# Non-Nutritive Feed Issues in Chicken Production
## October 2, 2001
## Tidewater Inn, Easton, Maryland
## Workshop Report

**Overview**

The Scientific and Technical Advisory Committee (STAC) sponsored and convened a responsive workshop entitled "Non-Nutritive Feed Issues in Chicken Production" on October 2, 2001 at the Tidewater Inn in Easton, Maryland. The workshop consisted of a series of keynote speakers who discussed various subjects related to the use of chicken feed additives such as the environmental impacts of pharmaceuticals and metals, as well as microbial resistance. Following the presentations, a panel discussion was held between the invited speakers and the attendees. There were 46 registered participants from various scientific institutions, government agencies, and agricultural industries throughout the Chesapeake Bay region (see Appendix A).

**Workshop Background**

There has been growing interest by a number of Chesapeake Bay committees on the issues surrounding the use of non-nutritives in animal feeding operations and their potential impacts on the Chesapeake Bay. Initially, a two-day workshop was proposed to address all animal types and all non-nutritive issues. It was reasoned that this would be a cumbersome approach since non-nutritives vary depending upon the type of animal. For example, hormones are not added to broiler chicken rations; however, they are added in other agricultural species. Additionally, the fate of some additives in the environment can vary greatly: application of chicken manures

containing arsenic will behave differently in the soil environment compared to arsenic in swine manure since swine manure has a higher acidifying effect on soils. Therefore, it was decided to examine each animal group separately using a one-day workshop model. It should be pointed out that this workshop model is also recommended for examination of issues related to human sewage.

This report addresses the first attempt to approach the broad area of non-nutritives in animal rations, in particular, broiler chicken production.

**Topics Covered**

Initial plans called for seven presentations: an overview of non-nutritive feed additives, industry perspective, aquatic and soil impacts from pharmaceuticals, aquatic and soil impacts of metals, and microbial resistance. Of these, only five topics were covered, as industry declined to present and no speaker was identified to cover pharmaceuticals in the soil environment. Additionally, one speaker withdrew at the last minute, because his supporters did not want him to discuss unpublished data dealing with pharmaceuticals in the aquatic environment. Fortunately, a replacement speaker, Mr. Charles Eirkson, FDA, was identified. A list of all speakers and their contact information is contained in Appendix B and STAC has copies of all of the power point presentations available for distribution.

**Presentation Highlights** (includes discussion session comments)

**Dr. John Doerr, UMD, "Non-nutritive Additives in Modern Day Broiler Operations"**

Dr. Doerr provided a comprehensive overview of all compounds and agents added as non-nutritive materials in animal feeds, with the list well beyond those materials covered in the workshop. Non-nutritives that were not addressed in the subsequent presentations that might need additional consideration in future potential Bay impacts include vitamins, mold/fungal inhibitors, phytotoxic compounds (e.g., sulfonamides), probiotics, pellet binders with high ion exchange and ammonium binding capacities, enzymes, and parasite inhibitors (e.g., wormers). A problem identified in assessing food additive impacts is that the feeding of broiler chickens is dynamic. Rations and in-turn non-nutritive additives may change daily; thus, there is no industry 'standard.' This complicates any approach that would try to quantify amounts of additives. Dr. Chaney noted (during the discussion session) that this is why it may be better to examine manures in order to identify what was used in the rations. Dr. Doerr noted that there is a need to expand the use of natural growth promotants, since these substances have shown to increase the weight of birds while reducing the amounts of nutrients needed in feeds. He also suggested several issues that need to be addressed in future activities such as increasing funding and applying this funding to non-traditional areas, meeting the questions of environmental risk with sound science, and a need to look at the overall health and performance of domestic products.

