IVC

FIRST YEAR

Dairying

FEEDS AND FEEDING OF DAIRY ANIMALS

STATE INSTITUTE OF VOCATIONAL EDUCATION
DIRECTOR OF INTERMEDIATE EDUCATION
GOVT. OF ANDHRA PRADESH

Telugu Academy Publication : Vocational Course

INTERMEDIATE VOCATIONAL COURSE FIRST YEAR

FEEDS AND FEEDING OF DAIRY ANIMALS

FOR THE COURSE OF DAIRYING

STATE INSTITUTE OF VOCATIONAL EDUCATION
DIRECTOR OF INTERMEDIATE EDUCATION
GOVT. OF ANDHRA PRADESH
2005

Intermediate Vocatioinal Course, 1st Year

FEEDS AND FEEDING OF DAIRY ANIMALS

(For the Course of Dairying)

Author (1) : Dr. P. Sunder Reddy
Asst. Director (A.H.)
O/D J.L. in Dairying
Govt. City Jr. College, Hyderabad.

Author (2) : Sri K. Vishweshwar
J.L. in Dairying
Govt. Jr. College, Kachiguda, Hyderabad.

Editor : Dr. N. Krishnaiah
Asso. Professor and Head
Dept. of Veterinary Public Health,
ANGRAU, Rajendra Nagar, Hyderabad.

Price : Rs. /-

Printed in India
Laser Typeset Reformatted by **SINDOOR GRAPHICS**, Dilsukhnagar, Hyderabad-60.
Phone : 24047464, 9393009995

CONTENTS

1. DIGESTIVE SYSTEM

1.1 SKETCH DIAGRAM OF DIGESTIVE SYSTEM OF DAIRY ANIMAL

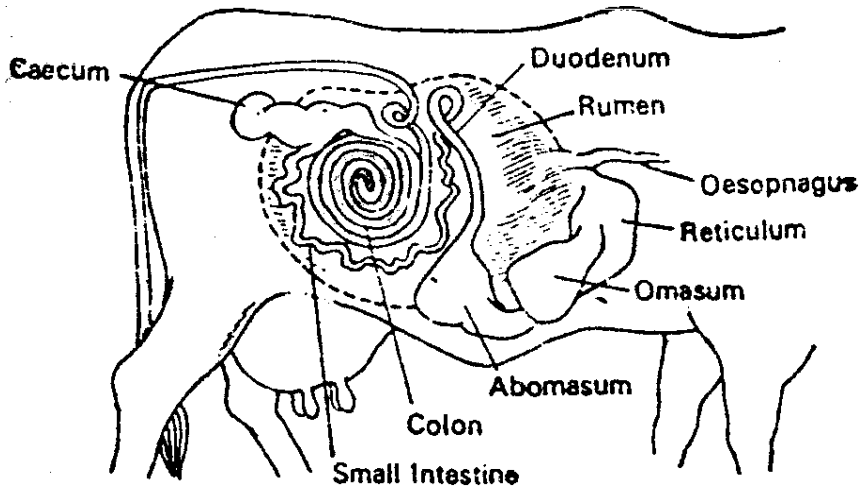


Fig: 1.1 A Digestive Tract of Cattle

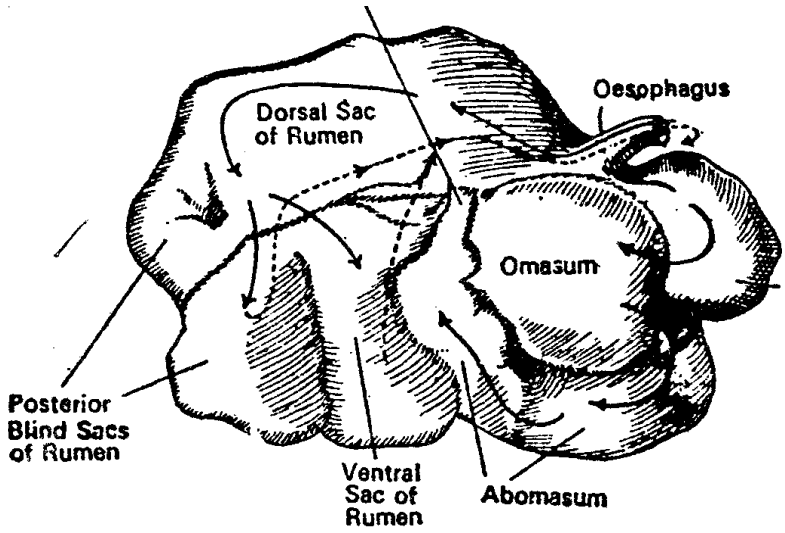


Fig: 1.1 B
ORGANS THAT COMPRISE THE STOMACH OF THE RUMINANT

1.2 - DESCRIPTION OF DIGESTIVE SYSTEM:

The digestive system of cattle. consists of mouth, pharynx, Esophagus, stomach, intestine, liver and pancreas.

1.2.1. MOUTH:

The mouth is the first part of the alimentary canal. It consists of lips, teeth, tongue and salivary glands.

a) **Lips :** There are two lips, upper lip and lower lip. The, upper front portion of the upper lip upto nostrils is known as Muffle, which is wet in health and dry when the anima! is sick.

b) **Teeth :** There are 32 teeth in cattle. The formula is as follows :

20b1+4 C Olo PM 313 M 313) — 32.

I =Incisors
C = Canine
PM=Premolars
M=Molars.

The lower jaw, which is known as Maxilla, consists of ‘12 molars only. “there are no incisors in upper jaw 1t consists of hard palate

c) **Torigue :** The tongue Is situated on ft floor ©f the mouth. It has three parts i.e. Root, Body and tip.

d) **Salivary Glands:** The glands -situated around, and in the mouth of the cattle are known as salivary glands. They are paratid glands, mandibular glands, sublingual glands etc.

1.2.2 PHARYNX :

The pharynx is a funnel shaped passage situated at the back of the mouth, which is common for respiratory and digestive passage.

1.2.3 OESOPHAGUS:

Esophagus is a muscular tube, which conveys the food and drink down to the stomach from the mouth.

1.2.4 STOMACH

The stomach of the cattle is very large and compound. It consists of four parts, Rumen, Reticulum, Omasum and Abomosion. The ruminating animals take the food plenty without chewing, and such food is stored in Rumen.

Stored food is brought back to the mouth for mastication and mixing of food with saliva to make a pasty material which is fit for digestion, this process is known as Rumination.

a) Rumen :

This is the first part of the stomach in ruminants. It is a big sac occupying the left side of the abdomen. It has papilated mucus secreting glands. The food after rumination is passed in to the Omosum. Rumen contains microbes which digest cellulose contain plant material which is known as Ruminant digestion.

b) Reticulum :

This is the second part of stomach of ruminants, The mucus membrane of this part is triangular or a square marking looking honey comb structure. The heavy or solid objects, which are swallowed by animal, are dropped in this portion. If these objects are sharp and pointed they may penetrate, the diaphragm and heart and causes a severe disease known as “Traumatic pericarditis.

c) Omasum :

This is the third stomach, of ruminants. It is in round shape, it has leafy rough portions through which the food passes crushed In between the leaves of this portion.

d) Abomasum :

This is the fourth part of stomach of ruminants. This is also known as "True stomach". !t follows the third stomach and is pear shaped sac lying on the floor of the abdotrAn an right side. It has digestive glands known as cardiac, fundus and pyloric. These glands secret gastric juice which further digestive and passes into small intestines.

1.2.5 INTESTINES :

This is the part of the alimentary canal. In this portion the digestion and absorption of foodstuffs takes place. The first portion is known as small intestines and the rest is large intestines.

a) Small Intestines :

The length of/the small intestine is about 130 feet in cattle and lies at the right side of the stomach. This is divided into three portions known as "Duodenum" " Jejunum" and "I 'Ileum".

b) Large Intestines :

The large intestine is divided into three 1° portions caecum, colon and Rectum. The caecum is about 2 '/z feet and colon is about 35 feet which is just like coils of watch springs. The third last position is Rectum which ends with Anus.

1.2.6 LIVER :

Liver is situated just close to the diaphragm. Its colour is dark red-brown. It is a large gland. The main function of this is to produce bile,which aids in digestion of foodstuffs. The bile is poured into small intestines through bile duct.

1.2.7 PANCREAS :

It is situated in abdomen infront of the kidneys. The colour is reddish cream; and it secrets pancreatic juice which is poured in small intestines and it helps in digestion.

1.3 DIGESTION OF CARBOHYDRATES, PROTEINS AND FATS IN RUMINANTS:

1.3.1 Digestion of Carbohydrates :

Ruminants ration largely consists of Carbohydrates rich in cellulose, hemi-cellulose and other carbohydrates, which are not attacked by the digestive enzymes, secreted by ruminants.

When these carbohydrates reach the rumen, these are then subject to breakdown by enzymes secreted by microorganisms inhibiting the rumen. The important end products of the process the monosaccharides are formed and immediately fermented to a 'mixture of organic volatile fatty CO_2 (V.F.A) viz. Acetic, propionic and butyric acids apart from gases like CO_2 and CH_4. Most of the gas produced is lost by ejection, if gas a'c'O4mufates it causes the condition known as Bloat, in which the 11i0tentiorl of rumen is great, that animal may die due to high pressure of the diaphragm towards heart.

1.3.2 DIGESTION OF FATS IN RUMINANTS:

The effect of microorganisms includes hydrolytic release of esterified fatty acids, hydrogenation of unsaturated of fatty acids and fermentation of free glycerol during lipolysis. A11 short chain fatty acids and volatile fatty acids produced from the hydrolysis and fermentation of lipids are largely.
absorbed through the rumen well.

1.3.3 DIGESTION OF PROTEINS IN RUMINANTS:

Digestion and absorption is proteins in ruminants is unique by Itself due to the presence of compound stomach. Micro organisms which are-present in the rumen digest the dietary protein by -releasing protoelytie enzymes, which are Mostly intra cellular, associated with the cell wall fraction from which it is liberated. Thus all the proteins and non-protein nitrogenous compounds are hydrolysed by the rumen microorganisms comprising bath the bacteria and protozoa. In the rumen protein is rapidly hydrolysed to amino acids which are then do-animated to ammonia. A portion of total ammonia of the rumen is absorbed directly from the,. rumen to the systemic blood, which in the liver is mostly converted into urea, A small fraction may also be utilized for the synthesis of non-essential amino acids or sources other compounds.

1.4 ANIMAL DIGESTION TRIALS

The chemical composition of feed gives only the potential value of feed. So the losses of nutrients in faces and urine are measured to know the actual value of feed. The digestion trial in values record of nutrients consumed and the amount of them voided in the faces. The time taken for a ration to traverse the entire length of gastro-intestinal track is about 710 days. So a preliminary period of 10 - 15 days on experimental ration is allowed.

1.4.1 PRİLIMINARY PERIOD:

The animal provided with water, salt licks all the time. They are fed individually the same ration as they are fed during experimental period. But no record of feed in take and faecal output are made. The animal aretired, with faecal bags. The preliminary period of 10-15 days is followed to eliminate the feed residues of the previous feed from the digestive tract.

1.4.2 COLLECTION PERIOD:

It is of 7-10 days after preliminary period is over. During the period the animal are fed individually, The weighted quantity of feed, and total dry matter consumed by each animal is determined daily. The faeces are collected from each animal weighted and an aliquot sample taken for dry matter estimation. Composite samples of feed and faeces are made for entire collection period.

After the collection period is over, the daily average dry matter intake and out put are measured. The composite samples of feed and faeces are analyzed for their proximate principles to arrive at the digestibility coefficient of the individual nutrients.

Digestibility = Amount of Nutrient in feed - Amount of nutrient in faeces

$$\frac{\text{Coefficient}}{\text{Amount of Nutrient in feed}} \times 100$$

SUMMARY

The digestive system of dairy animal was discussed in detail with the help of neat sketch diagram which was labelled. The digestion of carbohydrates, fats and proteins in ruminants were discussed well. The role of end products of carbohydrates, proteins and fats are explained well. The objective and use of animal digestion trials were explained.

Short Questions

1. Name the parts of ruminant stomach.
2. Which part of rumen is called honeycomb?
3. Which portion of stomach is ruminants is called True stomach?
4. What are the parts of small intestine?
5. What are the accessory glands present in digestive system?
6. What are the end products of carbohydrates digestion?
7. What is fate of end products of carbohydrate digestion in ruminants?
8. What is chyme?
9. What is the use of animal digestion trials?

Long Questions

1. Draw and label the parts of ruminants digestive system?
2. Briefly discuss about parts of ruminant stomach?
3. Explain about verious glands of digestive system of ruminants?
4. Write in detail the digestion of carbohydrates in rumen?
5. Briefly write about digestion of proteins and fats in ruminants.
6. What is the fate of end products of carbohydrate digestion in ruminants?
7. Briefly explain about the fate of end products of fats and protein digestion in ruminants?
8. Briefly explain about animal digestion trials?

2. COMMON FEEDS AND FODDERS.

2.1 STATUS OF FEED AND FODDER AVAILABILITY IN THE STATE AND COUNTRY.

Lack of adequate supply of quality fodders alone is the main constraint in achieving any increase in milk production in India. According to National Commission on Agriculture (1976), there is shortage of

44% concentrates
44 percent green fodder
38 percent of dry fodder

projecting the population for 1982 and working out the energy and protein requirement, it was seen that the deficiency of these two components amount to 37 and 34 percent respectively and in terms of roughage, and concentrates it comes to 36 and 44 percent respectively. Inspite of the research and development efforts for improving of range and common grazing lands, there has not been any serious increase in feed resources from these sources. Rather, there has been a reduction in the effective area available for grazing and the quality of grazing resources, because of the diversion of lands earlier available under natural vegetation for cultivation of dry land crops. This has forced the livestock to the poorer grazing areas, and in consequence has not only resulted in serious problems of soil erosion but also in poor nutrition of the livestock and thus their reduced production.

Realizing this fact the country has established seven regional stations in different agro climatic regions with the objective of quick transfer of technology on all aspects of fodder production, conservation and utilization and to assist the state agencies in the conduct of their extension programmes. A significant breakthrough has been achieved in the production of pasture legume seeds for use in grassland development. Improved varieties of fodder seeds are being multiplied at the central fodder seed production farm, Nasserghatta.

Because growing food and cash crops are more profitable, major !ands have been diverted toward cultivation of such crops resulting in inadequate production of green fodder. The cultivated fodder crops occupy only 6.91 million hectares, which is less than 5 percent of the area under cultivation in the country. It is only in a few states like the Punjab, where the percentage of area under

irrigated cultivated fodder is around 10 percent. If proper steps are not taken the future of India's live stock cannot be satisfactory. More areas are required to be brought under fodder crops for more production of green fodder to maintain health of the cattle as well as to increase the milk production. It may be noted that the economics of livestock production based on cultivated fodder production is much better than feeding of low quality roughage's / crop residues supplemented with concentrates. To augment milk production, it is therefore imperative to regenerate the existing grazing areas by adopting better management practices and also to increase the area under cultivated fodder crops and establishment of pasture wherever possible.

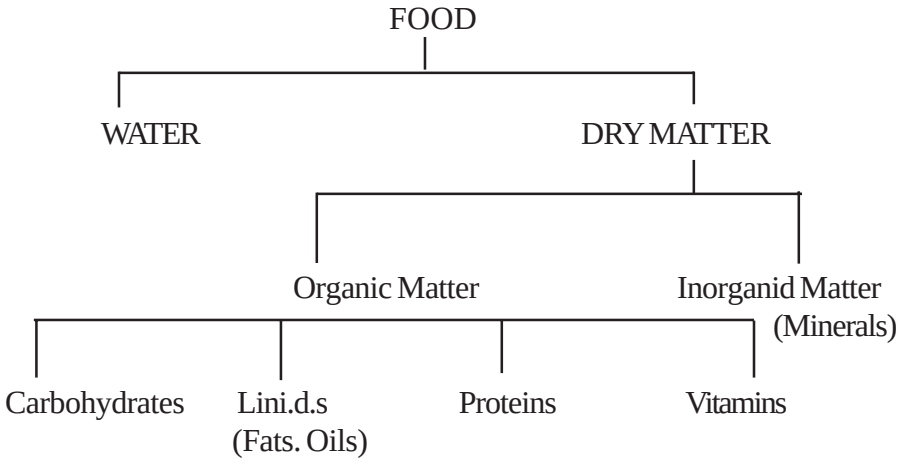
In this connection, the estimated requirements of feeds vis-a-vis availability by 2000 A:D. as estimated by the National Commission on agriculture is as follows. (In million Tons).

	Requirement	**Availability**	**Excess I Deficit**
Concentrates of Plant Origin	82.8	77.05	-5.75
Green Fodder	594.8	575.0	-19.8
Dry Fodder	373.0	356.8	-16.2

The position shown here is again on the deficit lined but somewhat better than previous years. The improvement was postulated by the committee only on assumptions that from now onwards all emphasis will be given on the reduction of feed requirement and simultaneously by increasing feed supply.

2.2 a) CLASSIFICATION OF NUTRIENTS AND THEIR ROLE IN ANIMAL NUTRITION. WATER, CRUDE FIBRE, ETHER EXTRACT, PROTEINS, MINERALS VITAMINS AND NITROGEN FREE EXTRACT.

The term nutrient is applied to any feed constituent or group of constituents of the same general composition, that are of' aid in support of life. Proteins, carbohydrate fats, water, mineral matter and vitamins are the general nutrients. Each type of nutrients has some special function to perform. The nutrients are found in all living organisms, plants or animals.



2.2.1 WATER :

Water is essential for all living bodies. Water acts in the body as a solvent in almost all vital activities like digestion, absorption, intermediary metabolism excretion and of reproduction and maintains homeothermy. Water is important as the excretion of urine, sweat and saliva and production of milk depends on it. The body of animal consists of 60% of water. If no foods are given to animals they live for 4 weeks together on water but if water is not given by any source. It dies in days.

2.2.2 DRY MATTER:

The dry matter is available in foodstuffs as organic and inorganic material as shown above.

2.2.3 CARBOHYDRATES:

Carbohydrates are the compounds of carbon with hydrogen and oxygen. The carbohydrates are the chief sources for the supply of energy to the animal body, for the maintenance of the body temperature and they are also necessary for the functioning of the organs, work and production. While surplus carbohydrates are converted into fat and stored in the body.

2.2.4 LIPIDS :

The lipids (fats and oils) are a group of substances found in plant and animal tissues, insoluble in water, but soluble in Benzene, Ether and Chloroform. They are important sources of stored energy.

2.2.5 PROTEINS:

Proteins are complex organic compounds containing nitrogen, carbon, hydrogen, oxygen and occasionally phosphorus and sulphur. They are essential constituents of animal and vegetable cells. Proteins are required for building of muscles for the growth or development of the animal body for the production of milk and eggs.

2.2.6. VITAMINS :

Vitamins are organic compounds and are effective in small amounts in promoting the health of animals, improving their appetite and digestion, stimulating growth and increasing the productive capacity of animals. Vitamins are essential for transformation of energy and regulation of metabolism. They are synthesized by plants and are found in animals as a result of food intake or of the activity of microorganisms in the gut.

There are about (15) vitamins, but more important in feeding of animals are Vitamins A.D.E.K.B and C. Each vitamins has a specific function.

VITAMINS

Fat Soluble Vitamins	Water Soluble Vitamins
Ex. Vit. A	Ex. Vit. B Complex
Vit. D	Vit. C
Vit. E	
Vit. K	

2.2.6.1 VITAMIN A :

This is fat-soluble vitamin. All green plants are rich in Vitamin A in shape of carotene, which will be converted in to Vit. A. Cod-liver oil, egg yolk, milk fat and fruits are excellent sources of Vitamin A.

It is essential for body growth vision, reproduction and maintenance of healthy epithelial tissue. The deficiency of this vitamin causes infertility in breeding animals. The growth stunted and eyes are blind. Animals will not suffer from hyper vitaminosis of Vitamin A because it has mechanism of lowered conversion rate of carotinoids to Vit. A.

2.2.6.2 VITAMIN - D

This is a fat soluble vitamin. Fish oil, egg yolk, butter fat and milk are good sources of this vitamin, Vitamin D is synthesized in animal body by the action of Ultra-violet rays though the sun light.

Vitamin - D promotes the health of animal. It is essential for absorption of calcium and phosphorus. The deficiency of this vitamin results in deposition of calcium in bones, knee joints and Hock joints are swollen. In tropical countries like India usually vitamin-D deficiency will not occur in cattle.

2.2.6.3 VITAMIN – E

Vitamin - E is a fat-soluble vitamin. All most all green fodders are rich in Vitamin - E. Cereal grains are also rich in Vitamin - E.

It acts as biological anti-oxidant in the body. The deficiency of this vitamin causes muscular dystrophy (White muscles).

2.2.6.4 VITAMIN – K

Vitamin K is fat-soluble vitamin. It is present in green plants, egg yolk, fish meal, liver, berseem, and in all green leafy material. Vitamin - K is essential in blood clotting process. Dairy animals never show the deficiency of this vitamin.

2.2.6.5 VITAMIN - B Complex:

All vitamins B complex are soluble in water and function is the transformation of energy in the body. All green leaves are rich in Vitamin - Bz, grains are rich in Vitamin B, and all cereal grains and milk is rich in vitamin - B6 (Pyridoxine)

Other B Complex group includes Niacin, pantothenic acid, Biotin, Choline, Vit B 12 (cyaroo cabalamine).

In ruminants Vitamin - B is synthesized in the body. Hence no supplement of Vitamin - B is required in feed.

2.2.6.6 VITAMIN – C

This is water-soluble vitamin. Green leafy vegetable and citrous fruits are good sources of vitamin - c. This is essential for man pigs, where as in farm animals, they synthesis vitamin - C from Glucose in the body. Therefore the deficiency of this vitamin is not observed in farm animals.

2.2.6.7 COMPERATIVE STUDY OF FAT AND WATER SOLUBLE VITAMINS:

S.No.	Fat Soluble Vitamins	Water Soluble Vitamins
1.	It contains CH_2O_2	Contains CH_2, 0_2, N_2, S, Co
2.	Occurs in provitamins or precursers	These are not provitamins
3.	These are essential for the metabolism of the structural unit. (Each vitamin has a separate function).	These vitamins are essential for transformation of energy
4.	These are absorbed in the presence of fats in intestines.	These are absorbed in the presence of water.
5.	These vitamins are stored whereever fat is deposited in the body	These vitamins are not stored in the the body
6.	These Vitamins are excreted through faeces.	Excreted through urine and less in faeces.

B) IMPORTANCE OF ANALYSIS (PROXIMATE) OF FEEDS.

ESTIMATION OF CRUDE PROTEIN (TOTAL NITROGEN)

a) PRINCIPLE:

Protein content of a food stuff is estimated indirectly by first determining the nitrogen content and then multiplying the N content by the factor 6.25 derived on the basis that all proteins contains on an average 16% of N. -The total N present in a sample is determined by the kjeldahl method. When a feed sample is heated with an excess of conc. H_2So_4, the protein is hydralysed and finally decomposed to NH_3. The NH_3 thus liberate combines with the excess H_2SO_4 present forming $(NH_4)_2So_4$ The $(NH_4)_2So_4$ so formed is distilled with strong alkali to liberate NH_3 which is quantitatively absorbed in a known volume and strength of standard H_2So_4 for its final estimation and calculation of the total nitrogen present.

b) APPARATUS

1. Kjeldahl flask 500 ml or 800 ml capacity.
2. Distillation assembly.

c) RAGENTS :

1. Conc. Fi2So4.
2. Anhydrous Na2So4
3. CuSo4.
4. Selenium
5. 40% Naoh
6. Std. N/10 Naoh
7. Std. N/10 H2so4

Methyl red indicator

Phenolphthalein indicator

d) PROCEDURE

1. Weigh accurate a suitable quantity of the given sample on a piece of glazed paper. Transfer the material to a kjeldhal flask.

2. Pour 25 ml of Conc. H2So4 along the neck of the flask so as to wash down any particles of the sample sticking to the sides.

3. Add 10 gms of anhydrous sodium sulphate or potassium sulphate, a crystal of copper sulphate and about 0.1 gm of selenium.

4. Drop a few glass beads into the flask to prevent spurting while heating. Heat the flask over a burning flame into a fume. Cupboard gently at first and then gradually to boiling point till contents become perfectly colorless. This is the end point of digestion and is reached in 2 to 3 hours of heating when an excess of CuSo4 is added the content will be pale blue in color. When the end point of digestion is reached, remove the flame and allow the flask'to cool.

e) DISTILLATION

A single unit distillation assembly consists of a 1 litre distillation flask, which is connected through a trap to the upper end of an upright condenser. The trap prevents any splashing of the contents of the distillation flask into the condenser. The lower end of the condenser should almost touch the bottom of the receiver flask in which a carefully measured quantity of N/10 H2So4 is taken.

1. Dilute the content in kjeldahl's flask with water rinsing the, sides and neck of the flask. Rotate the flask to dissolve content. The flask becomes very hot to touch due to the mixing of the H2So4 with water and evolution of heat. Allow the flask to cool.

2. Transfer the contents of Kjeldahl flask quantitatively to the distillation flask through a funnel. Wash the kjeldahl flask several times with water and transfer the washing also. The total quantity of water used jor washing should be about 200 ml. Drop a few glass beads and zinc granules into the distillation flask to prevent bumping.

3. Take a measured excess quantity of std N//10 H2So4 into the receiver flask by means of a pipette or burette.Add 1 drop of methyl red and place the receiver flask in the distillation assembly in such a way that the tip of the condenser is well below the level of the standard acid so as to prevent any escape of Nh3 during distillation.

4. To the content in the distillation flask add a few drops of phenafphalein followed by an excess of 40% NaoH slowly so that the alkali settle to the bottom without mixing with the contents of the flask. Close the flask and after assembly the distillation apparatus should be air tight

5. Heat the distillation flask and start the cold water circulation on the condenser. The distillate containing Nh3 gets collected in the receiver. Flask containing N/10 H2So4 which absorbs all the Nh3 liberated during distillation. Distil till 150 to 200 m! of distillate is obtained in the receiver flask.

6. When the distillate has been collected, stop the water circulation in the condenser so that only steam evolves through the condenser tip. Now remove the receiver flask after rinsing the tip of the condenser with distilled water.

7. Titrate the content in the flask against Std. N / 10 H2So4.

f) CALCULATION

To arrive at the vol of N /10 H2So4 actually utilized deduct the volume of N / 10 alkali required for the back titration in blank experiment from the measured volume of N /10 H2So4, taken in the receiver flask before distillation.

1 ml of N /10 H2so4 = 1.4 mgs. N.
Crude protein % = No. of . ml NI10 M2so4 x 1.4 x 6.25 x 100 / wt. of sample x 1/100.

ESTIMATION OF A CRUDE FIBRE

a) PRINCIPLE :

When a sample of moisture and fat free plant material is boiled first with dilute acid and then with dilute alkali the soluble carbohydrates and proteins go into solution and are extracted. The undissolved residue left behind representing cellulose, hemicellulose and lingin put together is called "Crude Fibre". When the residue after drying and weighing is heated, the fibre being organic in nature is burnt, where as the ash or mineral matter is left over. The fibre content is obtained by deducting the weight of ash from the weight of the dried residue.

b) APPARATUS:

1. Beaker, tall form, without spout 500 ml capacity
2. Filter flask 1000ml. Capacity with a rubber cork fitted with a 4" glass funnel.
3. Filter pump - glass
4. Muslin cloth with 18 threads to a centimeter

c) REAGENTS:

1. 1.25 % H2S04
2. 1.25% NaoH
3. Alcohol
4. Ether

d) PROCEDURE:

1. Weigh an aliquot of the moisture cum fat free sample into a beaker with a mark made at 200 ml level with a glass marking pencil. The moisture and fat free residue left in the extraction thimble in the previous experiment may be used.

2. Add 200ml boiling 1.25% H2So4 and heat gently on low flame to boil for exactly 30 mts. If the contents are boiled vigorously there will be much frothing which might be avoided.

3. Filter in a filter flask connected to a filter pump through a muslin cloth held over the glass funnel. Wash residue on cloth with boiling water till free from acid. Test with litmus paper.

4. Transfer material from muslin cloth back to the beaker. Add boiling 1.25% NaoH upto the mark and heat to boil for exactly 30 mts avoiding frothing.

5. Filter through the same muslin cloth on the filter flask connected to a filter pump. Wash with boiling water till free from alkali. Test with litmus paper. Wash residue with 150 ml of absolute alcohol and then with 10 ml ether.

6. Transfer the residue to a clean dry silica crucible. Dry at 105 o C in a hot air oven- cool and wealth.

7. Incinerate in a muffle at 600 o C for 30 min. cool.

e) CALCULATION:

Crude Fibre = Wt. Of silica crucible Wt. Of silica crucible with

$$\frac{\text{With content before ashing} - \text{Contents after ashing}}{\text{Weight of substance taken}} \times 100$$

ESTIMATION OF ETHER EXTRACT (CRUDE FAT)

a) PRINCIPLE :

When a sample of feed which is free from moisture is treated with a fat solvent like ether, the solvent extracts all the fat as well as other substances soluble in ether like steroids, lecithin's, resins and volatile oils. True fat is a mixture of triglycerides, whereas the latter substances are not. Hence the name crude at or "Ether extract" is given for the extract obtained in this method.

b) APPARATUS AND REAGENTS:

1) Soxhlet extraction Assembly : This consists of 3 parts a) Condenser at the top 2) Soxhlet or extractor in the middle and 3) The receiver flask at the bottom. The 3 parts are assembled by means of their ground glass joints.

2) Extraction thimble

3) Petroleum ether

4) Constant temperature water bath.

c) PROCEDURE:

1) Weigh accurately about 5 gms of the given sample (rendered moisture free) on a piece -of glazed paper and transfer into an extraction thimble. The sample left in the determination of moisture preserved in a desicator can be used for this experiment. Extraction thimbles are made of special type of fat free filter paper. When these are not available ordinary filter paper (watchman no. 1) can be improvised for the purpose.

2) Take the clean, dry receiver flask from the soxhlet assembly and weigh it accurately

3) Introduce the thimble with sample into the soxhlet. The top of the thimble should be well over the level of the siphon bend. Assemble the apparatus and fill soxhlet, with petroleum ether by pouring it through the condenser at the top by means of glass funnel. The amount of solvent taken is about 1.5 times the capacity of the soxhlet.

4) Place the apparatus on a water bath at 60 oc - 80 o C, start coldwater circulation in the condenser. Extract for 8 hours.

5) After extraction is over remove the thimble with the material from soxhlet. Assemble the apparatus again and heat it on the water bath to recover all the ether from the receiver flask. The flask now contains only the crude fat.

