UNIT 1 ENERGY AND PROTEIN FEEDSTUFFS

Structure

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1.0 OBJECTIVES

After studying this unit, you should be able to:

- explain the concept of essential nutrients and their functions;
- identify common conventional and unconventional energy-rich feedstuffs for use in poultry ration; and
- identify common conventional and unconventional protein-rich feedstuffs for use in poultry ration.

1.1 INTRODUCTION

The balanced feed containing all essential nutrients in appropriate amount is very much needed by poultry to produce optimum quantity and quality of egg and meat. Besides production of egg and meat, the nutrients present in poultry feed also plays vital role in the maintenance of health of the flock. A brief knowledge on different components of poultry ration and various ingredients especially of energy and protein rich feedstuffs commonly used is described in this unit which will be very much

helpful if you start a poultry farm on a small or large scale for egg or meat purpose. The success of poultry production depends primarily on feeds and feeding and therefore the information gathered through this course will also help you to run your farm for maximum return.

1.2 ESSENTIAL NUTRIENTS AND THEIR FUNCTIONS

First of all, you will learn about the different nutrients present in the feed. Like other living creatures including human beings, feed is very much required for body growth, production, reproduction and health maintenance. The feed is physically and chemically a complex material containing different ingredients that nourish living creatures called as 'nutrients'. These nutrients include carbohydrates, fats, proteins, minerals, vitamins and water. The organic nutrients are carbohydrates, fats, proteins and vitamins, whereas, the inorganic nutrients are minerals and water. Each of the nutrient and their functions are detailed below:

1.2.1 Carbohydrates

Do you know what are carbohydrates? The carbohydrates consist of carbon, hydrogen and oxygen in the proportion to form water with the general formula $Cn(H_2O)n$. You can find two forms of carbohydrates, the first one is simple form which includes sugar and the other one is complex form which includes starch. Do you know that the carbohydrate is the principal energy source in feed for poultry? Yes, it is a nutrient and produces or releases energy which can be utilized by poultry for carrying out several physiological and productive functions. Based on the digestibility, the carbohydrates are of two types:

i) **Soluble carbohydrates** - easily digestible and provides more energy.

ii) **Insoluble carbohydrates (known as crude fibre)** - not digestible and provides very less energy.

Cereals or cereal by-products are good sources of carbohydrate to the birds. Carbohydrates are digested in the stomach, absorbed from the intestine and broken down into simplest unit known as glucose during metabolism taking place in the liver of the bird. The glucose serves as a major source for energy production in the body system. For poultry, feeding this energy is usually expressed as metabolizable energy (ME) and its unit of expression is kilocalories per kilogram (kcal/kg) diet.

1.2.2 Fats

The fats are also called as lipids or oils. The supplied energy from fats is 9.4 kcal ME/kg diet which is 2.25 times more than the energy supplied by carbohydrates or proteins on weight basis. You cannot dissolve the fats in water but may do so in solvents such as alcohol, benzene, chloroform, ether, hexane etc. The fats are solid, while the oils are liquid at ordinary temperature. Hard fats include lard (fat from pigs) and tallow (fats from cattle) and are obtained from animal slaughter houses. The vegetable oils are usually of vegetable origin. The fats or lipids are digested in the stomach, absorbed from the intestine and broken down into simplest unit known as 'fatty acids' during metabolism in liver. The fats or oils also supply essential fatty acids such as arachidonic acid and linoleic acid and these can't be synthesized by the fowl. The non-essential fatty acids include linolenic acid and oleic acid. A deficiency of essential fatty acid (linoleic acid) in the ration causes poor growth, fat accumulation in the liver and increase susceptibility to respiratory infection of the fowl. The breeders'

diet deficient in this essential fatty acid produces small sized eggs and causes lower fertility and hatchability. The ME content of various fats used in poultry diet ranges from 7000-9000 kcal/kg diet. In general, the vegetable fats have higher energy values than the animal fats. The fat is also stored in the body and in eggs and is a medium for digestion of fat soluble vitamins (like vitamin A, D, E and K).

1.2.3 Proteins

The synthesis of body tissues primarily takes place with the help of proteins and therefore the proteins are components of blood, cells, enzymes, hormones, structural tissues etc. These are required for growth, body repairs, egg production and other physiological functions. The proteins present in animal or plant (vegetable) source are digested in the stomach, absorbed from the intestine and broken down into simplest unit called as 'amino acid' (AA) during the metabolism inside the liver. Though, the description of amino acid in this course is not essential but for your understanding, there are 11 essential amino acids for poultry *viz*. arginine, glycine, histidine, leucine, isoleucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. Protein deficiency leads to reduction in growth, egg production, egg weight, feed efficiency, immuno suppression and increased susceptibility to diseases.

1.2.4 Minerals

Inorganic elements found in soil, water, plants and animal tissues are called as 'minerals'**.** The minerals do not supply energy but can play an important role in metabolic processes. Some minerals are important components of bone and egg shell. Based on the amount required in the diet, minerals are often divided into two categories:

i) **Macro (Major) minerals** (expressed in per cent) include calcium (Ca), chlorine (Cl), magnesium (Mg), phosphorus (P), potassium (K), sodium (Na) and sulphur (S).

ii) **Micro (Minor/trace) minerals** (expressed in mg/kg or parts per million-ppm) include Copper (Cu), Iodine (I), Iron (Fe), Manganese (Mn), Selenium (Se) and Zinc (Zn).

If you don't provide adequate quantity of minerals in poultry rations, you may observe several deficiency signs in your flock causing leg weakness, poor body growth and thin shelled eggs. The body of the bird cannot synthesize minerals. Therefore, these have to be supplied to birds through diet. You may refer for various mineral deficiencies dealt in Unit 2 of this Block.

1.2.5 Vitamins

The vitamins are organic in nature and are essential for body growth, health, egg production and reproduction. These are required in very small quantities. Depending upon their solubility, vitamins are usually classified into two:

i) **Fat soluble vitamins** **-** Vitamin A, D, E and K.

ii) **Water soluble vitamins** - Vitamin B complex (B_1 or thiamine, B_2 or riboflavin, B_6 or pyridoxine, B_{12} or cyanocobalamin, biotin, choline, folic acid, niacin or nicotinic acid and pantothenic acid) and Vitamin C (Ascorbic acid).

Except Vitamin C, all other vitamins are not synthesized in the body. Therefore, it is necessary to add vitamins in the diets of poultry. The water soluble vitamins are not stored in the body, while the fat soluble vitamins are stored in the animal body in

significant amounts for future use, especially, when the feed sources lack in fat soluble vitamin. The unit of expression for different vitamins per kg of poultry diet has been reported as International Unit (IU) for vitamin A, International Chick Unit (ICU) for vitamin D, mg for all other vitamins such as C, E, K and B complex and microgram (mcg) for $B_{12.}$ You may also refer many vitamin deficiencies dealt in Unit 2 of this Block.

1.2.6 Water

Like other important nutrients, water is also an essential nutrient. You can understand the role of water in this way that the body of a bird can lose practically all of its fat and over half of the protein and yet live, while a loss of one tenth of its body water content results in death. Non-supply of water to young and adult birds or deprivation of water may affect adversely the performance and health of the birds and that will be reflected in low egg and meat production. The water is present in almost all parts of the body. It is an important constituent of blood, lymph and other body fluids. It plays its role in the digestion, metabolism, transport of nutrients, excretion of waste products and maintenance of body temperature. For every one kg of feed, the adult birds need 2 to 3 kg of water for proper metabolism depending upon the weather conditions.

Check Your Progress 1

Note: a) Use the space given below for your answers.

b) Check your answers with those given at the end of the unit.

1) Write True or False

i) Fat is composed of fatty acid _____

ii) Zinc is a major mineral _____

iii) Protein contains nitrogen _____

iv) Calcium is a trace element _____

v) Water is a nutrient _____

2) Name the unit of expression

i) Energy _____

ii) Protein _____

iii) Major mineral _____

iv) Trace mineral _____

v) Vitamin A _____

1.3 ENERGY RICH FEEDSTUFFS

Now, you must have understood that the poultry diets or rations are composed of different feed ingredients containing several nutrients described earlier. Though the energy is not a nutrient in convention, but it regulates various functions of nutrients and is derived through feedstuffs belonging to carbohydrate, fat and protein groups. Of various plant feedstuffs, the cereal grains, cereal by-products, agro industrial and forest by-products are usually used as energy feedstuffs. Based on their availability and use, one can divide various energy feedstuffs into common or conventional and unconventional sources.

1.3.1 Common Energy Sources

The cereals and cereal by-products are mainly energy sources and can constitute about 50-60% of the poultry diet. Some of the conventional cereals and cereal by-products are described below:

i) Maize

Maize (Fig 1.1) is also known as corn and is the most common cereal used in poultry diet due to its low fibre content (about 2%), high fat content (3-6%) and having high palatability (acceptability to taste). Yellow maize is preferred over its white variety as the yellow maize is rich in pigments (carotene-precursor of vitamin A and xanthophylls) responsible for deep yellow colouration of egg yolk and broiler skin. It contains 9-10% crude protein (CP) and 3300-3450 kcal ME/kg of energy. It can be fed up to 60% in poultry diet. While purchasing maize, you should take care of its moisture content, which should not be more than 11 to 12 %. In immature maize, chances of aflatoxin or fungal growth will be more.

Fig. 1.1: Yellow Maize

ii) Rice

Only broken rice (rice kani) or rejected lots which are unfit for human consumption are generally used as a common cereal for poultry feeding. The rice contains 7-8% protein and 2800-3000 kcal ME/kg of energy and can be included up to 10% in broiler diet and 20% in layer diet.

iii) Rice bran or Rice polish

Most important by-products obtained during milling of paddy for rice are rice bran and rice polish (Fig. 1.2). Practically, it is difficult to distinguish between bran and polish. The good quality rice bran contains 11-12% protein and 1800-2000 kcal/kg energy, while deoiled rice bran contains 12-16% protein and 1600-1800 kcal/kg energy. A good quality of rice polish contains 12-14% protein and 2600-2800 kcal/kg energy.

Fig. 1.2: Rice Polish

iv) Wheat

One of the common cereals is wheat and it contains 11-14% protein with 2900-3100 kcal/kg ME. The wheat is more digestible and a better source of amino acids, minerals and vitamin B group. Due to its maximum use as a human food, good quality wheat is not available for poultry feeding. However, if you get desired amount of wheat you can safely replace 50% of maize by wheat.

v) Wheat bran

It is the outer covering of wheat kernel and contains 14-15% protein and 1000-1400 kcal/kg energy (Fig. 1.3). It is an excellent source of amino acids, minerals and vitamins.

Fig. 1.3: Wheat bran

vi) Fats and Oils

Fats and oils are rich source of energy (7000-9000 kcal/kg). The oils are digested more readily than saturated fats like tallow. These provide energy, improve palatability, reduce dustiness etc. It can be used up to 5 % in broiler diets. Coconut oil, groundnut oil, linseed oil and soybean oil are commonly used in poultry rations.

1.3.2 Unconventional Energy Sources

In order to avoid dependency on some conventional ingredients because of non-availability, high cost etc., the nutritionists were always compelled to search for locally available alternate feedstuffs. Though, it is difficult to differentiate between conventional and unconventional feedstuffs, as some may be used in a particular area of the country due to its availability in large quantity, but may not be used widely in other areas and termed as unconventional or alternate ingredients. Some of the unconventional energy feedstuffs are described below:

i) Bajra

Bajra is also called Pearl Millet (Fig. 1.4) and contains 12-14 % protein and 2800-2900 kcal/kg energy with its inclusion level @ 30% replacing 50% maize in diet of broilers or layers.

