Rainbow Trout Performance in an Intelligent Aquaponic System - Abstract

Chris Vasdravanidis [1], Dimitris Papadopoulos [2,3], Ioanna Chatzigeorgiou [3,4], Athanasios Lattos [2,3], Ioannis A. Giantsis [1] and Georgios K. Ntinas [3,4]

[1] *Dept. of Agriculture, Faculty of Agricultural Sciences, University of W. Macedonia, Florina, 53100, Greece*
[2] *Dept. of Biology, Faculty of Science, Aristotle University of Thessaloniki, Thessaloniki, 54124, Greece*
[3] *Oecon Group, Business & Development Consultants, Frixou 9, Thessaloniki, 54627, Greece*
[4] *ELGO-Dimitra, Institute of Plant Breeding and Genetic Resources, Thessaloniki, Greece*

Summary

Growing population, climate change, overexploitation of environmental resources and food security issues, drive the need for innovating food production within a sustainability corridor. Aquaponics, combining the technology of recirculation aquaculture systems (RAS) and hydroponics in a closed-loop network, could contribute to addressing these problems. Aquaponic systems have lower freshwater demands than agriculture, greater land use efficiency and less harmful environmental impact combined with higher productivity. As a result of the great need for sustainable food production aquaponics is rapidly developing. However, there is limited research in economical feasibility of these systems and lack of focus on commercial implementation. Integrating new technologies may result in intelligent monitoring and control of the production, making these systems more intensive, accurate, efficient and finally profitable, attracting more investments.

The present paper focuses on the potential of hydroponic cultivation of vegetables along with rainbow trout *(O. mykiss)* utilizing intelligent monitoring of the system. *Oncorhynchus mykiss* is a psychrophilic species that requires temperatures between 14-20 °C, high clarity water and also high oxygen levels. Rainbow trout has significant commercial value, high growth rates and great feed conversation ratio. The aquaponic system used in this study is vertically operating. Two rearing tanks (1500 l) are located in the basement of the greenhouse along with mechanical and biological filter. Water supply comes from a rainwater tank, passes through the fish tanks and the filters and communicates through pipes with the upper greenhouse, where the water from fish tanks is used to fertilize the plants. In 10th of May 2022, 1080 juvenile rainbow trout were introduced from a breeding station.

Initial body weight and total length were 5.1±0.33 cm and 1.19±0.18 gr respectively. Fishes were stocked in biomass 0.45 kg/m3 and a stocking density of 360 fishes/m3. Daily feed amount was 3% (grams of food per gram of total fish biomass) and was provided in 5 equal food rations by automatic feeders. Every week, the fishes were weighted, and the daily amount of food was adjusted accordingly. At the end of the 28 days, body weight and total length of the fishes were measured. Survival rate of the fishes was calculated at 97.2 %. Specific growth rate of body weight was 3.1% per day and specific growth rate of total length was 0.81 % per day. Over the 28 days of the ongoing research, the mean room temperature was 17.65±1.22 °C, carbon dioxide at 374-811 ppm and the humidity 53-56 %. The water temperature was around 18.72±0.84 °C, the conductivity of the water was 323 μs/cm, pH was 7.5 and the dissolved oxygen was between 6.2 and 7.0 mg/l. The concentration range of total ammonia nitrogen, nitrite and nitrate were 0.06-0.25 mg/l, 0.059-0.25 mg/l and 5.0-37 mg/l respectively.

To sum up, this research presents the application of an intelligent aquaponic system. Automizing feeding and digital monitoring of water flow, fish behavior, environmental

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EMAIL: chrisvasdra@outlook.com.gr (A. 1); dimipap93@hotmail.com (A. 2); ichatzigeorgiou12@gmail.com (A. 3); aqualattos@gmail.com (A. 4); igiantsis@uowm.gr (A. 5); gntinas@ipgrb.gr (A. 6)
ORCID: 0000-0002-1257-7654 (A. 1); 0000-0002-8822-2665 (A. 3); 0000-0002-0773-9604 (A. 4); 0000-0002-6323-2955 (A. 5); 0000-0001-5205-9387 (A. 6)

conditions, and water parameters by using automatic feeders, surveillance cameras and recording sensors offered integrated management of the system. The high survival rate along with the adequate growth of the fishes are great signs of a well operating system.

Keywords
Aquaculture, hydroponics, rainbow trout, internet of things