

# Evaluating Mercury in Poultry from the South River Floodplain

## **Background and Objectives**

In February 2001, DuPont, VADEQ, and US Environmental Protection Agency (EPA) agreed to voluntarily establish an interdisciplinary team of individuals from industry, government, citizens' groups, academic institutions, and private research to revisit the issue of mercury contamination and its consequences on the South River. This group is called the South River Science Team (SRST). An Exposure Task Team (ETT) of the South River Science Team (SRST) was formed in 2008. The key objectives of the team's efforts are to identify possible routes of human exposure to mercury in the South River watershed, define possible risks and uncertainties, and communicate that information to the public.

**Specific Objective:** To sample eggs, selected organs and muscle to determine the potential for chickens reared on the South River floodplain to accumulate mercury. The information will be used to inform decisions about exposure through potential food consumption of eggs and chickens reared on the floodplain.

As a first step, ETT first commissioned a literature review of studies that have evaluated mercury uptake in animal species (including both game and livestock). The results are reported in *Literature Review of Mercury Exposure in Animals* (URS, 2012). Several studies were reviewed regarding THg and MeHg concentrations in chicken meat and eggs exposed to mercury. Total mercury concentrations in chicken muscle were less than 4 ng THg/g in Poland (Falandysz (1991) and from poultry farms in Pakistan (Shah et al. 2010). Liver tissue tends to have higher mercury concentrations than muscle tissue or other organs (Shah et al. 2010). A study from Brazil reported higher levels (0.5-30 ng THg/g) in chicken meat (Batista et al. 2012); it is not known what accounts for regional differences in mercury levels in chicken meat. Kamamanoli-Dimou et al. (1989) reported that MeHg concentrations were <56 ng MeHg/g in chicken meat and eggs in Greece. Higher MeHg concentrations are detected in eggs due to their high lipid content, as was the case in two studies, which found that egg MeHg concentration ranged between 10 and 40 ng MeHg/g (Sell et al., 1975; Shafer et al., 1976).

A potential environmental factor affecting concentrations of mercury in eggs is free-range foraging due to the increased likelihood of soil ingestion. Numerous factors influence the amount soil ingestion in free range chickens including vegetative cover of the soil, number of chickens per unit area, time spent outside of the coop, and specific feeding practices (Waegeneers et al., 2009a). Van Overmeire et al., (2006) reported THg concentrations up to 4 times higher in free-range eggs (2 µg THg/kg) than commercial eggs (0.5 µg THg/kg). In a follow-up study, Waegeneers et al., (2009b) documented mean THg concentrations in eggs ranging 3.15 to 4.44 µg/kg in eggs from private free-range farms in Belgium. These concentrations are within the range of THg concentrations (1.3 – 4 µg THg/kg) reported in chicken eggs from three other European Union states; however, these studies do not differentiate between battery farm and free range eggs (Waegeneers, 2009a). There was no difference in mercury concentration in chicken meat between free-range and confined chickens (Batista et al. 2012).

For the South River, a survey of how poultry are raised and used on the floodplain was performed. While no commercial farming operations were observed, five (5) locations were

noted where chickens were raised on the floodplain to varying degrees. Based on this survey, it appears that current practice does not suggest a consumption concern since rearing of these animals are limited (between 6 and possibly 24 chickens) and the locations are in areas that have limited to no contamination.

However, since it is possible that chickens may be reared in a free range manner in the future, this study was designed to represent reasonable worst-case exposure of poultry raised on the floodplain (as described below).

## **General Approach**

In evaluating potential exposure via consumption of poultry reared on the floodplain, a two-step approach will be used. First, samples will be collected from edible parts (including eggs) of chickens reared under reasonable worst case conditions on the South River Floodplain. Second, the results of the sampling along with conservative consumption assumptions will be used to determine potential human exposure to mercury from consumption of chicken that are reared in a free-ranged manner on the floodplain.

As a general approach, mature (i.e., of egg-laying age) birds of a common backyard breed are being reared in coops at the Augusta Forestry Center for a period of approximately 6 months. Eggs and muscle from birds are being sampled initially and at four other times over the six (6) months. Soils have been extensively sampled at the AFC and chickens have been placed in coops that allow them to forage in areas of contaminated soils in the 2-5 year floodplain (5-year floodplain) and in control areas (62 year floodplain) over the duration of the study. In addition, background samples of chicken muscle and eggs have been obtained from a local area farm (out of the contaminated area) and local area markets to provide context. Supplemental feed also was sampled to check that feed would not be a significant contributing source of mercury.

Samples are being analyzed for THg and MeHg by Brooks Rand, LLC, a NELAP-certified laboratory specializing in trace metal analysis of environmental samples, including animal tissue. Total mercury will be analyzed following the appendix to USEPA Method 1631 (USEPA 2001a), with a method detection limit of 0.04 ng/g in tissue samples. Methylmercury is analyzed following USEPA Method 1630 (USEPA 2001b), with detection limits of 0.07 ng/g in tissue samples. These limits fall below the ranges reported for tissue from poultry in the literature (URS, 2012).

The study is slated to conclude in late 2014 or early 2015. Limited data have been received from the analytical laboratory at this point in time. Modifications to the original study plan have also been made to account for predation of some chickens by a variety of predators.

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