Lecture 10

INTRODUCTION TO FEEDS AND FEEDING OF DIFFERENT CLASSES OF LIVESTOCK

The term 'food' is usually used in relation to human diets while the term 'feed' is used in relation to farm animals. However, foods and foodstuffs are sometimes used for both farm animals and human beings to describe foods or and feed ingredients are the sources of nutrients in the diet.

The expression concentrate foods' is used to describe those foodstuffs that contain less than 15% water.

Succulent foods are those that contain 70% or more of water. Succulent foods can be classified into 2 broad groups

(a) Roots and Tubers

(b) Green fodders

Classification of foods and Feeding stuffs

Foods and feeding stuffs can be broadly categorized into 5 as follows:

1. Energy sources:
2. Protein sources
3. Mineral Supplements
4. Vitamin supplements
5. Feed additives or non - nutritive additives

ENERGY SOURCES

This consists those foods, grains and feed ingredients that contain less than 20% of protein in dry state. Examples are cereals and some of their by-products, starchy roots, fats and oils, sugars and syrups.

STARCHY ROOTS AND TUBER

Starchy roots (i.e. tubers and roots crops) most widely cultivated in tropical and sub-tropical part of the world are cassava, yams, cocoyam’s and sweet potatoes in that order roots are also eaten in small quantities in some tropical countries. In temperate countries, the most widely cultivated root crop is irish potato. irish potato are also grown in some tropical areas.

Starchy roots contain large quantities of starch and so are high in energy per hectare than most cereal. They are however, generally low in protein (1 – 4%) minerals and vitamins. Starchy roots forms the major part of the diet of man in many party of the world. They are sometimes used in feeding of farm animals e.g. cassava and its products like gari, cassava flour or fermented cassava meal may be used to replace a large pro-portion or all of the grains in poultry and pig diets. In using cassava, care must be taken to balance the diets for protein and amino acids, especially methionine.

Starch and root crops are relatively easy to grow with high yield even on poor soils. They contain large quantities of starch and so are good energy source. They produce more energy per hectare than most cereals but are generally low in protein (1- 4%), minerals and vitamins. Starchy roots form the major part of the diets of man in many parts of the world. They are sometimes used in the feeding of farm animals.

CASSAVA

It is a very popular tropical plants use in feeding man and all classes of livestock. There are two main types. These are the varieties like types *manihot utilisima* or *manihot esculentus* and the sweet types *manihot palmate*.

It is easy to propagate from stem cutting and is one of the most productive root crops in the tropical areas. Its yield is between 10 and 20 tons per hectare. It is available all the year round. Cassava contains between 50 and 70 % water. It is low in protein (1 – 3 %), oil, ash and crude fibre (up to 5% CP can be obtained from some of the new variety). The protein content of cassava tuber is deficient in lysine, methionine, tryptophan, tyrosine and phenylalanine but high in arginine. It is low in minerals and most vitamins but it is high in energy content.

The peels of cassava are richer in protein, oil and ash than the peeled protion. On a dry basis, cassava leaves have protein content that range between 14 and 69% DM. It is fair in lysine content marginal in tryptophan and isoleucine but deficient in methionine.

Cassava is able to serve as substitute to maize in livestock feeds at levels between 5 and 50 %, well processed cassava leaves and peels are widely fed to cattle, sheep and goats.

LIMITATIONS

Both the bitter and sweet varieties contain cyanide. The content of cyanide in fresh tuber of bitter varieties contain less than 100mg/kg. The peels contain 3 – 10 times more cyanide than edible portion. Levels of cyanide less than 50mg/kg are considered harmless, 50 – 80mg/kg slightly poisonous, 80 – 100mg/kg toxic and above 100mg/kg fatal.

Symptoms of eating raw or improperly processed cassava in man include feeding of sickness nausea a, vomit by abdominal distention respiratory difficulty and collapse. Over a long period of consumption, raw cassava may caused goitre, deformed and mental defective cretinism, ataxia, neuropathy with mental retardation. Detoxification of cyanide is required.

