Quality Assurance for On-farm Feed Manufacturing

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Executive Summary

As animal producers strive toward greater profitability, many have implemented their own feed manufacturing operations. Personnel at the Food and Drug Administration’s (FDA) Center for Veterinary Medicine (CVM) estimate approximately 60,000 U.S. farmers manufacture their own feed. The goal of on-farm feed manufacturing is to produce feed that meets the intended specifications (both nutritional and with the desired medication level) and is free of adulteration. The production of quality feed will enhance animal performance and improve the profitability of the livestock enterprise.

A set of regulations for manufacturing feed, referred to as current Good Manufacturing Practices (GMPs), are designed to prevent feed contamination and provide reasonable assurance that medicated feed additives are used properly. Everyone involved in producing medicated feed, whether at a commercial off-farm plant or with an on-farm mill or grinder-mixer, must comply with the GMPs. By definition, failure to follow GMPs during the feed manufacturing process results in adulterated feed.

Few on-farm feed manufacturers are familiar with the GMPs. Furthermore, no routine inspections are conducted for on-farm feed manufacturing operations. In Kansas, approximately 11 percent of the meat animal drug residue problems result from medicated feed. Where the contamination source was identified, 100 percent were traced back to on-farm feed manufacturing operations.

Project Goal

The goal of this project was to reduce the likelihood of contaminated meat leaving the farm resulting from a failure by on-farm feed manufacturers to comply with the current Good Manufacturing Practices. This outcome was pursued through two project objectives. The first entailed a preliminary assessment of on-farm feed manufacturers’ compliance with GMPs (Phase I). The second involved development of training material (Phase II) designed to address the educational needs identified in Phase I. Training material would emphasize the rationale, methodology, and economic justification behind implementing GMPs.

Methodology

Phase I was accomplished through on-site evaluations of on-farm feed manufacturing operations. A systematic evaluation of feed processing units was developed and tested on three farms and then used to evaluate the entire population of on-farm feed manufacturers in Clay County, Kan. The data collection process gathered information pertaining to regulatory compliance, feed quality, information sources used by farmers, and their rationales for manufacturing feed. Participants received individual reports that identified operation strengths and opportunities for improvement. A county summary, also sent to project participants, included an economic analysis of all portable feed manufacturing systems and conclusions regarding feed quality and the level of GMP compliance.

Training materials were developed to assist on-farm feed manufacturers comply with GMPs. The first of these was an On-farm Feed Manufacturers Quality Assurance Pocket Manual. A prototype of the manual was developed and tested by project collaborators. Modifications were made based on participant recommendations. A Feed Quality Assurance Handbook was developed consisting of 17 bulletins addressing different cost centers in the feed manufacturing process. Most on-farm feed processors acquire information about feed manufacturing from their feed ingredient supplier. Training material was prepared in bulletin format to facilitate distribution by commercial feed suppliers to their farm customers.

Results

All farmers who manufactured their own feed (20 total) in Clay County participated in the project. Project cooperators indicated feed quality was the primary reason for manufacturing feed on-farm (60 percent listed this as the first or second priority), and cost savings occurred as the second most frequent response (55 percent listed this as the first or second priority).

Feed ingredient suppliers were identified as the principal information source pertaining to feed manufacturing issues, followed by veterinarians and Extension personnel.

Assessment of feed quality as indicated by finished feed particle size, feed uniformity, and drug content, revealed producers were manufacturing
good-quality feed. Two feed samples possessed a drug content below the minimum tolerance permitted by the GMPs, while none of the feed samples exceeded the target inclusion rate by more than 10 percent. Average feed particle size was 812 microns (a swine producer’s target is 600 to 800 microns).

Record-keeping and medicated feed ingredient storage were the primary GMP compliance issues farmers needed to improve. Most participants used sequencing of feeds to avoid drug carry-over between feed batches. Follow-up evaluations were performed on several farms. In those instances, farmers had come into compliance with GMP regulations pertaining to record-keeping and drug storage.

An economic analysis of data collected for portable grinder-mixers revealed the average cost of producing feed on-farm, excluding the cost of ingredients, was $8.06 per ton of feed with a standard deviation of $3.50 per ton.

Extension bulletins were prepared to address educational needs of producers pertaining to feed quality assurance, processing efficiency, and compliance with the GMPs. In-service training was conducted for Cooperative Extension Service agents in Kansas and for commercial feed manufacturers and veterinarians on a national basis. Commercial feed manufacturers and state grain and feed association personnel are distributing materials to their respective customers throughout the midwestern United States.

