

Monitoring and risk assessment of pesticides in the Slovak Republic

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According to FAO (Food and Agriculture Organization of the United Nations (UN)), pesticides are substances or mixture of substances intended for preventing, destroying or controlling any pest, including unwanted species of microorganisms, plants or animals causing harm or otherwise interfering with the production, processing, storage, transport, or marketing of food, agricultural commodities, wood, wood products or animal feedstuffs (FAO, 1986).

As a consequence of the use of plant protection products, residues of their parent compounds or any other specified derivatives such as degradation and conversion products and metabolites, remain in or on plants, or products of plant origin, animal products or elsewhere in the environment. According to principles of Good Agricultural Practices (GAP), plant protection products should be used “as little as possible, but as much as necessary”. For the expression of the maximum permitted levels of their concentration in agricultural commodities and food, the value of maximum residue limit (MRL) is used. It is expressed as mg/kg of edible portion. Defined maximum residue limits are usually lower than the upper safety limits. In addition, health risk from intake via dietary pathway is based on levels of the observed residue in the raw commodities, even though the most of the commodities are treated or processed before their consumption. However, significance of these doses for human health risk must not be disregarded, since these substances can be ingested via some food commodities daily over a lifetime.

According to the national official legislative acts, more than 270 substances are permitted for their usage in plant protection. Nevertheless there are still cases of inappropriate use of agrochemicals, and analyses of foodstuffs sometimes detect pesticide residues of compounds whose use was banned or a pesticide is confirmed to be present in a sample at a higher concentration level than MRL. Constant surveillance and monitoring in the use of pesticides is therefore very important. In countries that have strong legislative control over these substances, health risk of pesticides is at the very low level. However it must not be disregarded.

In the Slovak Republic, this domain has been in the permanent focus of the Agricultural Sector since 1986. Ministry of Agriculture commissioned Food Research Institute to operate as a “Centre for the Evaluation of the Contaminants Occurrence”, where all the data on contamination of the food chain are summarized and evaluated. The responsibility for sampling and analyses is assigned to laboratories of the Agricultural Sector which are accredited for this type of analyses. Within the monitoring of the pesticides in the Slovak Republic, the following organizations of the Agriculture Sector have participated: Central

Control and Testing Agriculture Institute, State Veterinary and Food Administration of the Slovak Republic, „Hydromelioration, state enterprise” and Food Research Institute. Besides analytical data from mentioned organizations of Agricultural Sector, the database of food contaminants of the Centre for the Evaluation of the Contaminants Occurrence also contains data from the Environmental Sector (Research Institute of Water Management) as well as from Health Sector (Public Health Authorities and Slovak Health University).

The obtained data on pesticide residues are statistically analyzed and subsequently evaluated by Centre for the Evaluation of the Contaminants Occurrence, in accordance with decrees and directions of Ministry of Agriculture, Ministry of Health and Ministry of Environment. The evaluation has been conducted in accordance with current standards (number of over limited samples; geographical either chronological aspect of the contamination dynamics, etc.).

Since 1986, total of 517 000 analyses of various pesticides residues occurrence in water, agricultural soil, feed, raw material of animal and plant origin and food commodities has been done in our country. The highest proportion of the analyses performed during this period has been focused on observation of food commodities and food raw materials (77%) as well as water (12.3%). Remaining 11% of the analyses were focused on soil, feed and other commodities. In general 160 various types of pesticides have been observed during the last 20 years. First analyses of the pesticide residues occurrence which were conducted in 1986 were focused on persistent chlorinated pesticides. Ten types of pesticides were evaluated: dichloro diphenyl trichloroethane (DDT) and hexachlorocyclohexane (HCH) and their isomers, hexachlorobenzene (HCB) and Aldrin. For the period of the last 20 years, the range of the observed pesticides was increasing and in 2005 total of 118 various types of these substances was monitored (chlorinated pesticides, organophosphate and carbamate insecticides, etc.). During the period of observation, also the number of analyses has increased from the previous 9000 in 1986 to 112800 in 2005. The most significant increase of the number of analyses was noticed in 2003, during the preparations of the Slovak Republic for joining the European Union, which also included preparations for implementation of new monitoring system of pesticides (in particular pesticides in plant commodities). Until 2003 up to 50 various types of the pesticides were observed and after joining EU (in 2004) this number increased up to 127 of the various pesticides.

