БИОХИМИЯ И ФИЗИОЛОГИЯ

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BIOCHEMICAL CHARACTERISTICS AND MINERAL COMPOSITION OF *IRIS* × *HYBRIDA* HORT. GROWN IN CONTRASTING CLIMATIC ZONES

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Climate and geochemical environment are known to affect greatly mineral composition and antioxidant activity of plants. Comparative evaluation of antioxidant activity and antioxidants and trace elements content in garden irises grown in two contrasting climatic zones (the Moscow region and the Nikitsky Botanical Gardens) was achieved. Despite close content of phenolics in roots, leaves and petals, petals antioxidant activity (AOA) was significantly higher in the Crimean cultivars. Contrary to garden irises *Iris pseudacorus* demonstrated significantly higher AOA in roots. Element composition of iris roots indicated strong mineral loading at the seacoast with the highest intervarietal differences in accumulation levels of Fe in irises of the Nikitsky Botanical Gardens (CV 49.3%) and Zn in plants of the Moscow region (CV 44.1%). A negative correlation was revealed between AOA of roots, leaves, petals of the Northern irises with copper content in roots and between leaves phenolics and Zn of the Southern irises.

Keywords: *iris; antioxidants; mineral content; geochemical peculiarities*

Introduction

The genus of irises combining about 260 species is widespread in the Northern Hemisphere. Some types of irises are found in wetlands, most of them live in the desert, semi-desert and dry, rocky habitats. Irises are highly valuable in landscape gardening, medicine, perfumery and food industry. Iris rhizomes are used as flavorings for confectionery and spices. Jam from petals of iris is popular in Azerbaijan. Essential oil from iris rhizomes is especially valuable in production of top-quality perfumes. In aromatherapy, the "iris root" is used as a sedative. Essential oil of iris rhizomes (constituting about 0.1%), improves immunity and has a generative effect [4]. Biologically active compounds of irises demonstrate anticancer, antibacterial and antiviral effects [16]. Recent studies indicate high prospects of irises utilization in production of antioxidants supplements, anti-carcinogenic, antiulcer, anti-mutagenic and antimicrobial substances [10, 14, 15].

More than 30 iris species are widely used in traditional medicine of India [2] and China [16]. All parts of irises (rhizomes, leaves and petals) demonstrate antibacterial activity [10]. Leaves mixed with salt, sugar and other spices are used in the treatment of skin diseases. *Iris ensata* is used in India as an anti-helminthic and diuretic drug, and mixed with other spices - for the treatment of sexually transmitted diseases [2].

Flavonoids and their glycosides, triterpenoids, anthocyanins, benzoquinones, and stilbene glycosides are distinguished among biologically active iris compounds [5].

Despite high medicinal value of irises, their utilization in Russia is mostly restricted to landscape gardening. Besides this, wide spectrum of Russian iris cultivars is poorly characterized giving no opportunity to reveal the most interesting cultivars with high antioxidant activity. Taking into account that biogeochemical characteristics of habitat greatly affect both mineral composition and concentration of biologically active compounds in medicinal plants, the aim of the present investigation was comparative evaluation of antioxidant status and element composition of irises grown in two contrasting climatic zones of Russia: the Moscow region and the Nikitsky Botanical Gardens (Crimea).

Materials and Methods

Ten cultivars grown at experimental fields of Federal Scientific Center of Vegetable Production (Moscow region) and 7 cultivars of the Nikitsky Botanic Gardens' collection (Crimea) were used for evaluation of geochemical effect on iris biochemistry. The Nikitsky Botanical Gardens' collection was presented by the following cultivars: 'Blue Crusader', 'Lotus land', 'Pink Bell', 'Golden Panther', 'Back in Black', 'Beverly Sills' and 'Salsa Rio'. Collection of the Federal Scientific Center of Vegetable Production included the following cultivars: 'Brown Lusso', 'Steping out', 'Zharok', 'Breeze', 'Sirenevy venochek', 'Giraffic', 'Purple Undersized', 'Olympic', 'White Dwarf', 'Irlev'. For comparison, *Iris pseudacorus* plants were gathered in the suburbs of Moscow. Climate peculiarities of experimental fields in the Moscow region and the Nikitsky Botanical Gardens are presented in Table 1.

