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MINISTRY OF FOOD AND DRUG SAFETY

National Institute
of Food and Drug Safety Evaluation

Risk Assessment of Acephate

Acephate, an organophosphorus pesticide, is applied to various crops, including lettuce, cottonseeds, beans, and celery, and is used to control harmful insects in indoor structures. The first registration of acephate in Korea was in 1981 in the form of a water-soluble powder. Its maximum residue limit (MRL) is set at 0.05–10 mg/kg for 43 foodstuffs such as nuts and peanuts (MRLs for Pesticides in Foods, May 31, 2016).

The key toxic effect of acephate is inhibiting the activation of acetylcholinesterase in the nervous system. In toxicity tests on rats, acetylcholinesterase in the brain appeared to be more sensitive than that in red blood cells; however, this effect was not observed in dogs or monkeys. Thus, this observation was suggested to be specific to rats, and the activation of acetylcholinesterase in red blood cells was chosen as a prime example of acephate's toxicity effect. There was no significant difference among the no-observed-adverse-effect levels (NOAELs) for inhibited activation of acetylcholinesterase in red blood cells, acephate's most representative toxicity endpoint, obtained from studies on rodents, dogs, and men. In relation to this, the acceptable daily intake (ADI) of acephate was established at 0.03 mg/kg bw/day by applying the safety factor of 10 to the NOAEL of 0.25 mg/kg bw/day drawn from a human epidemiological study (repeated dose test on male volunteers for 28 days).

The intake amount of acephate was calculated based on the results of 919 samples of 23 foodstuffs, including rice, in the Monitoring of Agricultural Products in Korea (2006) by the National Institute of Food and Drug Safety Evaluation. The monitoring results indicated that the pesticide level was below the limit of quantitation (LOQ), and thus, acephate was not detected in any of the samples. Concerning data lower than the LOQ, in case more than 60% of data were below the LOQ, estimation was made by applying a value of 0 (non-detection)

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as the lower exposure limit or LOQ (upper exposure limit), according to the “evaluation of low level contamination of foods” recommended by the World Health Organization (WHO). Food consumption was calculated through SAS 9.4 using the tertiary food code data from the Korea National Health and Nutrition Examination Survey (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. Risk characterization was made by calculating the hazard index (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, an adverse effect of toxicity is expected from the exposure, and when HI is lower than 1, an adverse effect is not expected. The results of the risk assessment of acephate in all age groups revealed HI between 0 (non-detection data, a value of 0 applied) and 0.002 (non-detection data LOQ applied), as shown in the table below, and that its concentration is within the safe level of human exposure.

Table 1. ADI and HI of acephate

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	2.6×10^{-3}	60	0	0.4×10^{-4}	0.03	0	0.002

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