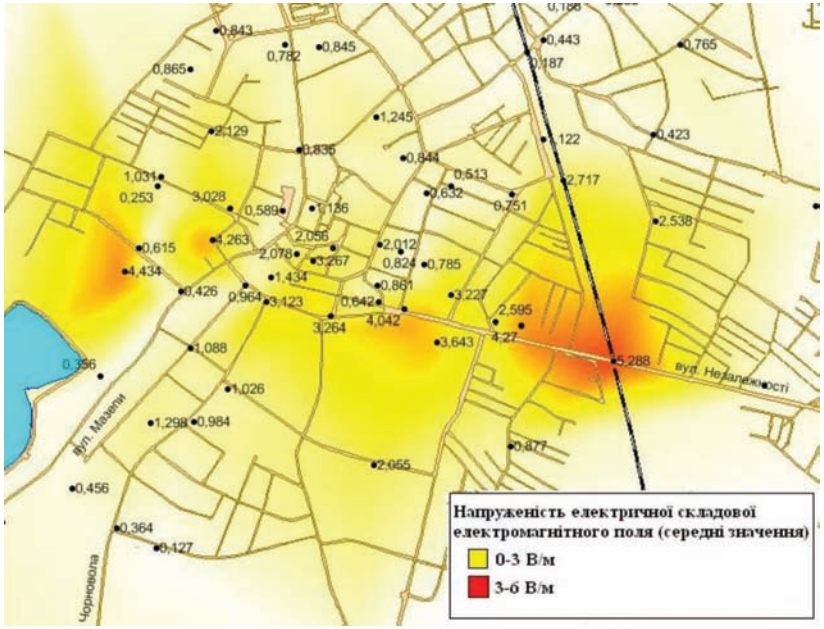

Рис. 4. Максимальні значення напруженості електричної складової електромагнітного поля в Івано-Франківську

Висновки. В урбосоціоекосистемі Івано-Франківська спостережено перевищення ГДР поверхневої густини потоку енергії ЕМП μ у розрізі середніх значень цього фактора у 7 точках тест-полігону і становить від 2,62 до 17,16 мкВт/см^2, а у розрізі максимальних значень цього фактора – у 22 точках тест-полігону і становить від 2,73 до 25,28 мкВт/см^2 (ГДР становить 2,5 мкВт/см^2). Середнє значення $\mu_{сер}$ по Івано-Франківську становить 0,65 мкВт/см^2, а середнє значення $\mu_{макс}$ – 1,73 мкВт/см^2.

Перевищення ГДР напруженості електричного поля E у розрізі середніх значень цього фактора спостережено в 11 точках тест-полігону і становить від 3,03 до 5,29 В/м, а у розрізі максимальних значень даного фактора – у 29 точках тест-полігону і становить від 3,08 до 12,65 В/м (ГДР становить 3 В/м). Середнє значення $E_{сер}$ по Івано-Франківську становить 0,97 В/м, а середнє значення $E_{макс}$ – 2,31 В/м.

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Семчук Я.М., Мердух И.И. **Воздействие электромагнитных полей радиочастотного диапазона на социальную составляющую урбосоциоэкосистемы города Ивано-Франковска**

На основе анализа литературных данных обоснована актуальность исследования влияния электромагнитных полей техногенного происхождения радиочастотного диапазона на социальную составляющую экологической безопасности. Использованы метод физико-математического моделирования распространения электромагнитных полей на основе вектора Умова-Пойнтинга и эколого-географический метод построения экологических карт на основе мониторинга воздействия электромагнитных полей техногенного происхождения на социальную составляющую экологической безопасности урбанизированной территории.

Ключевые слова: электромагнитные поля, урбосоциоэкосистема, социальная составляющая экологической безопасности, вектор Умова-Пойнтинга.

Semchuk Ya.M., Merdukh I.I. **The Influence of Electromagnetic Fields of Antropogenic Origin on the Social Component of Urban Social Ecosystem of the City of Ivano-Frankivsk**

The necessity of the study of the influence of electromagnetic fields of anthropogenic frequency range on the social component of environmental safety is based on the analysis of published data. The method of physical mathematical modeling of electromagnetic fields on the basis of the Umov-Poynting vector and eco-geographical method of constructing environmental maps is based on monitoring of electromagnetic fields anthropogenic component of social environmental safety of urban areas.

Keywords: electromagnetic fields, the urban social ecosystem, the social component of ecological safety, Umov-Poynting vector.

