6. FEEDS AND FEEDING

Can you recall ?

1. **Which nutrients are present in our food ?**
2. **Role of proteins, carbohydrates, lipids, vitamins and minerals in animal body.**
3. **What are the common sources of water for farm animals?**

6.1 FEED NUTRIENTS

The animal body derives all its required nutrients for various physiological functions of the body from the food it eats. In order to understand the science of livestock feeding, it is necessary to know certain facts about these feed nutrients, their contents in the feed-stuff and requirements, functions and symptoms of deficiencies in the animals. This topic deals with the basic study of the nutrients like water, proteins, carbohydrates, lipids, vitamins and minerals present in the animal feed.

Feed nutrient is a substance or any food constituent that nourishes the body and helps in maintenance, growth, production and reproduction of an animal.

6.1.1 Water

Can you tell ?

Why animals drink water?

Water plays vital role in almost all life processes. It is the simplest, readily available and cheapest feed nutrient. In cattle, water is approximately 75 to 80 per cent at birth, 68 to 72 per cent at 5 months and 50 to 60 per cent of body weight in the mature animals. Though not acting as a source of energy, water ranks far above all other nutrients in the body as regards the rate of turnover and is the most important single nutrient for the regulation of life and required in highest amount. Its shortage adversely affects the productive capacity of the animals, particularly in milk producing animals. In summer cool water has beneficial effect.

Remember...

- **In the absence of water an animal would die comparatively in a short time compared to any other nutrients.**

Sources of water for animals

1. *Drinking water :* This is a major source of water and contributes about 75-80 per cent of the total water requirement.
2. *Water available from feeds and fodders* : The water content in various feeds of plant origin is taken by the animals through their feeding. Green fodders supply 75 – 90 per cent water, while dry fodders and cereal grains and their by-products provide 8-10 percent, and oil cakes 10-12 per cent water. It contributes about 10-15 per cent of the total water requirement of the animal.
3. *Metabolic water :* Animals also obtain water resulting from the oxidation of food is called metabolic water. It contributes about 5 – 10 per cent of the total water requirement.

Remember...

Each gram of carbohydrates, protein and fat yields about 0.6, 0.4 and 1.1ml of metabolic water respectively.

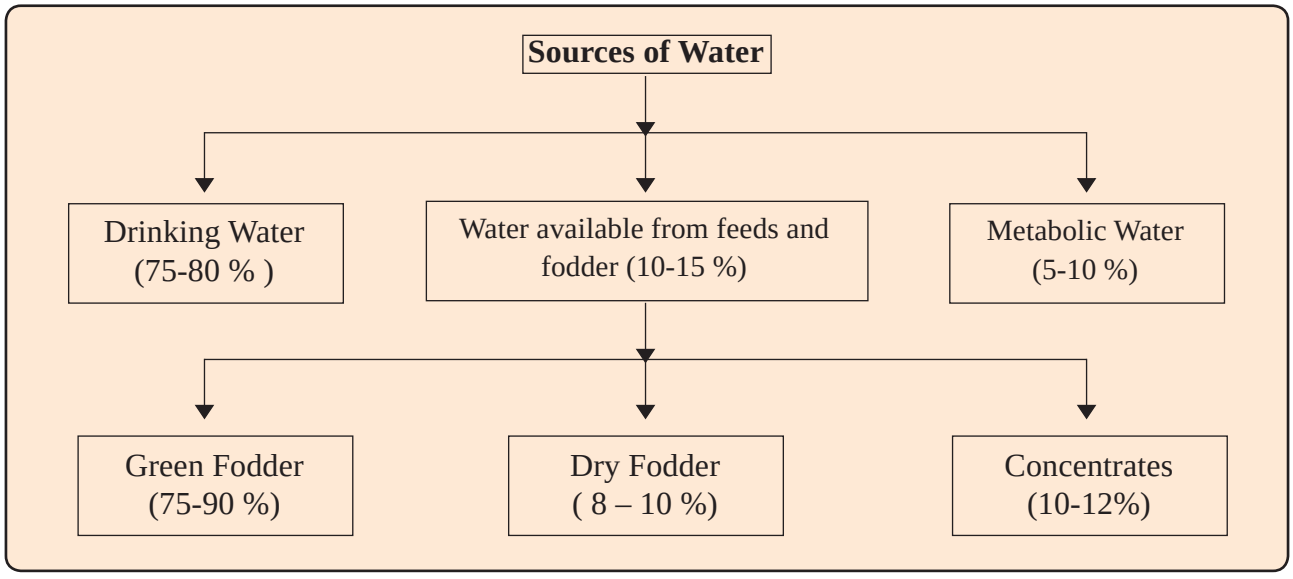


Fig 6.1 Sources of Water

Functions of water

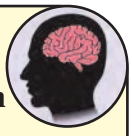
1. It is a major component of various body fluids like blood, urine, saliva, lymph and tears.
2. It is an important constituent of every living tissue.
3. It is an ideal solvent for nutrients.
4. It plays important role in thermoregulation of the body.
5. It makes the acid-base equilibrium in the body.
6. It is required in the metabolism by way of oxidation of nutrients.
7. It helps in the transportation of nutrients and hormones through blood to all the tissues.
8. It helps in the excretion of metabolic waste and toxic products from the kidney.
9. It also keeps the gastro-intestinal, reproductive and uro-genital tracts moist.
10. It helps in the transmission of sight and sound due to its refractive characteristics.
11. It acts as a cushion for the joints in the form of synovial fluid and for the nerves as a cerebrospinal fluid

Do you know ?

- **Why you drink water?**

6.1.2. Proteins

Can you recall ?



1. **Who coined the term "Protein"?**
2. **Deficiency symptoms of proteins in our body.**

Proteins are defined as complex organic nitrogenous compounds consisting of various amino acids joined together by peptide linkage. Chemically, all the proteins contain C, H, O, N and generally sulfur and occasionally phosphorous, iron, zinc and copper.

Classification of Proteins

On the basis of chemical composition, solubility and shape, proteins are classified as:

1. **Fibrous Proteins:** These insoluble animal proteins are resistant to animal digestive systems and are composed of elongated,

filamentous chains joined up by cross linkages. They are Collagens, Elastins and Keratins.

2. **Globular Proteins:** This group includes all the enzymes, antigens and hormones having proteins. They are Albumins, Globulins, Lacto globulins, Histones and Protamines.

3. **Complex Proteins***:* These are composed of simple proteins combined with non-proteins substances called 'prosthetic' group. They are Phospho-proteins, Glycoproteins, Lipoproteins, Chromoproteins, Nucleoproteins and Metalloproteins

Functions of Proteins

Can you recall ?

The sources of protein required for your body

1. They are structural and functional unit of animal cell.
2. Being constituent of enzymes, they act as catalytic agents in different kinds of chemical reactions.
3. Proteins stored as amino acids act as food nutrient for growing embryo, e.g. ovalbumin of egg white.
4. They are constituent of **haemoglobin and myoglobin** which help in transport of O_2 in blood and muscle cells, respectively.
5. Blood plasma proteins viz. **thrombin and fibrinogen** help in clotting of the blood.
6. They are component of antibodies, e.g. lacto-globulin in colostrum.
7. *Keratin* (Structural protein) is responsible for giving structure to skin, hooves, feathers.
8. They are important constituents of milk (Caesin) and egg (Albumin).
9. They are the components of hormones like **insulin** and **thyroxine**.
10. They act as energy source.

Remember...

One gram of protein yields about 4.08 Kcal of energy.

Internet my friend

- **Functions of essential amino acids.**

Amino Acids

Amino acids are the building blocks of protein structure and determine many of the properties of protein. They are produced when proteins are hydrolysed by enzymes, acids or alkalies.

Plants, ruminants and many micro-organisms are able to synthesize the amino acids and consequently the proteins from simple non-protein nitrogenous compounds (NPN) such as nitrates but monogastric animals cannot synthesize the amino acids in sufficient amounts required to build their body proteins, therefore it must be provided through a dietary source referred as essential amino acids. While some are synthesized in their body and hence need not to be supplied through the diet are referred as non-essential amino acids.

