QUALITY CONTROL
IN
FEED MANUFACTURING

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Introduction

First, let me define feed quality. Obviously, a finished feed should meet all label guarantees - protein, fat, fiber, vitamins and other micro-ingredient levels, that active drug level in medicated feeds and the ingredients listing. Assuming that feeds are properly formulated for the targeted animals, plant and company management must assure that:

1. All raw materials meet specified quality standards;
2. There are no foreign or superfluous materials in either the raw materials or the finished products;
3. Processed grains and other materials meet specified particle shape and size requirements;
4. The feed is manufactured as formulated;
5. Pellets and crumbles are properly sized and meet durability standards;
6. There is no cross-contamination from one feed to another (especially with medicated feeds);
7. There is no (or minimal) loss of vitamin potency or the potency of any other micro-ingredient in storage and handling or processing;
8. There are no deleterious substances or microorganisms in the feeds;
9. A minimum of separation or segregation is caused by post-mixer handling;
10. Package net weights and bulk weights are as labeled or invoiced;
11. The packaging is clean, neat, and attractive; and
12. The customer’s perception of quality is met.

Controlling quality in the formula feed industry consists of much more than a laboratory and its technicians. As important as they are, their role is to verify nutrient levels in ingredients and finished feeds, to provide technical assistance to the plant, to perform other after-the-fact analyses, and to keep the records.

Real quality control takes place on the production line, out in the plant where the action is; so quality control is the responsibility of plant personnel and their supervisors. Such in-plant quality control involves controlling raw materials, in-process materials, and finished products as well as the condition of materials handling and processing equipment and the general sanitation of the plant.

Raw Materials Quality Control

The company must establish written ingredient quality standards or specifications based on American Association of Feed Control Officials (AAFCO) standards or some other recognized standard (see Annex). Those standards are, then, to be used for the purchasing of the raw materials and understood by the operators at the receiving location(s) of the plant where physical examination takes place. At that point, the receiving operators and their supervisors should examine the raw material for such physical qualities as: granulation or particle size; the presence of foreign materials; aroma; color; test weight; evidence of mold, aflatoxin, or other microorganisms; moisture content; density; brix of molasses; and take a representative sample for laboratory analysis.

Obviously, the operators and supervisors must be trained to recognize the quality of raw materials to perform their visual and other physical examinations, and in the proper methods of sampling.
Also, they should be provided with the necessary equipment to perform their quality assurance function.

- Grain probes and triers,
- Bushel (or other) test weight equipment,
- Grain dockage sieves,
- A no. 10 sieve,
- A black light,
- A grain moisture tester (dielectric type) and/or a moisture oven,
- A tube probe for liquids sampling,
- A sample divider, and
- A cubic foot (or other dimension) container for checking bulk densities and a scale to weigh it on.

In addition to such testing at the plant’s receiving point(s), the protective devices of the plant should be properly installed, regularly inspected, and well maintained. Those include:

- Gratings over receiving and cut in pits,
- Magnets,
- Scalpers, and
- Cleaners.

**Foreign or Superfluous Materials**

The physical examinations and equipment outlined above should preclude the entry of sticks, stones, ferrous metals; and other foreign materials into the plant and the manufacturing processes. Removing those materials or not allowing them to be received will protect the plant, the personnel, and the products.

**Particle Size and Shape**

The condition of the screens in the hammermill, the condition of the corrugations and tramming of grinding and flaking rolls, and the condition of any sieving devices all affect particle size and/or shape and will affect the quality of finished products.

Regular sampling of the material streams from processing equipment and quick repair of any malfunctioning equipment will assure that particle size and shape standards are met.

**The Feed Manufactured as Formulated**

The accuracy of batching scales or continuous in-line feeders will determine whether or not the feed made is the feed formulated. Also, the condition of the mixer is critical to assure that all of the feed exiting the mixing system is the same feed that the nutritionist formulated and that the customer ordered.

Batching scales and other scales used to weigh ingredients must be regularly tested for their accuracy, properly maintained, and kept clean. Also, liquids addition meters or scales must be tested and maintained to assure accuracy.
Mixers must be properly designed and managed to assure that they provide a complete, thorough mix of all ingredients. They must be routinely tested, filled to proper levels, and kept clean and well maintained.

**Sizing of Pellets and Crumbles**

Feed plants producing pelleted products need to give careful attention to the sizing and durability of those products and to the amount of fine particles in the finished feeds. Standards for pellet sizes and durabilities should be established by management and adhered to by the operators of the pelleting equipment, and pellet durability testers should be provided and used.

