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Commentary

A manifesto for the valorization of wild edible plants

Loretta Bacchetta [a,1], Francesco Visioli [b,k,*,1], Giulia Cappelli [c], Emily Caruso [d], Gary Martin [d], Eva Nemeth [e], Gianni Bacchetta [f], Gianni Bedini [g], Alexander Wezel [h], Tedje van Asseldonk [i], Leo van Raamsdonk [j], Francesca Mariani [c], on behalf of the Eatwild Consortium [a,2]

[a] ENEA BIOAG-PROBIO, Rome, Italy
[b] Department of Molecular Medicine, University of Padova, Italy
[c] Institute Cell Biology and Neurobiology, National Research Council, Monterotondo, RM, Italy
[d] Global Diversity Foundation, UK
[e] Szent István University Budapest, Hungary
[f] University of Cagliari, Italy
[g] University of Pisa, Italy
[h] ISARA-Lyon, France
[i] IEZ Ltd., Beek, The Netherlands
[j] SDLO, Wageningen, The Netherlands
[k] IMDEA-Food, CEI UAM+CSIC, Madrid, Spain

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ABSTRACT

Ethnopharmacological relevance: Wild foods constitute an essential component of people's diets around the world, but despite their widespread use and their cultural importance, wild edible plants (WEPs) lack recognition as significant contributors to the human diet in developed countries.
Materials and methods: We stimulate national and international bodies dealing with food and agriculture, to increase their attention and investments on WEPs, leveraging the results of scientific investigation, enhancing the link between in situ conservation strategies and sustainable use of plant genetic diversity.
Results and conclusions: WEPs should be reconsidered throughout their value chain, capturing their important socio-cultural, health, and economic benefits to indigenous and local communities and family farmers who are engaged in their production and wild-harvesting.

1. Introduction

Wild foods constitute an essential component of people's diets around the world (de Cortes Sánchez-Mata and Tardío, 2016). According to the Food and Agriculture Organization (FAO), over 100 million people in the EU (i.e. 20% of the population) consume wild foods, while 65 million (14%) collect some form of wild food themselves at least occasionally (Łuczaj et al., 2012; Schulp et al., 2014). The EU BiodivERsA program (www.biodiversa.org) identified a total of 592 plants, from 305 genera, gathered from the wild in 17 countries in the EU. Simultaneously, wild plants form part of the cultural history of a region, contributing to people's local identity and traditions, as the Traditional and Wild Central Europe project (www.traditionalandwild.eu) concluded. Dishes made with wild plants are often identified as functional foods (foods with biological effects that go beyond their mere nutritional properties) and wild plants can contribute to overcoming periods of food or income shortages (Hernandez Bermejo and Leon, 1994). However, apart from a handful of studies (Heinrich et al., 2006b; Schaffer et al., 2005; Schunko et al., 2012; Schunko and Vogl, 2010; Tardío et al., 2006), quantitative data on wild food collection are

Abbreviations: CVD, cardiovascular disease; CWRs, crop wild relatives; EU, European Union; FAO, Food and Agriculture Organization; WEPs, wild edible plants

* Corresponding author at: Department of Molecular Medicine, University of Padova, Italy.
E-mail address: francesco.visioli@unipd.it (F. Visioli).

[1] These two authors contributed equally to the manuscript.

[2] *Eatwild Consortium* Sabine Glasl-Tazreiter, University of Wien, Austria; Slavica Dudas,Rjeci, Croatia; Marja Gregori, BCN, Naklo, Slovenia; Rudolf Bauer, University of Graz, Austria; Marwan Sabban, AUB, Beirut, Lebanon; Mauricio Izquierdo, University UNIMINUTO, Bogotà, Colombia; Daniela Di Baccio, Institute of Agro-environmental and Forest Biology (IBAF) CNR, Rome, Italy.

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scarce and scattered. By 'Wild edible plants' we intend a food-centered subcategory of the category 'utilized wild species' (Maxted et al., 2011a, 2011b) that includes Crop Wild Relatives (CWRs) and neglected crops that have the potential to diversify on-farm production and regional diets. It mostly includes native species growing in their natural habitat, but that may be managed, as well as introduced species that have been domesticated (Hadjichambis et al., 2008; Leonti et al., 2006; Menendez-Baceta et al., 2012). In the last decade, for example, borage (*Borago officinalis* L.) has received increasing agricultural interest because of the potential market for gamma linolenic acid extracted from its seeds (El Hafid et al., 2002). Similarly, purslane (*Portulaca oleracea* L.) is a major source of short-chain omega 3 fatty acids, alpha-tocopherol, and bioactive compounds (Uddin et al., 2012) and, because of this, there is increasing interest for its cultivation as food crop (De Lisi et al., 2014). Purslane also appears to be an excellent candidate for inclusion in saline drainage water reuse systems (Grieve and Suarez, 1997).

Despite the widespread use of wild foods, and their cultural importance, they lack recognition as significant contributors to the human diet. Plant and animal domestication, perhaps the most important cultural development of the past 13,000 years of human history, has resulted in the selection and use of a limited number of species for cultivation and commercialization (Heinrich et al., 2006a, 2006b). According to Garn and Leonard there exist between 300,000 and 500,000 plant species on the planet, 30,000 of which are thought to be edible (Garn and Leonard, 1989). Throughout history, of these 30,000 edible plants, only 7000 have been either cultivated or collected as food (Collins and Hawtin, 1999; Chivenge et al., 2015). Yet currently only 20 species provide for 90% of the world's food requirements with wheat, maize and rice accounting for 60% of man's diet (Prescott-Allen and Prescott-Allen, 1990); www.pfaf.org). Given the significant – and largely untapped – nutritional, agricultural, economic, and ecological potential of wild edible plants (WEPs), their current limited use is a lost opportunity which implies costs for our economy and society. In the face of rapid environmental change, particularly global climate change, livelihoods and agro-ecosystems are increasingly reliant on cheaply available, environmentally friendly, resilient and adaptable sources of nutritious foodstuffs (Dempewolf et al., 2014; Reyes-García et al., 2015). If appropriately acknowledged, harnessed, transformed, and publicized, WEPs will further enhance both the wellbeing of rural and urban communities and agricultural productivity.

