Chapter 2 – Classification of Feeds

Classification of Feeds

1. Carbonaceous concentrates (low protein)
2. Carbonaceous roughages (low protein)
3. Proteinaceous concentrates
   (1) Supplements of vegetable origin
   (2) Supplements of animal origin
      a. Animal tissue
      b. Fish products
      c. Milk products
4. Proteinaceous roughages
5. Additive materials: Nutrients and non-nutrient additives

Ⅰ. **Characteristics of Common Concentrate Feedstuffs**

A. Carbonaceous concentrates (high-energy feeds; mostly feed grains and their by-products. According to NRC nomenclature, these are products containing less than 20% protein and less than 18% fiber.)

1. General nutritive characteristics
   a. High in energy (TDN or NE)
   b. Low in fiber
   c. Low in protein (in relation to oil seeds and some mill feeds)
   d. Protein quality is variable and generally quite low
   e. Mineral level
   f. Vitamin levels

2. Some of the more important carbonaceous concentrates
   a. Corn-most popular and most widely fed in midwest
   b. Sorghum grains-(milo, kafir, hybrids, etc.)
   c. Oats-(65-70% TDN; 12% CP)
   d. Barley-(70-75% TDN; 11-12% CP)
   e. Rye-(75% TDN; 12% CP)
   f. Wheat-(80% TDN; 12-14% CP)

g. Corn-and-cob meal-(73% TDN; 7-8% CP)

h. Dried beet pulp-(65-70% TDN; 8-10% CP)

i. Molasses-must contain over 48% sugar (55-75% TDN)-generally of cane or beet origin

B. Proteinaceous concentrates

1. Protein quality
   a. Refers to kinds, amounts and ratio of amino acids in a feedstuff
   b. Variability in composition means that in non-ruminants, supplementation of certain amino acids will be necessary or a mixture of feeds provided to insure intake of all essential amino acids
   c. Non- protein nitrogen source (as urea) may be fed to ruminants but not swine or poultry
   d. While all amino acids are physiologically essential, there are some that must be supplied in diet of non-ruminants

2. The essential amino acids and some sources:
   a. Tryptophan
   b. Threonine, Histidine, Arginine, Isoleucine, Valine and Phenylalanine -Grains fair source
   c. Lysine
   d. Leucine
   e. Methionine
   f. Glycine (required by the chick and) glutamic acid. Corn is a fairly good source.
   g. When feeding high-grain rations to swine or poultry, ration levels or three specific amino acid must be carefully checked. They are:
      (1) Lysine
      (2) Methionine
      (3) Tryptophan

3. Some protein supplements.
   a. Urea-a protein supplement but a source of nitrogen for protein synthesis by rumen bacteria (1 lb. of urea contains as much nitrogen as 2.9 lbs. of protein)

b. Supplements of plant origin (oil meals)
(1) Manufacturing process for oil meals
(a) Expeller or hydraulic process (old process)-seed is crushed, heated in steam or cooked, pressed and ground
(b) Solvent process (new process)-seed is cracked, heated mildly, rolled, extracted with hexane; flakes are then toasted and ground
(2) Effect of processing
(a) Hydraulic or expeller processed meals contain more fat and less protein than solvent extracted. (Solvent less than 1% fat; Expeller 4-5% fat)
(b) Cooking improves palatability, color and increases availability of some amino acids. However, overcooking can destroy some of the amino acids
(c) In soybeans, cooking destroys an antitrypsin factor which suppresses non-ruminant growth and prevents action of the enzyme trypsin; also destroys urease enzyme
(3) Characteristics of the oil meals
(a) Soybean meal
(1') Nutritive characteristics
(a') Solvent: 44 to 50% of crude protein
(b')Dehulled: 50 % of crude protein
(2') Must be heated for maximum efficiency
(3') Considered a high quality plant protein and gives good results in swine and poultry rations as long as the B-vitamins are supplied
(4') On-the-farm processed soybeans
(a') Nutritive characteristics: 37-38% crude protein, 17% fat, 87-88% TDN
(b') Takes special equipment to uniformly heat beans to a constant temperature which will destroy the Antitrypsin factor (harmful to swine) and the urease enzyme (undesirable in beef diet, containing urea)
(c') Using whole cooked soybeans will likely improve feed efficiency (4-8%) due to higher fat content but will have little effect on daily gain
(b) Cottonseed meal (commonly used in southern states)