In ruminants all the amino acids required are synthesized in required amounts and proportion by the rumen-micro-organisms, thus making this class of animal independent of a dietary source.

The essential amino acids for the poultry birds are: Threonine, Valine, Leucine, Lysine, Histidine, Arginine, Phenylalanine, Tryptophan, Iso-leucine, Methionine and Glycine.

Table 6.1 Difference between essential and nonessential Amino acids

Essential Amino acids	Nonessential Amino acids
1. They are not synthesized in the body in adequate amount.	1. They are synthesized in the body in adequate quantity.
2. They are to be essentially supplied through diet.	2. They are not essentially required to be supplied through diet.
3. These are also called indispensable amino acids.	3. These are also called dispensable amino acids.
4. Examples are: Arginine, Histidine, Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Threonine, Tryptophan and Valine.	4. Examples are: Alanine, Asparatic acid, Cystine, Glutamicacid, Citrulline, Glycine, Hydroxyproline, Proline, Serine and Tyrosine

6.1.3 Carbohydrates

Carbohydrates are defined as polyhydroxy aldehydes or ketones. Chemically they contain carbon, hydrogen and oxygen.

Can you recall ?

- **Who discovered carbohydrates?**
- **What is the another name for carbohydrates?**

Classification of Carbohydrates

The carbohydrates, based on their chemical structures, are usually classified in two major groups as:

1. Sugars 2. Non-sugars

1. Sugars: All the sugars are either monosaccharides or oligosaccharides. Depending upon the number of carbon atoms present in their molecule, the mono saccharides are divided into trioses, tetroses, pentoses, hexoses and heptoses containing 3, 4, 5, 6 and 7 carbon atoms, respectively. The oligosaccharides include all the sugars other than monosaccharides and have disaccharides, trisaccharides and tetrasaccharides depending on the number of mono saccharides from 2 – 10.

2. Non- Sugars: This group includes those carbohydrates which have high molecular weight and are tasteless, insoluble and amorphous and have more than 10 mono saccharides. They are further divided into two sub-groups, namely

a) **Polysaccharides or Glycans :** These are the polymers of large number of mono saccharides units. e.g. Starch, Cellulose

b) **Complex carbohydrates :** These are the compounds containing carbohydrates and non-carbohydrates molecules. e.g. Glycolipids and Glycoproteins.

Functions of Carbohydrates

1. They are major source of energy to the animals.

Remember...

One gram of carbohydrate yields 4.18 kcal energy.

Table 6.2 Difference between monosaccharides and oligosaccharides

Mono saccharides	Oligosaccharides
1. They consist of single polyhydroxy aldehyde. 2. Examples a. Trioses → Glyceraldehyde b. Tetroses →Erythrose c. Pentoses →Arabinose, Xylose, Xylulose, Ribose and Ribulose d. Hexoses → Glucose, Fructose, Mannose and Galactose e. Heptoses → Sedoheptulose	1. They consist of more than one and less than 10 monosaccharide units. 2. Examples a. Disaccharides → Sucrose, Lactose, Maltose, Cellobiose and Treholose b. Trisaccharides → Raffinose c. Tetrasaccharides → Stchyose

2. They are the components of amino acids and glycoproteins, glycolipids and fatty acids.
3. They are constituent of RNA and DNA.
4. They are present in milk as lactose.
5. They play role in the synthesis of milk fat.
6. They form the bulk in the rumen and satisfy the hunger.

5. Lipids

Can you recall ?

Who coined the term "Lipid"?

Lipids are water insoluble organic bio molecules found in plant and animal tissues. Unlike polysaccharides and proteins, lipids are not polymers and contain carbon, hydrogen and oxygen but relatively much richer in first two. Lipid is a collective term used for wide variety of substances that vary from simple short chain fatty acids to large very complex molecules.

Classification of lipids

Based on chemical structure, lipids are classified into following three groups

1. **Simple lipids:** These are the esters of fatty acids with various alcohols. Fats and oils are constituents of both plants and animals, both have same chemical structure and chemical properties but differ in their physical properties i.e. oils are liquid and fats are solid at room temperature. Waxes are the esters of fatty acids with alcohol other than glycerol. Free fatty acids play important role in animal physiology.
2. **Compound lipids:** These are the esters of fatty acids containing other non-fatty prosthetic groups in addition to an alcohol and fatty acids. The best examples of phospholipids are fats containing phosphoric acids and N (e.g. Lecithin, Cephalin and Plasmogens) and Glycolipids

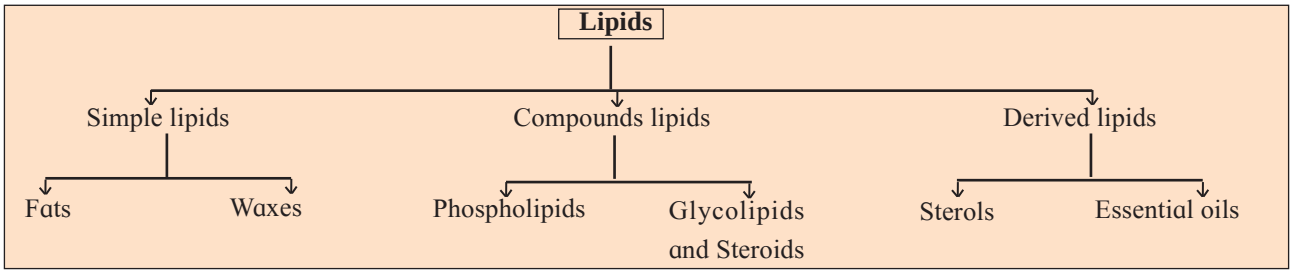


Fig. 6.2 Classification of Lipids

are fats containing carbohydrate and often N (e.g. Glycolipids and Galactolipids). Compound lipids consists of simple lipids combined with non-lipids.

3. **Derived lipids:** They are derived from compound lipids. The best examples are sterols, essential oils, fatty acids and alcohols.

Remember...

One gram of fat produces about 9.3 kilo calories of energy.

Functions of Lipids

1. They are rich source of energy and supply about 2.25 times more energy than carbohydrates and proteins.
2. They carry fat soluble vitamins i,e Vitamin A,D,E, and K.
3. They provide insulation to the vital organs and lubrication to the gastro-intestinal tract.
4. They improve the taste and palatability of the food and delay the sensation of hunger.
5. They regulate the heat as they are deposited in subcutaneous tissue and being a poor conductor of heat
6. They act as reserve food material; on account of their insolubility in aqueous solutions.
7. They supply all the fatty acids which are physiologically important as
   - i) Phospholipids play an important role in absorption and transportation of fatty acids and fat soluble vitamins.
   - ii) The synthesis of hormones like adrenocorticoids, sex hormones and steroids and bile.
   - iii) Cholesterol is an important constituent of brain.

6.1.5 Vitamins

Can you tell ?

What do vitamins do for our body?

Introduction to scientist

Casimir Funk (1884-1967): He was a Polish biochemist first to formulate the concept of vitamin, Which he called "Vital amines" or "Vitamines" in the year 1912

Vitamins (vital + amine) are the organic substances needed in minute quantities but are essential for various metabolic processes in the animal body. There are at least 15 vitamins which have been accepted as essential food factors. The system of naming the vitamins by alphabet is still widely used. However, now-a-days, their chemical names are accepted worldwide. Vitamins have no chemical resemblance to each other, but they have similar general functions in the metabolism. Most of the vitamins have been artificially synthesized. Some of the vitamins are synthesized in the body of some animals.

Remember...

In ruminants, the rumen microbes are capable of producing B vitamins required to support the tissue needs.

Classification of vitamins

Vitamins are generally divided into fat soluble (Vit. A, D, E and K) and water soluble (Vit. B groups and C) groups depending on their solubility and associations with fat or water.

