Course Code: ANGB 115 **Course Title: Fundamental Nutrition (Theory)**	**Credit Hour: 2**	**Level: 1**	**Semester: I**
Rationale: This course is arranged to provide knowledge about fundamental concept of nutrition.			
Course Learning Outcomes: The major learning outcomes of this course are to- ✓ gather knowledge about basic concept of nutrition ✓ obtain knowledge about composition of animal body and plant body ✓ acquire knowledge about nutrients present in feed ✓ familiar with human nutrition ✓ enrich knowledge about animal feeds and feeding			
Intended Learning Outcomes (ILOs) The students will able to-	**Course Content**	**Teaching-Learning Strategies**	**Assessment Strategies**
✓ define nutrition, nutrients, food, feed, fodder, forage, foliage, feedstuffs, compound feed, balanced feed ✓ differentiate demand and supply of nutrients ✓ distinguish human food and animal feed ✓ explain about the modern techniques used in nutritional research	**Introduction:** Different terminology related with animal nutrition, causes for feed requirement, demand & supply, human food versus animal feed, modern approaches of nutrition	Lecture Interactive discussion Visual presentation Brain storming Feedback	Quiz Short answer Broad answer Class attendance
✓ explain the compositional difference of plant and animal body ✓ differentiate animal protein and plant protein ✓ describe the relationship among the soil, plant, animal and human	**Animal and Plant body:** Composition of plant and animal body, animal protein vs plant protein, soil–plant-animal-human interrelationship	Lecture Interactive discussion Visual presentation Brain storming Feedback	Quiz Short answer Broad answer Class attendance
✓ classify different types of nutrients ✓ describe the general functions of CHO, protein, fat, vitamin, mineral and water ✓ discuss the dietary sources of nutrients ✓ explain the partitioning of feed	**Feed Nutrients:** Nutrients and their functions, dietary sources, nutritional composition of feeds, nutritional partition of feed	Lecture Interactive discussion Visual presentation Brain storming Feedback	Quiz Short answer Broad answer Class attendance
✓ identify the sources of energy ✓ describe energy present in nutrients ✓ explain the partitioning of energy ✓ describe the energy value of feed ✓ convert nutritional values ✓ discuss about the nutritional balances occurred in animal body	**Energy concept:** Sources of energy, energy present in nutrients, partitioning and measurement of feed energy, converting nutritional values, nutritional balances	Lecture Interactive discussion Visual presentation Brain storming Feedback	Quiz Short answer Broad answer Class attendance
✓ narrate the nutritional value of egg, meat and milk ✓ explain the importance of milk, meat and egg in human nutrition	**Human nutrition:** Role of animal products in human nutrition, composition and nutritive value of milk,	Lecture Interactive discussion Visual presentation	Quiz Short answer Broad answer Class attendance

✓ illustrate the production and demand of milk, meat and egg ✓ assess the requirement of milk, meat and egg in human body ✓ describe the dietary allowances for different age and sex group of humans	meat and egg; requirement of milk, meat and egg in human body, dietary allowances for different age and sex group of humans	Brain storming Feedback	
✓ classify animal feed stuffs ✓ define ration, balanced ration, maintenance ration, production ration, TDN, digestible protein, hay, silage, feed selection, choice feeding, feed restriction ✓ discuss requisite quality of ration ✓ explain feeding habit of sheep, goat, cattle and buffalo ✓ discuss about feeding system of livestock and poultry	**Animal Feeds and Feeding:** Feed stuffs, ration, balanced ration, maintenance ration, production ration, TDN, digestible protein, hay, silage, feed selection, choice feeding, feed restriction, good quality ration, feeding habit of different animals, feeding system of livestock and poultry,	Lecture Interactive discussion Visual presentation Brain storming Feedback Assignment Report writing	Quiz Short answer Broad answer Class attendance Report

Reference Books

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Chapter-1
INTRODUCTION

Animal nutrition is not only about feeding the animals, but more about how the animals can utilize the feed; what are the contents of the feed and what can the animal produce with this feed.

Feed requirement

In animal production in general feed is required for:

- maintenance (healthy animals);
- growth (development of the body);
- production (eggs, milk, meat/pork/chicken, wool, feathers, draught animals, etc.);
- reproduction (sperm/egg cells, embryo, foetus);
- social function (playing, walking, running).

Animal production

Animal produces-

- Meat
- Milk
- Egg
- Wool
- Draught
- New born

'Demand and supply'

For 'production' animals need nutrients (water/proteins/fat/carbohydrates /vitamins /minerals).
An animal should **consume** what it **requires** for a particular form of production.
That means: an animal should be able to obtain the nutrients it demands for a particular form of production.
In animal nutrition we discuss how we can balance the **consumption** of nutrients with the **requirements** of an animal or:
how we can **supply** the nutrients an animal **demands** for a particular form of production or a combination of production forms.
The requirements ('standards') of an animal should be expressed **in the same units** as the nutritional value (feeding value) of a feed (feed stuff). Because of many different expressions (units) can this be a source of many confusions.
The 'feeding value' of a feed stuff should indicate how far a feed stuff can satisfy the demands (requirements) of an animal in relation to its production.
Not only the 'chemical composition' of feed stuffs is of importance; also other characteristics are important (e.g.: the energy-value, palatability, the physical structure, etc.). It should be realized that laboratory analysis can only measure chemical components!

Justification for animal production

Justifications for animal production are:

- most human beings demand a mixed diet (plant and animal products);
  in many occasions it is difficult to compose a proper (well-balanced) diet;
- many products cannot properly be digested by man and only can be processed into foods suitable for man by feeding them to animals;
- in the most ecologically stable agricultural systems plants and animals are complementary and the utilization of both as sources of food may increase total food production per unit area of available land.

Human food versus animal feed

Some 600 million tons of cereals (over a third of world production) are fed to animals every year, and the proportion of world production used this way is rising steadily. Grain converted to meat loses 75 to 90 percent of its calories and 65 to 90 percent of its protein. It can be argued that grain fed to cattle, pigs and chickens could be better used to feed hungry people directly.

In developed countries over two-thirds of the grain consumed is fed to animals. The rising demand for feed has encouraged farmers to increase cereal yield. On average, these yields are now nearly 3.5 tons per hectare compared with about 1.1 tons per hectare in both developing and developed countries in the 1930s.

Preventing cereals from being used as animal feed would not automatically make more of them available for hungry people. In fact, it would probably reduce cereal production. The basic problem is that poor people do not have the purchasing power to buy the cereals that they need. Restricting the use of cereals for animals would not on its own solve the problem.