Fig 1.4.: Bajra (Pearl Millet)

ii) Barley

The barley (Fig. 1.5) is less palatable due to more crude fibre (6-7%). It is provides less energy (2700-2900 kcal ME/kg) when compared to maize. The protein content in barley is 9-10%. An anti-nutritional factor known as â-D-glucans present in barley results in sticky droppings in broilers and layers. Soaking in water and enzyme (â glucanase) supplementation can enhance its nutritive value. Chicks are sensitive to barley; however it can be used at the rate of 20% in layer diet.

Fig. 1.5: Barley

iii) Cassava or Tapioca meal

A meal obtained from the roots of cassava plant (Fig. 1.6) is rich in energy content (2700-2900 kcal ME/kg), crude fibre (9-10%) but poor in crude protein (2-4%). Presence of cyanogenic glucosides in this meal restricts its use.

Fig. 1.6: Cassava or Tapioca

iv) Jowar or Sorghum

Jowar or Sorghum (Fig. 1.7) is comparable with maize in terms of protein (9-11%) and energy (2800-3000 kcal/kg) and it can replace maize up to 70%, but its tannin content (above 0.5% level) may limit its safe inclusion. White variety (low tannin) is preferred over dark or brown coloured (high tannin) variety.

Fig. 1.7: Jowar or Sorghum

v) Molasses

A liquid obtained from sugar milling industry is the cheapest source of energy (1800-2200 kcal ME/kg) and is rich in minerals. It can be used to replace cereal grains up to 5% of the ration (Fig. 1.8). Cane molasses is usually higher in sugar content than that from beet. It is a binding agent and you can use 2-3% in the manufacturing of pelleted feed.

Fig. 1.8: Molasses

vi) Salseed meal

Salseed meal (Fig. 1.9) is a forest-origin feedstuff and contains 9-10% protein and 2300-2800 kcal ME/kg energy. Because of its high tannin content (12-13%), you cannot use it in poultry rations in higher quantity. However, a very low level of salseed meal up to 3% can be used in the diet of poultry in raw form.

Fig. 1.9: Salseed Meal

Check Your Progress 2

Note: a) Use the space given below for your answers.

b) Check your answers with those given at the end of the unit.

1) Name any three common energy sources.

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2) Give energy content of the following feedstuffs:

i) Jowar .....

ii) Maize .....

iii) Rice Bran .....

iv) Salseed Meal .....

v) Wheat Bran .....

Activity 1

Visit a feed market or feed mixing plant, identify and note down the different types of common energy rich feedstuffs available along with their characteristics.

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1.4 PROTEIN RICH FEEDSTUFFS

After having learnt about the basic concepts on energy-rich feedstuffs, now you will learn about various protein rich feedstuffs. Next to energy rich feedstuffs, the protein rich feedstuffs constitute the second largest component in poultry rations. This can contribute about one third of a complete ration and contributes 40 to 50% of the ration cost depending upon the type of protein feed supplements. Protein feedstuffs are grouped into two main groups *viz.,* animal and vegetable origin which are as follows:

1.4.1 Common Animal Protein Sources

Some of the common protein sources of animal origin are superior in terms of amino acid concentration and protein quality and are added to poultry rations to provide sufficient quantities of protein, energy, minerals and vitamins. Some of them are discussed here.

i) Fish meal

Dried residue (about 10% moisture) of ground tissue of un-decomposed whole fish or fish cuttings or both with or without the extraction of oil is termed as fish meal (Fig. 1.10). It is the most important and good quality animal protein supplement used in poultry diet. It contains protein (45-50%), energy (2000-2800 kcal/kg) and all essential amino acids, minerals and vitamins. A good quality of fish meal should not contain salt more than 7%.

Fig. 1.10: Fish Meal

ii) Meat meal

The meat meal (Fig. 1.11) is prepared by cooking and drying the animal by-products unfit for human consumption. When the bones are added in meat meal, it is called meat-cum-bone meal, which contains 45-50% protein and 2100-2400 kcal/kg energy. It is a good source of energy, minerals, protein, vitamins etc. Proper heat treatment is required to prepare the meat meal to destroy harmful bacteria. You should not store meat meal for longer periods as it may cause spoilage by rancidity of fat.