УДК 631.879

COMPARISON OF THE CHEMICAL COMPOSITION OF SELECTED CULTIVARS OF ONION (*ALLIUM CEPA* L.)

G. Jurgiel-Małecka[1], U. Bashutska[2], M. Gibczyńska[3], M. Nawrocka-Pęzik[4]

The analysis comprised four common onion (*Allium cepa* L.) cultivars grown in Poland of yellow-brown color of scale leaves and different ripening times: "Zorza" (very early cultivar), "Francisco" (medium early cultivar), "Kristine" (medium late cultivar) and "Polanowska" (late cultivar). All onion cultivars were obtained from the Experimental Station of Cultivar Testing in Węgrzce, near Kraków. The analysis comprised determination of content of macronutrients (N, Ca, S, K, P), micronutrients (Mg, Cu, Mn, Zn, Fe), reducing and total sugars, and vitamin C. The analysis showed significant differences in chemical composition between the analyzed cultivars. The late cultivar "Polanowska" accumulated the highest amounts of total macro- and micronutrients, and very early cultivar "Zorza" accumulated the least. The latter cultivar was marked by the highest content of vitamin C.

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Keywords: macronutrients, micronutrients, onion, reducing sugars, total sugars, vitamin C

Introduction. The onion (*Allium cepa* L.) is one of the oldest cultivated vegetables. The nutritional and medicinal values as well as the taste of onion **[**1, 22, 12**]**, make it a very popular vegetable all over the world. According to FAOSTAT **[**6**]**, world-wide production of onion is increasing, and in 2013 it amounted to 85.8 million against 82.5 million tons in 2012. Poland is the fifth largest producer of onion in Europe. In 2013, the area of land under onion cultivation was 20080 ha, and the yield amounted to 551072 tons. The amateur and commercial production of onion is popular due to various methods of its future use. Onion can be consumed raw, processed and stored. Even though onion is mainly used as a seasoning plant, it constitutes an important element of human food chain because of high content of flavonoids, fructans, micro- and macronutrients. Micronutrients are necessary for normal growth and development of plants as well as people – they are the ingredients or activators of various enzymes and play a catalytic role in many physiological processes.

The elements such as iron, manganese, zinc or copper take part in photosynthesis, decarboxylation and nitrogen fixation processes, as well as protein and carbohydrates metabolism. Antioxidants found in onion protect the human organism against free radicals which are responsible for ageing and cardiovascular diseases **[**28**]**. Fructans found in onion are considered prebiotic, and stimulate the growth of intestinal microbiota thus decreasing the risk of some diet-related diseases such as colorectal cancer **[**8**]**. The quantity and quality of onion yield depends on farming conditions **[**10, 11, 17, 29, 24, 4, 15, 16, 32**]** and cultivar characteristics **[**21, 13, 25**]**.

The onion of yellow-brown color of scale leaves is the most popular onion type cultivated in Poland. There are approximately 80 cultivars of this type of onion, each characterized by different features, including the shape, sharpness of taste, ripening time, or storability. The particular cultivar is selected on the basis of the method and region of farming, as well as intended future use. The early and medium early varieties are mainly used for immediate consumption, and medium late and late varieties are intended for storing. The aim of the study was to compare the chemical composition of four selected varieties of onions of different types of earliness and their consequent suitability for human consumption.

Materials and methods. Research material. The research material consisted of four common onion (*Allium cepa* L.) cultivars of yellow-brown color of scale leaves – characterized in Table 1.

Table 1. Characteristic of the studied cultivars of onion

Cultivar	Ripening time	Onion			The ability to store the crop
		Shape	Color of scale leaves	Color of onion flesh	
Zorza	very early	spherical	dark yellow	creamy	very short storage time
Francisco	medium early	spherica	light brown	white	short storage time
Kristine	medium late	spherica	golden-brown	white-creamy	long storage time
Polanowska	late	ovoid	yellow-brown	light green	very long storage time

In order to eliminate the differences in chemical composition of onions resulting from the conditions of farming, all cultivars under analysis were grown in one location (Experimental Station of Cultivar Testing in Węgrzce, near Kraków – 50.07° N, 19.59 ° E, 285 m.a.s.l.), and fertilized in the same way. In autumn, the field was fertilized with phosphorus and potassium in the amount of 35 kg $P \cdot ha^{-1}$ and 160 kg $K \cdot ha^{-1}$, with the use of triple superphosphate ($Ca(H_2PO_4)_2 + H_3PO_4$) and potassium sulphate (K_2SO_4). In spring, during vegetation season, the field was fertilized with nitrogen in the total amount of 150 kg $N \cdot ha^{-1}$ divided into three equal doses. The first and the second fertilization was carried out with the use of ammonium nitrate (NH_4NO_3), and the third with calcium nitrate ($Ca(NO_3)_2$). Onion was harvested when approximately 70 % of onion tops have fallen over. The samples were collected three weeks after harvesting, as specified in the norm **[**26, 27**]**.

