New Research Refutes Prior Study on Feather Meal

Editor's note – Zhixin Chen and Chen Liu are graduate research assistants at Clemson University and Dr. Joseph Thrasher is a professor of chemistry.

In recent years, the public has become aware of compounds that can accumulate in the environment and end up in food. Recently, researchers have studied pharmaceutical residues in food products for human and/or animal consumption.\textsuperscript{1-6} Pharmaceuticals and personal care products (PPCPs) as defined by the United States (US) Environmental Protection Agency (EPA) primarily include human and veterinary drugs, cosmetics, and other daily-use chemicals. The use of PPCPs has increased along with rapid population growth. According to a literature search using the American Chemical Society's SciFinder, the number of publications (i.e., scientific peer-reviewed articles, published abstracts from presentations at scientific conferences, etc.) on PPCPs increased from only three in 1999 to 175 in 2014. This confirms that the study of PPCPs is becoming progressively more important in the environmental, food, and life sciences, especially as analytical techniques continue to improve toward measuring increasingly smaller amounts.

In 2012, a group of scientists from the Center for a Livable Future at Johns Hopkins Bloomberg School of Public Health published a paper (Love et al. 2012) asserting a concern that PPCPs might be a food safety hazard. Their study reported positive detections of 24 PPCPs in a total of 12 feather meal samples (five feed grade and seven fertilizer grade) obtained from rendering plants, distributors, or animal feed mills in either the United States or China.\textsuperscript{7}

However, did this paper present the true scenario in feed-grade feather meal? Do these results represent the entire picture of the poultry and rendering industries, especially in the United States? Is chicken feather meal really a reentry route of PPCPs into the human food supply? First, the concentrations of the 24 PPCPs measured by Love et al. were not at high levels associated with risk to human health, but were sometimes near reportable detectable lower limits. (Analyte is a term used for a substance that is being detected and a reporting limit is the lowest level that an analyte can be both detected and measured within a reasonable degree of accuracy and precision.) The Love et al. publication was quickly questioned by the rendering industry and scientists familiar with the rendering process because of both insufficient information on the source of the samples tested and the lack of any attempt to eliminate other potential sources of contamination such as processing plant water and municipal water.\textsuperscript{8,9} North American rendering companies do not sell feed-grade chicken feather meal in the 0.5 to 22 kilogram bags used in the Love et al. study, but rather in bulk by the truck load. Therefore, the origin, age, and history of the samples used in the Love et al. study were questioned. Furthermore, other scientists pointed out that fertilizer-grade chicken feather meals are not fed to animals.\textsuperscript{9} In addition, feed-grade chicken feather meal from China has different product standards than in the United States and is not imported and fed in the United States.\textsuperscript{9} Thus, some might suggest that only three out of the 12 samples of chicken feather meal studied by Love et al. are relevant to the US feed supply. Love et al. did call for additional studies on chicken feather meal as well as some effort to identify the source of the contamination.

The rendering industry disputed the results of Love et al. and wanted to repeat the research on samples of known origin. Under the auspices of the Animal Co-Products Research and Education Center (ACREC) at Clemson University, Dr. Joseph Thrasher and his two graduate students Zhixin Chen and Chen Liu undertook a more detailed study of feed-grade chicken feather meal. Since many reports exist on the detection and measurement of PPCPs in surface, municipal, ground, and drinking water mainly due to human activities, the possibility of contamination of chicken feather meal by water was also considered.

To better study feather meal in the United States, samples of fresh chicken feathers and chicken feather meal as well as municipal water, plant water, and dissolved air flotation (DAF) solids and treated water were collected at three rendering plants from different geographical regions of the United States. DAF is a wastewater treatment method used in the rendering industry to remove the suspended solids from recycled water, rinse water, etc.\textsuperscript{10} The procedures for the collection of samples in this study were more clearly defined and under better control than Love et al. because:

1. samples were taken either directly off of the production lines at the rendering plants or, in the case of municipal water samples, were collected from supply pipes at the poultry slaughterhouses that were providing chicken feathers to those rendering plants;
2. samples were stored in the dark at less than -10 degrees Celsius until analysis; and
3. proper chain of custody paperwork was completed and kept on all samples.

Further sample preparation prior to analysis was carried out by the procedures outlined in EPA Method 1694. The samples were then taken directly from the freezer and shipped overnight on frozen ice packs to AXYS Analytical Services Ltd. (Sidney, British Columbia, Canada), which is the same commercial laboratory that carried out the analyses for the Love et al. study.

Three samples of chicken feathers (one from each plant), three samples of feed-grade chicken feather meal (one from each plant), and two samples of filter cakes from the filtration of DAF-in water were analyzed by AXYS Analytical Services. A total of 16 aqueous samples (one to two samples of water from each rendering plant, one to two samples of nearby municipal water per rendering plant, and one sample each of DAF-in and DAF-out water for each rendering plant) were analyzed by the same company. The study examined these samples for 60 different PPCPs. Of these, 46 were group 1 analytes and 14 were group 2 analytes. Group 1 analytes are antimicrobials and some non-antimicrobials, such as stimulants, antidepressants, antihistamines, and analgesics. Group 2 analytes are tetracycline antibiotics. Samples of peat moss and deionized water from the Clemson University laboratory were also analyzed as blank controls for solid and aqueous samples, respectively.