Table 1

Climate-geographical differences of experimental fields in the Moscow region and the Nikitsky Botanical Gardens

Parameter	Moscow region	Nikitsky Botanical Gardens
Coordinates	55°39.51'N; 37°12.23'E	44°30,725'; 34°14.089' E
Mean annual temperature	4.7°C	13.2°C
Sunshine duration	1600	2252
Mean annual rainfall, mm	674	578
Frost-free period, days	120-140	256

Iris leaves, petals and roots were gathered at the beginning of June in the Moscow region and in May in the Nikitsky Botanical Gardens. After harvesting, leaves, roots and petals were separated. Roots were washed with distilled water and dried at filter paper. Samples were cut with plastic knife to thin slices, dried to constant weight at 70 °C and homogenized. The resulting powder samples were kept in hermetically closed plastic bags until the analysis.

Polyphenols were determined in 70% ethanolic extracts, using Folin-Ciocalteu colorimetric method as described in [8]. The results were calculated as mg-eq Gallic acid per g d.w. (mg GAE/g d.w.) using standard curve built with 5 concentrations of Gallic acid (0-80 μg/ml).

The antioxidant activity (AOA) of iris roots, leaves and petals was assessed using redox titration method [8], via titration of 0.01 N $KMnO_4$ solution with ethanolic extracts of iris. Reduction of $KMnO_4$ to colorless Mn^{+2} in this process reflects the amount of antioxidants dissolvable in 70 % ethanol. The values were expressed in mg GAE/g d.w.

Nitrates were assessed using ion selective electrode by ionomer Expert-001 (Econix, Russia).

Total dissolved solids (TDS) were determined in water extracts of iris roots, leaves and petals (1g of dry power in 50 ml of distilled water) using portable conductometer TDS-3 (HM Digital, Inc., Seoul, Korea). The results were calculated in mg per g of dry weight.

Element composition was determined using AAS spectrophotometer Shimatsu 7000 after wet digestion of samples at 25-425 °C.

Data were processed by analysis of variance and mean separations were performed through the Duncan multiple range test, with reference to 0.05 probability level, using SPSS software version 21. Data expressed as percentage were subjected to angular transformation before processing.

Results and Discussion

Tables 1,2 represent antioxidant activity of roots, leaves and petals of *Iris x hybrida hort*. and *Iris pseudacorus* grown in the Moscow region and in the Nikitsky Botanical Gardens. The results indicate low inter-varietal differences in AOA value for plants grown both in moderate climate and in the South. Higher variations in AOA of petals may reflect great differences in pigments composition.

Petals and leaves of *Iris × hybrida* hort. from the Moscow region demonstrated significantly higher levels of AOA compared to AOA of wild type *Iris pseudacorus* while roots of decorative forms possessed lower AOA value. It seems significant that concentration of polyphenols in decorative and wild iris roots, leaves and petals are practically similar. *Iris pseudacorus* is known to inhabit terrestrial and temporarily flooded sites. This plant is valuable for phytoremediation due to high ability to remove organic matter [1] and heavy metals [3, 6, 7].

Table 2

Antioxidant activity (AOA) and polyphenol content (PP) in roots, leaves and petals of iris grown in contrasting climatic zones

