Sampling Feed Components and Finished Feed

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Ingredient quality is the foundation upon which an animal ration is built. Therefore, a plan to sample and evaluate incoming ingredients is a critical step in manufacturing quality feed.

The correct use of sampling techniques is the first and most important step in evaluating ingredient and finished feed quality. The need to collect a representative sample cannot be over-emphasized since no analysis can be better than the sample from which it is made. Correct sampling procedures enable the processor to characterize (or make inferences about) the quality of incoming grain, soybean meal, basemix, and finished feed.

This bulletin contains definitions of different types of samples and sampling procedures, methods and equipment used for sample collection, procedures for sample reduction and submission, procedures for receiving ingredients, and ways to use sample results to improve feed quality.

Definitions

To facilitate a discussion of sampling, definitions of the different types of samples are presented below (Pierce 1994).

Check Sample: One which is carefully subdivided with portions sent to a number of laboratories for analysis and used as a check on laboratory assay procedures.

Composite Sample: One formed by compositing or accumulating and combining a number of discrete samples; useful in determining the average composition of a large amount such as a shipload, carload, or truckload.

Discrete Sample: One representing a specific, usually small, amount of material. It is also known as an individual spot or grab sample and is useful in determining variations within a lot, adequacy of mixing, and other attributes that may vary throughout a larger amount of product or ingredient.

Duplicate Sample: A representative portion of an existing sample which is then provided to an additional laboratory and often used to resolve differences between laboratories.

Official Sample: One taken officially by a government official, either for regulatory purposes or to assign an official grade.

Purchasing Sample: A portion submitted by the supplier to a purchaser and purported to represent a lot offered for sale.

Referee Sample: One taken, often by an impartial sampler, and submitted to a referee laboratory for the purpose of arriving at a settlement between buyer and seller.

Reference Sample: A sample of known characteristics that is kept as a guide or comparison check for inspections or analyses. It is useful in comparing incoming ingredients against specifications. It is also useful in comparing finished products for color, texture, or other visual specifications.

Retained Sample: A duplicate portion of a lot retained in case an analysis is needed following use or distribution of the lot.

Standard Sample: One that has been carefully analyzed by experienced laboratories and provided to other laboratories as a means of standardizing or calibrating their methods or instruments.

Working Sample: The portion or portions of a sample used for analysis.

Characteristics of a Sampling Program

Important considerations in a sampling program designed to monitor incoming ingredients and finished feed quality include the following:

- sample size and sampling scheme,
- sampling equipment,
- sample preparation and retention,

- sampling frequency,
- sampling purpose (e.g. nutrition evaluation, animal health problem, sensory inspection), and
- sample material (e.g. grain, mineral, soybean meal, forage, liquid, complete feed).

Sample Size and Sampling Scheme

The feed processor who is interested in evaluating the physical and nutritional characteristics of grain received in **bulk** can follow procedures outlined by the Federal Grain Inspection Service (FGIS) for **bulk carriers** found in *Grain Inspection Handbook, Book I* (Anonymous 1979). These procedures are listed below.

The sample size for grain, prescribed by FGIS, is approximately 2 1/2 quarts but not less than 2 quarts in size.

The sampling pattern for flat-bottom trucks or trailers using a hand probe is depicted below in Figure 1. This pattern enables the grain sampler to detect variations in the load from front to back and side to side.

- Site A: Probe the grain approximately 2 feet from the front and side.
- Site B: Probe approximately halfway between the front and center, 2 feet from the side.
- Site C: Probe approximately 3/4 of the distance between the front and center of the truck, 2 feet from the side.
- Site D: Probe grain in the center of the carrier.
- Site E,F,G: Follow a similar pattern described above for Sites A,B,C for the back half of the carrier.

Carriers containing inferior portions of grain are sampled by FGIS as follows: 3 separate samples are drawn whenever a lot is not uniform — one sample of the entire lot, one sample of the inferior portion, and one sample of the remainder of the lot. Each sample is a minimum of 2 quarts in size and is obtained in a balanced manner depicted below in Figure 2. Clearly identify each sample and approximately from which portion of the lot it was taken.

Sample A. Probe the lot of grain as a whole (inferior and sound portions) as if both sections were the same condition.