Cyanide is detoxified into thiocyanide and thus involves the use of sulphur. Some of these sulphur are obtained from sulphur containing amino acid. Cyanide also interfere with thyroid gland and therefore interfere with iodine metabolism.

However, much of the cyanide is removed during processing of cassava. The processing method include cooking, frying, boiling, washing, grating, soaking, fermentation and sun drying and long period of storage. Properly processed cassava products are virtually free of HCN. High levels of cassava in feed make the feed to become dusty, hence molasses and oil may be added to reduce the level of dustiness.

The leaves and peels of cassava are widely fed to cattle, sheep and goats, although with fatal consequences sometimes.

YAM

It is mainly cultivated for human consumption. There are different species of yam. The most popular ones are:

1. Water yam Dioscorea alata
2. Aerial yam Dioscorea bulbifera
3. Yellow yam Dioscorea cayeneusis
4. Tritollate yam Dioscorea dumetorium
5. Chinese yam Dioscorea esculenta
6. White yam Dioscorea rotundata

Yam is high in water content, high in soluble carbohydrate, low in cp (1-4%), low in fibre and fair in ash. The protein content is low in lysine, methionine, tryptophan but contain fair amount of valin, arginine and isoleucine. It also contains fair amount of B. Complex and minerals. Yam peels are valuable as livestock feed especially in ruminant animals.

LIMITATION

The major set back in the use of yam as livestock feed is the content of its major antinutritional factor (alkaloid) which can reduce the level of intake with time. It also have an itching effect on the palate. Some varieties contain tannin up to 0.4% and saponin. Most of these antinutritional factors are destroyed during cooking and drying.

COCO YAM

Cocoyam can be fed to livestock. However cocoyam should be cooked before being fed to livestock particularly pigs since the acid (Ca – oxalate) or saptoxin contained in the corn is irritating to the digestive tract and may even be poisonous. The pods and leaves of cocoyam are valuable feed for ruminants (cattle sheep and goats).

Cocoyam are edible aroids. There are two major species and they are

1. The yaro cocoyam, colocasia esculenta (koko funfun) and
2. The yannia cocoyam, xanthosoma sagitt, folium (koko pupa)

Cocoyam produces cormes, a form of underground stem. The big central corm is surrounded by smaller ones called cormels. The cormels are the commonly used as human food. Cocoyams are fair high in water and carbohydrate contents. The starch of coco yam contains predominantly amylase and small amount of amylopectin. It is low in fat (less than 0.5%) and protein content. Proteins of cocoyam have fair amount of the essential amino acids but are low in lysine and hutidine. The peels are richer in oils than the inner content tuber. The leaves have higher nutrient content than the corms.

Limitations

-Cocoyam can be fed to livestock. However, cocoyam should be cooked before fed to livestock especially pig. The peels and leaves of cocoyam are valuable feed for ruminants (cattle goats and sheep)

-Cocoyam contains some toxic factors. Cocoyams are irritating to the body because of the presence of calcium oxalate in them. However, when boiled or roasted, the irritation disappears.
-The corms of cocoyam contain a gastrogenic substance.

SWEET POTATO

It is cultivated in both tropical and temperate areas. There are varieties. The varieties are colour yellow or red.

Fresh potatoes contain 70-80% of water. It is low in crude fibre, fat and protein. However, the protein content have high biological value and it is rich in essential amino acid. On dry basis over 90% of sweet potatoes tuber is made up of carbohydrate. The CHO is highly digestible when cooked but low when raw. Much of the starch in sweet potatoes is converted to maltose during cooking (i.e. heat, enzymatic hydrolysis and starch) and this is responsible for the sweet taste in cooked sweet potatoes.

