Omni-Akuatika, 13 (2): 16–24 , 2017
ISSN: 1858-3873 print / 2476-9347 online

Research Article

The Growth Performance of *Larasati tilapia* (*Oreochromis niloticus* Linnaeus, 1758) Farming Using Bioflocs Technology

Fajar Basuki[1,*], Sri Hastuti[1], Subandiyono[1] and Wartono Hadie[2]

[1] Fisheries Department, Faculty of Fisheries and Marine Science, Diponegoro University, Indonesia
[2] Research and Development Center of Aquaculture, Agency for Marine and Fisheries Research and Development, Indonesia

**Corresponding author:fbkoki2006@gmail.com*

Received 12 January 2017; Accepted 11 July 2017; Available online 27 November 2017

ABSTRACT

This research was aimed to discover the growth of converted *Larasati tilapia* (*Oreochromis niloticus* Linnaeus, 1758) using bioflocs system on its farming, the dynamics of its water quality, and the fish health condition. Bioflocs is the utilization of floc-forming bacteria (flocs forming bacteria) for sewage treatment. Waste mentioned in fish farming is particularly feces and feed residue. This research took place at Laboratory of Aquaculture, Fisheries Department, Faculty of Fisheries and Marine Science of Diponegoro University. The study was done after 3 months. The design of the research was exploratory. The data of *Larasati tilapia* are from Janti, weighted 93.32 g or 200 fish per m^3. The fiber tank with 2 m^3 capacity is prepared for the bioflocs technique. The result shows that the growth of *Larasati tilapia* with bioflocs system on its farming is better than with the conventional system. The survival rate (SR) reaches 90 % and food conversion ratio (FRC) reaches 0.82. The water quality showed that dissolved oxygen (DO) were 4 to 5 $mg \cdot L^{-1}$ and Ammonia around 0.01 to 0.015 $mg \cdot L^{-1}$. Based on the cell concentration and the blood chemistry, it can be concluded that the *Larasati tilapia* with bioflocs system on its farming is healthy.

***Keywords:** Bioflocs, growth, Larasati tilapia, Oreochromis niloticus, water quality*

1. Introduction

Nile tilapia is popular fish and its production is very important for aquaculture industry. Based on Avnimelech (2013), nile tilapia which belongs to tilapia is one of the ideal fish to be farmed using bioflocs technology. It is because nile tilapia is omnivore, which eats both natural and artificial feed, and they also consume the organic waste (Farouq, 2011). The productivity of nile tilapia is related to certain factors, which one of them is the strong immune system from infectious or non-infectious diseases. There were some studies about immune system of nile (Zaki et al., 2011; Sukenda et al., 2017), as well as the study related with genetic (Khaw et al., 2009; Budi et al., 2017). The research of finding new species is done to fulfill the demand of the high quality nile tilapia seed. It was reported by the local aquaculture research center in Janti area that *Larasati tilapia* is a high quality nile tilapia from the crossbreeding of female GIFT strain (GG) with Male Singapore strain (SS), third generation (F3) (Satker PBIAT Janti, 2011).

To maximize the production of aquaculture, as the Indonesian government through Ministry of Marine and Aquaculture does with their mission to industrialize the aquaculture, the intensification of aquaculture has been done. The uncontrolled intensification areas affect to the natural habitat of farming environment, and the fish grown in the artificial environment is potentially affected by disease. However, the new

http://dx.doi.org/10.20884/1.oa.2017.13.2.247

technology has been found to maintain the bad condition of farming environment. This new finding is called bioflocs technology of which stocking density is high. It reaches 1,000 fish per m^2.

Bioflocs technology is one of super intensive fish farming methods, which benefitted the heterotrophic bacteria for harvesting organic chemistry and amines from the fish metabolism residue to become bacteria protein. The size of bacteria is tiny, but it is super dense to form bioflocs together with other organisms and the organic particles in the water media. Bioflocs has 50 µm to 200 µm diameter, so it's possible for nile tilapia to eat them. The bioflocs system does not only creates the good environment, but also provides feed for fish so that it can minimize the conversion number of fish feed. This technology has been applied on the shrimp and fish farming.

One of the problems that should be reviewed is the bio-physiological fish condition related to the high density, whether the nile tilapia is healthy, or they get a liver function problem. There is lack of research about the condition of chemical blood of fish grown with bioflocs technology. *Larasati tilapia* is a new strain of high quality nile tilapia and it is potentially developed. Hence, the research on the performance of bio-physiological Larasati strain tilapia farmed using bioflocs technology should be conducted to find the right technology in order to support aquaculture industrialization. This research is aimed to discover the growth of converted *Larasati tilapia* (*Oreochromis niloticus* Linnaeus, 1758) using bioflocs system on its farming, the dynamics of its water quality and the fish health condition.