Figure 1. *Sampling Pattern for Flat-bottom Trucks or Trailers Using a Hand Probe*

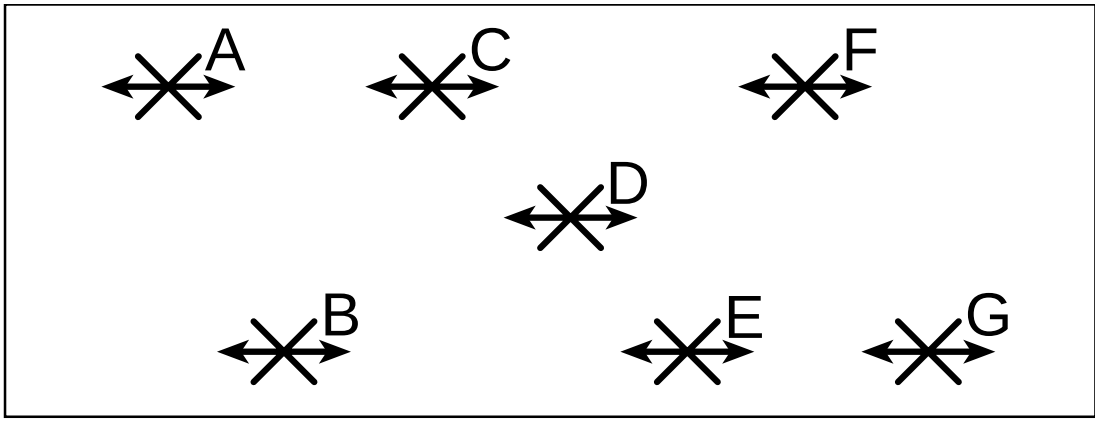
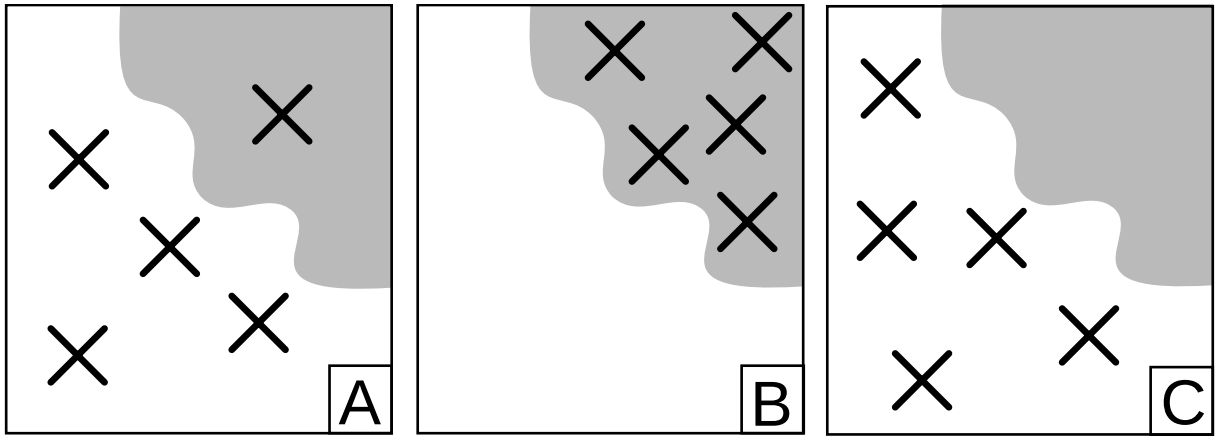


Figure 2. *FGIS Sampling Pattern for Carriers Containing Inferior Portions of Grain*



Sample B. Probe the portion containing the inferior grain thoroughly so a representative cross-section is obtained.

Sample C. Probe the sound portion to collect a representative sample.

Procedures followed by FGIS when using a mechanical probe entail the collection of five probes, one in each corner of the carrier and one in the center.

