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Short Communication

# INNOBIORT: Product and Process Innovation for the Exploitation of the Puglia's Vegetable Biodiversity

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## Abstract

After a brief introduction, regarding definitions of biodiversity and agro-biodiversity as well as the background of Puglia vegetables, in this note is described the INNOBIORT project. This project - supported by Puglia Region under "Future In Research" program - is directed toward the agro-biodiversity exploitation of vegetable crops, which allows to preserve the quality and boost consumer demand for local varieties. Scopes of the INNOBIORT project are: 1) assessment of nutritional, quality and sensorial traits for both local varieties of Puglia vegetables and wild edible plants; 2) experimentation of cultivation techniques for a sustainable production; 3) elaboration of holistic quality indexes; 4) prototyping of new functional food. The INNOBIORT project wishes to contribute to give effective solutions for combining protection and exploitation of the agro-biodiversity with the development of an innovative, sustainable, competitive and multi-functional agro-industrial chain.

**Keywords:** Agro-Biodiversity, Functional Food, Local Varieties, Sustainability, Wild Edible Plants.

## Introduction

According to Edward O. Wilson, the term "biodiversity" is intended as the entire variability or varieties of living-forms [1], while "agro-biodiversity" is a part of this variability and represents the diversity of cultivated agricultural ecosystems [2]. For better understanding the agro-biodiversity concept, it could specify as biodiversity in vegetable crops is composed by both species diversity (inter-specific diversity) and diversity of genes within a species (intra-specific diversity). Labor operated by farmers over centuries of selection has led to the creation of a plurality of local varieties, following domestication of ancient cultivated forms, and wild plants. This represents a precious heritage to save both from a genetic and a cultural-historical point of view (Elia and Santamaria, 2013). Therefore, the agro-biodiversity related to vegetable crops has assumed very articulated connotations. It is also important to specify that a "local variety" (also called: landrace, farmer's variety, folk variety) is a population of a seed or vegetative-propagated crop characterized by greater or lesser genetic variation, which is however well identifiable and which usually has a local name. These populations are closely associated with the traditions, the knowledge, the habits, the dialects and the occurrences of the human population that have developed it and/or continue its cultivation [3]. Moreover, according to another definition of biodiversity proposed by the Food and Agricultural Organization, traditional knowledge may be regarded as an integral part of agro-biodiversity, because it is the human activity that forms and saves this biodiversity[3]. In agreement to these remarks, it is possible to highlight as traditional foods and local gastronomy are strongly linked to the agro-biodiversity, since they could be considered as an important part of human activities related to environment and sustainable use of food.

## Agro-biodiversity in Puglia and Agri-food Traditional Products

Puglia, which is located in the Southern part of Italy, is particularly rich in local vegetable varieties, obtained by farmers themselves after repeated simple selection procedures generation after generation [3]. This availability of this in situ agro-biodiversity may be able to meet not only the requirements of breeders but also the needs of specific niche markets, such as those in which there is high demand for local products grown with environmentally friendly farming techniques. The local varieties of Puglia vegetables are very appreciated both as refined food and for the intake of several healthy nutrients. For example, the fruits of *Carosello* and *Barattiere*(herbaceous plants belonging to *Cucumismelo L.* species) (Figure 1) are consumed at the immature stage, fresh and raw, instead of cucumbers, due to their better quality profile. They are characterized by being refreshing and digestible as well as having high potassium and low reducing sugar and sodium contents [4].

