

Analysis of Animal Feed Products Sold in Connecticut During 2021

Carlos Tamez, PhD*, John Ranciato*, Meghan S. Cahill*, Craig Musante*, Kitty Prapayotin-Riveros*, Terri Arsenault*, Michael A. Ammirata*, Christian O. Dimkpa, PhD*, and Jason C. White, PhD**

*Department of Analytical Chemistry

**Director of The Connecticut Agricultural Experiment Station



*The Connecticut Agricultural Experiment Station
New Haven, CT*



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Technical Bulletin 30

September 2023

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*Department of Analytical Chemistry, The Connecticut Agricultural Experiment Station, New Haven, CT 06511

**Director, The Connecticut Agricultural Experiment Station, New Haven, CT 06511

INTRODUCTION

The Animal Feed Regulatory Program Standards (AFRPS) were designed to institute a uniform framework for the establishment of animal feed monitoring programs at the state level. In Connecticut, The Agricultural Commodities Division of The Department of Agriculture is responsible for regulation and inspection of animal feeding products and pet foods. Products collected by Department of Agriculture inspectors are delivered to the Department of Analytical Chemistry at The Connecticut Agricultural Experiment Station for analysis to ensure compliance with state and federal regulations. The laboratories in the Department of Analytical chemistry are ISO 17025:2017 accredited to perform percent crude fat, percent crude protein, and aflatoxin analysis in animal feeds. This accreditation ensures accurate results with appropriate quality control samples and record keeping.

Aflatoxins are carcinogenic toxins produced by the fungus *Aspergillus flavus*. *A. flavus* mold can grow on cereal grains and legumes such as corn or peanuts while in storage. As recently as December 2020 there were 28 fatalities linked to dog food contaminated with aflatoxins in US States other than Connecticut. (4). This event triggered an FDA recall of the associated animal feed batches. A similar event occurred in September of 2020, with a recall extending to animal feeds that used the same corn grain. There are four main Aflatoxins B1, B2, G1 and G2. Aflatoxin B1 is predominate and considered the most toxic.

If ingested, B1 and B2 can be transformed into aflatoxin metabolites M1 and M2 respectively, which can be transferred into milk. The toxins can also enter the human food chain both by direct consumption of the product, or through livestock that have eaten the contaminated product. Currently, the FDA has a set action level for combined Aflatoxins (B1+B2+G1+G2) ranging from 100-300 µg/kg for beef cattle, swine, or poultry fed animal feed containing corn, peanut, or cottonseed ingredients. A lower action level of 20 µg/kg is in place for animal feeds intended for dairy animals, immature animals, and pets.

METHODS

In calendar year 2021, The Department of Analytical Chemistry at The Connecticut Agricultural Experiment Station analyzed 51 animal feed products for label guarantees, 148 products for the presence of aflatoxins, 51 samples for Macro Minerals, 30 samples of dog food for copper analysis, 30 samples for toxic metals analysis, and 60 samples for pesticides analysis that were for sale in Connecticut. Animal feeds were collected by Department of Agriculture agricultural commodity inspectors at manufacturing facilities, wholesale dealers, and retail locations. Samples were drawn from bulk storage/delivery containers, as well as from retail bags, boxes, and cans.

After delivery to The Connecticut Agricultural Experiment Station, the animal feed products were sub sampled and prepared

for analysis. The samples were analyzed for protein, fat, and fiber based on modified methods described in Official Methods of Analysis (1). Samples analyzed for nutrients and toxic elements were digested with acid and analyzed by both Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) and Inductively Coupled Plasma Mass Spectroscopy (ICP-MS). Moisture was measured by loss on drying.

Aflatoxins were extracted using 80% acetonitrile in water, followed by solid phase extraction with cartridges specific for Aflatoxin B1, B2, G1, and G2. Analytes are then eluted using methanol. Aflatoxin analysis was performed using liquid chromatography with high resolution mass spectroscopy (LC-HRMS). The LC-HRMS detection limit for individual aflatoxin compounds was 1 µg/kg.

Pesticide residues were extracted using modified QuEChERS (quick, easy, cheap, effective, rugged, and safe) method, using acetonitrile as the extraction solvent, followed by cleanup. Sample extracts were analyzed using both a liquid chromatograph with a high-resolution mass spectrometer (LC-HRMS) and a gas chromatograph coupled to a tandem mass spectrometer (GC-MS/MS).

All results are submitted to the Department of Agriculture for possible regulatory response.

RESULTS AND DISCUSSION

Label Guarantees

Table 1 shows the results for the analysis of crude protein, crude fat, and crude fiber. The label guaranteed nutrient value is denoted as (G) and the laboratory determined nutrient value is denoted as (R). Deficiencies and excesses of a guaranteed nutrient are expressed in red.

The number of samples deemed unsatisfactory in one or more macronutrients was 4 out of 51 samples processed (7.8%). In one of the 4 samples, mislabeling occurred for claimed % crude fiber of 4.5% when analysis determined a value of 5.2%. In a second sample, mislabeling occurred for claimed % crude fat of 3.5% when analysis determined a value of 2.4%. The third mislabeling occurred for a sample with % crude protein of 18% when analysis determined a value of 13.9%. The fourth deficiency occurred for a sample claiming % crude fat of 4% when analysis determined a value of 3% (Table 1).

