The Effect of Various Media Salinities On Survival Rate and Growth of Best Tilapia Juvenil (Oreochromis niloticus)

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Abstract- BEST tilapia (*Oreochromis niloticus*) is one of the breeding species of tilapia from the 6th generation of GIFT tilapia. This study aims to examine the effect of various media salinities on survival rate and growth of BEST tilapia juvenile. The research was carried out at UD Windu Mandiri Hatchery, Aeng Batu-Batu Village, North Galesong District, Takalar Regency, South Sulawesi uses 12 black plastic basin containers with a volume of 20 L. The study used a completely randomized design with 4 salinity treatments with 3 replications each. The four salinities are 5, 10, 15, and 20 ppt. The data obtained were analyzed using variance (ANOVA). The analysis of variance showed that salinity had a very significant effect ($p < 0.01$) on survival and juvenile growth of BEST tilapia. The best survival and growth results at a salinity of 10 ppt and the lowest at 20 ppt.

Index Terms- BEST tilapia juvenile, growth, salinities, survival rate

I. INTRODUCTION

BEST tilapia (*Oreochromis niloticus*) is a type of tilapia produced from the 6th generation of GIFT tilapia, the result of research conducted by the Freshwater Aquaculture Research Institute in Bogor, West Java. BEST Tilapia (Bogor Enhanced Strain Tilapia) has advantages over its predecessors (Red NIFI, Nirwana and Gesit. This fish has 140% resistance to *Streptococcus disease* than non-superior tilapia and existing varieties, is resistant to extreme environmental conditions, growth faster, has 3-5 times more eggs than other tilapia, the larvae produced are relatively bigger, and resistant to disease (Ath-thar and Gustiano, 2010).

BEST tilapia is a freshwater fish, however, it is possible to keep this fish in brackish water ponds. To induce BEST tilapia into the brackish water environment (ponds) it is necessary to test its resistance to various levels of salinity. The success of BEST tilapia aquaculture is shown by high survival rate and growth. The maximum growth of tilapia can only be achieved if there is an excess of energy, after the energy consumed is reduced by energy needs for basic living (Schrama *et al*., 2010; Haidar, 2017).

Changes in environmental conditions, especially salinity, will affect the amount of energy used for osmoregulation so that it affects survival rate and growth (Iqbal *et al*., 2012; Kolbadinezhad *et al*., 2012; Kucuk *et al*., 2013). Although tilapia is euryhaline, which can live in a wide salinity range (El-Zaeem at al., 2011; Azepedo *et al*., 2015; Handayani *et al*., 2017), the salinity that supports growth is narrower than the salinity to maintain survival. To produce high survival rate growth and of BEST tilapia juvenile, it requires the salinity of maintenance media that is able to minimize energy use for osmoregulation so that the utilization of feed is efficient. This study aims to examine the effect of various media salinities on survival rate and growth of BEST tilapia (*O. niloticus*) juvenile.

II. RESEARCH METHODS

The research was carried out at UD. Windu Mandiri, Aeng Batu-Batu Village, North Galesong District, Takalar Regency, South Sulawesi Province. Osmolarity measurements were carried out at the Brackish Water Aquaculture Research Institute, Maros, South Sulawesi.

The test animal used was BEST tilapia (*O. niloticus*) juvenile, one month old with an average weight of 1.5 g ± 0.1. The juveniles were imported from the Lajoa Fish Seed Center (BBI), Soppeng Regency, South Sulawesi. The research container used a black plastic basin with a volume of 20 L filled with 12 L water media.

The feed used is artificial feed by breeder pro number 2 on the market with a composition of 35% crude protein and 5% crude fat. The dose of feed given is 10% of body weight per day with a frequency of twice per day, namely in the morning and evening.

This study was designed using a completely randomized design (CRD) with 4 treatments and each treatment had 3 replications. Thus, this study consisted of twelve experimental unit. The treatments that were tried were differences in media salinity, namely 5, 10, 15, and 20 ppt.

The parameters observed were the osmotic work level, survival rate, and growth of BEST tilapia juvenile. The osmotic working level (OWL) is determined by measuring the osmolarity of body fluid (plasma) of BEST tilapia juvenile and the treatment medium using an osmometer. The osmotic work level was calculated from the difference between the osmolarity value of BEST tilapia juvenile plasma and the osmolarity of the treatment medium (Lignot et al., 2000).

Survival rate is calculated using the following formula:

$SR = (N_t / N_o) \times 100$

where : SR is survival rate of BEST tilapia juvenile (%), N_t is number of BEST tilapia living at the end of the study (tail), and N_o is number of BEST tilapia at the beginning of the study (tail)

The spesific growth rate is calculated using a formula

$SGR = 100 \times (\ln W_t - \ln W_o)/t$

Where: SGR is spesific growth rate (%/day), W_o is average weight of BEST tilapia at the beginning of the experiment (g), W_t is average weight of BEST tilapia at time t (g), and t is length of maintenance (days)

As supporting data, during the research, several water quality parameters were measured, including temperature, pH, dissolved oxygen, and ammonia. Measurement of temperature, pH and dissolved oxygen were carried out twice a day, at 06.00 and 18.00. Ammonia levels were measured three times during the study, namely at the beginning, middle and end of the study.

