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RECIRCULATING AQUAPONIC SYSTEM ON DWC TYPE FLOATABLE SUPPORT AT ICDIMPH – HORTING

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Current Trends in Natural Sciences

Abstract
A recirculating aquaponic system on DWC type floatable support was carried out during the research activities carried out at ICDIMPH-Horting Bucharest in the period 2017-2021. It works on the principle of communicating vessels and satisfies the technological needs of fish and plant breeding. The system was placed in a micro-greenhouse made of polyethylene foil, according to a plan for the location of technological equipment, by reconditioning and arranging tunnels for growing of grafted plants. The construction included tunnels with a length of 7.40 m and a width of 1.81 m (fish growth tunnel, 70 cm high, made of 20 mm thick OSB boards, mesh and durable foil, 8 rectangular basins, with holes for aeration, water supply and drainage and inside two layers of ultra-additive foil, 0.2 mm thick and and tunnels for growing plant material), reconditioned by mounting a protective foil, attached in PVC clips to the skeleton of the tunnel and the base of the pools with an inclined slope of 5-10% for draining water and residues), installations, pumps, filters. It has been tested for growing carp (Cyprinus carpio) and lettuce (Lactuca sativa). Fish waste have been food for plants, and plants have naturally filtered water for fish, phytosanitary treatments with synthetic substances have been eliminated, lettuce obtained has had from quality categories I and II, the fish has had hematological parameters in the reference ranges indicated in the speciality literature for carp.

Keywords: aquaponics, carp, HORTING, lettuce

1. INTRODUCTION

Aquaponics combines two growing technologies: hydroponics (growing of plants without soil) and aquaculture (growing of fish or other aquatic organisms) (James et al., 2004; Masser, 2006; Rakocy et al., 2006; Snow et al., 2012; Antenen et al., 2015; Forchino, 2017; Dragomir, 2021), it is also called a balanced ecosystem (Bogoescu, 2015).

Climate change which affects most natural ecosystems can have more effects on large and semi-controlled aquaculture systems by lowering water quality, leading to increased stress and disease outbreaks (Handisyde et al., 2017). In a recirculating aquaponic system, plants and animals support each other and thus it can grow fish and other aquatic organisms, as well as vegetables and fruits, both for own consumption and on an industrial scale, in a BIO way (FAO, 2016 - quoted by Dragomir, 2021). And other researchers also argue that aquaponic products obtained in recirculating systems are organic agricultural products (Iliescu and Bulbuc, 2016).

The culture technique on the DWC floating system is best suited for vegetable crops with green leaves, but also for other types of crops such as radishes (Zweig, 1986; Rakocy et al., 1989; Timmons et al., 2001). The direct method is based on mounting of some floating polystyrene supports directly on the water surface, it is easy to operate because the polystyrene plates are easy to handle and transport. The indirect method consists, according to Petrea (2014), in the design of long

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and deep channels of 20-30 cm, hydrodynamically profiled, positioned according to the biological filtration unit, through which circulates the technological water with nutritional load.
The research has had a main purpose, the design and construction of the aquaponic system, the monitoring of the health of 2-year-old carp (*Cyprinus carpio*) grown in a recirculating aquaponic system, including by hematological blood tests and a secondary purpose, the recording of some production aspects of lettuce (*Lactuca sativa* L.) production obtained in recirculating aquaponic system on DWC floatable support.

2. MATERIALS AND METHODS

Aquaponic system

A recirculating pilot aquaponic system on DWC floating support has been designed and built during the research activities carried out at ICDIMPH-Horting Bucharest in the period 2017-2021. This works on the principle of communicating vessels and satisfies the technological growing needs for fish and plants. The system has been placed in a polyethylene foil micro-greenhouse, according to a plan for the location of technological equipment, by reconditioning and arranging of some tunnels for growing of grafted plants.

Biological materials

The aquaponic system has been tested for growing fish, carp (*C. carpio*) and vegetables, lettuce (*L. sativa*).
The carp is the basic species of cypress in our country, it adapts relatively easily, it has a great adaptability to the environment and a great economic importance. 5 kg with carp spawn (*C. carpio*) 2 years old /each experimental pool have been tested.
Lettuce seedlings (*L. sativa* L. conv. Incocta Helm., var. *Capitata*) have been used. The lettuce is a leafy vegetable with great denitrifying potential, so it can capitalize on nitrates from fish droppings.

Phytocomplexes

The phytocomplexes administered during the experiment have been: ParaProteX mixture and TSC mixture (pomace, cinnamon, cloves). The ParaProtex mixture consists in: *Quisquqlis indica* - fruit; *Chenopodium* - powder (lemon); *Berberis vulgaris* - extract (dracil); *Tabebuia impetiginoasa* (Lapacho) - powder; *Commiphoramyrrha* (myrrh grass); *Eugenia caryophyllata* - oil (cloves); *Juglans nigra* - powder (black nuts); *Allium sativum* - powder (garlic); *Juglans nigra* - oil (black nuts); *Citrus paradisi* (grapefruit seed extract).

Hematological tests

They have been performed by collecting blood from biological fish material through to the heart puncture method. The hematological parameters determined in carp have been: erythrocyte count (E), hemoglobin (Hb), hematocrit (Ht), mean erythrocyte volume (VEM), mean erythrocyte hemoglobin (HEM). Methods of investigation of hematological parameters have been determined from whole blood.

Biometric determinations

Weighing of lettuce plants have been performed to determine quality at consumption maturity.

