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Research Article

Fluctuating Asymmetry of Red Strain of Tilapia (*Oreochromis niloticus*) in Genteng Fish Hatchery Center, Banyuwangi

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ABSTRACT

Fluctuating asymmetry of bilateral meristic characteristic is one of the simple methods that can be used to determine the stability of an individual fish development. This study aims to provide quantitative information about the level of asymmetry of red tilapia (*Oreochromis niloticus*) in Genteng Fish Hatchery Center through bilateral meristic characteristic observation. A total of 100 fish samples (5-7 cm) were measured in this study. Three bilateral meristic characters were calculated i.e. number of soft pectoral fins, number of soft ventral fins, and number of scales on the lateral line. The results show that the highest value of the fluctuating asymmetry of magnitude (FAm) and fluctuating asymmetry of number (FAn) were obtained at the number of scales on the lateral line those are 3.71 and 0.86, respectively. Furthermore, on soft pectoral fins, the FAm value obtained was 1.29 and the FAn value was 0.58. Meanwhile, the lowest FAm and FAn values obtained from the soft ventral fins which were 0.93 and 0.50, respectively. The sum of the total value of fluctuating asymmetry of each bilateral meristic characteristic was observed. The overall FAm value was 5.93 and the overall FAn value was 1.94.

Keywords: *fluctuating asymmetry, red tilapia, genteng fish hatchery center*

1. Introduction

Tilapia (*Oreochromis niloticus*) is one of the main commodities of fish consumption in the world. In the development of tilapia culture, to improve productivity and quality, it has undergone a lot of cross-breeding to produce many varieties that have varied morphology and body color (Popma & Masser, 1999). One of the varieties of tilapia that is much in demand is red tilapia which color and shape are like red snapper. Fry quality is indispensable for the success and continuity of the production of red tilapia fish farming, such as growth performance and survival.

Genteng Fish Hatchery Center is a Technical Executive Unit of Department of Fisheries and Marine in Banyuwangi which provides red tilapia fry for fish farmers in Genteng district and its surrounding areas. Currently, there has been a decrease in fry quality of red tilapia in Genteng Fish Hatchery Center. It is indicated by the amount of abnormal fish that cause low growth and survival rates. Abnormality in fish are often occurred and gave the negative effect such as slow growth, disproportionate growth or stunted fish, the head of farmed fish tend to be more curved than wild fish stocks, the absence of operculum so that the gills are susceptible to disease, parts of dorsal fins curved into the body, and scoliosis.

The quality of tilapia is strongly depending on genetic variability. For example, fry abnormalities may occur due to high pressure in the crossbreeding, which can be caused due to the small number of broodstocks and inbreeding, thus causing low genetic variation (Sheridan & Pomiankowski, 1997). Inbreeding depression is more often observed in life-history traits than in morphological traits (DeRose & Roff, 1999). However, several studies have also found evidence of inbreeding depression on developmental stability of morphological traits (Alibert et al., 1994).

The low genetic quality could negatively impact on important traits in fish farming, among others decreasing survival and growth. Genetically, the phenomenon occurs because of the decreased stability of individual development, which is also characterized by increasing asymmetric and abnormality of individual (Vøllestad et al., 1999).

Clarke (1992) says that the development stability of paired organs in animals is closely linked to the level of genetic diversity. The

stability of paired organs is called by fluctuating asymmetry. The stability value of paired organs development is measured by two numbers, i.e. the average number of asymmetry traits per individual and the average number of magnitude asymmetry. The measurement of developmental stability with these two numbers on each individual, which later obtained the mean value of fluctuating asymmetry value the overall asymmetry, can be used to predict the reduction of genetic diversity due to inbreeding of a population of fish (Alibert et al., 1994). Although relatively simple, fluctuating asymmetry may indicate a difference in the stability of development. The phenotypic differences in individuals for its meristic and bilateral characteristics can show fluctuating asymmetry that is the difference between the characters on the left and right side of the body as a result of the individual's inability to be well and normally developed (Clarke, 1995).