Terminology

Nutrition

Nutrition is the sum total of the processes involved in the utilization of food substances by which growth, repair and maintenance of the body are accomplished. It involves ingestion, digestion, absorption and assimilation.

Nutrients

Nutrients are the chemical components found in feed materials, which are indispensable for life. They play an essential role in the metabolism of animals.

Food

which is used in human diet.

Feed

which is used in animal ration.

Fodder

The roughage, which is cultivated for animal feed.

Forage

Natural or cultivated green grasses.

Foliage

Tree leaves or cluster of tree leaves.

Feed stuffs

Feed stuffs are materials to be used as animal feed. Generally these are single materials (no mixture), but they can be utilized to make mixed feeds. In that case also terms like “raw materials” or “feed ingredients” are used

Compound feed

A compound feed is a mixture of various different feed stuffs, supplemented with minerals, vitamins, and/or other additives. The term compound feed is more or less identical to the term mixed feed. Not necessarily, but in many cases the term compound feed (or concentrate!!) is considered to be identical to 'balanced feed' and/or 'complete feed'.

Balanced feed (= complete feed)

The term 'balanced feed' refers to a feed consisting of various different ingredients (raw materials) which are mixed in such rations (proportions) that they (all together) meet the requirements of a particular class of animals. A 'balanced feed' is a compound feed.

A 'compound feed' is not necessarily a balanced feed. The term 'balanced feed' is identical to the term 'complete feed'.

Modern approaches of nutrition: Technological advances bring new opportunities for scientific research to aid our understanding of nutritional practices. This enables researchers and practitioners to build on traditional methods using different assessment tools to advance research and give the most appropriate advice. Many of the advances in improving the feeding, fertility and health of livestock have been possible with use of nuclear techniques. Some modern techniques commonly used in animal nutrition are given below-

Uses of radioisotopes for food safety: The irradiation is ideally suitable for foods of animal origin, especially those to be consumed raw or minimally processed (FAO/IAEA, 2008). Irradiated food commodity presents no toxicological hazards and requires no further testing since it introduced no special nutritional or microbiological problems in foods. The presence of potentially harmful substances in meat and other food products can also be monitored using RIA to safeguard their quality.

Uses of radioimmunoassay (RIA) in animal breeding: radioimmunoassays have already found practical use in cattle breeding.

Uses of radioisotopes in metabolic studies: radioactive amino acids can be used for metabolic labeling of tissue culture cells. most commonly used radioactive precursors for labeling protein is (35s) methionine because its decay is easier to detect and it is easily incorporated into protein and its incorporation is linear over a wide range of added label.

Chapter-2

Animal and Plant body

Chemical composition of animal and plant body

Species	*Water %*	*CHO %*	*Fat %*	*Protein %*	*Mineral %*	*Vitamin %*
Steer	55	0.70	23.0	17.0	4.0	Trace
Hen	56	0.70	18	21	3.2	Trace
Man	60.5	0.80	14	17	7.7	Trace
Maize (Plant)	73	22.8	0.7	2.1	1.3	Trace
Cowpea (Plant)	83	10.8	0.5	3.0	2.0	Trace

Animal protein Vs plant protein

ESSENTIAL AMINO ACIDS

Animal- protein is a complete protein. It contains all essential amino acids that our bodies need. Vegetable proteins do not generally contain all nine amino acids. However, by combining foods you can make a complete protein. Rice and beans are an example.

Also, this is a little knowing fact; broccoli is very high in protein. It contains almost 20% which is almost as good as beef. (It's not a complete protein. It lacks certain amino acids).

Mushrooms are considered complete proteins by nutritionists.

BIOLOGICAL VALUE OF PROTEIN [BV] *

The BV is an accurate indicator of biological activity of protein, measuring the actual amount of protein deposited per gram of protein absorbed. BV measure of protein quality expresses the rate of efficiency with which protein is used for growth.

PROTEIN BV

Egg 93.7, Milk 84.5, Fish 76.0, Beef 74.3, Soybeans 72.8, Rice, polished 64.0, Wheat, whole 64.0, Corn 60.0, Beans, dry 58.0

*Biological Value [BV]=proportion of protein retained in the human body for maintenance and or growth.

PROTEIN EFFICIENCY RATIO [PER]*

Milk Protein 3.1, Soybean Protein 2.1

*Protein Efficiency Ratio [PER]=Gain in body weight divided by weight of protein consumed.

PER

PROTEIN DIGESTIBILITY CORRECTED AMINO ACID SCORE [PDCAAS]*

SOY 1.00, WHEY 1.00, EGG 1.00, Beef 0.92, Pea 0.73, Oats 0.57, Peanut 0.52, Rice 0.47, Corn 0.42, Wheat Gluten 0.25