The data obtained were analyzed using analysis of variance (ANOVA). Data that had a real effect was followed by the W-Tukey further test. As a tool for statistical tests is the SPSS version 23.0 program package. The water quality data will be analyzed descriptively based on the viability of BEST tilapia juvenile life.

III. RESULT AND DISCUSSION

Result

Osmotic Work Level

The measurement results of media osmolarity, plasma osmolarity and osmotic work level of BEST tilapia juvenile are presented in Table 1.

Table 1. Average media osmolarity, plasma osmolarity, and osmotic work level rate of BEST tilapia juvenile at various salinities

Salinity (ppt)	Media Osmolaritas (mOsm/L H_2O)	Plasma Osmolaritas (mOsm/L H_2O)	Osmotic Work Level (mOsm/L H_2O)
5	143,92 ± 0,01[a]	157,10 ± 0,49[a]	13,18 ± 0,49[a]
10	288,52 ± 0,47[b]	302,87 ± 0,60[b]	14,68 ± 0,60[a]
15	432,99 ± 0,59[c]	469,94 ± 1,49[c]	37,28 ± 1,49[b]
20	587,72 ± 0,01[d]	625,21 ± 0,34[d]	46,49 ± 0,34[c]

Note: Different letters in the same column indicate that differences significant between treatments at the 5% level ($p < 0.05$)

The results of the analysis of variance showed that the salinity of the media had a very significant effect ($p < 0.01$) on the osmolarity of the media, plasma osmolarity, and the osmotic work rate of BEST tilapia juvenile. Media osmolarity, plasma osmolity, and osmotic work level increase with increasing media salinity.

Survival Rate

The average survival rate of BEST tilapia juvenile reared at various salinities is presented in Table 2

Table 2. The average survival rate of BEST tilapia juvenile reared at various salinities

Salinity (ppt)	Survival Rate (%)
5	96,67 ± 3,33[a]
10	96,67 ± 0,00[a]
15	95,56 ± 1,93[a]
20	81,11 ± 10,71[b]

Note: Different letters in the same column indicate that differences significant between treatments at the 5% level ($p < 0.05$)

Media salinity had a very significant effect ($p < 0.01$) on the juvenile survival of BEST tilapia. The highest survival rate of BEST tilapia juvenile was produced on media with salinity of 5 and 10 ppt and the lowest was at a salinity of 20 ppt.

Daily Growth Rate

The average daily growth rate of BEST tilapia juvenile at various salinities is presented in Table 3.

Table 3. The average daily weight growth rate for BEST tilapia juvenile at various salinities

Salinity (ppt)	Daily Growth Rate (%/day)
5	10,30 ± 2,41[ab]
10	14,93 ± 1,45[a]
15	8,97 ± 1,76[b]
20	7,37 ± 1,12[b]

Note: Different letters in the same column indicate that differences significant between treatments at the 5% level ($p < 0.05$)

The results of the analysis of variance showed that the salinity of the media had a very significant effect ($p < 0.01$) on the growth rate of the daily specific weight of BEST tilapia juvenile. The best daily specific weight growth rate was obtained at 10 ppt salinity media and the lowest at 20 ppt.

Water Quality Parameters

During the research, several water quality parameters were measured in the research media. Water quality parameters measured include: temperature, pH, dissolved oxygen, and ammonia. The values for the range of these parameters are between 27-30oC, pH 7.0-7.7; dissolved oxygen 3.8–6.7 ppm, and ammonia 0.01-0.04 ppm.

IV. DISCUSSION

The level of osmotic action describes the activity of dissolved ions such as sodium (Na^+), potassium (K^+), calcium (Ca^{2+}), chloride (Cl^-), sulfate (SO_4^{2-}) and bicarbonate (HCO_3^-). The level of osmotic action is the difference between the osmolarity of the media and body fluids. The results of this study indicate that the higher the salinity of the media, the value of media osmolarity and osmolarity of BEST tilapia juvenile plasma also increased. The same thing was obtained by Hasbullah *et al*. (2018) on hybrid tilapia (*Oreochromis* sp.) Syakirin *et al*. (2018) on grouper fish. This increase is due to an increase in the concentration of dissolved ions (Kolbadinezhad *et al*., 2012; Shui *et al*., 2018). According to Harvey (1976) the main ions that determine the osmolarity are Na^+ and Cl^- which contain 30.61% and 55.04% of the total water-soluble ions. The main ion sequences that determine the osmolarity of the media are: Cl^-, Na^+, Mg^{2+}, Ca^{2+} and K^+, the order of the ionic levels is in accordance with the main ion composition that determines the salinity of sea water (Nybakken and Bertness, 2005.