Fig. 1.11: Meat meal

1.4.2 Unconventional Animal Protein Sources

As far as protein source is concerned, the fish meal is an animal protein and serves as an excellent source of protein in the diets of poultry. However, due to its limited availability and higher cost, it is better to search for some other alternate animal feedstuffs to use as an efficient protein supplement in poultry diets.

i) Blood meal

The blood meal (Fig. 1.12) is a product prepared by spray drying of blood in a draft of warm and dry air to a moisture content of less than 8%. It contains 74-80% protein, 2000-2400 kcal ME/kg and is good source of amino acids but not very palatable. So, it is recommended to use only 2-5% in poultry feeds.

Fig. 1.12: Blood meal

ii) Feather meal

Rich in protein content (80-85%), but is indigestible due to higher content of keratin protein. In order to improve the quality of feather meal (Fig. 1.13), it needs proper autoclaving, drying and grinding to desired fineness. Use in poultry diet is restricted to not more than 5%.

Fig. 1.13: Feather meal

iii) Hatchery by-product meal

Infertile eggs, dead embryos, killed chicks and egg shells are cooked (autoclaved), dried and ground to a desired fineness. It contains 30-35% crude protein and may be used up to 2-3% in poultry ration.

iv) Poultry by-product meal

Obtained by dry or wet rendering of clean carcass of slaughtered poultry (Fig. 1.14). It contains non-edible parts such as head, feet, undeveloped eggs and intestine. The protein content is 56% and can be used up to 5% in chick or broiler ration and 7.5% in layer ration.

Fig. 1.14: Poultry by-product meal

v) Silkworm pupae meal

Major by-product of silk industry is deoiled silkworm pupae meal which contains about 45-48% protein and 2400-2600 kcal/kg energy. It can replace 100% fish meal in chick ration and 50% fishmeal in layer diet.

1.4.3 Common Vegetable Protein Sources

Vegetable proteins make major portion of protein requirements of growing and laying birds. Though, they have better digestible protein quality, but the presence of some anti-nutritional factors in vegetable proteins restrict it's use in poultry diets.

i) Canola/Mustard/Rapeseed meal

Canola, mustard and rapeseed are commonly called as mustard (Fig. 1.15). Its protein content ranges from 36 to 40% depending upon type of its processing and is relatively lower than that of groundnut cake (GNC) or soybean meal (SBM). Energy

content varies from 2400-2600 kcal/kg. Rapeseed meal (RSM) is deficient in lysine. The meal contains toxic material known as glucosinolates or thioglycosides. The glucosinolates being unpalatable on hydrolysis release goitrogen and limit the body tissue growth, inhibit thyroid metabolism and cause enlarged thyroid known as goiter. The presence of another anti-nutritional factor known as erucic acid and sinapin that can limit the safe use of meal in poultry ration beyond 10% level.

Fig. 1.15: Rapeseed meal

ii) Cottonseed meal

Ranking third among the total oilseed meals produced, the cottonseed meal (Fig. 1.16) is rich in protein content (35-40%) and contains 2000-2200 kcal ME/ kg energy. It has higher fibre content (11-13%) and deficient in lysine, methionine, threonine and tryptophan. It can replace half of the usual amount of soybean meal in grower poultry rations, but further use must be restricted because of gossypol and sterulic acid contents. Gossypol levels more than 0.04% will be harmful and causes discolouration (olive-green colouration) of egg yolk, particularly during storage as a result of chemical reaction between gossypol and iron in the egg.

Fig. 1.16: Cottonseed meal

iii) Groundnut cake

The groundnut cake (GNC) is also known as peanut cake/meal (Fig. 1.17) and is a good source of vegetable protein (38-42%) and energy (2600-2900 kcal/kg). Two types are available *viz.*, expeller pressed and solvent extracted meal. Deoiled GNC is slightly more in protein (40-48%), but low in energy and deficient in cystine, lysine, methionine and tryptophan.