**Mr. Charles Eirkson, FDA, "Environmental Antibiotics in Poultry Producing Areas - A CVM Perspective"**

Mr. Eirkson listed a number of environmental data gaps in pharmaceutical/microbial resistance. These include: lack of fate data on many older drugs, lack of effects data on many

older drugs, lack of microbial (resistance) fate data, and lack of data on transfer of resistance. He indicated that environmental consequences of the use of pharmaceuticals was not within the scope of his organization's mission, and could provide no information for this area from his scan of FDA activities. Environmental assessments were limited, and usually accomplished in numbers of microbes and bioassays with zooplankton (*Daphnia*), fish, and plant assays. Monitoring should be undertaken through estimating additive concentrations relative to 'thresholds of resistance', i.e., concentrations where impacts on microbial communities have been observed. Specific points made include that sorption and binding of antibiotics in manure would reduce bioavailabilty, but no data were presented. Further, Eirkson suggested that solubilities of additives might define impact potential, but provided no data to support the speculation. Overall, Eirkson focused on microbial resistance associated with non-nutritive additives, indicating this was a primary area of current FDA approaches. It was implied by both Dr. Doerr and Mr. Eirkson (and later by Dr. McDermott) that it should be borne in mind that microbial resistance may not only be caused by pharmaceuticals, but may also be caused by other additives such as sanitizers.

**Dr. Rufus Chaney and Dr. Eton Codling, USDA, "Potential for Adverse Effects of As, Se, and Other Trace Elements in Land-Applied Poultry Litter"**

According to Dr. Chaney, arsenic is the non-nutritive metal that should be of most concern in the soil environment due to pending EPA regulations, which would lower arsenic levels in soils. Poultry litter is usually found to have the highest levels of arsenic when considering animal feeding operations. The transfer of arsenic to top consumers through food, e.g., poultry, is not likely as the element is effectively purged from animal tissue. Arsenic toxicity

from land surfaces is through ingestion of soil, not through biota. Because arsenic is bound with similar complexes to phosphorus in the soil, Chaney noted that if you stop phosphorous runoff from manure applied fields you will simultaneously stop arsenic (and copper and zinc) runoff. In discussion, it was suggested that management scenarios might include consideration of pelletizing manure to increase burial, reducing runoff of arsenic. Therefore, any management plan to reduce phosphorus accumulation or runoff will be important to lowering arsenic inputs to surrounding waters. In response to a query on future research, Dr. Chaney indicated that research on the impacts of low arsenic dosing are unlikely for the future.

**Dr. Tracy Connell Hancock, USGS, "Reconnaissance for Arsenic in the Pocomoke River Basin, a Poultry Dominated Chesapeake Bay Watershed - Examination of Sources, Transport, and Fate"**

Dr. Hancock presented data from runoff, shallow well, and deep well sampling of aquatic arsenic, in a sampling scheme set up to follow major storms after manure applications in the Pocomoke watershed. Concentrations of arsenic in a suite of samples indicated that fresh litter contained 15-35 ppm arsenic, while composted levels were only 2 ppm, the latter similar to higher levels observed in 'control' forest soil. Concentrations in surficial and suspended sediments in the river were 1-11 and 1-21 ppm, suggesting some enrichment. Pre-storm and post-storm arsenic levels were <1-1.6 and 1.6-34 ug/L, respectively, suggesting transport to receiving waters during storms. Drainage ditch concentrations approximated 10.4 ug/L, again indicating runoff of some arsenic during storms in the watershed. Pore water concentrations in cores taken near fields had levels from 7-29 ug/L, suggesting transfer to depth. Particulate levels were highest in an iron rich strata, consistent with Dr. Chaney's suggestions in his earlier presentation. Shallow groundwaters

and deep wells had levels of <0.1-23 and <1-7.6 ug/L, respectively.

Dr. Hancock, and workshop participants, suggested a need to have a more holistic watershed monitoring approach to better identify what is happening to aquatic arsenic, and potential impacts from eluted arsenic. The latter activity includes collaboration with USGS scientists (V. Blazer, fish pathologist) in examining fish health and observed field concentrations of arsenic and other environmental stressors. This should include both hydrological and agricultural systems, and include time series sampling from land application through the spring and summer growing seasons and spatial subsampling downstream from application sites, as employed in the Wye Institute program conducted by Drs. Staver and Brinsfield. Finally, the breakdown of arsenal compounds, e.g., the non-nutritive additive roxarsone and its defecated derivatives, should be examined as sources of arsenic for the environment in future research.

