

Aquaponics Supplying the Nutrient Film Technology and Iron Supplementation in Livestock Wastewater: Impacts on the Development of Spinach and Phantasies Species

Abstract

Aquaponics using aquaculture wastewater and 28 plants/m², respectively in each aquaporin unit during the fifth harvest, the highest yield was observed in T2 (881.74 ± 17.16 g) followed by T1 > T3 > T4 > C. The nutrient analysis of plants revealed that the iron interacted with essential macronutrients and micronutrients and had a beneficial impact on their uptake, which a significant difference was found in the fish body weight among the treatments and control. The highest fish body weight was observed in T2 followed by T3 > T4 > T1 > C. Iron has a role in oxygen transfer, cellular respiration, electron transport, etc. in fish with haemoglobin function being particularly important. Therefore, iron supplementation may be required to optimize plant production. There is a dearth of data on the effect of iron addition to aquaculture water in aquaponics on crop productivity growth of fish and health.

Keywords: Aquaponics • Iron • Nutrient film technique • Pegasus • Spinach

Introduction

The canal water supplies are limited as they are diverted to different sectors; further, the quality of groundwater and land is also becoming unfavourable, which poses a threat to the sustainability of agriculture as the increasing demand for fish, a sustainable intensive farming method (aquaponics) is being deployed water, land, and soil. Several studies have identified various essential factors for optimal aquaponic product. Roost and Hamid pour, nutrients, with only iron (Fe), potassium (K), and calcium (CA) requiring supplementation. Iron levels are inadequate to the nutrient deficiency. Iron is an important micronutrient for the growth of fish and plants in aquaponics [1]. Iron has a role in oxygen transfer, cellular respiration, electron transport, etc. in fish with haemoglobin function being particularly important. economic value, Secondary vegetative systems in aquaponics, fruiting and green vegetables are successfully grown. Spinach is a leafy green flowering plant native to Central and Western Asia in the Amaranthaceous family. The main objective of the present study aimed was to determine the

optimum dose of iron supplementation; and to evaluate the effect of *P. hypophthalmus* in NFT based aquaporin systems [2].

Material and methods

Experimental setup

A 105-day experiment was conducted in the aquaponics unit officer-Central Institute of Fisheries Education, Mumbai. The setup of the experiment consisted one control and four treatments which included 15 individual and identical aquaporin units. Every aquaporin unit had a nutrient film technique (NFT) based hydroponic unit and 174.72 L (0.80 × 0.56 × 0.39 m) capacity fish culture tanks (100 L water volume). The Fatwa's placed above the fish tank unit constructed with filter cloth and gravel before the frequency of pumping was optimum dissolved oxygen. During the experiment, new water was added to compensate for evapotranspiration loss [3].

Experimental design and procedure

The experiment used a completely

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randomized design with three replicates for four treatments and one control. With control. Ironethylenediamine-N, N'-bis (2-hydroxyphenylacetic acid) (EDDHA) (%) was used as the primary source of iron fertilization in the present study. The nitrogen cycle was established in all the treatment units bicycling for the proliferation of nitrifying bacteria [4]. The seeds of spinach were sowed in coco peat and vermicomposting using nursery trays and 28 plants/m², respectively. The fish were fed with commercial feed containing 30 % crude protein and 637 mg Fe/kg at 4 % of fish bodyweight for 15 days and then reduced to 2 % for the remaining culture period. The feed was provided at 10 hrs. And 18 this every day. Water 60th, 75th, 90th, and 105th day. The experimental period. Following the standard laboratory techniques outlined anaphase dissolved oxygen (DO), hardness; alkalinity, total ammonia nitrogen (TAN), nitrite-nitrogen, nitrate-nitrogen, and phosphate were measured. Schematic diagram of aquaponic system (b) Experimental unit. A. Agricultural Water Management the nutrients such as calcium and potassium in water were analysed following standard [5].

Results

Quality of water

The quality of water and the profile of nutrients in different treatments and control groups over the course of the experiment are presented in Table 1. The water quality parameters viz., temperature, pH, dissolved oxygen (DO), hardness, alkalinity, total ammonia Cal nitrogen (TAN), nitrite-nitrogen, nitrate-nitrogen, phosphate, potassium, and calcium varied insignificantly ($P > 0.05$) and were found to be within the permissible limit for the aquaponics ($P < 0.05$) increasing pattern. The highest iron concentration was observed in T4 (1.25 ± 0.01 mg/L), and the lowest was found in C (0.19 ± 0.01 mg/L) [6].