6) Disconnect the receiver flask, wipe the outside of the flask thoroughly with a clean dry cloth to remove the film of moisture and dust and dry it in a hot air oven at 100 oC for one hour, cool in a desicator and weigh.

d) Calculation:

$$\text{Ether Extract (\%)} = \frac{\text{Wt. Cf extract}}{\text{Wt. Of substance taken}} \times 100$$

ESTIMATION OF NITROGEN FREE EXTRACT

NFE is that fraction of carbohydrates, which is obtained when the sum of CP, EE, CF water and TA is subtracted from 100. It includes all soluble carbohydrates comprising of pentoses, hexases, disaccharides, polysaccharides, dextrin's and starches. The simple sugars are readily hydrolyzed from digestive tract. The starch and dextrains undergo hydrolysis by the action of digestive enzymes into glucose and absorbed. According to weende method of analysis, the total carbohydrates are expressed in terms of CF and NFE from feed samples. It has to be estimated indirectly with the following formula.

NFE (%) = 100 - (Water + CP + EE + CF + TA)

NFE = (% on DMB) = 100 - (CP + EE + CF + TA)

ESTIMATION OF TOTAL ASH

Principle :

When a feed sample is burnt, only the mineral matter is left , behirvd. This is total ash or mineral content of sample.

Apparatus :

1) Silica basin
2) Balance
3) Box of weight
4) Muffle furnace
5) Metal tongs
6) Asbestos sheet
7) Desiccator

PROCEDURE:

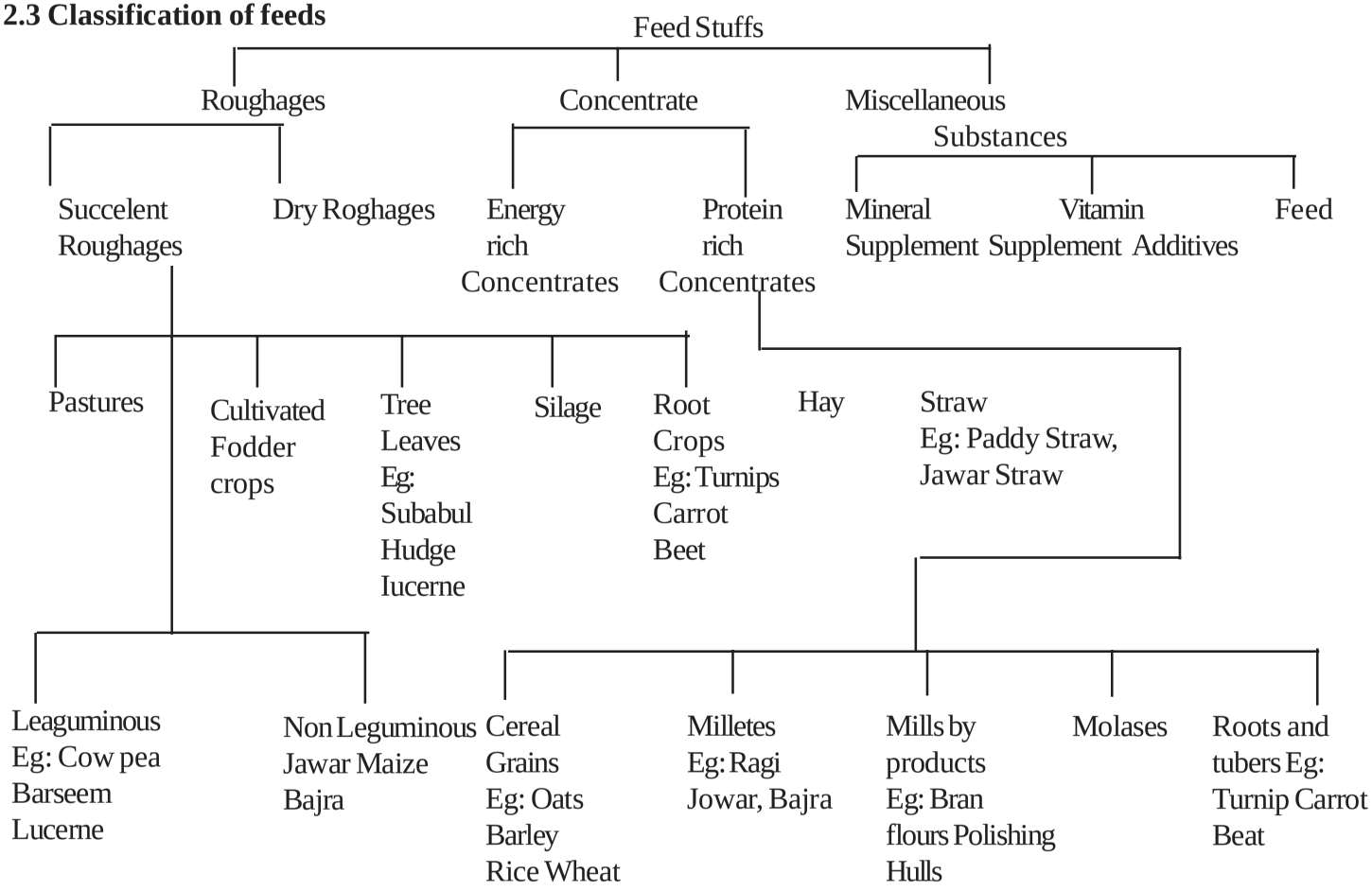
1. Take 5 g of sample in a silica basin and weigh accurately
2. Place the silica basin on a tripod stand and heat it over bansen flame till the mass is charred.
3. Transfer the silica basin to muffle furnance over 600 oC for 30 minutes.
4. Remove silica basin from furnance, cool it to room temperature in duriccator and weigh.

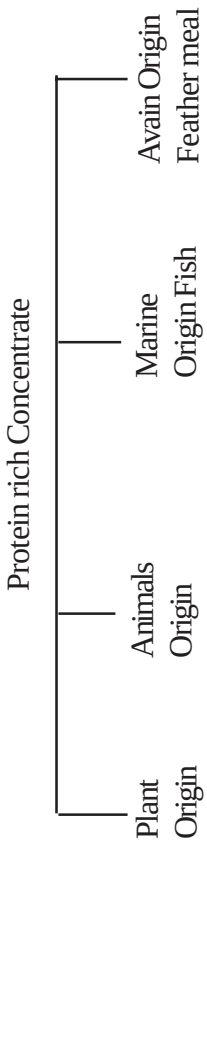
CALCULATION:

TOTAL ASH =

$$\frac{\text{Wt. Of Silica basin wtih ash - Wt. Of empty silica basin}}{\text{Wt. Of Sample}} \times 100$$

Fig. 2.3 Classification of feeds




Protein rich Concentrate
Avain Origin
Feather meal
Marine
Origin Fish
Meal
Animals
Origin
Meat, Bone
Blood Meals
Plant
Origin
Brewers
grains
And yeast
Oil Seeds
Cakes

A) Roughages:

Roughages are bulky feeds containing relatively large amount of less digestible material i.e. crude fibre more than 18% and low (about 60%) in total digestible nutrients (TDN) on air day basis.

Roughages are subdivided in to two major groups i.e. succulent and dry roughages based on the moisture content. Succulent feeds usually contains moisture from 60-90%, where as dry roughages contain only 1015% moisture. For the sake of convenience succulent feeds are again classified into 'pastures, cultivated fodder crops, tree leaves, silage and root crops. Dry roughages are dried plant materials, which are preserved for usage in summer and in unforeseen climatic conditions.

SUCCELENT ROUGHAGES

a) Pastures :

Young rapidly grown grasses in the wastelands are rich in protein and highly palatable. Better to feed in right growth stage. Pastures form the oldest form of livestock feed. The word pastures refer to land on which different types of edible grasses and other plants grow or are grown for grazing livestock. Permanent pastures are those covered with perennial or self-seeding animal species of plants . Temporary pastures are those planted with quick growing crops like Sudan grasses and millet to provide supplemental grazing during lean season.

b) Cultivated Fodder Crops :

Leguminous and non- - leguminous. Leguminous fodder consists of stem and leaves of a group of plants belonging to "Leguminosae". These plants by virtue of bacteria of Rhizobium group in their root nodules, fix nitrogen from atmosphere and make it available to themselves, other plants, anima(and man. Legumes contains 2-3% DCP and 10% TPN on fresh basis.

Eg : CowPea, (Vigna Sinesis)
Berseem (Trifolium Alexandriurn)
Lucerne (Medicago Sativa)
Sun hump (Crotalaria Juncia).

Legumes always have a higher nitrogen content and can form a major source of protein to animals. For cattle and buffaloes, if legumes are fed liberally, there is no need for any additional supply of protein. The disadvantage of leguminous fodder is production of gas in the rumen i.e. Bloat, if large quantities of legumes are fed legumes are low in phosphorus.

Non leguminous fodders contains lower percentage of nitrogen. 0.5 to 1.0% DCP and 11-15°,% TDN : Non Leguminous fodders consists of many cereal crops, cultivated grasses, indigenous grasses and introduced grasses.

Cereal Crops	Maize (Zea mays)
	Sorghum (sorghum Vulgare) Bajra (Pennisetum typhoides)
Permanent Cultivated	Paragrass (Brachiaria Mutica Guine grass (Panicum maximum) Napier grass (Pennisetum purpureum) Crops
Indigenous grasses	Anjan Grass (cenchrus ciliaris) Dhub grass (Cynodon dactylon)
Introduced Grass	Orchard grass (Dactylis alomQratr)) Signal grass (Brachiaia brizantha)

c. Tree Leaves:

Certain tree leaves are fed whenever fodder crisis occurs. Eg. Subabul (Lucenea leuco-cephala) and hedge lucerne)

d. Root Crops :

When root crops are grown well, the succulent leaves are used as fodder during other fodder shortage. They contain low crude fibre (5-11 %).

Eg. Tapioca Turnips Fodder beet Carrot

e) Silage:

Silage is conserved green fodder using fermentation process, to be utilized in lean season when green fodder is not available.

Dry Raughages :

a) Hay :

The green crops when become mature and before formation of seeds are cut and air dried to reduce the moisture content to 15-20% to inhibit the enzyme which spoils the grass are known as 'hay'. Thus green ryrass in a mature state is preserved for long time. According to type of forage, hav is again classified into legurrinous and non-leguminous.

Under leguminous Lucerne is best suitable for. hay making. Leucerne hay contains 14-16% DCP and 50% TDN. Berseem and cow-pea are difficult to make hay because of hollow ar)d thick stems. Most of the nonleguminous fodder crops are used far hay preparation. Non leguminous hay is less palatable and contains less proteins than legume.

b) Straws :

The stem parts oo food crops after harvesting the cereais and grains are dried and knovyn as straws eg. Paddy, Jowar, arid maize straws. Straws are poorest in protein and have largest percentage of crude fibre. They are comparatively poor in phosphorus, but rich in silica. DCP is practically Nil and TDN is around 40%.

B) Concentrates .

A feed or feed mixture which supplies primary nutrient (proteins, carbohydrates and fat) at higher levels but contains less than 18% crude fibre and more than 60% TDN.

Concentrates are classified as energy rich and protein rich concentrates. The crude protein will be less than 18% in energy rich concentrates. And more than 18% in protein rich concentrates.

Energy rich concentrates :

a) Cereal Grains : Cereal grains are rich in carbohydrates Eg : Maize, Barley, Rice, Oats. The concentrate mixture is prepared.

b) Millets : Eg: Ragi, Jowar and Bajra.

c) Mill by products : The by-products of milks i.e. Bran (Rice, wheat), Flour, hulls, polishing and embryo of seeds are used as a part ir; concentrate mixture

d) Molasses : By product in sugar factories used in feeds as biruding agent for pelletization. It proves palatability and increases the energy content.

e) Roots and tubors : It excess roots and tubers are available they can be fed to livestock's eg: Roots-turnip, sugar been, carrot. Tubers - potato, sweet potato.

PROTEINS RICH CONCENTRATES:

a) Plant Origin :

The by-products after removing oils of plant origin - are important plant protein supplements. Eg: Oil seed cakes i.e. Ground nut, cotton seed, linseed, mustard, suyabean etc. pulses as it can is, also be used for livestock feeding, but cost is the barrier.

Brewers yeast and grains which are by products of wine industry are also used. The sprouts are removed, processed and sold as brewers grains and the excess yeast is filtered, concentrated dried and sold as brewers yeast.

b) Animal Origin:

The by-products of slaughter houses i.e. meat, blood and bones are dried and made in to powders to be mixed in concentrate feeds.

c) Marine Origin :

The dried fish is used in live stock feeds.

d) Avian Origin:

Eg : Feather meal is crushed and mixed in concentrate mixture.

C) FEED SUPPLEMENTS

Mineral Supplements

Based on the work done in India on the mineral elements profile in the feeds and fodder ISI has recommended the mineral mixture for feeding the cattle and poultry. Many mineral mixtures are marketed under the different trade names. Generally salt, calcium carbonate, zinc sulphate and copper sulphate supplements improve production and reproduction.

Vitamin Supplements

Various Vitamin supplements for poultry, pigs, cattle are marketed in India under different names. For poultry vit A+B_2 and D_3 synthetic vitamin supplements are marketed.

D) FEED ADDITIVES

Hormones

Some of the hormones have growth promoting properties like oestrogens, androgens, progestogens, thyroxine and pituitary growth hormones. Iodinated

casein is a commercial product which has given variable response. In India this compound has given response for a shorter period in the lactating animals. Long-term feeding gave discouraging results.

Synthetic oestrogenic hormones like stillboestrol and hexo estrol are being used in many countries as growth promoters. these are being used for poultry, beef and lamb production. In case of poultry fatty carcasses are produced where as in ruminants lean carcasses are produced. These hormonal preparations are given either orally or implanted subcutaneously. The response varies between 25-60 percent in th ecase of beef animals.

There are certain side effects in the animals fed on synthetic hormones, like restlessness, milk secretion from rudimentary teats, etc. The most serious danger in the human beings arising from the residues of synthetic oestrogen is the meat which has carcinogenic properties. In USA the use of stilboestrol for chemical caponisation of poultry has been banned but it may be used for fattening beef cattle and sheep under strict regulations of the government.

In India there is no practice of feeding any synthetic hormone to any category of animals.

The other growth stimulating compounds like arsenticals, copper sulphate in pigs, surfactants (detergents) and tranquilisers have been used as growth stimulating agents in the different categories of animals. None of these is being used in India except to a very small extent copper sulphate is used in pigs.

Probiotics

Many microbial feed additives for ruminants have been used which include bacterial cultures from both ruminal and non-ruminal sources. Most commonly used products are based on Aspergillus oryzae and Saccharomyces cerevisiae. These probiotics increase in milk yield to about 5-7%. The mode of action is still not very clear.

Antibiotics

Antibiotics are not classified under nutrients, but are considered as feed supplements. They are chemical substances produced by the microorganism and have bactericidal or bacteriostatic action on the other microorganism. At lower intake the antibiotics are known to be effective in controlling the subclinical infections and stimulating the growth of animals when added to their feed and drinking water.

The exact mode of action of antibiotics is not known but many theories have been proposed. There is evidence to support atleast three possibilities : (1) they may inhibit or destroy the activity of pathogens causing subclinical infection; (2) they may increase the number or activity of organisms that synthesize growth factors which are ultimately available to the lost; (3) they may inhibit the growth of microorganism that compete the lost for supplies of nutrients. Besides this, there are other hypotheses for improving the growth rate of the animals viz., (i) they inhibit the growth of bacteria which produce toxins that reduce the growth of the animals; and (ii) they increase the absorptive capacity of the intestine. The latter one is based on the observation that feeding of antibiotics leads to thinning of the intestinal lumen.

There is an evidence that feeding antibiotics checks the subclinical infections and improves growth, since the growth response in animals (chicks, pigs) reared under infected buildings on antibiotics feedings was more than the birds reared under germ-free, new and clean environment where there was no response at all.

There is evidence also that supplementing antibiotics in the ration can be expected under most practical conditions, to increase feed intake and sometimes feed efficiency in producing gains. In pigs the growth is commonly stimulated by 10-15 percent with a improvement of feed efficiency to the extent of 5-7 percent. The beneficial effects of antibiotics feeding are inversely proportional to the degree of sanitation in the animals housing system. However, this conclusion may not be interpreted as bad management can be replaced by antibiotics feeding.

Both the ionophore and non-ionophore antibiotics have been used in non-ruminants and pre-ruminants, while only the ionophores have been used successfully in adult ruminants. In ionophores, monensin has got wide acceptance. The inophore feeding increases the proponate production and decrease methane production in the rumen. The ionophore antibiotics are inhibitory to gram positive bacteria and do not affect the gram negative. Therefore they have beneficial effect on protein degradation without affecting cellulose diagestion.

There are number of antibiotics which ahave been tested for the growth promotion effect like chlortetracycline, penicillin, oxytetracycline, bacitaium, streptomycin, terramycine, neomycin, erythromycin, flavomycin etc. Recently

in many countries there are some restrictions to use antibiotics as feed supplements. In India penicillin, terramycin, tetracycline, flavomycin etc. are being used as a feed supplements in poultry, pigs and pre-ruminant calves. These antibiotics are being amrketed under different trade names. Though recently in some quarters some objections have been raised for using them as feed supplements but no legislation has been passed on restricting their use.

2.4 IMPORTANCE OF UNCONVENTIONAL FEEDS:

The feed ingredients, which are not popularly used in the formulation of rations even though they have fairly good nutritious value, are known as unconventional feeds.

Eg : Tapioca, Mango -,eed kernel, sun hemp seed, salseed, tamarind seed, corn guarmeal, sunflower and safflower cakes, corn gluten meal from wet corn milling, Dried yeast from brewing industry, urea from fertilizer Industry, Dried poultry manure, etc.,

Why unconventional ingredients are used

1. To minimize the competition of livestock with the human race for conventional food grains.

2. To economise on the cost of feeding, as these are available at low prices.

3. Because of the limited availability of conventional foodstuffs.

At present in India there is a shortage of 11 % Dry fodder, 38% of green fodder and 44% of concentrates. To bridge the shortage the remedy is only using unconventional feed ingredients in livestock feeds.

Some of the important unconventional feeds and fodders are .

a)Tree Leaves as fodder :

Mulberry (10.7% DCP and 60% TDN). Bamboo (9% DCP and 49% TDA) Ardu leaves are used for feeding Livestock (13% UCP and 63% TDN).

b) Other unconventional roughage sources :

Jute leaves which are sweet and contains 13.95% DCP and 60.6% TDN) and sun hump (12.7% DCP and 65% TPN) can also be used for feeding cattle. Chakunda, a leguminous plant is not liked by cattle due to obnoxious smell can be converted into silage along with paddy straw to feed livestock. A water hyacinth luxurious by grown Weed causes diuresis and diarrhoea is cattle when fed. However this can be converted in to hay and fed along with paddy straw and cakes. Silage can also be prepared from water hyacinth with paddy straw in 4:1 proportion using 2% salt. Jhanji is yet another perennial semi aquatic plant which grows luxuriantly as very common weed in ponds contains 9.3% DCP and 44% TDN can also be fed along with paddy straw. Dried jhanji can also be prepared and fed to cattle.

Agricultural byproducts like, moong straw (4% DCP and 49% TDN) cowpea pcd shells (3.25% DCP and 59% TDN), Groundnut haulms (5.4% DGP and 51% TDN) soyabean bhosa (1.6% DCP and 45% TDN) are also

Banana leaves (8% DCP and 61% TDN) can be fed along with paddy straw and little quantity of oil cake. When these leaves are alone fed causes loose faeces.

Industrial by products i.e. lemon grass after extraction of oil for Vitamin A preparation (1% DCP and 54% TDN) can be used for cattle feeding. The bitter variety of tapioca (Manihot utilissima) which is generally used in the production of starch. The fibrous waste, left over after extraction of starch known as tapioca spent pulp can be used for livestock feeding. Sugar beet pulp, Rice husk at 33% lived as a roughage can be fed to growing calves. The left over of mulberry leaves and stalks after feeding to silk worms contains 7.8% DCP and 49% DDN and guar meal which is a byproducts after extraction of gum from guar seeds can also be fed to livestock as a part in concentrate feeds.

Mango seed kernel (6% DCP and 50% TDN) can be fed especially for work animals without any side effect babul pods (Acacia Arabica) pods contains 5.75% DCP and 62.5% TDN can be incorporated in the concentrate mixture. Kapok seeds cassiatora seeds can also be fed.

Tamarind Seeds (5.34% DCP and 60% TDN), Mahva cake (8% DCP and 60% TDN), Jamon seeds (5.8% DCP and 46% TDN) rubber seed cake (18.6% DCP and 54 % TDN) kidney bean chuni (16.3% DCP and 66.9% TDN) are also used for as a part in concentrate feeds.

Salseed meal after extraction of oil contains 6-12% tannins which is the main limiting factor, which causes unutilization of proteins (9-10%) It contains. Treatment with 0.1N sodium hydroxide with reduce 64% tannins and can be fed to growing calves, Oak kernels can be used for substitution of maize at 16% levels.

Most of the waste from vegetable and fruit processing industries are processed properly and can be fed to livestock. Fruit wastes are rich in soluble carbohydrates (70-80%) and vegetable wastes-are rich in proteins (20-30%). The cauli-flower leaves, dried tomato, pomace and empty pea pods are detrimental for live stock feeding. Sea weeds and fish wastes after proper extraction can be used for live stock feeding.

2.5 COMPOSITION OF COMMONLY USED FEEDS AND FODDERS

S.No.	Item	DCP%	TDN%
1.	Paddy straw	0	40
2.	Wheat straw	0	48.9
3.	Cow pea green	20.3	62.2
4.	Lucern green	16.2	60.2
5.	Oats (flowering green)	7.7	72.0
6.	Maize green	4.0	68.0
7.	Jawar green	4.0	68.0
8.	Maize grown	7.0	87.1
9.	Jawar grown	7.0	70.0
10.	Rice bran	9.1	76.1
11.	Wheat bran	15.0	82.2

12.	Ground nut cake	49.1	77.0
13.	Cotton seed cake	19.2	76.8
14.	Sesame cake	34.0	80.0
15.	Gram chuni	13.6	87.5

SUMMARY

The present status of feeds and fodder in the country is summarized. The nutrient present in the feeds and fodders are classified and their role in animal nutrition was explained well. Feeds and fodders were classified with suitable examples. The various feeds and fodders quality and importance was dicussed in detail. The various unconventional feeds used in animal nutrition were discussed which will decrease the feed cost as well as animals competing with human goods is minimized. Hormones and Antibiotics were discussed.

The feed analysis procedures for estimation of crude protein, crude fibre, ether extract, nitrogen free extract, Total ash were explained in detail, with explanation of principles involved and apparatus required. The objectives and use of animal digestion trials were explained, which helps in evaluation of feeds and fodders.

SHORT QUESTIONS

1. What reagents are used in estimation of crude protein?
2. Give the formulae for crude protein estimation.
3. What is the principle involved in crude fibre estimation ?
4. Mention the reagents used in estimation of ether extract ?
5. What is the principle involved in total ash estimation ?
6. What are animal digestion trials?

LONG QUESTIONS

1. Briefly discuss about the present status of feeds and fodder availability in our country?
2. Classify nutrients and briefly write about their role in animal nutri tion?
3. Classify feeds with suitable examples?
4. Briefly write about roughages?
5. Discuss in detail various types of concentrate feeds?
6. Briefly discuss about various unconventional feeds?
7. Write short notes on Hormones and Antibiotics?
8. Explain how do you estimate crude protein content in a given sample of feed.
9. How do you estimate crude fibre of feed?
10. Briefly write about estimation of ether extract in feed?
11. Give the principle and procedure for estimation of Nitrogen free ex tract.
12. How do you estimate total ash in feed?

3. FORMULATION OF RATIONS

3.1 DEFINITION OF RATION AND FEEDING STANDARDS

3.1.1 RATION: 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 portion at intervals.

3.1.2 BALANCED RATION: Ration which provides the essential nutrients to an animal in such a proportion and amount they are required for the proper nourishment of the particular animal for 24 hours is known as Balanced ration.

3.1.3 PRODUCT1ON RATI0N : Ration given to an animal for certain production i.e. milk, work, meat or egg is known as Production ration. It is in addition to the balanced ration.

3.1.4 MAINTENANCE RATION: This is the minimum amount of feed required to maintain the essential body process at their optimum rate without gain or loss in body weight or change in body composition.

3.1.5 FEEDING STANDARDS FOR CATTLE

A) Daily nutrient requirement of a calf growing at the ratio of 0.5 kg per day during first two years and reaching adult body weight at the age of approximately 3 years.

(As per the modified **MORRISON'S STANDARD**)

Body Wt. Kgs.	D.C.P (Kgs)	Energy		CA (Gms)	P (g)	Vitamin A(I.U)
		TDN (Kg)	ME (Kcal)			
45	0.17	0.9	3290	7	6	2000
70	0.22	1.3	4680	12	10	3000
100	0.28	1.9	6900	13	10	4000
150	0.35	2.6	9360	13	12	6500
200	0.40	3.0	11500	13	12	8500
300	0.47	4.0	12600	13	12	12500
450	0.48	5.0	13600	12	12	17000

b) Daily maintenance requirement of Dairy stock

Body Wt. Kgs	D.C.P (Kgs)	Energy		Ca (gms)	P (g)	Carotene (Mg)
		TDN (Kg)	ME (Kcal)			
250	0.168	2.02	7.27	6	6	27
300	0.197	2.36	8.50	7	7	32
350	0.237	2.70	9.72	8	8	37
400	0.254	3.03	10.91	9	9	42
450	0.282	3.37	12.13	10	10	47
500	0.296	3.64	13.285	11	11	52
550	0.336	4.00	14.40	12	11	57

c) Requirement for production of 1 kg of milk (to be added to requirement for maintenance and also for growth if any)

Fat Content of milk %	D.C.P (kgs)	Energy		CA (gms)	P (g)
		TDN (kg)	ME (Kcal)		
3.0	0.040	0.27	0.97	2.0	1.4
3.5	0.042	0.29	1.04	2.0	1.4
4.0	0.045	0.32	1.15	2.0	1.4
4.5	0.048	0.34	1.22	2.0	1.4
5.5	0.051	0.36	1.30	2.0	1.4
6.0	0.057	0.41	1.41	2.0	1.4
7.5	0.063	0.46	1.66	2.0	1.4

d) Nutrients required for a bull in service.

Body Wt (kg)	D.C.P (Kgs)	TDN (Kg)	ME (Kcal)	Ca (gms)	P (g)	Vitamin A.(I.U)
500	0.43	4.5	16.2	12	12	21200
600	0.48	5.1	18.2	14	14	25400
700	0.54	5.7	20.5	15	15	29600
800	0.60	6.3	22.5	18	18	33800

3.2 DESIRABLE CHARACTERISTIC OF A GOOD RATION

1. The ration should be such that it is fed liberally.
2. It should be fed individually.
3. It should be prepared properly balanced.
4. It should be palatable.
5. There shall be variety of foodstuffs in ration.
6. The components of ration should be of good quality.
7. It should contain sufficient mineral matter.
8. It should be Fairly laxative
9. It should have sufficient quantity of green fodder.
10. It should be prepared properly.
11. It should be fairly bulky, but not too bulky.
12. It should be economical and consume less labor.

3.3 THUMB RULES OF FEEDING CATTLE AND BUFFALOES

While considering the feeding schedule of adult dairy cattle, proper consideration should be made for the purpose for which the animal has to be fed. These are maintenance ration, gestation ration and production ratios.

3.3.1 MAINTENANCE RATION:

This is the minimum amount of feed required to maintain the essential body processes at their optimum rate without gain or loss in body weight or change in body composition.

Under such circumstances compound concentrate mixture which provides atleast 20% protein (14-16% DCP) and 68-72% TDN. For palatability and laxative, variety of feed should be included in the feed and balanced with minerals and vitamins.

The amount of concentrate mixture and straw, which provide maintenance requirement for adult dairy cattle, is given below:

	ITEM	FOR DAIRY CATTLE
1.	Straw	4-6 kgs.
2.	Concentrate mixture	1-2 kgs.

3.3.2 GESTATION RATION:

In the case of pregnancy, from fifth month onwards more nutrients should be provided for proper growth of foetus and to prepare the mother to produce more milk production on calving. For this in addition to maintenance ration 1 to 2 kgs of concentrate mixture is recommended.

	ITEM	FOR PREGNANT LOW
1.	Straw	5 Kgs or more 3.5 kgs.
2.	Concentrate	1.5 + 2.00

3.3.3 PRODUCTION RATION:

Production ration is the additional quantity of ration for milk production over and above the maintenance requirement. For cows 1 kg concentrate is required for every 2.5 kgs of milk and for buffaloes 1 kg for every 2.0 kgs of milk produced.

	ITEM	FOR MiLCH COW
1.	Straw	6 Kgs.
2.	Concentrate Mixture 2 + 5 (10 kgs for production)	7 Kgs.

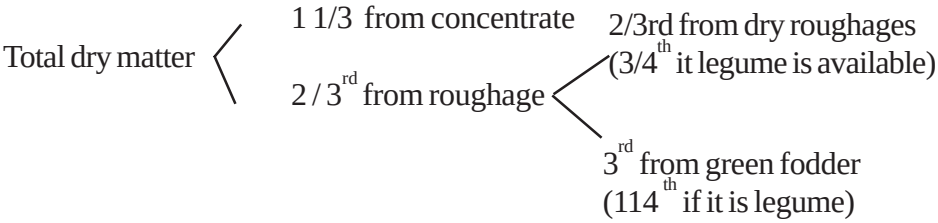
3.4 Formulation of ration for different class of animals. Heifer, Milch cows, Pregnant, bull and bullocks.

In computation of ration for cattle and buffaloes, the prime considerations is to ascertain and meet up the total requirement in terms of

1. Dry matter (DM)
2. Digestible crude protein (DCP)
3. Total digestible nutnents (TDN)

3.4.1 Requirement for Dry matter

The requirement of the quantity of dry matter depends on the body weight of the animal and also with nature of its production. Cattle will generally eat daily 2 to 2.5 kg dry matter for every 100 kgs body weight. Buffaloes and crossbreed animals are slightly heavy eaters and their dry matter consumption varies varies form 2.5 to 3.0 kg daily per 100 kg body weight. This means that the animal should consume only so much, and all its requirements whether organic nutrients like carbohydrates, protein and fat or minerals or vitamins should come from the total dry matter that has to be allotted. The DM should be given as given below:



For example cross breed cow weighing 400 kg the requirement are as follows.