All protein samples are analyzed in duplicate. However, there are no duplicates for Fat and Fiber. The results for protein reflect the average of duplicates. In Table 1, ND indicates that an analysis was not performed.

Table 4 shows the results of the analysis for toxic elements in animal feeds. Table 5 shows the results of the analysis for macro minerals and moisture in animal feeds. Table 6 shows the results for copper and moisture in dog feeds.

Aflatoxins

Animal feed products analyzed for aflatoxins during 2021 are shown in Table 2. All animal feeds tested, except samples KAN21-270M and KAN21-282M (shown in yellow), had a sum of aflatoxins B1, B2, G1, and G2 that was below the limit of detection. Samples KAN21-270M and KAN21-282M contained aflatoxin B1 at a concentration of 1.0 and 1.5 µg/kg, respectively. These concentrations are below FDA action levels of 20 µg/kg.

Pesticides

During 2021, 20 of the 60 animal feed samples tested for pesticide residues (Table 3) contained pesticides above the 0.01 mg/kg reporting level (shown in yellow). A total of

7 different pesticides were identified among the 20 samples, with an average concentration of 0.14 mg/kg. None of the 20 samples that contained detectable pesticides contained residues at a violative level.

Table 1. A comparison between label guarantees (G) and analytical results (R) for animal feeds received from the Connecticut Department of Agriculture for the calendar year 2021. Values in red indicate results that did not pass.

| Sample ID | Description | Protein % | | Crude Fat % | | Crude Fiber % | |
|------------|--------------|-----------|------|-------------|------|---------------|------|
| | | G | R | G | R | G | R |
| KAN21-136N | N/A | 9 | 14.8 | 6 | 9.8 | 4 | 1.1 |
| KAN21-140N | N/A | 5 | 6.9 | 2.5 | 3.9 | 1.5 | 0.52 |
| KAN21-144N | N/A | 45 | 44.6 | 28 | 36 | 5 | 1.5 |
| KAN21-148N | Dog Feed | 26 | 29.5 | 14.5 | 14.9 | 5 | 2.9 |
| KAN21-152N | Dog Feed | 11 | 14.8 | 7 | 5.8 | 5 | .81 |
| KAN21-176N | Horse Feed | 14 | 14.6 | 1.5 | 3.1 | 18 | 13.4 |
| KAN21-180N | Duck Feed | 19 | 20.9 | 2.3 | 3.6 | 5 | 3.4 |
| KAN21-184N | Dog Feed | 27 | 31.1 | 8 | 7.6 | 5.5 | 1.5 |
| KAN21-188N | Chicken Feed | 20 | 21.2 | 3.5 | 5 | 4 | 3.7 |
| KAN21-192N | N/A | 14 | 16 | 11 | 11.4 | 5 | 3.2 |
| KAN21-217N | Dog Feed | 21 | 23.3 | ND | ND | 4 | 3.1 |
| KAN21-221N | Dog Feed | 23 | 24.9 | ND | ND | 4 | 2.3 |
| KAN21-225N | Dog Feed | 12 | 17 | 7 | 7.6 | 5.5 | 3.8 |
| KAN21-229N | Dog Feed | 9 | 8.8 | 6 | 7.4 | 1.5 | .87 |

Cont. Table 1. A comparison between label guarantees (G) and analytical results (R) for animal feeds received from the Connecticut Department of Agriculture for the calendar year 2020. Values in red indicate results that did not pass.

| Sample ID | Description | Protein % | | Crude Fat % | | Crude Fiber % | |
|------------|----------------------------------|-----------|------|-------------|-----|---------------|------|
| | | G | R | G | R | G | R |
| KAN21-233N | Dog Feed | 9 | 9.7 | 5 | 4.5 | 1.5 | .96 |
| KAN21-256N | Livestock Feed | 6.5 | 7.9 | 2.5 | 2.6 | 3 | 2.7 |
| KAN21-260N | Livestock /Poultry Feed | 7 | 9.1 | 2.5 | 2.3 | 8 | 3.3 |
| KAN21-264N | Poultry Feed | 16 | 17 | 2.5 | 4 | 8 | 5.2 |
| KAN21-268N | Poultry Feed | 18 | 19.9 | 2.8 | 4 | 5.5 | 2.5 |
| KAN21-272N | Poultry Feed | 16 | 18.4 | 4 | 4.1 | 5.5 | 3.9 |
| KAN21-297N | Horse Feed | 14 | 16.8 | 7 | 7.9 | 15 | 15.5 |
| KAN21-301N | Game Bird Feed | 30 | 29.6 | 2.5 | 2.8 | 6.5 | 3.4 |
| KAN21-305N | Chicken Feed | 16 | 16.1 | 2.5 | 3.4 | 6.5 | 4.6 |
| KAN21-309N | Poultry/Waterfowl/Game Bird Feed | 17 | 17 | 2.5 | 3.5 | 7 | 4.7 |
| KAN21-313N | Rabbit Feed | 16 | 16.5 | 2.5 | 2.8 | 16 21 | 18 |
| FED21-02N | Poultry Feed | 16 | 16.5 | 3.3 | 3.9 | 6.5 | 4.6 |
| FED21-05N | Bovine Feed | 16 | 18.8 | 3 | 3.7 | 9 | 6.9 |
| FED21-08N | Sheep Feed | 16 | 17.5 | 3 | 3.8 | 10 | 10 |
| FED21-11N | Poultry Feed | 18 | 20.1 | 2.7 | 2.6 | 5 | 4.7 |
| FED21-14N | Pig Feed | 16 | 16.9 | 2 | 3.8 | 18 | 9.6 |
| FED21-31P | Dog Feed | 20 | 19.7 | ND | ND | 4.5 | 5.2 |
| FED21-34P | Dog Feed | 25 | 26.1 | ND | ND | 3 | 3.5 |
| FED21-37P | Dog Feed | 24 | 22.3 | ND | ND | 5 | 4.7 |
| FED21-40P | Cat Feed | 32 | 33.2 | ND | ND | 3 | 1.2 |

Cont. Table 1. A comparison between label guarantees (G) and analytical results (R) for animal feeds received from the Connecticut Department of Agriculture for the calendar year 2020. Values in red indicate results that did not pass.

| Sample ID | Description | Protein % | | Crude Fat % | | Crude Fiber % | |
|-----------|----------------------------|-----------|------|-------------|------|---------------|------|
| | | G | R | G | R | G | R |
| FED21-42P | Dog Feed | 31 | 32.3 | ND | ND | 3 | 2 |
| FED21-45P | Dog Feed | 26 | 27.3 | 16 | 14.2 | 4 | 3.5 |
| FED21-48P | Pig Feed | 16 | 17.6 | 2.5 | 6.6 | 5 | 4.4 |
| FED21-50P | Poultry Feed | 19 | 21.4 | 2.3 | 4.2 | 5 | 3.3 |
| FED21-52P | Pig Feed | 16 | 17.7 | 2.8 | 4.7 | 7 | 4.8 |
| FED21-54P | Equine Feed | 18 | 21.7 | 2.5 | 3.4 | 9 | 6.5 |
| FED21-56P | Small Animal (Rabbit) Feed | 16 | 16 | 2.5 | 2.7 | 16 | 20.1 |
| FED21-58 | Poultry Feed | 30 | 29.6 | 2.5 | 2.3 | 6.5 | 3.5 |
| FED21-62 | Poultry Feed | 18 | 16.1 | 3.5 | 3.5 | 3.5 | 2.4 |
| FED21-65 | Poultry Feed | 18 | 18.2 | 3.5 | 3.8 | 3.5 | 2.3 |
| FED21-68 | Pig Feed | 16 | 15.6 | 3.5 | 2.4 | 4 | 2.4 |
| FED21-71 | Poultry Feed | 18 | 13.9 | 3.5 | 7.2 | 3.5 | 3 |
| FED21-74 | Pig Feed | 16 | 14.5 | 3.5 | 7 | 4 | 2.7 |
| FED21-77 | Sheep Feed | 14 | 13.9 | 4 | 3 | 10 | 3.5 |
| FED21-80 | Equine Feed | 12 | 13.2 | 5 | 4.7 | 7 | 3.3 |
| FED21-83 | Poultry Feed | 20 | 19.8 | 3.5 | 3.2 | 3.5 | 2.9 |
| FED21-86 | Other Ruminant Feed | 16 | 15.3 | 3 | 3.3 | 10 | 3.6 |

Table 2. List of animal feeds tested for aflatoxins B1, B2, G1, and G2 in the year 2021.

| Sample ID | Description |
|------------------|--------------------|
| KAN21-102M | N/A |
| KAN21-106M | N/A |
| KAN21-110M | N/A |
| KAN21-114M | N/A |
| KAN21-118M | N/A |
| KAN21-121M | N/A |
| KAN21-122M | N/A |
| KAN21-123M | N/A |
| KAN21-124M | N/A |
| KAN21-125M | N/A |
| KAN21-126M | N/A |
| KAN21-127M | N/A |
| KAN21-128M | N/A |
| KAN21-129M | N/A |
| KAN21-130M | N/A |
| KAN21-131M | N/A |
| KAN21-93M | N/A |
| KAN21-95M | N/A |
| KAN21-97M | N/A |
| KAN21-99M | N/A |
| KAN21-135M | N/A |
| KAN21-138M | N/A |
| KAN21-142M | N/A |
| KAN21-146M | Dog Feed |
| KAN21-150M | Dog Feed |
| KAN21-154M | N/A |
| KAN21-156M | N/A |
| KAN21-158M | Dog Feed |
| KAN21-160M | Cat Feed |
| KAN21-162M | Dog Feed |

Cont. Table 2. List of animal feeds tested for aflatoxins B1, B2, G1, and G2 in the year 2021.

| Sample ID | Description |
|------------------|--------------------|
| KAN21-163M | N/A |
| KAN21-164M | Dog Feed |
| KAN21-165M | Dog Feed |
| KAN21-166M | Dog Feed |
| KAN21-167M | N/A |
| KAN21-168M | N/A |
| KAN21-169M | N/A |
| KAN21-170M | Cat Feed |
| KAN21-171M | Dog Feed |
| KAN21-172M | Cat Feed |
| KAN21-174M | Horse Feed |
| KAN21-178M | Duck Feed |
| KAN21-182M | Dog Feed |
| KAN21-187M | Chicken Feed |
| KAN21-191M | N/A |
| KAN21-194M | N/A |
| KAN21-196M | N/A |
| KAN21-198M | N/A |
| KAN21-200M | N/A |
| KAN21-202M | N/A |
| KAN21-203M | Dog Feed |
| KAN21-204M | Dog Feed |
| KAN21-205M | N/A |
| KAN21-206M | Cat Feed |
| KAN21-207M | Cat Feed |
| KAN21-208M | Cat Feed |
| KAN21-209M | Cat Feed |
| KAN21-210M | Dog Feed |
| KAN21-211M | N/A |

Cont. Table 2. List of animal feeds tested for aflatoxins B1, B2, G1, and G2 in the year 2021.

| Sample ID | Description |
|------------------|--|
| KAN21-212M | Cat Feed |
| KAN21-216M | Dog Feed |
| KAN21-218M | Dog Feed |
| KAN21-222M | Dog Feed |
| KAN21-226M | Dog Feed |
| KAN21-230M | Dog Feed |
| KAN21-234M | Dog Feed |
| KAN21-236M | Cat Feed |
| KAN21-238M | Cat Feed |
| KAN21-240M | Turtle Feed |
| KAN21-242M | Cat Feed |
| KAN21-244M | Cat Feed |
| KAN21-245M | Cat Feed |
| KAN21-246M | Rabbit, Guinea Pigs, Mice, Rats, Etc. Feed |
| KAN21-247M | Dog Feed |
| KAN21-248M | Cat Feed |
| KAN21-249M | Crustacean Feed |
| KAN21-250M | Bird Feed |
| KAN21-251M | Cat Feed |
| KAN21-252M | Dog Feed |
| KAN21-253M | Dog Feed |
| KAN21-254M | Livestock Feed |
| KAN21-258M | Livestock/Poultry Feed |
| KAN21-262M | Chicken Feed |
| KAN21-266M | Poultry Feed |
| KAN21-270M | Poultry Feed |
| KAN21-274M | Dog Feed |
| KAN21-276M | Parakeet Feed |
| KAN21-278M | Bird Feed |
| KAN21-280M | Chinchilla Feed |
| KAN21-282M | Chicken Feed |

Cont. Table 2. List of animal feeds tested for aflatoxins B1, B2, G1, and G2 in the year 2021.

| Sample ID | Description |
|------------------|----------------------------------|
| KAN21-284M | Dog Feed |
| KAN21-285M | Dog Feed |
| KAN21-286M | Dog Feed |
| KAN21-287M | Dog Feed |
| KAN21-288M | Cat Feed |
| KAN21-289M | Cat Feed |
| KAN21-290M | Hamster, Gerbil, Rat, Mice Feed |
| KAN21-291M | Dog Feed |
| KAN21-292M | Dog Feed |
| KAN21-293M | Dog Feed |
| KAN21-296M | Horse Feed |
| KAN21-300M | Game Bird Feed |
| KAN21-304M | Chicken Feed |
| KAN21-308M | Poultry/Waterfowl/Game Bird Feed |
| KAN21-312M | Rabbit Feed |
| KAN21-315M | Sheep and Goat Feed |
| KAN21-317M | Chicken Feed |
| KAN21-319M | Bird Feed |
| KAN21-321M | Dog Feed |
| KAN21-323M | Dog Feed |
| KAN21-324M | Dog Feed |
| KAN21-325M | Dog Feed |
| KAN21-326M | Cat Feed |
| KAN21-327M | Dog Feed |
| KAN21-328M | Cattle Feed |
| KAN21-329M | Rabbit Feed |
| KAN21-330M | Rabbit Feed |
| KAN21-331M | Goat Feed |
| KAN21-332M | Duck Feed |
| KAN21-333M | Duck Feed |
| FED21-03M | Poultry Feed |
| FED21-06M | Bovine Feed |
| FED21-09M | Sheep Feed |

Cont. Table 2. List of animal feeds tested for aflatoxins B1, B2, G1, and G2 in the year 2021.

| Sample ID | Description |
|------------------|---------------------|
| FED21-12M | Poultry Feed |
| FED21-15M | Pig Feed |
| FED21-16M | Small Animal Feed |
| FED21-17M | Equine Feed |
| FED21-18M | Equine Feed |
| FED21-19M | Cat Feed |
| FED21-20M | Other Ruminant Feed |
| FED21-21M | Equine Feed |
| FED21-22M | Poultry Feed |
| FED21-23M | Equine Feed |
| FED21-24M | Other Ruminant Feed |
| FED21-25M | Dog Feed |
| FED21-26M | Dog Feed |
| FED21-27M | Dog Feed |
| FED21-28M | Dog Feed |
| FED21-29M | Dog Feed |
| FED21-30M | Equine Feed |
| FED21-60 | Poultry Feed |
| FED21-63 | Poultry Feed |
| FED21-66 | Pig Feed |
| FED21-69 | Poultry Feed |
| FED21-72 | Pig Feed |
| FED21-75 | Sheep Feed |
| FED21-81 | Poultry Feed |
| FED21-84 | Other Ruminant Feed |

Table 3. List of animal feeds tested for pesticides in the year 2021.

| Sample ID | Description | Pesticide Found (mg/kg) |
|------------------|--------------------|--------------------------------|
| KAN21-92P | N/A | <0.01 |
| KAN21-94P | N/A | <0.01 |
| KAN21-96P | N/A | <0.01 |
| KAN21-98P | N/A | <0.01 |
| KAN21-100P | N/A | <0.01 |
| KAN21-104P | N/A | <0.01 |
| KAN21-108P | N/A | <0.01 |
| KAN21-112P | Cat Feed | <0.01 |
| KAN21-116P | N/A | <0.01 |
| KAN21-120P | Dog Feed | <0.01 |
| KAN21-133P | N/A | <0.01 |
| KAN21-137P | N/A | <0.01 |
| KAN21-141P | N/A | <0.01 |
| KAN21-145P | Dog Feed | <0.01 |
| KAN21-149P | Dog Feed | <0.01 |
| KAN21-153P | N/A | <0.01 |
| KAN21-155P | N/A | <0.01 |
| KAN21-157P | Dog Feed | <0.01 |
| KAN21-159P | Cat Feed | <0.01 |
| KAN21-161P | Dog Feed | <0.01 |
| KAN21-173P | Horse Feed | Etofenprox, 0.015 |
| KAN21-173P | Horse Feed | Malathion, 0.052 |

Cont. Table 3. List of animal feeds tested with detected pesticides in the year 2021.

| Sample ID | Description | Pesticide Found (mg/kg) |
|------------------|--------------------|--------------------------------|
| KAN21-173P | Horse Feed | Piperonyl Butoxide, 0.018 |
| KAN21-177P | Duck Feed | <0.01 |
| KAN21-181P | Dog Feed | <0.01 |
| KAN21-185P | N/A | Piperonyl Butoxide, 0.038 |
| KAN21-189P | N/A | Chlorpropham, 0.113 |
| KAN21-189P | N/A | Piperonyl Butoxide, 0.023 |
| KAN21-193P | N/A | Piperonyl Butoxide, 0.025 |
| KAN21-195P | N/A | Etofenprox, 0.403 |
| KAN21-197P | N/A | <0.01 |
| KAN21-199P | N/A | Chlorpropham, 0.966 |
| KAN21-201P | N/A | <0.01 |
| KAN21-214P | Dog Feed | <0.01 |
| KAN21-219P | Dog Feed | Malathion, 0.267 |
| KAN21-223P | Dog Feed | <0.01 |
| KAN21-227P | Dog Feed | <0.01 |
| KAN21-231P | Dog Feed | Chlorpropham, 0.054 |
| KAN21-235P | Dog Feed | <0.01 |
| KAN21-237P | Cat Feed | <0.01 |
| KAN21-239P | Cat Feed | <0.01 |
| KAN21-241P | Turtle Feed | <0.01 |
| KAN21-243P | Cat Feed | <0.01 |
| KAN21-257P | Livestock Feed | <0.01 |

Cont. Table 3. List of animal feeds tested for pesticides in the year 2021.

| Sample ID | Description | Pesticide Found (mg/kg) |
|------------|-----------------------------------|-----------------------------|
| KAN21-261P | Livestock/Poultry Feed | <0.01 |
| KAN21-265P | Poultry Feed | Malathion, 0.033 |
| KAN21-269P | Poultry Feed | <0.01 |
| KAN21-273P | Poultry Feed | Cyhalothrin (lambda), 0.042 |
| KAN21-273P | Poultry Feed | Etofenprox, 0.045 |
| KAN21-275P | Dog Feed | <0.01 |
| KAN21-277P | Bird Feed | Etofenprox, 0.031 |
| KAN21-279P | Bird Feed | Propargite, 0.038 |
| KAN21-281P | Chinchilla Feed | <0.01 |
| KAN21-283P | Chicken Feed | Cyhalothrin, lambda, 0.196 |
| KAN21-283P | Chicken Feed | Etofenprox, 0.384 |
| KAN21-294P | Horse Feed | Malathion, 0.075 |
| KAN21-298P | Game Bird Feed | Malathion, 0.049 |
| KAN21-298P | Game Bird Feed | Piperonyl Butoxide, 0.255 |
| KAN21-302P | Chicken Feed | Malathion, 0.104 |
| KAN21-306P | Poultry/Game Birds/Waterfowl Feed | Malathion, 0.042 |
| KAN21-310P | Rabbit Feed | Cyhalothrin, lambda, 0.288 |
| KAN21-314P | Sheep and Goat Feed | Malathion, 0.066 |
| KAN21-316P | Chicken Feed | <0.01 |
| KAN21-318P | Bird Feed | Methoxyfenozide, 0.017 |
| KAN21-320P | Dog Feed | <0.01 |
| KAN21-322P | Dog Feed | <0.01 |