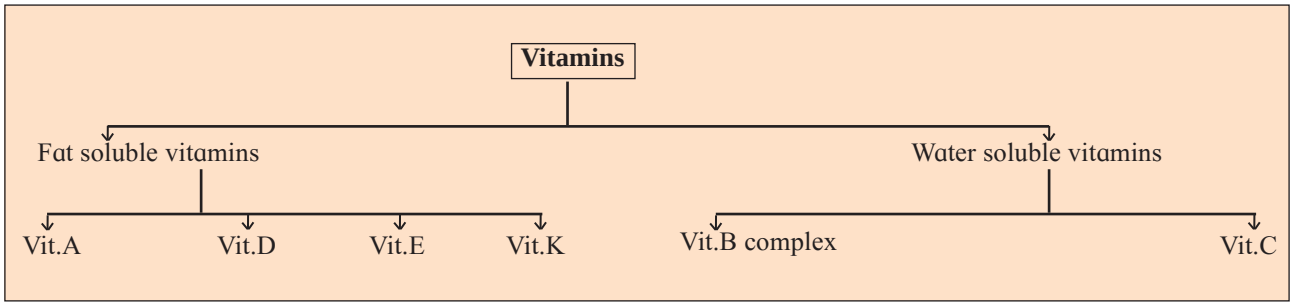


Fig. 6.3 Classification of Vitamins

Remember...

Rumen synthesizes all the water soluble vitamins, (Vit. B complex and Vit. C) hence they are not dietary essential vitamins.

Importance of vitamins

1. They are required for proper metabolism of proteins, carbohydrates, fats and minerals.
2. They are helpful in digestion.
3. They are essential for normal growth, health and maintenance.
4. They provide immunity against diseases.
5. They are constituents of some co-enzymes.

Table 6.3 Differences between Fat-soluble and Water-soluble Vitamins

Fat soluble Vitamins	Water soluble Vitamins
1. Structurally they contain C, H, and O	1. Their chemical structure contain C,H, O and N, S, or Co.
2. They are soluble in fats.	2. They are water soluble.
3. They are stored in good quantity wherever fat is stored.	3. They are not stored anywhere in the body
4. They are absorbed from the GI tract in presence of fat.	4. They are absorbed along with water from GI tract.
5. They are required for the regulation of metabolism of the structural units. Each vitamin has one or more independent and specific role.	5. They are collectively concerned mainly with the transfer of energy in every cell.
6. Following metabolic use, they are excreted through faeces.	6. Following metabolic use, they are excreted through urine.
7. e.g. Vitamin A,D,E & K	7. e. g. Vit. B Complex and C

Table 6.4 Sources, functions and symptoms of deficiencies of vitamins in livestock

Vitamin	Sources	Biological functions	Symptoms of deficiencies
Vitamin A (Retinol) *Anti-xerophthalmic factor*	• Green forage, • Yellow maize, • Green pastures.	1. Required for normal vision as it synthesizes rhodopsin. 2. Maintains integrity and activity of epithelial cells and bony tissues. 3. Helps in keeping the fertility normal. 4. Protects the body from infections by maintaining the normal epithelial lining.	1. Deficiency symptoms occur in animals on high cereals and dry roughages. 2. Mild deficiency results in 'night blindness' 3. Xeropthalmia i.e. excessive watering, softening and cloudiness of cornea resulting in absence of vision 4. Blindness in calves. 5. Dry, rough and scaly skin. 6. Infertility and abortions.
Vitamin D *Anti-rachitic factor*	• Sun dried roughages, • Egg yolk, • Fish • Colostrum	1. Helps in the absorption of calcium and phosphorous from the gastrointestinal tract. 2. Enhances re-absorption of Ca and P from kidney. 3. Required for deposition of Ca and P in bones.	**1. Rickets** in young animals characterized by bending of legs, enlarged and painful joints. 2. **Osteomalacia** in adults characterized by lameness, bone deformities and weakness of bones.
Vitamin E (Tocopherol) *Anti-sterility factor*	• Vegetable oils • Green fodders • Germinated • Cereal grains • Fish meal.	1. Acts as antioxidant of cell membranes. 2. Prevents the formation of peroxides(harmful products) 3. Essential for the normal function of muscles.	1. Muscular dystrophy or White muscle disease in calves, resulting in degeneration and necrosis of the muscles. 2. Stiff lamb disease in lambs. 3. Infertility in males and females

Vitamin K *Coagulation factor*	• Green leafy materials • Egg yolk • Liver and fish meal.	1. Required for blood coagulation	1. Deficiency results to increased coagulation time
Thiamin (Vitamin B_1)	• Brewers' yeast, • Green pastures/ fodders, • Milk • Cereal grains, • Egg yolk.	1. Thiamine helps in enzyme system for the synthesis of fats from proteins. 2. It has potential role in oxidation of sugar in tissues including brain.	1. Loss of appetite 2. Retarded growth 3. Weakness typical neuritis 4. Diarrhoea in pigs and calves
Riboflavin (Vitamin B_2)	• Brewers' yeast, • Green pastures/ fodders • Milk and milk products especially whey.	1. Helps to oxidize substrate to generate ATP within the mitochondria. 2. Mediates the first oxidative step in the oxidation of fatty acids.	1. Alopecia (hair loss), 2. Dry and scaly skin, 3. Poor appetite, 4. Retarded growth, 5. Diarrhoea
Niacin **(Vitamin B_3)**	• Green Lucerne • Leafy vegetables • Yeast • Poultry-products.	1. Two niacin containing coenzymes are required for the metabolism of carbohydrates, proteins and fats.	1. Black tongue in dogs 2. Poor growth, 3. Skin lesions, 4. Diarrhoea in pigs
Pantothenic acid (Vitamin B_5**)**	• Molasses • Wheat bran • Peas • Egg yolk • Yeast • Milk	1. It has stimulating effect on central nervous system. 2. Being precursor of cholesterol, Coenzyme A is involved in the synthesis of steroid hormones	1. Slow growth, 2. Dermatitis, 3. Loss of hair 4. Diarrhoea. 5. Goose stepping in pigs 6. Premature graying of hair in dog

Pyridoxine (Vitamin B_6)	• Cereal grains and by-products • Brewer's yeast • Rice bran • Pulses • Milk	1. Required for protein metabolism. 2. Required in the absorption of amino acids from the intestine. 3. It helps in the synthesis of fats from proteins and carbohydrates.	1. Dermatitis 2. Retarded growth 3. Anaemia 4. Incoordination of movements and convulsions. 5. Diarrhoea
Folic acid (Vitamin B_9)	• Green leafy vegetables • Cauliflower • Cereals • Extracted oil-seed meals • Animal protein meals	1. Essential for the synthesis of DNA in the cells 2. It takes part in the formation and maturation of the RBC. 3. Along with the vitamin$B_{12,}$ it helps in the synthesis and metabolism of nucleic acid.	1. Poor growth and reproductive failure 2. Reduced appetite and anaemia
Cyanocobalamin (Vitamin B_{12}) APF(Animal Protein Factor)	• Chiefly foods of animal origin i.e. milk, fish, fish meal • Brewer's yeast, kidney, beef extract • Fungus *Streptomyces griseus*	1. It has major enzymatic role in the one-carbon metabolism and synthesis. 2. The coenzyme form of vitamin B_{12} function in several important enzyme systems. 3.Vitamin B_{12} alone is necessary for the synthesis of RNA.	1. Poor appetite and growth in young calves 2. Reproductive failure 3. Anaemia.
Vitamin C (Ascorbic acid)	All citrus fruits	1. Ascorbic acid is a strong reducing agent; 2. It is essential for collagen formation. 3. It is an important antioxidant.	**1. Dental carries:** Spongy haemorrhagic friable gums, loose teeth. 2. Poor healing of wounds 3. Reproductive failure in both males and females.

6.1.6 Minerals :

Can you tell ?

Why do you need minerals ?