Bag shipments of basemix, premix, and medicated feed articles should be sampled with a bag probe using the following procedure:

- stand the sacks up on end and insert the probe into the top corner of the sack,
- move the probe diagonally through the sack until the end of the probe touches the bottom corner opposite the top corner and withdraw sample,
- for shipments of one to 10 bags, sample all bags; for shipments of 11 or more, sample 10 bags selected at random; for shipments less than five bags, collect at least five probes so as to gather enough material to perform an assay and retain a sample.

Drums or **barrels** of **liquid ingredients** such as fat or molasses can be sampled using a tube of glass or stainless steel, 3/8 to 1/2 inch in diameter and several feet long, referred to as a drum thief. Sample at least 10 percent of the containers and collect a minimum of 1 pint. Bulk shipments of liquid ingredients may be sampled using a bomb sampler or core sampler. In all cases, liquid ingredients should be subject to some stirring action (e.g. rolling drums) prior to sampling to ensure ingredient distribution.

Forage samples should contain several pounds of material. The sampling scheme, procedure, and sample preparation will vary depending on whether the material is a dry forage, silage, pasture, green chopped forage, or forage in the field.

Collect **dry forage** from at least 20 different locations using a core sampler. If a core sampler is not available, hand (grab) sampling can be used. Try to avoid leaf loss when using this procedure.

Collecting **silage** samples from trench silos should be performed by removing a column 6 inches deep by 12 inches wide on the open face. Mix the silage and place a number of random handfuls in a plastic bag. Pack the sample tightly and seal the bag to exclude air. Sample upright silos by taking random handfuls of silage from the unloader or wagon during the feeding period. Pack and seal as described above. Freeze samples that will not arrive at the laboratory within 12 hours.

Pasture and **field forage** sampling is difficult due to variation in soil fertility and moisture content. Randomly select eight to 10 locations for sampling, remove 1 square foot of forage at grazing height at each location, composite and mix subsamples, and reduce material to a 2-pound working sample. Immediately dry or freeze green pasture samples to prevent marked chemical changes.

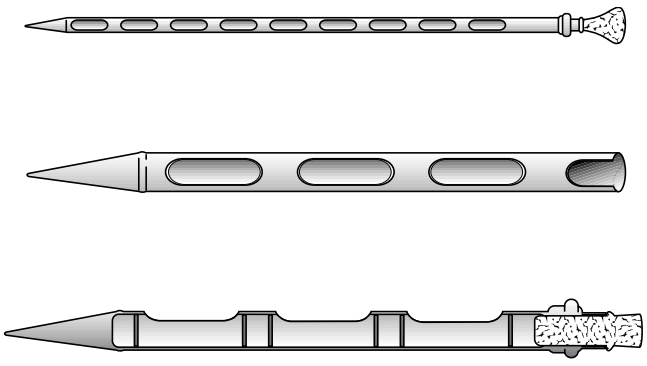
Water samples may be collected directly into a clean sample container from ponds, lakes, tanks, or other sources. Immerse the container, holding it neck down, to 1 foot below the surface, then turn it mouth up and allow the container to fill. Sample well water after extended pumping (2 to 4 minutes) to be sure the water being sampled has not been standing in pipes. Use a sterile container for samples from which a bacterial examination is performed.

Finished feed can be sampled as it is transferred to the delivery vehicle if feed is in bulk form. In the case of cattle feed that is mixed during transport, collecting the sample from the feed bunk is an acceptable practice. Collecting feed samples from portable grinder-mixers during discharge into bulk feeders is a recommended practice, particularly when evaluating mixer uniformity (MF-1172).

Sampling Equipment

Slotted grain probes may be used to collect a representative sample from grain, soybean meal, or finished feed. The grain probe should be long enough to penetrate at least three-fourths of the depth of the feedstuff. Official grain samples are collected using a 1-3/8 inch diameter probe which consists of two tubes, one inside the other (Figure 3). The inner tube is divided into compartments that enable the individual collecting the sample to detect inconsistencies in grain quality across the profile (depth) of the carrier. This procedure is more labor-intensive since the contents of the probe must be emptied onto a tarp or

Figure 3. *Grain Probes*



trough and inspected before the grain is transferred into a container.

Open-handled grain probes, in which the inner tube is not divided into compartments, may be used for sampling feed ingredients including grain. The probes' contents are emptied from the handle end and mixing will occur, making it difficult to perform a visual inspection for load inconsistencies by depth.

