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Lead Content and Pesticides Residues in Dietary Supplements

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ABSTRACT: The aim of the present study was to determine the lead concentrations and pesticide residues levels in different widely used dietary supplements. For evaluation of the lead content was used inductively coupled plasma mass spectrometry and for the evaluation of pesticide residues levels, a multimethod based on GC-MS/MS and LC-MS was used. All dietary supplements (n=10) were purchased from Bulgarian pharmacies and had plant or animal origin. The following pesticides were found in two of the samples: boscalid, thiamethoxam, acetampirid. It was established that one of the analysed samples could provide a lead intake of 6μg per day.

KEYWORDS: Dietary supplements, lead, pesticides, food safety.

I. INTRODUCTION

Nowadays the control and prevention of lead and pesticides exposure have become important health and environmental challenges.

Lead toxicity is associated with serious adverse effects like neurological dysfunction, haematological dysfunction, nephropathy, hypertension, etc [1]. Exposure to pesticides could cause serious consequences including cancer, neurological dysfunction, liver damage, reproductive adverse effects, skin lesions and others [2–9]. Moreover, pesticides are regarded as one of the most dangerous pollutants for the environment and the different ecosystems [9]. Pesticides could be found in the soil, water, and food, causing adverse effects to non-target organisms.

Especially dangerous is the severe or prolonged exposure to lead or pesticides. Sources of long-term exposure to lead or pesticides could be food, dietary supplements, water, cosmetics, environment. Therefore, the exposure to lead or pesticides is not always easy to be controlled or predicted.

The aim of the present study was to determine lead concentrations and pesticide residues levels in different widely used dietary supplements (DSs).

II. MATERIALS AND METHODS

The analysed samples were dietary supplements (n=10) purchased from Bulgaria pharmacies. The origin of the manufacturer of eight of the analysed samples was European Union (EU), one sample was produced in Canada and one in the USA. The composition of the samples had animal or plant origin.

For evaluation of the lead content was used inductively coupled plasma mass spectrometry (ICP-MS).

For the evaluation of pesticides content, a multimethod based on GC-MS/MS and LC-MS was used. The screening included 127 pesticides. The method applied was performed according to the guidelines of the Bulgarian Institute for Standardization for the determination of pesticide residues in foods of plant origin (EN 15662:2018) [10,11]. Prior to analysis the samples were stored in sterile containers.

III. RESULTS AND DISCUSSION

Pesticides were found in 2 of the analyzed samples (20% of the samples). In general, both DSs were recommended for a long-term intake for achieving better effects.

The pesticides detected were: boscalid, thiamethoxam and acetampirid (table 1).

The highest levels of lead were found in sample № 5 - 3.046 mg/kg. According to the EU legislation the maximum levels for lead in dietary supplements are 3.0 mg/kg [12]. The recommended daily intake of this product was between 1.5 and 2 g. It was established that sample № 5 which was promoted to provide beneficial effects on nervous exhaustion, emotional exhaustion, tense conditions, anxiety could provide daily intake of lead up to 6 μg per day. This product is normally included in the diet of the consumers for a long period of time.

The lead content in the other samples was less than 3.0 mg/kg.

Samples № 4 and 9 were found to contain pesticides. The fungicide boscalid or 2-chloro-N-(4'-chloro[1,1'-biphenyl]-2-yl)pyridine-3-carboxamide(fig.1), was detected in sample № 4. Thiamethoxam and acetampirid were detected in sample №9.

Boscalid is a succinate dehydrogenase inhibitor, widely used in the agriculture [13]. Recent studies suggested that succinate dehydrogenase inhibitor fungicides are not enough selective for their fungi targets but can also affect the mitochondrial function of non-target organisms including humans. It was reported that even a short-term exposure to boscalid could induce a mitochondrial dysfunction in human cells [13]. However, boscalid is considered as a low toxicity pesticide [14].

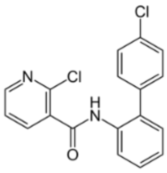

Fig. 1. Structure of boscalid

Thiamethoxam represents a mixture of isomers. It is used as a systemic insecticide and belongs to the neonicotinoid family. Neonicotinoid insecticides act selectively as agonists on insect nicotinic acetylcholine receptors [15]. However, thiamethoxam was reported to have potential effects on non-target organisms including humans (main target organs liver and kidney) [16].

