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INNOVAQUA project *Technological innovation for the improvement of productivity and competitiveness of Sicilian aquaculture*: aspects of experimental biology

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The INNOVAQUA project entitled *Technological Innovation for the improvement of productivity and competitiveness of Sicilian aquaculture* aims to stimulate the potential development of existing in Southern Italy aquaculture, through the definition of new technologies for the industry that require intensive researches and development in-house, and involving different stages of the production chain. The project holds in high regard the needs of health, safety and sustainability of consumers. The scientific partners of INNOVAQUA are: Acqua Azzurra SPA; University of Messina; University of Palermo; IAMC–CNR; IZS Sicily. The project has been founded by the Operative National Program Research and Competitiveness (PON R&C) to the Technological District *Agro Bio Pesca Ecocompatibile* of Sicily.

In order to maximize profitability and expansion in the increasingly competitive market, the project includes three specific work packages (WP 1-3) (Figure 1).

First, the activities planned in WP1 (Fish species diversification) aim to identify new fish species (umbra and amberjack) of commercial interest on which will be carried out tests of reproduction and larval rearing. A stock of breeding amberjack will be set up to develop suitable techniques for maintaining in captivity.

Second, the WP2 (Productivity increase of farmed fish) activities are designed to improve the productivity of seabass and seabream, representing almost the entire Mediterranean and European production. These activities represent an opportunity for industry development through importa nt technical-scientific progress and commercial applications.

Third, the WP3 (Actions to support innovation and competitiveness) activities will focus on the improvement of fish farming conditions, through the use of active molecules extracted from marine algae. The following activities (A1, A2, A3 and A4) of Experimental Biology will be developed (Figure 2).

A1. The algal biomolecules are of considerable interest in different sectors characterized by a wide spectrum of antibiotic activity and immunostimulant, as pharmaceuticals. Such molecules can greatly differ among related species and also within the same species. For this reason, the taxonomic identification of the species is carried out by the DNA barcoding techniques. The results will yield a list of local species producing bioactive macromolecules and protocols for the extraction of phyto-derivates. Local species of macroalgae producing bioactive macromolecules have been identified and obtained crude extracts will be characterized. Different methods of extraction on the basis of various active ingredients will also be tested.

A2. Diseases of bacterial origin are cause of considerable economic losses in aquaculture. The discovery of new bioactive molecules pro-

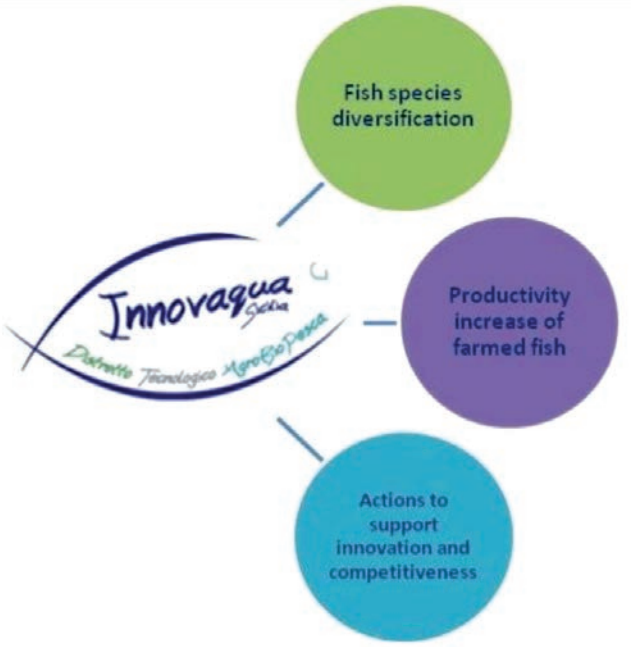

Figure 1. Three specific work packages included in the INNOVAQUA project.

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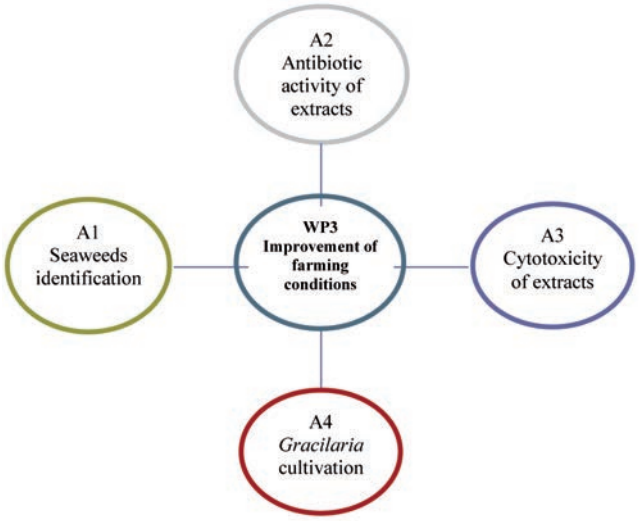

Figure 2. A1 to A4 activities of experimental biology developed.

duced by marine organisms is still today a promising challenge in the field of biotechnology, mainly in pharmaceuticals. The increasing phenomenon of resistance of pathogenic bacteria of humans and animals to current antibiotics raises the need for discovering novel active biomolecules useful in human therapy, in veterinary medicine and in the aquaculture industry, and with not any side effects on human and environmental health. Since the compounds extracted from marine algae have already been reported to have antibacterial and immunostimulant activities, in this study we analyze the extracts of algae belonging to the genera most widely distributed along our coasts against bacteria of great significance for fish and human health. Preliminary results indicate that the studied algal extracts could be sources of novel antibacterial compounds with potential use in the prevention and treatment of diseases of farmed fish.

A3. In order to evaluate cytotoxicity of algal extracts the common cytotoxicity test will be performed: the trypan blue assay that measures cytotoxicity based on alterations in plasma membrane permeability and consequent dye uptake, normally excluded by viable cells and the hemolysis assay, a sensitive and accurate tool used as a guide to assess the safety and utility of a molecule or pharmaceutical preparations. If the algal extracts will be neither cytotoxic nor hemolytic they will be administered to fish and afterwards studies on fish hematological parameters and on the gastric and intestinal transepithelial parameters, by short circuit current, I_{sc}, a measure of transepithelial ion transport will be carried out.

A4. Algae of the genus *Gracilaria* have been studied to verify various types of cultivation (on nets, on ropes). Once tested the growth of seaweeds in natural environment, a protocol for culturing these algae in the wastewater of a system of intensive aquaculture is in course of development, thus verifying the ability of seaweed to reduce the pollution load of wastewater. Also, the extractability of phycocolloids and agar from *Gracilaria* will be evaluated. The goal is the selection of strains of *Gracilaria* able to provide products of industrial interest and with capacity of phytoremediation of breeding water.

The experimental activity described is preparatory to evaluate the efficacy *in vivo* in experimental aquaculture plant. In fact, the antimicrobials and immune-boosting obtained from selected algal cultures will be tested on teleosts to assess their potential use as therapeutic and prophylactic agents.