**Dr. Patrick McDermott, FDA, "Anti-Microbials and Resistance"**

Dr. McDermott provided a broad overview of current FDA work on microbial resistance. His examination and available limited results in the literature indicate that 60-70% of the *Enterococcus* isolated from retail meats and the poultry production was environmentally resistant to streptogramins (virginiamycin and synercid). However, this resistance does not appear to be efficiently transferred through the food web, as only 1-2% of isolates from healthy humans are streptogramin resistant. This suggests that colonization of humans by enterococcus from poultry was low or transient, and not currently a problem. He indicated that FDA is still grappling with how to redefine safety. Some ideas for future research included optimizing antimicrobial dosing to help prevent resistance from developing, thus allowing the continued safe use of antimicrobials

in animals and humans. Dosing would be determined by antibiotic concentrations that eliminate pathogens without inducing bacterial resistance.

**Recommendations**

By far the most important outcome from this workshop is the need for STAC to assist in putting together (and identifying funding) more multi-disciplinary research teams on the issues of pharmaceuticals and non-nutritive metals in broiler feeds. These teams need to work in similar geographic areas. There should be very willing academic, federal (USGS, ARS, FDA), and even private partners to do a watershed scale study on the topics discussed at the workshop.

The concerns surrounding microbial resistance issues will certainly be with us for the foreseeable future. Many of the specific issues such as stability of any changes and actual causal agents still needed additional study. One issue that received little attention was the status of ongoing research to reduce or eliminate pharmaceutical use in broiler production. These approaches include the use of probiotics and genetic engineering/genetic selection for disease resistance.

As a land-based focused workshop, the meeting was a success. The foci of three of the five presentations identified types of non-nutritive additives and provided a general overview of the potential enrichment in manure produced in the broiler industry. Two presentations provided information on additives in receiving waters from manure-rich lands, with one referencing potential altered bacterial communities in waters immediately adjacent to manure application sites. The excellent summaries of compounds (particularly arsenic), concentrations, and impacts on the land provided in the workshop are a beginning to understanding potential impacts for several

additives in adjacent waters. The Toxics Non-Point Forum might want to consider future workshops where aquatic system responses to these and other non-nutritive additives (e.g., vitamins, mold/fungal inhibitors, phytotoxic compounds like sulfonamides, probiotics, pellet binders with high ion exchange and ammonium binding capacities, enzymes, and parasite inhibitors) might be examined. Linking manure additive compounds and concentrations to aquatic response is the means to guaranteeing appropriate feeding regimens least deleterious to the Bay's water quality and health.

Future workshops would benefit from several additional components. One, as a STAC responsive workshop requested by a Chesapeake Bay Program subcommittee, those requesting the needed information are those who would most benefit from the presentations and discussions. Those requesting the workshop should be encouraged to attend and participate, to ensure identification and collection of the information needed to advance subcommittee activities towards the goals outlined in the Chesapeake 2000 Agreement. Two, industry presentations and insight are sorely needed, to indicate industry-identified approaches to additives and the management advocated for manure by-products. Only through collaborations between industry, agencies, policy makers, and researchers can acceptable practices be identified in the production and treatment of nutritional material, in order to assure production of safe, cheap food, protect jobs, and minimally impact the Bay. Three, land *and* water environments must be addressed, with compounds, concentrations, impacts, and management options outlined. Fourth, as indicated above, the other food additives should be considered, as their impacts can only be guessed, eliminating sound science for resolving whether these compounds need to be managed. And fifth, greater participation by those assessing impacts of materials should be sought to assist in

interpreting potential threats of the materials deposited on the land and in the water. If levels observed in the systems are not threatening, then costly management can focus on other materials previously identified as problems, reducing economic stress on the local farming community.

## Appendix A
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