Potato tuber is rich in carotene (especially yellow varieties), ascorbic acid (especially yellow varieties) and B-vitamin. However, storage and cooking reduce the content of vitamins. It has fair amount of ash and minerals e.g. phosphorus, calcium sodium, chloride and potassium. Its leaves are rich in protein, minerals and vitamins.

Sweet potatoes are good for all classes of live stocks. The leaves and vines of potato are useful feed for ruminants.

Sweet potato has been used in diets of pigs and can be used in poultry diets along with suitable protein supplements. The leaves and vines of potato are useful feed items for cattle. Cooked Irish potato can be used effectively in the diets of pigs.

Other energy supplier feedstuffs include

- Confectionary products
- Bakery wastes
- Cull fruits and vegetables
- Snack food waste

Kitchen/cafeteria/canteen waste

SUGARS AND SYRUPS

SUGARS: sugars are cheap and easily digested forms of energy. Sugars are obtained from sugar came and sugar beet. After extraction, the crude sugar is refined and made into cubes (crystalline sugar).

Raw sugar, obtained from chewing the cane directly, contain small amounts of protein, minerals and vitamins refined sugars are however essentially carbohydrates and lack every other nutrients. All white sugars i.e. crystalline table sugar cube sugar, icing are practically 100% sucrose and are free of any toxic factors. Brown sugar is less highly refined sucrose and contains traces of other sugars, minerals and colouring matter.

Syrups: Syrups are highly concentrated solutions in which the sugar unable to crystallize out because of the presence of small qualities of other substances. Some syrups, such as molasses and golden syrup are by-products of the manufacture of crystallize cane sugar. There syrups contain some ants of protein (0.3%), Ca (0.03%) and Fe (1.5 mg/100g). They are devoid of any other ingredients.

Molasses: Molasses are mainly by products of the manufacture of sugar from either sugar cane or sugar beets. Their sugar content is about 50-60% and water content is between 22% (beet molasses) and 27% (cane molasses)

Beet molasses is higher in C.P (7-11%) then cane molasses (3-4%). Molasses have a mineral content of 8-10% composed mainly of Na and K salts. The Ca and P content are 0.10 and 0.02% respectively (for beet molasses) and 0.8 and 0.8% (for can molasses). The thiamine and riboflavin contents are each 0.05 mg/100g while the means content is about 1.5 mg/100g. The Fe content is between 0.01 and 0.02%

The use of molasses in poultry diets is limited by its laxative effects when used at high levels. Any level above 5% is laxative. Molasses may be used to prevent dustiness in mixed feeds and in the treatment of poultry blue comb diseases because of its sugar content.

Molasses can be used at a rate of 3-5% in the diet of sows to help prevent constipation enhance feed intake. It is also used to ensile forage during silage production for ruminant animals. The difficulties in obtaining the product limit the use of molasses in animal diets. Molasses is increasingly being used by human beings. It is sometimes used in place of honey.

Honey: Honey is made by bees. Most honeys glucose and fructose known as the invert sugars. Honey also contains some protein (0.4%), minute traces of Ca (0.005%), and small amounts of

Fe (0.4 mg/100g) thiamine 0.05 mg/100g, riboflavin 0.05 mg/100g and niacin 0.2 mg/100g. Honey is an attractive, pleasant and sweet food.

Jams: Jams are prepared by boiling fresh fruit, or a pulp preserved with sulphurdi-oxide (sulphite pulp), with sugar. Depending on the antinutritional factors present in the raw materials, pectin may or may not be added. Jam is a general name for all such products.

Marmalade is synonymous to Jam in some parts of the world. In other parts, notably is a name used specifically for jams made from citrus fruits.

Most jams contain about 65-70% sugar, 0.5% protein. It also has Ca (0.02 – 0.04%), iron (1.2 mg), Vitamin A (2-10 mg/100g) and Vitamin C 10-45 mg/100g. Jams are pleasant, attractive and sweet foods.

CEREALS

Cereals are mostly used in the tropical countries are maize, rice and guinea corn and to a less extent millet and wheat.