**Project Outcomes**

In response to this project, Clay County farmers have reduced the likelihood of producing pork with violative drug residues through better record-keeping, sequencing, and mixer cleanout. Because the material was designed for distribution by commercial feed manufacturers, it has found ready adoption both in and outside the United States. All of the bulletins have been translated into Chinese, and some of the bulletins have been translated into Spanish. The project has been expanded to other Kansas counties, and commercial companies have adopted the methodology used in this project to assist their on-farm feed customers improve their compliance with GMPs in the United States.
On-farm feed manufacturing represents the largest portion of hog feed produced in the United States. Reports indicate on-farm feed manufacturing accounted for 50 percent of the hog feed market on nonintegrated farms in 1972. By 1981, the on-farm feed manufacturing market share increased to 80 percent, and in 1992 it was reported to comprise 85 percent of the farm feed market (Anderson, 1981; Marbery, 1992).

On-farm feed manufacturers are required to follow the same FDA regulations as commercial feed mills (Title 21 CFR Part 225). These regulations are referred to as the current Good Manufacturing Practices (GMPs). The GMPs outline procedures for processing feed that help ensure meat, milk, and eggs produced from animals receiving medicated feeds contain no violative drug residues. The Federal Food, Drug & Cosmetic Act states a medicated feed will be considered adulterated if the methods or equipment used for its manufacturing, processing, packing, or holding are not in compliance with GMPs.

The FDA has determined that a lack of sequencing, flushing, and cleaning of mixer equipment accounted for 25 percent for sulfamethazine violations (Augsburg, 1989). Improper mixing and incorrect inclusion rates of medicated feed articles also were found to be major contributors to tissue residue violations. A collaborative effort by FDA, USDA, the Cooperative Extension Service, and industry was conducted to educate producers in methods to avoid violative tissue residue. This resulted in a decrease of sulfa violations from 13 percent prior to 1978 to about 5 percent between 1980 and 1987 (Augsburg, 1989). The most current statistics available from USDA indicate violative tissue residues due to sulfamethazine were less than 1 percent in 1993 (Domestic Residue Databook).

The GMPs highlight the importance of proper receiving, storage, proportioning, mixing, equipment cleanout, and record-keeping procedures. Although on-farm feed processors are required to comply with these regulations, they are not subject to routine inspections. Furthermore, the paucity of information regarding regulatory compliance and quality of finished feed processed on-farm hinders Cooperative Extension Service personnel, veterinarians, and commercial feed suppliers from addressing the educational needs of these producers.

In response to this dilemma, the following project was conducted to help identify the educational needs and regulatory compliance of on-farm feed processors.

Goals and Objectives

There were two project objectives. The first objective was to assess the current level of GMP compliance by on-farm feed manufacturers in Clay County, Kan. This information would enable the project team to identify educational needs and develop training material that appropriately addressed on-farm feed manufacturing practices. Project participants in Clay County also would receive assistance, in the form of technical recommendations and training, in complying with the GMPs.

The second project objective entailed the development and distribution of Extension educational material pertaining to on-farm feed manufacturing. The distribution of this material would occur through a train-the-trainer format with collaboration from state and national producer and feed manufacturer trade associations.

The desired outcome of this project was to see on-farm feed manufacturers comply with the GMPs, thereby helping ensure a safe supply of meat, milk, and eggs in response to learning more about feed quality assurance techniques.

This information transfer would occur directly from Extension personnel, veterinarians, and feed ingredient suppliers who received training in feed quality assurance techniques and through the direct distribution of multimedia Extension training material.

Materials and Methods

Clay County is located in the North Central crop reporting district of Kansas and has a hog and pig inventory value of $3.074 million (Kansas Ag Statistics, 1995). This ranks fourth in the state, which has a total hog and pig inventory value of $91.8 million. Clay County was selected for this case study because of its proximity to Manhattan, Kan., where the main campus of Kansas State University is located; the close working relationship between the Extension agent and swine producers; and the presence of a manageable number yet diverse group of on-farm feed manufacturers. Every hog operation in Clay County where feed is processed on-farm was included in the study.
A survey of feed production units and conformance to GMPs was developed after visiting and inspecting three cooperators’ farms (Appendix). This survey was tested at these locations prior to its use at 17 other operations in the county.

