

2016 SCIENTIFIC REPORT



MINISTRY OF FOOD AND DRUG SAFETY

National Institute
of Food and Drug Safety Evaluation

Risk Assessment of Chlorpyrifos

Chlorpyrifos is an organophosphorus pesticide mainly used to control mosquitoes, flies, crop pests, and pests in residential areas. In Korea, it was first registered in the forms of water-soluble powder and granules, and its MRL is set at 0.01–1 mg/kg for 20 foodstuffs, including spinach and cucumbers (MRLs for Pesticides in Foods, May 31, 2016).

The ADI of chlorpyrifos at 0.01 mg/kg bw/day was established by applying the safety factor of 10 (differences between individual entities) to the NOAEL of 0.1 mg/kg bw/day drawn from the single-dose toxicity test on male volunteers. In addition, the NOAEL on the inhibited activation of cholinesterase in red blood cells obtained from chronic toxicity, carcinogenicity, and multi-generation on rats carried out for two years was the same, i.e., 0.1 mg/kg bw/day.

The intake amount of chlorpyrifos was estimated based on the analysis of 2,082 samples of 52 foodstuffs, including rice, in the Monitoring of Agricultural Products in Korea (2011–2015) by the National Institute of Food and Drug Safety Evaluation. The results showed that chlorpyrifos was detected in 82 samples, and the pesticide level was below the LOQ, and thus, it was not detected in the remaining samples. Concerning data lower than the LOQ, in case more than 60% of data were below the LOQ, estimation was made by applying 0 (non-detection) as the lower exposure limit or LOQ (upper exposure limit), according to the “evaluation of low level contamination of foods” recommended by the WHO. Food consumption was calculated through SAS 9.4 using the tertiary food code data from the KNHANES conducted for five years (2010–2014). For the average weight of all age groups, 60 kg, the weight currently (as of 2016) applied for establishment and revision of pesticide residue standards, was used. Concerning the average weights of different age groups, the data

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from the KNHANES was used, applying 12.3, 19.2, 37.4, 59.5, 65, and 58.3 kg to the 1–2 year group, 3–6 year group, 7–12 year group, 13–19 year group, 20–64 year group, and the group aged 65 years or above, respectively. Risk characterization was made by calculating HI in consideration of the EDI calculated in the exposure assessment and the ADI, the safe level of human exposure.

In general, when HI is 1 or higher, the adverse effects of toxicity are expected, and when HI is lower than 1, adverse effects are not expected. The results of the risk assessment of chlorpyrifos in different age groups revealed HI between 0.002 (non-detection data, value of 0 applied) and 0.024 (non-detection data LOQ applied), as shown in the table below, and that its concentration is within the safe level of human exposure.

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Table 1. ADI and HI of chlorpyrifos

Age	EDI (mg/person/day)		Average weight (kg)	EDI (mg/kg bw/day)		ADI (mg/kg bw/day)	HI	
	0	LOQ (mg/kg)		0	LOQ (mg/kg)		0	LOQ (mg/kg)
All	1.6×10^{-3}	4.7×10^{-3}	60	0.3×10^{-4}	0.1×10^{-3}	0.01	0.003	0.008
1-2	1.5×10^{-3}	2.9×10^{-3}	12.3	0.1×10^{-3}	0.2×10^{-3}		0.012	0.024
3-6	1.7×10^{-3}	3.6×10^{-3}	19.2	0.1×10^{-3}	0.2×10^{-3}		0.009	0.019
7-12	1.7×10^{-3}	4.0×10^{-3}	37.4	0.4×10^{-4}	0.1×10^{-3}		0.004	0.011
13-19	1.6×10^{-3}	4.3×10^{-3}	59.5	0.3×10^{-4}	0.1×10^{-3}		0.003	0.007
20-64	1.6×10^{-3}	5.1×10^{-3}	65.0	0.2×10^{-4}	0.1×10^{-3}		0.002	0.008
≥65	1.1×10^{-3}	4.2×10^{-3}	58.3	0.2×10^{-4}	0.1×10^{-3}		0.002	0.007

Key words: Chlorpyrifos, Risk Assessment, Organophosphorus insecticide, ADI, Monitoring, Pesticide