An **open-handled spiral probe** is designed such that openings on the inside tube rotate around so it opens first at the bottom and then in gradual steps to the top. This assures a fair portion of the sample is collected across the profile (bottom to top) of the material. However, incorrect use of this probe can result in the opposite effect if the inside tube is rotated in the opposite direction, resulting in a disproportionate amount of sample collected from the top.

Probes come in standard lengths of 40, 51, 63, and 72 inches, 8, 10, and 12 feet. The probe should be inserted into the grain or feed ingredient at a 10-degree angle from the vertical, with the slots facing upward and completely closed. A 10-degree angle is used to obtain a cross-section of material, while placing the end of the probe as close to the bottom of the carrier as possible. The slots must be kept closed until the probe is inserted as far as it will go. If the probe's slots are open as it enters the grain, a disproportionate amount of material from the top will fill the probe.

After the probe is fully inserted, open the slots and move the probe up and down quickly in two short motions. Close the slots completely, grasp the probe by the outer tube, and withdraw it from the grain.

The **Pelican** sampler (Figure 4) is used for on-line grain sampling by FGIS personnel. The Pelican is a leather pouch, approximately 7 inches deep and 18 inches long with a band of iron inserted along the edge to hold the pouch open. The pouch is attached to a long pole. Pelicans are designed to catch grain as the pouch is swung or pulled through a falling stream of grain. The Pelican sampler would be useful for collecting grain, soybean meal, or complete feed samples while a truck is unloading.

Tapered bag triers are constructed of stainless steel and are characterized by a sharp point, a tapered body, and an open throat. These triers are available in lengths from 6 to 12 inches (Figure 5.) Tapered bag triers are used to sample closed bags of powdered and granular commodities.

Double-tube bag triers are constructed of stainless steel or chrome-plated brass. These triers are available in various lengths and diameters and in both close-ended and open-ended models. These triers are used to sample closed and opened bags of powdered and granular ingredients.

Single-tube open-ended bag triers are constructed of stainless steel tubing and are used to sample opened bags of dry, powdery commodities when removal of a core of material is desired.

Bomb or **zone** samplers are used to collect liquid ingredients from bulk carriers (Figure 6). These samplers consist of a closed cylinder ranging in size from 12 inches long by 1-3/4 inch in diameter to 16 inches long by 3 inches in diameter; with capacities of 4 ounces and 32 ounces, respectively (Anonymous 1991). A valve lifts when the bottom of the tank is reached, or it can be manually lifted by a cord attached to the valve's plunger if intermediate depths are sampled.

Figure 4. *Pelican Grain Sampler*

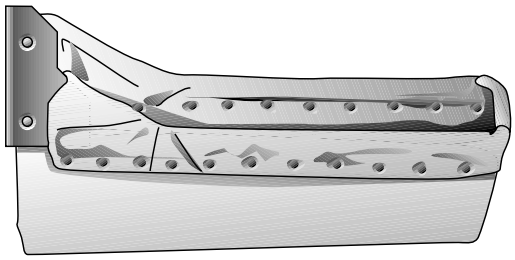


Figure 5. *Tapered Bag Trier*

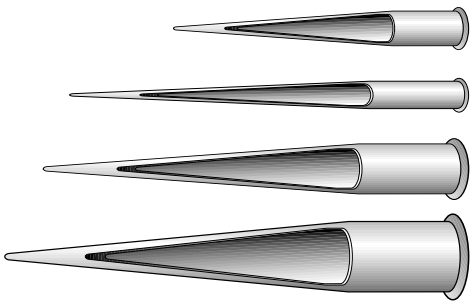
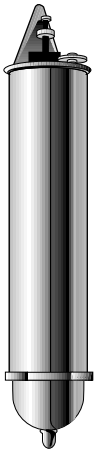


Figure 6. *Bomb Liquid Sampler*



Sample Preparation and Retention

The contents of each probe location should be mixed together prior to reducing the sample. Sample reduction may be performed using a riffler (Figure 7), Boerner Divider (Figure 8), or by quartering the sample (Figure 9). The end result of this process should produce a working sample of 1 to 2 pounds and a retained sample that should be kept for a predetermined time (usually until the meat animal is marketed and processed).