Cultivar	Roots		Leaves		Petals	
	AOA	PP	AOA	PP	AOA	PP
			Moscow region			
‘Irlev’	48.3±3.6a	25.0±1.3c	48.5±3.6c	27.1±1.4	94.0±8.1d	24.2±1.3b
‘White Dwarf’	34.3±2.6b	22.8±1.2c	42.2±3.4c	19.8±1.1b	92.0±8.0d	26.6±1.4b
‘Purple Undersized’	36.6±2.7b	19.9±1.1a	45.8±3.5cd	20.0±1.1b	75.0±6.1c	20.8±1.1c
‘Olympic’	51.2±4.5a	25.7±1.3b	49.0±4.2c	20.1±1.1b	62.5±5.2c	24.2±1.3ab
‘Sirenevy Venochek’	35.8±2.7b	25.4±1.3b	46.5±3.5cd	24.4±1.3c	59.1±5.1b	24.2±1.3ab
‘Giraffic’	35.2±2.7b	19.9±1.1a	48.3±3.6c	21.4±1.1b	58,4±5.1b	23.5±1.3a
‘Breeze’	33.8±2.6b	25.4±1.3b	38.4±2.8b	20.2±1.2b	57,6±4.7b	20.9±1.1c
‘Zharok’	38.9±2.8b	20.6±1.2a	39.6±2.9bd	18.7±1.1a	57,1±4.6b	23.3±1.3a
‘Steping Out’	35.1±2.7b	20.6±1.2a	34.5±2.6b	20.2±1.2b	51,5±4.2b	25.4±1.3ab
‘Brown Lasso’	35.1±2.8b	19.4±1.1a	35.3±2.8b	17.5±1.0a	43,5±3.4a	24.5±1.3ab
M±SD	38.4±4.6	22.5±2.4	42.9±4.9	20.9±	67.2±13.0	23.7±1.3
CV, %	12.0	10.7	11.4	10.0	19.3	5.5
Iris pseudacorus	46.9±2.8a	25.0±1.4c	27.1±1.1e	19.8±1.0b	30.9±1.8e	23.3±1.1ab
			Nikitsky Botanical Gardens			
'Back in Black’	39.7±1.6c	17.7±0.6a	60.7±2.9a	21.8±0.9ac	91.4±3.7d	24.1±0.9c
‘Blue Crusader’	58.5±2.8a	18.4±0.8a	62.3±3.0a	20.8±0.9abc	73.1±3.5a	20.6±0.7a
‘Salsa Rio’	42.6±1.7c	20.4±0.9c	50.2±2.3b	20.8±0.9abc	65.0±2.6c	23.0±0.8c
‘Pink Belle’	61.3±3.0a	23.8±0.9	35.7±1.3	21.3±0.9ac	62.6±2.6c	22.0±0.8a
‘Lotus Land’	58.7±2.9a	16.6±0.6b	49.4±2.2b	19.8±0.7b	56.0±2.5b	18.1±0.6b
‘Beverly Sills’	53.0±2.3b	16.9±0.5b	51.0±2.5b	23.1±0.8c	56.1±2.4b	19.7±0.6d
‘Golden Panther’	51.6±2.3b	18.6±0.7ac	47.2±2.1b	19.8±0.7b	55.3±2.4b	23.8±0.9c
M±SD	52.2±6.5	18.9±1.8	50.9±6.1	21.1±0.9	65.6±9.5	21.6±1.8
CV, %	12.5	9.5	12.0	4.3	14.5	8.3

Within each column, values followed by different letters are significantly different according to Duncan test at P≤0.05 (PP- polyphenols)

Table 2 and Fig.1 data indicate that differences in AOA between *Iris × hybrida* hort. and *Iris pseudocorus* reached 140.8-304 % for petals, 123.2-185.9% for leaves, and 72.1-109% for roots.