Many of the substances claimed to be present in the Love et al. report were not found in the samples in the current study. In each of the six samples of chicken feathers and feed-grade chicken feather meal tested in the ACREC study, only two to four analytes out of the 60 PPCP compounds sought were found at levels above the reporting limits, ranging from one to 150 parts per billion (ppb). This is vastly different from the Love et al. report, which claimed six to 10 PPCP compounds with positive detections in their samples of US feed-grade chicken feather meal. Three analytes were found at concentrations 7.5 to 50 times below the tolerances established by the US Food and Drug Administration (FDA) for drug residues in uncooked edible tissue of chicken, although they were two to five times the concentrations reported by Love et al. The analytes found in the ACREC samples of finished feed-grade chicken feather meal were not always exactly the same as those found in the samples of incoming raw chicken feathers; however, rendering plants receive feathers from numerous chicken slaughterhouses and this study took only representative samples. Nevertheless, further analysis of the data set did show a statistical correlation between the analytes found in the samples of chicken feathers to those found in the samples of feed-grade chicken feather meal from the same respective plant. Interestingly, the sample of peat moss that was examined as a blank control was found to contain two PPCPs with concentrations in the range of six to 22 ppb. Also, caffeine, a PPCP, was found in one sample of chicken feathers at approximately 40 ppb, which was above the reporting limit.

The aqueous samples of municipal water and plant water turned out to be relatively clean. However, anywhere from zero to three substances were found in each of these samples with concentrations typically ranging from 0.003 to 0.080 ppb, except for a couple of cases where caffeine was found at levels of 0.400 to 0.500 ppb. Again, for point of comparison, one substance (about 0.003 ppb level) was found in the deionized water from the laboratory. This same substance was also found in the two samples of municipal water taken from near one of the rendering plants, but in no other samples. Although some substances were found in the municipal and/or plant water supplying the slaughterhouses and rendering facilities, respectively, these results did not always give a statistical correlation to the substances found in the samples of feed-grade chicken feather meal produced by those processing plants.

As one might anticipate based on the function of a DAF system to treat wastewater, the solid and aqueous samples analyzed from these systems each were found to have both the largest number of analytes and the highest concentrations of those analytes. Anywhere from four to 12 different PPCPs were found in either the solid or aqueous samples from the DAF systems of the three rendering plants used in this study. In these samples, the concentrations of acetaminophen and/or caffeine were typically the highest in the aqueous samples.

Returning to the presence of caffeine in both solid and aqueous samples, only anecdotal evidence was offered in the Love et al. study for caffeine being found in chicken feather meal. As mentioned in the supporting information to their journal article, they quoted e-mail text from an unidentified man who claimed his father told him that chickens were fed caffeine in order to keep them awake longer so they would eat more and grow faster. The authors of the Love et al. paper also reported that coffee pulp and green tea powders have been used as poultry feed ingredients. However, to support their claim, they offered only three journal articles that previously reported experimental feeding studies in Ghana and Japan. The ACREC researchers could find no evidence supporting that any of the aforementioned practices were characteristic of the US poultry industry from either searches of the scientific literature or consultation with professors of poultry science in Clemson University’s Department of Animal and Veterinary Sciences.

Overall, about 40 percent of the PPCPs found in the samples associated with the current ACREC study are approved as drugs for administration in poultry primarily to fight disease and infection. The levels detected are much lower than the currently established tolerance levels for residue in chicken tissue, as outlined by FDA and in the Feed Additive Compendium. Common stimulants or drugs like caffeine and acetaminophen were often found in the DAF system but not in the processed, feed-grade chicken feather meal. Nevertheless, the levels of each were not of sufficient concentration as to pose a risk to human health. Furthermore, chicken feather meal is not consumed by humans and caffeine, when used appropriately as a food additive, is a substance generally recognized as safe by FDA.

Love and his colleagues Baron and Nachman have published a more recent paper in which they attempted to measure PPCPs in chicken breast meat among other samples (e.g., ground beef and milk), and they were unable to detect PPCPs in chicken breast meat with two exceptions. They obtained positive detection for caffeine and

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its metabolite 1,7-dimethylxanthine, but again the levels of caffeine were deemed by these researchers not to be harmful to human health. Based on their own estimate, a five-ounce cup of coffee contains over 33,000 times more caffeine than consuming chicken with the highest level of caffeine found in their study. In conclusion, both the ACREC study reported herein, from which a substantially more detailed manuscript is in preparation for submission to a peer-reviewed journal, as well as the new report from Love and colleagues on PPCPs in chicken meat refute claims that chicken feather meal is a previously unrecognized route for reentry of PPCPs into the US food supply. As a final note, this research was funded by a grant through Clemson University’s ACREC sponsored by the Fats and Proteins Research Foundation and the Poultry Protein and Fat Council.

References: