Funky Chicken

Consumers Exposed to Arsenic in Poultry

Between 1966 and 2000, average annual chicken consumption in the United States jumped from 32.1 to 81.2 pounds per person. Earlier studies have shown that trace elements ingested by chickens such as iron, iodine, and zinc can end up in the chicken meat that humans eat. This month, Tamar Lasky, an epidemiologist now with the NIH, and her colleagues at the Food Safety and Inspection Service (FSIS) of the U.S. Department of Agriculture report that American chicken consumers may be taking in more arsenic than previously suspected [***EHP* 112:18–21**].

Arsenic occurs naturally in the Earth's crust, and people are exposed to it in drinking water, dust, and foods. Inorganic arsenic is more toxic than organic forms, and is classified as a carcinogen; studies have linked chronic exposures of 10–40 micrograms per kilogram per day (µg/kg/day) with skin, respiratory, and bladder cancers. Among foods, seafood, rice, mushrooms, and poultry contain some of the highest reported arsenic levels. Arsenic is an approved feed supplement that farmers use to control intestinal parasites in chickens—especially young chickens ("broilers"), which are more vulnerable to such parasites—provided they wait five days after dosing to slaughter, to allow time for the toxicant to pass through the birds' bodies. Current data suggest that 65% of the arsenic in poultry is inorganic.

Since 1970, the FSIS has monitored meat and poultry through its National Residue Program, mainly in order to determine chemical residue levels in food and prevent contaminated goods from reaching the public. Lasky and colleagues analyzed the reported arsenic content of more than 20,000 meat samples taken by the FSIS between 1993 and 2000, including more than 5,000 chicken samples. They found that young chickens showed arsenic concentrations 3–4 times higher than those for mature chickens or other meat types: mean levels for young chickens were 0.33–0.43 parts per million. In 1997, broilers represented 99% of chickens consumed.

Bad news about broilers. New calculations show that people may be consuming more arsenic through poultry than is healthy.

The researchers used data on chicken consumption from a Department of Agriculture survey to estimate the mean amounts of chicken consumed by the U.S. population at the 50th, 95th, and 99th percentiles. By multiplying the amount of chicken consumed by estimates of arsenic in chicken muscle (the most popular form of the meat consumed), the researchers estimated the amount of arsenic ingested by the general population and various subgroups.

Lasky and colleagues calculated that a person consuming an average of 60 grams (about 2 ounces) of chicken per day may be getting 3.52–5.24 µg of inorganic arsenic daily. For a person weighing 70 kg (154 pounds), this breaks down to 0.05–0.07 µg/kg/day, well below the joint Food and Agriculture Organization of the United Nations/World Health Organization tolerable daily intake of 2 µg/kg/day inorganic arsenic. But groups that tend to eat more chicken (including children, people aged 55 and older, and African Americans) may face doses up to 10 times higher, constituting a sizable proportion of their tolerable daily intake.

The arsenic concentrations found in this study lead the authors to conclude that assumptions about the public's exposure to arsenic in food and water might need to be recalibrated by regulatory agencies. These initial reports on arsenic levels, they add, "may be useful in risk assessments of arsenic exposure and its consequences." **–David A. Taylor**

Poisoning Young Minds?

Methyl Parathion May Be Linked to Neurodevelopment Problems

Imagine a kindergartener who has difficulty remembering the story just read to her, who cannot sit still and gets angry easily, and who can't seem to maneuver playground equipment as easily as other children. These are some examples of short-term memory loss, attention problems, and impaired motor function that can be caused by exposure to organophosphates, a group of chemicals that interfere with the transmission of nerve signals to muscle cells. In a study of children who were exposed to the organophosphate methyl parathion in the 1990s, Perri Zeitz Ruckart of the Agency for Toxic Substances and Disease Registry and colleagues find evidence that such exposure may contribute to neurobehavioral problems in children [***EHP* 112:46–51**].

Methyl parathion is licensed only for use as an insecticide on certain crops in open fields. However, during the 1990s, this cheap, persistent, effective pesticide was used illegally for indoor cockroach control in homes in Alabama, Arkansas, Illinois, Louisiana, Michigan, Mississippi, Ohio, Tennessee, and Texas. Before this study, little was known about the effects of the chemical in children, as most research had been conducted on occupationally exposed adults.