Table 4. Results of animal feeds tested for toxic metals in the year 2021.

| Sample ID | Description | Tl | Pb | Ni | Cr | Cd | As | Hg | Se | Cu |
|-------------|------------------------|-------|------|-------|-------|------|-------|------|------|-------|
| | | ug/kg | | | | | | | | |
| KAN21-101TM | N/A | 1.3 | 37.3 | 122.6 | 350.4 | 11.8 | - | - | - | - |
| KAN21-105TM | N/A | - | 28.9 | 72.3 | 148.3 | 9.0 | 15.4 | - | - | - |
| KAN21-109TM | N/A | - | 12.7 | 70.4 | 197.9 | 2.8 | - | - | - | - |
| KAN21-113TM | Cat Feed | - | - | 1280 | 326 | 28 | 183 | - | - | - |
| KAN21-117TM | N/A | - | 10.6 | 117.8 | 676.0 | 20.3 | 461.7 | 11.3 | - | - |
| KAN21-134TM | N/A | - | 67.5 | - | - | 77.4 | 30.8 | - | 235 | 5366 |
| KAN21-139TM | N/A | - | 22.7 | - | - | 21.4 | 24.0 | - | 203 | 5323 |
| KAN21-143TM | N/A | - | 25.5 | - | - | 31.9 | 3789 | 71.2 | 1098 | 13113 |
| KAN21-147TM | Dog Feed | - | - | - | - | 54.2 | 80.9 | - | 862 | 34066 |
| KAN21-151TM | Dog Feed | - | - | - | - | 50.5 | 70.9 | - | 266 | 2579 |
| KAN21-175TM | Horse Feed | - | 117 | - | - | 134 | 332 | - | 747 | 38628 |
| KAN21-179TM | Duck Feed | - | 77 | - | - | 61 | 118 | - | 597 | 14165 |
| KAN21-190TM | N/A | - | 206 | - | - | 47 | 20 | - | 133 | 6001 |
| KAN21-183TM | Dog Feed | - | 82 | - | - | 27 | 14 | - | 717 | 7544 |
| KAN21-186TM | Chicken Feed | - | 149 | - | - | 145 | 447 | - | 780 | 17291 |
| KAN21-215TM | Dog Feed | - | 66 | - | - | 36 | 40 | - | 577 | 18456 |
| KAN21-220TM | Dog Feed | - | 88 | - | - | 64 | 169 | - | 476 | 12771 |
| KAN21-224TM | Dog Feed | - | 60 | - | - | 51 | 35 | - | 141 | 7405 |
| KAN21-228TM | Dog Feed | - | 6 | - | - | 6 | 6 | - | 285 | 5807 |
| KAN21-232TM | Dog Feed | - | 32 | - | - | 102 | 120 | 1.2 | 450 | 30905 |
| KAN21-255TM | Livestock Feed | - | - | - | - | - | - | - | 25 | 1679 |
| KAN21-259TM | Livestock/Poultry Feed | - | - | - | - | - | - | - | 30 | 2164 |
| KAN21-263TM | Poultry Feed | - | 108 | - | - | 34 | 95 | - | 615 | 19396 |
| KAN21-267TM | Poultry Feed | - | 72 | - | - | 71 | 121 | - | 443 | 15788 |
| KAN21-271TM | Poultry Feed | - | 252 | - | - | 84 | 248 | - | 704 | 18239 |
| KAN21-295TM | Horse Feed | - | 85 | - | - | 59 | 66 | 3.6 | 922 | 58400 |

| Sample ID | Description | Tl | Pb | Ni | Cr | Cd | As | Hg | Se | Cu |
|-------------|-----------------------------------|-------|-------|----|----|-----|-----|-----|-----|-------|
| | | ug/kg | | | | | | | | |
| KAN21-299TM | Game Bird Feed | - | 111 | - | - | 44 | 63 | 3.0 | 606 | 11570 |
| KAN21-303TM | Chicken Feed | - | 86 | - | - | 97 | 85 | - | 528 | 28399 |
| KAN21-307TM | Poultry/Game Birds/Waterfowl Feed | - | 53 | - | - | 74 | 60 | - | 521 | 14248 |
| KAN21-311TM | Rabbit Feed | - | 183.9 | - | - | 125 | 146 | 3.4 | 532 | 70989 |

Table 5. Results of animal feeds tested for macro minerals in the year 2021.