*THE PROTEIN DIGESTIBILITY [PD] METHOD FAVORS A COMBINATE PROTEIN MIXTURE

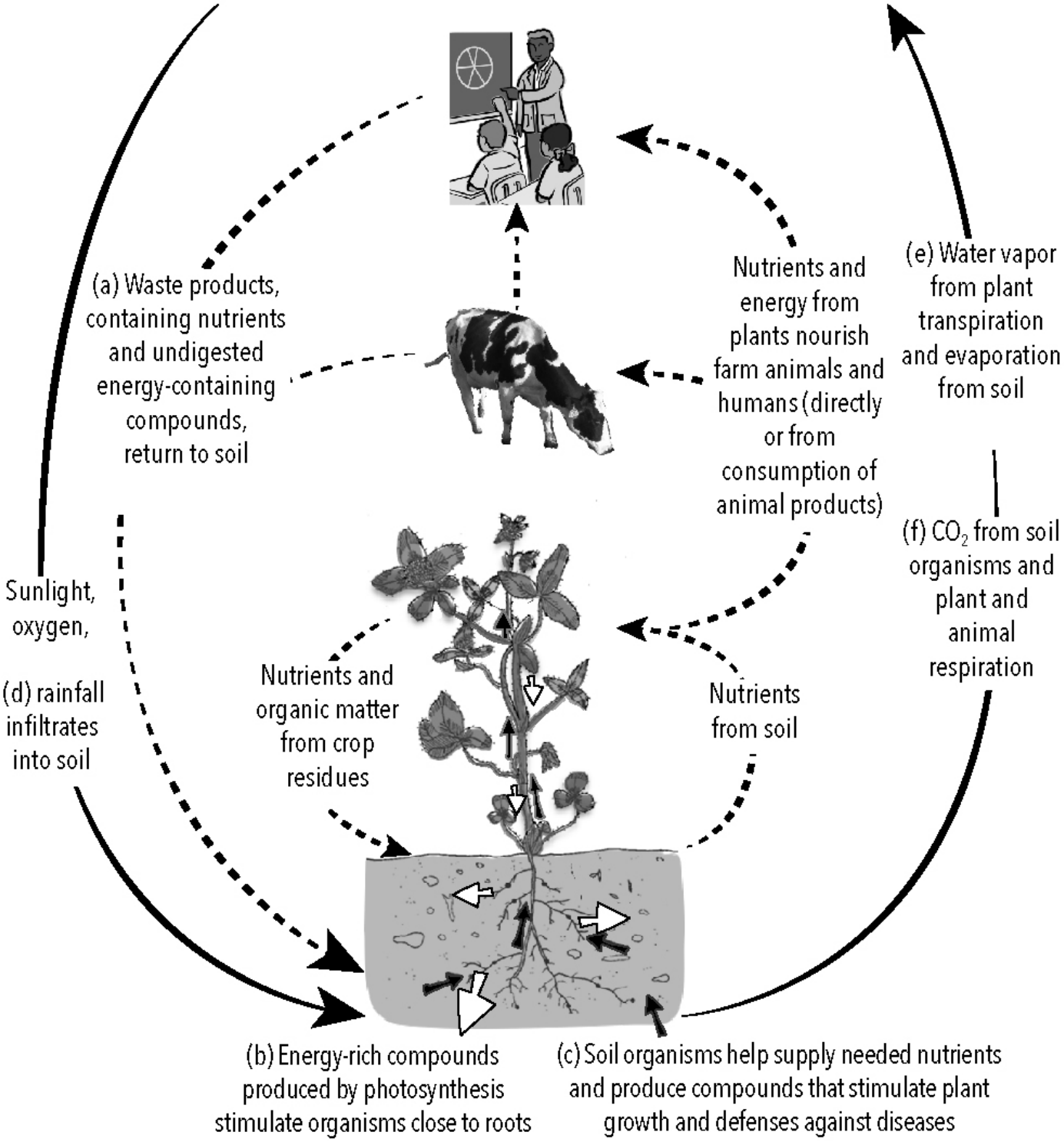
The proportion of food protein absorbed is called "Protein Digestibility".

NET PROTEIN UTILIZATION[NPU]* METHOD

Eggs 94%, Milk 82%, Brown Rice 70%, Meats[most] 65-57%, Soybeans(alone) 61%, Legumes[alone] 50-60%,Whole Grains 50-60%

*Net Protein Efficiency Ratio [NPU]=Proportion of protein intake that is retained.

Soil-Plant-Animal-Human Interrelationship



Chapter-3
FEED NUTRIENTS

COMPONENTS OF FEED:

1. Water
2. Dry matter
    a. organic
        i) carbohydrate
        ii) protein
        iii) fat
        iv) vitamins
    b. inorganic
        i) minerals

ESSENTIAL FEED NUTRIENTS:

Carbohydrate, protein, fat, minerals, vitamins and water etc which are essential for growth, maintenance, production and reproduction of a man or animal.

FUNCTIONS OF ESSENTIAL FEED NUTRIENTS:

Water:

- *Sources:* Metabolic water and drinking water
- *Requirement of water:*
    1. Poultry (adult)-0.20 liter/day
    2. Dairy cow- 40 liter /day
    3. Dry cow- 30 liter /day
    4. Bullock- 30 liter /day
    5. Sheep and goat- 0.5-1 Liter/d
    6. Horse-45 liter /day
- *Function:*

1. Cell rigidity and elasticity
2. Solvent action
3. Lubrication
4. Hydrolytic reactions
5. Ionic reaction
6. Transportation
7. Heat regulation
8. Respiration function

Carbohydrate:

1. Energy supply
2. Glycogen stored in liver and use in starvation
3. Maintain body temperature
4. Lactose helps to develop brain cell (lactose found in milk & it is known as milk sugar) (firstly CHO is used for energy supply in the body, if any kind of CHO deficiency occurs in the body then fat is used for energy supply, when CHO and fat both are deficit in the body then energy is produced from the protein)

Protein:

1. Build up body tissue

2. Repair of body tissue
3. Synthesis hormone and enzyme
4. Feathers, nail, hair and wool formation
5. Energy supply (CHO and fat deficiency)
   (animal protein is high quality than plant protein, because animal protein contains all essential amino acids and it is also efficiently utilized)

Fats:
1. Energy supply (It gives 2.25 times more energy than CHO and protein)
2. Skin smooth and oily
3. Flavor and palatability
4. It carries fat soluble vitamin (A,D,E,K)
5. Reserved under the skin and utilizes during starvation
   (excess CHO and protein converted into body fat)

Minerals:
1. Bone and teeth formation
2. Blood cells contain a small amount of minerals for the normal function of blood cells.
3. Maintenance of ionic equilibrium and osmotic pressure.
4. Maintenance of acid-base equilibrium.
5. Minerals are directly related to the structure and functions of membranes.
6. Minerals are also found as structural components of some hormones
7. It actives the enzymes.

Vitamins:
►Fat soluble vitamins:
Vit-A: Prevent xerophthalmia or night blindness. It helps eye vision.
Vit-D: It helps to absorption of Ca from the intestine for bone and teeth formation.
Vit-E: It helps in reproduction.
Vit-K: It helps to clot blood.
►Water soluble vitamins:
Vit-B Complex: Prevent anemia, helps growth and metabolism.
Vit-C: It is essential for the collagen formation (found in the gums) and prevents scurvy.

ONE GRAM NUTRIENT SUPPLIES:

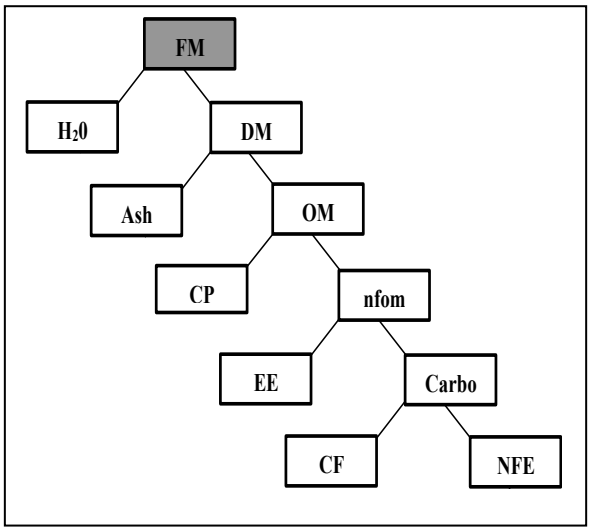
1g nutrient	***Energy (Kcal)***
CHO	4
Protein	4
Fat	9

No energy is produced from water, vitamin and mineral

DIETARY SOURCES FOR LIVESTOCK AND POULTRY

Nutrients	Sources
Carbohydrate	Green grass, Straw, Hay, Silage, Maize, wheat, oat, barley, broken rice, rice polish, wheat middling, wheat bran etc.
Protein	Animal source -Fish meal, blood meal, meat scraps, meat offal, frog meal, feather meal, meat meal, milk products etc. Plant source-Til oil cake, mustard oil cake, ground nut oil cake, soybean meal, Khesari , cottonseed meal, peanut meal, sunflower seed meal, sesame meal
Fat	Animal tallow (Beef), lard, corn oil, other vegetable oils.
Mineral	Common salt (Nacl), oyster shell, steamed bone meal, egg shell, limestone, dicalcium phosphate, rock phosphate, manganese sulfate, manganese oxide, zinc carbonate, zinc oxide, vitamin-mineral premix, etc.
Vitamins	Vitamin-mineral premix, alfalfa meal, leafy vegetables, and milk by-products
Water	Fresh clean drinking water, water with feed

NUTRITIONAL PATITIONAL OF FEED



Chapter-4
ENERGY CONCEPT

Utilisation of Energy

Energy is obtained by the animal through the metabolic processes in the body.

Organic matter, like glucose, is connected to oxygen through many biochemical reactions (the "Krebs-cycle"), in which energy is generated for all body functions. You may say that the body is "burning" organic matter, resulting in: available energy and the end-products CO_2 and H_2O.

All organic matter (proteins, fats and carbohydrates) is calculated to contribute to the energy value of the feed or feedstuff. After consumption of that feed, the final utilization of the energy is of course dependant on the losses that occur in the process.

Schematic presentation of the losses occurring in energy utilization

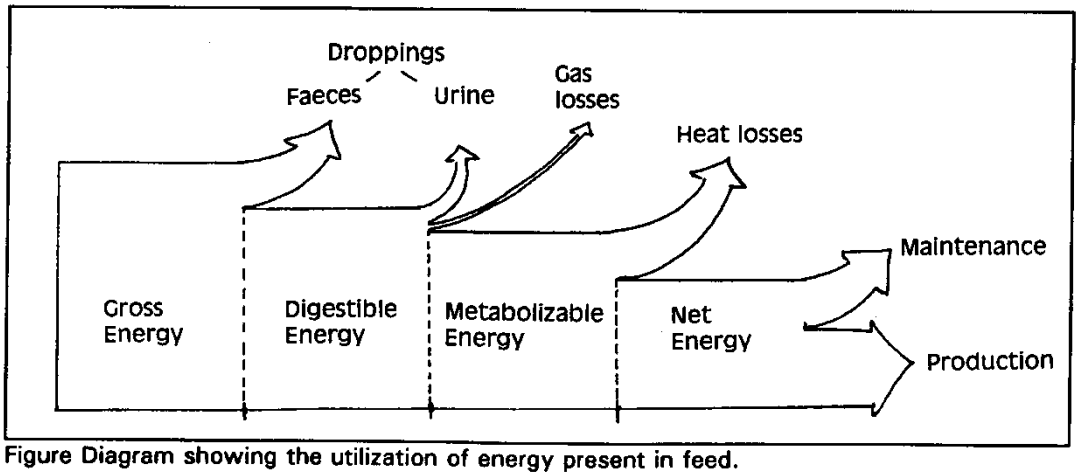


Figure Diagram showing the utilization of energy present in feed.

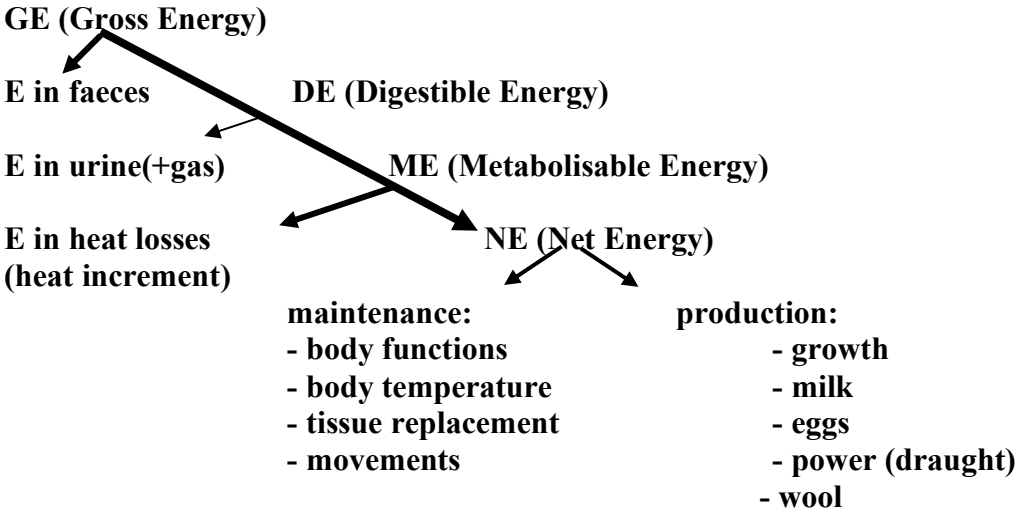
This scheme is applicable for all livestock, although the system how to express the energy value of feed for a certain species is dependent on the digestive system and agreement among nutritionists. Theoretically the energy value can be expressed on each level.
For poultry the system of ME (Metabolizable Energy) is utilized worldwide.

For pigs and ruminants DE (Digestible Energy) is more often utilized, although in Europe it is changed to express the energy in NE (Net Energy), in the relative amount compaired to barley.

Energy value can be expressed in either calories, or in Joules:

1 cal = 4.184 Joules (± 4.2 Joules) 1 Joule = 0.24 cal

To estimate the "utilised" energy for an animal, the losses of energy in digestion and metabolism should be subtracted, and the Net Energy remains. Net Energy will be used for maintenance and production. The following scheme should be familiar already:



Systems for energy values are in use:

For poultry (universally) : ME
pigs : DE, ME or NE
ruminants : DE or NE ($NE_{lactation}$ or NE_{growth})

For ruminants very often T.D.N. (Total Digestible Nutrients) are still in use (also possible for pigs), expressed as % TDN, or grams TDN/kg.