Some research on fluctuating asymmetry of tilapia has conducted to determine the quality as base information for breeding program (Fessehaye et al., 2007; Widiyati & Sumantadinata, 2007). The purpose of this study is to provide quantitative information about the level of asymmetry on red tilapia (*O. niloticus*) as a reference for the breeding program in Genteng Fish Hatchery Center.

2. Materials and Methods

Time and location

This research was conducted in October 2016 at laboratory of Anatomy (PSDKU Banyuwangi, Universitas Airlangga) and Genteng Fish Hatchery Center.

Fish sample and meristic measurement

A total of 100 red tilapia with total length ranged 5-7 cm from Genteng Fish Hatchery Center were used in this study. Red tilapia that serve as samples were chosen from those which were not damaged due to handling, then drawn randomly. Observation of developmental stability of individual fish was done through the percentages of asymmetry approach and fluctuating asymmetry, i.e. by comparing the number of bilateral meristic characteristics on the right side and the left side of each individual.

The characteristics of bilateral meristic which were observed are the number of soft pectoral fins, the number of soft ventral fins, and the number of scales on the lateral line. The way of calculating the bilateral meristic characteristics is based on Saanin (1984). Data on the calculation of all the characteristics which were observed is computed for its, both the fluctuating asymmetry of magnitude and number. Fluctuating asymmetry of magnitude (FAm) is the value derived from the sum of the difference of characteristics observed in the right and left divided by the total number of samples that was observed. Fluctuating asymmetry of number (FAn) is the number of asymmetric individuals found in the observations divided by the number of samples which was observed. The formula used in the calculation of fluctuating asymmetry is as follows (Leary et al., 1985a):

$$FAm = \frac{\sum(L-R)}{n},\ FAn = \frac{\sum(Z)}{n}$$

Information:

L : The number of left side organs
R : The number of right side organs
Z : Number of asymmetric individuals for specific meristic characteristic
FAm : Fluctuating asymmetry of magnitude
FAn : Fluctuating asymmetry of number
n : Number of samples

Based on each characteristic observed, its overall fluctuating asymmetry value can be searched. Overall fluctuating asymmetry can be obtained from the sum of the total value of fluctuating asymmetry of each bilateral meristic characteristic observed. Experimental data were analyzed descriptively and presented in graphical form.

3. Results and Discussion

The results of value measurement of fluctuating asymmetry of magnitude (FAm) and number (FAn) can be seen in Figures 1 and 2. Based on the two figures, we known that the greatest value of the FAm and FAn are in the number of scales on the lateral line, namely FAm is 3.71 (out of 100 fish samples tested, the number of meristic characteristic difference between the right and left is 371 pieces) and FAn is 0.86 (out of 100 fish samples tested, there were 86 asymmetrical individual). Furthermore, on the soft pectoral fins the obtained FAm is 1.29 and FAn is 0.58. Meanwhile, the lowest FAm and FAn values were obtained from the soft ventral fins, which are 0.93 and 0.50, FAm overall value is 5.93 and FAn overall value is 1.94 (Figure 3.).

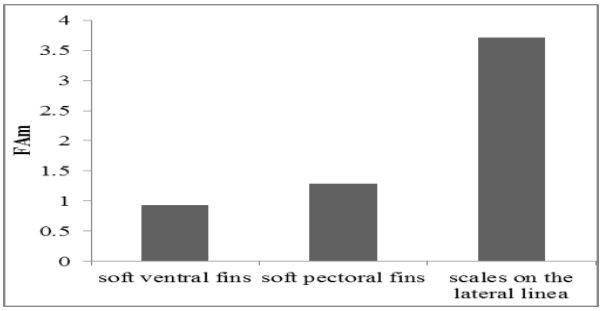

Figure 1. Fluctuating asymmetry of magnitude of red tilapia fish in Genteng Fish Hatchery Center

