



Antioxidant Activity of *Plantago* Species in Vegetative and Flowering Stages

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Dear Editor in Chief

Plantago L. genus (*Plantaginaceae*) includes a large number of species differing in salt tolerance; many of them are adapted to live in saline environments, thus making the genus *Plantago* a good model for comparative studies about responses to salinity stress (1). *Plantago* genus includes species well-known as medicinal plants and others can be used for food and animal feeding (*P. coronopus*, *P. lanceolata*, *P. serraria*). A large amount of data about the *Plantago* species usage refers to the leaves both in traditional and modern medicine. Extensive use of many *Plantago* species based on a remarkable variety of curative properties: astringent, antioxidant, anti-fungal, anti-cancer, antibacterial, spasmolytic, antiviral, antihyperlipidemic, immunostimulant, antitoxic, epithelising, pro-coagulant, anthelmintic etc (2). The seeds of several *Plantago* species are used as laxative, due to their emollient and diuretic properties. On the other hands, the seeds mucilage is an excellent thickening agent used in cosmetics but also as a stabilizer in the ice-cream industry or chocolate products (3). In addition, some *Plantago* species are also included in the diet being used as fresh salads, soups or side dish as well as herbal tea (4).

Plantago species contain several phytochemicals like caffeic acid derivatives (caffeic acid, ferulic acid, chlorogenic acid, plantamajoside R, acetoside R, p-cumaric acid and vanillic acid), lipids,

mucilage polysaccharides (plantaglucide, glucomannan), monoterpenoids (linalool), flavonoids and flavone glucosides (aspigenin, scutallarin, plantagonin, baicalein, luteolin, luteolin 7 glucoside, hispidulin 7 glucuronide), iridoid glycosides (aucubin, catapol, gardoside, geniposidic acid, mayoroside, melittoside), as well as terpenoids (loliolid, oleanolic acid and ursolic acid) and tannins. Alkaloids (indicain, plantagonin) and some organic acids have also been detected (5). In addition, *Plantago* species could be regarded as a possible new source of natural antioxidants (6). Moreover, there is a scenario describing the future in terms of increasing salt-affected areas in agriculture, the scarce of fresh water, food crisis and continuously growing population (7). Thus, there is a serious demand for extending the knowledge about salinity tolerance in plants with economic potential.

Nowaday there is a great interest focused on the natural food or medicinal plants due to their well-known abilities to scavenge free radicals, which are toxic. In this context, we tested the antioxidant activity of five *Plantago* species (*P. maritima* L., *P. media* L., *P. lanceolata* L., *P. coronopus* L. and *P. schwarzenbergiana* Schur), which have been collected different during vegetative and flowering stages. *Plantago* plant material has been collected from two saline areas located in Northeast (Valea Ilenei nature reserve) and South-East (Dobrogea –

Sulina) of Romania, during April-May and June-July of 2013, corresponding to vegetative stage and anthesis, respectively. Antioxidative activities of methanol extracts from plantain species were characterized by the DPPH scavenging test. Thus, DPPH reacts with an antioxidant compound, which can donate hydrogen and reduces DPPH. Moreover DPPH is a kind of stable organic radical and the capacity of biological compounds to scavenge the DPPH radical can be expressed as its magnitude of antioxidant ability. The plants with higher capacity donating of hydrogen have shown higher DPPH free radical scavenging activity. In

fact, antioxidant activity is monitored by measuring the change in colour (from deep violet to light yellow) which was detected by spectrophotometric method at 517 nm. The DPPH radical scavenging activity was recorded in terms of % inhibition (8). Data on the inhibition percentage (of DPPH) of leaves methanol-extractions of *Plantago* species are depicted in Table 1. The results revealed that the DPPH scavenging activity in extracts of *Plantago* species in vegetative stage varied from $21.70 \pm 5.14\%$ to $90.86 \pm 3.13\%$ in *P. schwarzenbergiana* and *P. lanceolata*, respectively.

Table 1: DPPH scavenging activities (as % inhibition) of methanolic extracts from the leaves of five *Plantago* species in vegetative and flowering stage (mean \pm standard deviation, n = 5)

Collecting point area	Species	Growth stage	
		Vegetative stage (% inhibition)	Flowering stage (% inhibition)
Dobrogea	<i>P. maritima</i>	49.88 ± 3.86	51.21 ± 1.37
	<i>P. media</i>	38.12 ± 0.17	44.56 ± 1.24
	<i>P. lanceolata</i>	42.41 ± 1.16	40.29 ± 4.85
Valea Ilenei	<i>P. coronopus</i>	71.73 ± 6.52	21.56 ± 1.95
	<i>P. media</i>	81.77 ± 4.57	77.67 ± 4.51
	<i>P. lanceolata</i>	90.86 ± 3.13	94.17 ± 0.36
	<i>P. schwarzenbergiana</i>	21.70 ± 5.14	45.56 ± 14.64

Regarding species sampled in flowering stage the minimum DPPH scavenging activity was recorded in the extracts of *P. coronopus* ($21.56 \pm 1.95\%$) while the maximum DPPH scavenging activity was observed in *P. lanceolata* ($94.17 \pm 0.36\%$) collected from Valea Ilenei. For the same samples, higher % inhibition in *P. lanceolata* extracts during both stages indicates better scavenging activity or antioxidant potential. Similar results have been also reported by Miser-Salihoglu et al. (2013), when studying the antioxidant activity of some herbals used in folk medicine; it has found that it was higher for *P. major* ssp. *major* and *P. lanceolata* as evaluated by the same method (9).

There is no significant difference between the antioxidant ability of *Plantago* extracts obtained from plants collected during vegetative and flowering stages. Nevertheless, concerning *P. coronopus* from Dobrogea, results showed that scavenging effect

was three fold higher in case of vegetative stage than flowering. On the other hands, *P. schwarzenbergiana* collected from Valea Ilenei revealed that antioxidant activity was twofold higher in flowering stage than vegetative stage. Our results are in agreement with other data (10) evidencing that the extract prepared from *Plantago* species possess significant antioxidant activity.

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