Database of the contaminants contains data on the location where the samples of the analyzed commodities were collected (agricultural holdings, sources of drinking water, retail network, locality of the sampling of game and fish etc.). In case of food commodities, the samples from import and samples from domestic production are analyzed separately, therefore the database also contains data on country of origin. During the first period of the observation, most of the analyzed samples were from the domestic production. For example in 1993 97.8% of total analyses were analyses of commodities from the domestic production and only remaining 2.2% were focused on commodities from the import. On the other hand, in 2005 47.9% of the analyses were focused on commodities from domestic production and 52.1% of them on commodities from import. Number of samples that exceeded limit values was also in decrease during the period of the observation. The most of the over limited samples were found in 1995 (57), with the major contribution of commodities from the private production. Regarding commodities from import, the highest share of the over

limited samples was stated in 1986 (for example content of the DDT in samples of the lunch-meat imported from China). In the last years of the monitoring the rate of the over limited samples (food and water) has decreased to 0.06%.

The first step in risk assessment of the pesticide residues is related to assessment of the concentration that could be harmful for the human health. The evaluation of the theoretical maximum daily intake (TMDI) of particular pesticides is based on the hypothesis that the observed pesticide is present in all items of food commodities with registered limit value or with the limit that is planned for the registration. The health risk from dietary exposure was assessed based on calculated exposure doses according to a model that combines data on the maximum allowable concentration of contaminant (MRL) in food commodities consumed in the human nutrition with data on their consumption. The calculated exposure doses are subsequently compared to limited exposure value e.g. ADI (acceptable daily intake).

In the period 2002–2004, Food Research Institute participated in the National Program on Health Support with project: “Exposure assessment of the population to additives and contaminants“. Within this project the theoretical exposure doses of the various contaminants were evaluated. Total of 278 various contaminants were observed and 263 of them were pesticides. The dietary risk assessment of pesticides was conducted, based on the calculated values of the theoretical maximum daily intake (TMDI) of observed contaminants via dietary pathway, with the presumptions that the concentration of the contaminants is at the maximum residue limit (100% MRL), 50% or 25% of the MRL that was set by The Food Codex of the Slovak Republic. Data on dietary intake of the particular commodities were utilized from Statistical Office of the Slovak Republic. As the average body weight of an inhabitant of the Slovak Republic 70 kg were used.

According to the results of theoretical dietary exposure of the Slovak population to particular pesticides, when the value of the 100% MRL was used for the calculations acceptable daily intake (ADI) was exceeded in case of 10% of the analyzed pesticides (Demeton-S-methyl, Parathion-methyl, Camphechlor, Dichlorvos, Aldrin, Dieldrin, Fenitrothion, Thiram, Azinphos methyl, Heptachlor, Ethion, Omethoate, Copper containing compounds, Dicofol, Fentin, Aminotriazol, Phosphamidon, Chinomethionat, Methidathion, Methyl bromide, Phorate, Diazinon, Mevinphos, Trichlorfon, Cyhexatin, Alachlor, Dazomet and Fosetyl-Al). However, the exposure doses calculated using this model were highly overestimated, since over 90% of the findings of observed samples of food and raw materials in our country were below the limit of the quantification (LOQ). In 2005 for example, 98.3% of the analyzed samples of the domestic production and 98.8% samples from import had findings below the limit of the quantification.

Taking the values of 50% MRL for the calculations of theoretical maximum daily intake (TMDI), the value of acceptable daily intake (ADI) was exceeded in case of 13 analyzed pesticides, and also in case of 4 additional pesticides (Demeton-S-methyl, Parathion-methyl, Campechlor a Dichlorvos) when the calculations of the theoretical maximum daily intake were based on values of 25% MRL. However Demethon-S-methyl has not been analyzed in food commodities in the Slovak Republic.

Evaluation of the pesticide residues occurrence in commodities of the plant origin in the Slovak Republic is conducted in accordance with regulations of the European and Slovak

Food Codex. The sampling system for particular commodities depends on dietary consumption in the Slovak Republic, production or import rate, analyses from previous period, reports of RASFF (Rapid Alert System for Food and Feed), requirements and recommendations of European monitoring system. Samples of food commodities for official control of the pesticide residues occurrence are collected by inspectors of the District Veterinary and Food Administration of the Slovak Republic in accordance with Directive of the commission No. 2002/63, which is transposed to annex No. 5 of the Decree of the Ministry of Agriculture of the Slovak Republic and Ministry of Health of the Slovak Republic from March 15, 2004 No.608/4/2004-100, that issues the eleventh chapter of the second part of the Food Codex of the Slovak Republic regarding residues of plant protection products. Commodities analyzed were sampled at the storages of the producers, trade distribution centers, retail network and from the customs service (products imported from developing countries). Samples of the observed commodities are analyzed in accredited laboratories of the State Veterinary and Food Institute from Bratislava. The analytical methods applied are in accordance with the principles of above-mentioned Decree, and with document SANCO No. 10476/2003.

Permanent attention to observations of food chain contamination in the Slovak Republic has been implemented to guarantee safe food production and protect individual compounds of environment, with the prior aim to protect health of consumers. The study proves the importance of organized and planned monitoring of food contaminants involving data interpretation, with potential impacts upon legislative feedback.