In temperate or dry climate, whet is the, barley, oat and rye may be available for use in the diets of farm animals and human beings. Cereals are high in starches that are readily digested by animals. They are relatively low in protein content. Cereal energy constitute below 45 - 70% of the energy in poultry, swine and rabbit diets. Cereals contain fair amount of Ca, P and Fe, although the absorption of these minerals. Whole cereals contain useful amounts of B vitamins although most of these B vitamins are lost in the milling process to which the grains are subjected in the preparation of various foods from them.

They are however totally devoid of vitamin B_{12} and ascorbic acid Vitamin A activity in cereals is low except for yellow maize cereals are also deficient in the amino acid such as lysine and tryptophan.

MAIZE (Zea mays)

It is grown extensively in the country for human food as well as livestock feed. It is used for all classes of livestock. Essentially maize supply energy which is as high as 14.2 MJ/kg. It is low in protein (8-10%) depend on the variety. Its protein content is low in lysine and tryptophan. The fat content is about 4% and high in linoleic acid an essential fatty acid (about 50%) yellow maize

contain Xanthophyll which gives yellow colouration to the shank, skin, egg yolk of birds and carcass of pig fed diet containing yellow maize.

Yellow maize contains carotenoids which have pro vitamin A activity 100 – 800 mlg/100g. white maize is low in xanthophylls and lacking in vitamin A activity.

Green leaves, palm oil or synthetic colourant can be added to white maize. Niacin in maize is in bound forin and is not easily available. However, treatment with home water makes the niacin more available. Maize is used up to 60% in livestock feed. It is sometimes difficult to do 100% replacement of maize.

SORGHUM (GUINEA CORN) Sorghum guiness

It is widely grown in several parts of the world. In Nigeria, it is grown in the Northern part. Sorghum can be grown successfully on poorer soils and in drier conditions than maize. Its energy content is comparable to that from maize up to 13.79MJ/kg. Its protein content is slightly higher than that of maize. It contains low levels of xanthophylls, linoleic acid, lysine, methionine, tryptophan and fibre. It is also low in calcium but high in phosphorus. It is used to substitute maize to a reasonable extent in livestock feeding. It is also used in human food in various forms especially in the Northern part of the country.

The use of sorghum in livestock feeding is limited by its content of tannin. Although low tannin sorghum has been bred to improved its utilization in poultry. Tannins are a group of compounds that bind proteins, thus impairing protein digestion. Tannins also reduces palatability.

Guinea corn leaves are used as feed for ruminant animals. However, it must be noted that young sorghum contains cyanogenic. The glycoside occurs in the germinated plant and its contents increases as the plant matures and disappears completely when grain appears glycoside hydrolysis yield hydrocyanic acid (HCN).

RICE (*Oryza sativa*)

Rice is grown locally but principally as human food, though it is useful in livestock feeding. By products obtainable from rice includes rice husk, rice bran, broken rice, rice polishing and rice mill by products.

Rice bran consists of the pericarp or bran layer and germ. The fat and linoleic acid contents of rice bran are relatively high. The protein content is between 12 and 13%.

Rice polishing is obtained in the operation of brushing the grain to polish the rice. The protein content and linoleic content of rice polishing are higher than those of maize. The crude fibre content is low (4.1%). Its energy value is higher than rice bran.

Rice mill by-products consist of rice husk, rice bran, rice polishing and broken rice grains. Its CF may be higher than 32%. Its CP is low and fat content 5 – 6 %. Its high CF ad its low ME values discourage its use in poultry and swine diets.