Acetampiride (fig. 2) is an insecticide which also belongs to the neonicotinoid family. In general, acetampiride is associated with low mammalian toxicity. However, high doses of acetamiprid are considered as toxic to humans [17].

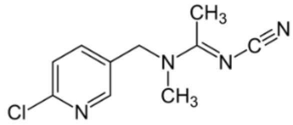

Fig. 2. Structure of acetampiride

In EU DSs are regulated as food. However, no data was found about the "Pesticide residue(s) and maximum residue levels" for food/dietary supplements in EU. The data about the maximum residue levels (mg/kg) in food were limited to fruits, vegetables, fungi, nuts, pulses, mosses and lichens, teas, coffee, herbal infusions, cocoa and carobs, hops, spices, honey, animal food products [18].

Although many countries have precise regulations and sophisticated systems for control of pesticides and lead content in many products, there is no international legal framework about the levels of pesticides in DSs. An international legal framework about the pesticide residue(s) and maximum residue levels pesticides for DSs should be adopted.

Regular monitoring of pesticides residues and lead in DSs is especially important for ensuring their safety.

Table 1. Pesticides and lead content in the analyzed dietary supplements

№	Content	Origin of the manufacturer	Formulation	Recommended daily intake according to the label of the product	Lead content (mg/kg)	Pesticides (mg/kg)
1.	Fish oil	USA	Capsules	3 capsules per day	0.025	-
2.	Fish oil	Canada	Capsules	Up to 3 capsules per day	Not significant	-
3.	Combination of plant extracts	EU	Capsule	1 capsule per day	0.196	-
4.	Valerian radix extract	EU	Tablets	6 tablets per day	0.076	boscalid (0,030)
5.	Valerian radix extract, St. John's wort extract, Hawthorn leaves and flowers extract, other compounds	EU	Tablets	3-4 tablets per day	3.046	-
6.	Betula pendula leaves extract	EU	Tablets	3 tablets per day	0.121	-

7.	Bearberry extract	EU	Capsules	2 capsulec daily	Not significant	-
8.	Serenoa repens extract	EU	Tablets	1 tablet daily	0.088	-
9.	Gingko biloba extract	EU	Tablets	1 tablet daily	0.017	thiamethoxam (0,014) acetampirid (0,022)
10.	Gingko biloba extract	EU	Tablets	1 tablet daily	0.054	-

IV. CONCLUSION

Nowadays the exposure to pesticides or lead is regarded as major public health concern. The widespread use of pesticides is associated with serious adverse effects for humans, animals, and the environment. Although many countries have precise regulations and sophisticated systems for control of pesticides and lead content in many products, there is no international legal frameworks about the levels of pesticides in DSs. Regular monitoring of pesticides residues and lead in DSs is especially important for the prevention of lead/pesticides exposure and for ensuring the safety of DSs as well.

REFERENCES

[1]. Lockitch, G. Perspectives on Lead Toxicity. Clin. Biochem.**1993**, 26, 371–381, doi:10.1016/0009-9120(93)90113-K.

[2]. Liu, R.; Li, J.; Zhang, L.; Feng, T.; Zhang, Z.; Zhang, B. Fungicide Difenoconazole Induced Biochemical and Developmental Toxicity in Wheat (Triticum Aestivum L.). Plants**2021**, 10, 2304, doi:10.3390/plants10112304.

[3]. Bal, R.; Türk, G.; Tuzcu, M.; Yilmaz, O.; Kuloglu, T.; Gundogdu, R.; Gür, S.; Agca, A.; Ulas, M.; Çambay, Z.; et al. Assessment of Imidacloprid Toxicity on Reproductive Organ System of Adult Male Rats. J. Environ. Sci. Health Part B**2012**, 47, 434–444, doi:10.1080/03601234.2012.663311.

[4]. Ubaid Ur Rahman, H.; Asghar, W.; Nazir, W.; Sandhu, M.A.; Ahmed, A.; Khalid, N. A Comprehensive Review on Chlorpyrifos Toxicity with Special Reference to Endocrine Disruption: Evidence of Mechanisms, Exposures and Mitigation Strategies. Sci. Total Environ.**2021**, 755, 142649, doi:10.1016/j.scitotenv.2020.142649.