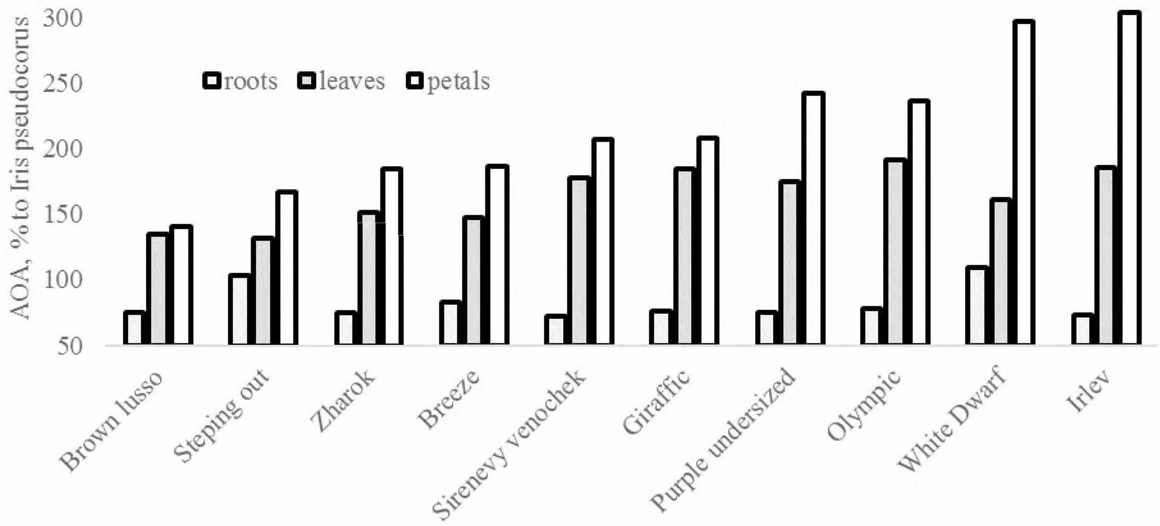


Fig. 1 AOA of roots, leaves and petals of decorative irises compared to *Iris pseudocorus*

Among decorative irises of the Moscow region 'Irlev' and 'White Dwarf' cultivars demonstrated the highest AOA in petals and among the Nikitsky Botanical Gardens' collection only 'Back in Black' cultivar demonstrated similar high level of AOA value.

Taking into account medicinal importance of iris roots several cultivars should be distinguished with significantly higher AOA. They are 'Olympic' and 'Irlev' cvs in the Moscow region's collection and all cultivars studied in the Nikitsky Botanical Gardens except 'Back in Black' and 'Salsa Rio' cultivars.

In general, comparing of root, leaves and petals AOA in iris of the Northern and the Southern habitats one may indicate similar AOA values for petals but much higher AOA of roots in plants grown in the Nikitsky Botanical Gardens (Fig.2).

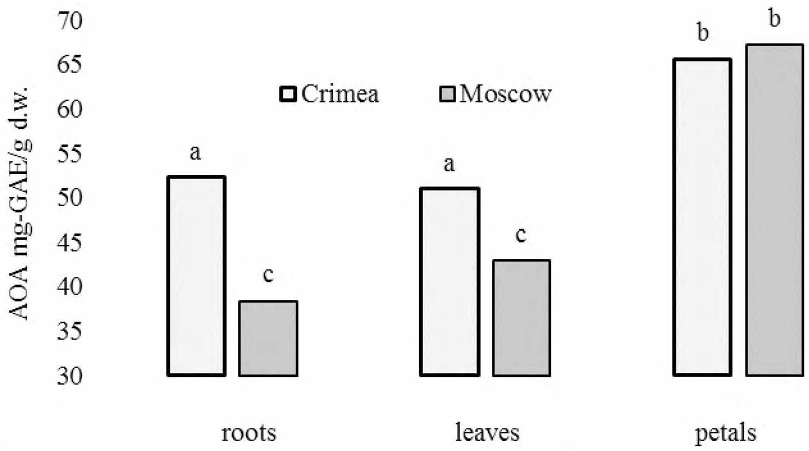


Fig. 2 Mean values of total antioxidant activity of iris in different habitats (values with similar indexes do not differ according to Dunkan test at P<0.05)

The highest differences in AOA for Northern and Southern irises were demonstrated for roots (35.9%; $p<0.001$). Much lower differences were registered for leaves (18.6%; $p<0.01$) while petals AOA was similar ($p>0.5$). Higher levels of AOA in roots of irises from the Southern habitat than from the North may be connected with the known fact that salt stress (which is common to the Nikitsky Botanical Gardens' area due to bordering to the sea) increases antioxidant content in plants [11].

Among *Iris x hybrid* hort. and *Iris pseudocorus* of the Moscow region one may indicate three groups of plants:
1) *Iris pseudocorus* with the highest root AOA; 2) 'Brown lusso', 'Steping out', 'Zharok', 'Olympic' and 'Irlev' varieties with similar AOA of roots and leaves; and 3) 'Breeze', 'Sirenevy venochek', 'Giraffic', 'Purple undersized', 'White Dwarf' cultivars with distinct higher AOA in leaves compared to roots.