Fig. 1.17: Groundnut Cake

iv) Sesame cake

It is also known as Til cake or Gingely oil cake (Fig. 1.18). Sesame is a minor oilseed crop containing 35-40% protein in expeller pressed and 40-45% protein in

solvent extracted. The ME content varies from 2400-2700 kcal/kg in expeller and 2000-2200 kcal/kg in solvent extracted. It is an excellent source of cystine, methionine and tryptophan, but very low in lysine and threonine. It contains high levels of anti-nutritional factors such as oxalic acid and phytic acid responsible for poor bioavailability of minerals.

Fig. 1.18: Gingely oil cake

v) Soybean meal

It is an excellent source of protein (45-48% in dehulled and 40-45% in hulled variety). The energy content may vary from 2400-2600 kcal/kg in dehulled and 2200-2400 kcal/kg in meal with hulls. The soybean meal (Fig. 1.17) is an excellent source of lysine, tryptophan and threonine, but deficient in methionine. The raw soybean seeds contain anti-nutritional factor known as anti-trypsin (trypsin inhibitor) and other substances which are growth inhibitors. Proper heat processing inactivates these compounds. Roasting of soybeans also increases its nutritive value and palatability in broiler ration.

Fig. 1.19: Soybean meal

vi) Sunflower meal

The sunflower meal is also known as sunflower cake or sunflower seed meal or Sunflower seed cake. Its composition varies due to level of dehulling and oil extraction method. The expeller dehulled meal contains 26-28% crude protein, 1900-2100 kcal ME/kg and 20% crude fibre, whereas, the solvent extracted meal contains 28-30% protein, 1700-1900 kcal ME/kg and 25% fibre. High crude fibre content and presence of chlorogenic acid as anti-nutritional factor restricts its use in poultry ration.

1.4.4 Unconventional Vegetable Protein Sources

Non-availability and rising cost of conventional vegetable protein sources always necessitate the search for an alternate or unconventional sources from plant kingdom to serve as a protein supplement. Their uses are possible but due to the presence of some anti-nutritional or toxic principles you have to use them very cautiously and for that a brief knowledge is very much essential.

i) Coconut meal

The coconut meal is also called as copra meal. It contains relatively low protein (19-23%) and energy (1200-1600 kcal ME/kg). Due to high crude fibre (12-14%) and low lysine and methionine contents, the meal can be fed only up to 5% for chicks and 10% for layers.

ii) Guar meal

The guar meal is a by-product of guar gum industry and contains 35-45% protein,

but low in energy (1800-2200 kcal/kg). Its residual gum, mucilages and anti-trypsin factor (anti-nutritional factor) may affect its safe use in poultry diet. It can be fed up to 5 to 10% in poultry diet.

iii) Linseed meal

The meal is obtained after removal of oil from linseed. It contains 8-10% crude fibre, 28-30% crude protein and energy of 1600-1800 kcal/kg. Anti-nutritional factors present in the meal like cyanogenic compound (linamarin), antipyrodoxine (linatin) and mucilages results in reduced growth. You may observe toxic signs in birds if you feed them with this meal in excess of 2-3% of the diet. Water treating by soaking and drying inactivates the inhibitor, but not feasible to use because of its relatively high cost.

iv) Maize gluten meal

The maize gluten meal (MGM) is also called as Corn gluten meal (Fig 1.20). It contains 40-60% protein, 2500-2800 kcal/kg energy and is an excellent source of methionine and xanthophylls, but is deficient in arginine, lysine and tryptophan. You can use MGM in layer ration up to 25% without any adverse effects.

Fig 1.20: Maize gluten meal

v) Neem kernel meal

The crude protein content in neem kernel meal or neem seed meal or neem seed cake varies from 30 to 35% and crude fibre from 10 to 30% depending on the type of the processing. The meal contains energy of 1500-1700 kcal ME/kg. The cake or meal is bitter in taste and contains many harmful substances such as nimbin, nimbidine etc. Raw unprocessed meal can be fed to broilers up to 10% and layers up to 20%. Alkali, alcohol, hexane and urea may be used as chemicals to detoxify the meal.

vi) Niger meal

The niger meal is also known as ramtil cake and contains 32-36% protein and 2000-2400 kcal ME/kg. It can be used as a substitute to groundnut cake on part basis. It can be used up to 10% in broiler diet and 15% in layer diet.

