ASSESSMENT OF THE RISK TO HUMAN HEALTH OF ACTIVE INGREDIENTS OF PLANT PROTECTION PRODUCTS (PPPs) WITH A COMMON TOXICITY MECHANISM

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Historically, the potential human health risk assessment associated with the use of pesticides in agriculture has been based on the effects on the human body of individual active ingredients of plant protection products. In this regard, the maximum levels of residues of active substances in food (MRLs) were also established for individual active substances, despite the fact that in real life a person can be exposed to several active substances of plant protection products at the same time. To overcome this apparent inconsistency, the United States Food Quality Protection Act (FOPA) [1], which entered into force in August 1966, ordered the Pesticide Program Authority to consider potential risks to human health in all food and non-food effects of several active ingredients PPPs with a common toxicity mechanism. This process is called cumulative risk assessment. To implement this requirement, the United States Environmental Protection Agency (US EPA) Guidelines for Assessing the Cumulative Risk of Pesticide Chemicals with a Common Toxicity Mechanism [2] .The EPA developed a common framework for identifying chemicals that can be included in the group toxicity mechanism [3].

The cumulative risk assessment of several pesticides with a common toxicity mechanism should take into account the possibility of their exposure to the human body in several ways, including food, drinking water and living (not professional contact) with air, soil, grass and domestic animals. The EPA believes that, for example, about 80% of the organophosphates in the body of a typical american city dweller come from food, the remaining 20% come from drinking water and from sources associated with the place of residence [4].

A group with a common mechanism of toxicity consists of chemicals whose scientific evidence confirms that the same toxic effect occurs in or on the same organ or tissue with the same sequence of major biochemical events. The EPA has identified 5 pesticide groups, each of which has a general toxicity mechanism, and therefore requires an assessment of cumulative risk: Organophosphates, N-methyl Carbamates, Triazines, Chloroacetanilides, Pyrethrins / Pyrethroid [5].

A striking example of the need to assess the cumulative risk to human health of xenobiotics with a common toxicity mechanism is dioxins and dioxin-like polychlorinated biphenyls. Each congener of dioxins or dioxin-like PCBs from 29 congeners that are subject to control exhibits a different level of

toxicity. In order to sum up the toxicity of all these different congeners, the notion of toxic equivalence factors (TEFs) was introduced to facilitate the assessment of risk to human health and subsequent regulatory control over their content in food and environmental objects [6]. This means that the toxicity of any congener is evaluated in relation to the toxicity of the most toxic congener 2,3,7,8 - tetrachlorodibenzo-para-dioxin (2,3,7,8-TCDD), whose TEF is 1. Analytical results, related to the content in the analyzed matrices of all individual congeners of dioxins and dioxin-like PCBs that have toxicological significance are expressed by the sum of the toxic equivalents of individual congeners (TEQs), which are obtained by multiplying the concentration of each congener in the analyzed matrix by his TEF . TEQs were obtained based on results from various studies and are updated as new data is received by the United Nations World Health Organization (WHO).

During the development of the domestic program for revising the MRLs of active ingredients PPPs that can have a cumulative effect on the human body (influenced by the work of EPA), we proposed to establish the allowable daily intake (AID) of the active ingredients of organophosphates and carbamates by analogy with polychlorinated dibenzo-para-dioxins, polychlorinated dibenzofurans and dioxin-like polychlorinated biphenyls [6] to express toxicity of organophosphates and carbamates using toxicity coefficients [7]. For example, the toxicity of organophosphates can be expressed in relation to parathion-methyl (metaphos), the most toxic among organicganophosphates used in agriculture, the toxicity coefficient of which is taken as a unit. Table 1 shows the toxicity ratios of some organophosphates calculated in this way.

Table 1

Toxicity coefficients of the active ingredints of organophosphates

Active ingredient	The toxicity coefficient
Parathion-methyl (metaphos)	1
Chlorpyrifos	0,02
Phosalone	0,02
Dimethoate	0,007
Diazinon	0,002
Fenitrothion	0,002
Phoxim	0,001

Table 2 shows the calculated toxicity coefficients for carbamates with respect to carbofuran, the most toxic among carbamates, the toxicity coefficient of which was also taken as a unit.

Table 2

Toxicity coefficients of active ingredients of carbamates

Active ingredient	The toxicity coefficient
Carbofuran	1
Formetanat	0,5
Methiocarb	0,4
Propoxur	0,2
Bendiocarb	0,1
Furatiocarb	0,1
Pirimicarb	0,06
Trimethocarb	0,06
Ethiofencarb	0,04
Benfuracarb	0,03
Carbaryl	0,03
Carbosulfan	0,03
Isoprocarb	0,02
Xylilcarb	0,02
Fenobucarb	0,01

To calculate the toxicity ratios given in Tables 1 and 2, LD 50 values were used for rats [8]. The values of AID and MRL in these cases should be expressed in "metapthos" or "carbofuran" equivalent. The calculation of the concentration of organophosphates and carbamates in the analyzed matrices, which in these cases is called the equivalent toxic concentration, should be made by multiplying the concentration values of the individual active ingredients by the corresponding values of the toxicity coefficients.

References

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