For the Northern habitat leaves and petals AOA were closely connected which was reflected in high correlation coefficient ($r=0.82$; $P<0.01$). Similar high relationship was demonstrated between polyphenols and AOA for roots, leaves and petals of the Northern iris (Table 3).

On the contrary, iris of the Southern habitat recorded no significant correlations for most of investigated parameters, except leaves/petals AOA with significant positive relationship (Table 3).

It is known that altitude significantly and negatively correlates with the content of tannin ($P < 0.05$). Annual sunshine duration and altitude are significantly and positively correlated to the flavonoids, rutin content and antioxidant activity ($P < 0.05$). Annual mean temperature significantly and negatively correlates to the content of total phenolics, while altitude significantly and positively correlates to the content of total phenolics ($P < 0.05$). Temperature and amount of sunny days are known to determine the levels of polyphenols and antioxidants accumulation [9].

Lack of correlations between leaves/petals polyphenols in iris of both habitats was in good agreement with the appropriate data obtained earlier for the Nikitsky Botanical Gardens' collection of roses [12]. Furthermore the data presented in Tables 1, 2 indicate that leaves/petals phenolics ratio may be higher or lower that 1.

Nitrates are the main nitrogen source for most of terrestrial pants. N is an essential element and signal molecule, participating in plant metabolism, growth, development and in adaptation to the environmental factors [13]. Essentiality of nitrogen determines the existence of strict metabolic control of nitrates and other N-containing compounds levels in plants. Nitrates are concentrated mostly in vacuoles from where they are transported via xylem. Xylem transports water and nutrients from roots to leaves while phloem transports products of photosynthesis from leaves to plant growth centers. This determines nitrates distribution between leaves and storage organs, such as seeds and tubers (roots) resulting in predominant accumulation of nitrates in leaves and lower concentration in storage organs.

Table 3

Nitrates and TDS accumulation by roots, leaves and petals of iris grown in contrasting climatic zones

Cultivar	Nitrates, mg/kg d.w.			TDS, mg/g d.w.		
	Roots	Leaves	Petals	Roots	Leaves	Petals
1	2	3	4	5	6	7
Moscow region						
'Irlev'	1131a	3452a	2059ac	22.2a	62.8a	32.5ac
'White Dwarf'	388c	2400b	2394ab	7.9d	48.0b	42.6b
'Purple Undersized'	592b	2722b	2414ab	12.6b	52.9ab	46.6b
'Olympic'	538b	2538b	2486b	9.4c	51.6b	49.8b
'Sirenevy Venochek'	405c	2877b	2000ac	8.8cd	60.3a	37.7a
'Giraffic'	357cd	2907b	2684b	7.5de	52.3ba	44.6b
'Breeze'	309d	2358b	2009a	6.8e	44.8c	38.0a
'Zharok'	375c	2397b	1942c	7.6d	44.9bc	37.6a
'Steping out'	313d	1855c	1411d	6.0e	37.7c	29.9c