(1) Nutritive characteristics
(a) 41-43% crude protein
(b) Protein quality is low which limits its use in swine feed
(2) Danger in swine and poultry feeding:
(a) Contains gossypol (.03-.2%) which is a toxic substance
(b) Symptoms of gossypol poisoning are similar to pneumonia except fluid develops in abdominal cavity which is typical of poisoning
(c) In poultry may cause green yolks and pink egg whites in eggs

c. Supplements of animal origin
(1) Tankage (meat meal tankage or digester tankage)
(a) 55-60% crude protein (60% most common)
(b) If over4.4% phosphorus, must be labeled "meat and bone tankage"
(c) Contains blood meal, gut, tendon, and connective tissue which reduces biological value of the protein
(d) Exclusive of hair, hoof, horn, manure, stomach contents and hide trimming
(2) Meat scraps (meat meal)
(a) Contains 45-55% crude protein (55% most common)
(b) If over 4.4% P, must be labeled "meat and bone scrap" or "meat and bone meal"
(c) Usually dose not contain gut, tendon, and connective tissue to the extent of tankage
(4) Fish meal
(3) Fish meal-dried, ground whole fish or cuttings
(1') Crude protein ranges from 35-70% depending on type of product (whole fish or cutting)
(2') Excellent protein quality and source of B-vitamins
(4) milk products
(a) Whole milk-normally too expensive to be fed to livestock, except to very young animals
(b) Dried skim milk-33% CP; fat and fat soluble vitamins

removed

(c) Dried buttermilk-32-33% CP; similar to skim milk, except slightly higher in fat

(d) Dried whey-13% CP; casein and most of fat removed

(5) Poultry by-products

(a) Poultry by-products meal.

(b) Hydrolyzed poultry feathers (Hydrolyzed Feather Meal).

Animal protein sources are generally used in swine and poultry rations. However, these emphasize SBM

Ruminants use primarily vegetable proteins and urea

C. Feed grain by-products (also called mill feeds)

1. By-products of corn (By-products result from milling to manufacture corn starch, corn sugar, corn oil, housing products, etc.)

a. Corn bran

b. Corn gluten meal-remains after-removal of larger part of starch, germ and bran

c. Corn gluten feed-remains after removal of larger part of starch, gluten and germ

d. Corn germ meal-ground corn germ from which most of the soluble have been removed

e. Hominy feed-corn bran, corn germ and a part of the starchy port on of the grain

f. Distillers by-product feeds (made largely from corn and some rye) DDGS(Corn distiller's dried grain with soluble)

3. Wheat by-products

a. wheat bran-outer coating of the kernel

b. wheat middling (shorts)-consists of fine particles of wheat bran, wheat germ, wheat flour, and some offal from the "tail of mill"

c. wheat germ meal-consists chiefly of the germ, together with some of the bran and middlings

4. Oat by-products

a. Oat hulls-consists primarily of the outer covering of the oat

b. Oat groats (hulled oats)-kernels produced from cleaned and dried

oats which have had the hull removed

c. Feeding oat meal-consists of broken rolled oat groats, oat groat chips and a small quantity of ground oat hull

5. Barley by-products

Brewers dried grains-the dried extracted residue of barley malt alone or in mixture with other cereal grain or grain products resulting from the manufacturing of wort

6. While many of the by-product feeds are fairly high in crude protein content, it should be remembered that the protein quality is low as in the original cereal grains and that these products are generally used to supply a part but not all of the protein for livestock rations