1.	Total D.M. required	4x2.5 = 10 kg
2.	DM from concentrate	10 x 1/3 = 3.33 kg
3.	DM from Roughages	10x213 =6.66kg
4.	DM from dry Roughages	6.66 x 2/3 = 4.44
		6.66 x 3/4 = 4.95
		(if legumes is available)
5.	D.M. from green grass	6.66 x1/3 = 2.22
		6.66x114=1.67
		(if it is legume)

Requirement for D.C.P and TDN

These requirement for only maintenance or production or pregnancy are as follows.

Table 1:

Body Wt. Kgs	D.C.P (Kgs)	Energy		Ca (gms)	P (g)	Carotene (Mg)
		TDN (Kg)	ME (Kcal)			
45	0.17	0.9	3290	7	6	2000
70	0.22	1.3	4680	12	10	3000
100	0.28	1.9	6900	13	10	4000
150	0.35	2.6	9390	13	12	6500
200	0.40	3.0	11500	13	12	8500
300	0.49	4.0	12600	13	12	12500
450	0.48	5.0	13600	12	12	17000

Table 2:

Body Wt. Kgs	D.C.P (Kgs)	TDN (Kg)	Ca (gms)	P (g)	Carotene (Mg)
250	0.168	2.02	6	6	27
300	0.197	2.36	7	7	32
350	0.237	2.70	8	8	37
400	0.254	3.03	9	9	42
450	0.282	3.37	10	11	47
500	0.296	3.64	11	12	52
500	0.336	4.0	12	13	57

Table 3:

Fat % in milk	D.C.P (Kg)	TDN (Kg)	ME (K.cal)	Ca (g)	P (g)
3.0	0.040	0.27	0.97	2.0	1.4
3.5	0.042	0.29	1.04	2.0	1.4
4.0	0.045	0.32	1.15	2.0	1.4
4.5	0.048	0.34	1.22	2.0	1.4
5.5	0.051	0.36	1.30	2.0	1.4
6.0	0.057	0.41	1.41	2.0	1.4
7.5	0.063	0.46	1.66	2.0	1.4

Table 4:

Body Wt. Kg	D.C.P (Kg)	TDN (Kg)	ME (Kcal)	Ca (gms)	P (g)	Carotene (Mg)
500	0.43	4.5	16.2	12	12	21200
600	0.48	5.1	18.2	14	14	25400
700	0.54	5.7	20.5	15	15	29600
800	0.60	6.3	22.5	18	18	33800

Table 5:

	Normal Work			Heavy Work		
Body Wt. Kg	D.C.P (Kg)	TDN (Kg)	ME (Kcal)	Ca (gms)	P (g)	Carotene (Mg)
300	0.33	3.1	11.2	0.42	4.0	14.4
400	0.45	4.0	14.4	0.52	4.8	17.2
500	0.56	4.9	17.6	0.71	6.4	23.1

Table 6:

D.C.P	0.14 kg
TDN	0.70 kg

3.5 FORMULATION OF MILK REPLACER AND CALF STARTER

Milk replacer is a constituted feed for dairy calves. Milk can also be substituted with milk replacer to make calf raising economical. Milk replacer resembles milk in biochemical composition and saves cost of calf rearing.

OBJECTIVES OF MILK REPLACER

1. To raise orphan calves
2. To supplement dam's milk
3. To wean calves at an early age.

4. To make raising of calves cheaper
5. To maintain normal growth of calves

ESSENTIAL POINTS FOR SUCCESSFUL RESULTS WITH REPLACER

1. Economical
2. Sound management of calves
3. Nutritionally adequate
4. Proper sanitation in calf pen
5. Easily mixable with warm water I milk
6. Adequate equipment and sterilized utensils
7. Palatable
8. Nearly similar to composition of milk
9. Less crude fibre
10. Contains additives like antibiotic mixture, vitablend / Rovi mix etc

It contains minimum 20 % crude protein. The milk replacer is diluted with water in the ratio of 1:8. The following composition of milk replacer has been worked out at NDRI karnal (Arora, 1979).

Wheat	10.0 Kg.	
Fish Meal	12.0 Kg	
Linseed meal	40.0 Kg.	To make 100 kgs and contain
Milk	13.0 Kg.	25.1 % CP 21.2 % DCP 88.7 %
Coconut Oil	7.0 Kg.	TDN mix 175 grams in 1 kg of
Linseed oil	3.0 Ka	milk.
Citric acid	1.5 Kg.	
Molasses	10.0 Kg	
Mineral mixture	3.0 Kg	
Butyric acid	0.3 Kg	
Antibiotic mixture	0.3 Kg	
Rovimix A, B2, D3	0.015	

Calf Starter : Calf starter has been evolved for use with limited whole milk. An ideal calf starter contains 20 percent DCP and 70 percent TDN. It is a mixture of grains, protein feeds, minerals, vitamins and antibiotics. Misra and Singh (1993) has suggested that a good calf starter should be palatable enough, rich in energy content and should contain approximately 18-20 % protein and fibre less than 7 percent.

Maize	35 Kg	
Barley	15 Kg	
Ground nut cake	30 Kg	
Wheat bran	10 Kg	
Fish Meal	7 Kg	For 100 kgs
Mineral mixture	2 Kg	
Common salt	1 Kg	
Antibiotic mixture	100 g	
Vitablend AB2 D3	15 g	

OTHER CALF STARTERS RECOMMONDED

Barley	47	
Ground nut cake	40	
Molasses	10	
Salt	1	
Mineral mixture	1	
Antibiotic mixture	100 g	
Vitablend Ab2 D3	15 g	
Ground nut cake	37	
Maize	30	
Wheat bran	20	
Grams	10	For 100 Kgs
Mineral mixture	1	
Salt	1	
Antibiotics	100 gm	
Vita blend	15 gm	

3.6 FORMULATION OF CONCENTRATE FEED

The cheap feed prepared to meat the demands during drought and famin conditions. This feed is prepared with the locally available cheap food stuffs. The Animal Husbandary Department with the co-ordination of A.P.D.D.C. Federation of Hyderabad, formulates and manufactures the cheap feed for the benefit of the farmer during the drought conditions at a lower and subsidised rates.

The field staff of Animal Husbandary Department identify the local farmers who cannot affort to purchase a high balanced ration for their livestock in drought conditions and recommend to the Government for supply of cheap feed. A.P.D.D.C. Federation manufacture the cheap feed in their feed mixing plants and supply to the Animal Husbandary Department for onwards distribution to the identified farmers at a subsidised cost.

The cheap feed is prepared with following ingredients.

Bajra	-----	30 Parts.
Pulses husk	-----	58 Parts.
Jagary or	-----	
D.O.B.	-----	7 Parts
Mineral Mixture	-----	3 Parts.
Common Salt	-----	2 Parts.

SUMMARY

The various terms of rations well defined and various feeding standards were mentioned. The various desirable characteristics of good ration listed The various thumb rules of feeding cattle and buffaloes were explained which helps feeding under non scientific methods. The nutrient requirements for different purposes were listed and rations were formulated in detail for various classes of animal. The preparation of milk replacer; and calf starter explained in detail.

SHORT QUESTIONS

1. What is Ration ?
2. Define balanced ration.
3. Define maintenance ration.
4. What is production Ration ?
5. What is pregnancy allowance given to cattle and buffalo as thumb rule?
6. Expand DCP and TDN.
7. Give DCP and TDN values of paddy straw ?
8 What is milk replacer ?
9 Define calf starter

LONG QUESTIONS

1. Explain feeding standards ?
2. Mention various desirable characteristics of a good ration?
3 Explain various thumb rules of feeding cattle and buffalo?
4. Give nutrient requirement for maintenance for different weights of animal.
5 Formulate ration for a cow weighing 450 kg giving 10 litres of milk with 4.5% fat using wheat straw, cowpea, and oats green, maize (crushed) G.N. cake and gram chuni.
6 Formulate ration for a cow weighing 400 kgs giving 8 litre of milk with 4% fat with advanced stage of pregnancy using wheat straw, oats and Lucerne green, maize (S -3ins) gram chuni, Rice bran and sesame cake.
7. Formulate milk replacer?
8. Formulate calf starter?

4 FEEDING OF DAIRY CATTLE

4.1 Importance of feeding in dairy animal production :

1. **Feeding for maintenance :** The maintenance requirements are the minimum requirements of nutrients which produce neither positive nor negative balance in animals.

2. **Feeding for frowth :** After birth before puberty the rate of growth is higher than after puberty and when the animal becomes nature the growth rate in negligible. The growing animals do not only increse in size and weight but simultaneously development in the animal also takes place.

3. **Feeding for lactation :** The feeding requirement for milk production depends upon the level of production and composition of milk.

4. **Feeding for reproduction :** The feeding influences age of puberty. Normally if the animals grows faster, they reach sexual maturity earlier.

5. **Feeding for pregnancy :** In the early stages of pregnancy the amount of nutrients deposited in the foetus is small. During the last quarter of the pregnancy, the growth of foetus and membrances is fast and therefore extra requirements are required.

6. **Feeding for work production :** For heavy and light work different feedings are recommonded.

4.2 Feeding of newly born calf :

When a calf is born its rumen will not be developed and it will take a few months until rumen is fully developed and start functioning. Until them the calf is similar to a simple-stomached animal nutritionally. It implies the following :

i) Essential amino acids should be provided in required quantity in the ration of calves. In other words they will benefit from high quality protein and from a mixed source of protein.

ii) Vitamins belonging to the B-complex group are a nutritional necessity for them apart from vitamins A and D.

iii) They cannot utilize non-protein nitrogenous substances like urea.

iv) They require more minerals for growth of bone, muscle and other tissues.

4.2.1 Importance of Colostrum Feedings :

In cattle the antibodies (gama globulins) are transferred from mother to the calf through colostrum. These gama globulins will be absorbed as such by the calf and will enter its system forming a ready made antibody resistance system for the calf against all the disease producing agents and other antigens the mother has had, encountered during its lifetime. This will protect the calf against diseases in the early stages, until their own 'antibody manufacturing' system takes over. Thus, if colostrum is not fed, the calves are denied antibody cover and, therefore, will remain susceptible to many diseases. Most likely, they will perish due to some disease or the other.

Besides, colostrum is highly nutritions. It is slightly laxative and prevents constipation. This is helpful because the diet of the young calf being totally devoid of crude fibre is constipatory.

Feeding the antibiotics. Antibiotic feed supplements like Aurcomycin, Terramycin, Penicillin and different combinations of these antibiotics when supplemented in feed result in :

1. Improved appetite
2. Increased growth (from 10-30 percent)
3. Smoother hair coat
4. Reduction in incidence of calf scours

For example feeding Aureomycin at a rate of 80 mg per calf per day between 4th and 116th day resulted in an increase of 10-30 percent in their growth rate. It has been observed that the antibiotic feed supplementation is more effective in less bygienic environments.

Feeding the young calf. The calf that is worth raising deserves raising well. The feeding and management during the early stages of life greatly influence the future production when it grows into a mature cow. The new born

calf should get colostrum for three to five days. If the calf is weak to drink milk on its own, it may be helped to do so by holding it up to its mother's udder or by pouring the milk into its mouth.

When weaning is practised in zebu breeds where maternal instinct is well developed, it is better not to allow the calf to suckle at all. Even the colostrum may be milked out and fed to the calf from a pail or from a nippled can.

Teaching a calf to drink from the pail. Withhold feed to the calf for two to four hours and let it work up an appetite. Dip your fingers in milk and let the calf suckle from it. Slowly lower your fingers to the pail containing milk pushing the calf's head if necessary. By repeating the process the calf will learn to drink from the pail. The pail should be very clean. Milk given should be heated to body temperature.

Nipple Feeding. In Western countries, milk utensils fitted with rubber nipples are used to feed milk to weaned calves. Milk at body temperature is poured into the vessel, which is kept at the level suitable for the calf to suckle. Strict hygienic measures in washing and sterilizing the nipples and vessels are necessary to avoid calf scours.

Avoid overfeeding. Overfeeding young calves causes calf scours. it is better to keep the calf on the hungry side than overfeed it. Similarly, milk with a high fat percentage also causes scours. Milk from a cow with low fat percentage can be fed or the milk with high fat percentage may be diluted with hot water and fed.

The calf should be fed according to its weight. They require 1 kg milk for every 10 to 12 kg body weight per day. The calf's appetite and condition may also be taken into account. Rate of growth and age are other important factors.

4.3 Feeding of calf up to 1 year age.

4.3.1 Feeding colostrums.

Feeding colostrum after birth within one hour to get maximum antibiotics especially in buffalo calves for developing immunity against diseases. Biological significance of the colostrum will be lost if feeding is delayed for more than 2 hours. Cows in 2nd or later lactation's produce larger quantity of colostrum and have higher immunoglobulins concentrations than cow in first lactation. This is because old cows would have been exposed to a wider range of diseases than young animals and therefore have produced more immunoglobulins against them. The calf is capable of absorbing antibodies from the colostrum only for a short period of time. Maximum absorption occurs immediately after birth and decrease with time. By 24 hours after birth very little absorption of antibodies occurs through the intestinal wall. Allow add iibitum of colostrum in the first 3-5 days.

4.3.2 Milk feeding to calf:

1 Whole milk one tenth of calf s body weight

2. Skim milk feeding -> after 2 weeks of whole milk feeding it can be replaced by skim milk at a gradient rate. Skim milk feeding may be discontinued at 24 weeks of age.

3. Reconstituted or butter milk feeding: Normal butter milk or reconstituted skim milk also be fed in place of fresh skim milk for raising dairy calves specially when calves have access to legume hay.

Milk feeding schedule for a calf

Body Weight Kg.	**Calf age (days)**	**Colostrum litres**	**Whole Milk litres**	**Skim Milk litres**
Up to 20	Up to 5	1 / 10 th body wt.	-------	--------
20 - 30	6-20	---- wt.	1 / 10 the body	-------

25 - 30	21-30	------	1/15 th of body	1/ 20 th body Wt
30 - 40	31- 60	------	1/20 th body Wt.	1/25th body Wt.
40- 75	61- 100	------	1/25th body Wt.	1/25th body Wt.

SCHEDULE OF FEEDING CALVES RAISED WITH CALF STARTER

Age Days	**Whole milk (kg)**	**Skim milk (kgs)**	**Calf starter(F8)**
0.5	Colostrum must be fed.		
6-7	2.75	---	---
8-14	3.25	---	---
15-21	2.75	1.0	0.1
22-28	1.75	2.0	0.2
29-34	1.0	3.0	0.3
35-42	0.5	3.5	0.5
43-56	---	3.5	0.75
57-84	---	2.5	1.0
85-112	---	0.5	1.25
113-140	---	---	1.75
141-182	---	---	2.0

1) After four months of age, calf can utilize grain mixture. The amount of grains needed for calf will depend upon the quality of roughages.

2) Clean and green and leafy legume or mixed hay forms the good fodder for young calves, hay can be offered to young calves after two weeks of age on free choice basis. They may start with handful of hay but will eat more and more with increase in age. Green legumes preferable mixed with other fodder is also good.

3) Pasture specially a mixture of legume with other grasses provides an excellent, feed for growing calves. They may be permitted to graze after 6 months of age. A separate pasture for calves is suggested.

4) A limited quantity of silage may be offered to calves preferably after 4 months of age. Care should be taken only 3-4 kg good quality silage along with mineral supplements. Is continued, watering to calves just before feeding milk should be favoided as it would reduce intake of milk.

4.3.3 Antibiotic feeding:

Use of antibiotics in calf starter or milk replaces will have the following advantages.

a) Increase feed efficiency
b) Decrease their B 12 requirement
c) Exert a protein sparing effect
d) Increase livability
e) Reduce incidence of calf scours and other disease.
f) Reduction in calf mortality rate
g) General improvement in conditions of calves.
h) Produce a more rapid growth by 15-20 percent.

Aureomycin is the antibiotic which is widely using. Others are Terramycin, pencillin, streptomycin, Bacitracin, Chloromycetin, Neomycin and Tetracycline etc.

Supplying Minerals calves should have an abundant supply of mineral particularly calcium and phosphorus. The requirement of these minerals is partly met when legume hay it fed liberally. A simple mineral mixture consisting of 2 parts of dicalcium phosphate and one part salt will usually give results. In areas where deficiency of Iodine and cobalt exists, the iodised salt and cobalt chloride should be included in mineral mixture. Salt licks are also used.

Supplying Vitamins: when the amount of whole milk in the diet of calf is being limited, the Vitamin A and D should be supplied in calf starter. Irradiated yeast

good source of Vitamin D or else cod liver oil specially in winter may also be added to skim milk to supply Vitamin A and D. Sun cured hay is also a good source of Vitamin D calves receiving available sunshine probably do not lack Vitamin D. Rovimix can also be added as a good source of Vitamin A, B2 and D.

Water for calves Growing calves should have access to fresh, clean water at all times, Particularly when milk feeding is reduced or

4.4 FEEDING OF HEIFER

Heifer is growing animals and so the requirements for growth is of higher order than for more maintenance during early stage relatively more protein is required than energy.

Daily nutrient requirement for growing heifer.

Body wt. (kg)	DCP (KG)	TDN kg.	M.E. (K.cal)	Ca (g)	P (g)	Vitamin A IU
70	0.22	1.3	4680	12	10	3000
100	0.28	1.9	6900	13	10	4000
150	0.35	2.6	9360	13	12	6500
200	0.40	3.0	11500	13	12	8500
300	0.47	4.0	12600	13	12	12500
450	0.48	5.0	13600	13	12	17000

Most young heifers grow well if excellent hay is given as much as they eat. The amount of growth depends upon the quality of forage in unlimited amounts. No grains need to fed after the calf is 9 months.

Feed ad libitum of green fodder so that the animal gets enough carotene. If leguminous fodders are fed it gives enough calcium, and other minerals. When the heifer is fed with adlibitur of roughages and concentrates, now and then check for its growth. Fat animal should be discouraged and feeding is practice to become non-fat animal.

The heifer with Pregnancy should be fed very carefully, because the - animal is still growing and for compensation for the growth of the foetus. An extra amount of 1.215 kg to 1.75 kg concentrate may be provided to allow the growth of the foetus normally. 6 weeks before calving 2-3 kgs of concentrates should be given. Laxative -feeding should be given from two weeks before calving which prevents consumption and difficulty in parturition.

Unless the heifer is the calf will not be healthy, and also causes dystocia, retained placenta etc.the production of the animal during first lactation and also subsequently solely depends upon the conditions of the animal at the time of first calving.

4.5 FEEDING MILCH AND PREGNANT ANIMAL:

However good the genotype of a cow be, it is of no use unless they are fed and managed to achieve maximum economical production. A dairy cow needs feed for maintenance, for development of foetus and for milk production. Besides in the first lactation a cow may be growing and producing simultaneously so that allowances for growth have to be in corporate over and above requirement. Therefore the first step in feeding a cow is to calculate the total requirements as for the standards. It has been observed that if ad libitum supply of good quality leguminous fodder in available no extra concentrates are necessary upto 10 kg milk production in cows and 7 kgs in buffaloes. Above that cows may be fed 1 kg concentrate mixture for every 2.5 kg milk produced. Buffaloes require 1 kg of concentrate for every 2 kg of milk. But this is only a thumb ruil. Actual feeding may be done on the basis of requirements calculated as per feeding standards.

Individual computation for daily feeding of cows in impracticable. Therefore certain thumb rules are widely employed. One of the guidelines is to consider that roughage will meet the requirement upto 4-5 kg of milk production and feed 1 kg concentrate for every additional 2kg milk yield. Thus a cow yielding 10 kg milk will have to receive 2.5 to 3.0 kg concentrate in addition to adequate roughage.

It is common practice to feed grains at the time of milking, and roughages after milking. This causes changes in digestion. The remedy in concentrates should be mixed with roughages or after the animal has consumed certain amount of forages.

4.5.1 Guide Lines to feed high yielders:

1 . Include optimum proportion of forage and concentrates in the ration. Good results are obtained by feeding a ration that derives 30 - 40 percent of the feed units from grains and 60-70 percent from forages.

2. The forage should be of excellent quality, at optimum stage. A short delay to cut the fodder can adversely affect its quality. The inferior quality of the fodder cannot be made good quality.

3. For high yielders : The density x digestibility value of the total feed may kept around 35.

4. The feeding schedule should be such that it will maintain a continuous fermentation in the rumen. The cows should be fed minimum of four times a day at 6 hours intervals. Each feeding should comprise both grain and forage. But if animals are to be fed for low levels of production, there is very little to be gained by frequent feeding.

5. When high levels of grains are fed, feed it mixed with the roughages or feed it after the animal has consumed some roughage.

6. Processing and reducing particle size of fodder may not be done unless they have a specific purpose (i.e. to minimize wastage of big sterms)

During the late lactation, intake ability of a cow exceeds nutrient needs. This is the time when the cow starts needing extra allowances for the growing foetus from 7 ‘ll2 month to 10 months lactation cows may be fed 1 to 2 kg concentrate feed in addition to their nutrient requirement. The cows may be made to gain 20-25 kg body weight during this period.

For challenge feeding, 2 weeks before expected date of calving, start feeding ½ kg of concentrate mixture increases this amount by 300 - 400 gms daily until the cow is consuming ½ to 1 kg concentrate for ever 100 . kg body weight.

Complete feeds i.e. mixture of concentrate and roughage at uniform. This can be done by pelleting process. This will cause more uniform fermentation in the stomach.

4.6 FEEDING A DRY ANIMAL

A Cow in dry period should be fed a well balanced ration during this period for the following purposes.

1. Maintenance of the cow
2. Growth of the animal if she is pregnant
3. Growth of the foetus
4. For the production of colostrum when she calves next
5. Forming sufficient reserves of nutrients in the body of the cow for ensuring lactation.

The recently calved high producing cow is unable to eat enough feed to support her milk production. This means that she should have enough reserves of stored nutrition to be drawn to tide over the period of heavy demand in the early lactation during which period the cow loses weight. Many of the problems resulting in ketosis, displaced abornasum, fatty liver, retained placenta, prolapse etc., can be minimized by resorting to an all roughage feeding during the dry period, The roughage should be tough enough to stimulate and restore rumen muscle tone. During dry period cows can be fed only good quality green fodder with 1 1/2 kg concentrate.

Just a week or two before freshning one should start feeding the cows with high milk production, increasing the quantity of concentrates to challenge them to produce at the maximum level. This challenge f1peding will condition her digestive system for the increased amount of concentrates of early lactation and provide enough nutrients to initiate lactation on a higher place.

During the dry period cows should receive enough of high quality green, fodder to provide enough of the precursor for Vitamin A. They also need salt, calcium, z phosphorus and whenever deficiencies occur, other minerals. When leguminous roughages are fed in large quantity, all that is needed is a. source like wheat bran. But when non-leguminous roughages predominate, sources of calcium and phosphorus like bone meal or dicalcium phosphate may be added to the ration. Other trace minerals may be needed if the soil and consequently the crops are deficit in them. Under normal circumstances, however addition of such minerals is not necessary in some cases.

4.7 Feeding newly calved cows and Buffaloes:

Within the nest few days after calving high protein feeds, specially oil cakes may be avoided. Feeds that tend to stimulate milk secretion at this stage are considered harmful by many authorities. However, when this period is over, the cow should be fed according to her requirement. Some authories advocate that an extra allowance of about 1 to 1.5 kg of concentrate mixture over and above the calculated amounts should be fed for a period of about 2 months to give the utmost encouragement ot a cow for larger production of milk.

Buffalo milk is rich in fat and contains about 7 percent of fat. The NCR recommendation for 6 percent fat when applied to buffaloes requires about 6kg of concentrate mixure to satisfy the energy part of the ration for 20 kg of milk. A greater allowance than the recommended by American authorities is difficult to conceive for economic reasons. In farms in India an allowance varying from 2/5th to 1/2 of the milk yield is generally recommended. This indicates that probably a substantial part of the energy secreted in the milk is derived from inferior quality roughages fed to these animals.

4.8 Feeding of animals during drought and cyclone:

The important of feeding of livestock during scan city period was recognised long back, when the country forced with a severe drought and shortage of livestock feeds. During 1972-73, when maharashtra was affected by severe drought, the new technology of feeding cattle during scancity with urea-molasses and bagasse was applied on large scale.

The use of by products of commercial crops as well as daought resistant vegetation in combination with non - protean nitngen materials (eg. urea) as a source of protein and of molasses as a source of energy, can be used for meeting the immediate nutritional requirements under conditions of scancity. Certain varieties of tree leaves and seeds can be used to meet the essential requirements of infact protein in ruminants.

During drought conditions effort should be made to utilize unconventional feed ingridients. These are devided into

1. **Unconventional concentrates :** Mango seed kennal, tamarind seed, sunhemp seed, rubber seed cake, Tobacco seed cake, neem seed cake, Babul pods etc.,

2. **Unconventional ranghages :** Tree leaves, groundnut straw, rice husk, coffee seed husk, sugar cane tops, forest grass, cotton straw, sunflower straw etc.,

3. **Unconventional industrial by products :** Fist waste, sugar cane bag gage, Fruit and Vegetable wastes, Distillation wastes slaughter house waste, poultry droppings, pulp and paper industry wastes, rumen con tents, molasses from alcohol industries.

During drought and famine conditions, when there is a shortage of green grass or dry grass, the animals are fed with silage which is preserved, when greens are plenty. Sometimes conducting cattle camps in severe drought conditions, providing dry fodders to the animals is also a regular practice. In protein deficiency animals due to continuous drought, providing urea mixed water in the cattle camps is also helpful (@3kg urea in 100 litres of water) to prevent protein deficiency. Other sources of feeding materials are tubers, forest leave, urea, molasses are fed to the animals. Enriched paddy straw with urea can be well utilized during drought. Feeding fats at high levels during summer should be combined with calcium compulsorily because calcium form foam with fats in the rumen, sodium bicarbonate, sodium chloride along with vitamin A,C, yeast, Lactobacillus, antioxidants, vitamin E should be added to the feeds. The animals should have free access to water at all times during summer.

Urea molasses feeding

Water	2.5%
Urea	2.5%
Molasses	92.0%
Mineral mixture	2%
Common salt	1%

SUMMARY

Feeding of calf up to one year was explained in detail, which helps to build up good quality of future stock for dairy animals. Feeding of. heifer, milch animals and pregnant animals, dry animals, bulls and bullocks are explained well which helps in giving guide lines for feeding of dairy animals.

SHORT QUESTIONS

1. What is Colostrum?
2. How much whole milk should be fed to the young calves ?
3. At what age calf starter should be started to the calf ?
4. What is the DCP and TDN in good calf starter?
5. What are the DCP and TDN requirements for a heifer weighing 150 kgs body weight?
6. In cattle how much extra DCP and TDN should be given for pregnancy?
7. For how much litres of milk in buffaloes one Kg extra concentrated is given?
8. Define heavy work for bullock.
9. Define light work for bullock.
10. How much extra concentrate should be given during advanced stage of pregnancy?

LONG QUESTIONS

1. Explain in detail the feeding of calf upto one year.
2. How do you feed a heifer for optimum growth?
3. Give feeding practices for milch cow.
4. What feeding practices are recommended for dry animal?
5. Give feeding schedules for working bullock.
6. Explain feeding of breeding bull.

4 FEEDING OF DAIRY CATTLE

4.1 Importance of feeding in dairy animal production :

1. **Feeding for maintenance :** The maintenance requirements are the minimum requirements of nutrients which produce neither positive nor negative balance in animals.

2. **Feeding for frowth :** After birth before puberty the rate of growth is higher than after puberty and when the animal becomes nature the growth rate in negligible. The growing animals do not only increse in size and weight but simultaneously development in the animal also takes place.

3. **Feeding for lactation :** The feeding requirement for milk production depends upon the level of production and composition of milk.

4. **Feeding for reproduction :** The feeding influences age of puberty. Normally if the animals grows faster, they reach sexual maturity earlier.

5. **Feeding for pregnancy :** In the early stages of pregnancy the amount of nutrients deposited in the foetus is small. During the last quarter of the pregnancy, the growth of foetus and membrances is fast and therefore extra requirements are required.

6. **Feeding for work production :** For heavy and light work different feedings are recommonded.

4.2 Feeding of newly born calf :

When a calf is born its rumen will not be developed and it will take a few months until rumen is fully developed and start functioning. Until them the calf is similar to a simple-stomached animal nutritionally. It implies the following :

i) Essential amino acids should be provided in required quantity in the ration of calves. In other words they will benefit from high quality protein and from a mixed source of protein.

ii) Vitamins belonging to the B-complex group are a nutritional necessity for them apart from vitamins A and D.

iii) They cannot utilize non-protein nitrogenous substances like urea.

iv) They require more minerals for growth of bone, muscle and other tissues.

4.2.1 Importance of Colostrum Feedings :

In cattle the antibodies (gama globulins) are transferred from mother to the calf through colostrum. These gama globulins will be absorbed as such by the calf and will enter its system forming a ready made antibody resistance system for the calf against all the disease producing agents and other antigens the mother has had, encountered during its lifetime. This will protect the calf against diseases in the early stages, until their own 'antibody manufacturing' system takes over. Thus, if colostrum is not fed, the calves are denied antibody cover and, therefore, will remain susceptible to many diseases. Most likely, they will perish due to some disease or the other.

Besides, colostrum is highly nutritions. It is slightly laxative and prevents constipation. This is helpful because the diet of the young calf being totally devoid of crude fibre is constipatory.

Feeding the antibiotics. Antibiotic feed supplements like Aurcomycin, Terramycin, Penicillin and different combinations of these antibiotics when supplemented in feed result in :

1. Improved appetite
2. Increased growth (from 10-30 percent)
3. Smoother hair coat
4. Reduction in incidence of calf scours

For example feeding Aureomycin at a rate of 80 mg per calf per day between 4th and 116th day resulted in an increase of 10-30 percent in their growth rate. It has been observed that the antibiotic feed supplementation is more effective in less bygienic environments.

Feeding the young calf. The calf that is worth raising deserves raising well. The feeding and management during the early stages of life greatly influence the future production when it grows into a mature cow. The new born

calf should get colostrum for three to five days. If the calf is weak to drink milk on its own, it may be helped to do so by holding it up to its mother's udder or by pouring the milk into its mouth.

When weaning is practised in zebu breeds where maternal instinct is well developed, it is better not to allow the calf to suckle at all. Even the colostrum may be milked out and fed to the calf from a pail or from a nippled can.

Teaching a calf to drink from the pail. Withhold feed to the calf for two to four hours and let it work up an appetite. Dip your fingers in milk and let the calf suckle from it. Slowly lower your fingers to the pail containing milk pushing the calf's head if necessary. By repeating the process the calf will learn to drink from the pail. The pail should be very clean. Milk given should be heated to body temperature.

Nipple Feeding. In Western countries, milk utensils fitted with rubber nipples are used to feed milk to weaned calves. Milk at body temperature is poured into the vessel, which is kept at the level suitable for the calf to suckle. Strict hygienic measures in washing and sterilizing the nipples and vessels are necessary to avoid calf scours.

Avoid overfeeding. Overfeeding young calves causes calf scours. it is better to keep the calf on the hungry side than overfeed it. Similarly, milk with a high fat percentage also causes scours. Milk from a cow with low fat percentage can be fed or the milk with high fat percentage may be diluted with hot water and fed.

The calf should be fed according to its weight. They require 1 kg milk for every 10 to 12 kg body weight per day. The calf's appetite and condition may also be taken into account. Rate of growth and age are other important factors.

4.3 Feeding of calf up to 1 year age.

4.3.1 Feeding colostrums.

Feeding colostrum after birth within one hour to get maximum antibiotics especially in buffalo calves for developing immunity against diseases. Biological significance of the colostrum will be lost if feeding is delayed for more than 2 hours. Cows in 2nd or later lactation's produce larger quantity of colostrum and have higher immunoglobulins concentrations than cow in first lactation. This is because old cows would have been exposed to a wider range of diseases than young animals and therefore have produced more immunoglobulins against them. The calf is capable of absorbing antibodies from the colostrum only for a short period of time. Maximum absorption occurs immediately after birth and decrease with time. By 24 hours after birth very little absorption of antibodies occurs through the intestinal wall. Allow add iibitum of colostrum in the first 3-5 days.

4.3.2 Milk feeding to calf:

1 Whole milk one tenth of calf s body weight

2. Skim milk feeding -> after 2 weeks of whole milk feeding it can be replaced by skim milk at a gradient rate. Skim milk feeding may be discontinued at 24 weeks of age.

3. Reconstituted or butter milk feeding: Normal butter milk or reconstituted skim milk also be fed in place of fresh skim milk for raising dairy calves specially when calves have access to legume hay.

Milk feeding schedule for a calf

Body Weight Kg.	**Calf age (days)**	**Colostrum litres**	**Whole Milk litres**	**Skim Milk litres**
Up to 20	Up to 5	1 / 10 th body wt.	-------	--------
20 - 30	6-20	---- wt.	1 / 10 the body	-------

25 - 30	21-30	------	1/15 th of body	1/ 20 th body Wt
30 - 40	31- 60	------	1/20 th body Wt.	1/25th body Wt.
40- 75	61- 100	------	1/25th body Wt.	1/25th body Wt.

SCHEDULE OF FEEDING CALVES RAISED WITH CALF STARTER

Age Days	**Whole milk (kg)**	**Skim milk (kgs)**	**Calf starter(F8)**
0.5	Colostrum must be fed.		
6-7	2.75	---	---
8-14	3.25	---	---
15-21	2.75	1.0	0.1
22-28	1.75	2.0	0.2
29-34	1.0	3.0	0.3
35-42	0.5	3.5	0.5
43-56	---	3.5	0.75
57-84	---	2.5	1.0
85-112	---	0.5	1.25
113-140	---	---	1.75
141-182	---	---	2.0

1) After four months of age, calf can utilize grain mixture. The amount of grains needed for calf will depend upon the quality of roughages.

2) Clean and green and leafy legume or mixed hay forms the good fodder for young calves, hay can be offered to young calves after two weeks of age on free choice basis. They may start with handful of hay but will eat more and more with increase in age. Green legumes preferable mixed with other fodder is also good.

3) Pasture specially a mixture of legume with other grasses provides an excellent, feed for growing calves. They may be permitted to graze after 6 months of age. A separate pasture for calves is suggested.

4) A limited quantity of silage may be offered to calves preferably after 4 months of age. Care should be taken only 3-4 kg good quality silage along with mineral supplements. Is continued, watering to calves just before feeding milk should be favoided as it would reduce intake of milk.

4.3.3 Antibiotic feeding:

Use of antibiotics in calf starter or milk replaces will have the following advantages.

a) Increase feed efficiency
b) Decrease their B 12 requirement
c) Exert a protein sparing effect
d) Increase livability
e) Reduce incidence of calf scours and other disease.
f) Reduction in calf mortality rate
g) General improvement in conditions of calves.
h) Produce a more rapid growth by 15-20 percent.

Aureomycin is the antibiotic which is widely using. Others are Terramycin, pencillin, streptomycin, Bacitracin, Chloromycetin, Neomycin and Tetracycline etc.

Supplying Minerals calves should have an abundant supply of mineral particularly calcium and phosphorus. The requirement of these minerals is partly met when legume hay it fed liberally. A simple mineral mixture consisting of 2 parts of dicalcium phosphate and one part salt will usually give results. In areas where deficiency of Iodine and cobalt exists, the iodised salt and cobalt chloride should be included in mineral mixture. Salt licks are also used.

Supplying Vitamins: when the amount of whole milk in the diet of calf is being limited, the Vitamin A and D should be supplied in calf starter. Irradiated yeast

good source of Vitamin D or else cod liver oil specially in winter may also be added to skim milk to supply Vitamin A and D. Sun cured hay is also a good source of Vitamin D calves receiving available sunshine probably do not lack Vitamin D. Rovimix can also be added as a good source of Vitamin A, B2 and D.

Water for calves Growing calves should have access to fresh, clean water at all times, Particularly when milk feeding is reduced or

4.4 FEEDING OF HEIFER

Heifer is growing animals and so the requirements for growth is of higher order than for more maintenance during early stage relatively more protein is required than energy.

Daily nutrient requirement for growing heifer.

Body wt. (kg)	DCP (KG)	TDN kg.	M.E. (K.cal)	Ca (g)	P (g)	Vitamin A IU
70	0.22	1.3	4680	12	10	3000
100	0.28	1.9	6900	13	10	4000
150	0.35	2.6	9360	13	12	6500
200	0.40	3.0	11500	13	12	8500
300	0.47	4.0	12600	13	12	12500
450	0.48	5.0	13600	13	12	17000

Most young heifers grow well if excellent hay is given as much as they eat. The amount of growth depends upon the quality of forage in unlimited amounts. No grains need to fed after the calf is 9 months.

Feed ad libitum of green fodder so that the animal gets enough carotene. If leguminous fodders are fed it gives enough calcium, and other minerals. When the heifer is fed with adlibitur of roughages and concentrates, now and then check for its growth. Fat animal should be discouraged and feeding is practice to become non-fat animal.

The heifer with Pregnancy should be fed very carefully, because the - animal is still growing and for compensation for the growth of the foetus. An extra amount of 1.215 kg to 1.75 kg concentrate may be provided to allow the growth of the foetus normally. 6 weeks before calving 2-3 kgs of concentrates should be given. Laxative -feeding should be given from two weeks before calving which prevents consumption and difficulty in parturition.

Unless the heifer is the calf will not be healthy, and also causes dystocia, retained placenta etc.the production of the animal during first lactation and also subsequently solely depends upon the conditions of the animal at the time of first calving.

4.5 FEEDING MILCH AND PREGNANT ANIMAL:

However good the genotype of a cow be, it is of no use unless they are fed and managed to achieve maximum economical production. A dairy cow needs feed for maintenance, for development of foetus and for milk production. Besides in the first lactation a cow may be growing and producing simultaneously so that allowances for growth have to be in corporate over and above requirement. Therefore the first step in feeding a cow is to calculate the total requirements as for the standards. It has been observed that if ad libitum supply of good quality leguminous fodder in available no extra concentrates are necessary upto 10 kg milk production in cows and 7 kgs in buffaloes. Above that cows may be fed 1 kg concentrate mixture for every 2.5 kg milk produced. Buffaloes require 1 kg of concentrate for every 2 kg of milk. But this is only a thumb ruil. Actual feeding may be done on the basis of requirements calculated as per feeding standards.

Individual computation for daily feeding of cows in impracticable. Therefore certain thumb rules are widely employed. One of the guidelines is to consider that roughage will meet the requirement upto 4-5 kg of milk production and feed 1 kg concentrate for every additional 2kg milk yield. Thus a cow yielding 10 kg milk will have to receive 2.5 to 3.0 kg concentrate in addition to adequate roughage.

It is common practice to feed grains at the time of milking, and roughages after milking. This causes changes in digestion. The remedy in concentrates should be mixed with roughages or after the animal has consumed certain amount of forages.

4.5.1 Guide Lines to feed high yielders:

1 . Include optimum proportion of forage and concentrates in the ration. Good results are obtained by feeding a ration that derives 30 - 40 percent of the feed units from grains and 60-70 percent from forages.

2. The forage should be of excellent quality, at optimum stage. A short delay to cut the fodder can adversely affect its quality. The inferior quality of the fodder cannot be made good quality.

3. For high yielders : The density x digestibility value of the total feed may kept around 35.

4. The feeding schedule should be such that it will maintain a continuous fermentation in the rumen. The cows should be fed minimum of four times a day at 6 hours intervals. Each feeding should comprise both grain and forage. But if animals are to be fed for low levels of production, there is very little to be gained by frequent feeding.

5. When high levels of grains are fed, feed it mixed with the roughages or feed it after the animal has consumed some roughage.

6. Processing and reducing particle size of fodder may not be done unless they have a specific purpose (i.e. to minimize wastage of big sterms)

During the late lactation, intake ability of a cow exceeds nutrient needs. This is the time when the cow starts needing extra allowances for the growing foetus from 7 ‘ll2 month to 10 months lactation cows may be fed 1 to 2 kg concentrate feed in addition to their nutrient requirement. The cows may be made to gain 20-25 kg body weight during this period.

For challenge feeding, 2 weeks before expected date of calving, start feeding ½ kg of concentrate mixture increases this amount by 300 - 400 gms daily until the cow is consuming ½ to 1 kg concentrate for ever 100 . kg body weight.

Complete feeds i.e. mixture of concentrate and roughage at uniform. This can be done by pelleting process. This will cause more uniform fermentation in the stomach.

4.6 FEEDING A DRY ANIMAL

A Cow in dry period should be fed a well balanced ration during this period for the following purposes.

1. Maintenance of the cow
2. Growth of the animal if she is pregnant
3. Growth of the foetus
4. For the production of colostrum when she calves next
5. Forming sufficient reserves of nutrients in the body of the cow for ensuring lactation.

The recently calved high producing cow is unable to eat enough feed to support her milk production. This means that she should have enough reserves of stored nutrition to be drawn to tide over the period of heavy demand in the early lactation during which period the cow loses weight. Many of the problems resulting in ketosis, displaced abornasum, fatty liver, retained placenta, prolapse etc., can be minimized by resorting to an all roughage feeding during the dry period, The roughage should be tough enough to stimulate and restore rumen muscle tone. During dry period cows can be fed only good quality green fodder with 1 1/2 kg concentrate.

Just a week or two before freshning one should start feeding the cows with high milk production, increasing the quantity of concentrates to challenge them to produce at the maximum level. This challenge f1peding will condition her digestive system for the increased amount of concentrates of early lactation and provide enough nutrients to initiate lactation on a higher place.

During the dry period cows should receive enough of high quality green, fodder to provide enough of the precursor for Vitamin A. They also need salt, calcium, z phosphorus and whenever deficiencies occur, other minerals. When leguminous roughages are fed in large quantity, all that is needed is a. source like wheat bran. But when non-leguminous roughages predominate, sources of calcium and phosphorus like bone meal or dicalcium phosphate may be added to the ration. Other trace minerals may be needed if the soil and consequently the crops are deficit in them. Under normal circumstances, however addition of such minerals is not necessary in some cases.

4.7 Feeding newly calved cows and Buffaloes:

Within the nest few days after calving high protein feeds, specially oil cakes may be avoided. Feeds that tend to stimulate milk secretion at this stage are considered harmful by many authorities. However, when this period is over, the cow should be fed according to her requirement. Some authories advocate that an extra allowance of about 1 to 1.5 kg of concentrate mixture over and above the calculated amounts should be fed for a period of about 2 months to give the utmost encouragement ot a cow for larger production of milk.

Buffalo milk is rich in fat and contains about 7 percent of fat. The NCR recommendation for 6 percent fat when applied to buffaloes requires about 6kg of concentrate mixure to satisfy the energy part of the ration for 20 kg of milk. A greater allowance than the recommended by American authorities is difficult to conceive for economic reasons. In farms in India an allowance varying from 2/5th to 1/2 of the milk yield is generally recommended. This indicates that probably a substantial part of the energy secreted in the milk is derived from inferior quality roughages fed to these animals.

4.8 Feeding of animals during drought and cyclone:

The important of feeding of livestock during scan city period was recognised long back, when the country forced with a severe drought and shortage of livestock feeds. During 1972-73, when maharashtra was affected by severe drought, the new technology of feeding cattle during scancity with urea-molasses and bagasse was applied on large scale.

The use of by products of commercial crops as well as daought resistant vegetation in combination with non - protean nitngen materials (eg. urea) as a source of protein and of molasses as a source of energy, can be used for meeting the immediate nutritional requirements under conditions of scancity. Certain varieties of tree leaves and seeds can be used to meet the essential requirements of infact protein in ruminants.

During drought conditions effort should be made to utilize unconventional feed ingridients. These are devided into

1. **Unconventional concentrates :** Mango seed kennal, tamarind seed, sunhemp seed, rubber seed cake, Tobacco seed cake, neem seed cake, Babul pods etc.,

2. **Unconventional ranghages :** Tree leaves, groundnut straw, rice husk, coffee seed husk, sugar cane tops, forest grass, cotton straw, sunflower straw etc.,

3. **Unconventional industrial by products :** Fist waste, sugar cane bag gage, Fruit and Vegetable wastes, Distillation wastes slaughter house waste, poultry droppings, pulp and paper industry wastes, rumen con tents, molasses from alcohol industries.

During drought and famine conditions, when there is a shortage of green grass or dry grass, the animals are fed with silage which is preserved, when greens are plenty. Sometimes conducting cattle camps in severe drought conditions, providing dry fodders to the animals is also a regular practice. In protein deficiency animals due to continuous drought, providing urea mixed water in the cattle camps is also helpful (@3kg urea in 100 litres of water) to prevent protein deficiency. Other sources of feeding materials are tubers, forest leave, urea, molasses are fed to the animals. Enriched paddy straw with urea can be well utilized during drought. Feeding fats at high levels during summer should be combined with calcium compulsorily because calcium form foam with fats in the rumen, sodium bicarbonate, sodium chloride along with vitamin A,C, yeast, Lactobacillus, antioxidants, vitamin E should be added to the feeds. The animals should have free access to water at all times during summer.

Urea molasses feeding

Water	2.5%
Urea	2.5%
Molasses	92.0%
Mineral mixture	2%
Common salt	1%

SUMMARY

Feeding of calf up to one year was explained in detail, which helps to build up good quality of future stock for dairy animals. Feeding of. heifer, milch animals and pregnant animals, dry animals, bulls and bullocks are explained well which helps in giving guide lines for feeding of dairy animals.

SHORT QUESTIONS

1. What is Colostrum?
2. How much whole milk should be fed to the young calves ?
3. At what age calf starter should be started to the calf ?
4. What is the DCP and TDN in good calf starter?
5. What are the DCP and TDN requirements for a heifer weighing 150 kgs body weight?
6. In cattle how much extra DCP and TDN should be given for pregnancy?
7. For how much litres of milk in buffaloes one Kg extra concentrated is given?
8. Define heavy work for bullock.
9. Define light work for bullock.
10. How much extra concentrate should be given during advanced stage of pregnancy?

LONG QUESTIONS

1. Explain in detail the feeding of calf upto one year.
2. How do you feed a heifer for optimum growth?
3. Give feeding practices for milch cow.
4. What feeding practices are recommended for dry animal?
5. Give feeding schedules for working bullock.
6. Explain feeding of breeding bull.

5. QUALITY CONTROL OF FEEDS

5.1 ANTI-NUTRIENT FACTORS IN FEED STUFFS :

Anti nutritional factors are those substances present in the feeds which by themselves or their metabolic products arising in the animal body interfere with feed utilization, reduce production or affect the health of the animal.

The anti nutritional factors present in feed stuffs can be broadly divided into four groups.

Group - I Proteins:

Under this group two types are available i.e. protease inhibitors and haemaglutinins, many legume seeds contain protease inhibitors that inhibit the proteolytic activity of certain digestive enzymes. Soyabean, Sunflower, horsegram seeds and beet root contains trypsin inhibitors - where as Acacia arabica and tamarind seeds contain both trypsin and chyrr?otripsin inhibitors. Steaming will destroy these inhibitors. The haerr.aglutinins causes agglutination of red blood cells. Castor bean (ricin); Soyabean aggiutin are some of the examples. Heat treatment and alkali treatment reduces this activity.

Group - II

This group includes saponins, cyanogens and Goitercgens. Saponins are present in legume forages i.e. alfa alfa, soya bean and also in beet root saponins are bitter in taste and hemolyses RBC.

Cyanogens are present in sorghum in the form of Dhurrin and in almond in the form of amyodaline which will release HCN on hydrolysis causing death of animal. Thorough cooking with water and discarding of water removes cyanogens. Sorghum crop should not be fed in the immuture stage. Most plants of crucifera family i.e. cabbage turnip and mustard green contains goitrogens which prevent utilization of iodine by thyroid gland (hypothyroidism)

Group III

Phenols group eg: Gossypol and Tannin. Cotton seed cake contains gossypol which is highly toxic to monogastric animal. Gossypol has an intribitary

effect on digestive enzymes. All cereals contain tannins which forms complexes with proteins and bind calcium and iron. Tannins also causes necrotic changes in liver, kidney heart, etc sodium and potassium

Group - IV

Antimetals, anti vitamins and others. Phytic acid and oxalates are antimetals, Phytic acid is present in cereals, dried legumes, oil seeds and nuts which forms complexes with Ca, Fe, Mg, Zn and copper. Oxalates are present in fodders like paddy straws and hybrid napier binds calcium Anti vitamin A and D are present in soyabean, Ravo kidney beans contains anti vitamin E, sweet clover contains antithiamin, ackee fruit anti riboflavin, sorghum anti niacin and linseed anti pyridoxine factor.

Other substances include aflotoxin, mymosine Aflotoxin is produced by aspergellus flavous mould which affects liver. Mymosine is present in the leaves and seeds of subabul. Sun drying and ferrous sulphate treatment will reduce mimosine.

5.2 PROCUREMENT AND STORAGE OF FEED INGREDIENTS

As the population grows increasingly, the food supply becomes an urgent priority. One vital and neglected towards this end is to reduce food, losses that occur between harvest and consumption. Inspite of advances in technology, tonnes of cereals are wasted every year through spoilage of various sorts.

Grains stored under favourable conditions for many years undergo relatively minor changes in composition and can be used as a source of nutrifions and palatable food or animal feed, but under unfavorable conditions results in complete spoilage of grain for food or feed purpose within a few days.

5.2.1 FACTORS AFFECTING FOOD VALUE AND DETERIORATION CONTROL MEASURES.

I. Physical Factors:

Moisture content and temperature are the principle factors in safe storage. At low moisture and temperature the destructive insects become inactive. The

optimum levels of moisture for storing the feed ingredients is less than 10% in India. Further the lower the temperature higher the level of permissible moisture for storage. High temperature (21 - 43°C) speeds up the life process of all microorganisms. Temperature below 159 C retared insect reproduction.

Control : Proper drying of the grain before storage and storing the grains at low temperature as far as possible.

II. BIOLOGICAL FACTORS:

Principle biological agents that cause deterioration during storage are

a) Insects
b) Fungi
c) Rodents

Ill. CHEMICAL FACTORS:

Such as break down of produce and pesticides will effect the food value and deteriorations during storage. Hence, such grains should be utilized as easy as possible.

IV. ENGINEERING FACTORS:

Such as structures (bag or bulk storage) and mechanical (conveying of produce, threshing and shelling) factors. During these process grains are broken and may result in rapid spoilage during the storage.

Essential Criteria for safe storage of products :

1) Entirely weather proof
2) Gas tight to enable fumigation of entire contents.
3) Fitted with controlable ventilation.
4) Proofed against entry of rodents and birds.
5) Free from Iight transmitting areas in the roof in order to avoid high temperature areas on top of stored produce.
6) Designed to permit in corporation of few fans in the walls and ducting on the floor for special storage requirement.

5.3 METHODS OF DETECTION OF FEED ADULTRANTS

Physical inspection (Visual inspection) will give a good assessment of quality of feed ingredients. Quality Control of Feeds

Items of physical inspection

a) Colour
b) Odour
c) Taste
d) Evidence of wetting
e) Evidence of deleterious substances or foreign material
f) Storage pests and
g) Evidence of damaged grain.

First 3 items can be done with reference to normal and abnormal by experience of having normal things in mind. Eg. Maize, Jawar, Wheat; .Rice etc.

d) Evidence of Wetting:

Moisture level is less than 13 % is considered as safe storage. Any grain generally will have below 10% moisture. Even upto 13% we can store safely without mould infestation. More than 13% moisture creates hot spots, which causes mould growth.

e) Evidence of deleterious substances like dust, sand, straw, clay, nails etc., can be fined out by visual appearance.

f) Storage pests : We can see the insects and faeces and eggs of insects by visual inspection and by smell especially in wheat bran; rice bran etc. If -we suspect, we can test and observe the insect eggs under microscope..

g) Evidence of damaged grain : Damaged or broken grain in unsafe for storage. Broken material will absorb more moisture and some times we see insects. In unbroken grain, seed coat is intact and will be resistant for moisture absorption.

The physical inspection is important for routine quality control and fit will ‘be effective only by experience.

5.4 QUALITY CONTROL OF FINISHED FEED :

The term quality means the composit of the characteristic that differing the degree of acceptability of that unit by the buyers. Quality control refers to the cycle of activities for achieving and maintaining the intended objective or standard. The standards specify the attributes or characteristics, which can be used for measuring or identifying quality control. The objective of quality control of feeding stuffs is to ensure that a consumer obtains feeds that are unadulterated, true to their nature and give desired results. A good system of quality control may therefore, be defined as the maintenance of quality at levels and tolerances acceptable to the buyer while minimizing the cost of processing.

The evaluation of quality of feeding stuffs is based on the evaluation of the ingredients that go in for formulation of feeds, the technique of blending and supplementing vitamins and minerals. To control quality of feeds it is necessary to have a reliable method quantitatively appraising specific characteristics of the feeds, such as moisture, fat content, protein and crude fibre are required to be compared with the stipulated requirement.

5.4.1 Quality Control Methods :

The various methods includes :

I. Physical Tests :

a) colour - Colour of desirable quality
b) Odour - Odour of a desirable quality ingredient
c) Texture’- Fine, Coarse or medium
d) Test weight - Cubic food weight
e) Miscellaneous - Adulterants, contaminants etc.

II. Chemical Tests:

a) Crude fat Crude fibre Minerals
b) total digestible nutrients (TDN)

c) Crude fat
d) Crude fibre
e) Minerals
f) Moisture

III TOXICOLOGICAL TESTS

a) Aflotoxin
b) HCN (Hydro cyanic acid)

IV. MICROSCOPIC TESTS

a) Done under low magnification.

- Particle size
- Softness
- Hardness

b) High magnification - requires more skill, but accurate results are obtained.

The use of microscopy in feed quality control can give even the smallest feed manufacturer. some measure of protection against adulteration and contamination of ingredients. Products may be examined for the presence or absence of basic ingredients and by means of spoxt test or tracer ingredients which give much information on the presence of drugs or other micro ingredients.

5.4.2 PROCEDURE FOR QUALITATIVE ESTIMATION OF INGREDIENTS

1. Sample preparation : Reduce sample by quartering. It meal,, may be examined without further preparation. It pellets, reduce by crushing with a mortar and pestle. If animal products or fish products or mixture with high fat contents, extract atleast 200 g with ether. It facilities are available determine, moisture, ash, protein, fat, fibre, calcium, phos phorus and salt.Crude protein and digestible crude protein (DCP) total digestible nutrients (TDN)

2. Separation : Separate the portions by using different seives and place portions obtained in glass dished or other containers suitable for use under the microscope, weigh each portion, these weights may be of aid in determining relative amounts of certain ingredients. It necessary mineral portion may be separated from 1 gram portion by flotation with chloroform or carbon -tetra chloride as in the AOAG method.

3. Examination (for determining of single ingredient or impurity) – Examine each portion, starting with the portion contained on the largest screen and examine by going through the portion using a dissecting needle or fine pointed forceps to single out the items concerned. It may be necessary to resort to flotation with chloroform to separate the light and heavy particles.

Combine the identified particles selected from the several portions in a container. Weigh and calculate percentage. This procedure will be found useful for meat scraps, meat and bone scraps, blood meal, fishmeal and similar products.

5.4.3 IDENTIFICATION AIDS (BY COLOUR OF PARTICLE)

White - lime stone, dicalcium phosphate, dried milk, bentonite etc.

Tan or buff - Soya bean meal, Vitamin A beads, bone meal etc.

Reddish or brown - Blood meal, meat scraps, corn bran, fishmeal, lin seed oil meal etc.

Black - Blood meal, meat scrap, charcoal, fishmeal

Yellow - yellow corn meal, cotton seed meal etc.

5.4.4 IDENTIFICATION AIDS (By treatment with reagents)

These tests are best applied by placing about two arops of the reagent in a clear or white spot plates or filter paper and sprinkling a small portion of the feed. This may also be used to identify single particles.

REAGENT	REACTION	COMPOUND INDICATE
Hcl 0.5 N	Efferevescance	Carbonates
Ammonium molybdate solution	No precipitate	Calcium carbonate
Ammonium molybdate solution	Yellow PPT	Bone meal, Dicalcium phoshate
Silver nitrate 0.1 N	White ppt	Salt
	No PPT	No Salt
Distilled water	White solution	Milk products
Sulphuric acid concentrated	Efferevescene	Carbonate or Nacl
	Blue Color	Chloretetria cycline
	Light red	Oxytetra cycline
	Red purple	Tetra cycline
	Orange brown	Riboflavin

5.4.5 ISI specification for cattle feeds

The compound cattle feeds shall be in the form of a meal or cubes or pellets. The feed shall be free from harmful constituents, metallic pieces and adulterants. The feed shall also be free from fungal growth and insect infection and from fermented, musty, rancid or any other objectionable odour. The proportion of urea when incorporated shall not exceed one percent man. When urea has been added the compound cattle feed shall contain not less than 10 % by man of easily digestible carbohydrates like molasses, cereal grains, potato starch etc.

Sno.	Characteristics	Requirements	
		Type l	Type II
1.	Moisture percent by man (max)	10	10
2.	C.P % (N x 6.25) by man (min)	22	20
3.	Crude fat by man (min)	3	2.5
4.	Crude fibre by man (max)	7	12
5.	Acid insoluble ash % by man (max	3	4

The requirement for the following characteristics shall be complied with and declared by the manufacturer after periodical testing.

Characteristics	**Requirement**
Common salt (as Nacl) by man (max)	2.0
Calcium % by man (min)	0.5
Phosphorus (as %) by man (min)	0.5
Vitamin. A 1.U / Kg	5000

5.5 PACKING AND FORWARDING OF FEEDS :

Packaging means, the wrapping and crating of goods before they are transported for marketing. The packing will have three fold functions.

1) To contain the product : The product should be within the packing material, which holds the feed ingredients or compounded feed.

2) To protect the product : The packing material should protect the products from biological agent and also from climatic conditions. It should not allow any entrance of insects and bacteria and moulds contamination. It should not absorb moisture.

3) Able to market : The packing material should be of optimum size and attractive with labels so that the customers attracts to purchase it.

The commonly used packing materials for feed ingredients and concentrate feeds are gunny bags, plastic bags. The latest packaging materials are polythene, poly shell (polythene + Cello fan) and multiwaif paper bags. Some times the packaging material is changed during the course of transport from producer to consumer. To compete stiff competition attractive packings are used which costs more to the consumer. For concentrate feeds packing gunny bags made of jute in a different system i.e. cloth made of jute is used to minimize loss of feeds. For feeds ingredients gunny bags in hessain system is used. Now a days jute blended with synthetics are also used. (inner polyethylene + outer jute).

In general the material used for feeds should have the following characteristics.

- The material have protective strength
- Attractive
- Consumer convenience
- Economy
- Free from chemical reaction.

Advantages of Packing :

Packing is a very useful function in the marketing process.

1. Packing protects the goods against breaking, spoilage, leakage or pilferage during their movement from production to consumption.

2. If facilitates handling of the feed during transportation and storage.

3. It helps for quality identification, product differentiation branding and advertisement.

4. Packing helps in reducing the marketing costs by reducing the handling and retailing costs.

5. It helps to check adulteration.

6. Packing with labeling facilitates the conveying of instructions to the buyers as how to cure or preserve and also gives its composition.

7 Packing ensures cleanliness of the product.

8. Packing prolongs the storage quality of the feeds by providing protection from ill effects of weather

The packing materials should be properly sealed / closed after filling to avoid leakages and also to give protection during storage and transportation. The gunny bags are closed with stitching by machine or by hands or tieng. Poalyethene and other plastic materials can be heat scaled.

Forwarding of feeds :

After production and packing of feeds in bags the marketing channel to the consumers are different types.

1) Direct selling by produces to customer,
2) Producer - Distributor – Customer,
3) Producer - Distributor - whole sale - Retailer – Customer,
4) Producer - Carry and forwarding agent - distributor - whole sale, - Retailer - Customer.

The feeds will be stocked in heavy quantities by C & F agents who will supply to next marketing persons. Sales representatives will do improving sales of feeds.

5.6 STORAGE OF CONCENTRATES - SPACE REQUIREMENT:

Storage. and marketing, if carried out efficiently will be a major contribution to the solution of world's hunger. Protecting of food supplies through sound storage practices is a matter of most vital importance.

Damage is a physical spoilage, often a partial deterioration. Loss is measured as a reduction in weight in the amount of food available for consumption. The loss also occurs during storage. The storage losses are due to

a) Storage environment : High temperature and humidity encourage mould formation and provide conditions for rapid growth of insect population.

b) Biological factors : Principle biological agents that cause deterioration during storage are insects, fungi, rodents

Controlling insects :

- God hygience
- Cleaning and checking of storage containers as well as stored food as far as possible.

- New dry grain should be kept separate from old grains.
- Stores should be remote from the field to reduce the risk of infestation.
- Traditional pest control system such as use of local herbs, mixing ash with grains and smoking are effective and should be encouraged.Yellow PPT Bone meal, Dicalcium
- Use of storage insecticides.

