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Hg contents and environmental characteristics of soils and *Taraxacum officinale* plants of the SW part of Lublin

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Abstract: This article compares the results of the study of the common dandelion (Taraxacum officinale) leaf and soil samples collected in the SW part of Lublin. Common dandelion is a plant that begins to release fresh shoots relatively early. It is also spread enough that it can be found in many places, not only in Lublin, but also in other cities, from around the polar regions to the Mediterranean. The purpose of this work was to show the degree of contamination of the plant surface and Hg content in soil samples. The analysis were performed in spring after the snow cover ceased. The presence of dust containing small amounts of NaCl, iron oxides, hydroxides, titanium, and relatively low Hg contents was revieled.

Keywords: environmental study, Hg contents, soils, *Taraxacum officinale*, SW Lublin

1. Introduction

Common dandelion is a plant that begins to release fresh shoots relatively early. It is also spread enough that it can be found in many places, not only in Lublin, but also in other cities, from around the polar regions to the southern part of Europe. Mercury is a harmful metal, both for man and for plants. The presence of mercury in the tested samples is closely related to the degradation of the natural environment, including the intensity of vehicular traffic of cars powered by fossil fuel derivatives [3]. Lublin is a city ranked among the largest cities in Poland, it is located in its south-eastern part [14]. It is a provincial city, located within the Lublin Upland (its northern edge) near the border between the Central European Lowland and the Polish Uplands [4, 8-11]. The city has about 300.000 residents. The area of Lublin is 147 km^2 [14]. The beginnings of Lublin date back to the 6th century and the first mentions were recorded in 1198 [1, 5, 12, 13]. In the period of the First Polish Republic, Lublin was the royal city of the Crown of the Kingdom of Poland and was also the city of the Lublin Province until today, retaining this privilege [1, 2]. Significant trade routes pass through the city: it is a part of the *Via Baltica* road connecting the Baltic countries and Eastern Europe with the Balkan countries located in Southern Europe [14]. Throughout Lublin, there are also routes from the east (Ukraine) to the west (Germany). The roads connect the city with Warsaw (towards the north), Białystok and Biała Podlaska (towards the north-east), Chełm and Włodawa (eastwards), Przemyśl and Rzeszów (towards south-east) and Sandomierz and Kraków (towards south-west) as well as Radom (towards West). In recent years, the northern part of the city beltway has been opened for use, allowing for the movement of traffic from Chełm to Kraśnik, significantly relieing the city, but in its south-western part (which is the subject of this study) there is a significant vehicular traffic, especially within the streets of Kraśnicka, Al Racławicka and Jana Pawła II. In the other streets, the volume of vehicular traffic in the peak period is also significant, car downtimes are created, contributing to air pollution in the discussed area.

Therefore the purpose of this research was to investigate whether other non-typical but important ions like chromate, can be determined in standard conditions. The work is focused on the application of isocratic ion chromatography with carbonate/bicarbonate eluents and suppressed conductivity detection for the simultaneous determination of chromate besides common inorganic anions in water and waste water samples.

Figure 1. Photographs from sample localization near Jana Pawła II St and Roztocze St (A), typical sample of *Taraxacum officinale* (B), microphotograph of the plants (C) and soil 07Lug (D).

2. Methods

There were 15 samples of dandelion plants (*Taraxacum officinale*) and soil samples from the north-western part of the city (Fig. 1 and Fig. 2) from the intersections of major streets and roundabouts. Photographic documentation of the discussed area was made using a Nikon D5200 digital camera.