2. Materials and Methods

The research takes place at the laboratory with exploratory research design. The *Larasati tilapia* is from Freshwater Fish Hatchery Janti Village, District of Klaten - Central Java, weighted 100 g or 200 fish per m^3. The tank capacity is 2 m^3 (Fig. 1). The water from well is filled until 80 cm depth and it is inoculated with the probiotic bacteria around 100 mL fused in 2,000 mL of water. The 500 mL of cane juice is added, and then it is poured into high aerated tank. The next step is adding the salt until its salinity is 1 ‰, and it is being rested around 1 wk.

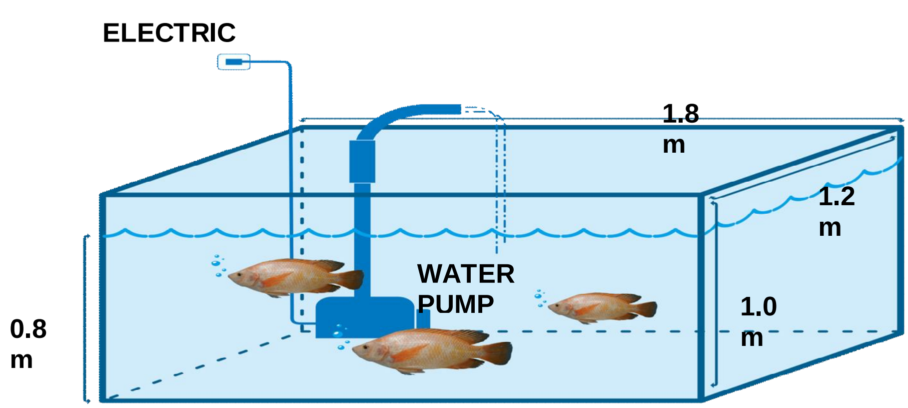


Fig. 1. Design of tank

The acclimated fish are poured. After the environment adaptation process, the fish is weighed as the data of initial weight. The feed given is noted every day, during 1.5 mo. The water should be changed maximum 30 % every 5 d. The water is organized with immobilization N technique, so the bacteria protein is formed which further the bacteria form flocs 50 µm to 200 µm in size so that they can be consumed by the fish.

At the end of cultivation (3 months), the fish are weighted to determine the last weight in order to calculate the growth. During the cultivation, ammonia level was measured weekly. At the end of cultivation, the fish is not only weighed, but also its blood is taken from its vena coundalis using syringe around 2.5 mL. The blood is collected into sample bottle to be analyzed, on concentration of various cells in the blood, blood chemistry consisting of blood glucose, total bilirubin, direct bilirubin, and indirect bilirubin. Aminotransferase enzymes in serum are also measured at the beginning and at the end of the cultivation.

The last is tabulating the data and making histogram graph. The data itself is analyzed descriptively and it is compared with the normal rate.

3. Results and Discussion

Fish growth and survival rate

The research showed that *Larasati tilapia* with bioflocs technology on its farming was growth (Fig. 2.). On the picture, the initial weight is 93.32 g, the weight after 15 d cultivation is 127.25 g. The weight of *Larasati tilapia* increases 36.36 % from the initial weight. The weight after 30 d cultivation is 156.75 g, or it is increases 67.97 % from the initial weight. The weight after 45 d cultivation is 191.70 g, or it increases 105.42 % from the initial weight.

The *Larasati tilapia* with bioflocs technology grows fast because of the internal factors, such as genetics, the ability of feed utilizing and immune system. The external factors enroll in it as well, such as water quality and feed quality. *Larasati tilapia* is high-yielding variety from Central Java. It is the result of selection and hybridization process. The growth is fast and resistant to disease (Basuki and Susilowati, 2009; Basuki *et al*., 2012). Tave (1999) also stated that the fish growth for productivity development of aquaculture can be done with selection process.