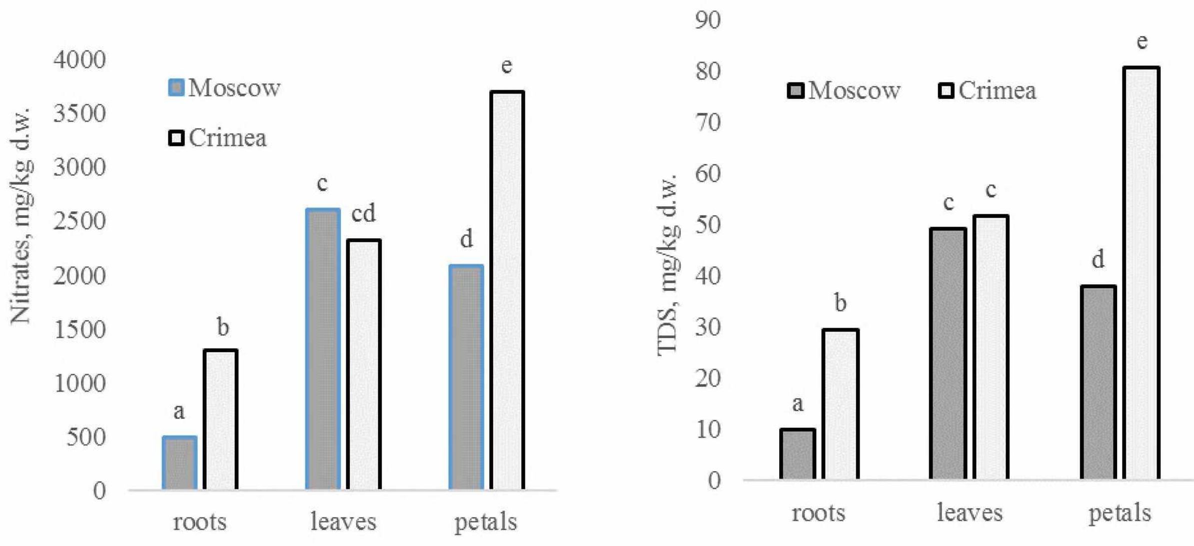
Continuation of table 3

1	2	3	4	5	6	7
'Brown Lasso'	541b	2405b	2500b	10.9bc	41.7b	45.1b
Mean	495	2591	2190	10.0	49.7	40.4
SD	164	319	306	3.2	6.3	5.3
CV, %	*33.1*	*12.3*	*14.0*	*32.0*	*12.7*	*13.1*
Iris pseudacorus	1296	4340	2642	24,7	78,8	49,8
Nikitsky Botanical Gardens						
'Back in Black'	1160c	2020b	4380a	25.7c	51.8b	86.8b
'Blue Crusader'	980c	2620a	3740c	21.1c	58.3a	80.8bc
'Salsa Rio'	910c	2120b	3080bd	23.1c	44.6b	67.9cd
'Pink Belle'	1640b	2650a	3280b	32.0b	58.9a	76.1bc
'Lotus Land'	1580b	1970b	3980ac	34.5b	43.3b	81.1b
'Beverly Sills'	620d	2100b	2610d	23c	47.9b	62.7d
'Golden Panther'	2180a	2800a	4810a	46.9a	57.1a	109.4a
Mean	1296	2326	3697	29.5	51.7	80.7
SD	432	312	606	7.1	5.5	10.1
CV, %	*33.3*	*13.4*	*16.4*	*24.1*	*10.6*	*12.5*

Within each column, values followed by different letters are significantly different according to Duncan test at P≤0.05

There are two peculiarities in nitrates accumulation by iris of the Northern and Southern regions: 1) levels of nitrates in roots of plants from the Nikitsky Botanical Gardens were 2.6 times higher than in conditions of the Moscow region; 2) while nitrate concentrations in the Southern irises decrease according to: petals>leaves>roots, in the Northern hemisphere other consequence is typical: leaves>petals>roots (Fig.3a). The latter is true also for *Iris pseudacorus*. The phenomenon may reflect easier transport of nutrients in warm climate compared to more severe conditions of vegetation.

The same pattern may be indicated for the levels of TDS accumulation (Tables 3; Fig. 3b). The Nikitsky Botanical Gardens' cultivars demonstrated 3 times higher levels of TDS in roots and two times higher- in petals compared to the appropriate data for plants, grown in the Moscow region.



(a) (b)

Fig. 3 Mean Nitrates levels (a) and TDS (b) in Northern and Southern iris (values with similar indexes do not differ according to Dunkan test at P<0.05)

Besides, a direct correlation between nitrates and TDS content was revealed for leaves, roots and petals of irises (r=+0.96, P<0.001; r= +0.99, P<0.001; and r=+0.90, P<0.01 accordingly).

The highest variations in nitrates accumulation were registered for roots of plants grown in the Southern (CV=33.3%) and Northern (r=33.1%) regions.

In a whole, among the Moscow region's irises the most interesting one seems to be 'Irlev' cv with the highest levels of TDS in roots, leaves and petals and high concentrations of phenolic in leaves and petals. Among the Nikitsky Botanical Gardens' collection 'Golden Panther' is distinguished by high TDS and AOA values while 'Back in Black' cv occupies the first place on the AOA level of petals.

