Iodine biofortification of *Eschscholzia californica* Cham. and its effect on the mineral composition of plants

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Introduction

One of the greatest challenges facing global health policy is the burden of chronic non-communicable diseases caused by nutrient deficiencies. Plants' biofortification has been proposed as a method of introducing essential nutrients into the human diet. An increased level of one element can affect the content of others in the plant and, thus, the health-promoting properties of plant materials.

Fig. 1 *E. californica* during cultivation in a greenhouse

Methods

The study aimed to determine the effect of biofortification with mineral (KI) and organic forms of iodine on the mineral composition of *Eschscholzia californica* plants grown in a hydroponic system (Fig 1). The following combinations were tested: (1) Control; (2) potassium iodide (KI); (3) 5-iodosalicylic acid (5-ISA); (4) 3,5-diiodosalicylic acid (3,5-diISA) (Fig.2). To determine the content of macro- and microelements using an ICP-OES spectrometer, plant samples were digested in HNO_3.

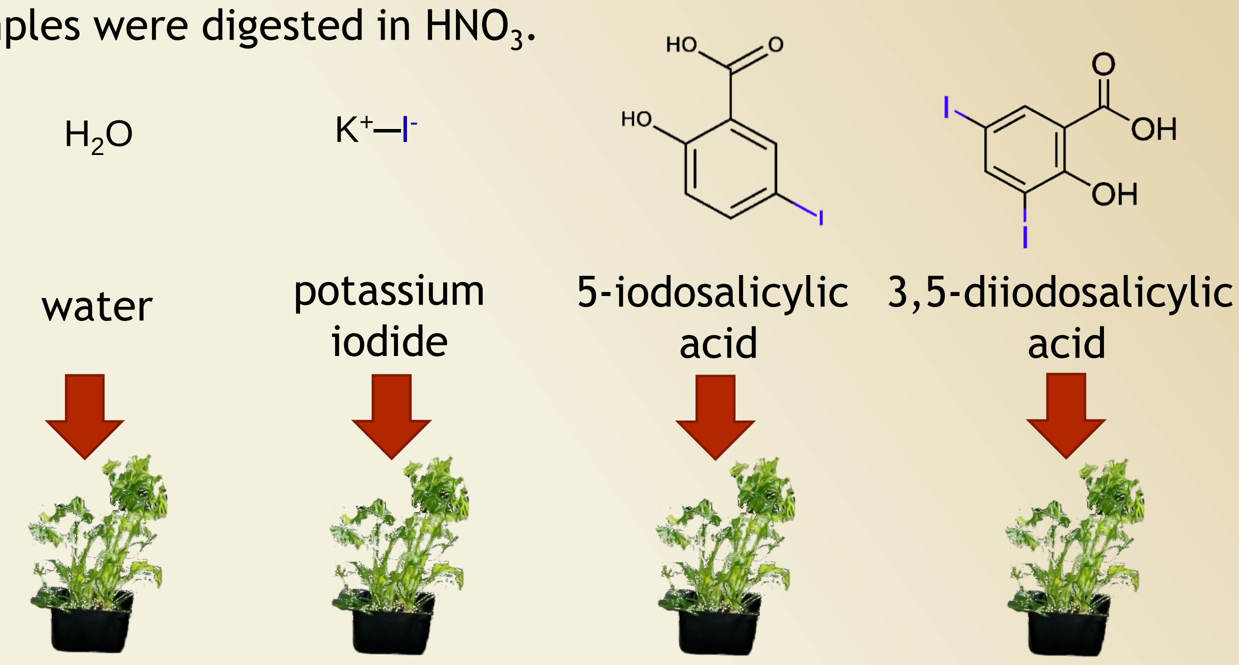

Fig. 2 Graphical representation of iodine supplementation in experimental groups

Results

Control plants had the highest macronutrient accumulation (Fig. 3). Particularly significant decreases were observed for K and Mg. The use of 5-ISA and 3,5-diISA resulted in a greater decrease in macronutrient content than KI, especially for P, K, and Mg. The concentrations of Be, Cr, and Fe did not differ significantly from those of the control group. The lowest concentrations of B, Ba, Li, Na, Al, Bi, Co, and Cu were observed after the use of mineral iodine. The content of most micronutrients was higher after the use of 5-ISA than after the use of 3,5-diISA. For Ni, all enrichment treatments increased the concentration of this element in the series 3,5-diISA > 5-ISA > KI, whereas KI and 5-ISA increased Zn concentration. The use of 5-ISA increased Al levels in the plant compared to the control group (Table 1).