Growth of plant and chlorophyll estimation

Control and treatments in the second, third, fourth, fifth and sixth harvests (Fig. 2; Table 2) harvest (90th day) in treatment T2 (881.74 ± 17.16 g) followed by T1 (812.00 ± 41.07 g), T3 (692.63 ± 57.92 g), T4 (660.00 ± 15.37 g), and the treatments supplemented with iron showed higher yield compared to the control (supplemented). However, no significant difference was observed in the yield of treatments T4 and T3, and T2 and T1. Significantly higher chlorophyll-a, b, and carotenoid content were

observed in T2 and lower in control (Table 3). There was no significant difference in chlorophyll a, b, and carotenoid values among the treatments T1, T3, and T4 [7].

Nutrients in plant

Treatments and control, the increased iron supplementation in the aquaponic system showed a sharp increase in the iron concentration in leaves of spinach [8]. The highest iron content was found in T4 (278.33 ± 9.02 mg/L) and the lowest value was recorded in C (159.67 ± 9.30 mg/L) iron ions in the solution. The highest potassium content in spinach leaves was found in T2 (3.29 ± 0.17 %) and the lowest in C (2.37 ± 0.22 %). The calcium content of leaves also exhibited a similar trend [9,10].

Conclusions

The present study demonstrated that increasing dosage of iron increased the uptake amounts of iron in the leaves. The lower amount of iron not only negatively affected the iron content in the spinach, but also the uptake of other nutrients. In contrast, the higher dose of iron in treatments T3 (2.0 mg/L) and T4 (2.5 mg/L) had a negative effect. The study also demonstrated that an excessive amount of iron could be hazardous to fish if exposed to it for an extended period. Hence, close nutrition managements necessary for better results. Based on the results of the present experiment, it could be concluded that an iron dose of 1.5 mg/L is optimum for the overall efficiency of the nutrient film technique based pangasiusspinach aquaponics.

References

1. Anderson JW, Ward K. High-carbohydrate, high-fiber diets for insulin-treated men with diabetes mellitus. *Am J Clin Nutr.* 32, 2312-21 (1979).
2. Booth FW, Chakravarthy MV. Physical activity and dietary intervention for chronic diseases: a quick fix after all. *J Appl Physiol.* 100, 1439-40 (2006).
3. Roberts CK, Won D, Pruthi S *et al.* Effect of a short-term diet and exercise intervention on oxidative stress, inflammation, MMP-9, and monocyte chemotactic activity in men with metabolic syndrome factors. *J Appl Physiol.* 100: 1657-65 (2006).
4. Chandalia M, Lutjohann D, von Bergmann K *et al.* Beneficial effects of high dietary fiber intake in patients with type 2 diabetes mellitus. *N Engl J Med.* 342, 1392-8 (2000).
5. Schwartz SE, Levine RA, Weinstock RS *et al.*

- Sustained pectin ingestion: effect on gastric emptying and glucose tolerance in non-insulin-dependent diabetic patients. *Am J Clin Nutr.* 48, 1413-7 (1988).
6. Reynolds A, Mann J, Cummings J *et al.* Carbohydrate quality and human health: a series of systematic reviews and meta-analyses. *Lancet.* 393, 434-445 (2019).
 7. Beccuti G, Monagheddu C, Evangelista A *et al.* Timing of food intake: Sounding the alarm about metabolic impairments? A systematic review. *Pharmacological Research.* 125, 132-141 (2017).
 8. Anderson JW, Ward K. High-carbohydrate, high-fiber diets for insulin-treated men with diabetes mellitus. *Am J Clin Nutr.* 32, 2312-21 (1979).
 9. Booth FW, Chakravarthy MV. Physical activity and dietary intervention for chronic diseases: a quick fix after all. *J Appl Physiol.* 100, 1439-40 (2006).
 10. Wingren G, Fredrikson M, Brage HN *et al.* Soft tissue sarcoma and occupational exposures. *Cancer.* 66, 806-811 (1990).