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Samples were examined using a binocular magnifying glass and an optical polarizing microscope in reflected light. The samples were also examined in a scanning electron microscope with an EDS attachment (Energy Dispersive Spectroscopy), where an inventory of soil grains and dust found on the plant surface was made. The samples of plants and soils after previous observations were generalized and preparations were made on a microscope table, which was then placed in the mucus of the test chamber. The analysis were performed under the low vacuum condition. Micrphotographs of backscattered electrons were made using a BSE (back-scattered electrons) adapter and point analyzes were carried out at an exposure of 45s during sample irradiation with a 10KeV electron gun. After drying the plant samples, Hg content analyzes were carried out in soil samples. Microscopic examinations were carried out using the Leica DM2500P polarizing microscope and analysis in a micro-area using the Hitachi SU6600 Electron Microscope. In total, 316 soil samples and 313 plant sample analyzes were performed. Chemical analyzes were performed using Varian AMA 254. The collected soil samples were dried to a constant mass at 105ºC. To separate the remains of plants and small stones, the soils were screened through a 1 mm mesh nylon sieve. After screening, each sample was homogenized by mixing. Hg determinations were made using a dedicated Varian AMA 254 mercury analyzer from the Varian company, i.e. atomic absorption spectrometer with the technique of generating cold mercury vapor. The camera ensures reproducibility of <1.5 % when detected at 0.05 ng Hg. Samples were weighed directly in the measuring cuvettes. The weights for subsequent tests were in the ranges of 0.01 - 0.45 g and were selected in such a way as to obtain the optimal range of the sensitivity of the apparatus. The measurement consisted of the following stages: drying: 60 s, decomposition: 150 s, waiting time: 45 s, absorption measure-ment. Each of the trials was determined at least 3 times, and in the case of unsatisfactory precision of determinations, the measurement was repeated up to 9 times, ensuring that the standard deviation did not exceed 10 % of the mean value. Extremely different values were omitted. All research was carried out at the Department of Geology and Protection of Lithosphere at the Faculty of Earth Sciences and Spatial Management Maria Curie-Skłodowska University in Lublin (Poland).

3. Results

The field observations carried out have shown quite high intensity of vehicular traffic in the discussed places connected also with the traffic of trucks, going out of the city (outgoing roads), the intensity of cars, buses and trolleybuses is also big. Field tests were carried out two weeks apart from the snow cover retreat which in 2018 was still in April. The area in question is located within the Nałęczów Plateau (its north-eastern part) which is characterized by the presence of loess covers and less-similar rocks [4 ,7-11]. Microscopic examinations showed that the sand fraction prevails in the soil, also associated with road clearance processes in the winter period, as well as with earthworks carried out at various times around the discussed streets. The research showed mostly quartz (gray quartz dominates, accompanied by small amounts of red-colored varieties [6] and to a lesser extent feldspar, heavy minerals such as zircons, microspheres characteristic of post-glacial rocks of southern Poland, having connotation with abrasion and transport of Scandinavian material In these soils there is a different share of humic substances as well as clay material tinting them to shades of gray to dark brown and black. In these soils there are also numerous letterings such as glass fragments, cigarettes, etc. The analysis in the micro-area showed that in these soils rock salt also appears relatively often as a small addition resulting from road differentiation works in winter [6]. In addition, small additions of iron oxides and hydroxides, titanium oxides, chromium and lead oxides were also found in them. Dust on the plant surface showed similar results. Analysis of mercury content in the soils of the discussed samples showed its relatively low concentration at the level of 0.01-0.06 ppm. The highest concentration of mercury was found in the area of Zana and Wileńska Streets as well as in Głęboka and Nadbystrzycka (Fig. 2, Table 2). These intersections, although they have a local character, show high traffic volume and often there are stagnation of cars. In the area of the intersection of Głęboka and Paga and Al. Kraśnicka and Jana Pawła II had the lowest Hg concentration in soils, which can be explained by the recent reconstruction of intersections in this region and the re-fertilization of a new layer of soil during technical works which could have affected relatively low mercury concentrations in soils in these well-known routes.

Table 1. Samples localization.

