



Quality Assurance and Control in Feed Manufacturing

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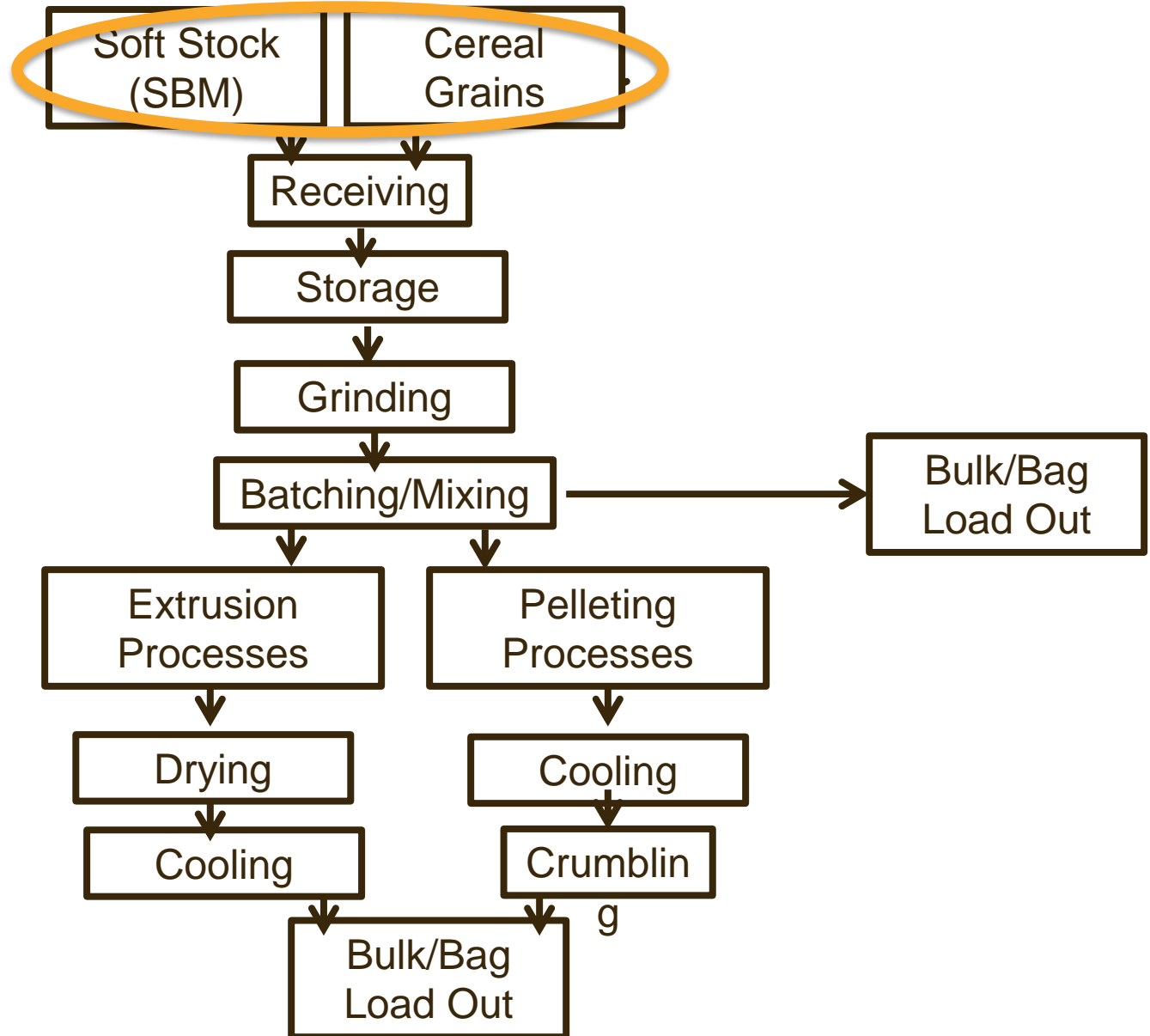
**EXCELLENCE
CENTER**

A  **SOY** program

Learning Objectives

- Learn the basic principles to develop a Quality Assurance and Control Program.
- Identify the key steps to develop a quality assurance and control manual.
- Understand the benefits on having a detailed Quality Assurance and Control Program.

Animal Feed Processing



Mission of a Feed Mill

- Make profit?
- Yes, but it is more than just making money
- It can be defined in many ways
- Provide customers with feed that is:
 - Efficiently manufactured
 - Safe for animals
 - Produce with high-quality ingredients
 - Have consistent nutrients required by animals for optimal body maintenance, growth, and reproduction
 - Correctly delivered to the animal facilities

How to fulfill the Feed Mill's Mission?

