

# 2016 SCIENTIFIC REPORT



MINISTRY OF FOOD AND DRUG SAFETY

National Institute  
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## Risk Assessment of Chlorpyrifos-methyl

Chlorpyrifos-methyl is an organophosphorus pesticide applied on various crops. It is used to control grain weevils, moths, borers, coleoptera, mealworms, rice weevils, red flour beetles, saw-toothed grain beetles, Indian meal moths, tineid moths, and silverfish that affect stored grain (e.g., seed oil and seeds), and utilized for seed treatment and granaries. In Korea, it was first registered in emulsion form in 1981, and its MRL is set at 0.05–1 mg/kg for seven foodstuffs, e.g., rice, grapes, and garlic (MRLs for Pesticides in Foods, May 31, 2016).

The ADI of chlorpyrifos-methyl 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 a repeated dose study on human (male) subjects conducted for four weeks. The supporting data, the NOAEL obtained from combined chronic toxicity and carcinogenicity studies on rats conducted for two years, indicated a NOAEL value of 1 mg/kg bw/day and carcinogenicity was not observed. The main toxicity effects of chlorpyrifos-methyl were the inhibited activation of choline in blood plasma or red blood cells and acetylcholinesterase in the brain as well as vacuolation in adrenal glands. Meanwhile, the NOAEL concerning the inhibited activation of acetylcholinesterase in the brains of the parental generation of rats obtained from a multi-generation study and that concerning the inhibited activation of acetylcholinesterase in the maternal brains obtained from a developmental toxicity test on rats were both 1 mg/kg bw/day.

The intake amount of chlorpyrifos-methyl was estimated based on the results 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 demonstrated that chlorpyrifos-methyl was detected in one sample (perilla leaf, 0.014 mg/kg);

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the pesticide level was below the LOQ, and thus, 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) being applied for establishment and revision of pesticide residue standards, was used. Concerning the average weights of different age groups, the data from KNHANES were 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 older, respectively. Risk characterization was made by calculating the 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 may be expected, and when HI is lower than 1, adverse effects are not expected. The results of the risk assessment of chlorpyrifos-methyl in different age groups revealed HI of  $0.3 \times 10^{-6}$  (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-methyl

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	$0.1 \times 10^{-5}$	$1.3 \times 10^{-3}$	60	$0.1 \times 10^{-7}$	$0.2 \times 10^{-4}$	0.01	$0.1 \times 10^{-5}$	0.002
1-2	$0.3 \times 10^{-7}$	$0.6 \times 10^{-3}$	12.3	$0.3 \times 10^{-8}$	$0.1 \times 10^{-3}$		$0.3 \times 10^{-6}$	0.005
3-6	$0.1 \times 10^{-6}$	$0.8 \times 10^{-3}$	19.2	$0.4 \times 10^{-8}$	$0.4 \times 10^{-4}$		$0.4 \times 10^{-6}$	0.004
7-12	$0.3 \times 10^{-6}$	$1.0 \times 10^{-3}$	37.4	$0.1 \times 10^{-7}$	$0.3 \times 10^{-4}$		$0.1 \times 10^{-5}$	0.003
13-19	$0.3 \times 10^{-6}$	$1.1 \times 10^{-3}$	59.5	$0.1 \times 10^{-7}$	$0.2 \times 10^{-4}$		$0.1 \times 10^{-5}$	0.002
20-64	$0.1 \times 10^{-5}$	$1.4 \times 10^{-3}$	65.0	$0.1 \times 10^{-7}$	$0.2 \times 10^{-4}$		$0.1 \times 10^{-5}$	0.002
$\geq 65$	$0.1 \times 10^{-5}$	$1.2 \times 10^{-3}$	58.3	$0.1 \times 10^{-7}$	$0.2 \times 10^{-4}$		$0.1 \times 10^{-5}$	0.002

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