Place	Geographical coordinates		Plant sample	Soil sample
Kraśnickie Rd. x Jana Pawła II St.	51^{0}13’39.36”N	22^{0}28’29.028”E	Lu01	Lu01g
Jana Pawła II St. x Roztocze St.	51^{0}13’33.312”N	22^{0}29’31.379”E	Lu02	Lu02g
Jana Pawła II St. x Armii Krajowej St.	51^{0}13’42.312”N	22^{0}30’49.896”E	Lu03	Lu03g
Jana Pawła II St. x Filaretów St.	51^{0}13’36.012”N	22^{0}31’25.559”E	Lu04	Lu04g
Kraśnickie Rd. x Roztocze St.	51^{0}14’4.668”N	22^{0}29’22.833”E	Lu05	Lu05g
Armii Krajowej St.x Orkana St.	51^{0}13’54.984”N	22^{0}30’44.172”E	Lu06	Lu06g
Zana St. x Filaretów St.	51^{0}14’17.052”N	22^{0}31’48.036”E	Lu07	Lu07g
Zana St. x Wileńska St.	51^{0}14’29.112”N	22^{0}31’8.148”E	Lu08	Lu08g
Kraśnickie Rd. x Bohaterów Mt Cassino	51^{0}14’32.748”N	22^{0}30’25.884”E	Lu09	Lu09g
Kraśnickie Rd. x Zana St.	51^{0}14’46.176”N	22^{0}30’54.972”E	Lu10	Lu10g
Głęboka St. x Pagi St.	51^{0}14’43.152”N	22^{0}31’39.359”E	Lu11	Lu11g
Głęboka St. x Filaretów St.	51^{0}14’37.32”N	22^{0}32’8.735”E	Lu12	Lu12g
Głęboka St. x Nadbystrzycka St.	51^{0}14’20.292”N	22^{0}33’7.092”E	Lu13	Lu13g
Zana St. x Nadbystrzycka St.	51^{0}14’4.452”N	22^{0}32’35.016”E	Lu14	Lu14g
Jana Pawła II St. x Zana St.	51^{0}13’284272”N	22^{0}32’12.012”E	Lu15	Lu15g

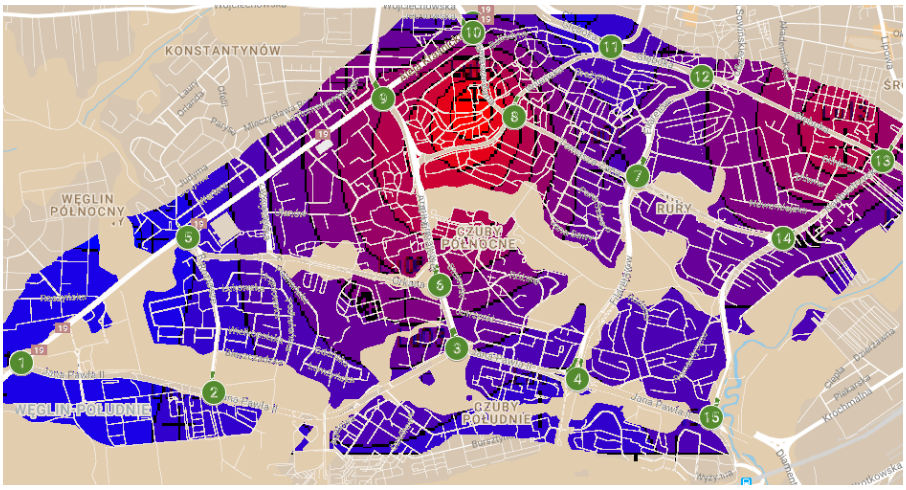

Figure 2. Map of Hg contents in study area (1-14 numbers, there are a localization of soil and plant samples e.g. 07=LU07 and LU07g).

Table 2. Results of Hg contents in soils samples.

Sample	Lu01g	Lu02g	Lu03g	Lu04g	Lu05g	Lu06g	Lu07g	Lu08g	Lu09g	Lu10g
M [mg/kg]	0.01181	0.01724	0.02518	0.01588	0.01026	0.03929	0.02479	0.06241	0.03136	0.02058
	0.0169	0.01582	0.02279	0.01345	0.00926	0.03356	0.02453	0.06499	0.03669	0.01369
	0.01214	0.01889	0.02412	0.01804	0.00899	0.02984	0.02426	0.06486	0.03512	0.01156
	0.01079	0.01413		0.01505	0.01057	0.02994	0.02498	0.05917	0.03083	0.01736
	0.01108	0.01451		0.01483	0.01067			0.06166		0.01241
	0.01095	0.0162			0.00946			0.06076		0.01446
	0.01221	0.01475								
A	**0.012269**	**0.015934**	**0.02403**	**0.01545**	**0.009868**	**0.033158**	**0.02464**	**0.062308**	**0.0335**	**0.01501**
SD	0.001965	0.001568	0.000978	0.001512	0.000658	0.003845	0.000271	0.002097	0.002475	0.003089
% SD	16.0%	9.8%	4.1%	9.8%	6.7%	11.6%	1.1%	3.4%	7.4%	20.6%

