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Wild edible plants as a source of mineral elements in the daily diet

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Introduction

What are 'wild edible plants'? According to Kalle and Sõucand (1) this term could refer to edible plants growing without intentional cultivation by people. Nevertheless, an important and often controversial point is the distinction between 'wild' and 'domesticated' plants, since there could be many intermediate stages between the use of wild plants and true domestication. Indeed, many wild species can occasionally be grown and some cultivated plants, that are not completely domesticated, sometimes grow like wild vegetables (2). Moreover, Elia and Santamaria (3) defined 'edible spontaneous plants' including… «*some progenitors of cultivated vegetables with which there is a continuum in the genetic profile*».

In the context of this note, the term 'wild edible plants' (WEP) indicate just the vegetables which grow spontaneous without any external input and/or human action. Therefore, WEP may be considered exclusively as the result of the interaction between vegetable biodiversity, ecosystem and natural resources.

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 (4). In Southern Italy, the harvesting of WEP is a time-honored custom and several species represent the essential ingredient to prepare some traditional food (3, 5, 6) (Fig. 1).

In the not so distant past many WEP constituted valuable supplementary sources of nutrition, instead of being eliminated from agricultural systems as for weeds. It is not a case that in the past our ancestors have usually gathered and eaten several WEP. Nevertheless, at the present also the most expert farmers know and utilize only few wild species as food (7). Fortunately, a recent interest on WEP is increasing for the greater attention toward a healthy diet as well as for the higher needs to restore a link with nature and old gastronomic traditions. Probably, the growing interest in the use of WEP nowadays stems from need to find alternatives to the industrialization and globalization of agriculture and to provide food security and shaping alternative models of consumption (8). Therefore, new trends seem to emerge and the interest for WEP is gaining many media attention; thus: 1) numerous field

Figure 1. *Fave bianche e cicorie*: purée of husked broad beans presented with boiled vegetables and raw *Cipolla rossa di Acquaviva delle Fonti*. This recipe is listed as a Traditional Agri-Food Products of Puglia (Southern Italy) by the Italian Ministry of Agriculture. The term *cicorie* is usually used to indicate several WEP (i.e. *Cichorium intybus L.*, *Sonchus* spp., *Helminthotheca echioides* [L.] Holub, etc.) (5).

guides are issued; 2) wild food/foraging workshops are organized; 3) new culinary vogues are promoted by media and health-oriented people (9).

WEP and dietary intakes of mineral elements

In recent years, there is a growing interest for the evaluation of mineral elements in vegetables due to their nutritional properties and beneficial health effects (10). Knowledge of the mineral elements content in food is needed especially for specific consumers like vegans. Generally, mineral elements are involved in several functions such as the regulation of enzymes activities, the preservation of osmotic and acid-base equilibrium, membrane transport mechanisms, and muscular and neural transmissions. They may also have a structural role, being constituents of bones or other tissues (11, 12). Some of the Nutrient Reference Values (NRV) for daily mineral elements intake established by the EU Regulation 1169/2011 (13) are reported in Table 1.

In this context, many WEP may be considered as good sources to dietary intakes of mineral elements. For example, most WEP usually contain more than 300 mg 100 g^{-1} fresh weight (FW) of potassium and many of them range into 500-1000 mg K 100 g^{-1} FW. Moreover, some WEP, such as such as *Beta vulgaris* L. subsp. *maritima* (L.) Arcang., *Chondrilla juncea* L., *Camelina rumelica* Velen., *Scolymus hispanicus* L., *Silybum marianum* (L.) Gaertn. and *Chenopodium album* L., can contain about 1000 mg K 100 g^{-1} FW or more (6, 14). Consequently, considering a serving size of 100 g, a portion of these WEP may provide about 50% of the potassium daily intake (Tab. 1).

As regards calcium, that is the fifth most abundant element in the human body (14), WEP have been found to be a good source. Indeed, many WEP such as *Parietaria officinalis* L., *P. judaica* L., *Urtica dioica* L. subsp. *dioica*, *Amaranthus retroflexus* L., *Chenopodium murale* L., *Tordylium apulum* L., *Foeniculum vulgare* Mill., *Borago officinalis* L., and *Diplotaxis erucoides* (L.) DC. subsp. *erucoides* can contain between 400-800 mg Ca 100 g^{-1} FW or more (6, 14). Thus, a serving size of these WEP could supply 50-100% of the daily intake (Tab. 1). Nevertheless, it is important to highlight that some WEP may present high levels of oxalate, which may significantly reduce the calcium bioaccessibility and promote Ca oxalate stone formation (15). For this reason, WEP with a ratio of oxalate/calcium lower than 2.5 should be preferably for human diet. Therefore, some WEP, such *F. vulgare* Mill., *Malva sylvestris* L. subsp. *sylvestris*, *Capsella bursa-pastoris* (L.) Medik. subsp. *bursa-pastoris*, *Eruca vesicaria* (L.) Cav., or some *Plantago* spp., would be a good nutritional choice for both their Ca content (>35% NVR) and low oxalate/calcium ratio (<1) (14).