Minerals represent the inorganic component of the animal body which contains about 3 per cent. Although required in small quantities, they play a vital role in animal nutrition.

Remember...

Minerals are the inorganic substances required for physiological functions of the body.

Classification of essential minerals

Essential elements/minerals are classified into i) major elements/macro minerals and ii) trace elements/micro minerals depending upon the concentration in the animal body. The concentrations of macro-elements in diet are expressed in percentage of the diet or in Kg of diet but micro-elements are expressed as ppm or mg/kg of diet.

Table 6.5 Classification of minerals.

Major elements/ *(Macro-minerals)*	Trace elements/ *(Micro-minerals)*
1. Calcium (Ca)	1. Iron (Fe)
2. Phosphorous (P)	2. Zinc (Zn)
3. Potassium (K)	3. Copper (Cu)
4. Sodium (Na)	4. Molybdenum Mb)
5. Chlorine Cl)	5. Selenium (Se)
6. Sulphur (S)	6. Iodine (I)
7. Magnesium (Mg)	7. Manganese (Mn)
	8. Cobalt (Co)

General functions of minerals

1. Macro-elements are important structural components of bones and other tissues and body fluids.
2. They play vital role in the maintenance of acid-base balance, osmotic pressure, membrane electrical potential and transmission of nerve impulses.
3. Micro-elements serve as components of enzymes and enzyme-cofactors and as components of hormones of the endocrine system.
4. They are required in tissue growth and repair for bone and teeth formation, hair, hoofs and horns, soft tissues and in blood cells.
5. Many elements are required for the synthesis of milk and egg shell formation.
6. They help in the digestion and absorption of nutrients in production of erythrocytes.
7. They are responsible for permeability of cell membrane
8. They help in production of erythrocytes and transportation of oxygen.
9. Some elements are now-a-days are used as isotopes for recording advanced metabolisms.
10. The isotopes of the following elements are used in animal experiments:

Ca^{45} of Calcium, P^{32} of Phosphorus, S^{35} of sulphur, Zn^{65} of Zinc, I^{131} of Iodine and Se^{35} of selenium

Table 6.6 Sources, biological functions and symptoms of deficiencies of minerals in livestock

Mineral	Sources	Biological functions	Symptoms of deficiencies
Calcium (Ca)	• Di-calcium phosphate • Bone meal • Milk • Green vegetables • Oil cakes	1. Formation of bones and teeth. 2. Helps in clotting of the blood. 3. Synthesis of milk. 4. Maintains the acid-base balance of the body fluid. 5. Regulation of heart beats and muscle tone	1. **Rickets** in young and **Osteomalacia** in adult animals. 2. **Milk fever i**n high yielding cows. 3. Reduction in milk yield 4. Poor growth rate
Phosphorous (P)	• Milk • Cereal grains • Cereal by-products • Bone meal • Oil cakes • Sodium phosphate • Di-calcium phosphate.	1. Essential component of the acid-base buffer system. 2 Oxidation of carbohydrates leading to the formation of ATP 3. Formation of bones. 4. Maintenance of normal appetite 5. Regularity of estrous cycle and maintenance of fertility. 6. Constituents of bone & teeth	1. Poor growth rate 2. Infertility 3. **Pica/depraved appetite** i.e. eating of wood, cloths, soil, paper, stone plastic, bones 4. Recumbency 5. **Rickets** in young and **Osteomalacia** in adult animals
Sodium (Na), Potassium (K) and Chlorine (Cl)	• Common salt • Animal and Marine by-products	**These minerals are closely associated with each other.** 1. Sodium and potassium maintain osmotic pressure of body fluids and the acid-base balance. 2. Potassium helps in the contraction and relaxation of the heart and activates certain enzymes. 3. Chlorine helps in cell nutrition.	1. Reduced appetite, growth and body weight 2. Low milk production. 3. Muscular weakness 4. Increased thirst. 5. Intense craving for salt, leading to pica. 6. Dehydration **Potassium deficiency usually does not occur**
Magnesium (Mg)	• Leguminous fodders • Brans • Oil cakes • Dried yeast, • MgO • $MgSO_4$	1. Activates phosphatase transferases, decarboxylases and acyl transferases. 2. Growth and development of bones and tooth. 3. Role in muscle contraction	1. Grass tetany / lactation tetany in cows and ewes. 2. Hyper-excitability and muscular twitching in calves.

Sulphur (S)	• S-containing amino acids, proteins (mucin, cartilage proteins) and vitamins.	1. Essential component of some amino acids and vitamins. 2. It is important in the enzyme system. 3. In association with the iron, it is used for the formation of haemoglobin in RBCs.	As diets invariably contain S-containing compounds like proteins and ruminants can synthesize all S-containing amino acids and vitamins from the dietary S-sources, no sulphur deficiency, in real sense, occurs.
Iron (Fe)	• Green forages, • Legumes and seed coats, • Feeds of animal origin • Ferrous sulphate	1. It synthesizes haemoglobin and red blood cells. 2. It helps in the utilization of oxygen by the blood. 3. It is concerned in the formation of melanin.	1. Iron deficiency results in to anaemia characterised by the paleness of mucosae and weakness. 2. Depigmentation of hair. 3. Greater morbidity and mortality are associated with depressed immune responses. 4. Decreased growth rate.
Copper (Cu)	• Copper sulphate • Concentrates	1. It is a component of cytochrome oxidase and tyrosinase 2. It is necessary for the formation of haemoglobin. 3. It plays important role in the production of 'crimp' wool. 4. It is required for the normal pigmentation of wool and hair.	1. Anaemia 2. Depigmentation of coloured hair and black wool. 3. **'Sway back disease'** in new born lambs. 4. **Falling disease** in cattle 5. Steely wool
Cobalt (Co)	• Legumes • Pastures • Liver meal • Cobalt sulphate • Cobalt chloride	1. It plays important role in the synthesis of Vit. B_{12} in ruminants. 2. It is necessary for the growth and development of body. 3. It is also involved in the synthesis of DNA and the metabolism of amino acids.	1. **Wasting disease** in ruminants characterized by loss of appetite, emaciation, rough coat and scaly skin, 2. Severe anemia, weakness and reduced resistance to infection leading to death.

Iodine (I)	• Fish meal, • Cod liver oil Iodized salts (Na-and-K iodide, or Na iodate). • Molasses	1. Iodine is essential for the synthesis of thyroxine and triiodothyronine. 2. It influences physical and mental growth and maturation of tissues.	1. **Goiter** in newly born animals. Animals may be born hairless, weak or even dead. 2. Fetal death or abortion can occur at any stage of gestation. 3. Retarded growth, 4. Poor mental and sexual development. 5. Infertility
Zinc (Zn)	• Yeast • Bran • Molasses • Germ of cereal grains. (Animal proteins are richer sources than plant protein)	1. Several enzymes contain the zinc which affects the metabolism of carbohydrates, proteins, lipids and nucleic acid. 2. Being a part of insulin hormone, it plays important role in carbohydrate metabolism.	1. Reduced feed intake 2. Reduced growth rate. 3. Alopecia ,rough coat 4. **Parakeratosis** in pigs 5. Infertility 6. Bone disorders 7. Disorders of feathers and hair coat 8. Skin diseases
Manganese (Mn)	• Whole rice • Green fodders • Bran	1. Manganese is important as an enzyme activator in number of phosphate transferases and decarboxylases. 2. It is believed to be involved in amino acid metabolism	1. In calves, weak legs and pasterns, enlarged joints, stiffness and twisted legs. 2. In heifers and cows, silent heat and low conception rate.
Selenium (Se)	• Fish meal, • Sodium selenite • Sodium selenate	1. It has non-specific antioxidant property. 2. It has a role in absorption and retention of Vitamin E.	1. Infertility and poor growth in most of the species. 2. **White muscle disease** in calves
Molybdenum (Mo)	• Cabbage • Soybean • Peas • Cereals	1. It stimulates action of rumen micro-organisms	1. No deficiency symptoms are recorded.

