Scientific Works. Series C. Veterinary Medicine. Vol. LXV (1), 2019
ISSN 2065-1295; ISSN 2343-9394 (CD-ROM); ISSN 2067-3663 (Online); ISSN-L 2065-1295

FUNCTIONAL SET UP STAGES OF AQUAPONIC EXPERIMENTAL MODEL

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Abstract

The aquaponic sistem is giving by concomitant aplication of hydroponia (plant culture without soil) and aquaculture (culture of fish). To set up a aquaponic system more stages are necessary. The environment for aquaponic sistem should be attently chosen to avoid pollution factors. Taking in consideration cold regime in our country aquaponic system was settled down inside of micro greenhouse belogs to Institute of Research and Development for Processing and Marketing of Horticultural Products Bucharest. Fishponds were building using 0.8 mm OSB panel covered with polyethylene wrap. Water physico- chemical analyzes was performed as following: temperature, oxygen dissolved (DO), nitrate, nitrite, ammonia, calcium, magnesium and phosphorus. The studies performed showed the maintenance of aquaponic system

Key words*: fish, lettuce, aquaponia, hydroponia, RAS.*

INTRODUCTION

Aquaponia is a bio-integrated system whose link RAS *(culture of fish)* by hydroponia *(plant culture without soil)*. (James E. et al., 2004), (Masser P.M., 2006). Aquaponia combine both systems (RAS and hydroponia) in a close recirculation system (Rakocy J.E. et al., 2006).
To utilize fish manure for plant culture is an ancient practice. The most well known examples are from Central America (Aztecs 1150-1350 BC), South Asia rice culture together with fishes 1500 years ago. (Turcios A.E. et al., 2014; Coche A.G., 1967).
At the beginning, the studies were conducted to use fish manure for plant culture. Nowadays, commercial aquaponic systems should be develop in controlled spaces or natural favorable climate using high tech equipment. To set up an aquaponic system free emissions and pollution environment should be chose. (Resh, H.M., 1995; Adler P.R., 2000).
Aquaponia can be useful indifferent of country economic development, with large population and week agricultural resources (Renee E., 2011, Mchunu et al., 2018) beeig valuable by offering good quality animal and vegetal proteine. In rural or city regions (Liang & Chien, 2013).
Fish meat, besides other animal meat, represent an important human food category (Petcu C.D., 2013). Aquaponic fish roe must respect specific food demand parameters alled in authorised conditions (Petcu et al., 2008). Fish manure reprisent an ecological plants food, plants which are filtering fish water environment (Figure 1).

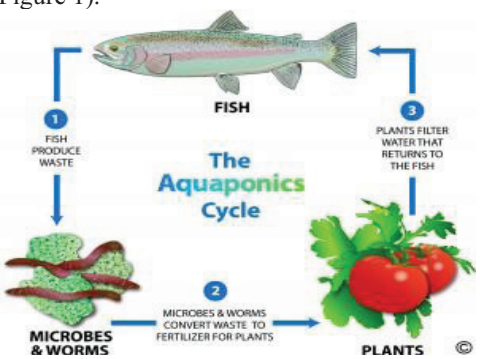

Figure 1. Aquaponics Cycle (www.theaquaponicsource.com)

MATERIALS AND METHODS

The aquaponic system was settled down inside of micro greenhouse belongs to Institute of Research and Development for Processing and Marketing of Horticultural Products Bucharest using three plants callusing tunnels Figure 2 and 3. Two of them were re - built special for plants growing (*Lactuca sativa*) each one being 7.4 x 1.8 x 0.3 M, and the third one for fishes 7.4 x 1.8 x 0.4 M was divided in eight equal tanks. Fish tanks were populated with 140 pieces of *Cyprinus carpio* 200 g, body weight average (Figures 4 and 5).

Figure 2. Aquaponic system carps tanks

Figure 3. Aquaponic system carps tanks

Figure 4. Cyprinus carpio 200g, body weight average

Figure 5. Cyprinus carpio 200 g, body weight average

To control aquaponic system functioning, Water physico- chemical analyzes was performed in two critical points fish tanks feeding and hydroponia water exhausting.

To increase filtration plants system was continuously loading. Water physico-chemical parameters were assayed at the Institute of Research and Development for Processing and Marketing of Horticultural Products Bucharest (temperature, DO, nitrate, nitrite, ammonia, calcium, magnesium and phosphorus).

D.O., pH, temperature were determined by AZ 86031 multiparameter device (Figure 6).

Figure 6. AZ 86031 multiparameter device

Calcium, magnesium and phosphorus were determined by Photometer HI 83225 device (Figure 7).

Figure 7. Photometer HI 83225 device

Nitrate, nitrite and ammonia were determined by LAMBDA 25, Perkin Elmer, molecular absorbtion device (Figure 8).