Cereal grain By-products

Cereals grain by- products are obtained during the processing of grains into food and drinks for human. The by-products are used mostly for feeding livestock. Some are now processed into human foods e,g oat bran breakfast cereals. Examples of cereal by-products include:

- Wheat Bran
- Wheat Shorts
- Wheat middling
- Wheat mill run
- Rice Bran
- Rice Polishings
- Rice mill by - products
- maize Gluten meal
- Maize gluten feed
- Maize Distillers Dried grains
- Hominy feed.
- Brewer's dried grains
- Sorghum distillers grain
- Breweries dried yeast
- Torula dried yeast
- Dried Bakery products

1. Wheat Bran: wheat bran consists of the coarse, outer covering of the wheat in the usual process of commercial milling of wheat. Although of low energy value, wheat bran is useful when low calorie diets are required. It is also cheap. The crude fibre level is above

9.5%

2. Wheat Shorts: Wheat shorts consist of fine particles of wheat bran, wheat germs. Wheat flour and the offal from the tail of the mill, in the usual process of milling wheat. Because of the endosperm fraction, wheat shorts contain more energy and less crude fibre than wheat bran. It has not more than 7% Crude fibre.
3. Wheat Middling: wheat middling are essentially similar to wheat shorts except for the differences in crude fibre content. Wheat middling consist of fine particles of wheat bran, wheat shorts wheat germ, wheat flour and some of the offal from the tail of the mill. Has not more than 9.5% crude fibre.
4. Wheat mill Run: This consists of coarse wheat bran, fine particles of wheat bran, wheat flour and the offal from. The tail of the mill. The chemical content of wheat mill run are similar to those to those of wheat shorts. Not more than 9.5% crude fibre.

   Wheat mill run and the other wheat by-products are ingredients that can be used but in restricted amount in poultry and swine diets.
5. Rice bran: Rice bran is the by-product of the milling of rice to produce edible rice. Rice bran consists of the pericarp or bran layer and germ of the rice, along with small quantities of hull fragments, and some chipped, broken rice and perharps $CaCO_3$ as is unavoidable in the rice milling process but which should usually not exceed 5%. The fat and linoleic acid contents of rice bran are relatively high. The protein content is below 12 – 13%.

   The oil gram rice bran is used largely in human diets. Rice bran is relatively high. The protein content is below 12 – 13%. The oil grain rice bran is used largely in human diets. Rice bran can be used successfully to replace some part of the grain portion of some poultry and swine diets. As much as possible, rice bran should be avoided in the diets of younger poultry and pigs.
6. Rice Polishing: this is a by – products of rice obtained in the milling operation of brushing the grain to polish the rice. The protein content and linoleic acid content of rice polishing are higher than those of maize. The product is characterized by relatively low crude fibre content 4.1%. Its energy value is higher than rice brain.

   There are no special limitations to the use of rice polishing in poultry and swine diets. It is however not as available as rice brain.

7. Rice mill by – product: this consist of rice hulls, rice polishing, and broken rice grains. Rice mill by-product is in actual fact the total offal obtained in the milling of rice. Its crude fibre content should normally not exceed 32%. Its protein content is low, with fat content of 5.6%.

   Maize gluten meal: Maize gluten meal is the dried residue from maize after the removal of the larger part of the starch and germ, and the separation of the bran by the process employed in the wet willing manufacture of corn starch or syrup or by enzymatic treatment of the endosperm it may contain fermented corn extractive and/or maize germ meal.

   The energy amino acid contents of maize gluten meal are much content of maize gluten meal are much higher than those of maize gluten feed. Like maize the maize by-products are deficient in lysine and tryptophan.
8. Maize Gluten feed: This is that part of the commercial shelled maize that remains after extraction of the larger portion of the starch, gluten and germ by the processes employed in the wet milling manufacture of maize starch or syrup it may or may not contain fermented Maize extractives and or maize. Contain about 21 – 23% crude protein and 9 - 10% crude fibre.
9. Maize Distillers Dried Grains: These are derived from the fermentation industry particularly the alcohol industry. There are 2 types of maize distillers dried grains, with soluble and maize distiller's dried grains, both containing 27% Crude protein. The crude fibre (12%) is high and energy value relatively.