What is TDN? Explain it. (Collect from previous Class Handout)

Energy present in nutrients:

Gross energy content of the pure fats and oils is about 9.4 kilocalories per gram which is approximately 2.25 times greater than that of starch (4.15 kilocalories per gram.).
The complete oxidation of 1 gram of carbohydrate in a bomb calorimeter yields on an average 4.15 kcal. While 1 gram of fat yields 9.4 Kcal and 1 gram of mixed protein (i.e. animal and vegetable protein) 5.3 Kcal.

Converting nutritional values

A quick (rough) conversion from TDN to DE can be made as follows:

1 kg TDN = 4400 kcal DE

Converting from DE to ME, or from NE to DE is also influenced by the kind of feed stuff. Especially forages do vary a lot in Nutritive Value. For conversion the table below may be of help, or (roughly) the following average recalculation factors may be used:

ME	=	0.95 DE	--→	DE	=	1.05	ME
NE	=	0.7 ME	--→	ME	=	1.43	NE
NE	=	0.65 DE	--→	DE	=	1.5	NE

Summary of most applied regression formulas estimating energy value

RUMINANTS

g TDN/kg feed = (1 x g dCP) + (2.25 x gdEE) + (1 x g dCF) +(1 x gdNFE)

The result is always strongly influenced by the digestibility coefficients and how reliable are the coefficients?

kg TDN x 4400 kcal = Kcal DE (for the same species)

Net Energy systems in ruminants will be shortly introduced during Ruminant Nutrition classes

PIGS

DE kcal/kg = (5.5 x g dCP) + (9.5 x g dEE) + (4.2 g dCF) + (4.2 x g dNFE)

Digestibility coefficients (roughly): CP ... 80-85%
EE ... 80-85%
CF ... 10-30%
NFE ... 75-85%

In the Netherlands: to estimate the **Net Energy value for pigs** another formula is used:

NE kcal/kg = (2.59 x g dCP) + (8.63 x g dEE) + (1.50 x g dCF) + (3.03 x g dNFE)

POULTRY

ME kcal/kg = (4.31 x g dCP) + (9.28 x g dEE) + (4.14 x g dNFE)

Digestibility coefficients estimates: CP 90%
EE 90%
CF 0%
NFE 80%

or:

ME kcal/kg = (3.82 x g CP) + (7.85 x g EE) + (4.1 x g Starch) + (3.6 x g Sugar)

The accuracy of the estimation of the Energy Value of feed stuffs can be improved substantially by using specific regression formulas for each feed stuff separately.
This system is suggested in the Netherlands by the Central Bureau of Animal Nutrition. This required a lot of research (comparing lab. analysis results with animal results) and may be referred to in the standard tables published by this organisation.

Chapter-5
HUMAN NUTRITION

Animal products are either produced by an animal or taken from the body of an animal.

Common animal products used as human food

1. Milk
2. Meat
3. Egg

Role of animal products in Human nutrition:

1. MILK:

Milk is the lacteal secretion obtained after complete milking of one or more healthy cows which is practically free from colostrums containing not less than 3.5% milk fat and 8.5% solids-not fat (S.N.F.).

COMPOSITION OF DIFFERENT SPECIES OF MILK

Parameter (%)	Cow milk	Buffalo milk	Goat milk
Water	87.3	84.2	86.2
Carbohydrate(Lactose)	4.5	5.2	4.7
Protein	3.8	3.9	3.5
Fat	3.7	6.6	4.5
Ash	0.7	0.8	0.8

NUTRITIVE VALUE OF MILK

The function of nutritional component of milk in human body-energy, water, fat, protein, vitamin and minerals is given below-

Energy

The energy in milk comes from its protein, carbohydrate and fat content. The calories provided by the amount of protein (4 kcal/gram), carbohydrate (4 kcal/gram), and fat (9 kcal/gram).

Water

Milk is approximately 87% water, so it is a good source of water in the diet. Water does not provide a nutritional benefit in the same manner as proteins or vitamins. However, water is extremely important in human metabolism. Water is a major component in the body. Water maintains blood volume, transports nutrients like glucose and oxygen to the tissues and organs, and transports waste products away from tissues and organs for elimination by the body. Water helps to lubricate joints and cushions organs during movement. Water maintains body temperature regulation through sweating.

Carbohydrate

Milk is approximately 4.5% carbohydrate in the form of lactose. Carbohydrates are the primary source of energy for activity. Glucose is the only form of energy that can be used by the brain. Excess glucose is stored in the form of glycogen in the muscles and liver for later use. Carbohydrates are important in hormonal regulation in the body. Lack of adequate levels of glucose in the blood and carbohydrate stores leads to muscle fatigue and lack of concentration.

Fat

Milk is approximately 3.7% fat. Fats are a structural component of cell membranes and hormones. Fats are a concentrated energy source and are the main energy source used by the body during low intensity activities and prolonged exercise over 90 minutes. Fat is the main storage form of excess energy in the body. Fats cushion organs during movement.

Protein

Milk is approximately 3.8% protein and contains all of the essential amino acids. Proteins are the fundamental building blocks of muscles, skin, hair, and cellular components. Proteins are needed to help muscles contract and relax, and help repair damaged tissues. They play a critical role in many body functions as enzymes, hormones, and antibodies. Proteins may also be used as an energy source by the body.

Vitamins

Vitamins have many roles in the body including metabolism co-factors, oxygen transport and antioxidants. They help the body to use carbohydrates, protein, and fat. Milk is good source of vitamin A, C, D, E, K and thiamin, riboflavin, niacin, Pantothenic acid and Vitamin B12.

Minerals

Minerals have many roles in the body including enzyme functions, bone formation, water balance maintenance, and oxygen transport. They help the body to use carbohydrates, protein, and fat. Milk is good source of Ca, Cu, Fe, Mg, P and Zn.

2. MEAT:

The term meat refers to all parts of the flesh of healthy dressed carcass whether beef, veal, lamb, pork and mutton composed mainly by amino acids bound together by peptide bond.

COMPOSITION OF BUFFALO, CATTLE, GOAT, SHEEP AND POULTRY MEAT

MEAT	WATER	FOOD ENERGY CAL/100 G	PROTEIN (%)	CARBOHYDRATE (%)	FAT (%)	ASH (%)	Ca mg/100g	P mg/100g
Beef	60	273	17.5	<1	22	0.9	10	150
Buffen	61	230	18.5	<1	19	0.9	8	120
Mutton	66.3	206	17.1	<1	14.9	0.9	10	191

MEAT	WATER	FOOD ENERGY CAL/100 G	PROTEIN (%)	CARBOHYDRATE (%)	FAT (%)	ASH (%)	Ca mg/100g	P mg/100g
Chevon	60	240	18	<1	20	1	12	150
Poultry meat	57	200	21	<1	19	o.9	10	140

NUTRITIVE VALUE OF MEAT

Meat is a high-quality, concentrated and easily digested source of a wide variety of nutrients and it is well balanced with a regard to the relative amounts of the specific nutrients which it contains. Meat is an excellent source of high quality protein, vitamins of the B-complex and of certain minerals.

Protein serves as building material for the growth and repair of body tissues. Proteins function as component of enzymes and hormones, help regulate fluid and electrolyte balance and maintain the acid-base balance and are integral part of immune system. Protein can even be used for energy. Meat is high in both protein quality and quantity. Protein is made up of amino acids. The 9 essential amino acids or the amino acids that the body can not make and get from food, are found in meat, making it a complete protein.

Fat is a concentrated source of energy for the body, providing 9 calories per gm. It is generally recommended that not more than 30% of the total calories consumed come from fat. The fat in food provides flavour, aroma and texture as well as increasing the feeling of satisfaction after a meal.

Cholesterol is a waxy, fat-like substances needed for cell building, manufacturing hormones and vitamin D and other functions. If no cholesterol is eaten, the body can make all the cholesterol it needed. Blood cholesterol levels is affected by several factors including heredity, age, sex and to varying degrees and by the amount of cholesterol eaten in food. No more than 200 mg of cholesterol per day should be consumed.

Iron is the part of protein hemoglobin which carries in the blood and part of the protein myoglobin in muscles which makes oxygen available for muscle contraction. Iron is also important for energy metabolism. Nursing mother, premenopausal women and athletes have an increased need for iron. Dietary irons occur in two forms-Heme and Nonheme. Heme iron is found in bound to hemoglobin in blood and myoglobin in muscle tissue. Heme iron is found only in meat, fish and poultry and is more easily absorb by the body than nonheme iron. About 40% of the iron found in meat is heme iron.

Zinc is a component of insulin and many enzymes. Growth and reproduction, appetite, taste, night vision and the immune system are a few of the physiological functions that are dependent on an adequate supply of zinc. Meat is a good source of zinc.

Thianin, riboflabin, niacin and pyridoxine are found in substantial quantities in meat. They are a part of coenzyme in energy metabolism.

3. EGG:

An egg may be defined as the female reproductive unit covered with hard shell which contains adequate amounts of nutrients for the growth and development of future offspring and it is also used as an excellent source of nutrient for human consumption.

COMPOSITION OF EGG

Parameter	Entire egg	Egg content	Yolk	White
A) Water (%)	66	74	48	88
B) Dry matter (%)	34	26	52	12
a) Protein (%)	12	13	17	11
b)Fat (%)	10	11	33	-
c) Carbohydrate (%)	1	1	1	1
d) Minerals (%)	11	1	1	-

NUTRITIVE VALUE OF EGG

The birds egg is composed of substances that form the basis of all animal life. Eggs are composed of proteins, fats, carbohydrates, minerals and vitamins.

Proteins:

The proteins are present in every part of the egg. The chief source of protein is albumen and yolk and only a small amount is present in the shell and shell membranes. The various parts of the average chicken egg contains the following amounts of protein:-

Component of egg	Protein (%)
Whole egg	12-13.4
Albumen	9.7-10
Yolk	15.7-16.8

Simple proteins are predominant in albumen and conjugated proteins in more complex forms are present in the yolk. The egg is composed of following different proteins-

a) Yolk:
- Ovovitellin
- Ovolivetin

b) Albumen:
- Ovalbumin
- Ovoconalbumin
- Ovoglobulin
- Ovomucin
- Ovomucoid

About eighteen amino acids have so far been found in the egg proteins. The egg proteins are excellent source of essential amino acids.

Fats:

In the eggs a variety of fats and fat like substances are present which are of high energy value. Fats are of 4 main types-

a) True fat (Glycerides): 3.8 gm

b) Phospholipids: 2gm

- Ovolecithin
- Ovocephalin
- Ovosphingomyelin

c) Sterols (Cholesterol): 0.3gm

d) Cerebrosides (Traces)

- Ovophrenosin
- Ovokerasin

Of the 6.2 gms of fat in the egg about 99% is present in the yolk.

Carbohydrates:

The egg contains only 1% of carbohydrate of the total egg content. The energy values of the egg vary because of the species and size of the egg. Food energy per 100 gm edible portion of the egg in chicken, duck, turkey and quail egg is 162, 170, 161 and 161 kcal respectively.

Minerals:

Minerals are essential to life and only small quantities are needed. Eggs offer an excellent source of many major and trace minerals.

a) Major minerals: Ca, P, Mg, K, Cl, Na, S & Fe.

b) Minor minerals or trace minerals: Essential for human and listed in descending order of amount found in the egg are Zn, Cu, Br, Mn & I.

Vitamins:

Eggs are specially valuable for many vitamins which are grouped as:-

a) Fat soluble vitamins: A, D, E & K.

b) Water soluble vitamins: The 9 water soluble vitamins namely- thiamin, riboflabin, niacin, pantothenic acid, inositol, pyridoxine, biotin, folic acid & cholin.

Digestibility:

Eggs are superior in digestibility and biological value to various other food groups. The average digestibility and biological value of proteins obtained from egg-

a) Digestibility: 96%

b) Biological value: 97%

Dietary allowances for different age and sex group of humans

Age (years)	Sex	Weight (kg)	Height (cm)	Energy [a] (kcal)	Protein (gm)	Water soluble vitamins						
						Thiamin (mg)	Niacin[e] (mg)	Riboflavin (mg)	Vitamin B_6 (mcg)	Folate (mcg)	Vitamin B_{12} (mcg)	Ascorbic acid (mg)
0-6 months	both	6	-	Kg×117	Kg×2.2(2.0)[d]	o.3	5	0.4	o.3	40	0.3	20
7-11 months	both	9		Kg×108	Kg×1.4	0.5	6	0.6	0.4	60	0.3	20
1-3	both	13	90	1400	22	0.7	9	0.8	0.8	100	0.9	20
4-6	both	19	110	1800	27	0.9	12	1.1	1.3	100	1.5	20
7-9	M F	27 27	129 128	2200 2000	33 33	1.1 1.0	14 13	1.3 1.2	1.6 1.4	100 100	1.5 1.5	30
10-12	M F	36 38	144 145	2500 2300	41 40	1.2 1.1	17 15	1.5 1.4	1.8 1.5	100 100	3.0 3.0	30
13-15	M F	51 49	162 159	2800 2200	52 43	1.4 1.1	19 15	1.7 1.4	2.0 1.5	200 200	3.0 3.0	30
16-18	M F	64 54	172 161	3200 2100	54 43	1.6 1.1	21 14	2.0 1.3	2.0 1.5	200 200	3.0 3.0	30
19-35	M F	70 56	176 161	3000 2100	56 41	1.5 1.1	20 14	1.8 1.3	2.0 1.5	200 200	3.0 3.0	30
36-50	M F	70 56	176 161	2700 1900	56 41	1.4 1.0	18 13	1.7 1.2	2.0 1.5	200 200	3.0 3.0	30
51+	M F	70 56	176 161	2300[b] 1800[b]	56 41	1.4 1.0	18 13	1.7 1.2	2.0 1.5	200 200	3.0 3.0	30
Pregnant	-	-	-	+300[c]	+20	+0.2	+2	+0.3	+0.5	+50	+1.0	+20
Lactating	-	-	-	+500	+24	+0.4	+7	+0.6	+0.6	+50	+0.5	+30

[a] Recommendations assume characteristic activity pattern for each group

[b] Recommended energy allowance for age 66+ years reduced to 2000 for men and 1500 for women

[c] Increased energy allowance recommended during second and third trimesters. An increase of 100 kcal per day is recommended during the first trimester.

[d] Recommended protein allowances of 2.2 gm per kg body weight for infants age 0-2 months and 2.0 gm per kg body weight for those age 3-5 months. Protein recommendation for infants 0-11 months assumes consumption of breast milk or protein of equivalent quality. [e] Approximately 1mg of niacin is derived from each 60 mg of dietary tryptophan

REQUIREMENT OF MILK, MEAT AND EGG IN HUMAN BODY

Products	Need per capita	Availability per capita
Milk	250 ml/day/head	165.07 ml/day/head
Meat	120 g/day/head	124.99 g/day/head
Eggs	104 numbers/year/head	103.89 numbers/year/head

Source: DLS, (2018-19)

Chapter-6
ANIMAL FEEDS AND FEEDING

CLASSIFICATION OF LIVESTOCK FEEDS:

1. Roughage Feeds:

Roughage: Roughage are bulky feeds containing large amount of crude fibre (CF) more than 18% and low (about 60%) in T.D.N. on air dry basis. eg, straw, grass, fodder etc.

A. Succulent or Green
i) Non-legume Fodders -Maize, Napier, Para, Bajra, Guinea, German, Jowar, Sorghum, Oats, Barley, Sudan grass etc.
Tree Leaves - Jack-fruit, Bamboo, Mander, Banana , Gigha etc.
ii) Legume Fodders- Cowpea, Khesari, Motor, Maticali, Dhancha, Berseem, Alfalfa or Lucern etc.
Tree Leaves- Ipil-Ipil, Bubla etc.

B Dry roughage
Straw (Non-legume): Rice, Wheat, Barley, Jowar, Maize
Straw (Legume): Khesari, Maticali, Motor, Cowpea etc.
Hay (Legume): Khesari, Maticali, Motor, Cowpea, Berseem
Hay (Non - Legume): Sorghum, Jowar, and Oats.

2. Concentrate Feeds:

Concentrate: Concentrates are feeds which contain small amount of CF (less than 18%) and high (more than 60%) in T.D.N. on air dry basis. eg. grain, oil cake, fish meal etc.

A. Animal origin -
Fishmeal, Blood meal, Meat Offal, Meat Meal, Feather meal, Hatchery by product meal, Surplus milk etc.

B. Plant origin -
Products: Maize, Wheat, Barley, Oats, Sorghum, Bajra, Khesari, Maticali, Sweet potato etc.
By - products: Rice bran, Wheat Bran, , Bran of Khesari and Maticali, Molasses, oil cake etc.

3. Mineral supplements: Oyster shell, Bone meal, Egg shell, Lime stone, Chalk powder, Common salt, Vitamin-mineral premix etc.

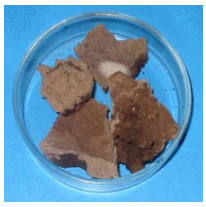
4. Vitamin supplements: All leafy vegetables, Yellow corn, Fish liver oil, Vitamin-mineral premix etc.

5. Feed Additives: Antibiotics, Hormones, Coloring Materials, Flavoring agents etc.


Rice straw


Maize


Wheat


Til oil Cake


Fish meal


Oystershell


Bone meal

Ration: A ration is the feed allowed for a given animal during a day of 24 hours. The feed may be given at a time or in portions at intervals. It may or may not be balanced.

Balanced ration: Ration which provides the essential nutrients to the animal in such proportion and amounts that an animal requires according to its age, purpose and condition.

Maintenance Ration-The balance ration which is required for an animal to maintain its normal physiological functions of the body. There is no loss or gain body weight and even no chemical change of body composition.

Production Ration- The balance ration which is required over and above maintenance ration. This is an additional allowance of ration with maintenance ration.

Total Digestible Nutrients (TDN): TDN is the sum total of all digestible organic nutrients where fat % is multiplied by 2.25. TDN indicates the relative energy value of a feed to an animal. It is ordinarily expressed in pounds or kilograms or in percent.

TDN= % DCP (digestible crud protein) + % DCF (digestible crud fibre) + % DNFE (digestible nitrogen free extract) + % DEE (digestible ether extract) X 2.25

TDN calculation from the following data:

Feed element	***Percent present***	***Percent digested***
NFE	65 %	90 %
CF	12 %	45 %
CP	15 %	75 %
EE	6 %	90 %

% DCF= 12x45/100 = ?
% DCP=……?
% DNFE=……..?
% DEE=……?
TDN=……?

Digestible protein (DP): The protein, which is digested in the stomach and absorbed from the small intestine, is known as DP.

DP= Feed protein - Fecal protein

Silage: Fermented ensiling condition of green fodder, which is preserved in silo-pit, by anaerobic condition. Its moisture content exists as it is.

Hay: Hay making is the most commonly method of conserving green fodder as dry condition. The aim in hay making is to reduce the moisture content (15 % moisture) of the green crop (at flowering stage) by sundry method.

