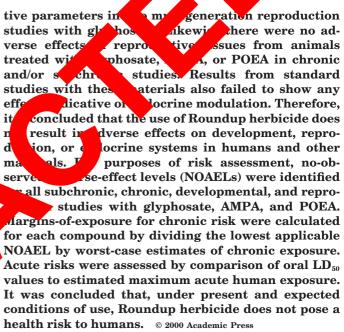
Safety Evaluation and Risk Assessment of the Herbicide Roundup¹ and Its Active Ingredient, Glyphosate, for Humans

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Reviews on the safety of glyphosate and Roundup herbicide that have been conducted by several regulatory agencies and scientific institutions worldwide have concluded that there is no indication of any human health concern. Nevertheless, questions regarding their safety are periodically raised. This review was undertaken to produce a current and comprehensive safety evaluation and risk assessment for humans. It includes assessments of glyphosate, its major breakdown product [aminomethylphosphonic acid (AMPA)], its Roundup formulations, and the pre nant surfactant [polyethoxylated tallow (POEA)] used in Roundup formulations worldw The studies evaluated in this review included th performed for regulatory purposes as pu glyphd lished research reports. The oral abs tion rial sate and AMPA is low, and both n nated essentially unmetabolized studies with Roundup show bsorption. very lo hown th Experimental evidence neither ccu. glyphosate nor AMPA bi ates in ally animal tissue. No significant vicity occ ed in acute, subchronic, and chroni tudies. Direc ular exposure Rour p formulation can result to the concentrate on, in transient irri rile normal spray dilutions cause, at most, only ımal e cts. The genotoxicity data for gl up were assessed using a weigh nce a ch and standard evaluaere was no convincing evidence for tion q eria. vitro or in vivo, and it was direct concluded at Roundup and its components do not pose a risk the production of heritable/somatic mutations in Mans. Multiple lifetime feeding studies have failed to demonstrate any tumorigenic potential for glyphosate. Accordingly, it was concluded that glyphosate is noncarcinogenic. Glyphosate, AMPA, and POEA were not teratogenic or developmentally toxic. There were no effects on fertility or reproduc-



Key Words: glyphosate; Roundup; herbicide; human exposure; risk assessment.

INTRODUCTION

History of Glyphosate and General Weed Control Properties

The herbicidal properties of glyphosate were discovered by Monsanto Company scientists in 1970. Glyphosate (Fig. 1) is a nonselective herbicide that inhibits plant growth through interference with the production of essential aromatic amino acids by inhibition of the enzyme enolpyruvylshikimate phosphate synthase, which is responsible for the biosynthesis of chorismate, an intermediate in phenylalanine, tyrosine, and tryptophan biosynthesis (Fig. 2). This pathway for biosynthesis of aromatic amino acids is not shared by members of the animal kingdom, making blockage of this pathway an effective inhibitor of amino acid biosynthesis exclusive to plants. Glyphosate expresses its herbi-



¹ Roundup is a registered trademark of Monsanto.

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