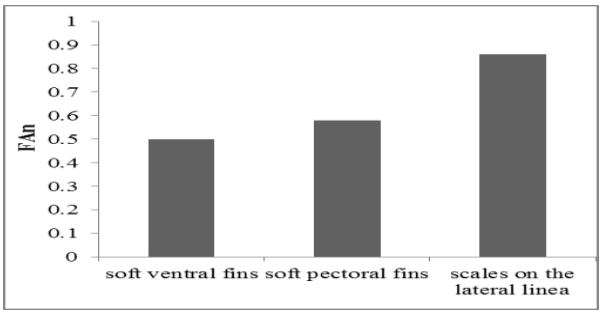

Figure 2. Fluctuating asymmetry of number of red tilapia in Genteng Fish Hatchery Center.

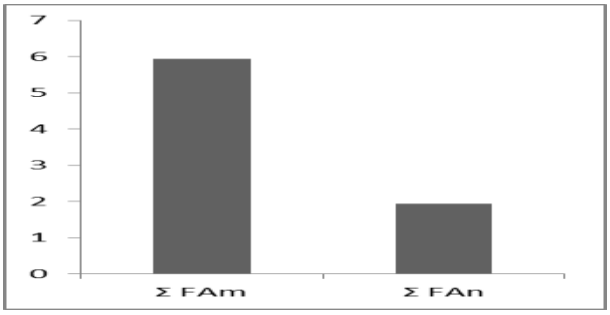

Figure 3. Overall value of fluctuating asymmetry of red tilapia in Genteng Fish Hatchery Center.

The high value of fluctuating asymmetry of bilateral meristic characteristics of an organ is caused by smaller energy priority given to its development compared to other bilateral meristic characteristic (Handoyo, 2002). Based on the results of this research, it is revealed that the biggest values of fluctuating asymmetry of magnitude (FAm) and fluctuating asymmetry of number (FAn) are in the number of scales on the lateral line. The value of fluctuating asymmetry of the number of scales on the lateral line is high because the number of scales on the organ is higher than the soft pectoral and soft ventral fins so that the energy used for the development of scales on the lateral line is not fulfilled.

Meanwhile, the FAm and FAn values of the soft pectoral fins are larger than the soft ventral fins. Similar results are also obtained on the observation of fluctuating asymmetry on goldfish with FAm and FAn values of soft pectoral fins are 0.80 and 0.74, compared with the soft ventral fins which are 0.40 and 0.40 (Sugiarto, 1991).

The overall FAm and FAn that were obtained show a significant high value when compared with the results of research by Widiyati & Sumantadinata (2007), where the value of the overall FAm and FAn of tilapia that origin from Sukamandi amounted to 2.84 and 1.75, while the overall FAm and FAn of tilapia that origin from Lake Tempe are 1.40 and 0.80. The high value of fluctuating asymmetry obtained is caused by low genetic variability associated with the occurrence of inbreeding which can increase the homozygosity. A slight number of broodstock allows the inbreeding which can lead to offspring that are homozygous (Hardjamulia, 1999). Inbreeding may affect developmental stability of

morphological traits because the lack of enzymatic diversity in homozygotes reduces the efficiency of normal developmental homeostasis processes (Fessehaye et al., 2007)

Leary et al. (1985a) stated that there is a positive relationship between homozygosity and low stability of individual development as measured by fluctuating asymmetry. According to Leary *et al*. (1985b), individuals with high heterozygosity will have a high developmental stability and have phenotype characteristics approaching the phenotype characteristics possessed by the normal population or often called as high homeostatic.

4. Conclusion

The highest values of the fluctuating asymmetry of magnitude (FAm) and fluctuating asymmetry of number (FAn) of red tilapia (*O. niloticus*) in Genteng Fish Hatchery Center are found in the number of scales in the lateral line, followed by soft pectoral fins, and the smallest obtained on soft ventral fins. The overall value of fluctuating asymmetry of red strain of tilapia in Genteng Fish Hatchery Center is higher than other areas.

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