INSECT MEAL, INSECT FRASS AND HYDROPONIC BY-PRODUCTS FED TO COMMON CARP (*Cyprinus carpio)* WHICH WAS CO-CULTURED WITH LETTUCE (*Lactuca sativa)* IN A CLOSED-LOOP AQUAPONIC SYSTEM: AWARE PROJECT

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Figure 1: Laboratory aquaponics facility at the School of Veterinary Medicine, Aristotle University of Thessaloniki, Greece

Aquaponics is recognized as an innovative and environmentally friendly production system (Figure 1).

The results of this study aim to contribute to the enhancement of the sustainable profile of *H. illucens* larvae produced as aquafeed ingredient for fish feeds in aquaponics.

The inclusion of hydroponic by-products at high rates (50 and 75%) significantly hindered larval growth.

A total of 297 *C. carpio* individuals were obtained from a local fish hatchery and were distributed in 9 CLA systems. In the hydroponic part of the system, 108 *L. sativa* individuals were placed in the hydroponic baskets. Three diets (3 replicates/dietary treatment) were formulated, the Control diet (C) containing 15% of fishmeal, the *H. illucens* diet (B), where the fishmeal protein of the control diet was replaced at 50% by *H. illucens* meal and the plant residues (F) diet where the fishmeal protein of the control diet was replaced at 50% by a mix of *H. illucens* meal, *H. illucens* frass and hydroponic by-products at a 2:1:1 ratio.

Growth performance indicators of common carp (Table 2) showed no statistically significant differences across the three dietary treatments (p>0.05) during the 45 days of the experimental period. All 9 CLA systems effectively cultivated lettuce with optimal root-to-shoot ratios.

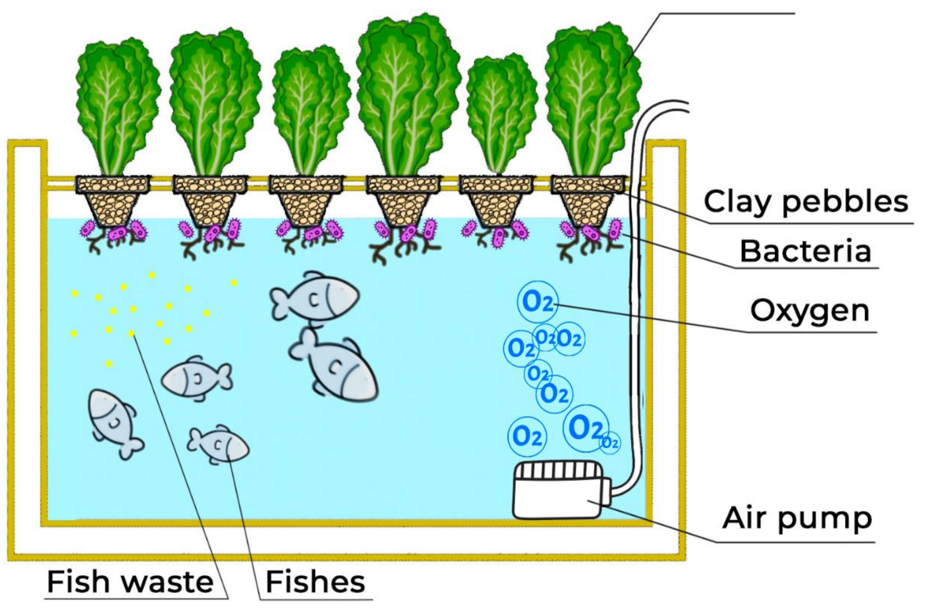
Table 2: Growth performance of carp and lettuce (means ± standard error)

	C	B	F
Weight Gain (g)	5.04 ± 1.83	5.01 ± 1.74	4.53 ± 1.71
SGR (%/day)	2.08 ± 0.11	2.15 ± 0.11	2.16 ± 0.12
Total Leaf Number	34.34 ± 0.86	36.08 ± 0.77	36.92 ± 1.27
Plant fresh weight (g)	78.01 ± 7.89	104.10 ± 8.06	89.80 ± 10.57
Plant height (cm)	21.67 ± 0.36	22.40 ± 2.64	21.65 ± 3.07
Root-to-shoot ratio	0.19 ± 0.02	0.16 ± 0.008	0.19 ± 0.032

The nutrient composition of lettuce leaves (Table 1) reveals that nitrogen was equally absorbed by all plant groups. Potassium content was statistically significant lower in treatment B (P<0.05), and zinc content was statistically significant lower in treatment F (P<0.05). The manganese content in lettuce leaves was statistically significant higher in treatment F (P<0.05) compared to the other treatments. No statistically significant differences (P>0.05) were observed between treatments for the other macro/micronutrients.

