AQUAPONICS: A CIRCULAR FARMING SYSTEM TO IMPROVE SUSTAINABILITY, REDUCE ENVIRONMENTAL IMPACT AND INCREASE PRODUCTIVITY AND QUALITY.

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Sustainability and innovation are the terms on which the future of agriculture depends. Globally, agricultural production will have to meet a growing demand for food and maintaining the right balance between productivity, quality, profitability, low production costs, sustainable management of natural resources and ecosystems conservation. The current agrifood system has a very negative impact on environment, economy and health, therefore an ecological footprint reduction and a more efficient use of resources necessarily need sustainable and integrated production models. This can be achieved by closing the loop between plant crops and animal production through a circular exploitation of resources. Aquaponics is a productive system that integrates Recirculating Aquaculture System (RAS) with Hydroponics (soil-less culture). It is a promising eco-friendly growing method able to increase productivity and to improve crops quality standard at competitive cost. Aquaponics is an ecosystem of plants, fish, and bacteria, growing together symbiotically. In aquaponics, nutrient-rich water from fish tanks cycles through filters, hydroponic crops and finally back purified to fish. Bacteria are biological engine of system, which removes toxic waste converting it into usable plant nutrients. Main strengths of aquaponics are: extremely efficient use of water, no need of soil and fertilizers or synthetic pesticides, production management similar to "Organic", high level of biosafety and zero-discharge. Moreover, the higher control over production may offer an advantage over soil-based growing since cultural conditions and water chemistry, can be manipulated to optimize production of nutrient-rich crops and boost natural bioactive molecules. The loop can be closed using renewables for energy demand and biological residues from crops as fish feed.

To date, several studies have shown that aquaponics growth rates and yields are higher than traditional crops, and comparable or superior to hydroponics, but qualitative aspects of productions still has not been deep studied. This PhD project aims to: i) study the expression of primary and secondary metabolites of aquaponics crops compared to traditional mode, ii) study cultural conditions that influence organoleptic and nutraceutical properties and development of quality protocols, iii) formulation of culture medium and experimentation of models and culture protocols to preserve and implement organoleptic and nutraceutical characteristics. For this purpose vegetables and officinal plants will be grown in a aquaponic pilot unit and crops analysed with Mass Spectrometry in combination with Gas Chromatography and HPLC technique, to study changes in plant primary and secondary metabolism.