- Many ways, but based on a comprehensive **Feed Quality Assurance Program** that will manage:
 - Ingredients and supplies
 - Equipment
 - Personnel
 - Procedures (Receiving, sampling, analysis)
 - Policies
 - Process Controls (**Quality Control**)
- Goal is to yield consistent quality and safe feed

Importance of Quality Control

- Most Important!!!
 - Quality feed begins with quality ingredients
 - Poor quality ingredients cannot be improved in the feed process
- Without a good QAC program, you will eventually be the target of vendors selling inferior quality ingredients

Importance of Quality Control

- Having a good QAC program:
 - Ensures that you receive what you paid for
 - Nutrient variability can be identified
 - Protects against natural toxins, unintentional contaminants & intentional adulterations
 - Helps to keep feed safe from contaminants

Feed Ingredient Quality Control Cycle



Field



Postharvest, transportation & processing

Problems of farmer & supplier

Problems of importer and buyer

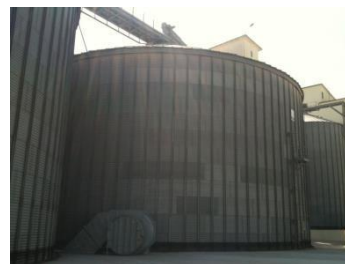
It is important to know that the quality of the ingredients and feed should be maintained throughout The whole production-feeding cycle



Transport & Receiving



Storage



End-User



Procesamiento Y transporte

Quality Assurance & Control

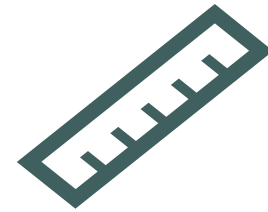
- **Quality Assurance:** Company's policy and procedures to develop a constant end-product.
- **Quality Control:** Sampling and measurements to check the quality specifications of feed ingredients and finished product.

Quality Assurance & Control



Quality Assurance

- Ingredient specifications
- Analysis plan for feed ingredients
- Scales routine calibration
- Analysis plan for finished feed



Quality Control

- Mycotoxin quantification
- Particle size measurement
- Measurement of CV for mixer
- Moisture content quantification

What Is Quality Control?

- **Definition:**

In-plant analysis or measurements to ensure that quality specifications are met for ingredient receiving, during production process, and delivery of finished feed

- Key factors:

- Develop manual
- Follow procedures (sampling)
- Trained personnel
- Correct Analysis
- Document results
- If not met (reject)

Quality Assurance & Control Manual

- Must include:
 - Company's quality policy
 - Procedures on how to handle quality
 - Preventive and corrective actions
 - Organizational structure
 - **Standard Operating Procedures**
 - **Sampling procedures**
 - Inspection points
 - Data documentation
 - Recall procedures
 - **Programs:** Sanitation, Pest Control, GMPs, Biosecurity, Worker Safety, and Trainings

Trained Personnel

- Develop quality assurance practices for your operators
- QC positions should not be filled by people with little experience
- Train your operators on the program
 - Make expectations/goals clear
 - Cross-train as much as you can

Standard Operating Procedures

- Purpose
- Range
- Description
- Requirements
- Procedures
- Equipment
- Standards
- References

O.H. Kincaid Food Technology Innovation Center & Food Safety Research Center (FSRC)
Department of Grain Science & Animal Science
Kansas State University
Manhattan, Kansas

SOP #: _____
SOP title: _____
Developed (authors) by: _____
Developed: _____ Approved by: _____ Implemented: _____ Revised: _____

Standard Operating Procedure

1. Purpose
Describe the process for the name of SOP with relevant background information.

2. Scope
Identify the personnel and/or activities where this SOP may be relevant.

3. Prerequisites
Outline information/training required before proceeding with the listed procedure.
Ex 1: Completion of training modules 1 and 2 developed by the KSU Institutional bio-safety committee and submission of training certificate is mandatory before commencing any work in this facility (<http://www.k-state.edu/research/through-the-training/index.html>)
Ex 2: Hand gloves, lab coat, safety glasses, face shield etc.

4. Responsibilities
Identify the person's primary role in the SOP and describe how their responsibilities relate to the SOP. If necessary, include contact information.

5. Procedure
Provide step-by-step procedure to perform this task (who, what, when, where, why, how).
Include a process flowchart.

6. Equipment
List the equipment needed to perform this SOP.

7. Definitions and regulatory standards
Identify the regulatory guidelines and frequently used terms or acronyms that are relevant or needed to understand and perform this SOP.

8. References
List resources that may be useful when performing the procedure, for example, NIH/CDC guidelines, BSL 7th edition book chapter XX etc.

Importance of Documentation

Everything should be documented: (trainings, evaluations, Suppliers, inventories, maintenance, sanitation, quality specs, etc).

“If it was not documented, then it didn’t happen!”

Key Factors For Developing a QAC Program

Key factors:

- Develop manual
- Trained personnel
- Follow procedures (sampling)
- Correct Analysis
- Document results
- If not met (reject)