Ⅱ. Characteristics of Common Roughage Feedstuffs

A. General characteristics

1. Feed materials low in energy and containing more than 18% crude fiber
2. Includes pasture, hay, silage or soilage; the crop may be the same but preservation can influence the nutrient value to the animal
3. Higher in fiber than concentrates and usually lower in energy. Variable in protein content
4. Needed for bulk in ruminant rations
5. Higher in calcium and trace mineral elements than most concentrates
6. Legumes are higher in protein and B-vitamins than some concentrates
7. Better sources of fat soluble vitamins than most concentrates
8. Palatable to ruminants
9. Limited or excluded in swine rations (not suited for finishing rations)
10. Limited in beef finishing rations and in some high energy lactating rations
11. Required in lactating dairy cattle rations to help maintain normal fat level in milk
12. More variable in nutritive content and acceptability than concentrates due to variation in stage of maturity and

harvesting and storing procedures

B. Proteinaceous roughages

1. legume forages

a. Advantage of legume forage

(1) Higher in protein than other forages
(2) Protein is of good quality
(3) High in calcium
(4) Excellent in Vitamin A activity when harvested
(5) Sun cured hay is rich in Vitamin D
(6) Increase soil fertility
(7) Excellent in combination with grasses

b. Variety of legume forages

(1) Alfalfa hay
(2) Alfalfa haylage (low-moisture silage)
(3) Dehydrated alfalfa meal
(4) Other legume or legume-grass mixture

(a') Red clover
(b') White clover
(c') Sweet clover
(d') Ladino
(e') Pasture mixes (alfalfa-brome; clover-grass, etc.)

2. Grass hays such as Brome, Orchard Grass, Timothy and various wild grasses may contain 10-14% crude protein if harvested in the immature stage

C. Carbonaceous roughages

Include:

1. Corn and sorghum silages
2. Sorghum pasture
3. Corn cobs
4. Stover
5. Fodder
6. Straw
7. Note: If ruminant animals are to make maximum use of low grade roughages, they must be supplemented with:

a. Adequate protein
b. Readily available carbohydrate (starch from grain and / or sugar from molasses)
c. Additional minerals (major and trace minerals)

d. Vitamin A

D. Soilage (green chop)-refers to green forage taken directly from the field to the feedlot

1. Advatages:

a. Produces maximum yield per acre; larger yield of nutrients in "hay stage" than if kept grazed
b. Less loss of nutrients than with other harvesting procedures
c. Less fencing than if pasture; crop not trampled by livestock (tall crops, e. g., sudan grass)
d. Doesn't eliminate, but tends to reduce bloat problems with certain legume crops
e. Used most commonly in large commercial dairy operations although not usually better than good pasture for dairy or beef cattle

2. Disadvantages:

a. Lack of uniform quality from day to day
b. Weather can be a problem-muddy fields
c. May be expensive due to labor and machinery unless handled in volume
d. Could not have this crop year-round

E. Hay

1. Good hay is:

a. Cut at proper stage of maturity
b. Properly cured
c. Free from mold
d. Palatable
e. Low in foreign material

2. Federal grades of hay based on color, leafiness and stems-No. 1, 2, 3, Sample grade
3. Hay making

a. Purpose of curing is to dry down to 25 per cent moisture of less (22 per cent if to be chopped and stored as such)

F. Silages

1. What occurs in the silo

a. Plant cells continue to respire

Oxygen is consumed → Carbon dioxide is produced → Mold will not grow

b. Temperature of silage increases
   (1) Desirable temperature of silage after respiration stops is 80-100°F
   (2) Lower temperature-lactic acid forming bacteria can not compete with butyric acid forming bacteria
   (3) Temperatures above 100°F-Palatable but much nutrient value has been lost

c. Fermentation
   (1) Anaerobic environment necessary
   (2) Bacteria (normally present on all field crops) begin to multiply and attack plant sugars, forming the following acids:
      (a) Acetic acid
      (b) Lactic acid
      (c) Butyric acid
      (d) Propionic acid

d. The lowered pH stop all bacterial growth and silage remains in a fairly stable state in the silo

2. Crops for silage

a. Corn
b. Sorghums
c. Small grains-oat crop is best
d. Legume or grass silage

3. Consideration for use of silage

a. Advantage
   (1) Feed more livestock per acre of land
   (2) Forage harvesting, storing and feeding can be mechanized
   (3) High-quality, succulent feed and eaten practically without content
   (4) Earlier harvest; can be harvested over a range of moisture content

b. Disadvantage
   (1) Once ensiled, you are committed to livestock feeding
   (2) Rate of gain is reduced when high levels are fed, which increases the amount of feed for maintenance