   Generally the distillers dried Grains and the distiller dried soluble are by-products obtained after removal of ethyl alcohol by distillation from the yeast fermentation of grains and the distillers dried soluble are by products obtained after removal of ethyl alcohol by distillation from the yeast fermentation of a grain or grain mixture.
10. Homing feed: this is a mixture of maize bran, maize germ and part of the starchy portion of the maize grain as produced in the manufacture. There have at least 5% Crude fat (ether extract). The fat of homing feed is high in linoleic acid (3.2%) and the energy content is fairly high.
11. Brewers dried grains: this is the dried extracted residue of barley alone or in mixture with other cereal grain or grain products resulting from manufacture of beer and may contain

pulverized dried spent hops in an amount not exceeding 3% evenly distributed. Because of its low energy content and high fiber content (over 18%). BDG is more suitable as cattle feed. It is also used extensively in swine production.

Other cereal by products includes sorghum distillers' grain, brewers dried yeast, torula dried yeast and dried bakery by product.

FATS AND OILS

The term fat general, referred to a group of food or feed ingredients including animal fats, vegetable oils and related compounds. Technically, fats refer to those that are

- Solid at room temperature e.g butter, fallow and land while oil is the term used to describe fats that exist as liquid at room temperature e.g. groundnut oil, corn oil etc.
- Fats and oils are concentrated sources of linoleic acid and linolenic acid (two essential fatty acids). Fats and oils may be a source of fat soluble vitamins. Most vegetable oils contain significant amounts of vitamin E. Red palm oil is a rich source of beta carotene and hence a good source of vitamin A. corn oil contain small ants of carotene. Fish liver oils, milk fat (and thus butter and milk) and animal fats generally contain vitamins A, and D. Most vegetable oils do not contain vitamins A and D.
- Fat commonly included in livestock feeds (for poultry and pigs) can be divided into 6 general groups

1. **Animal fats:-** these are rendered fats from beef or pork by-products.
2. **Blended feed grains animal fats:** these may include mixtures of beef, tallow, pork lard, poultry grease and possibly restaurant grease
3. **Poultry fat or grease: T**his is rendered fat from poultry offal.
4. **Vegetable oil:** these are oils derived from vegetable materials e.g groundnut, soybean, palm nut etc.
5. **Blended animal and vegetable fats:** these may include proportions of animal and plant fats
6. **Soapstocks:** This is also used in the manufacture of soap: these contain products not wanted in oil meant for human consumption including free fatty acids.

The use fats and oils in poultry and pig diets would depend on their price and availability relative to other energy source. Fats should be used in diets where higher energy levels are required such

as those for broiler chickens and turkey poults, weaning pigs, fast growing market hogs and lactating sows.

It is not economical to add any fat at levels above 5% in poultry and swine diets. It is however possible to use levels between 5-8% if prices are favourable. Animal tallow and restaurant greases are the most used animal fat.

All fat supplements used in animal diet should contain an anti oxidant to prevent rancidity. Contain raw oil seeds such as groundnut and soybean may deteriorate under certain circumstances. It is wise to use artificial antioxidants to preserve butylated hydroxyl toluence (BHT), butylated hydroxyl anisole (BHA), ethoxyquin, propyl galate and octylgallate.

ANIMAL PROTEIN SOURCE

It is made from dried ground, whole fish, or fish cuts, offals with or without oil extraction. There are various brands of fish meal but the commonest are those with high oil including herring, menhaden, salmon and low white fish.

FISH MEAL

It is a very common animal protein feed ingredient in use. It is a by-product of fish industry. It is usually made from whole fish. However, fish offal of high quality could also be used. Local fish meal is lower in its protein content than the imported fish meal. Crude protein content of fish meal may vary from 55 and 77% depending on the fish type use and extent of oil extraction. Calcium (3-6%) and phosphorus (1.5 – 3%) contents and micro mineral are in high content are high (i.e 3-6% and 1.5 – 3%) respectively.