Comparison of Fe, Cu, Zn, Mn and Pb content in roots of iris from the Northern and Southern habitat indicates significantly higher plants loading with the above elements in the Nikitsky Botanical Gardens, which is, undoubtedly, connected with the vicinity of the sea in the latter case. Indeed, the process of macro- and trace elements transport from the sea surface with aerosols is known to be typical especially for the Southern regions with high temperature and intensive sunshine. Thus, mean levels of Fe, Cu, Zn and Mn accumulation by irises in the Southern hemisphere are 1.5-2.6 times higher than the appropriate values for irises from the Moscow region (Table 4).

Table 4

Element composition of iris roots (mg/kg d.w.)

Cultivar	Fe	Cu	Zn	Pb	Mn
Moscow region					
'Irlev'	110a	2.1a	3.2a	1.8a	4.9a
'White Dwarf'	109a	2.5ac	2.8a	2.3b	4.7a
'Purple Undersized'	28b	1.6b	1.5b	0.7c	2.7c
'Olympic'	85ce	1.8b	2.1c	1.8a	4.0ad
'Sirenevy Venochek'	64de	2.6ac	8.1d	1.4de	3.7d
'Giraffic'	55d	3cd	3.9e	1.3d	3.2c
'Breeze'	71`e	3.4d	4.21e	1.6ae	4.9ab
'Zharok'	71e	2.6a	5.1f	1.0f	5.0b
'Steping Out'	117a	3.5d	2.4c	2.5b	4.5a
'Brown Lasso'	76ec	3.8d	1.7b	2.5b	8.8f
M±SD	79±23	2.6±0.5	3.4±1.5	1.7±0.5	4.6±1.1
CV, %	29.1	19.2	44.1	29.4	23.9
Nikitsky Botanical Gardens					
'Back in Black'	78a	4.9a	5.5a	0.7a	4.5a
'Blue Crusader'	274b	4.1a	4b	1.0b	6.7b
'Salsa Rio'	396c	8.4b	5.2a	1.8c	9.8c
'Pink Belle'	293b	3.9c	5.2a	1.3d	6.9b
'Lotus Land'	224d	5.9d	6.9c	2c	6.4b
'Beverly Sills'	76a	2.8e	2.4d	1.8c	4.8a
'Golden Panther'	111e	4.5a	5.7a	1.8c	8.2c
M±SD	207±102	4.9±1.3	5.0±1.0	1.5±0.4	6.7±1.3
CV, %	49.3	26.5	20.0	26.7	19.4

Within each column, values followed by different letters are significantly different according to Duncan test at $P \leq 0.05$

Special attention should be payed to high variations of Fe content in the Southern flowers and Zn- in irises of the North. In this connection, 'Salsa Rio' cv of the Nikitsky Botanical Gardens demonstrated the highest levels of Fe, Cu and Mn accumulation, white 'Sirenevy venochek' cv of the Moscow region dominated in the amount of Zn level.

Analyzing relationship between the parameters investigated one may indicate that for both habitats a significant positive correlation exists between nitrates and TDS in leaves, roots and petals (Table 5). On the other hand, it seems obvious that Northern and Southern environment greatly affect other links between the parameters. Thus, a strong negative correlation between root Zn and leaves polyphenols is registered only for the Nikitsky Botanical Gardens' irises. In the Northern habitat a strong positive correlation was revealed between TDS and AOA and polyphenols in iris leaves and no appropriate relationship seems to exist in the Southern area. Other relationships with lower statistical significance ($p<0.05$) need further investigations due to relatively small number of samples in the present research.