The "yellow-purple Polignano carrot" (a multicolored landrace of *Daucuscarota* L) (Figure 2) is greatly appreciated by local people for its special taste, tenderness, crispness, flavour, fragrance and great variety of colours, which range from yellow to dark purple in the outer core and from pale yellow to light green in the inner core. The roots of this local variety, which is grown without fertilizer near the sea, have a great potential for culinary applications and promising uses as raw material for new food products [5]. The *Acquavivadelle Fonti* red onion (*Allium cepa* L) (Figure 3) is renowned for its sweetness and is recognized by its colour, between carmine red and purple, which becomes lighter toward the inside, until it becomes completely white (Elia and Santamaria, 2013) [2]. *Galatina* and *Molfettese* (Figure 4) are two local varieties of stem chicory (*Cichoriumintybus* L., Catalogna group) that represent a nutritious and refined food [6]. In fact, these local varieties of chicory show a high content of sterols and phenols and low nitrate content [7]. The *Galatina* and *Molfettese* chicories are appreciated both raw and cooked also for the bitter-flavored stems, due to different type and levels of their sesquiterpene lactones content [8]. The *Regina* tomato (Figure 5) is the name of a tomato (*Solanumlycopersicum* L.) landrace grown in the coastal saline soils of the central Puglia. The hot-arid conditions of the local environment favored the adaptation of this landrace to the scarcity of the natural resources. So, plants of Regina are generally grown without irrigation or with sporadic supplemental irrigation by using brackish water coming from aquifers. This agronomical practice favors the obtaining of tasty tomato fruits very appreciated by local consumers. *Cima di rapa* (*Brassica rapa* L., *broccoletto* group) (Figure 6) is an ancient species of Mediterranean origin, linked to the culinary traditions of a large part of Central-Southern Italy. In the last decades, this vegetable has attracted the attention of an increasing number of consumers in Europe, United States, Canada, Argentina and Australia. In North America *cime di rapa* are also known by the names of broccoli rabe, broccoli de rabe, broccoli raab, raab, rapa, rappini, rapini, spring broccoli, Italian turnip and taitcat [9]. Recently broccoli raabhas been used in the menu for the Italy state dinner at White House [10]. The popularity of this typical Puglia's vegetable is probably due both to its aromatic taste and content of glucosinolates, well-known as important healthy compounds.

**Figure 1:** Different types of *Carosello* and *Barattiere* (Cucumismelo L.).

**Figure 2:** Yellow-purple Polignano carrot (*Daucuscarota* L.). Photo credit: Angelo Signore.

**Figure 3:** *Acquaviva delle Fonti* onion (*Allium cepa L.*). Photo credit: Beniamino Leoni.

**Figure 4:** *Molfettese* (left) and *Galatina* (right) *Chicories* (Cichoriumintybus L., Catalogna group).

**Figure 5:** Regina tomato (*Solanum lycopersicum* L.). Photo credit: Angelo Signore.

**Figure 6:** *Cima di rapa* (*Brassica rapa* L., broccoletto group).

A particular segment of Puglia's agro-biodiversity is represented by Wild Edible Plants (WEP), which includes some progenitors of cultivated vegetables with which there is a continuum in the genetic profile (Elia and Santamaria, 2013) [2]. WEP are a favorite delicacy in many countries and represent an extraordinary source of essential elements for the human health. They may be used to diversify and enrich modern diet with many colors and flavors, playing an important role in the diet of inhabitants in different parts of the world [11]. In Puglia, the harvesting of WEP is a time-honored custom and several species represent the essential ingredient to prepare some traditional food [12]. For example in the dish *Favebianche e cicorie* (Figure 7) a purée of husked broad beans (*Viciafaba* L.) cooked in earthenware is presented with boiled vegetables. The term *cicorielle* is traditionally used to indicate WEP (i.e. *Chicoriumintybus* var. *silvestre* Bischoff, *Sonchusoleraceus* L., *Helminthotecaechioides* L, etc.); however, it is possible to use different types of cultivated chicory (C. *intybusvar*. *foliosum*) as single vegetable or mixed with WEP. Crenate broomrape (*Orobanchecrenata* Forsk.) is a root parasite plant that produces devastating effects on many crop legumes and has become a limiting factor for broad bean production in the Mediterranean region. However, in Puglia it is considered a WEP used to prepare several traditional dishes. On the other hand, crenate broomrape is interesting for its content of phenols that are both flavor components and healthy compounds as antioxidants [13]. Traditionally,

the stems are clean, washed and boiled in water and salt. After boiling, the stems are soaked in water to reduce the bitter taste and used as an ingredient in several recipes, like a salad with extra virgin olive oil, vinegar, mint and fresh garlic (Figure 8).

**Figure 7:** *Favebianche e cicorielle*: purée of husked broad beans presented with boiled vegetables and raw *Acquavivadelle Fonti* red onion.

**Figure 8:** Salad of crenate broomrape (*Orobanchecrenata Forskal*) with virgin olive oil, vinegar, mint and fresh garlic.

Based on all these information we must also take into account Agri-food Traditional Products (ATP) that represent a visiting card for the quality of Italian agriculture. The ATP refer to agri-food products whose methods of processing, conservation, and maturation are maintained over time, are consistent throughout the interested territory, according to traditional rules, for a period of not less than 25 years. The exploitation of these productions must be integrated into the territory and the exploitation of the multi-functionality of farms, through initiatives also including farm visits and the development of commercial proposals with other complementary products (Elia and Santamaria, 2013)[2].