| Sample ID | Description | Cu | S | P | Na | Mg | K | Ca | Moisture |
|------------|--------------|---------|--------|-------|------|------|-------|---------|----------|
| | | (mg/kg) | | | | | | | % |
| FED21-01TM | Poultry Feed | 13 | 2541 | 4.1 | 2029 | 2999 | 6494 | 41808 | 9 |
| FED21-04TM | Bovine Feed | 21 | 2805.4 | 6 | 3260 | 4455 | 12343 | 10437.9 | 10 |
| FED21-07TM | Sheep Feed | 10 | 2636 | 1.8 | 2069 | 3286 | 11533 | 13233 | 9 |
| FED21-10TM | Poultry Feed | 18 | 2463 | 2.5 | 1470 | 2759 | 10418 | 7371 | 8 |
| FED21-13TM | Pig Feed | 20 | 2366 | 3.1 | 1670 | 3733 | 11152 | 11255 | 9 |
| FED21-35MM | Dog Feed | - | 4480 | 8287 | 4500 | 1143 | 7533 | 13569 | 8 |
| FED21-38MM | Dog Feed | - | 3130 | 8561 | 3214 | 1257 | 9161 | 13650 | 8 |
| FED21-41MM | Cat Feed | - | 4251 | 10733 | 3817 | 1202 | 7812 | 11544 | 8 |
| FED21-43MM | Dog Feed | - | 4129 | 9296 | 4078 | 1092 | 6744 | 12275 | 7 |
| FED21-46MM | Dog Feed | - | 4234 | 10243 | 4716 | 1667 | 6921 | 12588 | 9 |
| FED21-49MM | Pig Feed | - | 3193 | 6092 | 2273 | 2554 | 9597 | 5635 | 10 |
| FED21-51MM | Duck Feed | - | 3253 | 6506 | 1154 | 2201 | 10798 | 8817 | 10 |

| Sample ID | Description | Cu | S | P | Na | Mg | K | Ca | Moisture |
|------------|-------------------|---------|--------|---------|--------|--------|---------|---------|----------|
| | | (mg/kg) | | | | | | | % |
| FED21-53MM | Pig Feed | - | 2580 | 7263 | 2818 | 2892 | 9797 | 7212 | 10 |
| FED21-55MM | Equine Feed | - | 4376 | 8364 | 8550 | 4453 | 14713 | 10928 | 11 |
| FED21-57MM | Small Animal Feed | - | 1940 | 5380 | 1034 | 2807 | 15530 | 7214 | 9 |
| FED21-59MM | Poultry Feed | - | 3540 | 8191 | 1741 | 2485 | 14983 | 12377 | 11 |
| FED21-32MM | Dog Feed | - | 3044 | 7905 | 2037 | 1220 | 6926 | 11725 | 9 |
| FED21-61 | Poultry Feed | - | 2101.3 | 4061.1 | 1472.7 | 2080.9 | 7710.3 | 41029.9 | 9.9 |
| FED21-64 | Poultry Feed | - | 2241.6 | 4929.2 | 1425.0 | 1906.4 | 8845.9 | 8637.3 | 10.9 |
| FED21-67 | Pig Feed | - | 1822.4 | 4434.1 | 1681.8 | 2367.6 | 8594.0 | 6413.3 | 11.1 |
| FED21-70 | Poultry Feed | - | 1668.3 | 3787.7 | 571.5 | 1733.9 | 6897.2 | 28483.6 | 10.1 |
| FED21-73 | Pig Feed | - | 1400.7 | 3927.2 | 1062.7 | 1962.6 | 7254.8 | 4466.4 | 10.7 |
| FED21-76 | Sheep Feed | - | 2159.8 | 4195.9 | 1477.4 | 2001.4 | 7128.4 | 4883.4 | 11.7 |
| FED21-79 | Horse Feed | - | 1872.2 | 5574.9 | 1638.6 | 1744.7 | 7760.6 | 4024.9 | 10.6 |
| FED21-82 | Poultry Feed | - | 2204.6 | 5016.8 | 1378.5 | 1824.8 | 9112.7 | 11450.0 | 10.3 |
| FED21-85 | Other Ruminant | - | 2663.5 | 7845.2 | 2602.1 | 2068.2 | 9422.4 | 9281.3 | 10.4 |
| FED21-126 | Dog Feed | - | 5313.9 | 12569.6 | 3999.2 | 1489.2 | 9000.3 | 16751.7 | 6.3 |
| FED21-128 | Dog Feed | - | 4018.6 | 14457.8 | 3736.8 | 1926.6 | 8617.1 | 24421.8 | 5.9 |
| FED21-130 | Dog Feed | - | 4148.7 | 10351.0 | 4135.9 | 1660.8 | 8211.2 | 13849.8 | 4.6 |
| FED21-132 | Dog Feed | - | 4780.1 | 9366.5 | 6624.1 | 1688.9 | 14682.3 | 14325.9 | 6.7 |
| FED21-134 | Dog Feed | - | 3906.6 | 13030.4 | 3367.8 | 1765.9 | 8823.5 | 21438.2 | 4.8 |
| FED21-136 | Dog Feed | - | 5156.1 | 12263.6 | 8127.3 | 966.1 | 10726.0 | 11526.1 | 1.4 |
| FED21-88 | Dog Feed | - | 1516 | 1959 | 1621 | 184 | 1951 | 2745 | 81 |
| FED21-90 | Dog Feed | - | 916 | 3119 | 2084 | 264 | 3231 | 3318 | 72 |
| FED21-92 | Dog Feed | - | 993 | 2400 | 931 | 195 | 1557 | 2856 | 85 |
| FED21-94 | Dog Feed | - | 1341 | 3894 | 1793 | 323 | 3665 | 3929 | 72 |
| FED21-96 | Dog Feed | - | 1618 | 2961 | 2353 | 191 | 2283 | 4433 | 80 |