Table 5

Correlations for iris plants grown in contrasting climatic zones

	AOA-r	PP-r	AOA-l	PP-l	AOA-p	PP-p	N-r	N-l	N-p	TDS-r	TDS-l	TDS-p	Fe	Cu	Zn	Pb	Mn
AOA-r	1	.206	-.428	-.208	-.555	-.654	.275	.450	-.153	.210	.341	-.031	.174	-.475	-.039	.223	-.055
PP-r	.489	1	-.667	-.045	-.032	.381	.233	.503	-.229	.056	.465	-.100	.585	.103	.084	-.158	.452
AOA-l	.571	.412	1	.123	.627	.025	-.481	-.305	.228	-.490	-.094	.039	-.247	.035	-.202	-.479	-.323
PP-l	.399	.563	.607	1	.245	-.025	-.724	-.322	-.641	-.626	-.046	-.634	-.361	-.477	-.802	-.288	-.604
AOA-p	.332	.331	.521	.531	1	.479	-.290	-.215	.262	-.461	.188	.043	-.117	.066	.035	-.93	-.363
PP-p	.176	.139	-.004	.110	.126	1	.253	.320	.404	.196	.398	.450	-.068	.203	.128	-.427	.285
N-r	.665	.245	.451	.634	.588	-.005	1	.547	.729	.947	.382	.831	-.098	-.016	.692	.182	.287
N-l	.449	.318	.794	.774	.539	-.121	.744	1	.292	.457	.879	.532	.102	-.359	-.060	-.129	.355
N-p	.116	-.141	.498	-.182	.145	-.083	.118	.393	1	.661	.318	.944	-.349	.041	.646	-.230	.020
TDS-r	.580	.215	.443	.653	.599	-.072	.992	.777	.121	1	.233	.801	-.267	-.066	.566	.393	.252
TDS-l	.468	.510	.876	.834	.580	-.004	.626	.925	.278	.653	1	.472	-.098	-.561	-.158	-.551	-.032
TDS-p	.125	-.132	.361	-.452	-.065	-.117	-.120	.065	.882	-.137	.058	1	-.357	-.083	.519	-.100	.140
Fe-r	.251	.281	-.272	.204	.266	.699	.195	-.206	-.467	.125	-.189	-.549	1	.641	.218	.137	.727
Cu-r	-.610	-.304	-.775	-.353	-.648	.087	-.464	-.510	-.278	-.450	-.657	-.334	.233	1	.544	.264	.688
Zn-r	-.265	.306	.032	.330	-.323	.110	-.231	.200	-.205	-.182	.308	-.281	-.161	.297	1	.119	.315
Pb-r	-.044	.038	-.501	-.137	-.091	.671	-.013	-.403	-.196	-.070	-.436	-.228	.791	.554	-.219	1	.427
Mn-r	-.102	-.199	-.627	-.362	-.338	.218	.101	-.240	.014	.086	-.444	-.045	.323	.618	.100	.628	1

White background- Moscow region; grey background- Nikitsky Botanical Gardens. Abbreviations: AOA-antioxidant activity; PP- polyphenols; r-roots; l-leaves; p-petals; N-nitrates

Conclusion

The first assessment of accumulation levels and distribution of antioxidants and minerals between the organs of decorative irises of different habitat supposes prospects of further investigations in plants utilization not only for decorative purposes, but also in medicine, indicating higher roots AOA and mineral content of the Crimean irises.

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Известно, что климат и геохимические особенности места произрастания значительно влияют на элементный состав и антиоксидантную активность растений. Проведена сравнительная оценка антиоксидантной активности статуса и содержания антиоксидантов и минералов в садовых ирисах, выращенных в двух контрастных зонах (Московская область и Никитский ботанический сад). При сравнительно сходных уровнях накопления полифенолов в корневищах, листьях и лепестках растения Южного берега Крыма отличались существенно более высокой антиоксидантной активностью лепестков. По сравнению с садовыми ирисами *Iris pseudacorus* характеризовался существенно более высокими уровнями АОА в корневищах. Анализ элементного состава корневищ выявил более мощную нагрузку минералами в условиях Южного берега Крыма при наибольших различиях в коэффициенте вариации для Fe у ирисов Никитского ботанического Сада (CV 49,3%) и Zn у ирисов Московской области (CV 44,1%). Выявлена отрицательная корреляция между АОА корневищ, листьев и лепестков и содержанием Cu в корневищах ирисов Северного региона и между содержание полифенолов и цинка листьев ирисов Московской области.

Ключевые слова: *ирисы; антиоксиданты; минеральный состав; геохимические особенности*