Other factors affecting pellet quality involve the formulation; the quality of steam and the condition of the steam system; the overall condition of the pellet mill, cooler, and screener; the condition of the crumble rolls; the condition of the down stream handling system; and operating practices.

**Cross-Contamination**

Cross-contamination can be a serious quality problem, especially, when medicated feeds are involved. Where does cross-contamination occur in a feed plant?

- Residue in conveying equipment before and after mixing,
- Valves that don’t seat and turnheads that do not align properly,
- Leaks in materials handling equipment,
- Human or mechanical errors in binning,
- Incomplete mixer and/or surge bin clean-out,
- Residues in the boots of bucket elevators,
- Hang-ups in bins - especially finished feed bins ahead of pelleting, packaging, and bulk load out,
- Improper flushing of systems or batch sequencing, and
- During packaging, warehousing, or bulk loading.

**Vitamin Potency (Losses)**

It has been well documented that vitamins, especially the fat solubles, will lose their potency under given storage and handling conditions; but the effects of those conditions and the magnitude of the losses are not well understood, or, too frequently, ignored by Feed Manufacturers and Feeders.

**Deleterious Substances or Microorganisms**

Deleterious substances refer to harmful or, possibly, poisonous substances that might be introduced into the feed in the plant (although it is possible that such substances could come in with ingredients). Good examples are lubricants that come into contact with the feed that are not approved for food use and polychlorinated biphenols (PCBs) that may leak from PCB
containing transformers, capacitors, and other PCB containing equipment.

It is the responsibility of management, operative, and maintenance personnel to control those, and other, poisonous substances in their plant to avoid contamination of products.

Microorganisms refer, primarily, to molds that may enter the plant with the raw materials and are caused by conditions in the plant and the manufacturing processes. Detection of such microorganisms often requires laboratory analysis; but, at times, they can be detected by the naked eye or the nose. Molds created, or multiplied, in the plant can, often, be avoided by operative practices and proper maintenance. Some of the areas, or causes, of mold growth are:

- Leaks in bins and roofs that allow rain water to fall on ingredients or feeds,
- Hang-ups of materials in bins,
- Materials left in the boots of elevators, in conveyors, and elsewhere in the materials handling systems,
- Heat build-up in the grinding process that may lead to items 2 or 3 above,
- Improper venting of bins allowing condensate to form,
- Water leaking into liquids systems (fats, molasses, etc.),
- Flaked grain or pellet coolers that do not cool or dry properly, and
- Improper bin aeration or grain dryers that do not dry properly.

Separation and Segregation

The propensity of premixes, concentrates, supplements, and final feeds to separate/segregate in post mixer handling may be one of the most critical, yet often neglected, quality assurance problems in the feed industry.

Even if a feed is “perfect” when it exits the mixer, it will most likely become considerably less perfect in the handling systems of most feed plants, thus, affecting its quality and efficacy.

Feed plant designers, managers, operators, and quality control personnel should be aware of the effects of free fall, bin charging and discharging, the electrostatic properties of some feed ingredients, dust separation in dust collection systems, and transportation (especially of bulk feeds).

Segregation and separation can be reduced, but not totally avoided by:

- More positive control of the particle sizes of ingredients,
- Reducing the distance of the free fall of feeds into bins (silos),
- The use of liquid binders (molasses, fats, etc.),
- Pelleting,
- Returning collected dust immediately to the stream from which it is taken, and
- Grounding all equipment.
Finished Product Weights

While product weights may not be a quality consideration, per se, accurate weights monitoring is a responsibility of operators and quality control personnel on a regular basis to satisfy the weights and measures laws and regulations, the satisfy customer requirements, and to protect the profits of the company.

Packaging scales should be tested daily, or more often; and truck scales should be tested, at least, monthly.

The Customers’ Perception of Quality

Feed manufacturers must be constantly aware of what his Customers consider as quality standards. Those might include: the color, smell, or granulation of the feed; the appearance of the packaging; the appearance of the plant and grounds; fines in pelleted products; and so on.

Knowing those “quality” requirements of the customers allows management to take such actions as will meet or come as close to those requirements as possible.

Housekeeping and Sanitation

Good housekeeping and the maintenance of a sanitary house which is free of insects, rodents, and birds is another aspect of in-plant quality control. Cleanliness begets cleanliness, and has strong quality implications. The control of product quality takes on greater meaning for all employees when they work in clean, neat surroundings. Unfortunately for our industry and its general image in the community, not all feed manufacturers have learned that lesson.