For your easy understanding, the common and unconventional energy and protein feedstuffs along with their crude protein and energy contents are summarised in Table 1.1.

Table 1.1: Common and unconventional energy and protein feedstuffs along with their crude protein and energy contents

Ingredient	Crude Protein (%)	Energy (kcal ME/kg)
Common Energy Sources		
Maize	9-10	3300-3450
Rice	7-8	2800-3000
Rice Bran	11-12	1800-2000
Rice Bran (Deoiled)	12-16	1600-1800
Rice Polish	12-14	2600-2800
Wheat	11-14	2900-3100
Wheat Bran	14-15	1000-1400
Fats and Oils	-	7000-9000
Unconventional Energy Sources		
Bajra	12-14	2800-2900
Barley	9-10	2700-2900
Cassava or Tapioca Meal	2-4	2700-2900
Jowar or Sorghum	9-11	2800-3000
Molasses	-	1800-2200
Salseed Meal	9-10	2300-2800
Common Animal Protein Sources		
Fish Meal	45-50	2000-2800
Meat Meal	45-50	2100-2400
Unconventional Animal Protein Sources		
Blood Meal	74-80	2000-2400
Feather Meal	80-85	-
Hatchery by-product Meal	30-35	-
Poultry by-product Meal	56	-
Silkworm pupae Meal	45-48	2400-2600
Common Vegetable Protein Sources		
Mustard/Rapeseed Meal	36-40	2400-2600
Cottonseed Meal	35-40	2000-2200
Groundnut Cake	38-42	2600-2900
Groundnut Cake (Deoiled)	40-48	-
Sesame Cake (Expeller Pressed)	35-40	2400-2700
Sesame Cake (Expeller Pressed)	35-40	2400-2700
Sesame Cake (Solvent Extracted)	40-45	2000-2200
Soybean Meal (Dehulled)	45-48	2400-2600
Soybean Meal (With Hull)	40-45	2200-2400
Sunflower Meal (Expeller Dehulled)	26-28	1900-2100
Sunflower Meal (Solvent Extracted)	28-30	1700-1900
Unconventional Vegetable Protein Sources		
Coconut Meal	19-23	1200-1600
Guar Meal	35-45	1800-2200
Linseed Meal	28-30	1600-1800
Maize Gluten Meal	40-60	2500-2800
Neem Kernel Meal	30-35	1500-1700
Niger Meal	32-36	2000-2400

Check Your Progress 3

Note: a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) Indicate True or False

   i) Glucosinolates are present in groundnut cake .....

   ii) Gossypol is present in soybean meal .....

   iii) Meat meal is an animal protein source .....

   iv) Nimbin is an adverse factor present in neem seed meal .....

   v) Til cake is a vegetable protein source .....

2) Give alternate name of following feedstuff

   i) Canola meal .....

   ii) Corn gluten meal .....

   iii) Groundnut cake .....

   iv) Niger meal .....

   v) Sesame cake .....

Activity 2

Visit a feed mixing plant, identify and note down the different types of common and unconventional animal and vegetable protein sources available along with their characteristics.