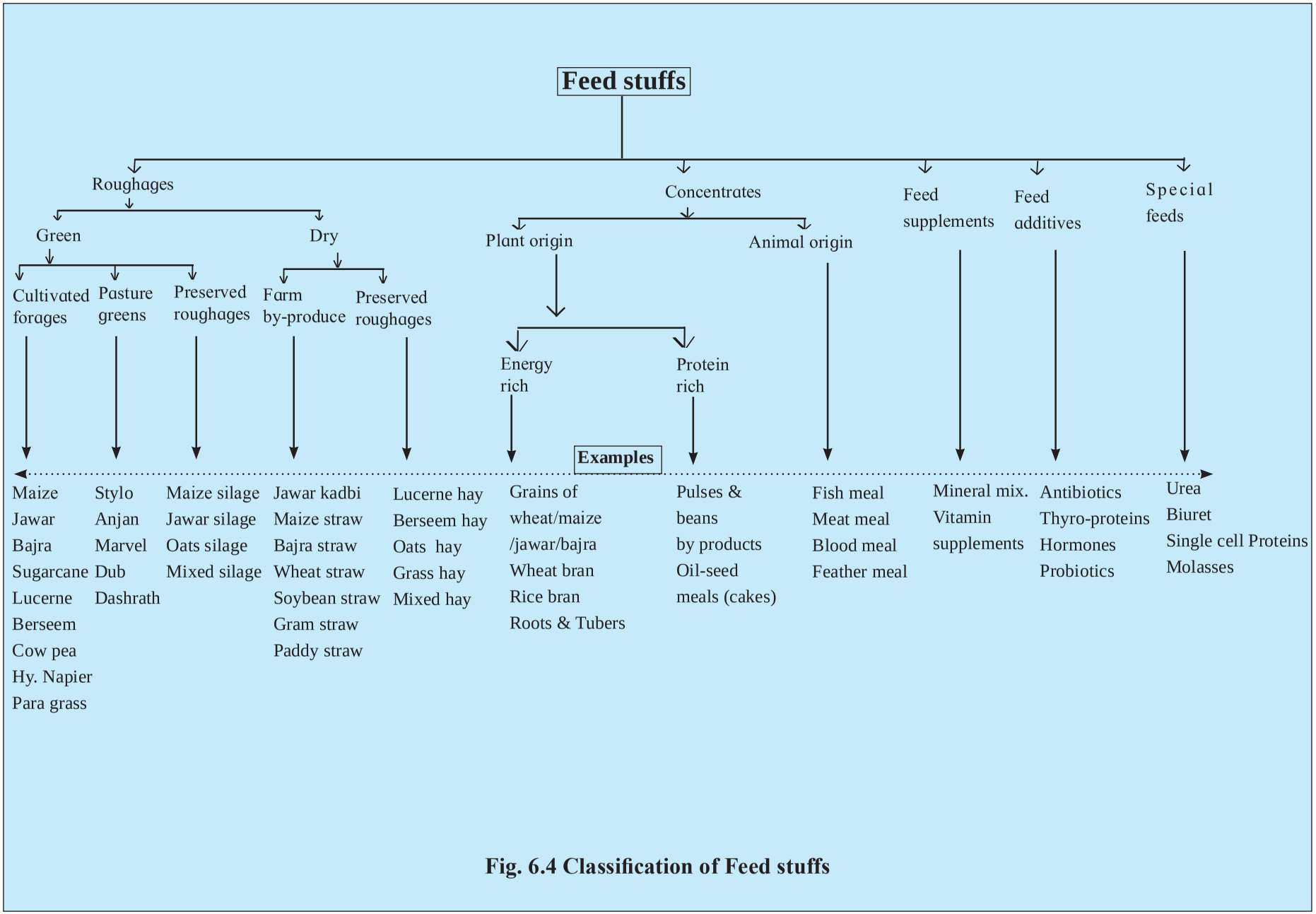


Fig. 6.4 Classification of Feed stuffs

6.2 CLASSIFICATION OF FEED STUFFS

Feedstuff is any material fed to animal for providing nourishment. The diet of farm animal primarily consists of plants and plant-products; however, feeds of animal origin are also used in limited proportion.

The various feedstuffs used in livestock feeding are broadly classified into following groups:

1. Roughages
2. Concentrates
3. Feed supplements
4. Feed additives
5. Special feeds

6.2.1 Roughages

Remember...

- **Roughages are the feedstuffs which contains more than 18% crude fibre and less than 60% TDN.**
- **In absence of roughages, ruminants can not synthesize required proteins, vitamins and enzymes.**

Roughages are voluminous feedstuffs and are poor in nutrient quality. They are edible herbages eaten by the animals. The term forage is also used for roughage. They are bulky due to their light weight or due to high moisture content and loose structure. All roughages are fed mainly to fulfill the voluminous stomach of the ruminants and are utilized either for maintenance or production purpose depending upon the contents of digestible proteins. Fortunately, all these roughages are available on the farm either as crop residues, pasture grasses or can be cultivated on the farm and can be fed either as greens, hay, silage or straws to the dairy animals. Thus, the farm animals do not compete with the man for foods.

The roughages are further classified as-

1. **Green roughages:** They contain 80-90% moisture. e.g. Pastures, cultivated fodder, silage, tree leaves
2. **Dry roughages:** They contain about 10-15% moisture. e.g Paddy**,** Wheat straw , Jawar kadbi, hay, dry grasses.

Importance of feeding green roughages to the ruminants

1. Green roughages are bulky (voluminous) and, therefore, act as filler and satisfy the appetite of multi-stomach ruminants and mono-gastric animals as well.
2. Green roughages have cooling effect on the body of the animal.
3. They contain 'unidentified' growth factors that favour the normal growth of the animals.
5. They provide nutrients at a cheaper cost than concentrates.
6. Feeding leguminous green fodders like berseem alone can sustain about 10 litres of milk production per day, thus saving feeding cost up to 20 percent.
7. Green roughages are rich in carotene i.e. precursor of vitamin A which maintains the normal vision, skin luster and also build body resistance.
8. Greens supply soluble sugars like glucose, fructose and sucrose, amino acids, vitamins, proteins and minerals in required amounts to all types of livestock.
9. All roughages can be obtained from a cultivated, non-cultivated or pasture land which provide variety of roughages.

Table 6.7 Differences between roughages and concentrates

Roughages	Concentrates
1. Roughages contain more than 18 % crude fibre.	1. Concentrates contain less than 18 % crude fibre.
2. They contain less than 60 % TDN.	2. They contain more than 60 % TDN.
3. They are more bulky and lighter per unit weight.	3. They are less bulky and heavier per unit weight.
4. They have comparatively low nutrient digestibility.	4. They have comparatively high nutrient digestibility.
5. They have less nutritive value per unit weight.	5. They have more nutritive value per unit weight.
6. They have low nutrient density.	6. They have high nutrient density.
7. They have wider to medium nutritive ratio(NR).	7. They have narrow to medium nutritive ratio(NR).
8. They are cheaper than the concentrates per unit weight.	8. They are costlier than the roughages per unit weight.
9. Examples: jawar kadbi, wheat straw, lucerne hay	9. Examples: wheat bran, rice bran, oil seed cakes

Paddy Straw Jawar Straw Wheat Straw

Fig. 6.5 Dry roughages

Ground nut cake Cotton seed cake Fish meal

Fig. 6.6 Concentrates

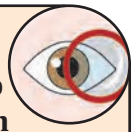
6.2.2 Concentrates

Concentrates are high in nutritive value, and physically require less space and more digestible than roughages. They are rich either in energy or in proteins depending upon their source. Generally concentrates of legume origin are rich in digestible proteins and those from non-legume origin show high contents of energy and low proteins. Further, concentrates from agro-industry are having both proteins and energy in medium range. Animal origin concentrates are rich in proteins. Generally animal origin concentrates are fed to the poultry birds.

Remember...