Besides the genetic factor, the feed given is fermented commercial feed. The fermented feed is easy to digest for fish, because there is the lignin wall changing or there is breaking down from polymer chain into monomer by nitrification bacteria (Ziemiński and Frąc, 2012). It affects to the increase and stabilization of protein in the fish feed. Furthermore, fermentation fish feed with probiotic bacteria may develop the number of nitrification bacteria in the water area, since the feed would be easier to break down become inorganic material. When there was abundance inorganic material, the nitrification bacteria will also growth more. This is in the same line with study of Harwanto et al (2011) that the nitrification rate was faster with the higher ammonia loading rate. The function of this bacteria in fish feed is to make it easy to digest, and it accelerates the process of nitrification in the water so that the nano-sized flocs protein formed. When the nitrification process occurs, the fish are still safe, because of the high aeration (supply O_2).

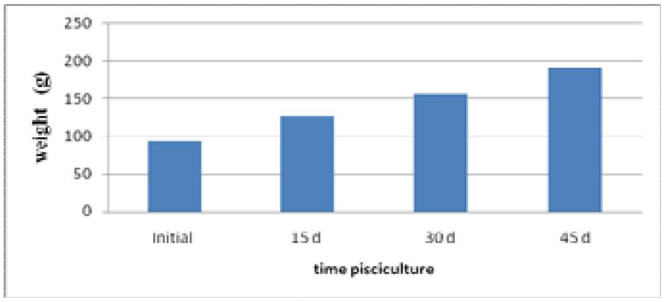


Fig. 2. The *Larasati tilapia* growth (g) with *bioflocs* technology

Fish farming with bioflocs is also purposed to increase the area of productivity with density development. The research results show that stocking density with bioflocs system reaches 200 fish per m^2 with the survival rate (SR) of 90 %.The initial weight is 100 g per fish, and after 45 d the weight reaches 191 g. Hence, the productivity per m^2 reaches 34.38 kg. According to Basuki *et al*. (2012), *Larasati tilapia* farming using rice-fish farming system results in 5 fish per m^2 to 10 fish per m^2 for its stocking density, with its SR of 80 % and the harvest weight of 300 g per fish. So, the productivity per m^2 ranges from 1.2 to 2.4 kg per m^2. Referring to the research result of fish farming with bioflocs compared to the common fish farming, the production with bioflocs is higher until 14.33 times than the farming with traditional system. In comparison to rice-fish farming system, the result with bioflocs ranges from 14.33 until 28.66 times higher (Basuki *et al*., 2012). It can be concluded that bioflocs is a new system which gives new hopes for developing the aquaculture productivity. The research results the survival rate *Larasati tilapia* farming with bioflocs during 45 d is 95 %. This result was acceptable based on Indonesian National Standard (2009) which mentioned that survival rate of black nile tilapia for the cultivation (91 to 170 d old) should be reached 90 %.

Food conversion ratio (FCR)

The result of FCR (Food Conversion Ratio) shows that *Larasati tilapia* farming with bioflocs during 45 d is 0.82. It means to produce 1 kg of fish, the feed needed is 0.82 kg with 35 % of protein.

There is not an academic article yet about FCR of Larasati tilapia. The data was obtained from report of a local aquaculture research center in Janti area (PBIAT Janti). In 2009, *Larasati tilapia* has been reported had low FCR. The FCR was 1.2 to 1.3 (Satker PBIAT Janti, 2011).

The research result shows that FCR of *Larasati tilapia* farming with bioflocs has a lower rate compared to the conventional farming. Bioflocs is assumed to be supplying feed for nile tilapia due to Megahed (2010) statement that bioflocs contains around 19.8 % to 21.1 %, of protein and 11.6 % to 11.9 % of fat.

Quality of water as farming media

Before fish stocking, probiotic bacteria and sugar cane molasses were inoculated into the water as farming media, and then highly aerated for 7 d. The observation on the water quality as farming media shows that there have been changes in the quality of water as farming media. Total Ammonia Nitrogen (TAN) in initial water media showed some fluctuations under the threshold required for nile tilapia farming which is 0.01 mg. L^{-1}.

After fish stocking, the fish were then feed. The food consumed will go through metabolism process to be fish meat and residual substances, which are excreted in forms of feces, urine and excreted from gills. Feces, urine and excess feed might reduce the quality of water, especially the increase of ammonia content in water. Organic-N substances are processed into ammonia (NH_3) by decomposers. The amount of NH_3 in farming media should be monitored since it is poisonous for fish.