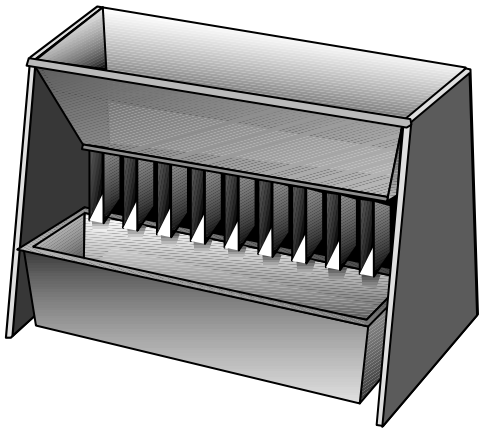
Complete feed and feed ingredients may be partitioned into uniform subsamples using a **riffler**. The sample is poured into the hopper, which is divided into equal portions by two series of chutes that discharge alternately in opposite directions into separate pans (Anonymous 1991).

The **Boerner Divider** is the grain industry's standard for splitting samples. A sample of grain is placed in the hopper and then released down a cone, where grain is cut into 38 separate streams, which rejoin into two streams and then empty into the pans (Anonymous 1991).

Quartering is a method for reducing the sample size of a high roughage feed (e.g. cattle feed) to a convenient amount for analysis. Spread the mixed composite sample on clean plastic or paper to form an even layer. Mark into quarters. Take two opposite quarters, mix, and repeat until the two quarters selected give the desired sample size.

Heavy plastic bags, zip-lock bags, or plastic containers with lids make excellent sample containers for dry ingredients or finished feed. Label samples as they are taken, identifying the date, sample number, and the contents (or ingredient to assay). Preservation of samples is highly important. Immediately freeze high-moisture feedstuffs, silage, or green forage; store other materials in cool, dry locations.

Figure 7. *Riffler*



Sampling Frequency

How often should incoming ingredients be sampled? A number of considerations influence this decision, including ingredient type, amount of ingredient received, cost of analysis, and storage space to keep retained samples. Pierce (1994) recommends that all ingredients other than microingredients (drugs, vitamins, and trace minerals) should be sampled and subjected to physical inspection. The number of samples to be sent to the laboratory for actual analysis must depend upon laboratory availability, assay cost, supplier reputation and performance, the use of the ingredient, and the effect that an out-of-specification ingredient will have on a final mixed product.

The Food and Drug Administration (CFR 1994) requires feed mills to perform periodical assays of medicated feeds for drug components requiring approved Medicated Feed Applications. At least three representative samples of medicated feed containing each drug or drug combination used shall be collected and assayed by approved official methods at periodic intervals. Although nonregistered mills are not subject to as strenuous regulations, annual evaluation of feeds for correct drug inclusion is a good business practice.

Complete feed sampling frequency will vary depending on whether the feed mill is producing commercial feed for sale or if the mill is located on-farm and only produces feed for animals on that farm. As

Figure 8. *Boerner Divider*

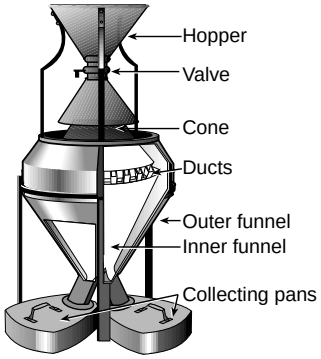
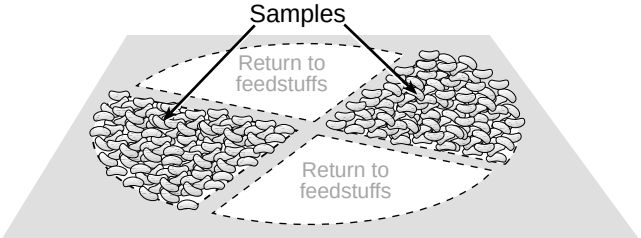


Figure 9. *Quartering the Sample*



a general practice, commercial mills should collect and retain a sample for each run of a given product. The sample should be retained as long as potential liability exists (e.g. until the meat animal is marketed and processed).