Concentrates are the feedstuffs which contain less than 18% crude fibre and more than 60% TDN.

Observe and Record...



Dry and green roughages fed to cattle, buffalo, sheep & goats in your locality.

The concentrates are classified as-

1. **Energy rich concentrates:** They are rich in energy. e.g. Cereal grains and their by products.
2. **Protein rich concentrates:** They may be of plant or animal origin.
   a. Plant origin - e.g.oil cakes, pulses, soybean.
   b. Animal origin - e.g.Fish/Bone/Meat meal.

6.2.3 Feed Supplements

Feed supplements are the compounds supplemented to improve the nutritional value of the basal diet so as to take care of any deficiency. Following are some commonly used feed supplements:

A. Mineral supplements

Mineral contents of various feedstuffs vary depending upon the soil profile and individual genetic variation of the plants from which the feedstuffs are prepared.

Do you know ?

The benefits of mineral supplements.

Can vitamin and mineral supplements be harmful ?

Further, the mineral requirement of animals varies with age, sex, type and stage of production. The diet meant for an animal may not supply the required minerals in appropriate quantity which may result in its deficiency. Therefore, mineral supplements do take care of the deficiency of one or more deficit minerals for the effective animal production. These mineral supplements are prepared from the sources like common salt, calcium carbonate, rock phosphate, bone meal etc.

B. Vitamin Supplements

Like mineral supplements, vitamin supplements do play a vital role in livestock feeding particularly in commercial farms. Usually different feedstuffs used for livestock feeding are deficit in one or more dietary vitamins and to take care of these vitamin deficiencies, use of specific vitamin(s), vitamin mixture is advised for feeding.

Observe and Record...

Collect the information about mineral and vitamin supplements fed to livestock in your locality.

6.2.4 Feed Additives

Can you tell ?

Which feed additives are available in market for livestock?

Feed additives are non-nutritive substances, added to the basal diet in small amount in order to improve the feed efficiency and production performance of the livestock. They neither provide any nutrients nor used as a drug for the treatment of any disease.

Feed additives give protection against undesirable environmental influences. By changing the nutritional behavior, they prevent the composition of the diet from undergoing harmful biochemical reactions. Further, they enhance the feed efficiency and improve the performance of the animal directly or indirectly. e.g. thyroproteins, probiotics, antibiotics, etc.

Remember...

Feed additives do not provide any nutrient nor energy to the animals.

Following are some feed additives used in livestock feeding :

1. **Antibiotics:** These are the anti-bacterial chemicals used in calf feeding.
2. **Antioxidants**: They are used to prevent oxidation of feed-fats and thereby rancidity.
3. **Enzymes:** They are used to improve digestion and feed efficiency.
4. **Thyroproteins** (Iodinated caseins): They are used to increase wool and milk production.
5. **Hormones :** They are used to improve the performance in growth and reproduction, but they should not be used for increasing the milk production.

Remember...

Like thyro-proteins, hormones are not used for increasing milk yield

6. **Probiotics :** These preparations are based on live micro-organisms that are consumed as food and feed additives which have beneficial effect on the health status of livestock. They help to prevent imbalances and enhance the growth of healthy microflora.

Remember...

The bacteria most commonly used as animal feed probiotics are *Lactobacillus, Bacillus, Steptococcus, Pediococcus, Enterococcus and Bifidobacterium.*

7. **Prebiotics :** These are defined as non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth / activity of one or limited number of bacteria in colon. The most commonly used prebiotics to yield heath benefits are carbohydrate substrates such as oligosaccharides or dietary fibre with low digestibility.

Do you know ?

Use of probiotics and prebiotics in animal feed has shown to benefit digestion, animal performance and improvement in the immunity.

Functions of Prebiotics and Probiotics

1. They inhibit growth or reduce the activity of harmful bacteria in intestine.

Internet my friend

Search the various prebiotics and probiotics available in the market for livestock.

2. They help in increasing immunity
3. They improve the secretion of digestive enzymes and help in proper digestion.
4. They increase the production of lactic acid and regulate pH of tract.
5. They promote acidic pH for the absorption of protein and minerals like calcium, copper, magnesium, iron and manganese.
8. **Coccidiostats :** They are used to prevent coccidiosis.
9. **Flavouring agents:** They are used to improve palatability and feed appeal.
10. **Pigments:** They improve the quality of animal products e.g. egg yolk colour in poultry.
11. **Pellet binders:** They improve pellet quality and lessen dustiness in the mill.
12. **Feed sweeteners:** They increase palatability and feed conversion.

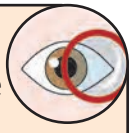
6.2.5 Special Feeds

Definition : Special Feeds are the substances which are added in the roughage component of the diet to enrich its nutritive value.

Low quality dry roughages like wheat straw, paddy straw, jawar kadbi, maize straw, bajra straw and even crop residues etc are poor in their nutritive value and palatability. However, all these fodders form the major proportion of staple diets of the ruminants.

Observe and Record...

Low quality dry forages available for cattle feeding in your locality.



Hence, the process of enrichment of these fodders with suitable low-cost energy and protein sources makes them not only palatable but they can be efficiently and completely utilized by the ruminants. Ruminants can efficiently digest fertilizer-grade urea with the help of micro-organisms in to quality proteins, hence urea is used to enrich such low-quality roughages. Feed urea provides 2900 g crude protein/kg. When urea is heated, biuret is obtained. Both are equally useful in ruminants' feeding. Biuret provides 2550 g crude protein/kg.

Use of urea-molasses for increasing the nutritive value and palatability of wheat straw, jawar kadbi, etc is now-a-days practised for their efficient utilization on the livestock farms. The treatment increases digestibility and intake of the treated straw, rate of rumen degradation by more than 50 %. The process is relatively inexpensive, easy to adopt and makes the treated straw pliable and palatable.

6.2.6 Unconventional Feedstuffs

Maize, jawar, bajra, hybrid napier, para grass, etc are routinely fed to the livestock hence they are conventional types of feedstuffs. Besides such conventional feeds, the man has lot of choice in the nature to select and feed such feedstuffs which are not commonly used for livestock feeding. For example, we generally neglect to feed mung or wheat straw and either leave it in the field or burn in the field itself. But if one thinks to utilize such feedstuffs for livestock feeding then all such feeds become unconventional feedstuffs. Considering their palatability and nutritive value, they are to be 'prepared' and then fed to the livestock. Such practice of feeding is most popular during the periods of scarcity or fodder shortage.

Unconventional feedstuffs are, therefore, those which are not commonly/conventionally used for feeding of livestock but fed during the period of fodder scarcity. However, it is to note that these unconventional feedstuffs (i) have poor nutritive value, (ii) their inclusion in the basal diet is limited and (iii) they can efficiently be used only after some or other physical, chemical or biological treatment.

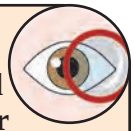
Classification of unconventional feedstuffs
Like conventional feed stuffs, there are two types of unconventional feedstuffs :

1. Roughages 2. Concentrates

1. Unconventional roughages: They include crop residues and straws and tree leaves from pasture lands. Their contents of DCP range between 0.00 to 9.00 percent and TDN between 40.0 to 50.0 percent depending upon whether they are leguminous or non-leguminous. On the other hand, they have high insoluble ash and lignin; some have such anti-nutritional factors as phytic acid, alkaloids, tannins which reduce palatability and the intake if fed without any treatment.

Some unconventional fodders such as wheat straw, mung straw, maize straw, soybean straw, sugarcane tops, gram straw; others are leaves of banana, glyricedia, babul, sanhemp, tapioca, peepal, banian also form a component of unconventional roughages.

Observe and Record...



The various unconventional roughages available in your locality.

2. Unconventional concentrates: This group includes variety of plant as well as animal origin materials that can be prepared and used for feeding the livestock. They are:

A. Plant origin : Tapioca waste, mango seeds, babul seeds, sugarcane bagasse, tomato pomace, sugarbeet pulp, groundnut kernel, niger cake, neem seed cake, sunflower and safflower meal, etc.