## Concept, objectives and methodological approach of the INNOBIORT project

Although Puglia represents about 22% of the Italian total vegetable-growing area, the genetic diversity of vegetable crops in this region has been eroded, due to several factors such as abandonment of rural areas, ageing of the farming population, failure to pass information down the generations (leading to loss of knowledge and historical memory), which can vary in relation to the type of genetic resource and location [14]. For these reasons, the Puglia Region planned specific actions under the Rural Development Program (RDP) in order to preserve regional genetic biodiversity. "Protection of biodiversity" is one of these actions that provides financial support for a five-year period for seed savers committed to preserving in situ the plant genetic resources listed in a specific annex of the RDP, while "Integrated projects and regional biodiversity system" funds the salvage of native plant genetic resources and knowledge of ethno-botany. The overall goal is to create a biodiversity network to promote the exchange of information between stakeholders to facilitate the diffusion and protection of genetic resources in agriculture.

The Puglia RDP is an example of protection and recovery of agro-biodiversity at risk of genetic erosion, and its implementation could help to identify much of the plant germplasm at risk of genetic erosion. Nevertheless, the financial support it provides to seed savers for preserving plant resources in situ is too limited to provide an adequate incentive for cultivation. Therefore, it must be highlighted that the in situ conservation of genetic agro-biodiversity needs to be based not only on institutional programs, but also mainly on the possibility, for young growers, of using these resources for productive activities which would imply a real income. In this regard, specific research activities should be directed toward the agro-biodiversity exploitation of vegetable crops, which allows preserving the quality and boosting consumer demand for local varieties. In this case, it could be necessary to evaluate quality traits of local varieties for promoting their diffusion in the markets. Moreover, it could be also necessary to evaluate the suitability of these vegetables, as ready to use products after the application of a food process [15].

Starting from these remarks, one scope of the INNOBIORT project is to experiment cultivation techniques for a sustainable production and innovative models for a holistic characterization of the quality. Another scope is to test industrial processes to obtain new foods, while preserving the nutritional characteristics of some local varieties of Puglia vegetables.

The work plan is organized in research and technological development activities included in follows Work Packages (WP):

- WP 1: Nutritional, quality and sensorial assessment of both local varieties of Puglia vegetables and WEP traditionally used in this region.
- WP 2: Experimentation of protocols for a sustainable cultivation of local varieties and WEP.
- WP 3: Elaboration of holistic indexes correlating data from rapid and/or non-destructive analysis with nutritional, quality and sensorial traits.
- WP 4: Prototyping of new functional based on local varieties and WEP by the application of mild technologies to preserve the nutritional quality of the raw products.

The INNOBIORT project is supported by Puglia Region under "Future In Research" program and is conducted from the Department of Agricultural and Environmental Science - University of Bari Aldo Moro (Italy), in collaboration with the Institute of Sciences of Food Production, CNR - National Research Council of Italy.

## Expected Results and Impact

### Potential results expected:

- Integrated quality characterization and development of innovative techniques to obtain holistic indexes for some nutritional and economical traits;
- New functional foods: prototypes of ready to use products based on typical vegetables and WEP;
- Cultivation protocols for WEP and local varieties of Puglia vegetables;
- Original results exploitable for future industrial research and/or for new patents/trademarks.

The INNOBIORT project wishes to contribute to give effective solutions for combining protection and exploitation of the agro-biodiversity (diffusion of vegetables at risk of genetic erosion) with the development of an innovative (new process and agri-food products), sustainable (integrated with the territory and the local agri-food system), competitive (healthy and quality products) and multi-functional (promotion of gastronomic tourism) agro-industrial chain. The identification of the qualitative traits of the vegetables at risk of genetic erosion, the development of new methods to measure the quality, and the creation of new foods based on these vegetables are all objectives that are consistent with the interests to protect and exploit the biodiversity and typical Mediterranean productions. In effect, by easily identifying the functional traits of typical vegetables (expression of biodiversity) and exploiting them by the creation of new functional foods (in convenience foods), it is possible to create the optimal conditions for an increase in demand and thus an increase in the cultivated area. Therefore, they could trigger spontaneous mechanisms of an in situ conservation currently promoted only by government interventions (i.e. prizes to keepers-farmers). The suggested exploitation is also consistent with the interest for "healthy products", expression of a "sustainable and competitive agri-food industry", because it proposes functional foods processed with mild technologies able to preserve their healthy properties. Finally, the development of growing protocols satisfies the interest towards the rational use of resources and innovative cropping systems with the perspective of the environmental sustainability and an integration with the territory.

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