Feed uniformity (mixer performance) was evaluated using procedures outlined by the American Society of Agricultural Engineers (ASAE, 1990). Ten representative samples were collected from portable grinder-mixers by subsampling at even time intervals during feed discharge. Stationary mills were sampled at 10 representative locations using a Seedburo grain probe (Chicago, Ill.). Salt assays were performed using Quantab titrators (Elkart, Ind.), and the coefficient of variation percentage (CV%) was calculated.

Corn and sorghum test weights were determined using procedures outlined by the Federal Grain Inspection Service (FGIS, 1990, 1993). Grain moisture was measured using the air oven method described by the American Association of Cereal Chemists (AACC, 1994a). Drug assays and particle size analyses were performed on a composited feed sample collected for evaluation of mixer performance. Drug assays were performed by a commercial lab following the Association of Official Analytical Chemists (AOAC) methods (Ragheb and Smallidge, 1990). Particle size was measured by following the ASAE (1993) method of determining and expressing fineness of feed materials by sieving. Soybean meal and protein supplements were analyzed for total nitrogen content using the kjeldahl method (AACC, 1994b).

Hammermill shaft speed was measured using a Fisher brand tachometer (Pittsburgh, Pa.); this value was used to calculate hammer tip speed in feet per minute. Screen size opening and hammer width were measured using a screen gage and caliper, respectively. A stopwatch time study was performed to collect time-motion data. These data were used in two technical reports (Herrman et al., 1997a and b).

Evaluation of producer changes occurred in an informal format since all had received a comprehensive report on their feed-manufacturing operation and GMP-compliance issues were discussed during the survey. During subsequent contact with project participants by the county Extension agent through on-farm visits or conversation, information regarding changes was gathered.

Results and Discussion

Participant Profile

Eighteen of the 20 study participants used a portable grinder-mixer to manufacture feed. The quantity of feed manufactured varied from 1.5 to 200 tons per week. Three operations produced breeding stock, one purchased feeder pigs, and one occasionally sold feeder pigs. Sixty percent of the participants manufactured feed using a grain, soybean meal, and base mix ingredient system; 20 percent batched feed using phosphorus, calcium, and premix with their grain and soybean meal; and 20 percent used a supplement (a combination of protein, minerals, and vitamins) and grain to prepare feed.

On average, participants had been manufacturing feed for 20 years. Study cooperators provided reasons for manufacturing feed in order of priority (Table 1). Feed quality (35 percent) received the highest response for processing feed on-farm, followed by cost (25 percent), and convenience (25 percent). Grain quality was the principal reason study cooperators indicated their feed was superior to commercial feed.

<table>
<thead>
<tr>
<th>Reason</th>
<th>First</th>
<th>Second</th>
<th>Third</th>
<th>Fourth</th>
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</thead>
<tbody>
<tr>
<td>Cost</td>
<td>25%</td>
<td>30%</td>
<td>40%</td>
<td>0%</td>
</tr>
<tr>
<td>Quality</td>
<td>35%</td>
<td>25%</td>
<td>0%</td>
<td>5%</td>
</tr>
<tr>
<td>Convenience</td>
<td>25%</td>
<td>15%</td>
<td>20%</td>
<td>10%</td>
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<tr>
<td>Value added</td>
<td>5%</td>
<td>20%</td>
<td>5%</td>
<td>0%</td>
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<tr>
<td>Dispose of grain</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>15%</td>
</tr>
<tr>
<td>Sanitation</td>
<td>10%</td>
<td>10%</td>
<td>5%</td>
<td>10%</td>
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</table>
Feed-processing Quality Assurance Program

Most study participants conducted some routine quality tests of feed ingredients. Seventy-five percent of the study cooperators reported they inspected incoming ingredients visually, measured test weight and moisture of grain, or smelled the ingredients to detect off odors. Only 20 percent reported that they performed assays on finished feed or soybean meal, and no one evaluated finished feed for drug content. Particle size analysis and mixer performance testing had been performed on 35 percent and 30 percent of the farms, respectively.

Buildings, grounds, storage bins, and equipment were inspected to assess the degree to which study cooperators complied with the GMPs. All buildings provided adequate shelter for feed manufacturing equipment, 75 percent of the producers separated their feed operation from their agrichemicals and application equipment, and 30 percent of the ingredient storage rooms prevented entry of birds and rodents. Sixty percent of the producers stored their medicated feed additives in their original closed containers, and 80 percent correctly followed the label for medicated articles. Most scales (80 percent) used to proportion drugs possessed 1-pound weighing increments (none were designed to weigh less than 1 pound), and 35 percent of the producers checked their scales for accuracy.

Nine of the 20 study cooperators participated in the National Pork Producers Council’s (Des Moines, Iowa) Pork Quality Assurance (PQA) program. Six of these individuals kept feed-processing records that denoted feed formulation, date of mixing, and delivery point on their farm. Of the 11 study cooperators who were not enrolled in the PQA program, only one kept records that denoted feed processing date, ration, and delivery information.

Feed and Ingredient Quality

The protein level in soybean meal or concentrate was approximately 98.9 percent of the guaranteed minimum content (Table 2). One sample (5 percent) was outside the American Association of Feed Control Officials (AAFCO) permitted analytical variation (AAFCO, 1995). Drug assays performed on complete feed indicated the average drug inclusion rate was 85 percent of the target level. Only 55 percent of the producers incorporated drugs in feed batches during the farm visits. Of those 11 farmers, two incorporated their medicated feed additive below FDA tolerances (Title 21 CFR Part 558); one of these was 15 percent of label usage.

Most of the feed manufactured on-farm possessed a good average particle size and mixing uniformity (Table 2). The average coefficient of variation across mixers was 12.9 percent, and coefficients of variation ranged between 3.9 percent and 33.6 percent. Average particle size of finished feed was 812 microns, and the range was between 581 microns and 1,075 microns. Only one farmer used a roller mill for grinding grain, whereas the rest of the farmers used hammermills.

Avoiding Cross-contamination of Feed

Producers were questioned about techniques they used to avoid cross-contamination of feed. Eighteen of the study participants (90 percent) used a medicated feed article that had a withdrawal time. When questioned about their equipment cleanout practices, all indicated feeds were prepared in a sequence to avoid cross-contamination. None of the study cooperators utilized a ground grain flush treatment following the last batch of feed containing a Category II drug, nor did any of them clean their mixer following discharge of a feed containing a drug with a

<table>
<thead>
<tr>
<th>Component</th>
<th>Average</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein (% of label)</td>
<td>98.9</td>
<td>103</td>
<td>91</td>
</tr>
<tr>
<td>Mixing CV percentage</td>
<td>12.9</td>
<td>33.6</td>
<td>3.9</td>
</tr>
<tr>
<td>Particle size (micron)</td>
<td>812</td>
<td>1075</td>
<td>581</td>
</tr>
<tr>
<td>Drug assay</td>
<td>85.4</td>
<td>103</td>
<td>15</td>
</tr>
</tbody>
</table>
withdrawal time. Although sequencing may be an adequate method of preventing cross-contamination of feed containing a medicated feed additive requiring a withdrawal time, 60 percent of the producers in this study did not keep adequate records to validate that a sequencing pattern was followed from one day to the next.

Feed carryover was measured in 13 of the 18 portable grinder-mixers (two systems did not contain cleanout ports, and three systems inadvertently were not measured). The amount of feed carryover for these portable grinder-mixers averaged 18.1 kilograms (39.7 pounds) or 0.70 percent, with a high of 36.3 kilograms (80 pounds) and a low of 1.4 kilograms (3.2 pounds). In five cases, the amount of feed carryover exceeded 1 percent of the batch size. As little as 1 part per million (ppm) of sulfamethazine, or 1 percent carryover between feed batches, can cause violative tissue residues (Franco et al., 1990).

**Feed Processing Information**

Study participants were asked to identify their primary information sources regarding various feed processing issues (Table 3). In all cases except GMPs, study participants used their feed ingredient supplier as their primary information source. For some feed-processing issues (drug use and feed rations), study participants utilized several information sources. In several cases, such as ingredient sampling and GMPs, study participants did not seek out information because they were unaware of the need for it in relationship to feed processing and quality assurance. Two information sources identified as “other” in Table 3 represent trade magazines and the National Pork Producers Council’s PQA program.

Because of the close proximity of Clay County to Kansas State University, it was assumed that a bias toward Extension personnel might occur. Either this assumption was incorrect or an even greater percentage of on-farm feed manufacturers throughout Kansas rely upon their feed ingredient supplier for technical information. Regardless, to effectively communicate information pertaining to feed processing and quality assurance programs, study results indicate the feed ingredient supplier and veterinarian should be involved as educators.

**Training Material**

Current Extension material pertaining to on-farm feed manufacturing was nonexistent. Quality assurance material developed by the National Pork Producers Council and National Cattlemens Beef Association were evaluated to identify information gaps and consider how new training material would augment existing quality assurance programs. The project team and steering committee met several times to discuss a strategy for developing training material. As an outcome of these discussions, the group chose to prepare a series of Extension bulletins; these bulletins would focus on single issues and provide greater depth on a specific topic.

The preparation of individual bulletins would permit distribution of one or several bulletins on a select topic that addressed a producer’s educational need. Such a strategy would also permit more frequent updates of time-sensitive information and

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**Table 3. Information Sources for On-farm Feed Manufacturers**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Feed supplier</th>
<th>CES</th>
<th>Vet</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed ration</td>
<td>70%</td>
<td>25%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Ingredient price</td>
<td>85%</td>
<td>0%</td>
<td>0%</td>
<td>10%</td>
</tr>
<tr>
<td>Ingredient quality</td>
<td>70%</td>
<td>15%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Sampling methods</td>
<td>35%</td>
<td>20%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>GMPs</td>
<td>5%</td>
<td>5%</td>
<td>0%</td>
<td>15%</td>
</tr>
<tr>
<td>Laboratory assays</td>
<td>70%</td>
<td>25%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Drug use</td>
<td>65%</td>
<td>0%</td>
<td>70%</td>
<td>25%</td>
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</tbody>
</table>
permit a diverse group of research, Extension, and industry personnel to participate in the writing process. The following bulletins were developed for the Feed Quality Assurance Handbook:

- Sampling Feed Components and Finished Feeds
- Evaluating Feed Components and Finished Feeds
- Mycotoxins in Feed Grains and Ingredients
- Bagged Ingredient Storage
- Bulk Ingredient Storage
- Preventative Maintenance for Feed Processing Facilities and Equipment
- Medicated Feed Additives for Swine
- Medicated Feed Additives for Cattle
- Hammermills and Roller Mills
- Evaluating Particle Size
- The Effects of Diet Particle Size on Animal Performance
- Testing Mixer Performance
- Rotating Drum Mixers
- Portable Grinder-Mixers
- Premixing
- Avoiding Drug Carryover During Feed Processing and Delivery
- Rights and Liabilities Arising From the Sale of Defective Agricultural Goods

The need to develop an on-farm feed manufacturing recordbook was discovered during Phase I of the project. Since many farmers are accustomed to keeping pesticide application records in a pocket recordbook, a similar format was adopted for this project. A GMP self-audit, similar to the survey form used during the farm visits, was included in this publication entitled On-farm Feed Manufacturers Quality Assurance Pocket Manual.

A new employee training video was prepared detailing the GMPs within the context of on-farm feed manufacturing. This piece was the last part of the project training material to be developed.

**Project Changes**

Several changes occurred as an outgrowth of information gained in Phase I. The project team discovered a need for a pocket recordbook that also included a self-audit checklist of the GMPs. This booklet was developed in addition to more detailed information bulletins contained in a Feed Quality Assurance Handbook.

Second, it was discovered that commercial feed manufacturers and veterinarians were the primary sources of information for on-farm manufacturers. In view of this discovery, feed manufacturing workshops were conducted for these groups rather than Extension personnel. Extension personnel can perform an important function in assisting farmers in complying with GMPs; however, such an undertaking will likely require a multistate approach. Training material for this type of endeavor is now available.

**Accomplishments of the Project**

Through the on-farm surveys, individual reports, and county summary, on-farm feed manufacturers in Clay County became more knowledgable about the role of GMPs in their feed processing operations. Individual follow-ups revealed producers adopted many of the suggestions offered in the individual reports. Farming is a competitive business, and often there is little incentive to share information with neighbors. However, farmers who were early participants in Phase I were instrumental in convincing their neighbors to cooperate, resulting in 100-percent project participation.

The comprehensive evaluation of every on-farm feed manufacturing system in one county revealed a wide range of practices. For example, while some flagrant GMP violations were observed, it was also found that many on-farm feed manufacturers produced excellent feed.

Earlier work by the Cooperative Extension Service in the form of a drug residue avoidance program has helped educate farmers about the importance of sequencing feed batches when using a withdrawal drug. However, most farmers did not understand the link between feed production records and ensuring that sequencing feed rations were correctly performed. A second study was conducted in a different Kansas county and similar trends were observed regarding GMP compliance and feed quality.