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1.5 LET US SUM UP

The balanced feed containing all essential nutrients in appropriate amount is very much needed by poultry to produce optimum quantity and quality of egg and meat. Like other living creatures including human beings, feed is very much required for body growth, production, reproduction and health maintenance. The feed is physically and chemically a complex material containing different raw ingredients giving several small and distinct groups that nourish living creatures called as 'nutrients'. The organic nutrients are carbohydrates, fats, proteins and vitamins, whereas, the inorganic nutrients are minerals and water. Cereals and cereal by-products are good sources of energy, whereas, animal proteins and vegetable proteins supply protein. The common energy sources are maize, rice, rice bran, wheat, wheat bran, fats and oils. Some of the common unconventional energy sources are bajra, barley, cassava or tapioca meal, jowar or sorghum, molasses and salseed meal. The common animal protein sources are fish meal and meat meal. Some of the unconventional animal protein sources are blood meal, feather meal, hatchery-by-product meal, poultry by-product meal and silkworm pupae meal. The common vegetable protein sources are rapeseed meal, cottonseed meal, groundnut cake, sesame cake, soybean meal and sunflower meal. The unconventional vegetable protein sources include coconut meal, guar meal, linseed meal, maize gluten meal, neem kernel meal and niger meal.

1.6 GLOSSARY

Amino Acid : The simplest unit of nitrogenous protein nutrient.

Anti-nutritional : Anti-nutritional are those substances or factors which reduce nutrient utilization or feed intake in birds and animals.

By-product : A product made during the manufacture of something else.

Carbohydrates : Chemical compounds containing carbon, hydrogen and oxygen and serves as a major source of energy in poultry feeds.

Crude Fibre : A crude fibre is the indigestible portion (not very useful) of carbohydrates present in plant materials. The higher the fibre, the lower the energy content in feed and making the diet more unpalatable.

Crude Protein : Crude Protein is the organic nitrogenous nutrient and essential constituent of living organism. The total amount of protein present in the feed can be estimated and calculated by multiplying the total nitrogen present by 6.25.

Energy : In poultry nutrition, the energy is a nutrient which is released by metabolism of carbohydrates, fats and proteins.

Hull : The dry outer covering of a fruit, seed, or nut.

Metabolizable Energy (ME) : Metabolizable energy is the digestible energy intake minus the energy in the urine, minus the energy in the gaseous product of digestion. It can vary from feed to feed and is expressed in kcal/kg.

Mineral : Inorganic element present in soil, feed, water having various physiological functions.

Nutrient : An element, compound or group of compounds that can be used as nourishment by a living creature.

Palatability : Acceptable to the taste; sufficiently agreeable in flavour to be eaten.

Protein : A complex compound containing carbon, hydrogen, oxygen, nitrogen and usually sulphur are composed of one or more chains of amino acids. Proteins are essential in the diet of animals for growth, production and reproduction.

Vitamin : Organic nutrient needed in minute quantity to sustain life of birds and present in feeds.

1.7 SUGGESTED FURTHER READING

Banday, M.T. and Mondal, S.S. 2002. *Poultry Feeding and Nutrition*. Pixie Publication India (P) Ltd., Karnal.

Mandal, A.B., Yadav, A.S., Johri, T.S. and Pathak, N.N. 2004. *Nutrition and Disease Management in Poultry*. International Book Distributing Company, Lucknow.

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Mandal, A.B., Elangovan, A.V., Tyagi, Praveen K., Tyagi, Pramod, K. and Rajvir Singh. 2004. *Feedstuffs for Livestock and Poultry*. Lead Centre NATP (RNPS-16), Central Avian Research Institute, Izatnagar.

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Saxena, U.C. 2000. *A Handbook of Poultry Feeding and Management*. Pixie Publication India (P) Ltd., Karnal.

1.9 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1) i) True
   ii) False
   iii) True
   iv) False
   v) True

2) i) kcal/kg
   ii) per cent
   iii) per cent
   iv) mg/kg or ppm
   v) International Unit (IU)

Check Your Progress 2

1) Three common energy sources are Maize, rice and rice bran.

2) i) 2800-3000 kcal/kg
   ii) 3300-3450 kcal/kg
   iii) 1800-2000 kcal/kg
   iv) 2300-2800 kcal/kg
   v) 1000-1400 kcal/kg

Check Your Progress 3

1) i) FALSE
   ii) FALSE
   iii) TRUE
   iv) TRUE
   v) TRUE

2) i) Mustard cake/Rapeseed meal
   ii) Maize gluten meal
   iii) Peanut cake
   iv) Ramtil cake
   v) Til cake