



The term “pesticide exposure” may mean different things to different people. If someone had been in a room or farm field when pesticides were being applied, the person might feel that he or she had been exposed to pesticides. Indeed, many epidemiology studies seek to ascertain people’s exposure to a pesticide by asking them if they have ever used or been present during the use of the product.

In terms of determining potential risk, however, there is general agreement that exposure should be based on the amount of pesticide that has penetrated into the body, the so-called internal dose (Franklin *et al.*, 1986; Chester and Hart 1986). Several studies indicate that glyphosate is poorly absorbed by the body. When trace amounts are absorbed, through skin for example, the body does not metabolize glyphosate. This means that glyphosate is not biologically transformed into a different chemical or broken down into several different chemicals that may have different toxicity profiles to glyphosate. Rather, it is eliminated unchanged, primarily in urine (JMPR, 2004).

In addition to extensive laboratory research with animals to understand absorption through skin and inhalation, a number of biomonitoring studies have been conducted to monitor the internal exposure of people who mix, load, apply or otherwise come in contact with glyphosate. Biomonitoring is the assessment of human exposure to chemicals by measuring chemicals or their metabolites in human blood, urine or tissues. These biomonitoring studies have demonstrated that normal and expected use of the product produces no or extremely low levels of internal exposure.

The most extensive biomonitoring study is the Farm Family Exposure Study, conducted by investigators at the University of Minnesota with guidance offered by an advisory committee of recognized international experts in exposure assessment (Acquavella *et al.*, 2004, Mandel *et al.*, 2005). The study monitored farm families, including spouses and children. Urine samples were collected the day before glyphosate was to be applied, the day of application and for three days after application. Only sixty percent of the 48 farmers who applied glyphosate had detectable levels of glyphosate in their urine on the day of application. The detection method was capable of detecting 1 part per billion (ppb) glyphosate¹ and the maximum estimated absorbed dose was 233 ppb (0.004 mg/kg). The average urine concentration was 3 ppb. For farmers who apply glyphosate 10 times per year for 40 years, this maximum dose is approximately 30,000-fold less than the EPA reference dose² of 1.75 mg/kg/day. For spouses, only 4% showed detectable exposures and the maximum systemic dose was 0.00004 mg/kg/day.

¹ 1 part per billion would be analogous to one pinch of salt in 10 tons of potato chips.
<http://www.nesc.wvu.edu/ndwc/articles/ot/fa04/q&a.pdf>

² The reference dose is a “numerical estimate of a daily oral exposure to the human population, including sensitive subgroups such as children, that is not likely to cause harmful effects during a lifetime.”
<http://www.epa.gov/OCEPATERMS/rterms.html> (accessed November 13, 2014).

Two other biomonitoring studies were conducted for the U.S. Forest Service to determine the internal exposure of people who work with or near glyphosate, including people who mix and load and apply with backpack sprayers. One study, conducted in collaboration with the University of Arkansas (Lavy *et al.*, 1992), found that none of the urine samples collected from the workers contained quantifiable levels of glyphosate (the limit of quantification was 10 ppb). Although there likely was some dermal exposure, the lack of detectable levels in the urine was attributed to the limited ability of glyphosate to penetrate the skin (Acquavella *et al.*, 2001).

The other study involving herbicide workers was conducted in collaboration with Georgia Tech Research Institute. That study, which is discussed by Acquavella *et al.* (2001) found that only 5 of 96 urine specimens contained quantifiable levels of glyphosate, the highest level being 14 ppb.

By learning the concentration in urine, it is possible to calculate the amount of glyphosate that actually was absorbed by the body. In the three studies, the highest absorbed amount was calculated to be about 97,000 times lower than a dose that caused no adverse effect when administered to laboratory animals for several months.

These biomonitoring studies demonstrate that people who regularly work with glyphosate have very low actual internal exposure. Biomonitoring studies differ from epidemiology studies, in which groups of people – some with illnesses and some without – are asked to recall what pesticides they may have used or come in contact with. Those studies depend on the ability of the person to recall accurately, but more importantly, they do not measure whether there actually was any internal exposure.

All the evidence from biomonitoring studies as well as animal laboratory studies demonstrates that glyphosate use in real world conditions would not be expected to result in exposure capable of causing serious illnesses.

References

- Acquavella JF, Cowell JR, Cullen MR, Farmer DR, Pastides H. (2001) Implications of glyphosate toxicology and human biomonitoring data for epidemiological research. *Journal of Agromedicine* 7(4): 7-27.
- Acquavella JF, Alexander BH, Mandel JS, Gustin C, Baker B, Chapman P, Bleeke M. (2004) Glyphosate biomonitoring for farmers and their families: Results from the Farm Family Exposure Study. *Environmental Health Perspectives* 112(3): 321-326. doi:10.1289/ehp.6667.
- Chester G, Hart TB. (1986) Biological monitoring of a herbicide applied through backpack and vehicle sprayers. *Toxicology Letters* 33:137-149.
- Franklin CA, Muir NI, Moody RP. (1986) The use of biological monitoring in the estimation of exposure during the application of pesticides. *Toxicology Letters* 33:127-136.
- JMPR. (2004) Pesticide Residues in Food -- 2004. Report of the Joint Meeting of the FAO Panel of Experts on Pesticide Residues in Food and the Environment and the WHO Core Assessment Group on Pesticide Residues. FAO Plant Production and Protection Paper, 178
- Lavy T, Cowell J, Steinmetz JR, Massey JH. (1992) Conifer seedling nursery exposure to glyphosate. *Archives of Environmental Contamination and Toxicology* 22: 6-13.

Mandel JS, Alexander BH, Baker BA, Acquavella JF, Chapman P, Honeycutt R. (2005)
Biomonitoring for farm families in the farm family exposure study. *Scandinavian Journal of
Work, Environment & Health* 31 (Suppl 1):98-104.

-