Ⅲ. Characteristics of Common Nutrient "Additive" Feedstuffs

A. Sources of Minerals and their Potency
   1. Major Minerals-the following sources of major minerals may be obtained individually or in some form of a mixture
   2. Trace minerals—each of the trace minerals may be obtained individually or , perhaps more commonly ,as a trace mineral mixture
      a. Iodine
      b. Fe, Cu and Co
      c. Potassium and Magnesium
      d. Manganese
      e. Zinc

B. Sources of Vitamins
   1. Vitamin A
   2. Vitamin D
      a. D_2 (plant form)
      b. D_3 (animal form)
   3. Vitamin E
      a. Vitamin E concentrates
      b. Wheat germ meal or oil
   4. Vitamin K
   5. B-vitamin concentrate

Ⅳ. Methods of Feedstuff Preparation

A. Why process feedstuffs?
   1. Increase efficiency of handling from an engineering standpoint
   2. Increase efficiency of utilization
      a. Palatability
      b. Digestibility
         (1) Increase surface area for greater bacterial and/or enzymatic activity
         (2) Alter molecular structure to enhance digestion

B. Specific processes
   1. Grinding
      a. Feed particles may separate; all the course material in the

middle and the powder around the edges

b. Degree of fineness:
   (1) Finer grind will be more subject to wind loss
   (2) Finer grind will tend to "ball up" in animal's digestive system
   (3) Finer grind may result in cattle going off feed (reduced palatability)
   (4) Finer grind dose not "feed down" properly in a self-feeder
   (5) Finer grind tends to have a faster rate of passage through digestive tract
   (6) Finer grind may cause digestive disturbances
      (a) Stomach ulcers in swine
      (b) Ruminal parakeratosis in feedlot cattle
c. Grinding grain for swine—medium to fine grind for both corn and milo
d. Grinding grain for sheep—probably not necessary except for sorghum grains (milo) which could be coarsely ground
e. Fine grinding of grain for dairy cattle will result in lowered milk fat production; grains should be coarsely ground
   (1) Dry rolling and coarse grinding of corn are approximately of equal value for beef cattle
f. Grinding hay for cattle and sheep
   (1) Definitions:
      (a) Chopped = 2" in length
      (b) Ground hay = less than 1"
      (c) Finely ground hay = 1/16-1/4"
   (2) As hay is ground to finer degree, there is a general decrease in
   digestibility of the nutrients (probably due to increased rate of passage through digestive tract)
   (3) Chopping hay may results in increased intake, gain and efficiency compared to long (unchopped) hay
   (4) Chopping a poor quality hay would be more advantageous than chopping a high quality hay (increased intake)

2. Pelleting
   a. Swine rations

(1) Advantages
    (a) Reduced dustiness
    (b) Less loss of fine particle ingredients in transport
    (c) Reduced selective eating and feed wastage
    (d) Reduced storage space
    (e) Increase utilization of fibrous fraction of feedstuffs
    (f) Adaptable to bulk and mechanized feeding
    (g) Partial gelatinization of starch making more susceptible to enzymatic action and better digestion
(2) Disadvantages
    (a) Increased cost. Pellet quality sometimes not ideal
    (b) Added transportation if pelleting mills are not local
    (c) Improper pelleting procedures may cause feed spoilage
    (d) Cereal grains require finer grinding
    (e) Rations high in fat are difficult to pellet
(3) In general, pelleting swine diets will result in increased feed consumption and improved feed efficiency

3. Steam Flaking of Grain

4. Roasted Grain: Roasted corn is a new process of treating dry corn before feeding. The dry corn is passed through a roaster of the type used for roasting soybeans. The corn is heated to approximately 300°F. The moisture content is decreased to about 5 per cent or less, and the bulkiness of the grain is increased about 15per cent. It indicated 8 to 12 per cent improvement in rate of gain and 9 to10 per cent improvement in feed efficiency.