The researchers examined study cohorts in Mississippi and Ohio. The children in each group, who were identified by their respective state health departments, were aged 6 years or younger when their homes were sprayed with methyl parathion. Exposure status was based on environmental wipe samples from inside the homes and biomarker levels for exposure in urine specimens. Residences in Mississippi were sprayed between 1994 and 1996, and tests to determine the extent of exposure were conducted in 1996 and 1997. The Ohio homes were sprayed between 1991 and 1994, and exposure monitoring tests were conducted in 1994.

Groups of unexposed children the same age from the same localities provided a comparative control.

In 1999, all 279 children in the two cohorts took a standardized battery of tests to measure performance in learning, motor skills, and sensory perception. Parent interviews and questionnaires provided additional information for evaluating cognitive abilities and behavior.

Statistical analyses confirmed that exposed children had more difficulty with short-term memory and attention, and more problems in behavior and motor skills. These results are inconclusive, however, because there were some inconsistencies between the two cohorts. For example, in the Verbal Cancellation Test, which measures attention, one statistical method showed an effect in Ohio but not in Mississippi, whereas the other statistical method showed an effect in Mississippi but not in Ohio.

The children were retested in 2000 to see whether effects initially observed were temporary, or whether they persisted over time and thus could be expected to have a longer-lasting impact on the lives of the exposed individuals. The results suggest that, among children who performed lower than expected the year before, methyl parathion exposure was no longer associated with deficits.

One factor that may have contributed to the inconsistent results was the timing of exposure in relation to when neurobehavioral testing was conducted. Children in Mississippi were exposed two years later than children in Ohio; therefore, the Ohio children, who were older at the time of testing, may have outgrown any methyl paration–related neurobehavioral effects.

Despite the inconclusiveness of these findings, they do suggest that methyl parathion exposure may subtly impair memory, attention, and behavior. However, such exposure is not expected to impact general intelligence or integration of visual and motor skills. **–Mary Eubanks**

Do-It-Yourself Biospecimens

The Benefits of Home Collection

Epidemiologic studies often rely on biospecimen analysis to reveal variables that influence or indicate a population's health. Collection of biospecimens places some burden on participants, which may in turn affect participation rates and compliance. In this month's issue, researchers led by John C. Rockett of the U.S. Environmental Protection Agency National Health and Environmental Effects Research Laboratory weigh for the first time the utility and potential value of home-based biospecimen collection in a large longitudinal study [***EHP* 112:94–104**]. Their findings indicate that home-based collection of biospecimens might relieve some of the burden, thereby increasing participation and compliance.

Rockett and colleagues provide this review as background for the design of the proposed National Children's Study. This multiagency study is being planned to follow 100,000 children from before birth through their late teens. It will require the collection and analysis of biospecimens from the children as well as their parents. Among other end points, analyses will reveal participants' environmental exposures to a wide array of natural and synthetic chemicals. Some exposures may occur during embryonic or early fetal development, and advice on study design has been solicited from experts in fertility and early pregnancy. They present their findings as a mini-monograph in this month's issue.

In their contribution to the mini-monograph, Rockett and colleagues say that home-based biospecimen collection is usually more convenient and private for epidemiologic study participants. The researchers hypothesize that these attributes might bolster participation rates and propose testing whether this theory holds true for various types of biospecimens and across multiple socioeconomic groups.

Biospecimens that have a history of successful home collection include urine, blood, and semen. Collection is not complicated, although blood samples almost always must be drawn by trained staff. Urine, blood, and semen samples are typically transported and analyzed as fluids, but some analyses can be accomplished with blood or urine that is collected and dried on filter paper.

Less commonly used biospecimens include saliva, breast milk, hair and hair follicles, nails, and buccal (inner cheek) cells. Such samples may be simpler, less invasive, or less costly to collect compared to the more common biospecimens, but they may also yield more limited data. Rockett and colleagues describe some of the data these less commonly used samples can yield, and point out that more consistent methods for collection and analysis are needed to standardize samples taken at different sites and to better allow for cross-study comparisons.

The researchers caution that quality control can be complicated in home collection. Study participants must be able to understand and follow directions for sample collection and storage. Further, it's necessary to specify the conditions under which samples will be transported to clinics or laboratories, and to know how stable samples remain between collection and delivery. Laboratory receipt, storage, and analysis compose another area for consideration in study planning.

With more complete information about home-based biospecimen collection, researchers could develop better procedures and integrate a wider range of biospecimens into studies. This would enhance the quality of epidemiologic studies. **–Julia R. Barrett**

Aim and shoot. Home collection of biospecimens may enhance participation rates in epidemiologic studies.

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