3. RESULTS AND DISCUSSIONS

The ecirculating aquaponic system on DWC floatable support

The construction has included tunnels with a 7.40 m length and a 1.81 m width (figure 1), as follows:

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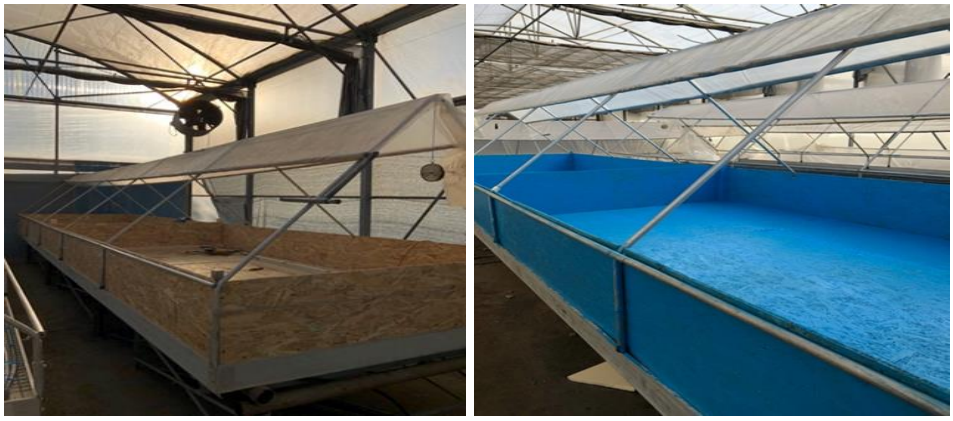
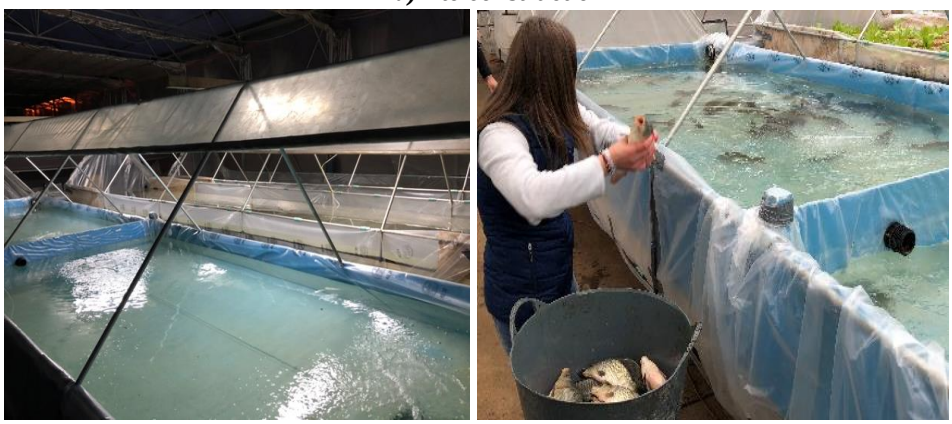
- tunnel with 70 cm high for growing of fish, made from OSB boards with 20 mm thick, resistant mesh and foil, 8 rectangular pools with holes for aeration, water supply and drainage and inside two layers of ultra-additive foil (5 additives), with 0.2 mm thick;
- tunnels for growing of vegetal material, reconditioned by mounting a protective foil, attached in PVC clips to the tunnel frame and the base of the pools with a slope of 5-10% sloping to drain of water and debris,

but also several installations, pumps, filters etc., as follows:

- IH-5.0 lighting installation, with PI plant lighting panels (LED lamps) placed on metal supports, above the hydroponic basins;
- water heating installation ("floor type");
- water drain/drain holes, with subassemblies secured with taps;
- water recirculation pump, model CPM 158 with a flow rate of 120L/minute, for wastewater collection and transport, through polypropylene pipe;
- Hailea Hap air pump;
- pawl for palnts, not to get into the water jet and to be flooded;
- water supply and drainage facilities;
- water recirculation and aeration pumps;
- water spreading diffuser;
- mechanical filter with 120 micron sieve.



a) to construction



b) to research

Figure 1. Recirculating aquaponic system on DWC floatable support at ICDIMPH-HORTING

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The haematological parameters for carp (*C. carpio*) have been within the reference ranges indicated by specialized literature, as follows:

- *Erythrocyte count (E)*: E=1,1-2,2x10^6 /µl,
- *Hemoglobin* (Hb): Hb = 6.5-10.6 g / dl,
- *Hematocrit (Ht)*: Ht=32-43,9%,
- *VEM - average erythrocyte volume*: VEM=152-364µm^3,
- *HEM - average erythrocyte hemoglobin*: HEM=50-63pgHb/eritrocit.

The quality parameters for lettuce (*L. sativa*) have been into quality categories I and II.

4. CONCLUSIONS

The recirculating aquaponic system on DWC type floatable support has presented several advantages: fish waste came from fish has become plant food, and the plants naturally filtered the fish water; the phytosanitary treatments with synthetic substances have been eliminated; fish and plants obtained in these systems and reduced space are considered organic products by the specialists from this domain; lettuce have been into quality categories I and II; the haematological parameters for carp have been within the reference ranges indicated by specialized literature; obtained agricultural products ensure the protection of consumer health and the environment.
The recommended domain of application for this aquaponic system is represented by the industrial ecosystems (fish complexes), subsistence farms, teaching and research institutions.

5. ACKNOWLEDGEMENTS

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