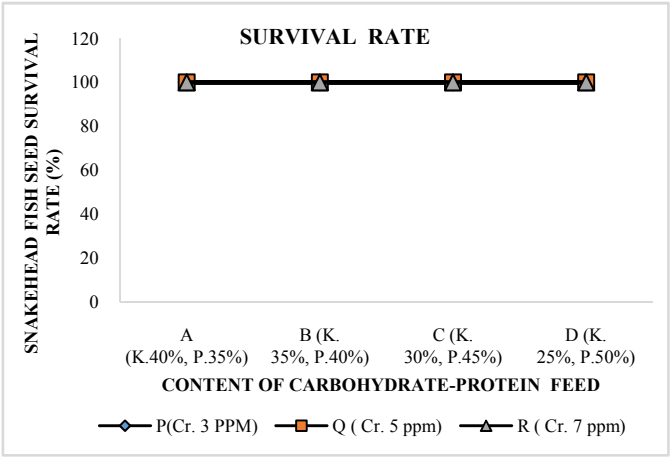

Figure 4 Survival Rate of Snakehead Fish (*Channastriata*)

In the above Figure 4, it can be seen that the survival rate achieved in this research for all treatments indicated the value of 100%.The survival rate of snakehead fish between treatments did not show any differences. Because the percentage of feeding was 20% of biomass weight given in an *adlibitum* way was the optimal percentage so snakehead fish seed did not undergo a lack of leed so it did not cause cannibalism that could decrease the value of survival rate.

The high percentage of survival relates to the sufficiency of feed given and survival rate of 100% also showed that snakehead fish were in a good living condition, although it is seen that the treatment of feeding chrome 5ppm underwent a peak of decrease in blood glucose at hour 4, it showed that in the four-hour period after feeding the condition of fish was in the condition of needing feed. Nevertheless, it did not yet cause the occurrence of cannibalism traits that could cause a decrease in the percentage of survival rate, but this could be made as a guide in determining the time of feeding in the narrow period.

Water Quality. Water quality during this research was in the range that could be tolerated by snakehead fish seed and supported growth and survival rate. Water quality during this research, [21] water temperature ranged from 26^{o}C to 27.5^{o}C, dissolved oxygen ranged from 5,3-6.9 mg/l. Ammonia ranged from 0.003-0.18 mg/L and range of pH was 6.7-7.2

CONCLUSION

1.*Influx* of blood glucose of snakehead fish was highest in the treatment of Carbohydrate 35%-Protein 40% and Chrome 5 ppm; 2. Growth of snakehead fish seed was highest in the treatment of Carbohydrate 30%-Protein 45%. Crome 5ppm; 3. The survival rate of snakehead fish in this research reached 100% for all treatments.

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