Analytical methods. The chemical analyses were conducted in two replications with the use of methods generally accepted in agricultural chemistry. The content of vitamin C was determined in fresh weight using Tillman's method. Other chemical analyses were performed using dry weight. Dry mass of each cultivar was obtained from 2 kg of randomly selected onions which were peeled, chopped and dried at the temperature of 40°C to constant weight and then grinned. The content of reducing and total sugar was determined by means of water extract and Luff-Schoorl method. Total content of macro- and micronutrients was determined after previous wet mineralization of samples in concentrated sulfuric (VI) acid with H_2O_2, or in a mixture (3:1) of nitric (V) acid and chloric (VII) acid. In the solutions derived from mineralization of samples in sulfuric (VI) acid with H_2O_2, the following was determined:

- nitrogen – with the use of Kjeldahl's method,
- potassium, magnesium and calcium – atomic absorption spectrometry.

In the solutions derived from mineralization in the mixture of nitric (V) acid and chloric (VII) acid, the following was determined:

- phosphorus – Barton's method at wavelength λ=470 nm,
- sulfur – turbidimetric method at wavelength λ=490 nm,
- iron, zinc, copper, manganese – atomic absorption spectrometry.

Statistical methods. The statistical analysis of the results was conducted using Statistica 10 software. In order to determine the significance of the differences in chemical composition of the analyzed onion cultivars, one way analysis of variance **[**ANOVA**]** was conducted. For the purpose of determining homogenous subsets of means, the post hoc Newman-Keuls test was conducted at significance level $\alpha = 0.05$.

Results and discussion. The tested onion cultivars showed different content of the analyzed elements (tab. 2).

Macronutrients (N, Ca, S, K, P). The highest total content of macronutrients was determined in late cultivar 'Polanowska' (48.2 $g \cdot kg^{-1}$ DM, 9 % above the average), and the lowest in very early cultivar 'Zorza' (39.97 $g \cdot kg^{-1}$ DM, 11 % below the average). The cultivar 'Polanowska' had the highest content of nitrogen (23.10 $g \cdot kg^{-1}$ DM, 7 % above the average), calcium (0.97 $g \cdot kg^{-1}$ DM, 47 % above the average) and sulfur (5.64 $g \cdot kg^{-1}$ DM, 40 % above the average). The lowest content of nitrogen was found in the cultivar 'Zorza' (19.04 $g \cdot kg^{-1}$ DM, 12 % below the average), and the lowest content of calcium and sulfur in medium late cultivar 'Kristine': 0.41 $g \cdot kg^{-1}$ DM and 3.28 $g \cdot kg^{-1}$ DM (40 % and 19 % below the average) respectively. Earlier studies by other authors give similar values of nitrogen accumulation **[**7, 19**]**, and slightly

higher values for calcium [29, 5, 19]. The content of sulfur determined in cultivar 'Polanowska' corresponds very well with values presented in the literature of the subject, i.e. sulfur content in onion was found to be at the level of 5-6 g S·kg^{-1} DM [7, 14, 5, 19]. The content of sulfur in cultivars 'Zorza', 'Francisco' and 'Kristine', did not show any significant variation and amounted to 3-4 g S·kg^{-1} DM at the lower level. Similarly low content of sulfur (on average 3.82 g·kg^{-1} DM) was found by Chope and Terry [5] in cultivar 'SS1', and by Kleiber et al. [19] in cultivar 'Aurora' (on average 3.9 g·kg^{-1} DM). Cultivars 'Francisco', 'Kristine' and 'Polanowska' did not show any significant variations in terms of accumulation of potassium, and comprised a homogenous group with mean content 14.3 g K·kg^{-1} DM. Similar potassium content was determined by Chope and Terry [5] in cultivar 'SS1' (on average 14.9 g K·kg^{-1} DM). Significantly lower content of potassium was found in very early cultivar 'Zorza' (12.74 g·kg^{-1} DM, 8 % below the average). Additionally, this cultivar showed the lowest content of phosphorus (3.98 g·kg^{-1} DM, 11 % below the average). The highest content of phosphorus was found in medium early cultivar 'Francisco' (4.83 g·kg^{-1} DM, 8 % above the average). Similar values of phosphorus accumulation in onion (3-6 g P·kg^{-1} DM) are given in other publications [29, 30, 19].