The osmotic properties of the media depend on all the ions dissolved in the media. The difference in osmolarity of media and plasma due to differences in salinity will determine the osmotic work level (osmotic load) of BEST tilapia juvenile and will subsequently affect the level of feed consumption. The subsequent effect will determine survival rate and juvenile growth of BEST tilapia. The level of osmotic work experienced by BEST tilapia is proportional to the difference in osmolarity between media and plasma. Based on Table 1, it can be seen that the highest osmolarity of BEST tilapia media and plasma is produced at a salinity of 20 ppt, while the lowest is at a salinity of 5 ppt. Likewise, the highest working level of juvenile BEST tilapia was produced at a salinity of 20 ppt while the lowest was at a salinity of 5 and 10 ppt. The high osmotic working level of BEST tilapia juvenile at salinity of 20 ppt shows the efforts made by the fish to adapt to environmental conditions, in this case the salinity of the maintenance media. In this condition, there is high energy use in facing less than ideal environmental conditions.

The highest survival rate of BEST tilapia juvenile was produced in media with a salinies of 5 and 10 ppt and the lowest was at a salinity of 20 ppt. This illustrates that the 5-10 ppt salinity media maximally supports the survival of BEST tilapia juvenile fish. In media with salinity of 5-10 ppt BEST tilapia juvelile have a better ability to deal with osmotic stress so that the fish can survive to live. The survival rate of BEST tilapia juvenile obtained in this study ranged from 81.11 to 96.67%. Chowdhury *et al*. (2006) obtained a survival rate of tilapia of 97-100% at salinity of 8 ppt, while at a salinity of 15-25 ppt it was 57.5-65.0%.

BEST tilapia juveniles reared on 20 ppt of media salinity face osmotic stress due to high osmotic work. This can be seen from the difference in the gradient between the osmolarity of the media and the plasma of BEST tilapia juvenile. Under these conditions, it is suspected that BEST tilapia juveniles experience osmotic stress, resulting in high energy use. The low survival rate of BEST tilapia at a salinity of 20 ppt is a reflection of the loss of capacity of the fish in osmotic changes, changes in sodium or chloride concentration which are the main contributors to osmolarity in their environment.

The juvenile survival of BEST tilapia produced provides an overview of the results of the interaction between the carryng capacity and the feed. The availability of adequate and quality feed and the carrying capacity of the environment, especially salinity, will make energy use more efficient so that it can sustain its life. According to Schmidt and Nielsen (1990), salinity is an important abiotic factor that affects the survival rate of aquatic organisms. Therefore, it is necessary to determine the salinity in accordance with the needs of the organism to support its survive.

The daily specific weight growth rate was produced on 10 ppt salinity media and the lowest was at 20 ppt. At 10 ppt salinity medium, the osmotic work level experienced by BEST tilapia juveniles was low and the level of feed consumption and nutrient retention was the highest. The low osmotic work level of BEST tilapia juvenile causes low energy use for osmoregulation so that a portion of the energy is available for growth. According to Jobling (1994) growth can occur when the energy retained or stored energy is greater than the energy used for body activities. BEST tilapia juvenile obtains energy through the feed it consumes and uses it for various activities including for osmoregulation purposes. In addition, a low level of osmotic action on media with a salinity of 10 ppt will reduce the workload of the Na^+-K + ATPase enzyme and the active transport of Na^+ -K^+ and Cl^-, as a result the energy (ATP) used for osmoregulation is reduced so that the energy portion is available for growth. Setiawati and Suprayudi (2003) obtained the highest growth rate of red tilapia at a salinity of 10-20 ppt of 2.57-2.74%/day.

In media with a salinity of 20 ppt, the osmotic work rate of BEST tilapia juvenile fish is high so that the energy use for osmoregulation is high and the energy portion for growth is low. In this condition, BEST tilapia juvenile must perform osmotic work to maintain its internal environment. According to Guner et al. (2005) too high salinity can affect growth due to the effect of salinity which affects metabolism of changes in function in gill epithelial cells chloride cells and Na + -K + -ATPase activity. This effect absorbs energy that should be used for growth and is used as an energy source for changes in the metabolic process and causes the juvenile growth of BEST tilapia to be not optimal. In addition, the 20 ppt media is suspected to be less than ideal media for BEST tilapia juveniles. For salinity that is suitable for physiological conditions and the osmoregulation system, BEST tilapia juvenile can increase growth as seen at a salinity of 10 ppt.

The water quality of BEST tilapia juvenile rearing media during the research was still in a decent condition. According to Setyo (2006), the ideal temperature for tilapia maintenance ranges from 25-33 ^oC, pH 7.0–8.0, dissolved oxygen > 3 ppm, and ammonia < 0.1 ppm.

V. CONCLUSION

Based on the results of this study it can be concluded that a salinity of 5 to 10 ppt resulted in the highest survival rate, feed

utilization efficiency, and growth rate, while the lowest was at a salinity of 20 ppt.

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