| Sample ID | Description | Cu | S | P | Na | Mg | K | Ca | Moisture |
|-----------|-------------|---------|------|------|------|-----|------|------|----------|
| | | (mg/kg) | | | | | | | % |
| FED21-98 | Dog Feed | - | 1345 | 2607 | 2280 | 183 | 2332 | 3251 | 76 |
| FED21-100 | Dog Feed | - | 1724 | 1938 | 2379 | 301 | 2618 | 3339 | 75 |
| FED21-102 | Dog Feed | - | 1501 | 2607 | 2441 | 215 | 2280 | 2771 | 80 |
| FED21-104 | Dog Feed | - | 1381 | 3153 | 1556 | 418 | 3849 | 4363 | 72 |
| FED21-106 | Dog Feed | - | 1843 | 2688 | 2504 | 220 | 2789 | 4008 | 78 |
| FED21-108 | Dog Feed | - | 1222 | 3461 | 1423 | 289 | 2667 | 5430 | 75 |
| FED21-110 | Dog Feed | - | 1204 | 2658 | 2056 | 342 | 2001 | 3519 | 73 |
| FED21-112 | Dog Feed | - | 1210 | 5267 | 1319 | 428 | 3578 | 8801 | 72 |
| FED21-114 | Dog Feed | - | 1383 | 1889 | 1155 | 200 | 2133 | 1883 | 77 |
| FED21-116 | Dog Feed | - | 2252 | 5370 | 1713 | 506 | 3852 | 8871 | 75 |
| FED21-118 | Dog Feed | - | 1256 | 3121 | 1302 | 279 | 3556 | 4964 | 75 |
| FED21-120 | Dog Feed | - | 852 | 1637 | 775 | 327 | 2484 | 2543 | 75 |
| FED21-122 | Dog Feed | - | 1507 | 3274 | 2637 | 207 | 2672 | 4303 | 73 |
| FED21-124 | Dog Feed | - | 1573 | 1616 | 1075 | 447 | 4106 | 2694 | 77 |

Table 6. Results of dog food tested for copper and moisture in the year 2021.

| Sample ID | Description | Cu | Moisture |
|-----------|-------------|---------|----------|
| | | (mg/kg) | % |
| FED21-33C | Dog Feed | 12 | - |
| FED21-36C | Dog Feed | 17 | - |
| FED21-39C | Dog Feed | 12 | - |
| FED21-44C | Dog Feed | 28 | - |
| FED21-47C | Dog Feed | 16 | - |
| FED21-125 | Dog Feed | 27.2 | 6.3 |
| FED21-127 | Dog Feed | 17.2 | 5.7 |
| FED21-129 | Dog Feed | 14.6 | 4.7 |

| Sample ID | Description | Cu (mg/kg) | Moisture % |
|------------------|--------------------|-----------------------|-----------------------|
| FED21-131 | Dog Feed | 18.4 | 6.6 |
| FED21-133 | Dog Feed | 13.8 | 4.7 |
| FED21-135 | Dog Feed | 44.0 | 1.5 |
| FED21-87 | Dog Feed | 4 | 81 |
| FED21-89 | Dog Feed | 18 | 72 |
| FED21-91 | Dog Feed | 4 | 85 |
| FED21-93 | Dog Feed | 22 | 71 |
| FED21-95 | Dog Feed | 8 | 80 |
| FED21-97 | Dog Feed | 17 | 75 |
| FED21-99 | Dog Feed | 20 | 76 |
| FED21-101 | Dog Feed | 6 | 81 |
| FED21-103 | Dog Feed | 7 | 73 |
| FED21-105 | Dog Feed | 9 | 79 |
| FED21-107 | Dog Feed | 6 | 75 |
| FED21-109 | Dog Feed | 12 | 79 |
| FED21-111 | Dog Feed | 7 | 72 |
| FED21-113 | Dog Feed | 7 | 77 |
| FED21-115 | Dog Feed | 9 | 73 |
| FED21-117 | Dog Feed | 7 | 75 |
| FED21-119 | Dog Feed | 4 | 75 |
| FED21-121 | Dog Feed | 20 | 74 |
| FED21-123 | Dog Feed | 4 | 79 |

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ACKNOWLEDGEMENTS:

This Federal Award Project Title “FDA LFFM- Continuation of human and animal food/feed programs at the CT Agricultural Experiment Station” supported by the Food and Drug Administration (FDA) of the U.S. Department of Health and Human Services (HHS) as part of a financial assistance award FAIN U19FD007094 totaling \$675,000 with 100 percent funded by FDA/HHS. The contents are those of the author(s) and do not necessarily represent the official views of, nor an endorsement, by FDA/HHS, or the U.S. Government. Financial support from the USDA-NIFA Hatch CONH00102 on inspection of feed products is also acknowledged.

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