Losses due to Fungi :

Fungi produces metabolites like afiotoxin, zearalenone. The fungus occurs in the stored feed ingredients in the cases of

- Inadequate drying
- Due to high humidity
- Due to wetting

These can be reduced by drying and storage technology.

Losses due to rodents : They not only consume food but also foul with their excretion. They also destroy containers by gnawing holes that results in leakage and wastage of grain.

Control :

- Rodent exclusion efforts in store construction
- Improvea sanitation.
- Trapping and hunting
- Use of cats and dogs
- Rodent repellents.
- Fumigation with phosphine and other gases
- Poison baiting such as war farrin, chlorophacinone, comarin (antico agulant) zinc phosphate, barium carbonate.

The sound storage practices which will reduce storage losses are

- Proper preparation of grain for storage Sound storage structure
- An appropriate system of monitoring in quality of the stored grain and handling it while it is in store.

Designs of Stores :

Grains are stored in bags in areas where road transport facilities are poorly developed and delivered in small lots. Storage in bulk in the open, directly on the ground or in containers which are either totally or partially in the ground. These containers vary in size and may be constructed with metal, wood, brick and concrete materials.

Building for the storage of feeds and feed ingredients must be water tight. The roof, walls, doors, windows and floor must be -leak proof. The floor must not transmit water vapours from the soil. Doors, windows, should be sealable in order to permit control of ventilation. Building must have devices to protect against the entry of rats, mice and birds (gaps between roof and walls should be sealed with local mud, sheet metal or close netting. Pipes, shafts, ducts etc should be fitted with wide metal guards outside and netting inside.

Essential criteria for safe storage of products :

- Entirely weather proof
- Gas tight to enable fumigation of entire contents
- Fitted with controlable ventilation
- Proofed against entry of rodents and birds.
- Free from light transmitting areas in the roof in order to avoid high temperature areas on top of stored produce.
- Designed to permit incorporation of few fans in the walls and ducting on the floor for special storage requirement.

In control of rodents, moist baits are superior to dry baits, but mould problems, which can be prevented by addition of 0.025% paranitro phenol, but lowers the palatability.

In acute cases - Zinc phosphate, calcium cyanide, Aluminium phosphide - at 0.5%.

In chorinic case - Wasferin, comarin at 0.05 %

5.7 CLEANING AND FUMIGATION OF STORES:

5.7.1 Cleaning :

Cleaning means removal of dust, remnants of feed ingredient, dust, dirt and spider webs etc., in the feed store rooms. The floor, walls and roof should be properly cleaned using broom sticks or with. vaccume cleaner. See that no dirt, dust or spider webs are present especially at the corners, in the cracks of the floor and walls. See for any holes made by rodents in the floors or walls and

repair the holes plugging with cement and chips. For cleaning of roofs it is better to clean by sucking operation with vaccume machines, which will squeeze dust, dirt, insects eggs or insects, spider webs easily. Clean the floors with washing with, detergent solution and let it dry without any moisture. After wards follow sanitization procedures.

5.7.2 Sanitation :

Sanitation is a way of 'life. It is the quality of living that is expressed in the clean home, the clean farm, the clean business and industry, the clean neighborhood, the clean community.

The prime objective of sanitation in feed plants is to assure the consumer a product free of contamination produced in a clean plant from wholesome raw materials.

Sanitize means adequate treatment of surfaces by a process that is effective in destroying vegetative cells of pathogenic bacteria and substancially reducing other micro organisms. Such treatment shall be adversely effect product and shall be safe for the consumer.

The following warehouse sanitation practices are recommended as an aid in protecting the products from contamination.

I. Inspect a11 incoming products for possible rodents, insects and other forms of contamination. Look for these signs of possible contamination.

a. Live insects crawling on products containers.
b. Insects 'trails' in the dust an bags or cases.
c. House of rat pellets on product containers.
d. Rodent gnawed bags.
e. Undesirabfe odors.
f. Stains on product containers.

II. Product storage conditions :

1. Store products on lean pallets. Do not store directly on floor. All emptied storage bags should be swept clean before being refilled with the products.

2. Leave on 18" floor space between pallets of product and the wall. Do not store pallets directly against wall.

3. Do not store-dog foods etc, adjacent to flour, cake mix, etc. Do not store flour, cake mixes etc, adjacent feeds containing storing odour.

4. Practice., stock rotation, use older stock first. Frequently restack older stock and carefully examine exterior of containers for signs of possible contaminations.

5. Remove to rework room daily, all warehouse and/or rail road damaged products. Any torn containers should be taped or otherwise closed to prevent the entrance of any contamination.

Damage caused by rodents:

1. Consume large quantities of food (one rat consumes 20 Ibs of food in a year).

2. Contaminate much more foods than they consume.

3. Damage structure like packages materials, wooden structures etc. Each rodent produces about 70 faecal pellets and about 16 ml of urine a day They damage electrical and so can cause fires, short-circuits etc.

4. They are sources of fleas, hair, filth and other contaminants

5. They are reservoirs for leptospirosis, salmonella and cause rat bite fever

Rodent control :

1. Keep weeds and high grass from growing on the property immediately adjacent to the ware house premises.

2. Do not allow scrap wood or other debris to collect on outside perimeter or premises.

3. Place an adequate number of rodent bait boxes, containing anticoagulant type rodenticide, on the exterior and interior perimeter of the ware house. Services these boxes at least each two weeks.

4. Place an adequate number of snap type and/or wind-up type rodent traps at strategic locations throughout the ware house.

5. Rodent proof the building as much as possible by sealing holes through which rodents may enter.

II. a) Highly toxic rodenticides

1. Thallium sulfate
2. Strychine
3. Zinc phosphide
4. Arsenic troxides

b) Moderately toxic rodenticides.

1. Alpha – nuptial thiourea
2. D.D.T

c) Anti – coagulants.

1. Warfarin.
2. Fumarin
3. Coumachlor

Insects :

Principal Stored grain insects :

1. Granary weevil (sitophilus granarius)
2. Saw-toothed grain beetle (oryzae philus surinsmensis)
3. Red flour beetle (Triboliumacastaneum)
4. Larger cabinet beetle (Trogoderma inclusum)
5. Leeser grain borer (rhyzopertha dominica)
6. Rice weevil (sitophilus oryzac)
7. Indian meal moth (Plodia interpunctelta)
8. Cadella (Tenebroides mauritanicus)
9. Flat grain beelte (crytolestes pusillus).

Most important and effective means of preventive pest control.

1. Accumulation of debris, junk, improperly stored equipment and products etc. provide cover and harborage for rodents and situations dafific;uat to inspect and clean.

2. Accumulation and spillage of food materials attracts insects, rodents and bird pests and helps maintain their populations.

3. Although difficult to measure, a clean plant probably provides an environment conductive to increased productivity:

Chemical control of insects - Insecticides

1. Insecticides classification based on mode of action.

a) Stomach poisons.

b) Contact poisons : 1. Applied in liquid or dust formns 2) Contant with insects in two ways (I) direct application of insecticide to insect body (ii) indirect contact with insecticide by crawing over a treated surface.

2. Most important types of insecticides (based on chemical classification).

I. Insecticides on vegetable origin.

a) Pyrethrins - from dried flowers and buds of pyrethrum plant.

b) Paralyzes insects by penetrating the waxy covering on the exoskeleton:

3. Good knock down effect; better than its killing effect

4. Short residual life; deteriorates rapidly on exposure to light and air.

5. Used in conjuction with material called synergists - improves effectiveness by more than additive effect.

- Piperonyl butoxide
- N-octyl picyloheptene dicarboximide

a) Uses : Grain protectants - direct application to grain prior storage.

- Residual spraying
- Fogging - missing
- Insecticide treatment of products containers.

b) Chlorinated hydrocarbons - persistant.

1. Methoxychlor

i) Used only as a bin spray; no -direct application to grain.

ii) Tolerance established for raw agricultural commodity 6ufrtofiew, finished foods.

2. D D.T

i) No use in food plants.
ii) No tolerance established for raw agricultural commodities or processed foods.

3. B.H.C or lindane

i) Lindane is gamma isomer of BHC - Low odor.
ii) No tolerance established for grains or finished foods.

4. other chlorinated hydrocarbon insecticides which should not be used around food plants - chlordene, aldrin, dieldrin, endrin, heptachlor, toxaphene.

ii). Organic phosphorus compounds -short residual life :

1. Malathion

2. Relatively low mammalian toxicity.

ii) Uses : Grain protectant - direct application to grain - residual spray (grain bins, elevators, warehouses etc.)

2. Dichlorovos, DDVP or Vapona.

i) A volatile material used primarily for fly control, shows promises for cereal product insect control ingrain and ware houses.

ii) Used in various forms : Ompregnated resin bars for fly and mosquito control.

- Baits for fly control_
- Surface spraying.

4. Organic phosphates that should not be used in or near food plants - paranthion, tetraethyl pirophosphate (TEPP) ‘

IV. Diatomaceous earth :

1. General

j) Fossilized diatoms - abrasive
ii) results in desiccation of the insects
iii) may be impregnated with insecticides.

Fumiqation : All fumigants volatilize to form toxic gases. In a way they are also insecticides.

Ideal Fumigant:

1. Low cost for effective dosagg and application.
2. High toxicity to insects; low to man.
3. High volatility and penetration; low absorption.
4. Non-corrosive
5. Non-Explosive, non-flammable
6. No damage to product quality
7. Aerate rapidly, no residue.
8. No damage to germination
9. Residual spraying

Fumigants:

Solid	**Liauid**	**Gas**
1. Aliminium phosphide	1. Carbon tetrachloride 2. Carbondisulphide	Hydrogen cyanide Methyl bromide
2. Calcium cyanide	3. Ethylene dibromide	
	4. Ethylene dichloride	

Fumigation by Formaldehyde

Fumigation is the process of production of formaldehyde gas by adding required quantity of formaldehyde solution (40% formaline) to K permanganate is an enamel mass large enough to hold 10 times of the quantity of material used. Use 40 ml formaldehyde solution to 20 g of KM No4 for every 100 cft air space. The other method is to dip a piece of cloth in 100 ml of formaldehyde and hang near to fan in the

Effective at turn or relative humidity at above 75%. Formaldehyde gas is irritant to eyes and skin hence handle carefully and wear protective cover. Close air vent and exhaust. Min. 30 mts gas contact for disinfection.

If necessary use ammonium hydroxide 25% to neutralize formaldehyde.

Pervention of Fire and Dust explosions in feed Plants:

With an increasing number of feed plants being established throughout the country, it is becoming more important to know about the dust control and fire prevention. Explosions and fires are occuring quite frequently in feed plants. The importance of an effective fire and dust control programme for plants can be over emphasized. During the planning arid construction of many new plants, very little emphasis and attention is paid on the installation of -som, and fire-prevention equipment. -installation of such-equipment; would not only decrese the possibility of losses, but would also save money on insurance rates.

Dust Explosion :

Preparation, processing and use of organic materials which are'finely ground or which contain an appreciable content of fines, can pose serious explosion hazards. All feed mills must guard against the ignition and explosion of 'ingredients. Cleanliness can result in saving not only the mill, but lives of the workers.

5.8 USE OF PESTICIDES IN FEED STORES TO CONTROL - BIOLOGICAL AGENTS.

The main biological agents are

a) Insects
b) Fungi
c) Rodents

a) Insects :

At temperature 32 °C rate of multiplication is 50 times. The nutritive requirements of insects are same as those of vertebrates. Dead and live insects and their excreta cause the commodity unpalatable and . unacceptable.

Control :

1) Good bygiene

2) Cleaning and checking of storage containers as well as the stored food as far as possible.

3) New dry grain should be kept separate from old grains.

4) Store should be remote from the field to reduce the risk of infestation.

5) Traditional pest control system such as use of local herbs. Mixing as with grain and smoking are effective and should be encouraged.

6) asking use of grain storage insecticides like Contact poison3, such as dust, dispersible powders and emulsions (malation b) fumigants gasses which can penetrate bulk of grains and kill insects and larvae living within the grain but should be used by trained personnel.

b) Funai Fungi produces metabolities tike aflotoxin zearelenone. The fungus development occurs in the stored feed ingredients incase of a) dying b) due to high humidity and c) due to wetting.

Control : Losses due to fungi can be reduced by applying drying and storage technology.

c) Rodents : They not only consume foud but also foul with their excretions. Further they destroy containers by growing holes that results in leakage and wastage of frain.

Control :

1) Rodent exclusion efforts in store construction.
2) Improved sanitation
3) Fumigation with phosphine and.other gases
4) Trapping and hunting
5) Use of cats and dogs
6) Rodent repellants and
7) Poisson baiting such as chlorofacamone, warfarub, comabin zinc phosphate, barium carbonate etc.

Note : Moist baits are superior today baits but mould problems, which can be prevented by addition of 0.025% paranotro phenol but lowers the palatability.

Dose : In acute case: Zinc phosphide
Calcium cyanide 0.5%
Aluminium phosphide

In chronic case: Warferin comarrin
Warfarin 0.05%
Comarin

SUMMARY

Various anti-nutrient factors in feed stuffs were explained which limits the use of feed stuffs were explained. The procurement and storage of feed ingredients were explained. The various methods of detection of feed adulterants were detailed in simple way. Various methods of testing quality of finished feeds are furnished. Packing, forwarding and storage of feeds explained. Cleaning and fumigation procedures explained to keep feeds in good condition. Use of pesticides explained to use in feed stores to control biological agents.

SHORT QUESTIONS

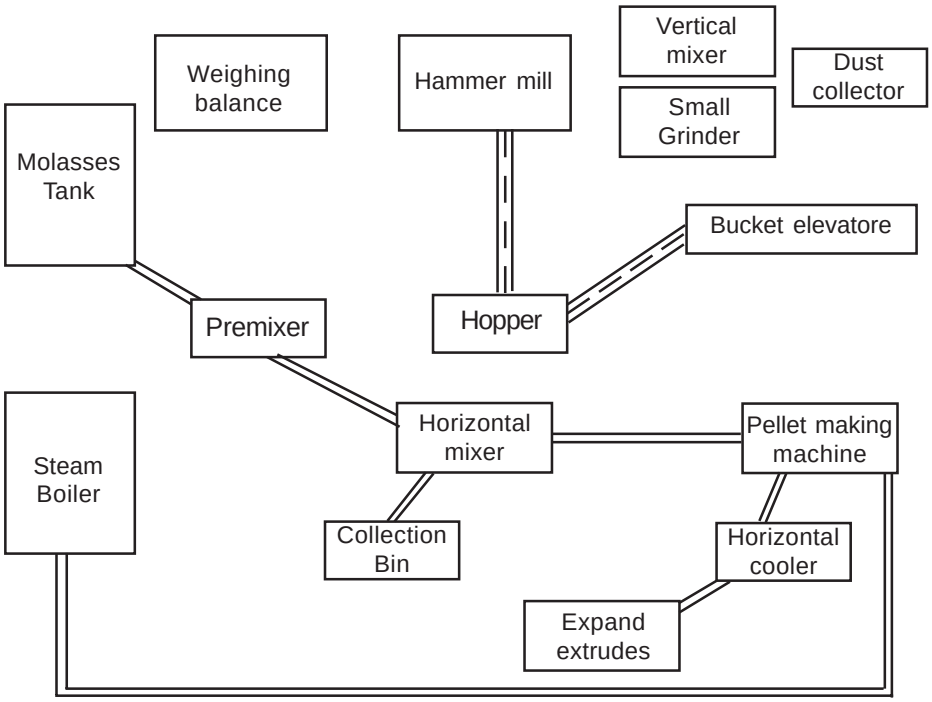
1. What are Anti-Nutrient factors?
2. What are the common feed adulterations?
3. What are the physical tests in Quality controls methods?
4. What are the chemical tests in quality control methods?
5. What is packing of feeds?
6. What are the pesticides used in feed stores?

LONG QUESTIONS

1. Explain briefly about various antinutrient factors in feed stuffs:
2. How do you procure and store feed ingredients.
3. Explain in detail about the methods of detection of feed adulterants.
4. Explain various quality control methods for finished feed?
5. Briefly write about packing and forwarding of feeds.
6. Explain cleaning and fumigation process in feed stare?
7. Briefly write about storage of concentrates?
8. How do you control biological agents in feed stores by using pesticides?

6. FEED PLANT

6.1 Layout of feed plant :



The layout or arrangement of different equipment and work area is important for efficient plant operation. The arrangement, either installed or in plam includes the space needed for material movement, storage, indirect labourers and all other supporting activities or services, as well as for operating equipment and personnel.

The advantages of good plant layout :

1. Increases the output
2. Reduced risk to health and safety of employees
3. Improved moral and workes satsisfaction
4. Fewer production delays
5. Saving in floor space
6. Reduced materials handling

7. Greater utilization of machine, manpower and services
8. Reduced inventory in process
9. Easier and better supervision
10. Better appearance and more sanitary condition of work areas.
11. Less congestion and confusion

Principles of plant layout

1. Principles of overall integration : A best layout integrates, the men, materials, machines, supporting activities and any other considerations in a way that results in the best compromise.

2. Principles of minimum distance moved : It should permit the material to move the minimum distance between operation.

3. Principles of flow : It should arrange the work area for each operation or process in the same order or sequence that theats the products.

4. Principles of cubic space : Economy is obtained by using effectively all avilable space both verticle and horizonal.

5. Principles of satisfaction and safety : It should make the work satisfying and safe for the workers.

6. Principles of flexibility : The layout should be adjusted and rearanged at minimum cost and inconvenience.

6.2 Methods of purchasing, procurement of feed ingredients and their physical evaluation :

As the population grows increasingly, the food supply becomes anurgent priority. One vital and neglected towards this end is to reduce food, losses that occur between harvest and consumption. Inspite of advances in technology, tonnes of cereals are wasted every year through spoilage of various sorts.

Grains stored under favourable conditions for many years undergo relatively minor changes in composition and can be used as a source of nutricions and palatable food or animal feed, but under unfavorable conditions results in complete spoilage of grain for food or feed purpose within a few days.

6.3 Grinding of feed ingredients – Equipment

Grinding is the firsi and important processing methods in feed processing. It is a process of particle size reduction. Grinding may be coare medium and fine according to the resultant particle size. Grinding of feed stuffs, concentrates and roughages are usually done by hammer mills. Principle involved in hammer mill is implication. Feed ingredients are reduced into smaller particles by means of hammers and surface. Component parts of hammer mill are

a) Feeder
b) Dome
c) Shaft
d) Hammers
e) Rotor- contains several plates keyed to the shaft
f) Sieve or screen
g) Pully of shaft
h) Motor with pulley
i) Belt of motor
j) Exit

Hammer mills are commonly used in feed industry at farm and commercial levels.

6.3.1 Working:

Material is fed through the feeder while the motor is running. Due to the movement of the hammers at high speed (2,100 to 7500 ft / min) impaction develops. The material will be in free flight and touches the hammer tips or screen and gets reduced to smaller size. If the first impact of the hammers against the grain does not break it up so that it will fall through the screen, it rebounds and is again struck by the hammer tips. The process continues until all particles are reduced to size that will allow them to pass through screen and comes out through exit.

6.4 Mixing of feed ingredients – Equipments :

Mixing is defined as blending of more than 2 different types of ingredients. Mixing is important of all the processes in feed processing operation and hence the name feed mixing plant. There are two types of mixers which are commonly used in feed industry.

1) Horizontal mixers
2) Vertical mixers

6.4.1 Horizontal mixers

Component parts are

1. Hopper - for holding the ground material
2. Small hooper - For introduction of mealy ingredients
3. Small opening - For adding micro ingredients
4. Window - opening in the hopper to observe the proceedings.
5. Horizontal mixer - has a round bottom and square top - A trough is present on the horizontal mixer which has small openings for molases to pass through it. Inside the mixer, ribbons or paddles are moulded on center driven shift.
6. Dischargegate - located at the center of the bottom
7. Motor with belt and speed reducer
8. Legs or stand on which the mixer is kept
9. Platform

6.4.2 Working

The ground materials are introduced one by one through the small hopper. Start the motor. If the formula contains molasses, preheat the molasses and introduce the quantity during mixing at the last phase. After complete mixing the material is discharged through discharge gate. Surge bin holds the compounded material for faster bagging or binning of the material 3 - 5mts are required for completing the operation.

6.4.3 Advantages

1) Molasses can be mixed
2} 100 % clean.aut
3} Short mixing time (3-7 mts)
4} Surgebins can be used for continuous mixing

6.4.4 Disadvantages

1) Consumes more power
2} Cannot be used by small mills due to high cost

6.4.5 Vertical mixer

Components parts are

1) Screw convaycr
2) Window
3) Feeder
4) Exit
5) Legs
6) Motor
7) Pulley
8) Belt

6.4.6 Working

Introduce the ground mealy ingredients dumping of material should be in the order of bulk ingredients, minor ingredients and micro ingredients close the inlet after introduction of all ingredients. Start the motor. The feed moves with the help of screw and it will be dropped on either side. By repeated elevation of material from bottom to top results in blending. This has to be run for 15 - 20 mts depending on formula. After mixing the material is taken through the exit. Stop machine after complete discharge of material from mixer.

6.4.7 Advantages

1) Low power consumption
2) Can he used in small feed plants due to low capita(investment

6.4.8 Disadvantages

1) Long mixing time (20 - 30 mts)
2) Liquid supplements more than 2-3% cannot be mixed
3) Clean out is not 100 %
4) Surgebins cannot be used for continuous mixing.

6.5 PELLETING PROCESS - ADVANTAGES – DISADVANTAGES

The process of pelleting can be roughly defined as plastic moulding operation of the extrusion type. Ingredients containing proteins, acids, sugar, fibre and minerals can be softened and conditioned by addition of heat and water and when sufficiently controlled compression is applied to the conditional feed ingredients may form a dough dense mass shaped to confirm to the die against which it is pressed and when the heat and moisture is again with drawn "dried and cooled" the shaped mass 'pellet' retains its shape and density and is of such toughness as to with stand moderately long time handling without excessive breakage and has retained or enhanced nutritive value.

Pelleted feeds have been defined as agglomerated feeds formed by extruding individual ingredients of mixtures by compacting and forcing through die openings by any mechanical process.

Pellets are generally formed which will have diameters from 10 / 64 into 48 / 64 inch and will be some what longer than the diameter. The shapes may be cylindrical, triangular, square or oval. Smaller size of 10 / 64 inch are desired in most cases.

There are two types of pellets i.e. hard and soft pellets. Hard. type pellets are produced on equipment using a combination of rollers and die for pressure and forming and the principle is

a) Blended and conditional mash is introduced into a pelleting chamber and distributed by means of gravity centrifugal force and mechanical deflectors.

b) Pressure resulting from rotation of discs and rollers forced feed through perforations in die which compressed and forms the feed into pellets.

c) Adjustable knives cut pellets into desired length

d) The pellets are then cooled and dried before bagging or binning.

Soft type pellets are those containing over 30 % molaases and produced on equipment using a combination auger and die pressure and forming the basic principle in this is

a) A blended mash and molasses is introduced into allges.

b) A rotating auger conveys material to the die and builds up pressure for extrusion.

c) The pressure resulting from rotating augers forced feed through perforations in the die compressing it and forming in to pellets.

d) Pellets are usually allowed to break off by force of gravity, sizing in generally random and further handling eliminates excessively long particles.

e) The pellets are dusted-with bentonite or finely ground cotton seed meal to absorb excess of molasses which would cause pellets to stick together.

f) The pellets are cooled and dried before bagging or binning.

The pelleting unit consists the following parts.

1. **Supply bin :** Two bins each of a capacity not less than one and half times the capacity of the batch mixer used to supply feed to the pelleting unit.

2) **Pellets mill (Hard Type) :** the conventional pellet mill consists of
a) Feeder - The purpose of feeder is to provide a constant controlled even flow of feed to pelleting operation.

b) **A mixer is provided in order to properly condition the feed**, conditioning is almost universally accomplished by the addition of controlled amounts of steam. This mixer can also be used for the addition of molasses.

c) **Pelleting device :** In this conditional mash is forced through holes in the die by roller pressure.

d) **Speed reduction device :** Which regulates the speed of the die.

3. **Cooler :** Pellets will leave the pellet mill at 190oF temp and 17 % moisture. The moisture must be reduced to 10 - 12 % and temp to 15 o F above the ambient temperature which is accomplished by passing a stream of air through a bed of pellets which evaporates excess moisture.

4. **Crumbler :** For production of feed particles smaller than 10 / 64 inch crumbles is used. It consists of corrugated rolls.

5. **Sifting Device :** Which grades depending upon the size of pellets

6. **Pellet elevating system :**Pellets are elevated by standard bucket elevators or by air. The work is conveying the pellets.

7. **Steam Supply :** Boiler is instanstelled depending upon the stearn requirement.

Advantages of Pelletins :

1. Improves the intake and digestibility of the feed.
2. Reduces the wastage by the animal.
3. Increases or improves the palatability of the feeds because of cooking effect.
4 Increases the density, there by cuts down the storage facility.

5. Improves the feeding value of different feeds especially with roughages as compared to concentrate.
6. Saves labour because of ready made feed, can be handled mechanically.
7. Uniform feed supplies to the animal and in a concentrated form.
8. No possibility of segregation or picking up the ingredients
9. There will be working and sterilizing effect during pelleting process.
10. Increase the growth rate and milk production.

Disadvantages :

1. Cost of pelleting will be high
2. Reduces the feed passages time in gastro intestinal tract.
3. In dairy animals, feeding of pellets results in low butter fat content in milk.

6.6 Compounding of feeds - Objectives - Advantages :

Individual ingredient feeding will have in imbalance or ration and the animal gets whatever nutrients present in that ingredient and the animal suffers from deficiency of nutrients which are lacking / low quantity in that particular feed as it is, without any processing the digestibility and assimilation will be less. If these ingredients are grinded into small particles, the surface area available for enzymatic action will be increased and so the digestibility increased and also digested quickly.

The requirement of different nutrients for different classes of animals are different. i.e. growing, pregnant, milch animal, working, dry animals, etc. No single ingredient will satisfy all the requirement of nutrients. So different ingredients are selected and proportions of each ingredients are selected and proportion of each ingredients is calculated to make a definite quantity. Which will satisfy the nutrient requirement for that class of animals. If all the ingredients are mixed and fed without processing individual ingredient, there is chance of picking only certain ingredients by the animals selectively leaving others. To counter act this disadvantage, all the ingredients are ground into smaller particles powder (grinding) and mixed very well (mixing) so that the animal takes all the ingredients mixed in that feed.

Objectives :

1. To improve the nutritive value of feed
2 To balance the protein and energy requirement.
3. To balance minerals and vitamins
4. To mask the non tasty food ingredients
5. To utilize the agro industrial and livestock industry by products
6. To have uniform protein and energy and other nutrient per unit weight of feed.
7. To improve the palatability.
8. To avoid wastage by binding and pelletization process.
9. To improve the digestibility of nutrients.

Advantages

1. Compound feeds are complete feeds containing all the necessary nutrients at optimum level.

2. Compound feeds can be prepared for different class of animals and quantity of feed given can be calculated depending on the production.

3. Feed wastage can be minimized.

4. Compound feeds will have high digesting and assimilation properties due to processing methods.

5. Agro Industrial by products and livestock industry by products can be mixed without affecting the palatability. Otherwise these ingredients will not consumed by the animal

6. The cost of nutrient per unit weight is cheap "by utilizing wastes / by products.

7. The animal will be healthy, as they receive all the vitamins and minerals at optimum quantities.

8. Production of milk will be increased due to balance of protein and energy.

9. By using molases no feed wastage will be occurred.

10. No wasting of feed by dusting by using pellets.

6.7 Machinery used for compounding of feeds :

The principle equipment used for compounding of feeds are

1) Grinder
2) Mixer
3) Pelletization equipment

1. Grinder :

This is an instrument which causes reduction of particle size of feed ingredients. Impact grinding occurs when the particles to be reduced, meet the milling surface at a high velocity. The energy for rupture of the particle is produced essentially from kinetic energy. The reduction taking place would depend on the relative velocity of the particles and the impact surface. The particles would be reduced more easily, if it contains grooves, stratifications or impurity inclusions.

2. Hammer Mill :

This is used for the grinding of both grains and forages. The hammer mill consists of a cylinder or rotor made up of several plates keyed to the main shaft or axle. Pins through these plates, near the edge, carry the hammers, which are attached to them. Outside the rotating cylinder is a perforated steel screen. The holes in this screen may be as small as 1/32" or as large as 2 or more inches. Hammer mills may be of the single or double or triple reduction type with either rigid or swigging hammers. The double, triple, reduction types have knives or blunt disks on one side of the rotor to chop the longer stemmed materials such as maize fodder or alfalfa in to small pieces before they come in contact with hammers. This type of mills is usually fed from a central opening, so the material being reduced will come into contact with knives and disks first.

There is also a combination type mill which employs rotary knife mounted above the mill. This type of mill is well suited for forage type material.

It is assumed that the most of the grinding occurs as the hammer strikes the material in the air as it falls in to the mill. The hammer tip may travel at a speed of 7000 – 2500 ft per minute. If the first impact of the hammers against the grain, does not break it up so that it will drop through the screen, it rebounds and it rebounds and it again strike by the hammer tips. This process continues until all particles are reduced to a size that allows them to pass through the screen.

A fan or blower is usually used for product transport after grinding, the fan may be connected to the same shaft that drives the hammer mill or it may installed wh+ch utilize mechanical conveyers, such as bucket elevators, to maintain an air through the screen, some hammer mills use an air recirculation system which takes air from the outside of the screen. The hammers serve as blades for a centrifugal fan action to maintain the airflow. Other types of grinding mills are

3. Attrition mills :

These are heavy duty precision plate mill used in the commercial preparation of feed and food products. Each plate rotates and is driven independently, speeds are higher and design and construction are more precise than other mills. In general it can be said that an attrition mill is more efficient when producing a courses product and hammer mill is more efficient when producing a finer product. The attrition mill also produces a more uniform grind than hammer mill.

4. Roller Mills :

Used in feed processing for the crimping or crushing of grains. The double roller mill used for this purpose consists of two roles rotating in opposite directions at the same speed, the material is crushed between the rolls. Rolls are usually corrugated or serrated. Roller mills may have one or two pairs of rolls in a stand.

2. Mixer-

The aim of mixing is to despose the ingredients of a certain assortment, so that each small unit of the whole have the same proportions of each ingredient as the original.

Mixing feeds is an important, for animal performance to have uniformity having the required nutrient. Proper mixing of feed prevent toxicity when NPN substances such as urea are added. Vitamins and minerals which are in traces and the distribution of the content effect utilization of nutrients are also effect production.

Two types of mixers are generally used for mixing feed.

1. Vertical Screw type of Mixer :

They may be single screw or double screw for elevating the material. However, single screw mixer is popular, these are relatively in expensive and do a good job of mixing most ingredients. They are little slower than horizontal mixers and are not used in large feed mills.

2. Horizontal Mixer :

In this the mixer with right and left hand angers, the material is conveyed from one end of the mixer to the other, while it is tumbled within the mixer. These mixers are equipped with opening at several places along the bottom to aid !n more- rapid discharge. Continuous mixers which are to be used for mixing high• level of molasses are frequently used in commercial plant. One or two shafts with paddles attached, convey material from the inlet end to outlet end. The material is conveyed through the mixer and mixed by paddles.

In commercial use the following types of mixers are available.

A) Vertical batch Mixer :

Consisting of a vertical bin tapering to a point at a bottom, a tube, containing a vertical screw conveyer elevates and mixes the material and is used to elevate the material as the mixer is filled. The conveyer continuously elevates the product and distributes it over the top of the mixer. Repeated

elevation of the product produces blending. Some mixers use two screw conveyers and few use other elevating devices. Normally screw is driven from the top but it can be driven from the bottom. Unit range in capacity from 1/2 to 5 tones.

B) Horizontal Batch Mixer :

The ribbon auges assembly is constructed with opposing outer and inner ribbons mounted on a centre driven shaft. Normally hellicle screw flighting or paddles are located in the centre of the assembly for additional action in the core of the batch. This ribbon assembly is housed in a tub, the lower half of which is circular. Material to be mixed is conveyed from end to end, top to bottom or side to side in the mixer. Discharge gate can be located at either end or centre. Multiple gate assemblies are available to provide more rapid complete discharge low mixing speeds are used. In order to empty the mixer more rapidly, than the product can be conveyed away with most elevators, a surge bin is usually provided. The mixer is dumped into the surge bin and another load can be mixed while the surge bin is emptying.

C) Premix batch mixer :

It is horizontal type batch mixer usually 5 - 20 cft capacity for mixing micro ingredients nrith between ribbon and tub available with drop bottoms for complete clean out. It has same speed and mixing characteristics as a standards horizontal mixer.

D) Continuous high sped mixer :

Construction usually includes a single horizontal shaft on which paddles are placed at appropriate angels to convey and mix the mash. Housed in a cast iron cylinder to resist abrasions.

E) Liquid application mixer :

Designed for controlled addition of molasses, fats, fish solubles or other liquids individually or simultaneously to the flow of dry mixed feed. Usually construction is single shaft. operating at 1150 rpm on which paddies project at 90° to the shaft. The paddles are subjectable and entire shaft assembly rotates in a fabricated metal cylinder. Product is fed into forward section by a

controlled feeder and liquid is introduced by parts of manifolds. Dry feed and liquid are moved the full length of cylinder, pumps regulators and meters, coordinated with volumetric dry product flow. The liquid product is usually heated with the mixer unit or separately prior to introduction in to the mixer.

6.8 Efficient management of feed plant:

It must be pointed out that the use of automated equipment has reduced the cost of labour, there by reducing the cast of manufacturing feeds. Because machinery was becoming more complex, additional trained mechanics are required to keep the production department machinery in operation.

For better management of maintenance programme, the maintenance supervisors (found they needed) requires.

1. A System for measuring the efficiency of each machinery
2. A schedule of regular inspections to prevent the breakdowns of production time.
3. A system of scheduling the work.
4. A method of coordinating requests for work.

These aids have to be considered to reduce cost of finished products.

1. Working sampling
2. Budgets
3. prevents maintenance.
4. Corrective maintenance
5. Planning arid Scheduling
6. Standard parts for standard machines
7. Store room parts control and its location.
8. Work simplification.

1. Work sampling :

It is. a method of determing the relative distribution of the activities of personal or equipment by randorr observatirm. This anatysis have provided useful information in improving the efficiency, by pointing out to the management necessary delays and other non-productive activities. Since the work sampling surveys will be conducted on periodic basis, they also provides sufficient data to iryrpliment a planned improvement programme in a feed plant.

2. Budgets:

It is a -management's indication of what t;: expect to spend for any given operation. The plant manager is expected to produce the desired quantity of manufactured feed without spending more than the amount of money attoted for the purpose. The manager is also expected to keep all the equipment in proper conditions to operate for the expected life of each machine.. it is most important that budgets be established in Coorperation with the manager of the maintenance department since he is responsible for the results.

3. Preventive maintenance :

It is nothing but -correcting the potential breakdown before it arises. It is based on two features or factors

1. Periodical Inspection of all ' production machinery, utility equipment and building : Inspection in no case will be more frequent than once per year. Inspection or routine maintenance done more than once in a month are considered to be operational rather than a maintenance, problem. The periodical inspections. are usually made by the production department managers. When special skills are needed to inspect equipment, the maintenance department will upon request perform inspection.

2. Development of complete maintenance history y on each item, of Machinery equipment or other facility. It is periodically reviewed to note items having high maintenance cost subjected to respective failures. Information of this nature points out the areas where corrective measures in one of the following forms are needed.

1. Alteration of the process, 2. Redesign of respective failing component, 3. Replacement of equipment is the maintenance expenses is great enough to justify the replacement.

Breakdowns: A record is kept of all breakdowns and also production losses.

Proforma of a breakdown

Unit No	Macine	Date of last Inspetion	Hours lost due to break down	Production lost break	Descripti on of the cce down	Corrective maintena required
1	2	3	4	5	6	7

4. Corrective maintenance :

It becomes necessary when a major breakdown of a plant occurs. It is the 'surgery' necessary to put the manufacturing line back in operation. The corrective maintenance can be performed when the production line is not scheduled to operate but ordinarily the breakdown happens during operation which then necessities the shut off of at least a portion of production line. Corrective maintenance is performed as a result of breakdown-and to prevent its reoccurances. The corrective maintenance will not eliminate all the breakdowns. It reduces the down time (dead time) and the elimination of breakdown will usually increase the production. Through preventive maintenance, equipment is inspected. To findout worn out or faulty parts that will cause breakdown. The preventive maintenance will follow this up in order to keep the equipment in conditions.

5. Planning and Scheduling :

Planning and scheduling determines the efficiency of the maintenance of the plant. With efficient planning and scheduling, repairs can be done with a reducedcost to some extent. The main objective of planning and scheduling is to utilize fully the man power, equipment and facilities of the plant.

Purpose of planning and scheduling of mechanical work :

1. It will be useful to classify, analyse and properly process all the job sheets of persons working in the feed.plant.

2. It provides a clear cut description or the job to be performed by a particular individual.

3. Job priorities can be established.

4. It establishes the equipment availability as to time and date.

5. It provides material and tools required for the particular job.

6. It distributes the available man power to the best advantages.

7. It avoids the conflicting work scheduling of the job.

6. Standard parts and standards machines :

It becomes important in a multi planned or in multi machine operations. It permits the exchange or replacement of the worn out parts. It reduces the investment costs, cut down time and reduces the repair and labour costs.

7. Store room parts control and its location

a) Store room parts Control : It is a system of maintaining a correct inventory of each and every part. The present inventory of each item is recorded. An additional parts are needed or issued for use, these transactions should be noted in the record.

For maintening correct inventory, a. Minimum inventory and 2. An economy order inventory has to be established for each part. When parts are issued, reduce the stock supply to the minimum inventory of the parts. This system will indicate when to order the economic order quantity.

Advantages of store room parts control :

1. It eliminates the production, interruptions caused by non-ava liability of the spare parts.
2. Eliminates the purchases of extra quantities of non-recurring items.
3. It reduces the annual repair expenditure.
4. Spare parts for the out – dated machines are eliminated.
5. It provides material and tools required for the particular job.
6. It distributes the available man power to the best advantages.
7. It avoids the conflicting work scheduling of the job.

b) Store room Location:

Usually it should be located in a corner of the plant further away from the usual operations.

Precautions to be taken in locating store room. 1. Convenient transport from store room to plant, 2. It must be of sufficient size to efficiently store all parts. 3. Items should not be damaged by moisture, heat etc.

8. Work simplifications :

The maintenance supervisor will constantly observe for the design changes and new tools or techniques will improve the efficiency of the machine. With work simplication 1. increased efficiency will be there, thereby 2. Decreasing the maintenance costs.

Planned maintenance program : Nothing but he inspection of parts of the mill at specified intervals.

	Name of the equipement	When to insepct	Inspection
A.	Bucket elevators		
1.	Elevatro belt	Every 2 months	Froyed edges & loose splies.
2.	Bucket	Every 2 months	Loose buckets, loose bolts and nuts and alos for the missing buckets.
3.	Causing	Every 2 months	Misalignments & balts rubbing in the sides.
4.	Head and boot	Every 2 months	Misalignment of shift and belt
B.	**Hammer Mill**		
1.	Hammer or blades	Every 2 months	Inspect for the wear and tear of the baldes and also balancing of the baldes.
2.	Screens or sieve	Every 2 months	Look for the holes and wear and tear of the screens
3.	Coupling	Every 2 months	Examine for the wear and tear and repack with greece.
4.	Belts	Every 2 months	Check the tension of the belts

C.	**Mixer**	One month	Look for the loose mixer baldes, shift asignment and also for the wear and tear.
1.	Eletrical 6 months	Every 6 months	Check for the vibration and also inpsect the oil level.

Lubrication is very important. Any moving parts needs lubricationto prevent wear. Even though today we are using more and more antifrition bearings, they still need lubrications. There are a number of quality lubricants available for each application. Most equipment is furnished with a recommended list of types of libricants.

Over - lubrication can do just as much harm as under lubrication. We should not allow our lubrication to be done by just any one. The person doing this job should be properly instructed.

SUMMARY

The process of grinding and mixing of feed ingredients were furnished. The equipment used for grinding and mixing of feeds were explained. The process of pelletization which limits feed wastage was discussed with advantages and disadvantages. The tips in efficient management of feed plant were mentioned. The objectives and advantages of compounding of feeds mentioned and the equipment used for compounding of feeds explained.

Short Questions

1. What is grinding ?
2. Define mixing.
3. Mention different types of grinders ?
4. Define pelleting process.
5. What is compounding of feeds ?
6. Mention the equipment used for compounding of feeds ?
7. What is the binding ingredient used in pelletization ?
8. Define efficient management.

LONG QUESTIONS

1. Explain grinding of feed ingredients.
2. Briefly write about various types of grinders.
3. Explain mixing process of feed ingredients?
4. Discuss about various types of mixers
5. Explain pelleting of feeds.
6. What are the advantages and disadvantages of pelleting process?
7. Give tips for efficient management of feed plant.
8. Give objectives and advantages of compounding of feeds ?
9. Briefly write about compounding of feeds.
10. Explain about the machinery used for compounding of feeds.

7. FODDER PRODUCTION

7.1 STUDY OF SOILS FOR FODDER PRODUCTION

Generally soils plays an important role in increasing fodder production. So to know about different soils which are suitable for different crops is most essential. The soils are mainly divided into two group. I.e. Red and Slack. These are again divided as sanc'y soil, loamy soils and clay.

7.1.1 Red soils : General Charcteristics

Red soils occupy 65 % of the cultivated area in Andrtra pradesh. They are found in Chittor, Ananthapur, Visakapatnam, Karimnagar, Medak and Hyderabad district.

They are derived from rocks like granite and genesis. They are red in colour The red colour is due to the presence of iron. Rich sandy loamy soils but clay is very less . These soils are suitable for jawar and maize production.

7.1.2 Black Soils (General Characteristics)

They occupy 25% of the cultivated area in A.P. They are called as black cotton soils, as they are best suited for cotton under rainfed cultivation. Guntur, Krishna and Rayalaseema districts have large area as of black soils. They are clay in nature. They absorb water slowly. Their water holding capacity is high. They are rich in plant nutrients. The water table is low. The water contains salts and so the water is not useful for irrigation.

They shrink in summer and swell on wetting. They form deep and wide cracks during summer. Their P.H is 8.5 to 9. Jonna (Jawar) is the main food crop. They are good for cotton.

7.1.3 Soil Texture and Structure :

Soil texture indicates fineness or otherwise of the soil depending upon the relative proportion of the particles of varying sizes.

The soil particles which resulted from weathering vary greatly in size. They are classified into gravel, sand, silt and clay on the basis of their size.

1.	Coarse sand	:	2.00 to 20 mm
2.	Fine sand	:	0.20 to 0.002 mm
3.	Silt	:	0.02 to 0.002 mm
4.	Clay	:	less than 0.002 mm

Clay particles are so small that they are not visible even under ordinary microscope. Sand grains feel gritty and are easily visible by naked eye. Gravels range from pebbles to particles of 2.5 mm diameter. The various size groups are termed as soil separates. Most soils are mixtures of the soil separates in different proportions. Depending on the proportion of the soild particles of different sizes, soils are grouped into 3 main textural classes. Viz. Clays, Loams, and sand.

1. Sandy soils :

They contain more of coarse fractions. They absorbs moisture quickly, permits sowings early. Hence they are called "Early soils". They are loose and friatle, in village is easy. Hence they are called "Light Soils. They contain less of organic matter. They are poor in plant nutrients. They are called hungry soils. They do not crack in summer and deep cultivation is necessary. Addition of organic matter increases their water holding capacity. They are suited for heavy rainfall areas.

2. Clay Soils

Fine fractions are more in clay coils. They absorb water slowly. Their water holding capacity is high. They are hard and sticky. Tillage is difficult, hence they are caned heavy soils. They permit sowings late and for this reason they are cahed "Late soils". They crack deep in summer, and swell on wetting. They are called self tilled soils. Addition of organic matter improve the structure drainage and aeration of the soils. They are suited to low rainfall regions.

3. Loamy Soils

They contain coarse and fine fractions in equal proportions. Water absorption and movement is not slow not rapid. Soil is not too loose nor too stiff. They contain good amount of organic matter and plant nutrient. Good drainage is present. They hold moisture sufficiently. They are suited to all crops and all types of climatic conditions.

Within each group of textural classes, there are 3 to 4 sub-groups recognised. They combine the properties of more than one group.

PERCENTAGE OF SAND, ILT AND CLAY IN PRINCIPAL TEXTURAL CLASSES (USDA - 1960)

Sl.No.	Textural Name	Range (Percentages)		
		Sand	Silt	Clay
1	Sand	85-100	0-15	0-10
2.	Loamy Sand	70-90	0-30	0-15
3.	Sandy Loamy	43-80	0-50	0-20
4.	Loam	23-52	28-50	7-27
5.	Silt loam	0-50	50-88	0-27
6.	Silt	0-20	80-100	0-12
7.	Sandy clay loam	45-80	0-28	20-35
8.	Clay loam	20-45	15-53	27-40
9.	Sandy clay	45-65	0-20	35-45
10.	Silty clay	0-20	40-60	40-60
11.	Clay	0-45	6-40	40-100

7.1.4 Study of soils for fodder production :

The following table shows suitable soils for fodder.

	Name of Soils	Types of Fodder
1.	a) All types of soils b) Wll levelled loamy soil.	Jawar Maize (N L A)
2.	Deep detentive fertile loams to clay loams	Napier (N L P)
3.	Loamy soils	Low pea (L A)
4.	Clay loamy oils (Sandy not Suitable)	Beerseem (L P)
5.	Deep and well drained loamy soil	Lucerne (L. P)
6.	Sandy to clay soils (Water logged soil)	Paragrass (NLP)
7.	Neutral to alkaline soils	Subabul (FT)
8.	Rich fertile deep loamy to clay loamy.	Guinea grass (NLP)
9.	Feely drained light texture soils	Stylo (Legume pasture)

NLP - Non legume perinal
NLA - Non legume Annual
LA - Legume Annual
LP - Legume perinal
FT - Fodder Trees

7.2 Importance of green fodder feeding for economic milk production.

a) Green ferage is essential in the feeding of -dairy cattle for economic milk production.

b) Green fodder feeding practice maintains the normal health and reproduction of all herbivores.

c) The longevity and production are adversely affected when cattle are reared without green ferage, even though they may be provided with best quality of concentrates. Such animals usually give birth to weak, stunted or blind calves.

d) Green forages are also praised for their over all cooling effect on the body due to the nature of being easily digestible, more palatable, being slightly laxative in action and above all provide fresh nutrients in most natural form resulting in efficient utilization of these feed without any strain on the body organs.

e) Dairy cattle yielding as high as 10 litres of milk can easily be maintained solely on green fodder without any complaint. By this the feed costs are reduced by 20 % over a normal dry roughage (straw) and a concen trate mixture.

The good characteristics of green fodder are

1. These are highly digestible mostly when harvested at a proper time (55 - 65 %) .

2. The crude protein may range from as little as 3°i° in very mature forage to over 30 percent in young heavily fertilized grass (on dry matter basis).

3. The soluble carbohydrates of grasses include fructanes and sugar glucose, fructose, sucrose, raffinose etc ranging in the dry matter from 4 percent to 30 percent. The cellulose is generally within the ranges of 20-30 percent of the dry matter.

4. Grass proteins are particularly rich in arginine, and also contain glutamic acid and lysine.

5. Lipid content hardly exceeds 4 percent

6. The mineral content of pasture is very much dependent on soil type, stage of growth, species and cultivation of condition.

7. Green ferages are excellent sources of carotene, the precursor of vitamin A and quantities are high as 250 mg I kg may be present in the dry matter.

Thus a dairy farmer will be economically in a safe portion it he maintains his cattle mostly on forages. !f one has irrigation facilities, he may adopt intensive crop rotations for the production of quality fodders.

7.3 Crop Rotation:

Growing two or more crops in a sequence one after the other, on the same piece of land is termed as sequential cropping. Depending on the, , number of crops grown in one year, the systems are called double cropping, tripple cropping, quadruple cropping etc. If the same crop is grown season after season or year after year, it is termed as mono culture and if different crops are grown it is termed as crop rotation.

Eg: Maize - Berseem

Sorghum - Oats - Maize

Maize - Cow pea - SSG (Multi cut sorghum)

Availability of irrigation water is more important to adopt this system.

Normally in crop rotation one legume crop is followed by non leguminous followed by leguminous is followed to have beneficial value of

a) The leguminous crops will fix nitrogen in the soil, which will be utilized by successive non leguminous fodder. So we can reduce the fertilizer for non leguminous crops.

b) With this rotation the amount of biomass production will be increased.

c) This system will alter the soil condition, so that next crop is easy on soils.

d) The forage quality in crop rotation system will be improved.

e) The cost of production of forage production for one year will be decreased at 30-40 %

Inter cropping i.e. growing one or more crops simultaneously on the same piece of land together for their entire life cycle or atleast for part of their life cycle is also beneficial.

Eg : Sorghum + cowpea + cucumber -> mixed cropping
Sorghum + cowpea , maize + cowpea -> Row cropping.

In mixed cropping in the system in which two or more crops are mixed and sown by broad casting without distinctive spacing. Sowing two or more crops in distinct rows with narrow ratios of 1:1 or 1:2 or 2:2 is termed as row inter cropping.

The system of sowing two or more crops in alternate strips (slightly larger ratios' such as 10 : 10 or so) is termed as strip cropping.

Eg : Stylosanthesps + guinea grass

For crop rotation one system of the above three system after another system can also be practice
eg. Mixed cropping - row cropping - strip cropping.

7.4 STUDY OF DIFFERENT FORAGE FARM EQUIPMENT-PLOUGHING, HARROWING, PLANKING ETC.

I. Ploughing

Ploughs are used for primary tillage. Implements used for opening and loosening of the soil are known as ploughs. Ploughs are of three thypes. i.e. wooden ploughs, Iron or invension ploughs and sepcial purpose ploughes.

A. Indigenous plough or wooden plough

It is made of wood with an iron share point. It consists of body, shaft pole, share and handle. 'V' shaped funow is cut and opens the soil, but there is no inversion. Ploughing operation is not perfect because some unploughed strip is always left between funows.

Types of wooden ploughs

3 varieties on size and purpose. Peddamadaka of Rayalaseema is a heavy plough, which ploughs 15-20 cm depth and is drawn by 3-4 pairs of cattle. Also called black soil plough. Dryland plough is smalles ploughs. Worn out dryland plough is used as a wetland plough. Since black soils ofter more resistance for opening, the head of the body is smaller, the angle between the shaft and share is acute, but the length of the body is more than light soil plough. The above three types covers 0.1 to 0.15, 0.15 ro 0.25 and 0.24 to 0.28 hactors per 8 hours day.

B. Soil turning ploughs

Mould board plough

This type of plough leaves no unploughed land as the furrow slices are cut cleanand invested to one side resulting in better pulverisation. The parts of this type are frog or body, mould board or wing, share, landside, connecting, rod, bracket and handle. Two mouled board plough are attached to tractor where as simple one is animal drawn. This is used when soil inversion is necessary.

Disc plough

It resumbles mould board ploughs. A large revolving concave steel disc replaces the share and the mould board. The disc turns the furrow slice to one side with a scooping action. This is useful where there is much fibrows growth of weeds, as disc cuts and incorporates the weeds. No harrowing is necessary to break the clods of the upturned soil as in a mould board plough.

Turn - wrest or reversible or one way plough

Plough bottom in this is hinged to the beam such that the mould board and the share can be reversed to the left or to the right side of the beam. This adjustment saves the trouble of turning the plough in filly tracts, but yet facilitates inversion of the furrow slice to one side only.

C. Special ploughs

Subsoil plough

This is designed to break up hard layers or pars without brinking them to the surface. The body of the subsoil plough is wedge shaped and narrow while the share is wide so as to shatter the hard pan and making only a slot on the top layers.

Chisel plough

It is used for breaking hard pan and for deep ploughing with less disturbances to the top layers. Its body is thin with replaceable cutting edge so as to have minimum disturbance to the top layers. It contain replaceable share to shatter the lower layers.

Ridge plough

It has two mould boards, one for turning the soil to the right and another to the left, with a comman share, i.e. double winged. It is used to split the field in to fidges and funows and for earthing up of crops. it is used to make broad bed and funows by attaching two ridge ploughs on a frame at 150 cm space in between.

Rotary plough or rotary hoes

It cuts the soil and pulverises it cutting of soil is done by blades or tynes. It is suitable for light soils. Blade types are widely used.

Basin lister

It is heavy implement with one or two mould boards or shovels. Shovels are mounted ona special type of frame, on which they act alternatively. It is used to form listed ferrows (broker furrows with small dams and basins) to prevent free run off of rain fall and blowing of the soil in low rain fall areas.

II Harrowing

Harrows are used for shallow cultivation in operations such as preparation of seed bed, covering seeds and destroying weed seadings. Harrows are two types i.e. disc harrow and blade harrow.

Disc harrow

It consists of a number of concave discs of 45-45 cms in diameter. Discs are smaller than disc plough, but no are more, which are filted 15 cm apart on axles. Two sets of discs are mounted on two axles. All the discs revolve together with axles. The discs cut through the soil and effectively pulverises the clods.

Blade harrow

It is used for removal of weeds and stubbles, crussing of clods, working of soil to shallow depth, covering the seeds, intercultivation and groundnut harvesting etc., Blade harrows are 2 types

i) Indigenous blade harrows : It is known as 'Guntaka' consists of a beam to which two pegs are attached at the ends. A blade is attached to these two pegs. Two shaft poles and a handle are other parts depending on the beam length and weight, this again have two sub types i.e. pedda guntaka and Guntaka.

Pedda Guntaka : is a blade harrow with a heavy beam of 100-120 cm length. It is used for summer deep harrowing to control weeds.

Guntaka or blade harrow : is smaller than pedda guntaka. It is used for removed of weeds and stubbles and covering crop seeds.

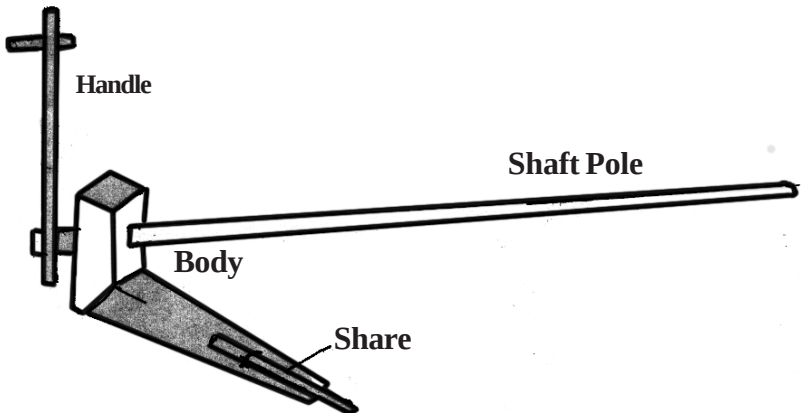
ii) Improved Guntaka : Indigenous have the problems of clogging and lack of penetration in to hard soil. When weeds are more, they twist round the blade and subsequently, the blade can not cut through the soil. Soil and clods do not pass through the blade harrow. To avoid this R.E guntakas and H.M. guntakas developed. R.E guntaka was developed by research engineer at coimbatore. Blade is fixed at angle, whose angle can be changed to get required depth.

H.M. guntakas developed by hils on and munro. Depending on the length of blade these are called 0,1 and 2. 0 size is used for intercultivation, while other sizes are used for other purposes.

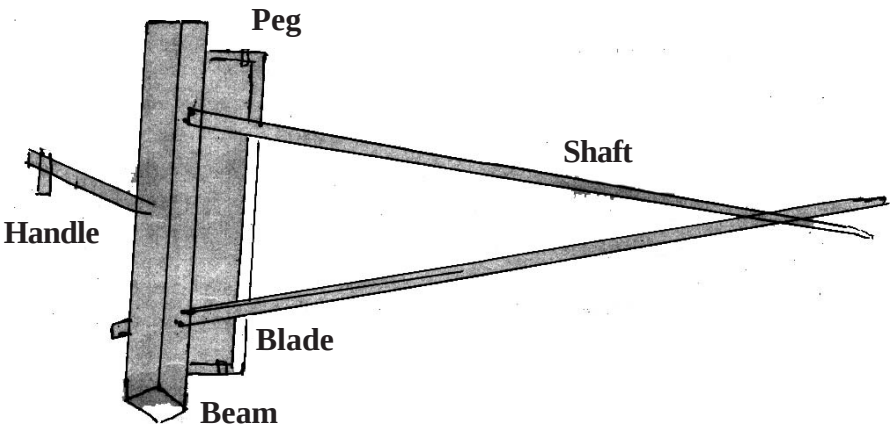
III Planking

Plank is a very simple implement and consists of a heavy wooden beam of 2 m in length. In addition, shafts and handle are fixed to the beams. When it is worked most of the clods are crushed due to its weight. It also helps in microlevelling and slight compaction necessary after sowing.

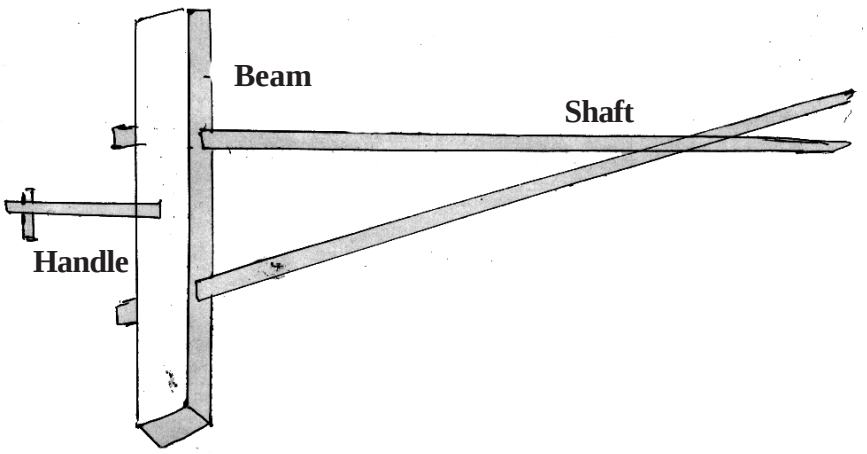
Rollers are used mainly to crush the hard clods and to compact the soil in seed rows.



Wooden Plough



HARROW



PLANK

7.6 CULTIVATION PRACTICES OF

a) Cowpea (Vigna Sinensis)

Cowpea varieties are numbrous differing in habit from erect to prostrate. Cowpea can grown on a wide range of soils, but moist medium loams with p^H range of 5.0-6.5 are the best for this crop. It can also be grown on sandy soils and heavy soils. It can be grown in any month of the year.

Two or three ploughings are needed before beds of suitable size are formed. The seeds are sown broadcast and watered immediately after. Seed rate of 30-40 kg/ha is used. It can also be grown as a mixed crop with maize, jowar or bajra. The seed rate is 15kg/ha.

Irrigations are needed depending on the soil moisture. As a fodder crop, it can be cut in 60-70 days after sowing the yield about 12-15 tonnes/ha of green fodder. Plant protecting measures are needed for cowpea crop such as dusting of B.H.C. 10% powder.

The cowpea fodder is cut and fed as green or preserves and fed as hay.

Sunnhemp (Crotalaria Juncea) :

An erect shrubly annual, 1,2,3 in height with simple, narrow subsessile leaves and bright yellow flowers. It is quick growing and fairly drought resistant. It can frow on wide variety of soils but thrives best on light, well drained loans. Heavy clays and water logged or saline are detrimental of crops.

It is grown both in the kharif and rabi seasons, the actual time of sowing varies according to local conditions. It is grown popularly as a rice fallow crop.

A seed rate of 28-30 kg/ha is used. Seeds are sown broadcast. Harvesting at 45 days (50% bloom) after sowing give good quality forage. The yield is 20-30 tonnes/ha of green forage.

Sunnhemp is a nutritious forage and can be fed as green or as hay. It is popularly used as a hay, storing in alternate layers with rice straw. Feeding of rice straw along with supplementary feeding of sunnhemp hay provides balance diet for cattle and buffaloes.

7.5 GENERAL PRINCIPLES OF IRRIGATION, FERTILIZERS REQUIREMENT IN FODDER PRODUCTION :

Like many field crops, most of the fodder crops are also season bound. They perform well only in a particular season. The requirements of all the fodder crops are also not similar. They differ very widely. The fodder craps and their varieties have to be selected for any particular situation after carefully considering various aspects such as season, soil, availability of resources like irrigation water, manure and fertilizers, credit etc. apart from other things like number and type of the animals, their nutritional requirements.

Green and dry fodders and available from two different situations I.Cultivated fodder Pasture lands.

IRRIGATED AREAS

Crops intensification through inter cropping as well as sequential cropping is possible in irrigated areas. It is also easy to cultivate perennial fodders when there is adequate irrigation. The following are some of the productive cropping systems for irrigated areas.