Two of the greatest surprises in Phase I were the reasons why farmers manufacture their own feed and their primary information source. On the sur-
face, it appears illogical that farmers believe they could manufacture better feed than commercial feed manufacturers, yet they would seek advice on many feed manufacturing topics from these same individuals. This apparent conundrum is explained by the issue of grain quality; producers were suspicious of the quality of grain used in commercial feed while they were confident of the quality grain they used in manufacturing their own feed. Since commercial feed manufacturers are the principal information outlet to on-farm feed manufacturers, Extension training material should be channeled through commercial feed suppliers.

Phase II accomplishments consisted of developing and distributing new Extension material aimed at improving on-farm feed quality, regulator compliance, and production efficiency. Several trade magazine articles assisted in stimulating interest in this information in the United States and Canada. Portions of this material have been translated into Spanish for use in Mexico and the entire Feed Quality Assurance Handbook has been translated into Chinese and distributed throughout that country by the U.S. Feed Grains Council.

State grain and feed associations have assisted in the distribution of the On-farm Feed Manufacturer’s Quality Assurance Pocket Manual via their members who service on-farm feed manufacturing accounts with premixes, basemixes, and supplements. On-farm feed manufacturing is now a topic presented at all Grain Science and Industry training sessions for commercial feed manufacturers. Information developed by K-State faculty is now used by some major commercial feed manufacturers as training material they share with their farmers. In addition, training material has been shared with veterinarians at several region conferences conducted in the upper midwest of the United States.

Literature Cited
American Association of Feed Control Officials. 1995. Official Publication. Atlanta, GA.
KANSAS STATE UNIVERSITY
ON-FARM FEED MANUFACTURING
SURVEY FORM

SECTION I — IDENTIFICATION
Date of inspection ____________________________
Firm name __________________________________
Address __________________________________________________________________________________
Telephone __________________________________
Type medicated feed manufactured:    Sale _______ Own use ________

SECTION II — BACKGROUND INFORMATION
Type of Operation:

◆ HOGS
% sold as feeders ______ % sold as market hogs ______ % sold as breeding stock ___________
Farrow to finish _______ Number of sows ____________ Number of pigs marketed/year _______

◆ CATTLE
Cow-calf _____________ Other _____________________
Number of cows _______ Number of cattle marketed/year ____________________________________

Feeding System/Program:
1. Tons of feed manufactured per week __________ Hours per week making feed _________________
2. Separate conveying/distribution system for medicated and non-medicated feed ______________________
Delivery system type: Wagons ______________ Portable grind/mix _________________________
3. Feed cost/pound of gain ____________________
   Feed conversion _______________________
4. Do you mix?    Grain & supplement__________ Grain, protein & basemix ________________
   Grain, protein, calcium, phosphorous & premix __________

History:
Length of time manufacturing feed ______________

Rank the following reasons for manufacturing feed:
A. Cost of manufactured feed lower than purchased feed ______
B. Quality of manufactured feed higher than purchased feed ______
C. Convenienc e ______
D. Value added to grain ______
E. Dispose of poor grain ______
F. Other ______

Information source for the following practices:
Formulations __________________________________________________________________________
Ingredient price ________________________________________________________________________
Ingredient/feed quality __________________________________________________________________
Sampling method _________________________________________________________________________
GMPs ________________________________________________________________________________
Labs and analyses ______________________________________________________________________
Use of medicated feed additives ___________________________________________________________
How to manufacture feed_________________________________________________________________
225.12 BUILDINGS AND GROUNDS
1. Is there adequate shelter for grinder/mixer? Yes _______ No _______
2. Can drugs be separated from other agrichemicals? Yes _______ No _______
3. Do buildings minimize rodent and pest infestations? Yes _______ No _______
Comments: __________________________________________________________________________________________

225.135 WORK AND STORAGE AREA
1. Is the work area and equipment for feed not used for manufacturing or storing agrichemicals? Yes _______ No _______
2. Is the work area and equipment used for production or storage of medicated feed or components separate from agrichemicals? Yes _______ No _______
   _____ Empty bags present – used to store other material
   _____ Pesticides, rodenticide
   _____ Other contaminants: specify _____________________________________________________
Comments: __________________________________________________________________________________________