Magnesium is the fourth most abundant mineral element in the human body and the second most abundant intracellular cation (4, 14). Among WEP some species of the genus *Chenopodium* may provide more than 375 mg Mg 100 g^{-1} FW (14), reaching almost the whole magnesium daily intake for a serving size (Tab. 1). Moreover, other WEP, such as *Sanguisorba minor* Scop., *Bunias erucago* L., *P. judaica* L., *U. dioica* L. subsp. *dioica*, *Portulaca oleracea* L. and *Verbena officinalis* L., also represent a good Mg source, since they can contain between 150-200 mg Mg 100 g^{-1} FW (14), supplying about 50% of the daily intake for a serving size (Tab. 1).

Apart from the mineral macro-elements (needed in amounts of about 100 mg per day or higher) previously described, WEP could be considered also a good sources of micro- and trace elements, needed in lower amounts but essential to maintain body functions. For example some WEP such as *Amaranthus viridis* L., and *Polygonum bistorta* L. can contain between 5-6 mg Fe 100 g^{-1} FW (14), supplying about 35-40% of the daily intake for a serving size (Tab. 1). Moreover, many other species, such as *Cakile maritima* Scop. subps. *maritima*, *Rumex vesicarius* L., *Portulaca oleracea* L., *Verbena officinalis* L., *Sonchus tenerrimus* L., *Sisymbrium irio* L. and *Picris echioides* L. show also high iron values (around 4 mg 100 g^{-1} FW) (14). It is interesting to highlight that the iron content of these WEP is higher in comparison with some cultivated vegetables, such

Table 1. Nutrient Reference Values (NRV) of the daily intakes (refered to adults) for some mineral elements according to the European Union Regulation No 1169/2011 (13).

K	Ca	Mg	Fe (mg per day)	Mn	Zn	Cu
2000	800	375	14	2	10	1

spinach (2.8 mg 100 g^{-1} FW) (6), usually considered as the vegetable source of this mineral element.

As regards manganese, some WEP such as *Chenopodium* spp., *Chondrilla juncea* L., and *Montia fontana* L. can contain over 1 mg 100 g^{-1} FW, supplying about 50% of the daily intake for a serving size (Tab. 1); these amounts are rarely found in conventionally grown vegetables (16). However, also many other WEP could be considered as a good manganese sources, providing more than 0.3 mg 100 g^{-1} FW: *Portulaca oleracea* L., *Asparagus acutifolius* L., *Urtica dioica* L. subsp. *dioica*, *Verbena officinalis* L., *Salicornia europaea* L., *Sonchus asper* (L.) Hill, *Chenopodium opulifolium* Schrad. ex W. D .J. Koch & Ziz and *Chenopodium murale* L. (14).

Zinc, the second in abundance among trace elements after iron, supports several important functions in the human body. WEP are not generally recognized as good sources of this element, exhibiting Zn levels usually below 1 mg 100 g^{-1} FW (4) (about 10% of the daily intake – Tab. 1), which are also the levels usually found in grown vegetables (16). On the other hand, some WEP such as *Smilax aspera* L. and *Chenopodoium* spp. could contain an amount about two-fold higher in comparison with other WEP and domesticated vegetables (14).

Finally, regarding copper some WEP such as *Portulaca oleracea* L., *Asparagus acutifolius* L., *Verbena officinalis* L., *Salicornia europaea* L. contain between 0.3-0.4 mg Cu 100 g^{-1} FW (14), supplying about 30-40% of the daily intake for a serving size (Tab. 1). Other WEP, such as *Urtica dioica* L. subsp. *dioica*, *Chondrilla juncea* L. and *Papaver rhoeas* L. subsp. *rhoeas*, can show an average contents over 0.4 mg Cu 100 g^{-1} FW, although with a wide variability (14).

On the basis of all above reported information, it is possible to highlight that there is a great potential for WEP to play a major role in a more sustainable and diversified diet (17), considering that they may be regarded as good vegetable sources of many mineral elements. It could therefore be concluded that the consumption of WEP should be encouraged not only for preserving traditional food habits as a valuable cultural heritage but also as an useful tool for improving the nutritional quality of the daily diet. In perspective, future research activities could be needed to assess the content of mineral elements also in domesticated WEP with the aim to promote a large-scale diffusion of these promising food product expression of vegetable biodiversity.

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