In the context of agricultural evolution, WEPs are of particular importance because they are at the dynamic interface between native useful plants, edible ruderal species and domesticated crops. Some of them, for example *Brassica spp*., are wild relatives of important vegetable crops, providing a critical reservoir of genetic diversity (Branca et al., 2011). Others, such as *Portulaca oleracea* L. and *Urtica dioica* L., are occasionally cultivated as minor crops in Europe and elsewhere but are primarily known as invasive species that colonize ruderal environments and occupy anthropogenic spaces, such as gardens and cultivated fields (Amirul Alam et al., 2014). Some WEPs, such as *Reichardia picroides* (L.) *Roth* and *Borago officinalis* L., are being domesticated and show signs of human selection and genetic modification, but are not yet completely dependent on people for their survival (Dempewolf et al., 2008). Wild species such as *Scolymus hispanicus* L. and *Malva spp* L. were widely cultivated in Roman times (Frayn, 1975; Hernandez Bermejo and Leon, 1994; Kuijper and Turner, 1992) and later abandoned. Others, like *Campanula rapunculus* L. and *Atriplex hortensis* L., are found as relics of former widespread cultivation that have returned to a semi-wild state as a result of displacement by more popular crops. This hidden harvest is beginning to re-emerge in gardens and kitchens around Europe, where we increasingly find products such as black salsify (*Scorzonera hispanica* L.), amaranth (*Amaranthus spp.)* and burdock (*Arctium lappa* L.) in farmers' markets and nettle soup (*Urtica dioica* L.) in restaurants (Łuczaj et al., 2012; Turner et al., 2011; Turreira-García et al., 2015).

Given this complex natural and social history, WEPs have an immense potential to enhance food sovereignty, improve nutrition, diets, and wellbeing, diversify agricultural productivity and improve the resilience of diverse crops (Box 1). As many are in an advanced state of genotypic and phenotypic modification (Supplementary Tables 1 and 2), they are predisposed to domestication.

2. WEPs as contributors to health

Despite the gradual abandonment of traditional practices, pressures of changing markets, and changes in lifestyle, in many areas of Europe there has been a recent resurgence in interest in, and harvest and use of, WEPs – particularly in urban areas (Tardío, 2010). Health food shops in Spain, Poland, Italy, Estonia, and France offer products made, or enriched with, wild herbaceous plants, for example *Cichorium intybus* based coffee, *Taraxacum spp.* syrups, and pasta made with powder of *Urtica spp*. WEPs are sold in local markets, especially in Mediterranean countries such as Italy, Croatia, Greece, Spain, and Turkey (Dogan et al., 2013).

The functional food and nutraceutical market is steadily growing and will reach a total turnover of about €43 billion by 2017 (Marone et al., 2016).

Simultaneously, new gastronomies and experimental cuisines within diverse entrepreneurial initiatives have shown a growing interest in wild food items, tapping the repertoire of WEPs.

However, the physiological significance of the consumption of WEPs is largely unexplored (with some exceptions described by Heinrich et al. (2006b) and Schaffer et al. (2005)). Moreover, the real impact of the regular consumption of these foods in terms of the prevention of diet-related, preventable and chronic diseases is unknown. In general, plants from the wild tend to be richer in micronutrients and bioactive secondary metabolites than corresponding cultivated ones (Heinrich et al., 2006a, 2006b). Scholars have shown that wild vegetables often contain high concentrations of minerals, proteins, high levels of vitamins A and C, and significant percentages of fiber, often more so than in cultivated vegetables (Aberoumand and Deokule, 2009; Amirul Alam et al., 2014; Guil Guerrero et al., 1998). Wild plants also generally contain a large spectrum of plant secondary metabolic products like polyphenols, terpenoids, polysaccharides, etc., which make them good candidates as "nutraceuticals", i.e. functional foods, which contain potentially health-promoting ingredients. More than a simple food, WEPs may constitute proto-dietary supplements with hypothetical cardio- and chemopreventive properties (Visioli and Galli, 2001; Visioli et al., 2004), e.g. via microbiota modulation (Goulet, 2015) or nitrate provision (Bondonno et al., 2015).

Nevertheless, data on the safety of WEP use in nutritional supplements is scarce as only a very limited range of plant species has been thoroughly investigated and large arrays of species are only tentatively listed (ESCO working group on botanicals and botanical preparation, 2009). Similarly, there exist few surveys on WEPs for veterinary use (Van Raamsdonk et al., 2015). WEP metabolic pathways may also produce toxic compounds, which must be detected in order to safeguard human and animal health (Mohan and Kalidass, 2010). WEPs may also contain high levels of toxins accumulated from the environment. The potential for bioaccumulation of such toxins can be put to good use in the phytoremediation of contaminated soils yet it is important to ensure that plants for human and animal use are harvested from safe soils.

However, numerous WEPs have been studied in vitro models with human cells and shown to possess potentially beneficial