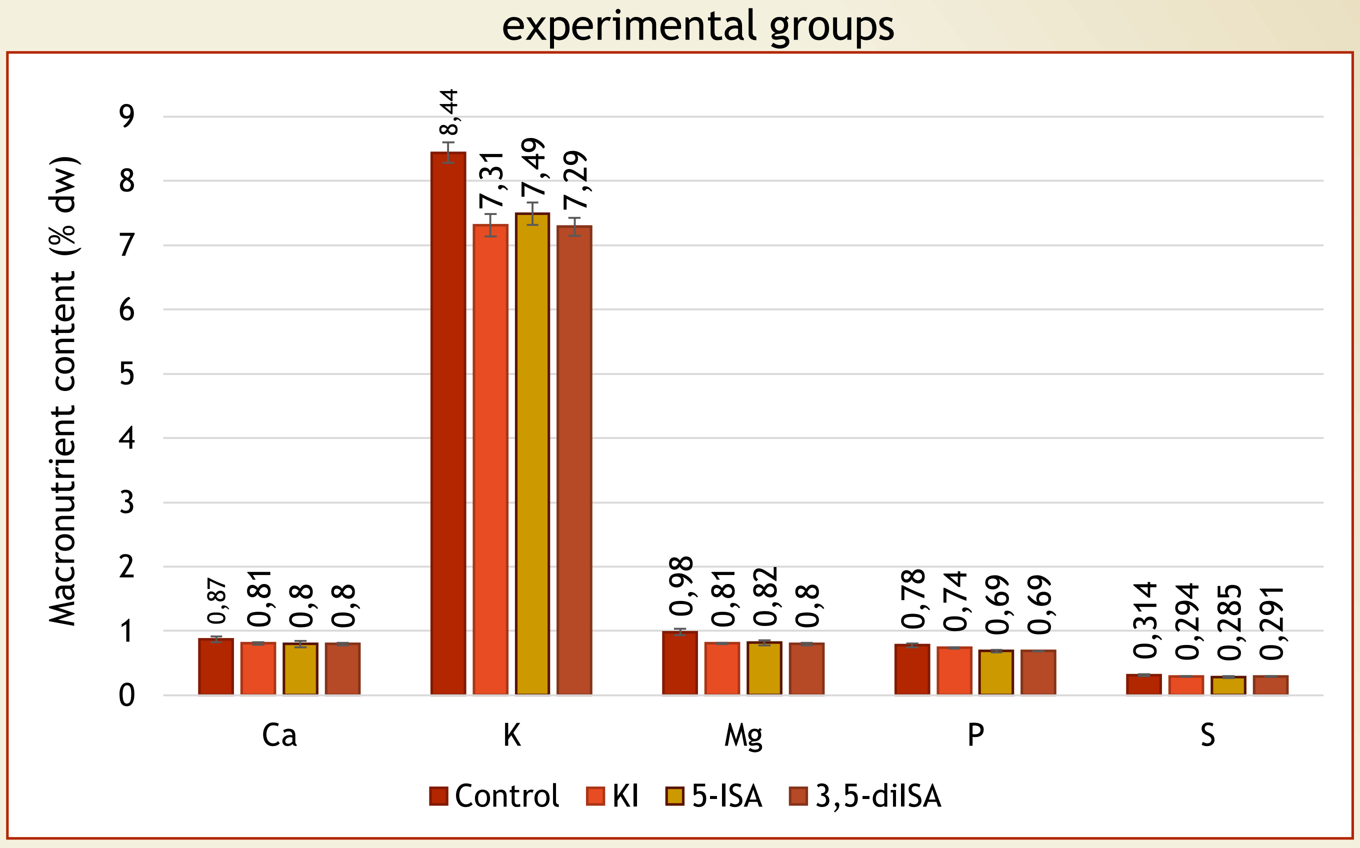

Fig. 3 The content of macroelements in biofortified *E. californica* leaves

Table 1. The content of microelements in biofortified *E. californica* leaves

Combination	Al	B	Ba	Be	Bi
	(mg · kg-1 dw)				
Control	52.88±3.10ab	35.87±1.95b	12.70±0.14d	0.12±0.01a	11.38±0.54c
KI	33.24±3.00a	31.28±0.26a	10.93±0.10a	0.14±0.01a	9.82±0.38ab
5-ISA	60.69±1.60b	32.73±1.56a	11.92±0.09c	0.13±0.01a	10.37±0.22b
3,5-diISA	28.93±2.40a	33.22±0.37ab	11.21±0.13b	0.14±0.01a	9.28±0.31a
Combination	**Co**	**Cr**	**Cu**	**Fe**	**Li**
	(mg · kg-1 dw)				
Control	0.54±0.05b	0.87±0.04a	10.06±0.47c	109.57±3.71a	4.79±0.31b
KI	0.37±0.03ab	0.37±0.03a	8.97±0.59ab	101.88±9.40a	3.54±0.05a
5-ISA	0.43±0.04ab	0.41±0.05a	9.45±0.42bc	128.13±4.95a	3.88±0.17a
3,5-diISA	0.28±0.06a	0.57±0.12a	8.45±0.13a	85.92±6.59a	3.69±0.04a
Combination	**Mn**	**Mo**	**Na**	**Ni**	**Zn**
	(mg · kg-1 dw)				
Control	134.11±1.02c	1.80±0.11c	892.37±21.89c	0.49±0.05a	85.65±2.52b
KI	115.49±1.81b	1.63±0.09b	673.44±12.85a	1.01±0.06b	92.21±1.51c
5-ISA	119.44±4.54b	1.42±0.02a	694.36±22.39ab	1.37±0.09bc	86.69±1.21b
3,5-diISA	84.67±2.01a	1.59±0.06b	712.51±2.58b	1.56±0.10c	72.62±1.17a

Mean value of three replication ± standard deviation.
Mean values signed the same letters in particular columns are non-significant different at 0.05 level of confidence

Conclusion

Application of iodine compounds did not contribute to increasing the levels of minerals in plant tissues. Application of organic iodine compounds resulted in a greater decrease in nutrient content, especially P, Mg and K in plants than KI. Iodine supplementation also reduced the content of micronutrients in most cases. Increases in Al content were noted after application of 5-ISA, Zn after KI, and Ni after each treatment.

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