Quality Manual

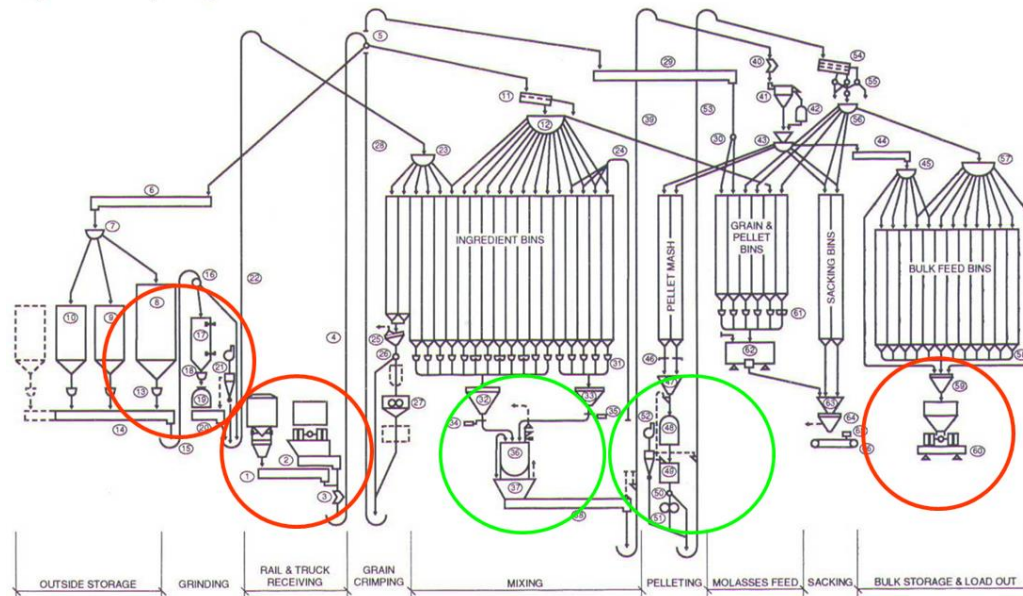
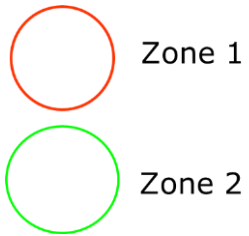
- It should include but not limited to:
 - Quality policy of company
 - Quality management system
 - Relation management-customer-improvement (preventive-corrective actions)
 - Organization structure
 - Standard operating procedures
 - Methods
 - Inspection points
 - Recordkeeping
 - Complain/recall procedure

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Understand your Facility

- **Development of Quality Assurance and Control Program**

Use diagram of plant to determine needs and tasks in each area:



Important Quality Assurance Steps

- Purchasing
- Receiving
- Sampling
- Analysis
- Evaluation (Management considerations)

Purchasing

Decisions:

- Ingredients used for least cost formula
- Medication needs
- Market availability
- Delivery time
- Storage capacity
- Develop contract quality specifications (when possible)
- Use standards:
 - SBM: NOPA
 - Feed Ingredients: AAFCO
 - Grains: US Grain Standards

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Association of American Feed Control Officials (AAFCO)

- Does not regulate, test or approved pet foods.
- Establish the nutritional standards for complete and balance pet foods.
- Have definition for ingredient with nutritional & physical analysis, and basis for rejection.

Example of AAFCO Standards

Soybean Meal – Dehulled, Solvent Extracted

AAFCO PRODUCT DESCRIPTION: Soybean Meal, Dehulled, Solvent Extracted is obtained by grinding the flakes remaining after removal of most of the oil from dehulled soybeans by a solvent extraction process. It must contain not more than 3.5% crude fiber. It may contain calcium carbonate or an anti-caking agent not to exceed 0.5% as defined in section 87 (Special Purpose Products) to reduce caking and improve flowability. The name of the conditioning agent must be shown as an added ingredient. When listed as an ingredient in a manufactured feed it may be identified as “Dehulled Soybean Meal.” The words “Solvent Extracted” are not required when listing as an ingredient in a manufactured feed.

AAFCO #84.7
IFN #5-04-612

Nutrient Analysis

| | | |
|----------|-----|--------|
| Moisture | max | 12.5% |
| Protein | min | 48-50% |
| Fat | min | 1.0% |
| Fiber | max | 3.5% |
| Ash | max | 6% |

Physical Properties


Color: Light tan to a light brown.
Odor: Fresh, typical of the product, not sour, musty or burned.
Bulk Density: 36-40 lbs. per cubic foot.
Sieve: 95% through #10 US

Basis for Rejection

1. Transportation method does not meet the FDA Regulations Governing the Transportation of Animal Proteins Prohibited From Use in Ruminant Feed
2. Product is adulterated or misbranded.
3. Contains product that got wet during shipping

Example of USDA-FGIS Quality Certificate

FORM FGIS-909
JAN 97



UNITED STATES DEPARTMENT OF AGRICULTURE
FEDERAL GRAIN INSPECTION SERVICE
U.S. GRAIN STANDARDS ACT

Approved OMB No. 0580-0013
DIVIDED-LOT ORIGINAL
US-NOFO-1-493333-1
NOT NEGOTIABLE

OFFICIAL EXPORT INSPECTION CERTIFICATE

LEVEL OF INSPECTION:
Original

ISSUED AT:
DESTREHAN, LA

DATE OF SERVICE:
May 23, 2017

IDENTIFICATION:
MV GREBE BULKER

LOCATION:
CHS, INC.
Myrtle Grove, LA

QUANTITY: (this is NOT a weight certificate)
32,200,718 Pounds

GRADE AND KIND: U.S. No. 2 or better Yellow Corn

RESULTS:



| | |
|--|---|
| Test Weight Per Bushel 57.5 lb/bu | Moisture 14.4 % |
| Heat-Damaged Kernels 0.0 % | Damaged Kernels Total 2.4 % |
| Broken Corn And Foreign Material 2.9 % | Aflatoxin result is negative. Aflatoxin equal to or less than 20 ppb. |
| Other Colors 0.0 % | |

REMARKS:
This grain was officially inspected as an undivided lot of 61,594,260 Pounds. No part of the lot was officially inspected as a separate unit.
Stowage: Hold Nos. 2,5; Hold No. 4 on top of burlap, plywood and polyweave separation.