Accumulations of dust, spills, scrap, and all of the other things that go with an unkept house adversely affect product quality and detract from the objective of feed manufacturers to produce a better product and provide better customer service than his competitor while being a responsible member of the community.

Plant and Equipment Maintenance

Because proper plant and equipment maintenance is so important to product quality, it cannot be stressed too much. It is next to impossible to expect high quality products to come from a plant that is poorly maintained. Materials handling equipment must work without leaks, spills, dust blowouts, or cross contamination; protective equipment such as magnets, scalpers, and cleaners must do their job; the batch scale must weigh accurately and the mixer must mix; the processing and pelleting equipment must be in top operating condition and the scales for packaging and bulk load out must be accurate. In the usual sense, these items may not be considered as quality control, per se; but consistent high quality cannot be achieved without them.
Conclusion

Quality control in a feed manufacturing company includes nearly every function and every level of management. General management must set the tone; purchasing must see to it that ingredients of appropriate quality are made available to the mill; sales management must articulate the standard of quality that is required in the field; nutrition must supply the formulas to meet sales and feeding requirements within the physical capability of the mill to produce; the laboratory must analyze and advise; and the production department must put it all together.
ANNEX

FEED INGREDIENT SPECIFICATIONS

Raw materials quality control must include written specifications for all ingredients used in the formulation of feeds. Those specifications, or standards, are used for the purchasing of the raw materials and for the inspection and analysis of feedstuffs as they are received at the feed mill. Ingredient quality must meet the purchasing specifications, and receiving operators must be trained to recognize and understand the standards.

Following are specifications for certain selected feed ingredients. More complete information regarding feed ingredient definitions appears in the Official Publication of American Feed Control Officials (AAFCO); and the publication is available from Charles P. Frank, AAFCO Treasurer, Georgia Department of Agriculture, Plant and Food Grain Division, Capital Square, Atlanta, Georgia 30334, U.S.A.

Ingredient analysis data are available from the Feed Industry Red Book, Communications Marketing, Inc., 9995W. 69th Street, Suite 201, Eden Prairie, Minnesota 55344, U.S.A. or from Feedstuffs Reference Issue, Miller Publishing Company, 12400 Whitewater Drive, Suite 1 60, Minnetonka, Minnesota 55343, U.S.A.
44 % PROTEIN SOYBEAN MEAL

Product Description

44 % Soybean Meal is produced by cracking, heating and flaking soybeans and reducing the oil content of the conditioned product by the use of hexane or homologous hydrocarbon solvents to 1 % or less on a commercial basis. The extracted flakes are cooked and ground into meal. The meal will not contain viable weed seeds. The meal may contain a nontoxic conditioning agent to reduce caking and improve flowability in an amount not to exceed that necessary to accomplish its intended effect and in no case exceed 0.5 %. The name of the conditioning agent must be shown as an added ingredient on the label.

Standard Specifications Are As Follows

<table>
<thead>
<tr>
<th>Specification</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein (Minimum)</td>
<td>44.0 %</td>
</tr>
<tr>
<td>Fat (Minimum)</td>
<td>0.5 %</td>
</tr>
<tr>
<td>Fiber (Maximum)</td>
<td>7.0 %</td>
</tr>
<tr>
<td>Moisture (Maximum)</td>
<td>12.0 %</td>
</tr>
<tr>
<td>Urease Activity-Range (as increase in pH)</td>
<td>0.05-0.20 %</td>
</tr>
</tbody>
</table>

Bulk Density Range

36 to 40 pounds/cubic foot.

Screen Analysis

95-100 % through U.S. Screen #10. 40-60 % through U.S. Screen #20. Maximum 6.0 % through U.S. Screen #80.

Desired Physical Properties

Color Light tan to a light brown.
Odor: Fresh, typical of the product, not sour, musty or burned.
Taste : Bland and free of any beany or burned taste.
Texture Homogeneous, free-flowing, without coarse particles or excessive fines.

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1 Urease Activity, A.O.C.S., Tentative Method Ba 9-58, Reference American Oil Chemists Society, 35 E.
   Wacker Drive, Chicago, Ill.

2 If the Soybean Meal is to be used in a mixture containing a significant level of soy, (20% or more) 5% or more of urea and 20% or more of molasses, or if a similar soya-urea mixture is to be exposed to hot, humid storage conditions, then it is advisable that the urease activity of the soybean meal does not exceed 0.12 increase in pH.
**Performance Criteria**

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>P.D.I. and/or N.S.I.</td>
<td>15.0 %</td>
<td>30.0 %</td>
</tr>
<tr>
<td>P.E.R. (Protein Efficiency Ration)</td>
<td>2.3</td>
<td>--</td>
</tr>
<tr>
<td>Chick Weights – 4 weeks; in gram</td>
<td>500.0</td>
<td>--</td>
</tr>
</tbody>
</table>

**Trading Rules**

Refer to Trading Rules of National Soybean Processors Association for information relative to settlement for failure of product to meet specifications as well as for information on the official methods of analysis.

**Factors That Influence Quality**

1. Soybean meal must be properly cooked during processing to provide optimum protein nutrition for critical animals, especially poultry, swine, lambs and calves, as well as pets and fur bearing animals.
2. Underheating of soybean meal may fail to destroy growth inhibitors, and result in as low protein efficiency for critical feeds as raw soybeans or an underheated meal produced for industrial uses. It is known that an underheated soybean meal greatly increases the need for vitamin D to prevent rickets of turkey poults.
3. Overheating of soybean meal tends to inactivate or destroy the essential amino acids lysine, cystine, methionine and possibly others.
4. Biological chick and/or rat assays are the only reliable means currently available for predetermining the nutritional value of soybean meal protein. Laboratory tests such as Urease Activity, Protein Dispersibility Index (P.D.I.), Nitrogen Solubility Index (N.S.I.), Thiamin, and Water Absorption have been found valuable in monitoring daily production for protein quality. Biological assays must be conducted periodically to verify results of chemical tests.
5. It is common knowledge that the qualitative DuPont Urease Test gives a negative result on soybean meal even though the meal shows a urease activity by the Quantitative Method (see Analytical Specifications of this “Ingredient Guide”), from nothing up to an increase in pH of slightly over 0.1. A reading under 0.05 increase in pH means that there is a good chance of the soybean meal protein being slightly to severely damaged from overheating.

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5 Using a medium energy “Carrick” type of corn-soy diet.
**Availability**

The 44 % Protein Soybean Meal is generally available throughout the year.

**Feed Application**

A properly processed 44 % Protein Soybean Meal is an excellent source of high quality protein. It is used in feeds for all classes of livestock and poultry.


AAFCO (1979) page 131 #84.61
NRC Ref. No. 5-04-604.
DEHULLED SOYBEAN MEAL

Product Description

Dehulled Soybean Meal is produced by cracking, heating and flaking soybeans and reducing the oil content of the conditioned product by the use of hexane or homologous hydrocarbon solvents to 1 % or less on a commercial basis. The extracted flakes are cooked and ground into meal. The meal will not contain viable weed seeds. The meal may contain a nontoxic conditioning agent to reduce caking and improve flowability in an amount not to exceed that necessary to accomplish its intened effect and in no case exceed 0.5 %. The name of the conditioning agent must be shown as an added ingredient on the label.

Standard Specifications Are As Follows

<table>
<thead>
<tr>
<th>Specification</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein (Minimum)</td>
<td>48.0 - 50 %</td>
</tr>
<tr>
<td>Fat (Minimum)</td>
<td>0.5 %</td>
</tr>
<tr>
<td>Fiber, (Maximum)</td>
<td>3.5 - 3.0 %</td>
</tr>
<tr>
<td>Moisture (Maximum)</td>
<td>1 2. %</td>
</tr>
<tr>
<td>Urease Activity-Range (as increase in pH)</td>
<td>0.05 - 0.20</td>
</tr>
</tbody>
</table>

Bulk Density Range

36 to 40 pounds/cubic foot.

Screen Analysis

95-100 % through U.S. Screen #10. 40-60 % through U.S. Screen #20. Maximum 6.0 % through U.S. Screen #80.

Desired Physical Properties

Color : Light tan to a light brown.
Odor: Fresh, typical of the product, not sour, musty or burned.
Taste : Bland and free of any beany or burned taste.
Texture : Homogeneous, free-flowing, without coarse particles or excessive fines.

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6 Urease Activity, A.O.C.S., Tentative Method Ba 9-58, Reference American Oil Chemists Society, 35 E. Wacker Drive, Chicago, Ill.
7 If the Soybean Meal is to be used in a mixture containing a significant level of soy, (20% or more) 5% or more of urea and 20% or more of molasses, or if a similar soya-urea mixture is to be exposed to hot, humid storage conditions, then it is advisable that the urease activity of the soybean meal does not exceed 0.12 increase in pH.
Performance Criteria

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>P.D.I. and/or N.S.I.</td>
<td>15.0 %</td>
<td>30.0 %</td>
</tr>
<tr>
<td>P.E.R. (Protein Efficiency Ratio)</td>
<td>2.4</td>
<td>--</td>
</tr>
<tr>
<td>Chick Weights – 4 weeks; in gram</td>
<td>600.0</td>
<td>--</td>
</tr>
</tbody>
</table>

I P.E.R. (Protein Efficiency Ratio) (4) Chick Weights - 4 wks., in gramms (3)

Trading Rules

Refer to Trading Rules of National Soybean Processors Association for information relative to settlement for failure of product to meet specifications as well as for information on the official methods of analysis.

