

# Integrated research activities for the advancement of marginal areas through the promotion of knowledge and techniques that enhance agroecological, social, and economic food sustainability

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## Preamble

Food sustainability is currently one of the topics at the center of global debate. The United Nations 2030 Agenda,<sup>1</sup> the program of action for people, planet, and prosperity signed in 2015 by the governments of 193 member countries, includes among its key objectives the elimination of food shortages and malnutrition, providing the entire world population with safe, highly nutritious, and healthy food, considering food quality as important as quantity. This ambitious goal calls for doubling the production and availability of traditional and innovative foods, while respecting the environment and its natural resources and promoting processes that increase the ecological, social, and economic sustainability of agricultural activities.

Strengthening technical and scientific knowledge is an essential tool for contributing to the achievement of the 2030 Agenda's Sustainable Development Goals, particularly those related to the relationship between food and health. From this perspective, models aimed at improving the connection between new agricultural solutions and industrial systems are of particular relevance.

The European Union's Green Deal,<sup>2</sup> the set of strategic initiatives launched by the EU in 2015 to achieve an ecological transition, complements the United Nations Agenda; the latter provides the global vision, while the former can be seen as an operational translation designed for the European context. This plan invests in innovation, clean technologies, and green infrastructure. Numerous policy areas are involved, including: energy, through the transition to clean sources; industry, through the identification of strategies to make the sector more competitive, green, and digital; transportation, by reducing greenhouse gas emissions, pollutants, and noise, and making it safer and more environmentally friendly; climate, through a path aimed at achieving climate neutrality; environment and oceans, to protect ecosystems and their animal and plant biodiversity; agriculture and rural areas, sectors which need to implement sustainability, competitiveness, resilience, and vitality; research and innovation, as a driver and accelerator of the transition process; financial support for regional development actions, as investments in creating a green future.

In this context, the Standing Committee on Agricultural Research (SCAR), in its 5<sup>th</sup> report titled 'Resilience and Transformation' published in 2020,<sup>3</sup> provided research and innovation recommendations for 2021-2027 which focus on making food systems more secure and equitable, managing natural resources and diets sustainably, circularly, and respectfully, while preserving the biodiversity of agricultural systems. The goal is to promote the transition from linear

to circular economic models, significantly reduce waste, and increase the efficient use of resources also to improve resilience to potential future pandemic crises. The guidelines for research and innovation highlight the importance of agroecology, technologies, and, more generally, the acquisition of new knowledge to support this transition.

## AGRITECH: the Italian national research center for technology in Agriculture

Providing satisfying food as for both quantity and quality in order to face the increasing needs of the world population, without depleting the natural resources, is a challenge that become more and more difficult due to the present climate crisis, and the strong competition among different sectors for energy, land and water. To deal with this challenge, the European Union has supported collaborative research projects under the NextGenerationEU action and derived national programs such as the Italian National Recovery and Resilience Plan (PNRR). Within the latter, the National Research Center for Agricultural Technologies-AGRITECH has been established, organized into hubs, spokes and work packages. The research and technology transfer activities of this center focus on five main objectives: a) Enhancing sustainable productivity and promoting resilience to climatic changes; b) Reducing waste and environmental impact; c) Developing circular economy strategies; d) Stimulating the sustainable development of marginal areas; e) Promoting safety, traceability and typical traits in agri-food chains. The activities related to these objectives are divided into nine spokes/thematic areas including "Integrated models for the development of marginal areas to promote multifunctional production systems enhancing agroecological and socio-economic sustainability", which involves nine Universities, one Research Center, and three Companies. This spoke has four work packages encompassing 'Technological solution and social impacts'. One of the tasks in this work package focuses on the 'Valorization of traditional productions, local unexploited resources, and food and wine tourism', in which the University of Foggia participates through 'Multidisciplinary approaches for the valorization of traditional fermented and non-fermented food and wine products'.

## Valorization of traditional fruit productions of marginal areas through the transformation into non-perishable ready-to-eat foods

Within this framework, activities related to the valorization of processed fruit production are also carried out, which are linked to the growing demand for ready-to-eat foods with high nutritional profiles and antioxidant properties.

In this context, a study was conducted on fresh purees obtained from fruits of ancient local apple genotypes, typical of the Southern and Central regions of Italy and adapt to climate stressing conditions,<sup>4</sup> namely 'Limoncella' and 'Sergente', and from the renowned Golden Delicious cultivar, taken as a reference, all produced in a marginal area of the Daunia Apennines applying low-input growing methods. From the analysis of technological parameters, such as sugar and organic acid content, bioactive compounds known for their significant health benefits, such as vitamin C and total polyphenols, and antioxidant activity, it emerged that the purees obtained from the two local genotypes were similar in terms of chemical parameters. Compared to the puree obtained from the fruits of the reference cultivar, the soluble solids content did not vary, but the percentage of simple sugars decreased, reducing the risk of glycemic excess in the human body. Furthermore, the organic acid, vitamin C, and total polyphenol contents were significantly higher, enhancing the potential antioxidant activity. The latter, in fact, exceeded that of the reference cultivar by 20 to 50%, highlighting the interesting potential of the purees from these local apple genotypes for the production of ready-to-eat derivatives with high health value.<sup>5</sup>

Even so-called "soft fruits", or berries, represent a highly nutritional food resource traditionally found in marginal and mountain areas and produced with low-input agricultural techniques. Given their rapid perishability and susceptibility to pest infestations, preventive decontamination treatments are necessary for the use of these fruits as fresh and processed foods. However, the treatments generally require chemicals or heat, raising health and environmental concerns. A study on the use of a non-thermal and environmentally friendly treatment, such as "cold plasma", was conducted on fresh raspberries to be homogenized for the production of processed foods. Analysis of the juiciness, carbohydrate and acid content, as well as phenolic compounds and antioxidant activity demonstrated that the homogenate of these "soft fruits" grown in marginal areas offer a high concentration of bioactive compounds that can be transferred to derived foods also after cold plasma decontamination, ensuring food safety and preserving their nutritional value.<sup>6</sup>

These research activities, dedicated to the implementation and use of knowledge and technologies for the sustainable development of agri-food production, aim to contribute to the objectives of the United Nations and the European Union by pursuing the ultimate goal of reducing the environmental impact of this economic sector, promoting the development of marginalized areas, addressing climate change adaptation, and ensuring the safety and protection of traditional products in food supply chains.

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## Conflict of Interest

The authors declare that there are no conflicts of interest.

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