APPLICANT NAME: CHS Inc.

ISSUING OFFICE: FGIS - New Orleans Field Office

I CERTIFY THAT THE SERVICES SPECIFIED ABOVE WERE PERFORMED WITH THE RESULTS STATED.
NAME OR SIGNATURE: Kennedy E. Green

United States Department of Agriculture
Grain Inspection, Packers & Stockyards Administration

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Grain, Rice & Pulses

Official U.S. Standards

U.S. Standards for Grain

Click here to see General Provisions (6/1/99) that apply to all of the grains. Click below for the U.S. Standards for specific grains.

- Barley (6/1/97)
- Canola (2/28/92)
- Corn (9/1/96)
- Flaxseed (5/28/87)
- Mixed Grain (5/1/88)
- Oats (5/1/88)
- Rye (5/1/88)
- Sorghum (6/1/93)
- Soybeans (9/1/94)
- Sunflower Seed (5/1/88)
- Triticale (5/1/88)
- Wheat (5/1/86)

Official United States Standards under the Agricultural Marketing Act of 1946

U.S. Standards for Rice (January 2002)

- Cover and Table of Contents

Related Topics

- Overview
- Inspection/Weighing Services
- International Services
- Research & Development
- Partnerships & Oversight
- Exporter Registration
- Advisory Committee
- Standardization & Quality
 - Equipment
 - Inspector Standardization
 - Methods
 - Official U.S. Standards
 - Quality Assurance

I Want To...

- Look at pictures of different grains
- See Grain Inspection Procedures
- See Program Directives and

Grades and grade requirements for soybeans

| Grade | Minimum test weight (lb/bu) | Damaged kernels | | Foreign Material (%) | Splits (%) | Soybeans of other colors (%) |
|------------|-----------------------------|------------------|-----------|----------------------|------------|------------------------------|
| | | Heat damaged (%) | Total (%) | | | |
| U.S. No. 1 | 56 | 0.2 | 2.0 | 1.0 | 10.0 | 1.0 |
| U.S. No. 2 | 54 | 0.5 | 3.0 | 2.0 | 20.0 | 2.0 |
| U.S. No. 3 | 52 | 1.0 | 5.0 | 3.0 | 30.0 | 5.0 |
| U.S. No. 4 | 49 | 3.0 | 8.0 | 5.0 | 40.0 | 10.0 |

Sample grade*

*U.S. Sample grade is soybeans that: (a) Do not meet the requirements for the grades U.S. Nos. 1, 2, 3, or 4; or (b) Contain 4 or more stones which have an aggregate weight in excess of 0.1 percent of the sample weight, 1 or more pieces of glass, 3 or more crotalaria seeds (*Crotalaria* spp.), 2 or more castor beans (*Ricinus communis* L.), 4 or more particles of an unknown foreign substance(s) or a commonly recognized harmful or toxic foreign substance(s), 10 or more rodent pellets, bird droppings, or an equivalent quantity of other animal filth in a 1,000 grams of soybeans; or (c) Contain 11 or more animal filth, castor beans, crotalaria seeds, glass, stones, or unknown foreign substance(s) in any combination; or (d) Have a musty, sour, or commercially objectionable foreign odor (except garlic odor); or (e) Are heating or otherwise of distinctly low quality.

From U.S. Department of Agriculture. Grain Inspection, Packers & Stockyards Administration. *Grades and Grade Standards*.

U.S. No. 1



U.S. No. 2



U.S. No. 3



Purchasing

- **Contracts:**
 - Develop description of ingredient
 - Quantity & Quality
 - Domestic commodities
 - Transportation
 - Trade rules (NAEGA-GAFTA)
 - Taxes, fees or government mandates
 - Based on US grades
 - Other quality parameters (mycotoxin levels)

Purchasing

- Supplier:
 - Develop list for each ingredient
 - Develop proactive relationship with supplier
 - When possible, periodically visit supplier
 - New suppliers:
 - Develop requirements (when possible)

Important Quality Assurance Steps

- Purchasing
- Receiving

Receiving

- Important step in a feed manufacturing process
- First entrance of feed ingredients
- SOPs on:
 - Receiving procedure (written)
 - Sampling procedure (written)
 - Analysis procedure (written)
- Well-trained personnel:
 - Experience
 - Cross-trained

Receiving

All feed ingredients need to be inspected:

- Weight
- Documentation
- Visual
- Odor
- Mold
- Physical damages
- Physical and chemical analysis



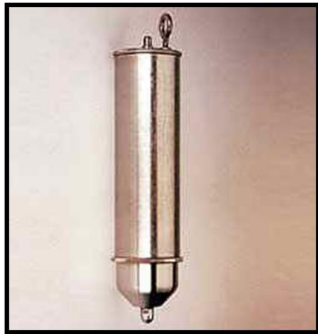
Important Quality Assurance Steps

- Purchasing
- Receiving
- Sampling

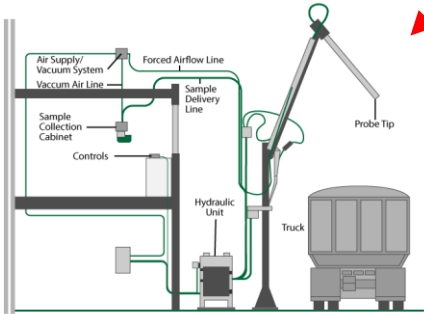
Importance of Sampling

- Objective: Obtain a portion of the inbound ingredients that represents (use a sampling device) the entire lot (truck, vessel, silo, warehouse, etc).
- Quality quantification
- Feed ingredient variability
- Number of samples depends on:
 - Lot size: truck silo, number of sacks, etc
 - Type of ingredient (variability)
 - Lab precision and capacity
 - Cost analysis
 - Ingredient value