[5]. Wang, G.; Lu, Y.; Han, J.; Luo, W.; Shi, Y.; Wang, T.; Sun, Y. Hexachlorobenzene Sources, Levels and Human Exposure in the Environment of China. Environ. Int.**2010**, 36, 122–130, doi:10.1016/j.envint.2009.08.005.

[6]. Nguyen, K.; Sanchez, C.L.; Brammer-Robbins, E.; Pena-Delgado, C.; Kroyter, N.; El Ahmadie, N.; Watkins, J.M.; Aristizabal-Henao, J.J.; Bowden, J.A.; Souders, C.L.; et al. Neurotoxicity Assessment of QoI Strobilurin Fungicides Azoxystrobin and Trifloxystrobin in Human SH-SY5Y Neuroblastoma Cells: Insights from Lipidomics and Mitochondrial Bioenergetics. NeuroToxicology**2022**, 91, 290–304, doi:10.1016/j.neuro.2022.06.002.

[7]. Feki, A.; Ben Saad, H.; Jaballi, I.; Magne, C.; Boudawara, O.; Zeghal, K.M.; Hakim, A.; Ben Ali, Y.; Ben Amara, I. Methyl Thiophanate-Induced Toxicity in Liver and Kidney of Adult Rats: A Biochemical, Molecular and Histopathological Approach. Cell. Mol. Biol.**2017**, 63, 20, doi:10.14715/cmb/2017.63.2.4.

[8]. Phogat, A.; Singh, J.; Kumar, V.; Malik, V. Toxicity of the Acetamiprid Insecticide for Mammals: A Review. Environ. Chem. Lett.**2022**, 20, 1453–1478, doi:10.1007/s10311-021-01353-1.

[9]. Singh, S.; Singh, N.; Kumar, V.; Datta, S.; Wani, A.B.; Singh, D.; Singh, K.; Singh, J. Toxicity, Monitoring and Biodegradation of the Fungicide Carbendazim. Environ. Chem. Lett.**2016**, 14, 317–329, doi:10.1007/s10311-016-0566-2.

[10]. https://www.en-standard.eu/csn-en-15662-foods-of-plant-origin-multimethod-for-the-determination-of-pesticide-residues-using-gc-and-lc-based-analysis-following-acetonitrile-extraction-partitioning-and-clean-up-by-dispersive-spe-modular-quechers-method/

[11]. https://bds-bg.org/en/project/show/bds:proj:102689

[12]. https://food.ec.europa.eu/safety/chemical-safety/contaminants/catalogue/lead_en

[13]. d'Hose, D.; Isenborghs, P.; Brusa, D.; Jordan, B.F.; Gallez, B. The Short-Term Exposure to SDHI Fungicides Boscalid and Bixafen Induces a Mitochondrial Dysfunction in Selective Human Cell Lines. Molecules**2021**, 26, 5842, doi:10.3390/molecules26195842.

[14]. EFSA (European Food Safety Authority); Anastassiadou, M.; Bernasconi, G.; Brancato, A.; Carrasco Cabrera, L.; Ferreira, L.; Greco, L.; Jarrah, S.; Kazocina, A.; Leuschner, R.; et al. Modification of the Existing Maximum Residue Level for Boscalid in Pomegranates. EFSA J.**2020**, 18, doi:10.2903/j.efsa.2020.6236.

[15]. Nauen, R.; Ebbinghaus-Kintscher, U.; Salgado, V.L.; Kaussmann, M. Thiamethoxam Is a Neonicotinoid Precursor Converted to Clothianidin in Insects and Plants. Pestic. Biochem. Physiol.**2003**, 76, 55–69, doi:10.1016/S0048-3575(03)00065-8.

[16]. Yi, L.; Zhang, S.; Chen, X.; Wang, T.; Yi, X.; Yeerkenbieke, G.; Shi, S.; Lu, X. Evaluation of the Risk of Human Exposure to Thiamethoxam by Extrapolation from a Toxicokinetic Experiment in Rats and Literature Data. Environ. Int.**2023**, 173, 107823, doi:10.1016/j.envint.2023.107823.

[17]. Imamura, T.; Yanagawa, Y.; Nishikawa, K.; Matsumoto, N.; Sakamoto, T. Two Cases of Acute Poisoning with Acetamiprid in Humans. Clin. Toxicol.**2010**, 48, 851–853, doi:10.3109/15563650.2010.517207.

[18]. https://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/start/screen/mrls/details?lg_code=EN&pest_res_id_list=244&product_id_list=