Factors That Influence Quality

1. Soybean meal must be properly cooked during processing to provide optimum protein nutrition for critical animals, especially poultry, swine, lambs and calves, as well as pets and fur bearing animals.
2. Underheating of soybean meal may fail to destroy growth inhibitors, and result in as low protein efficiency for critical feeds as raw soybeans or an underheated meal produced for industrial uses. It is known that an underheated soybean meal greatly increases the need for vitamin D to prevent rickets of turkey poults.
3. Overheating of soybean meal tends to inactivate or destroy the essential amino acids lysine, cystine, methionine and possibly others.
4. Biological chick and/or rat assays are the only reliable means currently available for predetermining the nutritional value of soybean meal protein. Laboratory tests such as Urease Activity, Protein Dispersibility Index (P.D.I.), Nitrogen Solubility Index (N.S.I.), Thiamin, and Water Absorption have been found valuable in monitoring daily production for protein quality. Biological assays must be conducted periodically to verify results of chemical tests.
5. It is common knowledge that the qualitative DuPont Urease Test gives a negative result on soybean meal even though the meal shows a urease activity by the Quantitative Method (see Analytical Specifications of this “Ingredient Guide”), from nothing up to an increase in pH of slightly over 0.1. A reading under 0.05 increase in pH means that there is a good chance of the soybean meal protein being slightly to severely damaged from overheating.

8 P.D.I. – Protein Dispersibility Index. AOCS Tentative Method Ba 10-65, or N.S.I. – Nitrogen Solubility Index, AOCS Tentative Method Ba 11-65.
10 Using a medium energy “Carrick” type of corn-soy diet.
**Availability**

Generally available throughout the year. Soybean Meal of 48-48.5 % protein with a maximum of 3.5 % fiber is produced in some western states where the protein content is lower in the original soybean. Soybean Meal of 49-50 % protein with a maximum of 3 % fiber is produced in areas where the protein content is higher in the original soybean.

**Feed Application**

Properly processed 48.0 %, 48.5 %, 49.0 % and 50.0 % Dehulled Soybean Meals are excellent sources of protein. They may be used in feeds for all classes of livestock and poultry. They are ideal for high-energy rations such as broiler, turkey, and pig starter feeds.

Adopted: Nov. 1971

AAFCO (1979) page 131 #84.7
NRC Ref. No. 5-04-612.
WHEAT MIDDLINGS

Product Description

Wheat Middlings are obtained from the milling of any of the classes of wheat in the usual process of wheat flour milling. Middlings consist of fine particles of wheat bran, wheat shorts, wheat germ, wheat flour and some of the offal from the tail of the mill. Middlings must not contain more than 9.5 % crude fiber.

It is the prevailing practice to include ground run of the mill wheat screenings in middlings. When such screenings are included, a declaration to that effect must be included on the label and in the guarantee.

Typical Analysis

<table>
<thead>
<tr>
<th></th>
<th>Protein, Minimum</th>
<th>Fat, Minimum</th>
<th>Fiber, Maximum</th>
<th>Moisture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15.0 %-17.0 %</td>
<td>3.0 %-4.0 %</td>
<td>8.5 %-9.5 %</td>
<td>12.5 %-14.5 %</td>
</tr>
</tbody>
</table>

Factors Influencing Quality

Unground or poorly ground run of the mill screenings.

Presence of screenings in amounts beyond “run of the mill.” The official definition of the Association of American Feed Control Officials prohibits the addition of screenings other than in “run of the mill” quantities.

Moisture content over 14 % could cause problems, particularly during hot, humid weather.

Good milling practice prevents excessive addition of floury products that may adversely affect intended use.

Physical Properties

Bulk Density : 17-22 lbs./cu. ft.

Screen Analysis :100 % through a No. 10 screen (USBS). 40 %, through a No. 40 screen (USBS). Not more than 25 % through a No. 60 screen (USBS).