Good Sampling Procedures and Equipment

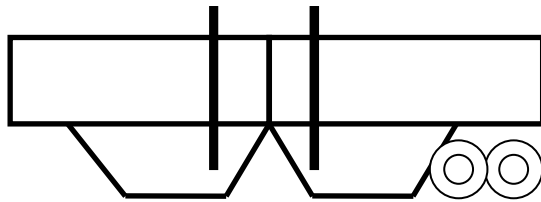


Truck Sampling

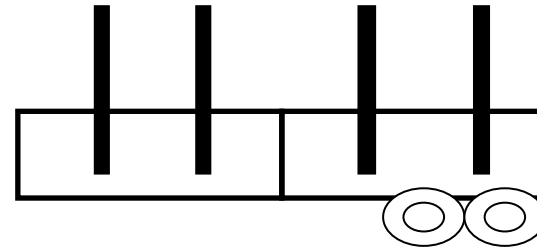
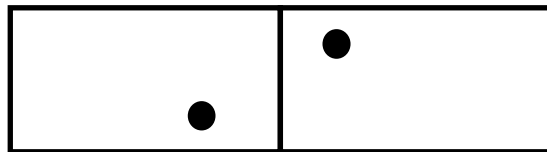


Grain Truck Sampling

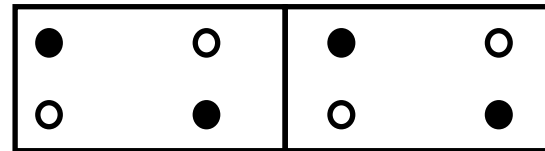
Avoid only sampling bottom or top part



Grain trucks



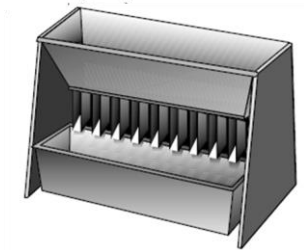
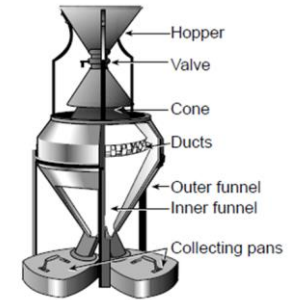
Flat beds



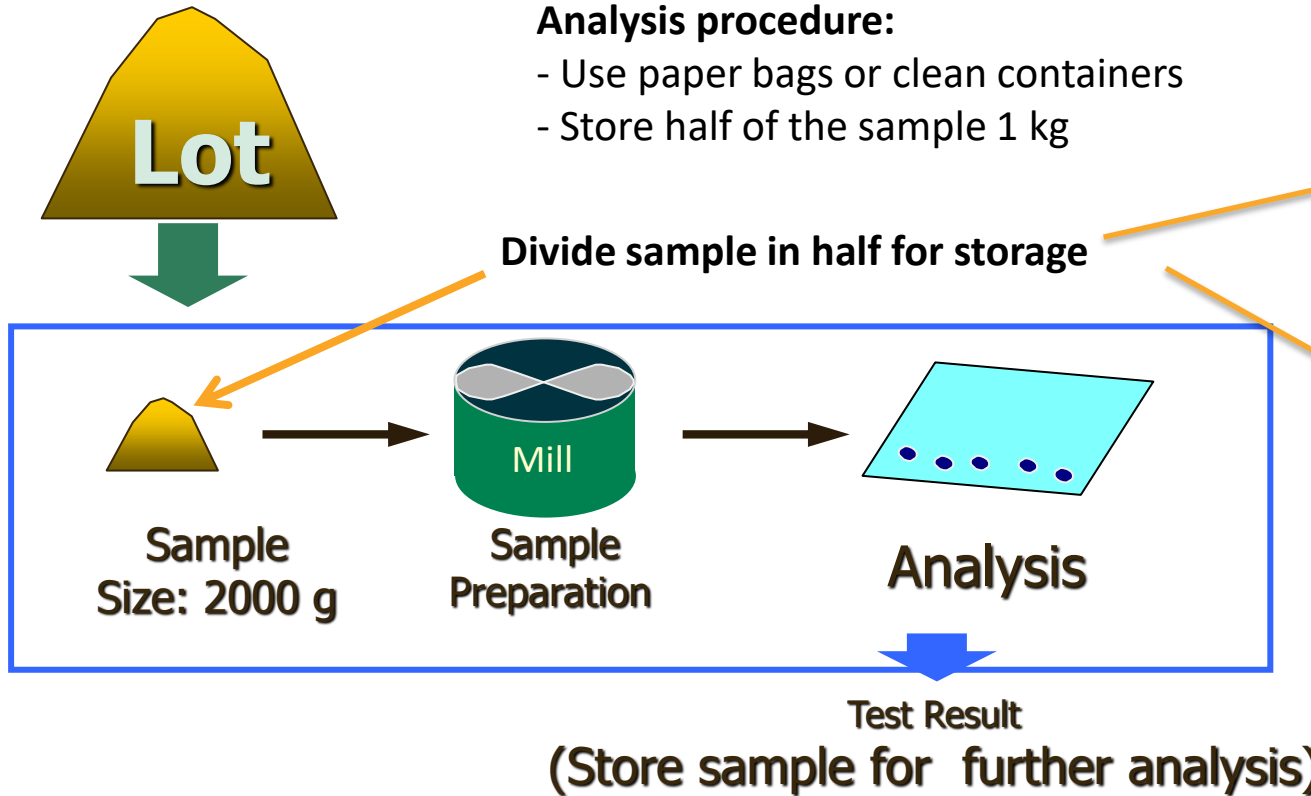
Sampling & Analysis Procedure

Analysis procedure:

- Use paper bags or clean containers
- Store half of the sample 1 kg



Divide sample in half for storage



Important Quality Assurance Steps

- Purchasing
- Receiving
- Sampling
- Analysis

Assessing Initial Quality

- Easily obtained
- Initial sensory assessment is invaluable
- Visual appearance
- Odor



Analysis of Physical Factors

- Measure specs
- Reference samples
- Equipment
- Document
- Sample comparison with private labs



Essential Factors to Measure in Grain (Chemical-Nutritional)

- Oil content: NIR, wet chemistry, look for rancid level
- Protein content: Use Khejdahl, nitrogen combustion or NIR for grain, mash ingredients (SBM, DDGS, fish meal, and finished feed).
- Fiber content: NIR, wet chemistry



Ingredient Assay Table

| Ingredient | Protein | Moisture | Fat | Fiber | Calcium | Phosphorous | Sodium | Magnesium | Aflatoxin | Pepsin Digest | Urease | Microscopic | M.I.U.* | Brix | Frequency** |
|------------------|---------|----------|-----|-------|---------|-------------|--------|-----------|-----------|---------------|--------|-------------|---------|------|-------------|
| Corn | X | X | | | | | | | X | | | | | | W |
| Cereal Grain | X | X | | | | | | | | | | | | | W |
| Soybean Meal | X | X | | X | | | | | | | X | | | | E |
| Middlings | X | X | | X | | | | | | | | | | | W |
| Alfalfa | X | | | X | | | | | | | | | | | W |
| Rice Mill Feed | X | | X | X | | | | | | | | | | | W |
| Corn Gluten Feed | X | | | | | | | | | | | | | | E |
| Corn Gluten Meal | X | | | | | | | | | | | | | | E |
| Fish Meal | X | | X | | X | X | X | X | | X | | X | | | E |
| Meat/Bone Meal | X | X | X | | X | X | X | | | X | | X | | | E |
| Poultry Meal | X | X | X | | X | X | X | | | X | | X | | | E |
| Peanut Meal | X | X | | X | | | | | X | | | | | | E |
| Peanut Hulls | X | | | X | | | | | X | | | | | | W |
| Cottonseed Meal | X | | | | | | | | X | | | | | | E |
| Cottonseeds | X | | X | X | | | | | X | | | | | | W |
| Sunflower Meal | X | | | X | | | | | | | | | | | E |
| Safflower Meal | X | | | X | | | | | | | | | | | E |
| Bakery Meal | X | | X | | | | | | | | | X | | | E |
| Molasses | | | | | | | | | | | | | | X | E |
| Fat | | | | | | | | | | | | | X | | E |
| Limestone | | | | | X | | | X | | | | | | | W |
| Feathermeal | X | X | | | | | | | | | | X | | | E |

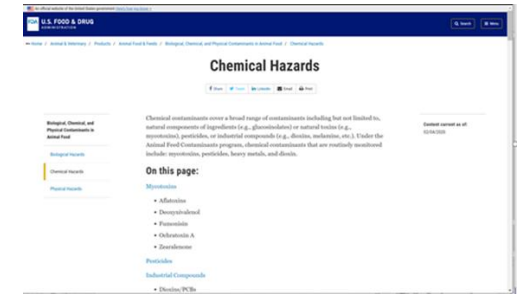
* Moisture, Impurities, Unsaponifiables

**W = Weekly, E = Every Load

Anti-Nutritional Factors

Mycotoxins:

- Metabolites of mold produced in field and storage.
- Use max level references

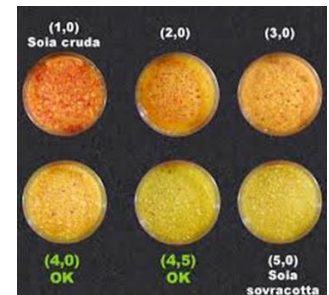


SBM:

- Measure over and under cook levels
 - Urease index indicates (based on pH change).
 - Potassium hydroxide (KOH) solubility indicates over heating of SBM.
 - Alteca references
- Calcium levels since it is used for anti-compaction agents

Other:

- Adulteration of fish meal with leather meal or bone meal.