Table 1: Nutrient composition of lettuce leaves cultivated in different treatments (means ± Standard Error). Different superscripts in a row denote statistically significant differences among treatments (P < 0.05).

	Elements	C	B	F
%	Total Nitrogen	$4.1±0.1^a$	$4±0.1^a$	$4.1±0.1^a$
	P	$0.7±0.02^a$	$0.7±0.04^a$	$0.7±0.03^a$
	K	$4.1±0.1^a$	$3.5±0.1^b$	$4.2±0.3^a$
	Ca	$3.6±0.1^a$	$4±0.1^a$	$3.4±0.2^a$
	Na	$0.2±0.02^a$	$0.17±0.01^a$	$0.18±0.01^a$
	Mg	$0.7±0.04^a$	$0.8±0.03^a$	$0.7±0.04^a$
ppm	Mn	$10.6±1^b$	$10±1^b$	$14.9±0.7^a$
	Zn	$200.2±16.1^a$	$190.3±16^a$	$134.6±4.4^b$
	Fe	$42.4±4.8^a$	$38.1±3.7^a$	$37.3±3.6^a$
	B	$46.2±1.9^a$	$45.8±2.2^a$	$44.5±2.4^a$
	Cu	$8.6±1.1^a$	$8.3±0.6^a$	$7.6±0.4^a$



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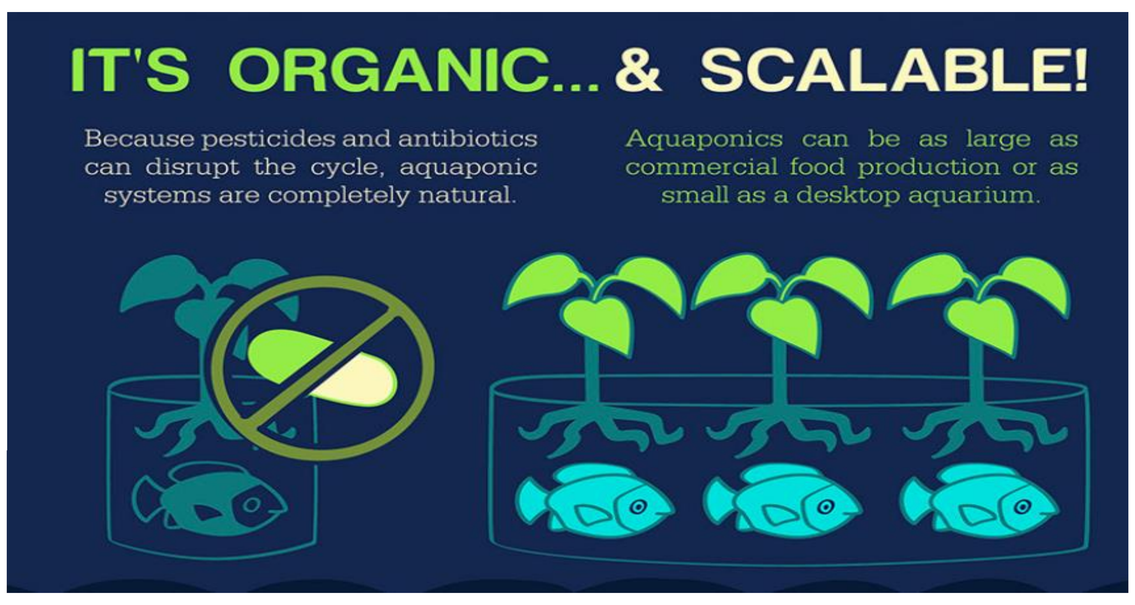

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https://zenodo.org/records/13145151 https://www.youtube.com/watch?v=1wbmetn2CJU