S.No	Kharif	Rabi	Summer
1.	Surghum / maize / Bajra + cow pea / lab - lab	Maize + Cow pea	Maize + Cowpea
2.	Amaranthus	Berseem /Oats	Cow pea
3.	Sorghum / maize / lab - lab	Maize + Cow	SSG 59.3 + Cow pea

FERTILIZERS REQUIREMENT :

Name of the crop	**Fertilizer**	**Irrigation**
Jowar	Farmyard manure 20-25 tonnes N-60 kgs (2 doses) P_2O_5 - 30 Kgs K_2O - 30 Kgs.	4-7 1-2 (rainfed)
Cowpea	Farmyard manure 10 tonnes N-20 kgs P_2O_5 - 40 Kgs K_2O - 30 Kgs.	3-4 (summer) 1-2 (Kharif)
Lucerne	Farmyard manure 20 tonnes N-20 kgs P_2O_5 - 80 Kgs K_2O - 30 Kgs.	8-10 days Intervals

Pillipesar (Phaseolus trillobus)

This is a popular legume of the rice growing tract, grown primarily as a rice fallow crop to enrich the soil and obtain good fodder. IT comes up well on all types of soils, from sandy to heavy black soils. It is anannual blooms of some four to five months duration. The land is given 2 to 3 ploughings and the seeds broadcast at 17 to 20 kg/ha when there is sufficient moisture in the soil. As a rice fallow crop, seeds are broadcast in the standing rice crop prior to five to six days of harvesting.

One or two irrigations will improve the growth of the plants. It can be cut at flowering stage and fed green or converted into hay or grazing may be allowed.

It provides a good leafy nutritious forage for livestock.

Berseem or Egyptian Clover (Trifolium alexandrium)

It is one of th emost important fodder crops and has been rightly been described as the king of fodders. It is highly esteemed fodder which has a special place in Animal Husbandry programmes throughout the Indian subcontinent. Though a migrant from Egypt it has established in this region for the last 60 years and may well be considered as a native of India. It has many desireble qualities. Ten to fifteen kg of fodder alone with straw constitute a maintenance ration. it can support growth and milk production on adlib feeding, balanced by straws. It does not tolerate acidic soils but grows in other kinds of soils except usar lands.

(i) Time and method of sowing. The crop is sown from middle of September to end of October in plains and from middle of August to first week of September in hills. This crop requires a thorough preparation of land. After harvesting of Kharif crop, the field is to be ploughed once with mouldboard or disc-plough which should be followed by two or three harrowings and finally completed by planking.

For satisfactory results a big plot is divided into number of smaller plots for convenience of irrigation. If the crop is cultivated for the first time, inoculation with bacterial culture is necessary. The seeds are inoculated just before sowing and the inoculated seeds should not be exposed to sun.

Berseem is now available in another form called Giant berseem . The advantage of giant berseem is that lesser irrigation is required. While the seed rate of ordinary diploid berseem is 20-25 kg that of giant berseem is 30-35 kg per hectare.

It is sown by broadcast which is then followed by irrigation.

(ii) Manuring and irrigation. Like all legumes it requires phosphatic manures. An application of 150 kg of ammonium sulphate or Kisan khad along with 500 kg of superphosphate per hectare at the time of sowing is necessary for good yield.

It requires irrigation after every 10-12 days in early winter and 15 days during the full swing of winter. After every cutting the crop is normally irrigated.

(iii) Yield and nutritive value. The crop is ready in 55-60 days after sowing for the first cutting. Subsequent cuttings are taken at 30 days interval during winter and spring. In all 5 to 6 cuttings can be obtained up to middle of May. The total yield obtained may vary between 500 to 600 quintals per hectare. For taking the seeds, plots are left uncut after February and in that case 4 to 5 qunitals seeds per hectare may be obtained. Though tetraploid berseem has been considered high yielding, but the trials conducted at UP Veterinary College, Mathura did not show any difference in yield between ordinary berseem and so-called giant berseem or tetraploid berseem.

b) Lucerne (Medicago sativa)

It is a perennial crop. Once grown it continues to supply nutritious fodder for 3-4 years. It is sown both as an annual and perennial crop. The crop is generally grown in irrigated areas of dry tracts and gives yield in well drained sandy loam soils.

(i) Time and method of sowing. The best time of sowing is between early October to end of November. The land should be prepared thoroughly like that of berseem. The seed rate is between 15 and 18 kg per hectare. it can also be sown like berseem by broadcasting. It does not, however, require culture as is the case with berseem. The lucerne canalso be sown on the boundaries as well. When the seeds are sown, the field is irrigated immediately after sowing. Another method of sowing specially when the field is not properly prepared is to fill the land first with water and then the seeds are sown by broadcasting. This operation is followed by planking.

(ii) Manuring and irrigation. An application of about 100 kg of nitrogen (500 kg of ammonium sulphate) and 100 kg of P_2O_5 (700 kg of super phosphate) gives the best yield, per hectare. It is better if half of the nitrogen requirement is met with compost of Farm yard manure and the other half with ammonium sulphate or Kisan khad.

Irrigation depends upon th eclimate and soil conditions. In summer, it is required after every 10 days and in winter (when taken as perennial) after 15-20 days. Usually after every cutting the crop should be irrigated.

(iii) Yield and nutritive value. First cutting is ready after 2-21/2 months of sowing. During rainy season its growth is affected by other monsoon grasses. After rains when soil is dried-up, it is harvested or else there are chances of roots coming out while harvesting. If taken as a perennial crop it may yield up to 1000-1200 quintals/hectare, when taken as an annual (up to June), the yield is 700-900 quintals/hectare.

This is a productive fodder which can support not only growth but milk production up to 8 kg when fed ad lib. Experiments at the UP Veterinary College, Mathura have shown that Haryana calves grow at the rate of 0.5 kg per head per day on this fodder alone without any concentrate supplement. Experiments at IVRI have shown that like berseem it can also support 8 kg of milk yield in the cows and buffaloes when fed ad lib.

Field beens (Dolichos lablab)

It is a vigorously growin gannual legume. Its vines attain a length of 3-5 m. The leaves are trifoliate with large ovate leaflets. The flowers are white.

It may be grown under rainfed conditions and requires hot and humid climate for its preliminary growth. it grows in every type of soil even under neglected conditions. The seed rate is 15-20 kg per hectare. The yield is about 130 quintals of green fodder per hectare in one cutting. The second cutting of the crop may also be obtained if it is irrigated once. When irrigated during the dry season it may produce sufficient fodder.

Besides its high yielding capacity D. lablab var. lignosis is more palatable and a productive type of fodder like other legumes. It can also be converted into excellent quality hay.

There are many varieties of D.lablab. One of these is an Australian strain Rongali which is a prolific yielder.

c) Jowar

Popular Varieties : M.P. Chari, CO-27, S.S.G. 59-3 X 989.

Cultural Practices : It has juicy stems, high tillering and ratooning ability and hardliness.

Land is prepared well to fine tilth. Farm yard manure of 20-25 tonnes / ha is applied. n, P&K of 30:40:20 is applied as basal dressing, seed rate is 40 kg / ha a spacing of 30 cm between the rows and 15 cm within the rows should be followed. 30 kg N is applied as top dressing after 30 days of sowing.

Irrigation is to be given at every 15 days interval. The crop should be harvested at 60-70 days after sowing (Flag) leaf stage to 50% flowering stage. Subsequent cuttings can be taken at 40-50 days interval. Yield of 50 to 70 tonners / ha of green fodder obtained in 3 cuttings.

Maize

Popular high yielding variety : Africen tall maize. It can be grown on all types of soil, but the performance will be best in sandy loans with good drainage.

Warm climates with fairly high day temperatue suit the crop ideally. It can be grown all round the year yielding as many as four crops a year (the crop gively single cutting only).

It can be raised as a pure crop as well as in mixture with some legumes. As a pure fodder crop the seeds can be sown in rows 30 cm apart continuously in the furrows. Seed rate is 15-40 kg/ha.

When sown in combination with legumes with cowpea, seed rate of 30 kg is enough and 15 kg cowpea seeds can fill up the rest of the area.

The crop should be irrigated regularly. As basal dressing 50 kg/ha is to be applied for the fodder crop.

For seed purpose, seed rate is 12 to 15 kg/ha. The crop is to be sown 30 to 40 cm apart in rows 60 to 70 cm away from each other. The fertilizers dosage is also more for a seed crop. Besides a basal dressing of 60 kg N and 50 kg P, two to dressings of 25 kg N should be given per hectare.

The plants can grow to 5 m. in height and with long and broad leaves. it can yield up to 60 tonnes and fodder / ha. For best yields both in quality and quantity, the crop should be out when it is 70-75 days old. Seed crop peaches maturity in 110 to 120 days.

Bajra (Pennisetum typhoides)

Sandy loam to clay loam
Mer.-Aug. (N) Feb. -Nov. (S)
10-12 (rais-fed)
30-40
50-60
Farmyard manure - 10-12 tonnes
N-40 kg
P O -30 kg
K_2O_5-20kg
2-3 (summer)
50-60
2-3 cut at 30-35 day intervals 300-400
Annual

d) Para grass (Brachiaria mutica)

Loam to clay loam, waterlogged and moist
Mar.-Aug. (N), Feb.-Nov. (S)
(i) 27,780
60 X 60 cm, 50 X 60 cm
Farmyard manure - 25-30 tonnes
N - 40 kg after each cut
P O -30 kg
2-3
1st cut-80-85 days subsequent cuts 30-35 days
4-5 (N), 10-11 (S)
2,000-2,500 (S), 1,500-1,750 (N)
Perennial

Guines (Panicum maximum)

Loam to clay loam
Mar.-Aug. (N), Feb.-Nov (S)
3-4 lag. or 20,00 rooted slips
1 m X 50 cm
Framyard manure - 20-25 tonnes N-30-40 kg after each cut
P_2O_5 -30 kg
10-15 day intervals, except during the monsoon
1st cut 70-75 days, subsequent cuts at 40-45 days intervals
5-6, 10-11
750-850 (N), 1,500-1,600 (S)
Perennial

Hybrid Napier Grass

To increase the yield of fodder and nutritive quality, several hybrids were evolved between Napier grass (Pennisetum purpureum) and bajra (P.Typhoides) grass.

Eg : Pusa Giant napier, NB_{21}, BN_2, CO-1, Cumbu-Napier hybrid, Brazilian Napier, etc.,

Pusa Giant Napier Grass was evolved at Indian Agricultureal Research Institute, New Delhi in 1961. It yielded 2,835 quintals of green fodder per acre i.e. nearly two and a half times as much as napier grass grown under identical condition.

Climate & Soil : Well drained, fertile loamy are best. It can't survive in water-logged fields.

Propagation : It does not produce viable seeds. hence it has to be propagated only vegetatively by planting root slips bearing a live, healthy bud or stem cuttings each with three nodes.

Cultural Practices : Prepare field by polughing four to six times. Being a heavy yielder hybrid napier requires liberal manuring (Farm yard manure / chemical fertilizers). 250 quintals of FYM / ha as basal application and 2.25 Q of N/

acre is to be applied as top dressing fifteen days after each cutting in a year. Form small plots to facilitate irrigation. Irrigate the plot and the slips are planted at an angle of 45 in 60 cm X 60 cm spacing between rows and plants. Slips required are 10,000 slips / acre. Provide irrigation as per the need.

Two or three interculturings may be necessary to keep down woods while the grass is getting established.

Yield : The first cutting can be taken from a newly-planted crop after three months and sebsequent cuttings at six to eight week intervals except in winter when growth is slowed down. Under favourable conditions of manuring and irrigation over 1,500 quintals of grown fodder per acre per annum have been recorded. It is necessary to replant the grass freshly after the fourth year.

Nutritive value : Hybrid napier grass is nutritious and contains 5-7% protein with calcium and phosphorus in proper balance and in adequate quantities. It should be cut and fed when young, otherwise fodder tends to get coarse if left to long in the field leading to much wastage of fodder and becomes poor in quality also. Always cahffed fodder should be supplied to animals for optimum utilization. The growth fodder can also be used for silage making.

It contains 25% more protein and 12% more sugars then Napier grass. The leaves are larger and greener with less serrated leaf margins and softer loaf-sheaths. It is also more juicy and succulent at all stages of growth. Oxalate content is lesser.

CO-1 (Cumbu-Napier Hybrid grass) : It is better yielder than the existing varieties BN2 and NB 21. This variety can yield 400 tonnes of green fodder per hectare a year.

Life period of this grass is more than 10 years. Multiplication is by rooted slips. Mutured stem portion can also be used as propagating material.

The first harvesting will come in 70 days and subsequent ones at 40-days intervals.

At the ahrvesting time, eathing up of the ridges along with N application at the rate of 100 kg / ha will keep the crop going well for 10 years.

This variety produces more leafy portion than the fibrous stem protion. Digestibility is 58%. CO-1 can produce 10-15 tillers which are uniform in growth and size at the harvesting time.

The higher micronutrient content like copper and iron and minerals such as magnesium and calcium increases the milk fat content and total solid matter.

Cultivation of this grass in 40 cents can meet the fodder requirement of four milch animals throughout the year.

e) Stylosanthes-hamata (Stylo-hamata)

Suitability : It grows well in regions with rainfall of 450-850 mm annually, the legume can be grown in many kinds of soil and does well even on sandy loam types with low fertility. It is capable of extracting last phosphorus reserves out of the soil.

Time of sowing : June to August (rainfed crop),
January to May (with irrigation)

Seed rate :

4-6 kg/ha for line sowing with 30 X 15 cm spacing. 8-10 kg/ha for broadcasting.

Establishment :

Plough the land thrice to a good tilth. Apply 10 tonnes of F.Y.M/ha before last ploughing. Fertilizer dosing is as per soil test recommendations or the blanket rule of 20:60:15 kg NPK/ha (Urea -44 kg, superphosphate-375 kg and potash 25 kg) as basl dose.

It is non-specific in the rhizobium requirement and nodulates freely. requires hot water (85^0C or 5 minures) treatment before sowing in order to damage the hard seed coat and to ensure better germination. Seeds should be sown within a depth of one cm as they are very small and deep soil coverage affect germination. Rainfall of 20mm can suffice for sowing. Work done at I.G.F.R.I, Jhansi revealed that treating stylosanthes seed with Bavistin0.2% control anthracnose desease (collectotrichum gloeosporioides) resulting in better

germination. For quick and better establishment a nursery can be raised and can be transplanted on the onset of rains.

Weeding may be given 45 days after sowing. The plants grow well and covers the soil surface in 60 days. This checks the weed growth and also conserves moisture for long periods. Plant protection measures are not needed since it is free from pests and diseases.

Yield :

The first cutting can be done 75 days after sowing or at the 50 percent flowering stage. Subsequent ones can follow at 45 day intervals with good rains. Yield cruing the first year is 20-25 tonnes of green fodder/ha and 30-35 tonnes subsequently.

Management :

Both flowering and seed shedding takes place simultaneously. Resowing is not needed for later years. Ratooning is maintain stylo pasture for more than five years with a single sowing. If grazing is allowed, grazing management is essential to stmulate the production of new leafly shoots and to avoid deterioration in pasture yield. After each cutting apply 2.5 tonnes of FYM/ha during rains to ensure good results.

Stylo is a good protein our forage to animals as it contains 15 to 18 percent of acude protein, The green fodder can be conserved as hay and fed to animals during lean periods.

Stylosanthus Scabra (Stylo-scabra):

It is a high yielding drought tolerant legume fodder suitable to watershed areas. It is an erect thick stemmed perennial small shrub. It grows even upto 2 m in height. It is more drought resistant plant than S. hamata. It can yield green fodder even in regions with low rainfall of 325-6000 mm/annum. Since it is leguminous, it can improve soil fertility by fixing the atmospheric nitrogen.

This legume forage comes up well even on very poor soils, hill slopes and waste lands. it grows favourably well in moderately saline soils as well. It also grows even without any rhizobium inoculation.

Siratro (Mactoptilium atropurpureum):

Siratro is also a drought tolerant legume fodder suitable for low rainfall dry regions. (400-1200 mm rainfall/annum). It can be cultivated in all types of soil quite successfully round the year. Howerver, sowing during the monsoons is recommended as it helps in easy germination and establishment.

The plant is speading and twining type. it can improve soil fortility by fixing the atmospheric nitrogen.

Time of sowing : June - July (rainfed crop)
February - may (irrigated crop)

Seed rate : 8-10 kg/ha to be sown in lines with 45 cm spacing.

Establishment :

Plough the field to good tilth. Sowing should be done in well prepared beds at shallow depths. The row spacing must be 45 cm with continous seeding in each.

As a basal application, 50 kg N, 75 kg P and 40 kg K, can be applied in irrigated conditions. For a dry crop half of this will suffice.

Since these crops cover the top soil, no wedding or after cultivation in needed.

Plant protection measures are not needed. For irrigated crops, irrigation once in 15 days will ensure a good yield.

Yield :

The crop is ready for the first harvest 90 days after sowing and the subsequent harvestings can be had in 454 to 50 days. In dry conditions, the frequency of harvesting is delayed due to a slower growth rate.

After each harvest, 15 kg p/ha should be applied to activate growth.

The yield of green fodder is 15 to 25 tonnes/ha annually.

f) Anjan Grass

Synonyms : Dhaman grass, Kusa gaddi, Anjan grass.

It is an indigenous, perennial, tufted pasture grass 15 to 40 cm in height. It is commonly seen in dry areas. It comes up best on calcarious red soils.

Seed rate : 5-7 kh/ha

Establishment

Soaking of seed infesh water for 8 to 10 hrs before sowing gave better germination. Broadcast the seed on a well prepared soil. Line sowing may also be followed. For planted crop, nursery is raised using 1 kg seed percent and the seedings are pulled out at 20-25 cm height (3 weeks old) and transplanted in the field on rigges made at 45 to 60 cm apart, Ammonium sulphate and superphosphate are applied 112 kg/ha. For raising a pasture, 18-30 kg/ha of sed is broadcast with monsoon rains with proper manuring.

Yield :

First cutting is taken at 90-100 days after sowing. Irrigated crop yields 22-30 t/ha in 10 cuttings in a year. Rainfed crop yields 9-10 t/ha. It can be used for grazing as well as a cut fodder.

Rhodes Grass (Chloris gayana)

It is an excellent perennial grass and is native to South Africa. It grows luxuriantly and covers large areas and thus helps in checking soil erosion. It contains 6-9 percent protein and thus a maintenance quality roughage. This grass is reported to be useful in reclaming saline tracts.

The seeds of this grass are light and difficult to sow evenly. It may be mixed with about double its weight of saw dust and sown through a grain seed drill. It should not be sown deeply. Braodcasting into a prepared surface and rolling in May gives best results.

If sown, about 8-10 kg of seeds are required per hectare. The sowing season is either spring or monsoon. It gives an yield of about 450-600 quintals of fodder in 5-6 cuttings per year. The grass also spreads by means of running branches which root and produce tuft at every node.

g) Subabul - Leguminous fodder tree

Subabul plants can be raised as a live bund. The live bund should be laid out across the slope at an interval of 25 to 30 metres depending upon land gradient. All the agronomic operations should be carried across the slope of land. Soon after the rains, the pretreated subabul seeds should be sown on either side of the bund. The branches should be lopped restricting the height of plants to 45 cm from ground level.

Advantages

1. Helps in conserving soil and water.
2. Supplies protection leafly fodder, pods and seeds
3. Fallen leaves enriches the soil fertility.
4. Yields of cereals and oilseed crops increase by 30-40 percent over the control.
5. Bund remains as a perment feature in the farmers fields.

Avisa (Serbania grandiflera)

It is grown in Asian and African tropics. it grows strait the leaves are rich in protein. The fodder in suitable for ruminants it is apopted to wet areas and loose soils. It is perennial which grows to a height of 10 ft. These trees are generally used as supporting for Betalvine climbers. These trees can be planted on the boundaries of the fields, in the cattle yards etc to serve as a shade cum fodder producing plants. The space between trees should be 3-4 metres.

Hedge Lucerne

It is a protein-rich legume fodder. This plant will become woody, if it is allowed to grow tall. Hence it has to be clipped off when it is 10-12" height to obtain good quality tender green fodder.

Time of sowing

It can be grown all through rainfed crop, it flourishes well when sown between June and October.

Seed rate

15 to 20 kg/ha for line sowing with 50 cm of row to row spacing.

Establishment

Plough the field to obtain fine tilth and form ridges and furrows at 50 cm apart. Apply 15-25 tonnes/ha of FYM at the last ploughing and N.P.K. at 10:60:30 kg/ha by opening a furrow 5cm deep beside the ridges. Seeds are sown in lines at a depth of 1 cm in solid stand on the side of the ridges over the lines where fertilizers are applied.

Nursery can also be raised and seedings may be transplanted. Irrigate the field once in a week or depending upon the weather conditions. It is resistant to pests and diseases.

Yield :

First harvest can be done at 50 cm height (70-80 days after sowing) and subsequent cuts at every 40 days upto 125 tonnes of green fodder/ha/annum are obtained. *(at the same height) with irrigations kidds.

Hedge lucerne can be grown both as a pure and mixed crop. As a mixed crop, it can be raised with hybrid papier grass at 1:3 (one row legume and three rows grass).

7.7 SILVI PASTURE - HORTIPASTURES

Selvi pasture system of forage production involves growing of multipurpose nitrogen fixing trees with added fertility resources on waste lands along with grasses and legumes.

Grasses will conserve the soil and moisture the legumes benefit soil by nitrogen fixation and in the mixture they ehlp growth of grasses and trees besides improving the forage quality. Trees and bushes besides providing fire wood and timber, supply fodder during lean period. The system work well with improvement land productivity by 2.5 times compared to the traditional system at use. After 5 years grazing could be allowed thus reducing the cost of the grass harvesting.

The trees selected for these system should be fast growing, hardy with multiple use with the rural population.

In areas no grasses are available in the fields are plouged and grass seed may be spread and fertilizers are applied to encourage grass growth.

In areas where potential grass are present introduce legume varieties.

Proper utilization is known to be the most important management factor influencing productivity and sustenance of a grass land. Therefore utilization andmanagement has to be so manipulated that it allows sufficient time to the plants to rebuild their roots preserve as well as the forage is available for longer periods continuous grazing or rotational grazing system may be followed depending upon the type of grass grown. Besides practicing grazing of grass lands their harvesting for stall feeding in lean periods is also important for the efficient management of grass lands. In many sutdies it is reported that the grass lands can be harvested at every month interval at 10-15 cms height during growth periods.

The grasses should be of high quality highly productive, long duration with high palatibility. The legmes should be hardy, palatable, nutritious with strong regeneration through roots or self seeds for semi arid and dry tropics species like acacia and subabul trees are recommended. In saline conditions species like dichrostachys cinerea and prosopis, juliflora are recommended. Under grasses species like cenchrus ciliaris, cichanthium annulatum are recommended for dry areas and for saline areas brachiaria mutica is recommended under legume varieties.

Horti Pastures

Horti - pastures are one of the numerous agro-forestry systems aimed at utilizing the limited resources (land and water) more efficiency. In this system fruit trees such as mango, guava, cashew and other orchards species like coconut, rubber are cultivated with pasture grasses occupying the inter spaces. The important grass species that can be used for pasturing in orchards include anjan grass (Cenchrus ciliaris), guinea grass (Panicum maximum var. trichoglume) stylos stylosanthes hamataor S. Seabra) etc. The pasture species should be chosen in such a way that their requirements for growth match with that of the orchard species, and at the same time they are not competitive to the trees. The recommended techniques and management practices should be adopted to establish and grow the pasture species. Depending upon the growth of pastures and the conditions of the tree species the grass can be either cut or allowed for grazing. In the present day circumstances, rearing of sheep with the help of the pasture component in horti-pasture systems appears to be more enterprising and economical.

Some suitable examples of horti-pastroval system are grass and stylos - in mango orchards grasses and clovers - in apple.

Blue panic grass + siratro	
Or	in cashew orchards
Cynodon + stylo	
Deenanath grass + Horse gram -	is also in cashew
Guinea grass or ruzi grass + stylo -	In coconut orchards
Stylos in citrus orchards etc.	

7.8 LAYOUT FOR FODDER FARM :

Layout of farm refers to the manner in which a farm is divided into fields and location and arrangement of other fixtures such as irrigation and drainage system, buildings and sheds, roads, fencing etc. The layout helps to obtain a high level of efficiency. Most of the Indian farms have no scientific layout worth the name. In some places there is not approach road at others too much land is wasted along the road side. At some places no provision for drainage is made and at other the soil is getting eroded. Fields do not have any regular shape layout directly affect.

a) Cost and efficiency in the use of man, power, bullock power and machinery.
b) Cost of efficiency of irrigation, drainage and fencing.
c) Cropping plan and profitability of farm business as a whole.

The following factors offer a general frame work for a good farm layout.

1. Purpose of farm
2. Topography
3. Variation in soil fertility
4. Size of the farm
5. Livestock kept
6. Cropping scheme
7. Irrigation and drainage problems
8. Building structure. ,
9. Farm communication -Situation - road and field paths.

A good farm layout should ensure.

Small number of good sized fields

- Rectangular fields
- Minimum area under building, roads, and water channels
- Access to every field
- Minimum fencing cost
- Uniformity of the soil with in a field and within major blocks
- Efficient arid economical irrigation and drainage system

An efficient layout is the one which takes into consideration the topography of the land, fits in well with the enterprises and crop rotation' leads to the savings of labour and ensures efficient checks and control on the farming operation.

Layout of the fields : the following paints should be kept in view while planning the layout of the fields.

1. The size, shape and location of fields should fit in with the rotation and layout of the land.

2. On a level land, a well laid out farm is the one that is divided into small no. of large fields. The number of main fields or blocks should either be equal to the no. of year in the rotation or a multiple there of so that they may be easily adjusted to the cropping rotation to be followed. A field rectangular in shape is considered to be better. III - Shaped fields waste much of the labour, time and resources.

3. As far as possible, a field should be uniform in soil type and level. Recommonded size of fields are -one acre land in case of bullock operated and 10-15 acres in case of tractor operated farm.

4. On a slopping land, the layout should-be planned with the object of checking or reducing soil erosion and conserving the soil. The fields should extend along the counter, instead of, up and down the slope.

Roads : Key approach roads, of course have to be there on the sides of the farm. Main approach road from the highway to the farmshed should be wider 15-20' and other linking roads may be kept narrow between 9-10'

Water Channels : Layout of water channels depends upon the source of irrigation. Each field must be connected with water channel without any duplication. A tube well or any other water lift should be installed at a higher point in order to facilitate an early flow of water to all the fields in, the commanded area.

Drainage : Provision of drainage is essential in any scientific layout. It depends upon the level of the land as to where and on which side of the farm drainage channels should be provided. If the land is of high level, the low level roads and water channel can serve the purpose.

Fencing : Fences are essential investment on a farm, but their type and extent depends upon the location of the farm as well as the type of the farm. Kaccha wall, pucca brick, shrub fensing such as sarkanda (Reeds) thore (cactus) Dhaincha, sadabahai, or barbed wire with wooden, brick concrete or iron poles, best barbed wire with angle iron poles. Layout should be easier for remodelling layout.

SUMMARY

This study of different soils suitable for various crops were studied very much. The system of crop rotation to increase the fodder production was explained. The importance of green fodder feeding for economic milk production was discussed. Cropping programs were prepared for different seasons in a year. The various fodder crops commonly cultivated were discussed for their yield, seed rate, fertilizers etc. The layout principles for fodder farm were explained.

SHORT QUESTION

1. Which soil is preferred for Berseem production?
2. Which crops can be cultivated in water logged are Define crop rotation
3. Give two examples for crop rotation ?
4. Give one cropping program for summer season.
5. What is yield of paragrass per acre?
6. Which fertilizer is recommended for Napier grass ?
7. Give the yield of Napier grass per acre ?

LONG QUESTION

1. Briefly write about various soils preferred for fodder cultivation ?
2. Explain crop rotation system ?
3. Briefly explain the importance of green fodder for economic milk production.
4. Prepare cropping program for a year ?
5. Explain about layout for fodder farm ?
6. Write in detail the cultivation, yield, seed rate and fertilization in the following crops?

    a) Napier grass
    b) Maize
    c) Para grass
    d) Cow pea

8. FODDER CONSERVATION

8.1 Chaffing of fodders - Advantages - Disadvantages

Chaffing :

Making the fodder stems or leaves into pieces by manual or mechanical means is known as chaffing. Manually cutting the roughage fodders in to small peices manually with the help axe or knife is known as manual, chaffing,

Mechanical : There are two types of chaff cutters.

1. Hand operated chaff cutter.
2. Electrical chaff cutter.

For small quantities or chaffed material a hand operated chaff cutter is used and for large quantities an electrical operated chaff cutter is used.

8.1.1 Advantages of chaffing

1. The stems of grass can be made into pieces of any small size.

2. The leafy material and tender part of fodder shoot is eaten away by the animal and the thick or hard stem is left, which goes waste. By this chaffing whole plant or stems are fully consumed by the animal

3. While eatingrim the man ger the un-chaffed grass or fodder is wasted by throwing it in the surroundings by the animal. The chaffed pieces are sompletely eaten by the animal.

4. Chaffed material can be packed in bags.

5. The chaffed fodder consumes less space for storage.

6. Feed additivesor other feed supplemts can easily mixed with the chaffed fodder.

7. The leafy portion, shoots and stems pieces are mixed while chaffing, hence it increases the palatability of the fodder.

8.2 Improvement of low quality roughages and non conventional feeds

Grinding of roughages like straw decreases the digestibility but increases the intake. The chaffing of the straw also increases the intake by the animals. Soaking of wheat straw increases the intake of dry matter by the animals but has no effect on the digestibility of the nutrients. Soaking of paddy straw removes some of the soluble oxalates and may improve the nutritive value of straw. The alkali treatment of straws has been dealt in detail as lot of work has been done in this country on this particular aspect.

(a) Alkali treatment of cereal straws.

The straws in general form the basal roughage in India. They do not contain any digestible crude protein and are poor in energy, minerals and vitamins. The only advantage of straws is that they containlarge quantities of complex polysaccharides like cellulose and hemicellulose which are poorly digested because of the complex formed with the lignin. Therefore manyu efforts have been made to improve their digestibility.

A considerable amount of work was done at the Indian Veterinary Research Institute, Izatnagar to improve the nutritive value of straws. In these investigations two types of cereal straws, namely, wheat and paddy were treated with dilute solution of caustic soda (1.25 per cent) in which straws were soaked overnight. The excess alkali was washed with water. The results indicated that alkali treatment of straws resulted in a significant loss of dry matter varying between 25 to 30 percent. There was a loss in crude protein, ether extract, total ash and nitrogen free extract content of treated straws; consequently the crude fibre content was increased.