Sample	Lu11g	Lu12g	Lu13g	Lu14g	Lu15g
M [mg/kg]	0.012146	0.02339	0.04116	0.01514	0.02005
	0.01402	0.02443	0.04094	0.01535	0.02029
	0.01224	0.02918	0.05309	0.01269	0.0214
	0.01342	0.02529	0.05166	0.01722	0.02039
		0.02601	0.04345		0.02236
A	**0.012957**	**0.02566**	**0.04606**	**0.0151**	**0.020898**
SD	0.000793	0.001965	0.00525	0.00161	0.000864
% SD	6.1%	7.7%	11.4%	10.7%	4.1%

Explanations: M – measurement, A – average, SD - standard deviation, Samples abbreviation – please see Table 1.

4. Discussion and conclusions

The area in question is an area with heavy vehicular traffic, resulting from the importance of the city's arteries running through it. Due to its importance, the roads were intensively sprinkled with salt, which contributed to the salinity of these soils. It also appears on the surface of plants. Small metallic admixtures found in soils and on plants are probably related to nearby road infrastructure (road cabling, screens, masts, lanterns, etc) that corrode and contribute to the appearance of anomalies. Some admixtures of iron oxides and hydroxides may also be associated with their initial post-glacial origin. There is a relatively small amount of mercury in the tested soil samples.

References

[1] J. Dobrzański, J. Mazurkiewicz, ***Dzieje Lublina. Próba syntezy***. Lublin, **1965.**

[2] H. Gawręcki, C. Gawdzik, ***Lublin, krajobraz i architektura.*** Arkady, Warszawa, **1964.**

[3] B. Gworek, J. Rateńska, *Ochrona Środowiska i Zasobów Naturalnych*, **2009**, 41, 614-623.

[4] M. Harasimiuk, A. Henkiel, ***Objaśnienia do szczegółowej mapy geologicznej Polski, w skali 1:50 000, arkusz Lublin,*** wyd. Państwowy Instytut Geologiczny, **1982.**

[5] M. Huber, P. Mroczek, *Biuletyn Państwowego Instytutu Geologicznego*, **2012**, 448, 441-450.

[6] M. Huber, S. Skupiński, *Environmental and Geoanalysis Journal* , **2018**, 4(1), 1-37.

[7] A. Jahn, Pr. Geogr. PAN, **1965**, 7.

[8] J. Kondracki, ***Geografia Regionalna Polski,*** PWN Warszawa, **1998.**

[9] L. Marks, A. Ber, W. Gogołek, K. Piotrowska, ***Mapa geologiczna Polski 1:500 000, ark. SE.*** Państwowy Instytut Geologiczny, Warszawa, **2008.**

[10] H. Maruszczak, *Czas. Geogr*, **1958**, 26, 335-353.

[11] H. Maruszczak, ***Wyżyny Lubelsko–wołyńskie***, [in:]: ***Geomorfologia Polski*** (red. M. Klimaszewski), T.1. Wyd. Geol. Warszawa, **1972.**

[12] A. Rozwałka, ***Lubelskie wzgórze staromiejskie w procesie formowania śedniowiecznego miasta.*** Wyd. UMCS, Lublin, **1997.**

[13] A. Rozwałka, R. Niedźwiadek, M. Stasiak, ***Lublin wczesnośredniowieczny: studium rozwoju przestrzennego.*** Fundacja na Rzecz Nauki Polskiej. Wyd. Trio, Warszawa, **2006.**

[14] D. Smaga D, ***Dane demograficzne.*** Urząd Miasta Lublin. **2017.**