Table 2 – The chemical composition of onion cultivars

Analyzed component		Cultivar				Mean
		Zorza	Francisco	Kristine	Polanowska	
Macronutrients (g·kg^{-1} DM)	N	19.04 ^{d}	22.68 ^{b}	21.84 ^{c}	23.10 ^{a}	21.67
	Ca	0.62 ^{b}	0.64 ^{b}	0.41 ^{c}	0.97 ^{a}	0.66
	S	3.59 ^{b}	3.62 ^{b}	3.28 ^{b}	5.64 ^{a}	4.03
	K	12.74 ^{b}	14.57 ^{a}	14.03 ^{a}	14.29 ^{a}	13.91
	P	3.98 ^{d}	4.83 ^{a}	4.44 ^{c}	4.72 ^{b}	4.49
	Total	39.97	46.34	44.00	48.72	44.76
Micronutrients (mg·kg^{-1} DM)	Mg	518.6 ^{b}	566.0^{ab}	564.9^{ab}	589.0 ^{a}	559.63
	Cu	3.41 ^{c}	4.61 ^{b}	4.62 ^{b}	5.97 ^{a}	4.65
	Mn	10.19 ^{c}	12.36 ^{a}	8.42 ^{d}	11.31 ^{b}	10.57
	Zn	21.64 ^{a}	21.88 ^{a}	19.26 ^{c}	20.39 ^{b}	20.79
	Fe	31.52 ^{b}	26.76 ^{c}	34.43 ^{a}	25.10 ^{d}	29.45
	Total	585.36	631.61	631.63	651.77	625.09
Reducing sugars (g·kg^{-1} DM)		225.3 ^{b}	248.9 ^{a}	177.1 ^{d}	194.2 ^{c}	211.4
Total sugars (g·kg^{-1} DM)		548.6 ^{b}	509.6 ^{d}	586.0 ^{a}	537.2 ^{c}	545.3
Vitamin C (mg·100 g^{-1} FW)		9.41 ^{a}	6.95 ^{b}	7.51 ^{b}	7.20 ^{b}	7.77
Mean values in each row marked with the same letter do not significantly statistically differ at α = 0.05						

Micronutrients (Mg, Cu, Mn, Zn, Fe). As shown in table 2, the cultivar 'Polanowska' accumulated the highest total amounts of all analyzed micronutrients (651.77 mg·kg^{-1} DM, 4 % above the average), and cultivar 'Zorza' accumulated the least (585.36 mg·kg^{-1} DM, 6 % below the average). The highest content of magnesium (589.0 mg·kg^{-1} DM, 5 % above the average), as well as copper (5.97 mg·kg^{-1} DM, 28 % above the average) was found in onion cultivar 'Polanowska'. The lowest content of these elements was determined in cultivar 'Zorza': 518.6 mg Mg·kg^{-1} DM (7 %

below the average) and 3.41 mg Cu·kg^{-1} DM (27 % below the average) respectively. The medium early cultivar 'Francisco' was marked by the highest content of manganese (12.36 mg·kg^{-1} DM, 7 % above the average) and zinc (21.88 mg·kg^{-1} DM, 5 % above the average). Furthermore, the lowest content of these elements was found in medium late cultivar 'Kristine' – respectively 8.42 mg Mn·kg^{-1} DM (20 % below the average) and 19.26 mg Zn·kg^{-1} DM (7 % below the average). However, this cultivar accumulated the highest amounts of iron (34.43 mg·kg^{-1} DM, 17 % above the average). The lowest content of iron was found in cultivar 'Polanowska' (25.10 mg·kg^{-1} DM, 15 % below the average). The contents of micronutrients presented above are in line with the results obtained by Chope and Terry [5] and Kleiber et al. [20], and slightly higher than that given by Rodrigues Galdón et al. [30].

Reducing and total sugars. The analyzed onion cultivars showed significant variation in terms of the content of reducing and total sugars. The greatest difference was found between medium early cultivar 'Francisco' and medium late cultivar 'Kristine'. The cultivar 'Kristine' which was marked by the highest content of total sugars (586.0 g·kg^{-1} DM, 7 % above the average), accumulated the least amount of reducing sugars (177.1 g·kg^{-1} DM, 16 % below the average). By contrast, the cultivar 'Francisco', which had the lowest content of total sugars (509.6 g·kg^{-1} DM, 6 % below the average), accumulated the highest amount of reducing sugars (248.9 g·kg^{-1} DM, 18 % above the average). Significant differences in reducing sugars content in bulb vegetables are also mentioned by various authors [2, 9, 23]. The mean total sugars content determined in the analyzed onion cultivars (545.3 g·kg^{-1} DM), was similar to the results obtained in other studies [18, 2, 9, 8, 31].

Vitamin C. There was no significant difference in terms of vitamin C content between cultivars 'Francisco', 'Kristine' and 'Polanowska', which comprised a homogenous group with mean content of 7.22 mg·100 g^{-1} FW. Significantly higher content of vitamin C was found in cultivar 'Zorza' (9.41 mg·100 g^{-1} FW, 21 % above the average). Similar results were obtained by Bieżanowska-Kopeć et al. [3]. The content of vitamin C determined in yellow-brown onion cultivars was at the level of 6-12 mg·100 g^{-1} FW.

Conclusions. The analyzed onion cultivars showed significant variations in terms of chemical composition, which affects the assessment of their suitability for consumption. The greatest significant differences in terms of the content of the analyzed elements were found between early cultivar 'Zorza' and late cultivar 'Polanowska'. These cultivars showed significant variation in content of all analyzed elements, except for total sugar. The very early cultivar 'Zorza' accumulated the least total macro- and micronutrients, yet it was marked by the highest content of vitamin C. In terms of nutritional value, this cultivar should be considered as a source of vitamin C in the spring season. Due to the time of harvesting, this cultivar can be recommended to be eaten raw, together with green chives. From all of the analyzed cultivars, 'Polanowska' accumulated the highest amounts of total macro- and micronutrients. This cultivar can be stored for extended periods, and should be treated as an important complementary source of macro- and micronutrients during the autumn-winter season.

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Юргєль-Малєцька Г., Башуцька У., Гібчинська М., Навроцька-Пензік М. **Порівняння хімічного складу деяких сортів цибулі (*Allium cepa* L)**

Досліджено чотири сорти цибулі звичайної (*Allium cepa* L.) із жовто-коричневим забарвленням лушпиння, які культивуються у Польщі та відрізняються часом дозрівання: "Зожа" (дуже ранній сорт), "Франциско" (середньоранній сорт), "Христина" (середньопізній сорт) і "Поляновський" (пізній сорт). Цибулини отримано із дослідної станції тестування сортів у Венгжце, під Краковом. Визначено вміст макроелементів (N, Ca, S, K, P), мікроелементів (Mg, Cu, Mn, Zn, Fe), редукованих і загальних цукрів, вітаміну С. Встановлено значні відмінності хімічного складу аналізованих сортів. Пізній сорт "Поляновський" нагромадив найбільше макро- і мікроелементів загалом, а дуже ранній сорт "Зожа" – найменше. Останній сорт має найвищий вміст вітаміну С.

Ключові слова: цибуля, макроелементи, мікроелементи, редукований цукор, загальний цукор, вітамін С.

Юргель-Малецкая Г., Башуцкая У., Гибчинская М., Навроцка-Пензик М. **Сравнение химического состава некоторых сортов лука (*Allium cepa* L.)**

Исследованы четыре сорта лука обычного (*Allium cepa* L.) с желто-коричневой окраской шелухи, которые культивируются в Польше и отличаются временем созревания: "Зожа" (очень ранний сорт), "Франциско" (средне-ранний сорт), "Кристина" (среднепоздний сорт) и "Поляновский" (поздний сорт). Луковицы получены с исследовательской станции тестирования сортов в Венгжце, под Краковом. Определено содержание макроэлементов (N, Ca, S, K, P), микроэлементов (Mg, Cu, Mn, Zn, Fe), редуцированных и общих сахаров, витамина С. Установлены значительные различия химического состава анализируемых сортов. Поздний сорт "Поляновский" накопил больше макро- и микроэлементов в целом, а очень ранний сорт "Зожа" – меньше. Последний сорт отмечен высоким содержанием витамина С.

Ключевые слова: лук, макроэлементы, микроэлементы, редуцированный сахар, общий сахар, витамин С.