The result of ammonia observation can be seen in Fig. 3, showing that after fish stocking, the ammonia level was below 0.01 mg. L^{-1}. Ammonia control in farming media was initiated by applying fermented food, which is easy to digest and environmentally friendly. It is suspected that probiotics in food and water as media accelerate the decomposition of organic-N to become nitrate, since heterotroph bacteria has role to convert organic carbon to inorganic carbon (Stickney, 2005). Furthermore, the presence of oxygen in the water helps to release ammonia into the air, in turns, organic materials will be flocs which are eaten by fish. Water replacement, which is conducted every 5 d as much as 30 % from total volume, also reduces ammonia level in the water so that the fish grows healthier and better. According to Wheaton et al (1994) and Losordo et al (1998), the amount of total ammonia in farming media should not exceed 1 mg.L^{-1}.

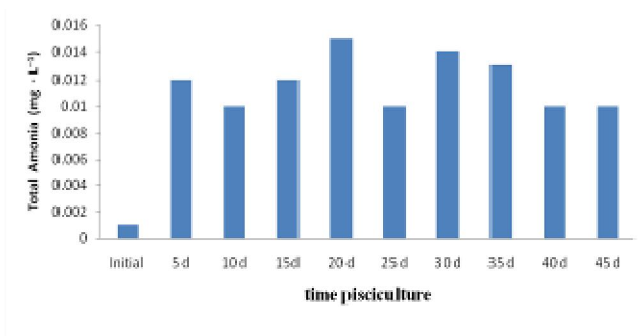


Fig. 3. Dynamics of ammonia in water as farming media (mgl. L^{-1})

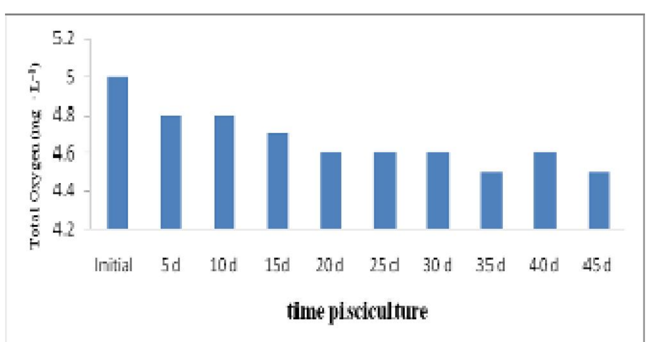


Fig. 4. Dynamics of oxygen (mg. L^{-1}) in water as farming media

The observation on oxygen level in bioflocs can be seen in Fig. 4, showing that after fish stocking, the level of oxygen in the media is above 4 to 5 mg.L^{-1}. The oxygen is vital, because it is essential for the fish and bacteria to produce flocs.

Performance of cell concentration and blood chemistry

Blood cells of *Larasati tilapia* are presented in Fig. 5. The effect of bioflocs technology to cell description and blood chemistry can be seen in Fig. 6a. *Larasati tilapia* reared with bioflocs technology contains fewer leukocytes compared to the fish without bioflocs system. The concentration of erythrocytes, hemoglobin, hematocrit and platelet of *Larasati tilapia* reared with bioflocs technology has increased. It can be concluded that *Larasati tilapia* reared with bioflocs technology has a better health condition.

Concentration of chemical substances in blood which consist of total bilirubin, direct bilirubin, and indirect bilirubin of *Larasati tilapia* reared with bioflocs technology shows lower value compared to the concentration at the beginning of the farming, yet still in normal level (Figure 6a).