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11 Analyses, as guaranteed by Seller, vary with type of wheet ground and time of year.
The product shall have a sweet odor and should not be heating or contain hard lumps. Color varies from light tan to reddish brown depending upon wheat class being milled, wheat quality, and comparable factors.

**Availability**

Middlings are the second most plentiful by-product ingredient in use in the U.S. They are freely available throughout the year. Production is widely distributed in the U.S. or located in favorable transit network. Year to year production is relatively stable.

**Major Feed Applications**

An important source of energy, protein, minerals, and vitamins. Heaviest utilization is in ruminant, hog, and horse feeds. Middling are also used in some poultry, and specialty feeds.

**Detailed Technical and Nutritional Information**

Information is available in the “Millfeed Manual - A Compendium of Wheat Millfeed Technology”, published by the Millers’ National Federation, 14 East Jackson Boulevard, Chicago, Ill., 60604, USA.

Adopted: May 1972

AAFCC (1979) page 143 #93.5
NRC Ref. No. 4-05.205.
COTTONSEED MEAL

Product Description

Cottonseed meal is a product of cottonseed composed principally of the kernel, with such portions of the fiber, hull and oil as may be left in the course of manufacturing.

Typical Analysis

<table>
<thead>
<tr>
<th>Method of Processing</th>
<th>Screw Pressed</th>
<th>Solvent Extracted</th>
<th>Direct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein %</td>
<td>41</td>
<td>41</td>
<td>41</td>
</tr>
<tr>
<td>Fat, %</td>
<td>3.5 – 4.3</td>
<td>0.3 – 1.3</td>
<td>0.9 – 3.3</td>
</tr>
<tr>
<td>Crude Fiber, %</td>
<td>10.8 – 14.4</td>
<td>10.7 – 14.5</td>
<td>9.2 – 13.4</td>
</tr>
<tr>
<td>Moisture, %</td>
<td>8 – 10</td>
<td>8 – 10</td>
<td>8 – 10</td>
</tr>
<tr>
<td>Free Gossypol, %</td>
<td>0.02 – 0.04</td>
<td>0.02 – 0.06</td>
<td>0.11 – 0.37</td>
</tr>
</tbody>
</table>

Method of Processing

Cottonseed are partially delinted, dehulled, conditioned, flaked and the oil then extracted by either mechanical or solvent means or by a combination of both. The extracted flakes are then ground or pelleted.

It is estimated that presently approximately 40 % of the total cottonseed crushed is in screw press mills and 30 % each in direct and prepress solvent mills.

Factors Affecting Quality

Nutrient Composition - Certain nutrients vary between cottonseed meal production processes. These variations are important in determining the level of usage in scientifically formulated rations.

Screw pressed cottonseed meals are relatively high in residual lipids and are lowest in free gossypol and protein quality for non ruminants, as indicated by nitrogen solubility and available lysine.

12 For complete analysis of cottonseed products write: National Cottonseed Products Assn., Inc. POBox 12023, Memphis; Tennessee 38112, USA.
13 It should be noted that certain meals may not follow these general observations.
14 Ammoniated Cottonseed Meal is obtained by the treatment of cottonseed meal with anhydrous ammonia. The maximum percentage of equivalent crude protein from non-protein nitrogen shall be stated on the analysis guarantee.
15 Cottonseed meal merchandised as “Solvent Extracted Cottonseed Meal” may be processed by either prepress or direct solvent extraction.
16 Cottonseed meal may contain 36-50% crude protein. The percentage of crude protein is specified in the analysis guarantee.
17 Low Gossypol Cottonseed Meal refers to meals with not more than 0.04% free gossypol.
Prepress solvent meals are low in residual lipids and free gossypol and moderate to high in protein quality, moderate in residual oil, and are highest in free gossypol.

It should again be noted that there are meals which do not fit these general observations and that protein quality, as used in this discussion, refers only to the availability, as used in this discussion, refers only to the availability of essential amino acids for poultry and swine.

Overheating cottonseed meal tends to inactivate or destroy the essential amino acids: lysine, cystine, methionine and possibly others.

**Physical Properties**

Color: Cottonseed meal is typically a shade of brown, ranging from golden brown to reddish brown. Color of the meal is influenced in part by the fineness of grind.

Odor: Cottonseed meal should have a fresh odor, not one that is sour, musty, or burnt. Bulk Density: Cottonseed meal will have a density of 35-40 pounds/cubic foot.

**Availability**

Cottonseed meal is available throughout the year.

**Areas of Use**

Cottonseed meal and cake are the second most important sources of protein for animal feeding. Only soybean meal is used in larger volume. Extensive research has been done on the nutritive value of cottonseed meal and use recommendations have been established.