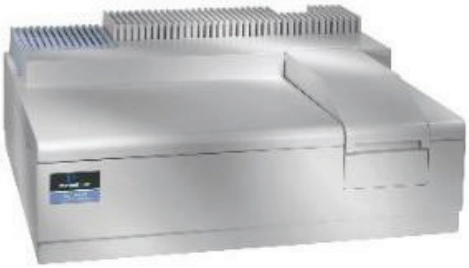

Figure 8. LAMBDA™ 25/35 Series UV/Vis Spectrophotometers, PerkinElmer

RESULTS AND DISCUSSIONS

To the aquaponia experiments *Lactuca sativa* was chose being a tested plant with a good yield and good demand on the market. *Lactuca sativa* also is resistant during the cold season and consume more ammonia.

The *Lactuca sativa* necessary for the system were prepared 20 days before being populated in experimental system (Figure 9).

Figure 9. *Lactuca sativa,* 20 days before being populated in experimental system

Lettuce was populated on a 10 cm water level in continitors. Population was started with 3 pieces/continitor, in final being 8 pieces/continitor (Figures 10 and 11).

Figure 10. *Lactuca sativa* in experimental system

Figure 11. *Lactuca sativa* in experimental system

To increase DO in water a special plastic separator was installed to avoid growth disturbance of lettuce (Figure 12).

Figure 12. Water a special plastic separator

Aeration system Hailea HAP/120 was installed too (Figure 13).

Figure 13. Aeration system Hailea HAP/120

Carps (*Cyprinus carpio)* 140 pieces, 200 g, body weight average were populated after three days of running system. Carps were provided from research farm of Institute of Research and Development for Aquatic Ecology, Fishing and Aquaculture Galați.

Carp (*Cyprinus carpio)* is a very resistant fish species well known to be growth and also very popular on the national market.

During December-February 2019 water physico-chemical analyzes was performed, monitoring fish population adaptation to environment condition by increasing lettuce plants pieces.

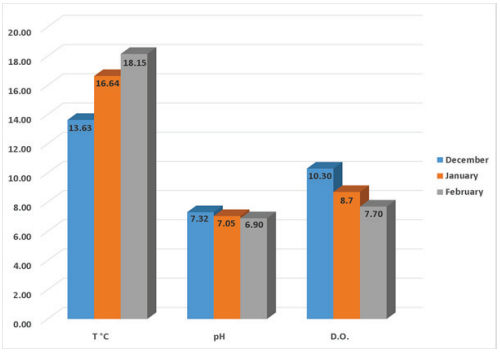

Figure 14. Temperature, pH, and DO values in 1-4 Tanks, Dec-Feb 2019

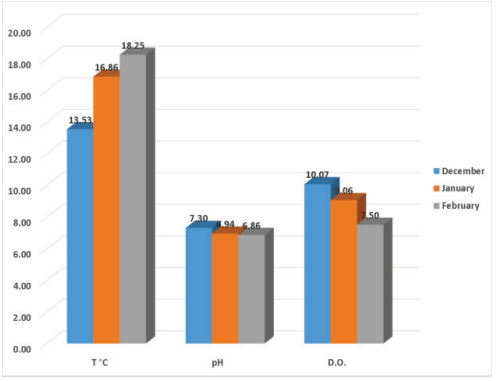

Figure 15. Temperature, pH, and DO values in 5- 8 Tanks, Dec-Feb 2019

From Figure 14 and Figure 15, it can be observed a constant pH value, an increasing water temperature and a decreasing value of DO.

To adjust water parameters in optimum value, micro greenhouse temperature was adjust too.

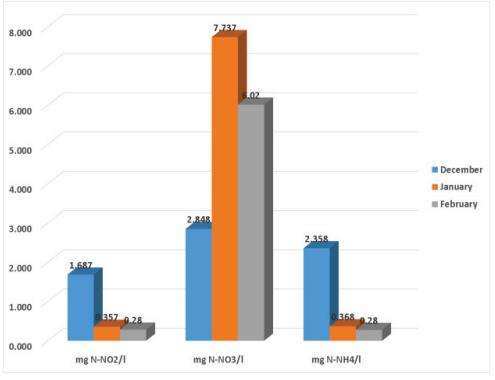

Figure 16. Nitrite and nitrate values in 1-4 Tanks, Dec-Feb 2019

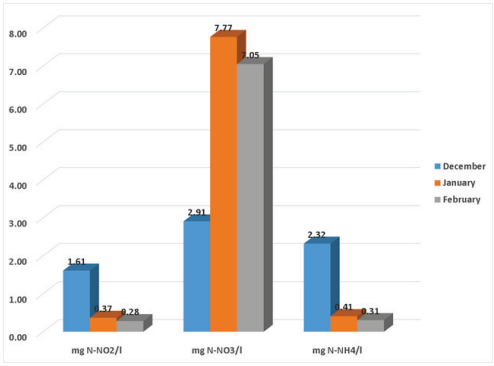

Figure 17. Nitrite and nitrate values in 5-8 Tanks, Dec-Feb 2019

During analyzed period nitrate values exceeded the maximum in January and February and nitrite values exceeded the maximum in December and January all do to fish feeding with to large quantity of food and water temperature value increasing (Figures 16, 17).