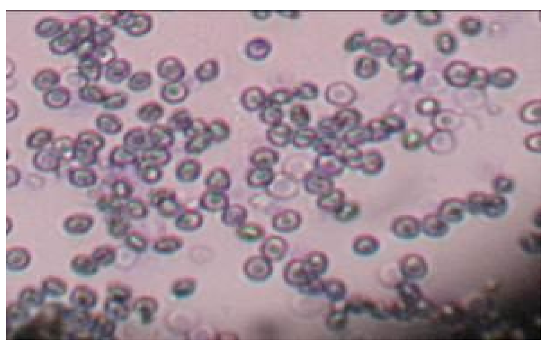
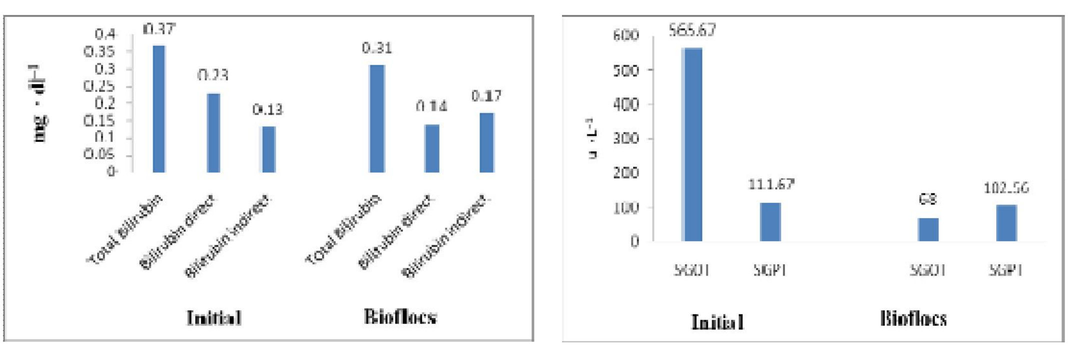
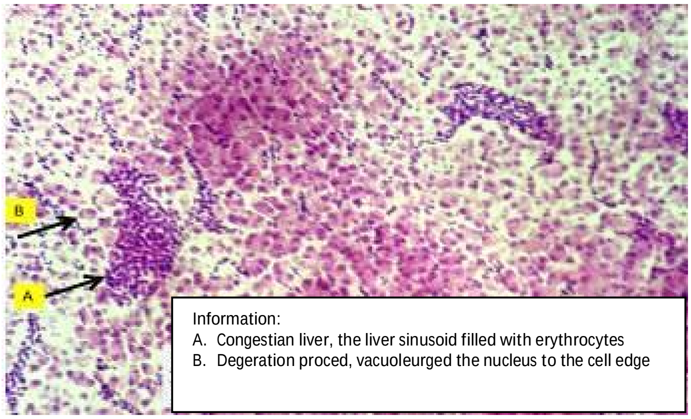


Fig. 5. Blood cells of *Larasati tilapia*

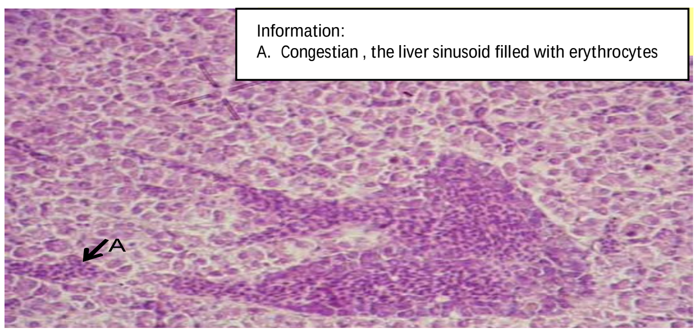


(a) (b)

Fig.6. Performance of chemical substances in blood of *Larasati tilapia* reared with bioflocs technology



(a)



(b)

Fig.7 : Histology of liver of *Larasati tilapia* (a) initial reared and (b) reared with bioflocs technology

Concentration of SGOT and SGPT of *Larasati tilapia* reared with bioflocs technology shows less value than initial concentration. It means that bioflocs technology is able to repair liver function, indicated from the decrease of SGOT and SGPT value (Fig. 6b). Some earlier study founded that the SGOT and SGPT levels of fish with not ideal condition would be higher than control (with ideal condition) (Kavya et al., 2016; Singh et al., 2016). The increase of glucose concentration in *Larasati tilapia* blood after reared with bioflocs technology shows better consumption of food. Concentration of SGPT and SGOT can be confirmed with the condition of liver cells presented in Fig. 7. *Larasati tilapia* reared with bioflocs technology shows better liver cells (7b) compared with the initial condition (7a).

Conclusion

Larasati tilapia reared with bioflocs technology shows better growth compared to the conventional rearing. The production with bioflocs is higher until 14.33 times than the farming with traditional system. The highest SR was recorded as 90 % and the highest FRC was recorded as 0.82. There were dynamics in water quality. Dissolved oxygen level ranges from 4 to 5 mg.L^{-1}, and ammonia value ranges from 0.01 to 0.015 mg.L^{-1}. The fish reared with bioflocs technology is in good health

Acknowledgement

Special thanks to the Directorate of Higher Education No. DIPA-023.04.2.189815 and Rector Diponegoro University who have provided funding so that the research can be done.

References

Avnimelech, Y. 2013. Biofloc technology: A practical guide book. USA: World Aquaculture Society.

Basuki, F. and Susilowati, T. 2009. Analisis Performa Reproduksi Induk dan benihnya Hasil Persilangan Ikan Nila Gift (*Orechromis* sp.) F2 dengan Nila Merah Singapura (*Orechromis* sp.) F2 [Analysis of parent fish reproductive performance and the fingerlings as the result of Gift Tilapia (*Orechromis* sp.) crossbred F2 with Singapore Red Tilapia (*Orechromis* sp.) F2.] Aquacultura Indonesiana 10(3): 187–193.