Animals with a functioning rumen are not affected by gossypol.

Non ruminant tolerance of gossypol depends upon specie and age and other components of the ration. Older animals are less sensitive than young. Poultry are less sensitive than swine, but discoloration of eggs stored longer than three months can occur at levels lower than those which reduce performance. Addition of iron salts increases gossypol tolerance. Restricting cottonseed lipids to no more than 0.2 % helps to avoid egg discoloration.

Egg production is not affected by dietary free gossypol levels up to 200 ppm (0.02 %). Fifty ppm (0.005 %) will not cause discoloration of eggs stored up to three months; this tolerance may be increased to 150 ppm (0.015 %) by addition of FeSO₄ at a weight ratio of 1:1. Restricting cottonseed lipids to no more than 0.2 % helps to avoid egg discoloration.

Broilers are not affected by a dietary level of 150 ppm (0.015 %) gossypol, and the tolerance is increased to 400 ppm (0.04 %) by adding FeSO₄ at a ratio of 1:1.

Growing and fattening pigs tolerate dietary levels of 100 ppm (0.01 %) gossypol and additional free gossypol may be present when FeSO₄ is added at a weight ratio of 1:1 but no more than 400 ppm of FeSO₄ should be fed.
Additional information on the proper use of cottonseed meal may be obtained from the National Cottonseed Products Association, Inc.

Adopted: May 1973

AAFCO (1979) page 103 #24.10, 24.12
NRC Ref. No. 5-01 -625, 5-01 -632.
MENHADEN FISH MEAL

Product Description

The product resulting from processing whole menhaden fish.

Typical Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>60%</td>
</tr>
<tr>
<td>Fat (Ether Extract)</td>
<td>11%</td>
</tr>
<tr>
<td>Fiber</td>
<td>1%</td>
</tr>
<tr>
<td>Moisture</td>
<td>7-11%</td>
</tr>
<tr>
<td>Pepsin Digestible Protein (Mm.)</td>
<td>92%</td>
</tr>
<tr>
<td>Sand</td>
<td>Content in excess of 1% to be declared</td>
</tr>
<tr>
<td>Salt (NaCl)</td>
<td>Content in excess of 3% to be declared</td>
</tr>
</tbody>
</table>

Physical Properties

Texture 100% to pass U.S. No. 7 Standard Screen
98% to pass U.S. No. 10 Standard Screen
Bulk Density 32-38 lbs/cubic ft.

Method of Processing

The whole fish are cooked, pressed to remove water and oil, and then dried.

Factors Affecting Quality

Treatment with an anti-oxidant and holding under conditions permitting detection and avoiding of excessive temperature which could reduce protein quality is desirable. A self-monitoring salmonella control program is recommended for all fish meal plants.

Major Feed Application

Fish meal is used in chick, broiler, layer, and breeder rations, in turkey and swine feeds, and for commercial fish farming feeds. Fish meal should be incorporated into feed formulas on the basis of its content of essential amino acids, its energy value, available phosphorus, source of unknown growth factor, and trace elements such as selenium.

Trading

All sales are made on the basis of a contractual agreement between buyer and seller.

Adopted: May 1973

AAFCO (1979) page 112 #51.14
NRC Ref. No. 5-01-977.
MEAT AND BONE MEAL

Product Description

Meal and Bone Meal is the dry rendered product derived from mammalian tissue, exclusive of hair, hoof, horn, hide trimmings, manure and stomach contents, except in such amounts as may occur unavoidably in good manufacturing practices. Fresh blood may be added during the rendering process. It shall contain more than 4.4 % phosphorus (P) and not more than 14% pepsin indigestible residue 19. Not more than 11 % of the protein shall be pepsin indigestible. It must be designated according to its protein content. If the product bears a name description of its kind, composition or origin it must correspond thereto.

Typical Analysis

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>50 % or as specified</td>
</tr>
<tr>
<td>Fat</td>
<td>8%- 11%</td>
</tr>
<tr>
<td>Fiber (Maximum)</td>
<td>3%</td>
</tr>
<tr>
<td>Calcium</td>
<td>2 times phosphorus level</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>4.4 % - 5.0 %</td>
</tr>
<tr>
<td>Ash, not more than 6.5 times the phosphorus (P) level Moisture (Maximum)</td>
<td>10 %</td>
</tr>
<tr>
<td>Pepsin indigestible residue (Maximum)</td>
<td>14%</td>
</tr>
</tbody>
</table>

Factors Influencing Quality

The quality and composition of the raw material will have some effect on the quality of finished product produced. Raw material will vary with different areas of the country. A high fat content of the raw material protects the lysine content during the process of rendering. Overcooking may influence the palatability of the finished product.