Choice Feeding: In this system of feeding the bird is given a chance or freedom to select its own feeds since the individual feeds are made available separately. It is believed that the bird can balance its own ration of given opportunity owning to an instinctive ability of bird to choose the proper feed constituents when given free choice of the diet.

Restricted Feeding: When the intake of animal is restricted by any method, the process is called restricted feeding. Feed restriction should be aimed at maintaining wastage and

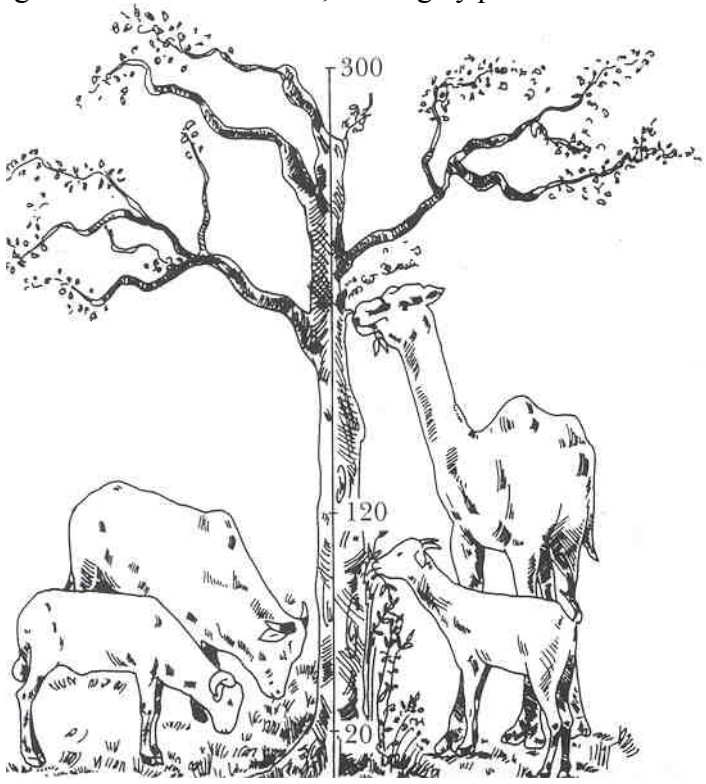
deterioration of feed. It is practiced when the target or standard live weight under goes beyond the control.

Requisites of good quality ration for livestock:

1. The ration should be properly balanced
2. The feed must be palatable
3. Variety of feed in the ration
4. The ration should contain enough mineral matter
5. The ration should be fairly laxative
6. The should be fairly bulky
7. Allow much of green fodder
8. Avoid sudden change in diet
9. The feed must be properly prepared
10. Good flavor in the ration
11. The ration should be highly digestible
12. It is free from larva of parasite, mold, fungus
13. Ration should be economic

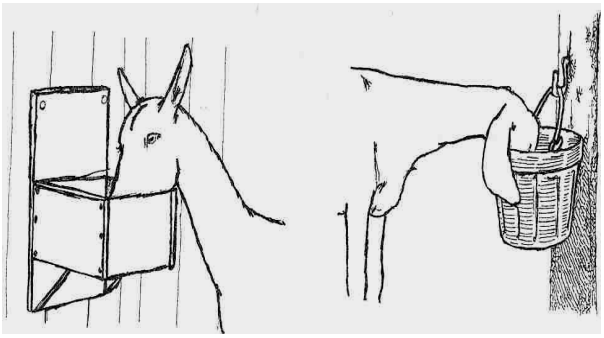
Feeding Habit of Animals

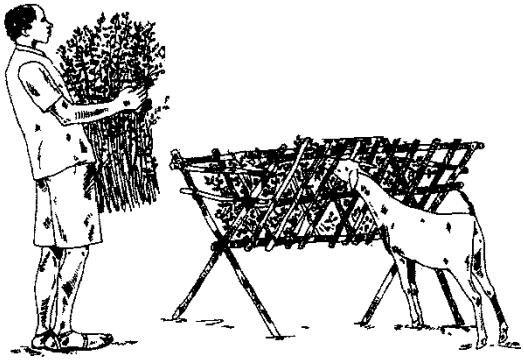
The goat is a natural browser, feeding by preference on tree leaves, flowers and seedpods, when it can. Goats naturally prefer to eat at a height 20 - 120cm above the ground. They can stand on their hind legs for long periods and even climb into trees in order to reach some particularly delicious part of the tree.



Cattle are grazers and browsers, eating a wide variety of grasses, forbs and leaves from shrubs and trees. They need adequate grazing time to eat enough forage to meet their needs. They bite short grass with the lower teeth and hard upper palate, but cannot graze as closely as a horse or sheep.

Feeding heights (in centimetres above the ground of sheep, goats, cattle and camels).





Feeding System of Livestock

The farmers are supplying feeds to the animal in 3 systems.

1. Grazing 2. Tethering 3. Stall feeding

In Europe and America grazing and stall feeding methods are practiced. In our country we practice tethering and stall feeding.

1. Grazing: Sometimes animals are allowed in the grazing or pasture land to eat grass or fodders. The farm owner should be maintained different grazing system.

2. Tethering system: Sometimes animals are allowed to eat forage within a limited area. For this animal is tied with a tether by rope or chain.

3. Stall feeding: In stanchion housing this is the most common feeding system for animal. In this system cutting fodders or grasses and concentrate feeds are supplied in the manger.

Feeding System of Poultry

1. Backyard feeding system
2. Commercial feeding system
    a. Automatic feeding system
    b. Manual feeding system

Methods of Animal Feeding

1. Green grass and/or straw
2. Green grass and/or straw with mash (ground grain and grain by product are mixed and make mash)
3. Green grass and/or straw with commercial pellet or cube

Methods of Poultry Feeding

A well-balanced ration improperly fed will not give the most satisfactory results unless a satisfactory method is followed. Some of the methods are as follows:

1. Whole grain feeding system: In this system feed ingredients are supplied to the birds in the separate containers.

2. Grain and mash method: In this system some ingredients are supplied as grain or grain mixture along with balanced mash.

3. All mash: This is a scientific and popular method. Ingredients mixture mash is fed either in dry or wet.

4. Pellet feedings: Now-a-days it is a very popular method. There is no option for bird during feed intake. Pellet is prepared from dry mash under high pressure. In this system wastage of feed can be avoided.

5. Restricted or controlled feeding: The method involves restrictions of feeding pullets during 6-20 weeks of age instead of *ad libitum* feeding as is practiced at present in most poultry farm.