The digestibility of the treated straws was improved. The digestibility of total carbohydrates was improved by about 30-35 percent. Consequently the total digestible nutrients in treated straw was also improved. Though the protein digestibility in the treated straw was reduced but the utilisation of protein was improved.

In the case of paddy straw the general trend with regard to loss of dry matter and improvement in the nutritive value was the same as of wheat straw. The paddy straw is rich in oxalates, the major portion of which is present in the form of soluble potassium oxalate; a small faraction is present in the insoluble

ration. At central Institute of Research on buffaloes, high producing buffaloes are fed with urea treated straw when green fodder is not available.

(e) Bio-degradation of Fibrous Crop Residues.

Fungi like phanerochaete chrysosporium, Dichomitus squalens, etc. have been used to degrate lignin content in the straw and increase the dry matter digestibility. The treatment leads to a loss of dry matter also. Spent straw from mushroom cultivation could be used for feeding. Its protein content is increased after mushroom cultivation.

Methods of making silage from straws

In pit silo the bottom and sides of the pit are covered with straw and the cut green fodder crop is staked in layers adding mollasses or jagary sprinkle. In order to compress it thoroughly the material should be trampled and all air from it is excluded. The silage pit is filled upto about 2/3 above ground level and a layer of paddy straw is put and the material is covered wit polythene sheet and to for weight put soil over it. The fermentation occurs in 2-3 months.

8.3 Aims of Fodder conservation - Advantages and disadvantages

With the availability of high fodder yielding varieties of season bound and perennial fodder crops, there is a glut of fodder during the peak periods of growth and scancity during other periods. The best way to regulate the supply of palatable and nutritive fodder during th elean periods of october and novermber and may to july is to conserve the surplus fodder in the form of hay and silage. A similar situation is also experence in the case of grassland species which essentially comprise the mansoon grasses. These grasses give abundant fodder during the mansoon period and summer the forage production is almost negligible owing to their dormancy with the advent of winter and acute moisture stress. Thus it is essential that surplus fodder should be conserved during the period of excess growth, in the form of hay and silage. The need for the conservation of fodder is all the more warranted in th edrought - prone areas, where crop failures are frequent.

Advantages

1. It is less at risk from the weather than hay-making

2. The ensiling process is the only means by which the entire forage plant can be preserved in a succulent form. The crops can be harvested and stored at the time of its development when it has the maximum nutritive value.

3. Retains higher proportions of nutrients than hay because losses due to shattering and bleaching are minimized. Silage preserves 85 percent of feed energy. Hay under best conditions preserves only 80 percent and under poor conditions 50-60 percent.

4. Silage crops have more yield than other hay-crops. Earlier cuttings at higher levels of digestibility is possible and regrowths are quicker. Thus, more feed nutrients can be grown on an acre of crops used for silage than an acre used for most other purpose.

5. The crop can be preserved as silage more cheaply, more quickly and with less labour.

6. Mechanization from field cutting to feeding is easier with silage.

7. It requires less storage space than hay.

8. Fear of fire is a voided

9. Practically any forage crop is fit for ensiling. Weedy crops and crops with thick stalks can be ensiled equally well.

10. Many by-products can be economically used.

11. Where conservation is incidental to or integrated with grazing, silage making is more dependable as a method of cleaning up soiled swards and ensuring aftermath grazing.

12. Converting crop into silage clears the land earlier.

13. It is palatable and slightly laxative.
14. It is a better source of protein and carotene than hay.
15. There is a wider choice of feeding methods for silage.
16. Ensiling ensures better storage for a long time.

Disadvantages

1. Requires silo and special equipment
2. Less amount of vitamin D in silage than hay.
3. Additional expenses are involved for preservatives
4. Due to moisture content, tonnage and transporting charges are increased
5. Wet silage can present difficult problems of disposal of effluent.
6. Smell from poorly fermented silage can create problems.
7. Wastage may be high when only small amounts are made at one time.

8.4 Selection and harvesting of crop for silage

Crops suitable for making silage to be used viz. Maize, sorghum, all green grasses, lucerne, Berseem, cow peas, soya beens, Oats, barley, red clover, lavidoclover etc.

Almost all forage crops are suitable for silage making. Even some crops that are unsuitable as green fodder (or) hay due to bitterness or off flavour are suitable as silage as they appear to lose these qualities during ensiling.

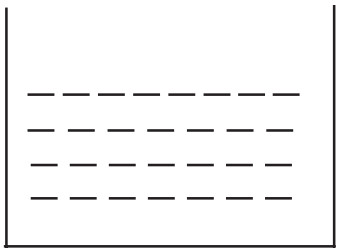
Maize is a popular crop for silage - It yields highly. Besides, at the stage of cutting for ensiling, it possesses the required dry matter percentage and available sugars. Thus normal fermentation is ensured without the addition of any preservation. The fodder can be harvest at 60 - 70 days cutting and yield 20-25 tonne per acre. Three crops can be obtained in a year. Sorghum is

another important silage crop. The sweet sorghum is better for silage than grain sorghum. It should be cut in the dough stage. Grasses and legumes when used for silage are usually reffered to as haycrop silages. Ensiling them requires special methods.

8.5 Design of silage pit :

There are two types of silipits

1) Pit silo
2) Tower silo



A pit of 3 x 1 5 x 1 meter dimension is prepared (or) dug. For 100 quintals of green grass. The bottom and sides of the pits are covered with paddy straw. The silage pit is filled with green fodder upto about 2 / 3 above the ground level and covered top make silage.

Tower Silo:

Tower silo is round, Cylindrical and is constructed above the ground level. The height varies from 5 to 10 meters with a diameter of 10 to 15 meters. The construction of tower silo is expensive. In tower silo the filling of fodder crop material and sealing is the same as in pit silo. The material is well preserved in this.

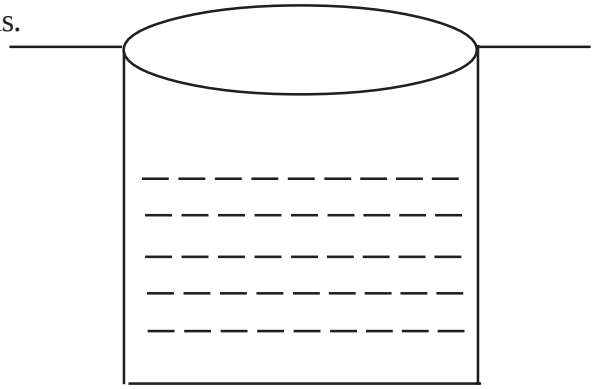


Fig: 8.5.2 TOWER SILO

8.6 METHODS OF SILAGE MAKING

8.6.1. Requisites of Silo :

a) The walls should be unpermeable.
b) Should be sufficiently deep.
c) Must be located in an elevated ground.
d) The size of the silo should be calculated on the basis of the number of animals to be fed and length of the feeding period.

For 100 quintols of grass 3 x 1 , 5 x 1 meter dimensions pit is required.

8.6.2 Silage making:

a) Crops suitable for making silage to be used viz. Maize, sorghum which donot require special treatment (or) preservatives like mollasses (or) mineral acids but almost any green crop can be converted into silage by special method.

b) The crop to be ensiled should contain about 75% moisture.

c) For the preservation of silage, the crop has to be packed will so that there is not air left over in the silo, micro organisms involved in the fermentation desirable in silo. The object of making silage is to promote conditions favourable for lactic acid producing. Micro organism to develop: Therefore for efficient packing the green crop is cut into 1" to11/2" pits by means of chaff cutter then packed layer by layer. After the silo is filled and packed well the top of the silo is covered with a one foot layer of wet paddy straw. This layer is then plastered with clay or clay and cowdung (10: 1) to keep the silo air tight and water tight. (or) a polythene sheet and for weight put soil over it. This will provide necessary compression to the top layers of silage.

If air gains entry into the silo pit yeast fungi and aerobic organisms begin to multiply which will destroy the lactic acid and silage putrifies.

b) Addition of Mollasses :

For grasses 10 - 20 kg per tone.

For legumes 30 - 35 kg per tonne.

8.7 IMPORTANCE OF FEEDING SILAGE TO DAIRY ANIMALS

8.7.1 Characteristics of Good silage

a) A good silage should be yellowish green in colour
b) It should not have strong objectionable odour.
c) It should be palatable to live stock
d) It should have less than 75% moisture.

8.7.2 Advantages of Silage.

1) Silage can be stored in less cubic space than hay.
2} Silage supplies the green succulant roughages through out the year.
3) Nutrition loss in silage making is less than hay making.
4) Silage is more palatable than hay.
5) Silage can be made even in rainy season when they cannot be made.
6) All most all fodder crops can be converted into silage.
7) More number of animals can be maintained on a given area of land when silage is fed when compared to hay.
8) Many undesirable things present in a fresh crop eliminated after ensiling.
9) Fear of fire is avoided.
10) It is less at risk from the weather than hay making.

8.7.3 Disadvantages :

When once silo pit is opened it has to be used continuously.

8.7.4 Importance of silage feeding to dairy anima

a) Green fodder can be kept in a succulent condition for a considerably long period. Silage furnishes high quality forage in any desired season of the year at a low expense. As there is an acute shortage of green fodder during the summer months, silage can meet this deficiency during that part of the year.

b) Grass silage preserve 85 percent or more of the feed value of the crop.

c) It is the most economical form in which the whole stalk of maize or sorghum can be processed and stored on the other hand, a considerable part of this cop is wasted during the courses of feeding in dry condition even if it is of good quality.

d) During mansoon months, preserving food as silage is the only method as it is not possible to make hay.

e) The ensiling process kills practically all weeds that are present in the field because of their harvest before seed formation and there by stopping dissemination of their seeds.

f) It is very palatable feed and slightly laxative in nature.

g) It is a better source of protein and of certain vitamins, especially carotene, and perhaps some of the unknown factors than dried forage.

h) It makes for less waste, the entire plant being c nsumed which is an important consideration with coarse, steamy forages

8.8 SELECTION AND HARVESTING OF CROPS FOR HAY MAKING

Preparation of hay by sun curing depends on the type of crop available and the climatic conditions. Thick stemmed crops like maize and jowar are not suitable for hay making as it will take longer time for the stems to dry. Thin stemmed crops like Lucerne, oates and grasses are suitable for hay making.

The stage of maturity of the crop at the time of cutting is very important as far as nutritive value of the hay is concerned. An early cut means more nutritive value but less yield. Late cutting on the other hand will result in less nutritive value but more bulk.

Legume hays are made out of leguminous plants like lucerne and other clovers. They are rich in proteins, vitamins and minerals. The nonlegurrinous hay contains less proteins, minerals and vitamins. These hay may be from grass.

8.9 METHODS OF HAY MAKING

The fodder crop is cut When 2/3° of the entire crop is in flowering stage. The cutting should be dame in coo! hours of the morning arid protected grass from sun rays. !t is put in small heaps in shade, so that it is easy to take turning process - it is than stacked on an elevated ground. The heaps of the hay is put up to a height of 7 to g meters. Around the heap a channel of 20cm deep and 30cm wide is provided to drain the rainwater. The hay can also be stocked in a well ventilated shed.

Characteristics of Good hay

1 Hay must be leafy. Green to brown in colour.
2. It should heave soft and pliable stems.
3. It should be free from moulds, weeds and dust.
4. It should be palatable and have pleasant smell and aroma.
5. It should not contain more than 20% moisture.

Advantages of hay :

1. Hay is less expensive to prepare.
2. More quantity can be stocked on less space.
3. It is nutrious compared to straw.
4. It is paiafabie and animal eats it greedily.

Disadvantages :

1. It acquires more space, when composed to silage.
2. Vitamin A is less in hay when compared to silage.

8.10 Importance of Hay making :

Hay refers to grasses or legumes that are harvested, dried and stored 85 90? percent dry matter. When harvested in the proper physiological stage of growth and well, cured to 20 percent or less moisture at the tirrie of storing, hay can be utilized as an excellent feed for daily cattle, particularly when fodder is scare or pasturage is insufficient. May contains more nutrients compared to poor quality of straws, as it is prepared before harvesting. So nutrients which goes to grains and seeds are retained. 1n India during mansoon, there is lot of scope far growing of excess of fodder crops. These excess fodder crops can be cut and made into hay which retains most of the nutrients of green grass and can be fed during lean season.

During the time of harvesting there is sudden interruption of the transportation stream. The shutting off the water supply from the roots and a continued evaporation from the leaf surface leads to wiftiny.drying and death. However while the forage is being dried, plant respiratory enzymes activity will continue resulting in the oxidation of some valuable plant nutrients. Some biochemical changes during hay preparation and storage at ambient temperature are 1) Soluble carbohydrates which are highly digestible will be oxidized causing toss of dry matter 2) Total soluble nitrogen of amino acids as opposed to protein nitrogen increases as a result of proteases. 3) Cyanogenic glycosides of Jowar, White cloves and few other forages have been shown to loose their toxicity property during drying which may be due to denateration of the enzymes responsible for liberation of hydrocyanic acid 4) Rapid drying of hay tends to protect the carotene content due to quick inactivation of the concerned enzymes. 5) The exposure of ultraviolet rays of sun converts ergosterol in to ergocalciferol (Vitamin D2) in plants thus the process of hay making by sun drying increases the value of Vitamin D . 6) Hay stored may under go some fermentation which gives silage type of flavour.

On a whole better prepared hay is better than very mature green crops. Nutritive properties of hays are then similar to those of forages. Maintenance ration for all classes of animals can be feeding solely hay. Upto 5 litres of milk production hay can be use of soil feed without any concentrates. Hay is excellent source of cellulose, sufficient ruminant termination, and increase butter fat production.

8.11 Fodder bank use and management of fodder banks.

The livestock in India in general has never been adequately fed. It is estimated that there is a deficiency of 60% proteins and 47 % energy in their rations. If this gap could be covered these animals could yield 30-35 % more milk. In the case of green fodder and dry fodder are also deficiate. Normally the farmers, cattle owners and traders collect available fodder and store it for use in non-producing seasons. During drought years the prices of fodder go up, the farmers are unable to purchase and even they are ready to sell their animals. To solve the above problems, establishment of fodder banks is the only solution. Enough fodders are stored in these banks, they are properly preserved and distributed in such a way that the neady are not exploited.

8.11.A Sources of fodder for fodder banks :

Normally the production of green fodder or straw remains with the owners and a small percentage is sold to others. So we cannot relied upon them for sources to create fodder banks. The main supplies for these -banks can come from grass lands and government owned lands. Where mansoon grasses grow in abendence. These lands can be improved by soil conservation making hay and proper fodder culture. The grasses and hay from these lands could be store in these banks.

8.11.B Management of fodder banks :

The fodder banks should be located in all draught prone areas at different localities, from where the stocks can be conveniently drawn or distributed to the neady even in rainy season. It is better to locate this fodder banks in places where villagers normally comes for other works i.e. at rural markets, mandal head quarters, veterinary hospitals.

The fodder can be procured from the land owners who grow fodders especially for sale and also surplus fodder from cattle owners. The grasses available in the forests can also be used as source for these banks by entering with an agreement with the forest department. Fodder can also be obtained from other surplus fodder banks. The ownership of these fodder banks should be with individuals. It is better to be organized by milk cooperative unions, state departments like forest, agriculture and animal husbandary. The rights to use community lands of forest grasses should be reserved for these fodder banks and they should be charged only in such a manner that the final retail price of fodders is not beyond the reach of any animal owners. Technically qualified persons should be engaged in grass cultivation, preparation of hay and storage. - Old reserves should be disposed first and new stocks 'kept in reserve. In some years these stocks will not be utilized due to rains and so good.

8.12 Preparation of vermi culture from compost :

Earthworms maintained as cultures on organic waste feed on the substrate. The bed material, therefore, undergoes physical and chemical breakdown in the earthworm gut by the action of the digestive enzymes and the residing microbes. The undigested matter is excreted out through the anus as mucus coated granules. The feeding and excretion is a continued process.

Earthworms used in culture tanks consume three- to five times their body weight of material every day. About 5 to 10 % is absorbed into their system for their growth and development and the rest is excreted. The accumulated, excreta of the earthworms has become a value based product in agriculture. Thus, vermicompost is a physically, chemically and biologically degraded organic material produced by earthmorms which consists mainly of digested soil and organic matter. It is rich in all major and micronutrients, such as nitrogen, phosphorus, magnesium, zinc and calcium in simple forms so that the plant root systems can readily absorb them. To the advantage of the common man to understand the practical utility of material in the field of agriculture, it is given the name "Vermicompost".

8.12.1 Rate of Composting

Earthworms like Eudrilus eugeniae, Eisenia fetida and Perionyx excavatus introduced into 8 x 4 x 3 ft. pits filled with 800 to 1000 kg of organic waste will convert much of the added material to compost in 60 to 70 days time. The biomass or total weight of the earthworm population required for this process is about 8 to 10 kg of earthworms. The weight of the finally recovered compost will be 400 to 500 kg by the end of second month. Depending on the number of pits and the number/weight of earthworms ;and availability of waste in the surroundings, vermieompost can be produced to an extent of 3 - 10 tonnes per month on farm land. In other places such as parks, kitchen gardens, etc., as the waste collection is done in tanks, it is advisable to place PVC pipes (2.5 cm diameter) with a series of holes at 30 cm apart into the collected waste. This helps to aerate the waste and remove the bad smell. After filling the tank with waste, 1 to 1.5 cm thick soil paste has to be applied over the waste leaving holes to provide aeration. After two to three weeks of collection, earthworms have to be introduced. This care and attention is essential from hygienic and aesthetic point of view. The quantity of vermicompost produced depends on the nature of the waste product used, species of earthworm and the environmental factors during the process of composting.

8.12.2 Precautions

(i) The tank/plastic tub should be thoroughly cleaned with fresh water before use.
(ii) Grease should be applied all around the tank to prevent the attack of crawling insects onearthworms.
(iii) Proper moisture should be maintained in the bedding waste material during composting.
(iv) Waste material should be placed layer by layer as described in the following procedure.
(v) Water should be sprinkled once or twice a day on the gunny cloth till approx. 25-30 % moisture is attained.
(vi) When compost is ready for composting, sprinkling of water shc vuld be stopped.

8.12.3 Materials Required

(i)Tank made of cement, plastic or wood
(ii) Grease

(iii) Waste oil
(iv) Agricultural waste/Kitchen garden waste
(v) Gardening shovel
(vi) Mason's sieve with pore size 3mm
(vii) Soil
(viii) Cowdung
(ix) Earthworms
(x) Gunny cloth

8.12.4 Procedure

Construct .a cement tank or use a plastic tub. A wooden tank may be constructed using slender poles of Eucalyptus or Bamboo. Tie the poles in horizontal and vertical rows in the form of a tank.

Keep the tank above the ground level so as to prevent infestation of predators.

To prevent entry of ants, a layer of grease or oil can be applied all around the tank. A channel filled with waste oil can also be put around the tank for preventing entry of ants.

Place a 2-3S' thick layer of soil on the surface of the tank.

Fill the tank with waste materials such as leaves, coir from coconut trees, saw dust, rice husk, sugarcane

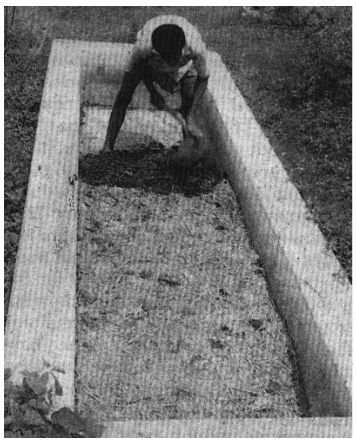


Fig. 8.12.1 Filling of waste material in a cement tank for vermicompost production

trash, wheat straw, etc. over the top layer with loose dry litter or straw to prevent loss of moisture. The straw can be used as a bedding material in successive rounds of composting.

Place a layer of kitchen waste and 1/2 - 1 kg T-8 days old cowdung.

Release about 150-200 earthworms on the piled up waste material.

Cover the material with a moist gunny cloth and leave it for 2-3 months.

Successive vermicompost can be harvested after every 4 to 6 weeks.

Push aside the compost in the tank and collect decomposed compost with any gardening spatula, shovel or hand.

Separate unfed material, cocoons and worms.

Dry the compost in shade for on or two days and pass through a sieve of 3 mm

Transfer separated cocoons and worms back to culture.

Sieve the compost again and dry in shade to remove moisture before packing.

Prepared vermicompost is in the form of a fine loose powder or fine granular dark substance which can be easily separated from the material which is not fed by the earthworms.

SUMMARY

The conservation of fodder is important, as the green fodder will not be available in winter and summer season. There are two methods of preservation that is Silage making and Hay making for better utilisation of fodder it is chaffed and fed to animals and preparation of vermi culture from compost were disgussed.

SHORT QUESTIONS

1. What is Chaffing ?
2. What is Hay ?
3. What is Silage?
4. What are the aims of Fodder Conservation ?
5. What is Varmi compost ?

LONG QUESTIONS

1. What are the advantags and disadvantages of Chaffing?
2. What are the principles of Fodder Conservation and mention the advantages and disadvantages?
3. Draw a neat sketch diagram of Silage pit and write the methods of Silage preparation.
4. What are the Characteristics of the good Hay ?
5. How is Varmi Compost prepared ?

REFERENCES

Text book of Animal husbandary by G.C. Banerjee : Oxford LB.H Publication.

Farm animal management and poultry production by Sastry, N.R.S. Thomas, C.K and Singh. R.A. Vikas, publication.

Characteristics of cattle and buffaloe breeds of India by ICAR New Delhi (1979).

Hand book of animal husbandry, ICAR, New Delhi (1978).

Dairy farming and milk production - C.P. Anantkrishnan & P.N. Padmanabhan. Shri.Laxmi publication, 42 Harelys road,Kalipank, Madras. Forage crops of India. T.R. Narayana and P.M. Dabadhao.

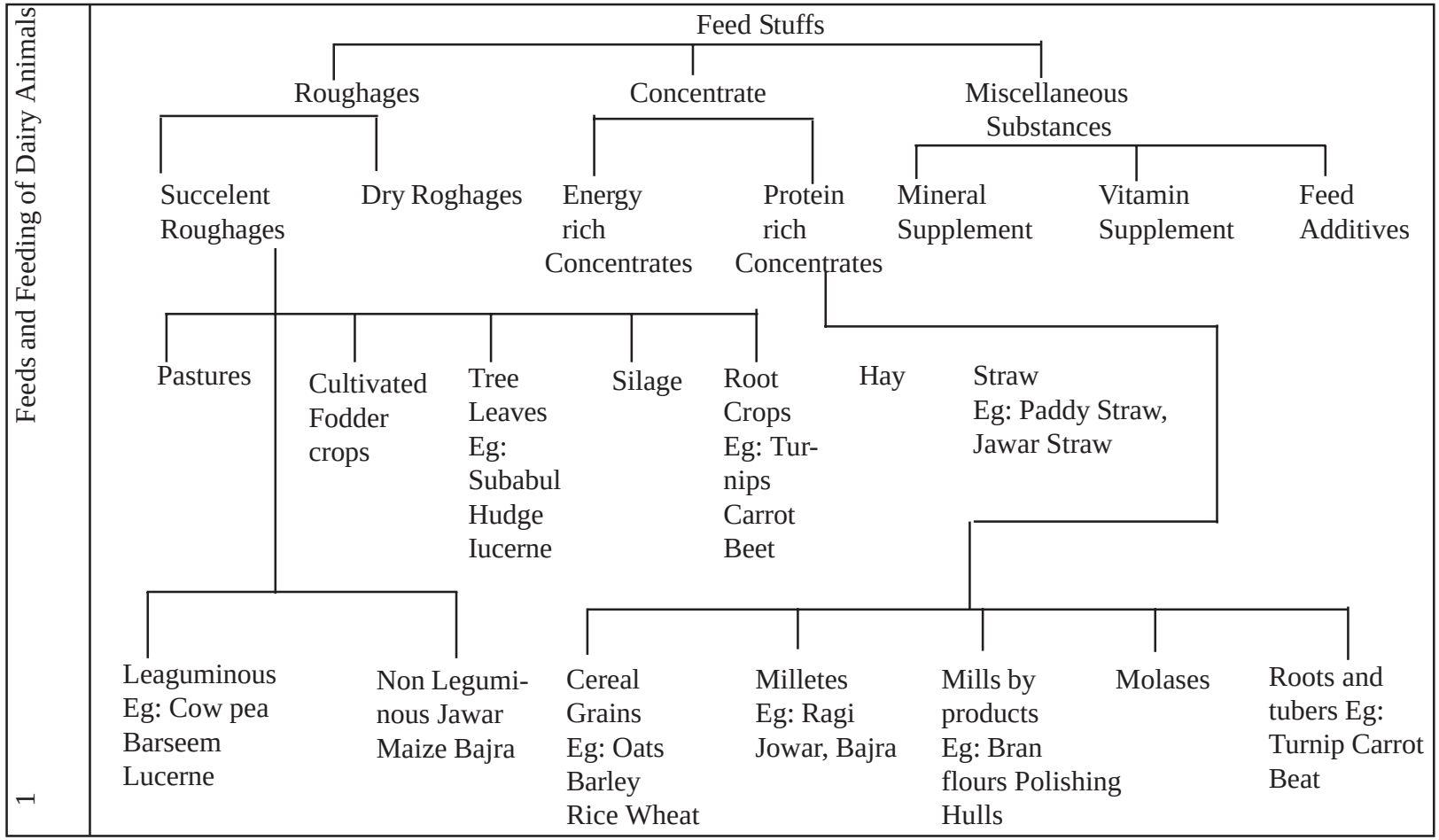
Animal nutrition and feeding practices, Rajan, S.K.

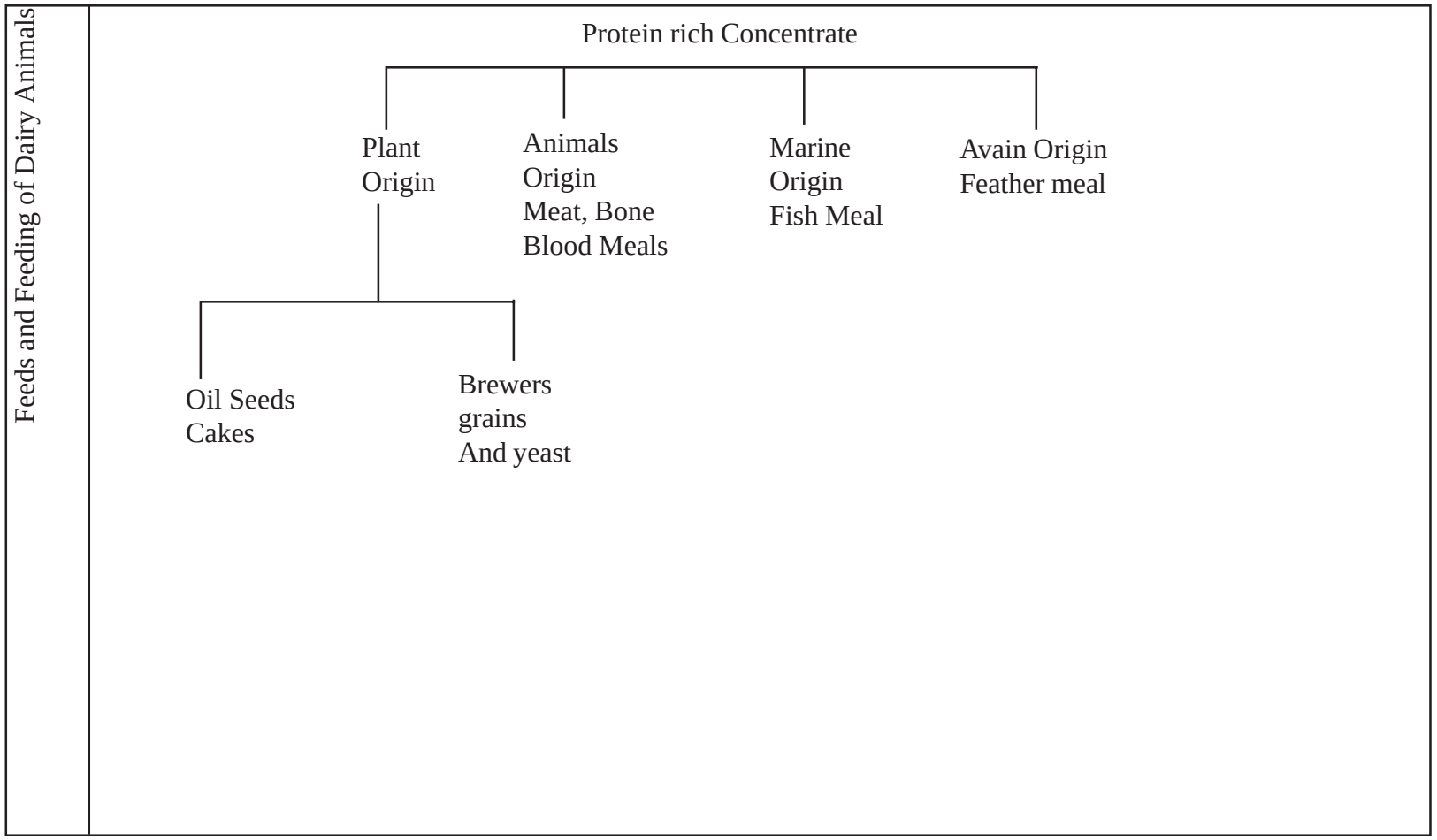
Hand book of food analysis, ISI publication.

Live stock and poultry production, Singh Harbans and Moore E.N.

IDA Manuals.

NDDB Manuals.


Feed Stuffs
Roughages
Concentrate
Miscellaneous Substances
Succelent Roughages
Dry Roghages
Energy rich Concentrates
Protein rich Concentrates
Mineral Supplement
Vitamin Supplement
Feed Additives
Pastures
Cultivated Fodder crops
Tree Leaves Eg: Subabul Hudge Iucerne
Silage
Root Crops Eg: Tur-nips Carrot Beet
Hay
Straw Eg: Paddy Straw, Jawar Straw
Leaguminous Eg: Cow pea Barseem Lucerne
Non Legumi-nous Jawar Maize Bajra
Cereal Grains Eg: Oats Barley Rice Wheat
Milletes Eg: Ragi Jowar, Bajra
Mills by products Eg: Bran flours Polishing Hulls
Molases
Roots and tubers Eg: Turnip Carrot Beat


Feeds and Feeding of Dairy Animals
Protein rich Concentrate
Plant Origin
Animals Origin Meat, Bone Blood Meals
Marine Origin Fish Meal
Avain Origin Feather meal
Oil Seeds Cakes
Brewers grains And yeast