Important Issues With Ingredients In Quality Assurance and Control

- They are several issues that need to be consider for ingredients in quality control
- Quality control should be flexible until a point

Important Issues With Ingredients In Quality Assurance and Control

- **Risk**
 - Contaminants vary among ingredients, thus risk vary with ingredients
 - The level in which ingredients are included in the diet may impact risk
 - Potential risks should be reviewed regularly so that QC program can be adjusted

Important Issues With Ingredients In Quality Assurance and Control

- **Cost**

- What is the value of the ingredient and the quantity purchased?
- What gives this ingredient value or what are the potential detrimental characteristics?
- What is the cost to assay for these characteristics?
- Benefits must out-weigh costs (economical or health hazards)

Important Issues With Ingredients In Quality Assurance and Control

- **Time for delivery and storage**
 - Depends on the manner in which ingredients are received (bag, truck, or rail)
 - Depends on inventory/duration of storage
 - Depends on labor situation

Important Issues With Ingredients In Quality Assurance and Control

- **Equipment/Lab Space**

- The training/experience required may be limiting
- Lab space/Equipment/Chemicals

Important Issues With Ingredients In Quality Assurance and Control

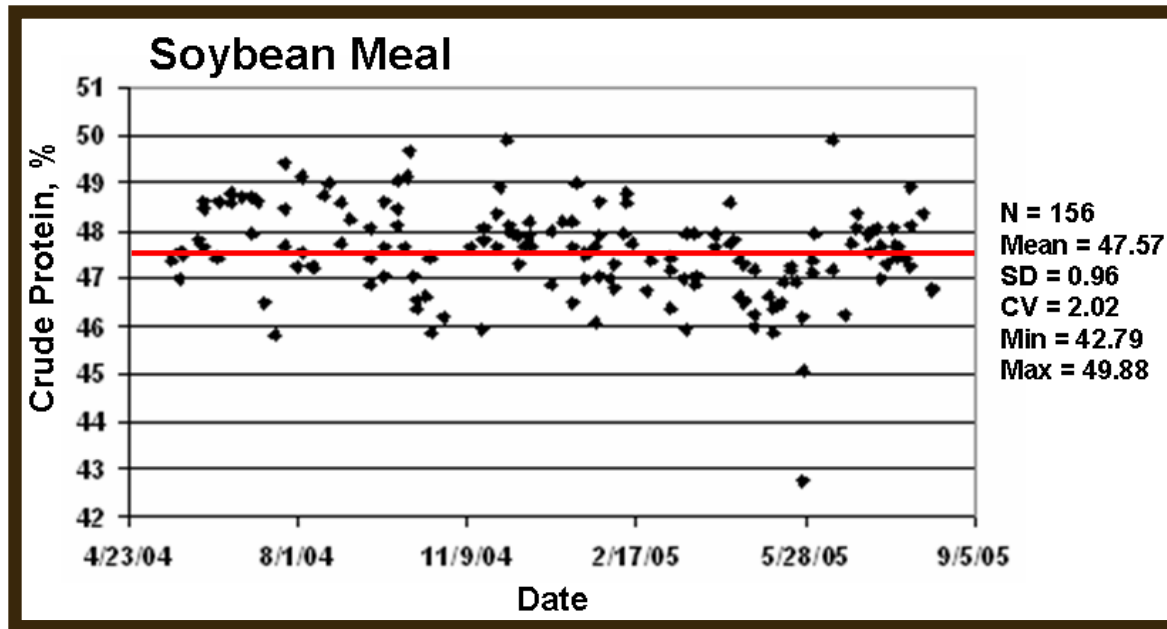
- **Ingredient Availability**

- When feed stocks are in short supply nutrient specs may need to be relaxed a little
- When prices are high there may be the temptation to cheat by blend in inferior quality feedstuffs or adulterating the product

Important Issues With Ingredients In Quality Assurance and Control

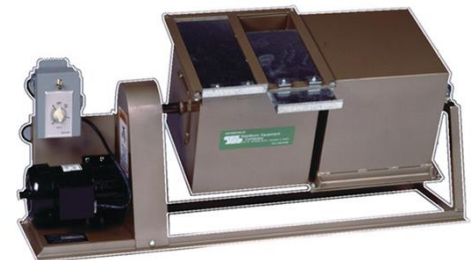
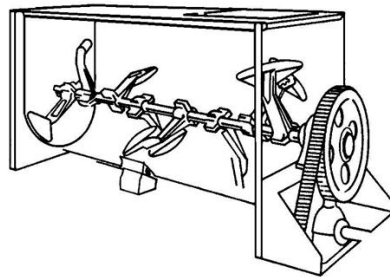
■ Ingredient Variability

- Nutrient values are generally based on averages and don't reflect variety, managerial, & environmental variations

