

The Fate and Speciation of Arsenic in Soils and Poultry Production Systems

by:

Jennifer Seiter

Environmental Soil Chemistry Group
University of Delaware

Advisor: Dr. Donald L. Sparks
Committee Members:
Dr. Antonio Lanzirotti
Dr. William Saylor
Dr. Tom Sims

ABSTRACT

Arsenic (As) is a toxic metalloid found in soil environments. One source of As in Delaware soils is the incorporation of poultry litter into agricultural fields. The most common source of As in poultry litter is an organic arsenical called roxarsone.

Poultry litter amended and wooded (background) soils were sampled to assess the arsenic status of Delaware soils. The litter amended soils were not elevated with respect to the wooded soils, indicating that litter amendments do not cause As accumulation in the sandy soils of this region. Arsenic retention in the presence of P was investigated, and the results indicate that regardless of the phosphate concentration, P is preferred over As.

Arsenic speciation in poultry litter was investigated. A flock of birds was grown on a roxarsone diet. Litter was collected from the poultry house, and at the conclusion of the experiment, the litter was stored and sampled over the course of one year. Arsenic content and speciation were determined for all litter samples using X-ray absorption spectroscopy (XAS) and Liquid Chromatography-Inductively Coupled Plasma-Mass Spectrometry (IC-ICP-MS). The results indicate that roxarsone degrades into a mix of As species. Both reduced (arsenite) and oxidized (arsenate) were found in all litter samples. In general, the litter samples collected in the poultry house contained more roxarsone than the stored litter samples. Roxarsone was identified in litter stored up to one year, demonstrating that organic As can remain for long periods of time.

Arsenic content and speciation of As treated broiler excreta and tissues were determined. Excreta, liver, breast muscle, digestive tract (ileum) contents, skin, and feathers were collected. As content in all samples were determined. As speciation and distribution using XAS was determined for excreta, ileal contents, breast and liver tissues. Ileal and excreta samples contain a mix of As species, including reduced, oxidized, and organic As. Speciation of liver and breast concluded that both were dominated by reduced arsenic species.

The results of these studies indicate that roxarsone degradation is occurring within the bird, meaning that land application of poultry litter may introduce a mix of As compounds into soil and water environments.