Receiving Procedures

All feed processors, whether a commercial or on-farm mill, should develop and follow a set of procedures for receiving feed ingredients. This should include inspecting the carrier's paperwork to ensure the correct material is on the carrier, a sensory inspection of ingredients collected from the sampling process, and documentation of receipt of those ingredients.

When receiving bulk material, inspect the shipping documents for ingredient identification, mill and supplier, and hauler name. Inspect the ingredient label and compare to previous labels. If no label accompanies the feed ingredients (with the exception of grain), do not unload the carrier until a label can be supplied. Check the label for the correct ingredient and analyses guarantees.

Ingredients should be examined for sensory characteristics (color, odor, texture, insect infestation and moisture). This inspection procedure should be compared to reference samples or pre-established standards for comparison purposes. Do not unload ingredients that do not pass this initial inspection; particularly with bulk ingredients, once the material is unloaded, you own it.

A receiving report that documents receipt of ingredients will augment a sampling program. This report should include the date, ingredient name, supplier, carrier name, license, bill of lading, purchase order or invoice number, time received, weight, bin number where the ingredient was placed, sensory or physical qualities, and signature of the individual who unloads the material (Figure 10).

Procedures for evaluating physical (test weight, bulk density, foreign material) and nutritional properties of feed indgredients are described in Kansas State University Extension bulletin MF-2037.

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Sampling For Livestock Health Problems

Proper treatment of a livestock problem case depends on correct identification of the causative agent. A carefully compiled history will usually provide adequate background for immediate and practical emergency treatment. A correct diagnosis of the causative agent usually rests upon sample assays of feed, water, surrounding environment, or animal tissue and body fluids.

A case report (Figure 11) form at the back of this bulletin lists a number of important pieces of information to collect when livestock health problems occur (Wilcox 1972).

Conclusion

Sampling is a critical part of any quality-assurance program. Steps involved with collecting a representative sample include following a sampling scheme; collecting enough sample to ensure it is representative; using the correct sampling equipment and procedure; inspecting the sample for its sensory characteristics; reducing the sample and preparing it for shipment, retention, or both; incorporating sampling into a structured method for receiving ingredients; sampling finished feed; and using sampling as a tool to help diagnose animal health problems.

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Kansas State University Agricultural Experiment Station and Cooperative Extension Service

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Figure 10. *Receiving Report*

RECEIVING REPORT

Date Received	Date Unloaded

Commodity

Shipper's Name

Truck Name

Trailer No.	PO No.	Bill of Lading

Weight Ticket No.	Net Weight

Bin No.

Time In

Time Out

Unloaded By

PHYSICAL QUALITIES

Color _____ Odor _____

Texture _____ Moisture _____

Insects _____

Sample No. Assigned

Remarks

Figure 11. *Case Report Form*

Case Report Form

Date Report Prepared _____
Owner's Name _____
Address _____
City _____ State _____ Zip _____

Report Prepared By _____
Address _____
Telephone Number _____

If a company's product is in question, have they been notified? ☐ Yes ☐ No
Date notified _____
Veterinarian's or fieldman's report is attached? ☐ Yes ☐ No
Date called _____

Sample Identification: (give each sample a number or letter) _____

Description of Case: (see suggested list of case information)
Class of Livestock _____ Number _____ Age _____ Sex _____
Raised on Farm _____ If Purchased, When _____ Where _____
Describe symptoms in detail and date first noticed _____

Describe ration in detail and method of feeding. Include all changes made recently _____

Dates and details on every drug, vitamin, antibiotic, hormone, wormer, insecticide, vaccinations, disease-preventive shots or disease treatment used on livestock (include castrations, dehorning, etc.) _____

List any contact livestock could have had with poisons (refuse, trash pile, fertilizer sacks, paint cans, weed sprays, insect sprays, etc.) Any toxic weeds? _____

Weather conditions, especially sudden changes in preceding two weeks _____
Water supply checked for nitrates? _____ for salinity? _____ for potability? _____
Readily available to livestock? _____
Describe housing, lots and management problems _____

Other pertinent information _____

I declare that to the best of my knowledge this is a true, complete and correct report.

Signature of Livestock Owner _____