225.130 EQUIPMENT
◆ SCALES
1. Are scales and liquid metering devices checked annually? Yes _______ No _______
2. Are there proper breaks? Yes _______ No _______
◆ GRINDING
1. Is particle size of ground grain known? Yes _______ No _______
   Dgw _______ Sgw _______
2. Hammer number _______ Hammer dimensions _______ Hammer wear _______
   Screen size _______ Screen condition _______
   Diameter of hammer circumference _______
   Clearance between hammer and screen _______
   Shaft rpm _______
3. Roller dimensions _______ Corregation _______
   Differential speed _______ Gap _______
4. Is equipment in clean, orderly condition? Yes _______ No _______
   PERFORMANCE CHECK:
   Dgw _______ Sgw _______ Grain _______
◆ MIXER
1. Is mixing capability measured? Yes _______ No _______ _________ CV
2. How was the mixing time selected? _________________________________
3. Minutes per mix _______
4. Mixer type _______ Manufacturer _______ Model _______
   Capacity _______
5. Sequence of ingredients into mixer _________________________________
   PERFORMANCE CHECK:
   Survey results; CV _________
<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Power requirement and capacity</th>
<th>Age and condition</th>
<th>Original cost</th>
<th>Floor type</th>
<th>Percent use</th>
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225.142 FEED AND DRUG COMPONENTS
1. Are 1900 drugs present at nonregistered mill? Yes _______ No _______
2. Are drug codes recorded or compared to invoice? Yes _______ No _______
3. Have drugs passed expiration date? Yes _______ No _______
4. Are drugs used according to label? Yes _______ No _______
5. Are drugs kept in original/closed container? Yes _______ No _______
6. Are separate scoops used for each drug? Yes _______ No _______

FEED INGREDIENT LIST

<table>
<thead>
<tr>
<th>Product name</th>
<th>Drug A.I. and potency</th>
<th>Cost</th>
<th>Quantity of purchase and unit size</th>
<th>Payment</th>
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INGREDIENT CHECK
1. Do you inspect incoming ingredients? Yes _______ No _______
2. How frequently? _____________________________________________
   If no, why not? _____________________________________________
3. Method of inspection: Visual ____ Smell ____ Lab assay ____

Feed/Ingredient Assays
- Soybean meal: ________________________________
- Grains: ______________________________________
- Finished feed: _________________________________
- Other: _______________________________________

225.158 ASSAYS
1. Are drug assays performed on finished feed? Yes _______ No _______
2. Is drug inclusion rate within acceptable range? Yes _______ No _______
3. Was there a follow up investigation if not in range? Yes _______ No _______
4. Were records kept for one year? Yes _______ No _______

PERFORMANCE CHECK:    DRUG ________________ ASSAY RESULTS __________
                        Inclusion ________________ Drug ________________

225.165 EQUIPMENT CLEANOUT PRACTICE
1. Does the grower sequence feed? Yes _______ No _______
2. Does the grower flush between medicated feeds? Yes _______ No _______
   When?
   How is flush handled?
3. Are there scheduled cleanings of the mixer? Yes _______ No _______

PERFORMANCE CHECK:    Weight of cleanout material ________________
### 225.18 LABELING
1. Do all feed ingredients delivered to the farm have labels?  
   Yes: _______  No: _______  
   Exceptions: ______________________________________
2. Does grower toll mix feed for the neighbor?  
   Yes: _______  No: _______  
3. Is toll feed accompanied with a label?  
   Yes: _______  No: _______

### 225.202 RECORDS
1. Do records show formulation, mixing date, and distribution of feed?  
   Yes: _______  No: _______  
   Exceptions: ______________________________________
2. Are records kept for one year?  
   Yes: _______  No: _______  
3. Are there sufficient drug records for tracking in feed?  
   Yes: _______  No: _______  
4. Can system be validated by reconciling feed produced with pounds of drug used?  
   Yes: _______  No: _______

   Results: ______________________________________
5. Can you accurately estimate feed cost/pound of gain?  
   Yes: _______  No: _______  
6. Can you figure feed shrink?  
   Yes: _______  No: _______  
   Percentage: ______________

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<tr>
<th>Seconds</th>
<th>Activity</th>
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## SWINE DIETS

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Kansas State University Agricultural Experiment Station and Cooperative Extension Service

MF-2033 November 1997

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File Code: Grain Science 2 (Feed Manufacturing)