Fish meal is low in fat soluble vitamin because they are extracted along with the oil. It is however, high in vitamin B complex vitamins especially vitamin B_{12}. Its biological value is very high and usually varies from 60-80%. It is a good source of sulphur amino acid i.e methionine is about 1.8%. Its lysine content is about 4.5%. Fish meal must be properly stored because of its residual oil causing rancidity.

Limitation of fish meal

1. It is usually used at a level between 0 – 5% for economic reasons.
2. High levels of inclusion may make animal go off feed.
3. Fish meal flavor may also be imparted to the carcass at higher level of inclusion.
4. Fish meal must be properly stored because of its residual oil.

BLOOD MEAL

It is a slaughter's house by products. It is prepared from fresh and clean animal blood free of all extraneous materials such as stomach content, hair and urine. The water in the blood is usually removed by parboiling. It is parboiled or mechanically dewatered the resulted semi solid blood mass is rapidly dried and ground to obtain meal.

It is high in protein (80-88%). It is an excellent source of lysine if properly prepared. It is also rich in leucine but is low in isoleucine, ash calcium and phosphorous. It can partly replace fish meal in starter diets for broiler chicks and turkey but can replace all the fish meal in broiler finisher.

Limitation

1. Badly processed blood meal may expose animal to the attack of salmonella organisms create problems of flies.
2. Its amino acid content is not well balanced. It is low in sulphur containing amino acids. Its biological value is low (i.e about 19%.
3. It is not usually utilize beyond 5% level. Higher levels make animal go off feed.
4. Over heating reduces lysine availability of protein is less digestible.

MEAT AND BONE MEAL

It is the rendered product from animal (especially mammal) tissues including bone. It excludes blood hair, hoof horn, hide trimmings, manure, stomach and rumen content.

It contains about 50% CP and it is high in fat and ash. The protein quality is variable depending on the quality of meat and amount of extraneous material. It is a good source of lysine, calcium and phosphorous but it is deficient in methionine, cystine and tryptophan.

Limitations

-Excessive processing temperature may reduce lysine availability.

-Too high levels of inclusion may result in undesirably high levels of calcium and phosphorous.

MEAT AND BONE MEAL TANKAGE

It is similar to meat and some meal except that it may contain blood or blood meal.

MEAT MEAL (MEAT SCRAP)

It is the rendered products from animal (especially mammal) tissue. It excludes bone, blood, hair, hoof, horn, hide trimmings, manure stomach and rumen content. It is similar to meat and bone

meal except that it is low by calcium and phosphorous unit than 4.4%, it is classified as meat and bone meal.

It is used at about 7-10 % dietary inclusion level. Meat meal is virtually nonexistent in Nigerian as virtually all parts of the animals are consumed

MEAT MAEL TANKAGE

It is similar to meat meal except that it contains blood or blood meal.

POULTRY BY-PRODUCT MEAL

It consists of the ground, dried, rendered parts of the carcass of slaughtered poultry such as heads, feet offals, undeveloped eggs and intestine. Feathers are not included.

It is an excellent source of protein (i.e 55% CP). It is rich in lysine tryptophan, calcium and phosphorous. The level of inclusion is as discussed for meat and bone meal.

FEATHER AND HAIR MEALS

Feather and hair are not digestible commercially available feather and hair meals are often referred to as hydrolysed feather and hair meal. This is obtained by pressure streaming undecomposed clean feathers from slaughtered poultry. Excessive heat may destroy cysteine and lysine. They are about 75% digestible.

Hydrolysed feather meal is high in cystine and threonine but deficient in lysine, methionine, histidine and tryptophan.

DRIED POULTRY MANURE

It is dried poultry excreta. Its chemical contents may vary depending on the source and age of the birds from which manure is obtained. The protein content is between 25 and 29%%, fat content 1.5 – 2.5% and fibre 14 – 20%. Lysine content 0.3 – 0.5%, methionine 0.10 and 0.15%. Dried poultry manure is used in ruminant and mongastric animal feeding.