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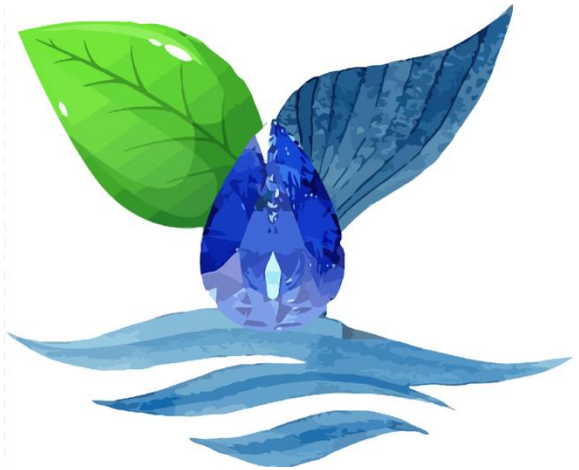
Sustainability in Aquaponics: Plants Production, High quality food and Increased Reduction of Environmental impact



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WP1: Starting-up aquaponic system, cultivation of selected plants and monitoring of the cultivation parameter (RU-PD, RU-RM, RU-SA).

The chosen plants, bean (*Phaseolus vulgaris* cv. anellino di Trento) and kale (*Brassica oleracea* var. *sabellica*) will be grown in aquaponic by tuning the cultivation parameters and compared to similar soil grown plants.

Plants will be sampled during their life cycle and monitored in terms of

- Vitality;
- Physiological state;
- Development;
- Fruiting;
- Microbiological analyses will be carried out and modification will be applied to optimize the aquaponic system (AS).

Plants will be tested both in a neutral AS and in a bacteria-promoting-activities-enriched AS.

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Task 1.1 – Assessment of growth (e.g., morphometric and morphological analysis of bean and kale).

Task 1.2 – Monitoring of plant-photosynthetic activity (e.g., electron transfer analysis, spectrophotometric quantization of photosynthetic pigments); Investigations on the oxidative state (e.g., tissue detection of ROS, analysis of antioxidant enzymes, investigations on cellular oxidative damage).

Task 1.3 – Study of the concentration of metals under varying growth conditions.

Task 1.4 – Culturable strain characterization for plant growth promotion activities and metabarcoding of bacterial aquaponic communities.

Task 1.5 – Study of the plant growth promoting activities by the isolated culturable strains.

Task 1.6 – Inoculation using the culturable fraction and evaluation of bacterial population after inoculation of different growing condition of plant (aquaponic system 0, aquaponic system with new bacteria, organic soils).

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WP2: Growth parameters variation effects on quality of selected plants (RU-RM, RU-SA).

The plant products, obtained in aquaponics with different condition, will be analyzed to assess whether the treatments have been able to improve its development, nutraceutical, and nutritional properties.

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Task 2.1 – Preparation of lyophilized matrices from dry bean seeds and kale leaves.

Task 2.2 – Extraction of phytonutrients from lyophilized matrices by using fluids under pressure (supercritical CO_2 and/or subcritical H_2O).

Task 2.3 – Analysis of metabolomic profiles of selected plants: i) total spectrophotometric measurement of phenols; ii) total quantization of flavonoids; iii) assessment of the levels of total carotenoids; iv) chromatographic characterization of the biochemical profile (i.e., qualitative and quantitative variations of selected secondary plant metabolites); v) chromatographic analysis of antioxidant metabolites.

Task 2.4 – Analysis of nutritional properties of selected plants: i) total protein content; ii) study of the quality of vegetable proteins (e.g., quantization of amino acids essentials, protein digestibility test); iii) measurement of total starch; iv) content in total sugars.

Task 2.5 – Comparison of endomembranous system in protoplasts and/or tissues in plants grown in soil and in aquaponic system.

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WP3: Analysis of polysaccharide and dietary fiber variations in relation to different growth conditions (RU-SA).

Task 3.1 – Immunochemical characterization of cell wall polysaccharides in bean seeds and kale.

Task 3.2 – Transformation of bean seeds and kale leaves with cell wall fluorescent chimeras.

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WP4: Health: analysis of biological effect of the plant extracts (RU-RM, RU-SA).

Study of the biological effect on the consumer of high-quality foods produced in aquaponics according to the proposed cultivation methods.

In vitro analysis on cell lines will be carried out to demonstrate the antioxidant and anti-inflammatory properties that these plant foods on human health. In fact, in plants there are several micronutrients known to have beneficial properties, being, respectively, capable of interacting with some antioxidant enzymes and modulators of signaling pathways involved in the inflammatory process.

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Task 4.1 – Evaluation of the antioxidant and anti-radical capacity of the plant extracts under examination, by means of DPPH and FRAP spectrophotometric assays.

Task 4.2 – Study of the anti-inflammatory capacity of plant extracts.

Task 4.3 – Investigations of the antioxidant and anti-inflammatory capacity of different concentrations of plant extracts on normal hepatic (THLE-2, ATCC #CRL-2706) and colon (CCD-18Co, ATCC #CRL-1459) cell lines and on cancerous hepatic (Hep-G2, ATCC #HB-8065) and colon (HT-29 and DLD1, ATCC #HTB-38 and #CCL-221,) cell lines by analyzing: i) cell viability (MTS test); ii) Annexin V/PI and PI cytofluorimetric assay; iii) production of nitric oxide (NO; Griess assay) and reactive oxygen species (DCF-DA); iv) synthesis and release of pro- and anti-inflammatory molecules; v) measurement of glutathione and antioxidant enzymes; vi) evaluation of the oxidative damage to macromolecules (e.g., carbonylated proteins, lipid peroxidation).

TASK 4.4 – The level of protein ANCs, in particular lectins will be evaluated. Since the majority of plant lectins exhibits a specificity against animals carbohydrates, where they evolved as a protein defense, we will measure their difference between aquaponic- and soil-cultivated plants.

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WP5: Communication and dissemination of the project and its results (RU-RM, RU-PD, RU- SA).

This WP will be dedicated to the promotion, communication and dissemination of the project, its results, and its potential on the Local, National and International stakeholders, towards the entire scientific community and not. The project will be given a specific identity, through the realization of the following Tasks:

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Task 5.1 – Creating a logo.

Task 5.2 – Development of a dedicated website.

Task 5.3 – Development of a strategic and operational communication plan that will also make use of online advertising systems tools, such as Google, Facebook, and other social-media platforms.

Task 5.4 – Development of an editorial plan which will be based on publications of scientific articles in journals with international impact and on journalistic articles with national impact.

Task 5.5 – Implementation of communication and dissemination events for the project.

Task 5.6 – Organization of demonstration events in the Botanical Gardens of Padova and Tor Vergata, aimed at presenting the proposed innovative cultivation system and its advantages.

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