B. Animal origin : dried poultry droppings, hydrolysed poultry feather meal, crab meal, cow dung meal, etc.

6.3 Antinutritional factors in feedstuffs

Antinutritional factors/ substances are defined as "those substances which are generated in the natural feedstuffs by normal metabolism of the species from which the material originates and by different mechanisms exerting effects abnormal to optimum nutrition.

Intake of such substances through feed causes reduced growth, poor feed conversion, hormonal changes and sometimes histo-pathological alterations in important organs, ultimately causing economic loss in livestock production. Therefore, care must be taken that they are not present in the animal's diet.

Antinutritional factors are classified on the basis of their origin and the biological response produced by the animals.

1. Depressing digestion and metabolic utilization of proteins

a. Protease inhibitors have the ability to inhibit proteolytic activity of some digestive enzymes. e.g. Inhibiting trypsin present in soybean and kidney beans seeds.

b. Saponins, present in lucerne, produce gases in the rumen digesta—leading to 'bloat' when green lucerne is fed in excess

2. Reducing solubility or interfering mineral utilization

a. Phytic acid is present in linseed, castor beans, soybean, cotton seed, rice, maize and wheat. It has 6-phosphoric acid radicals and it forms salts with minerals. Though its salts with Na and K are soluble, those with Ca, Mg, Fe and Zn are insoluble. However, addition of enzyme *phytase* to plant feeds increases phosphorous availability. Phytic acid depresses the utilization of minerals like Ca, Mg, Fe and Zn by forming insoluble compounds which get eliminated through faeces.

b. Oxalic acid is present in grasses, hybrid napier and paddy straw. In ruminants, excess oxalates combine with feed calcium and thus calcium becomes unavailable for absorption. The calcium oxalate crystalizes in various tissues especially kidney and rumen wall causing oxalate poisoning characterised by rapid and laboured respiration, depression, weakness, coma and finally death.

c. Gossypol present in cotton seed cake. It is highly poisonous particularly to poultry birds. It reduces the appetite and body weight.

Remember...

Saponins in lucerne, oxalic acid in hybrid napier, nitrates in oats and dhurin in young jawar plant are the antinutritional factors.

d. Glucosinolates present in crops of *Brassica* family; are responsible for pungent odour. They depress the synthesis

of thyroxine hormone and cause depressed iodine uptake.

3. **Inactivating certain vitamins/ hormones**

a. **Mimosine** is present in subabul. When fresh leaves of subabul are fed to ruminant, mimosine is converted to a toxic component which shows alopecia, excessive salivation, poor appetite, weight loss and death. Subabul is toxic to poultry.

b. Rancid fats inactivate biotin and destroy Vitamin A, D and E.

4. Others

a. **Cynogens** are a) Dhurin–present in premature jowar plants. When hydrolysed by the enzyme present in rumen yields hydrocynic acid(HCN) which causes death and b) Linamarin – occur in linseed, pulses, cassava.

b. **Nitrates (NO_3)** present in oats are not poisonous but when oats are fed to the cattle, this NO_3 are reduced to NO_2 which is poisonous.

c. **Mycotoxins**: Under favourable conditions, various fungal species secrete their metabolites called mycotoxins which are harmful to the animals. Aflatoxins are produced in cottonseed and groundnut cake and cereal grains. Toxicity affects numerous liver functions and cumulative impact can be fatal to animal. Dairy animals, sheep, goats, pigs and poultry are affected by aflatoxins.

Observe and record...

Storage conditions favourable for fungal growth in feeds and fooder.

Internet my friend

Search which mycotoxins are harmful to livestock.

6.4 RATION

Remember...

Ration is defined as amount of food given to the animal for a period of 24 hours.

Types of rations

1. **Maintenance ration:** It is the amount of feed required just to maintain various body processes at optimum rate without any gain or loss in body weight or any change in body composition.

Remember...

Production ration is offered over and above the Maintenance ration.

2. **Production ration:** This is the additional allowance of the daily diet i.e. over and above the maintenance ration to meet demands of production either of milk, meat, wool, egg, etc, as per the type of the livestock. For milking cow, for example, 1 kg of concentrate mixture is offered for every 2.5 litres of milk production. This is production ration.

3. **Balanced ration:** This is the' total' diet which furnishes all the nutrient demands of the animal in such a proportion and amount that are required for proper nourishment of an animal without any loss or change in body weight.

4. **Pregnancy ration:** It is an extra allowance of ration given to a pregnant animal during the last term of gestation to meet the nutrient requirements of fast growing foetus and also to keep the mother for optimum milk production after calving.

Remember...

The pregnancy quota of the ration is given during the last trimester of gestation.

Desirable characteristics of ration

1. Ration should be palatable and should contain digestible feedstuffs so as to ensure optimum feed intake and nutrient availability.
2. It should include sufficient green forages, preferably legumes.
3. It should be free from toxic compounds and foreign substances like metals, moulds, dust, etc which may have undesirable odour.
4. It should be fairly bulky and laxative to satisfy the hunger and to expel the undigested material out.
5. It should include variety of feedstuffs providing all 'dietary' essential minerals, vitamins and their precursors.
6. It should be economical

Do you know ?

Feeding cost contributes 60-70 per cent of the total cost of production.

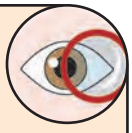
7. It should be properly processed to ensure a desirable effect.
8. Irrespective of any type of ration, a ration should fulfill the dry matter needs (and thus the appetite) of the animal. Generally, dry matter requirement depends on the live weight of the animal and with the nature of its production. The DM need and intake is calculated at the rate of 2.5 to 3.0 % of live weight.

Remember...

Indigenous cattle, require dry matter (DM) @ 2.5 percent whereas, crossbred cow and buffalo require @ 3.0 percent of their live weight.

6.5 THUMB RULE IN CATTLE FEEDING

Observe and record ...



Different Feeds and fodders required for adult cow/buffalo per day.

The conventional method of feeding livestock is thumb rule feeding. This method is simple and easily adoptable by common farmer.

Principles of Thumb Rule:

1. Dry matter requirement is 2.0 percent of live weight of a dry cow, 2.5 percent of live weight of indigenous lactating cow and 3.0 percent of live weight of milch cross-bred cow or buffalo.

Table 6.8 : Concentrate requirement for maintenance

Type of requirement	Concentrate requirement
Maintenance	**Indigenous :** 1.0 kg, **Crossbred cow/buffalo :** 1.5 to 2.0 kg
Milk production	**Indigenous :** i) 1 kg / 2.5 lit milk, if dry roughages are 2/3rd ii) 1 kg / 3.0 lit. milk if dry roughages are ½ **Crossbred cow/buffalo :** i) 1 kg/2.5 lit milk if dry roughages are ½
Pregnancy	i) For *cow*, 1 kg extra allowance during 6th month of pregnancy and 2 kg during 7/8/9th months ii) For *buffalo*, 1 kg extra allowance during 7th month of pregnancy and 2 kg during 8/9/10th months.
Breeding	**Bull :** 1 kg extra allowance during the breeding period

2. Roughage requirement should be fulfilled as 2/3rd of total DM through dry roughages and 1/3rd through green.
3. The requirement of concentrate mixture for maintenance, milk production and pregnancy is as below:
4. Daily feeding of common salt @ 25-50 gram / animal be practised.
5. Minerals are required when good quality greens are not available or when only straws are fed. Commercial mineral mixtures are available and may be used at 1-2 % level.
6. Vitamin mixtures are also available in suitable packs; their use at 20 – 30 grams / 100 kg concentrate mixtures is sufficient.
7. When straw is used as sole roughage, addition of 1 – 2 % lime stone powder(150 mesh) is beneficial.
8. In areas where greens are available for stock feeding, the DCP content of the concentrate mixtures be reduced from 18 to 15 % in line with the quantity of green or hay legume and to 17 % when mixed legumes and grasses are fed.