Physical Properties

Color: Golden to medium brown.
Odor: Fresh, meaty, crackling odor.
Screen Analysis: 100 % to pass U.S. No. 7 Screen - 98 % to pass U.S. No. 10 Screen.
Uniformity: Each lot should be uniform as to color, grind, and composition.

Availability

Meat and bone meal is available the entire year, but production in some areas may be seasonal.

19 Determined by AOAC Method 7.040.7.048.
Major Feed Application

Meat and bone meal may be used as a protein source in formulating feeds for all classes of poultry, livestock, many exotic animals, dogs and cats, and some species of fish.

Detailed information may be obtained from the:

NATIONAL RENDERERS ASSOCIATION, INC.
3150 Des Plaines Avenue - Des Plaines, Illinois 60018, USA.

Adopted: Nov. 1973

AAFCO (1979) page 95 #9.41
NRC Ref. No. 5-00-388.
Product Description

Cane Molasses is a by-product of the manufacture or refining of sucrose from sugar cane. It must not contain less than 46% total sugars expressed as invert. If its moisture content exceeds 27%, its density determined by double dilution must not be less than 79.5° Brix.

Typical Analysis

- Brix, minimum: 79.5°
- Total sugars as invert, minimum: 46%
- Moisture, maximum: 25%
- Ash, maximum: 10%
- Crude Protein, minimum: 2%
- pH: 5.0 - 5.5

Factors Influencing Quality

The sugar content of cane molasses will vary with country of origin, efficiency of sugar mill extraction, and season. Protein content will vary with origin.

Physical Properties

Color: Dark Brown.
Odor: Slight sweet odor.
Viscosity: Approximately 3000 centipoises at 75°F. May vary based on type, origin, temperature and processing variables.
Density: Approximately 11.7 pounds per gallon at 68°F.

Availability

Generally available in adequate supplies throughout the year from several distribution points throughout the United States. Produced in tropical areas of the world and in Florida, Louisiana, Texas, Hawaii and Puerto Rico of the United States.

Major Feed Applications

Cane molasses is used as a source of energy, dressing agent, rumen fermentation factor and for improved palatability in livestock and poultry rations. Cane molasses is widely used as a major component of liquid feed supplements for ruminants.
Additional Information


Adopted: May 1976

AAFCO (1979) page 126 #63.7
NRC Ref. No. 4-04-696.
Feed quality-control programs must blend these tools to deliver feeds that consistently contain the formulated nutrients in an available form and contain minimal levels of toxic substances. The American Feed Industry Assn. (AFIA) has defined feed quality-control programs as: All actions directed towards ensuring the product meets the specifications established by the manufacturer. In many situations, feeds are used rapidly following manufacture and animals consume the feeds before any assays can be performed. However, finished-feed assays are necessary and important because they provide the mill with a final report card on how well quality was controlled. How much finished-feed sampling and analysis should be done? Consult extension personnel or feed equipment manufacturer September 15, 2010, Feedstuffs 63 Reference Issue & Buyers Guide 2011.indd 63 8/18/2010 9:54:14 AM Feed Quality Control in feed manufacturing specifications. This system is supposed to force competition employees to the SOPs or don’t follow them as written. SOPs between suppliers, driving the price down and quality up, should be developed for each critical operation in the feed. However, purchasing on price alone does not account for manufacturing process. They should be included in new em- all of the cost connected with the Feed Quality control in feed manufacturing. should be checked at least twice each year. Sometimes premix manufacturers will check mixer times as a service to their customers. However, no matter who checks the mixers uniformity, mixing time should be correctly evaluated. Procedures for checking mixing time are outlined in Feed Manufacturing Technology V (which can be purchased through AFIA) and the Feed Additive Compendium (Jones, 2010). While a coefficient of variation (CV) of 10% or less is generally accepted as a homogenous mix, the guidelines shown in the Table can be used when evaluating mixing uniformity. Quality control is a collaborative effort and a vital reflection of all production factors. However, companies inevitably face the problem of standardizing quality control procedures. Plus, it can be challenging to standardize responses, either in the presence or absence of issues. In cases when subjects of quality control have different or even unique features, it gets especially hard to identify and eliminate defects. Keeping these issues in mind, we offer our computer vision solution aimed at streamlining this process cost-effectively and with high precision. Quality contr...