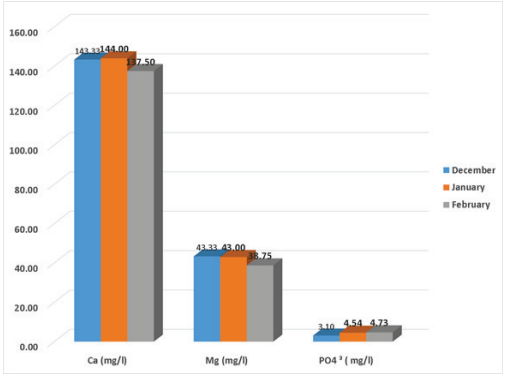

Figure 18. Ca^{2+}, Mg^{2+}, and PO_4 values in 1-4 Tanks, Dec-Feb 2019

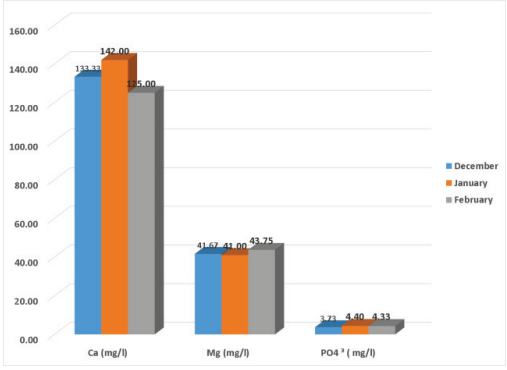

Figure 19. Ca^{2+}, Mg^{2+}, and PO_4 values in 5-8 Tanks, Dec-Feb 2019

During all studied period only PO_4 had increased values. All increased water physico-chemical parameters do not had negative influence on fish population which registered a good grow rate (Figures 18, 19).

CONCLUSIONS

Aquaponia represents an important technical solution for obtaining in the same time high quality animal and vegetal food products in controlled systems.

The monitoring of water physico- chemical parameters is a very important measure to be performed in aquaponic systems.

Both cultures, carp and lettuce, seem to be propitious with good results in aquaponic systems.

The experimental aquaponic system was built in low inputs energy and only controlled food ratio for fishes show as it efficiency.

REFERENCES

Adler P.R., Harper J.K., Wade E.M., Takeda F., and Summerfelt S. T. (2000). Economic Analysis of an Aquaponic System for the Integrated Production of Rainbow Trout and Plants, *International journal of recirculating aquaculture*.

Coche, A.G. (1967). Fish culture in rice fields a world-wide synthesis. *Hydrobiologia*, 30, 1–44.

James E. Rakocy, R. Charlie Shultz, Donald S. Bailey and Eric S. Thoman (2004). Aquaponic Production of Tilapia and Basil: Comparing a Batch and Staggered Cropping System*, Agricultural Experiment Station University of the Virgin Islands* RR 2, Box 10,000, Kingshill, VI 00850, USA.

Liang, J.Y., Chien, Y.H. (2013). Effects of feeding frequency and photoperiod on water quality and crop production in a tilapia-water spinach raft aquaponics system. *Int. Biodeterior. Biodegrad.* 85, 693–700. https://doi.org/10.1016/j.ibiod.2013.03.029.

Masser P. Michael. (2006). Recirculating aquaculture tank production systems: Aquaponics-Integrating fish and plant culture, *https://www. researchgate. net/ publication/ 284496499*.

Mchunu, N., Odindo, A., Muchaonyerwa, P. (2018). The effects of urine and urine-separated plant nutrient sources on growth and dry matter production of perennial ryegrass (Lolium perenne. L*). Agric. Water Manage*. 207, 37–43. https://doi.org/10. 1016/j.agwat. 2018.05.023.

Petcu Carmen, C. Savu, Iuliana Neagu, Dana Tăpăloagă, Cristina Manta (2008). Features of some preliminary programmes in a fish processins unit, Simpozion internaţional "Progrese şi Perspective în Medicina Veterinară", Universitatea de Ştiinţe Agricole şi

Medicină Veterinară “Ion Ionescu de la Brad”, Vol. 51(10)- II, pag. 872-878 - Iaşi , ISSN 1454-7406.

Petcu Carmen (2013). *Obținerea, ambalarea și controlul sanitar veterinar al peștelui și al produselor din pește*, Editura Granada. Bucureşti, ISBN 978-606-8254-36-4.

Rakocy, J.E.; Masser, M.P.; Losordo, T.M. (2006). Recirculating Aquaculture Tank Production Systems: Aquaponics - Integrating Fish and Plant Culture; Southern Regional Aquaculture Center: Stoneville, MS, USA; pp. 1–16.

Renee Elisha, Spirn Anne Whiston (2011). *Aquaponics: community and economic development*, Massachusetts Institute of Technology.

Resh, H.M. (1995). *Hydroponic food production*. Woodbridge Press Publishing Company, Santa Barbara, California.

Turcios, A.E.; Papenbrock, J. (2014). Sustainable Treatment of Aquaculture Effluents-What Can We Learn from the Past for the Future? *Sustainability* , 6, 836–856., www. theaquaponicsource.com