Remember...

Roughly for every 10 kg of quality greens, 1 kg concentrate mixture can be cut from the concentrate quota with the additional advantage of dry matter, TDN, minerals and vitamins in favour of greens.

Limitations of Thumb Rule

1. If low quality feed ingredients are fed, this method fails to meet the nutrient requirements.
2. It is unsatisfactory method for milch buffaloes because of their high milk fat per cent content.
3. Thumb rule does not work as efficiently as for low yielders with moderate fat content in milk.
4. It does not fulfill the nutrient requirements (especially TDN) of high yielding cross-bred cows.

Remember...

Requirements of a cross-bred cow producing more than 15 litres milk may not be met by thumb rule feeding with straw alone.

Try this...

1. **Calculate DM, green, dry roughages and concentrate requirement for indigeneous cow weighing 300 kg and yielding 2.5 liter of milk per day.**
2. **Calculate DM, green, dry rouhages and concentrate requirement for buffalo weighing 400 kg and yielding 5.0 liter of milk per day.**

6.7 WATERING OF ANIMALS

Importance of watering the animals

Water is required essentially for all body functions. It is vital to the life of the animal that water level in the body be maintained. Under normal conditions, excess water is not harmful to the live animals; they normally drink what they require. On the other hand, an animal will die more rapidly if deprived of water than if deprived of food.

Remember...

Reduced water intake adversely affects digestion, assimilation and excretion of waste products in urine and faeces.

Water is taken by the animal generally when feed is taken and the type of feed in a given set of environment reflects the amount of water the animal requires. Hence the water requirements are highly related to the amount of 'dry matter' the animal consumed. Increased consumption of dry matter increases the water requirement and consumption. Generally, water requirement of adult cattle is 3-5 kg per kg of dry matter intake and for suckling calves it is 6-7 kg for every kg of dry matter. Consumption increases during late pregnancy. Milking cows and buffaloes require additional amount of water to the tune of 4-5 kg for each kg of milk produced. Birds require less water compared to mammals per unit of body size.

Do you know ?

Intake of drinking water is generally 2.5 times that of dry matter or 10-15 percent of body weight.

Factors affecting water intake

Following factors do affect the intake of drinking water by the animal-

1. **Quality of feed**: The high protein diet, pentosans, salt, fats and fibre in the diet increase the water requirements. Silage and laxative feeds increase the water needs.
2. **Time of watering:** More water is consumed during night than day-time. Further, season also affects the water requirement and consumption by the animals.

Remember...

Water should be available to the animals at all times.

3. **Quality of water:** Water may carry many toxic materials because of its property as a solvent. Presence of excess of mineral salts, in the water, contamination with toxic substances, micro organisms and unnatural smell make the animal to refuse to drink the water irrespective of thirst. On the contrary, clean, free flowing and abundant fresh water is preferred by all the animals.

Remember...

Animal drinks more water when it is cool, clean and fresh.

Try this...

Record how much water does a cow drink in summer

Drinking water requirement (per day)

a. For maintenance:

Cattle	30 - 40 lit.
Sheep and goat	4 - 5 lit.
Poultry	0.5 lit.
Pig	6 - 8 lit.

b. For lactation 3 - 4 lit. / kg milk

Remember...

Ratio of dry matter intake to water intake is 1:4

Q.1 Fill in the blanks

1. Milk casein is an example of..... .
2. Roughages are the feed stuffs which contain more than.....per cent fibre.
3. Urea is an example of ..... .
4. Vitamin ..... is also called as coagulation factor.
5. Calcium is an example of ..... essential mineral.

Q.2 Make the pairs.

A Group		B Group	
i.	Vitamin A	a.	Rickets
ii.	Vitamin D	b.	White muscle disease
iii.	Vitamin E	c.	Night blindness
iv.	Vitamin K	d.	Friable gums
v.	Vitamin C	e.	Increased coagulation time
		f.	Alopecia
		g.	Dermatitis

Q.3 Identify the odd one out

1. Arginine / Histidine / Alanine / Valine / Lysine
2. Pastures / Wheat straw / Jawar Kadbi / Hay / Dry grasses
3. Calcium / Phosphorus / Potassium / Copper / Sulphur
4. Trioses / Tetroses / Pentoses / Disaccharides / Hexoses
5. Iron / Zinc / Iodine / Sodium / Cobalt

Q.4 State True or False

1. Concentrates are voluminous feed stuffs and are poor in nutrient quality.
2. Dry roughages contain about 10 - 15 per cent moisture.
3. Antioxidants are the anti bacterial chemicals used in calf feeding.
4. Thyroproteins are used to increase wool and milk production.
5. Enzymes are used to improve digestion and feed efficiency.

Q.5 Give examples

1. Feed additives used in livestock feeding.
2. Unconventional concentrates.
3. Vitamin supplements in livestock feeding.
4. Essential amino acids.
5. Protein rich concentrates

Q.6 Answer in brief

1. Write Importance of feeding green roughages to the ruminants.
2. Give the importance of livestock in Vitamin supplements
3. Write a short note on feed additives.
4. Give classification of unconventional feed stuffs.
5. Give importance of watering in livestock.
6. Write the qualities of drinking water for livestock.
7. Write the principles of thumb rule.
8. Write the limitations of thumb rule.
9. Write the factors affecting the intake of drinking water by the animals.

Q.7 Differencate between

1. Essential and non essential amino acids.
2. Monosaccharides and oligosaccharides.
3. Fat soluble and water soluble vitamins.
4. Roughages and concentrates.
5. Micro and macro minerals.

Q.8 Give scientific reasons.

1. Amino acid are also called as buildings blocks of protein.
2. Roughages are called as voluminous feed stuffs.

3. Feed additives are added to the basal diet of livestock.
4. Unconventional feed stuffs are not commonly fed to livestock.

Q.9 Answer the following questions.

1. Complete the table.

Vitamin	Source	Functions	Deficiency
Vitamin A			
Vitamin D			

2. Explain with the help of examples.
   i. Major essential elements or minerals in animal body.
   ii. Trace elements or minerals in animal body.
3. Calculations.
   i. Calculate the DM required for 400 kg weighing indigenous lactating cow by thumb rule method.
   ii. Calculate the DM required for 500 kg weighing buffalo by thumb rule.

Q.10 Answer in detail.

1. Give classification of feed stuffs of livestock with suitable examples.
2. Write the functions of water in animal body.
3. Write the functions of minerals in livestock

Q.12 Read the given following paragraph and answer the questions based on it.

Special feeds

Special feeds are the substances which are added in the roughage component of the diet to enrich its nutritive value. Low quality dry roughages like wheat straw, paddy straw, jawar kadbi and even crop residues are poor in their nutritive value and palatability. However, all these fodders form the major proportion of staple diets of the ruminants. Hence the process of enrichment of these fodders with suitable low – cost energy and protein sources make them not only palatable but they can be efficiently and completely utilized by the ruminants. Ruminants can efficiently digest fertilizer – grade urea with the help of micro organisms in to quality proteins, hence urea is used to enrich such low quality roughages. Feed urea provides 2900 g crude protein / kg. When urea is heated, biuret is obtained. Both are useful in ruminants feeding. Biuret provides 2550g crude protein / kg. Use of urea – molasses for increasing nutritive value and palatability of wheat straw, jawar kadbi, etc. is now a day's practiced for their efficient utilization on the livestock farms.

Questions

1. How the nutritive value of wheat straw is increased for feeding livestock?
2. How much quantity of crude protein is provided by feeding urea to livestock?
3. How ruminants can digest fertilizer – grade urea?
4. What happens when urea is heated?
5. Write the names of dry roughages you know having low quality nutritive value.

Q.11 Complete the following table

Sr. no.	Mineral	Source	Functions	Deficiency
1	Calcium			Milk fever
2	Phosphorus	oil cakes		
3	Cobalt		Synthesis of $VitB_{12}$	
4	Iron		Role in muscle contraction	Anaemia
5	Vit A			