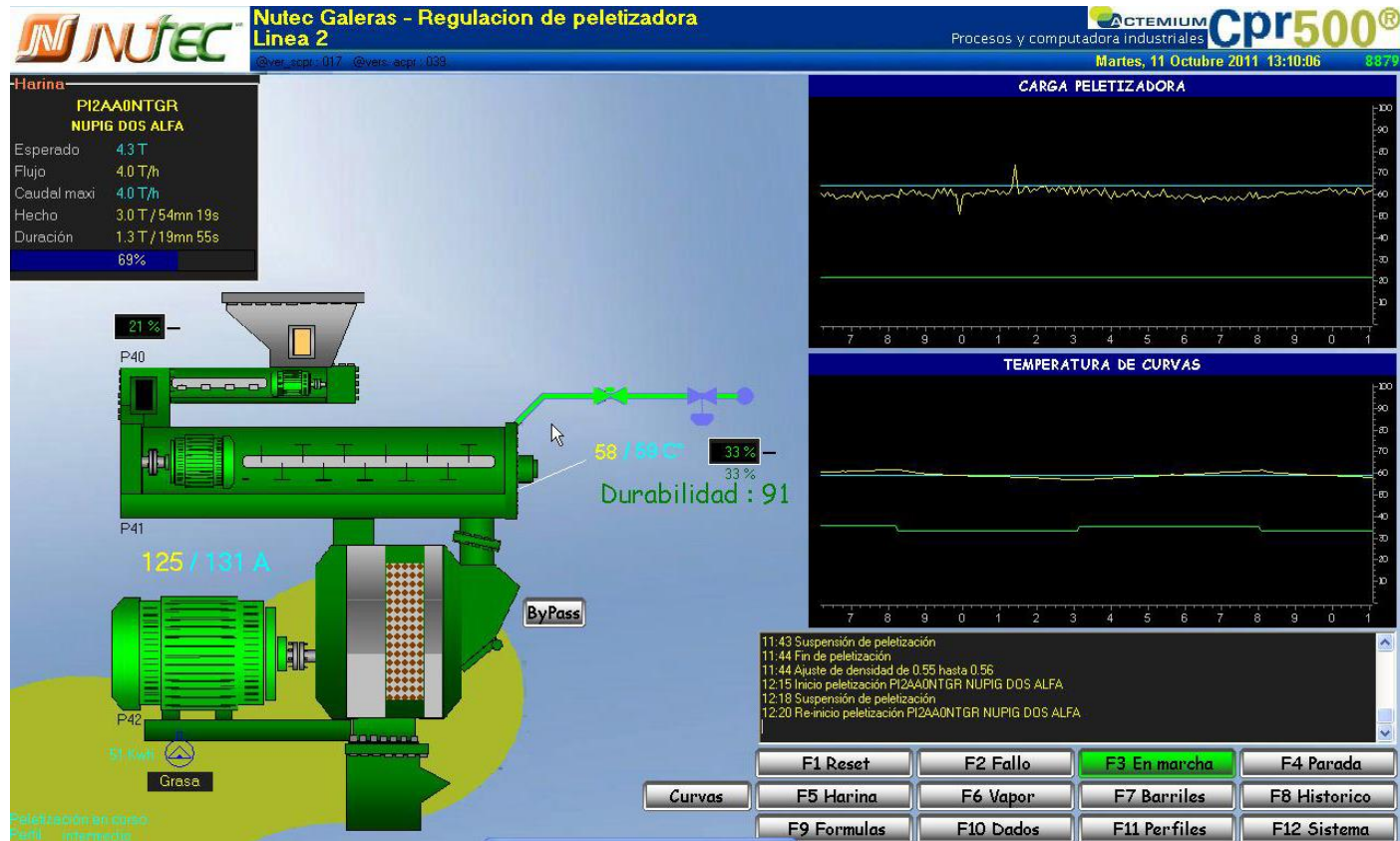


Quality Control During Processing and in Finished Feed

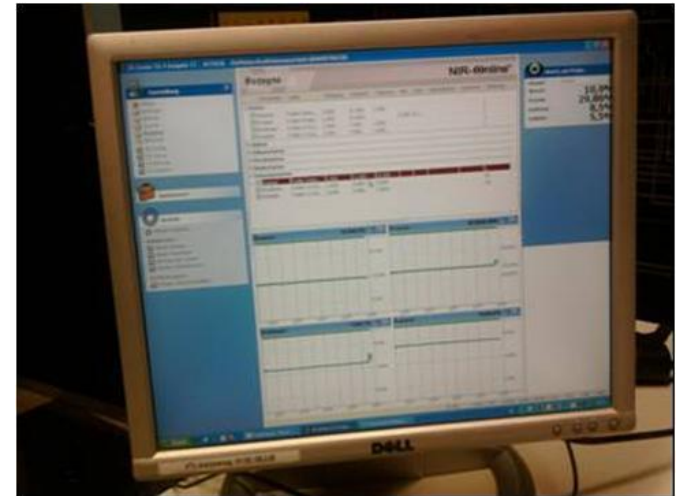
- Parameters should be established in the manual and performed during processing
- Results should be documented for traceability
- Analysis during processing:
 - Grinding: Particle size analysis
 - Mixing: Measurement of CV
 - Pelleting: PDI



In-line Processing Quality Analysis



In-line NIR Analysis for Control after Mixer



Important Quality Assurance Steps

- Purchasing
- Receiving
- Sampling
- Analysis
- Evaluation (Management Considerations)

Evaluation (Management Consideration)

- Quality specifications met for ingredient?
- Ingredient supplier fault? Rejection?
- Feed quality not met due to:
 - Storage problems? (ingredient-finished feed)
 - Equipment process problems?
 - Formulation problems?
 - Low quality ingredient?



Other Important QC Responsibilities

- Bin routing mistakes
- Batching Systems (design, scale drift, employee sabotage ...)
- Bin clean-out
- Mix Uniformity & Carry-over
- Load-out mistakes



Complaints/Non-conforming Products

- **Corrective action consists of four activities:**
 - Adjusting the process
 - Dealing with non-conforming products
 - Correcting the reason for the occurrence
 - Maintaining records of corrective action

Conclusions

To have success in quality assurance and control of feed ingredients and finished product, we need to have good:

- Inspection (sampling)
- Analysis and documentation
- Evaluation



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Thank you!