Basuki, F., Rejeki, S., Hastuti, S., Yuniarti, T., Nugroho, R..A. 2012. Uji Performa Pertumbuhan Benih Strain Pandu, Kunti Dan Hibrida Larasati F5 Dalam Program Pemuliaan Ikan Nila Oreochromis sp. Proceeding of 2nd Annual National Seminar of Research in Fisheries and Marine. Diponegoro University, Semarang, Central Java.

Budi D.S., Lutfiyah L., Juni Rr.T. 2017. Fluctuating Asymmetry of Red Strain of Tilapia (*Oreochromis niloticus*) in Genteng Fish Hatchery Center, Banyuwangi. Omni-Akuatika 13 (1): 1–4.

Farouq, A. 2011. Probiotic, Prebiotic and Sinbiotic Application in Food to increase Immune Responses and Life Sustainability of Tilapia Fish Oreochromis niloticus infected with *Streptococcus agalactiae*. [Thesis]. Department of Aquaculture, Faculty of Fisheries and Marine Science, Bogor Institute of Agriculture, Bogor.

Indonesian National Standard. 2009. Produksi benih ikan nila hitam *(Oreochromis niloticus* Bleeker) kelas benih sebar. SNI 6141:2009. 7

Harwanto D., Oh S.Y., Jo J.Y. 2011. Comparison of the Nitrification Efficiencies of Three Biofilter Media in a Freshwater System. Fisheries and Aquatic Sciences 14(4): 363-369.

Kavya K.S., Jadesh M., Kulkarni R.S. 2016. Hematology and serum biochemical changes in response to change in saline concentration in fresh water fish *Notopterus notopterus*. World Scientific News 32: 49-60.

Khaw H.L., Bovenhuis H., Ponzoni R.W., Rezk M.A., Charo-Karisa H., Komen H. 2009. Genetic analysis of Nile tilapia (*Oreochromis niloticus*) selection line reared in two input environments. Aquaculture 294, 37–42

Losordo T.M., Masser M.P., Rakocy J. 1998. Recirculating Aquaculture Tank Production Systems: An Overview of Critical Considerations. Southern Regional Aquaculture Center Publication No. 451. Southern Regional Aquaculture Center, Soneville, MS, US.

Megahed M.E. 2010. The effect of microbial biofloc on water quality survival and growth of the green tiger shrimp (*Penaeus semisulcatus*) fed with different crude protein level. Journal of the Arabian Aquaculture Society 5(2): 119–142

Singh S, Rawat R.S., Singh S., Sharma H.N. 2016. Studies on Liver Marker Enzymes (SGOT and SGPT) of Fish *Heteropneustes fossilis* (Bloch.) After Famfos

Intoxication. Journal of Advance Laboratory Reseach in Biology 7(4): 99-102.

Stickney, R.R. 2005. Aquaculture: an introductory text. CABI Publishing. UK. 265p.

Sukenda S., Sumiati T, Nuryati S, Lusiastuti A.M., Hidayatullah D. 2017. Specific Immune Response Kinetics and Mortality Patterns of Tilapia *Oreochromis niloticus* on Post-Cocktail Vaccination Period against the Infection of Aeromonas hydrophila and Streptococcus agalactiae. Omni-Akuatika 13 (2): 7-15.

Tave, D. 1999. Inbreeding and brood stock management. Fisheries Technical Paper. No. 392. Rome: FAO. p.122

Wheaton F.W., Hochheimer J.N., Kaiser G.E., Malone R.F., Krones M.J., Libey G.S., Easter C.C. 1994. Nitrification filter principles. In: Aquaculture Water Reuse Systems: Engineering Design and Management. Development in Aquaculture and Fisheries Science. Vol. 27. Timmons MB and Losordo TM, eds. Elsevier, Amsterdam, NL, pp. 101-126.

Zaki M.M., Eissa A.E., Saeid.S. 2011. Assessment of the Immune Status in Nile Tilapia (*Oreochromis niloticus*) Experimentally Challenged with Toxogenic / Septicemic Bacteria During Treatment Trial with Florfenicol and Enrofloxacin. World Journal of Fish and Marine Sciences 3 (1): 21-36.

Ziemiński K., Frąc M. 2012. Methane fermentation process as anaerobic digestion of biomass: Transformations, stages and microorganisms, African Journal of Biotechnology 11 (18): 4127–4139.