Feeding of Cattle :-

imp

(1) Feeding of new born Calves :-

- Since the rumen of the calf does not develop and begin to function until several days after birth, the young calf is dependent upon the ration provided to them to obtain all the essential food nutrients in comparison to full developed ruminants (after three month age) in which microbial digestion will take place and capable of converting poor quality protein into microbial protein with high biological values.
- Introducing roughage and concentrates in diet of calves at an early age will help in early establishment of microbial population and development of rumen, resulting in utilisation of coarse fodders and starchy foods.
- (Thus the knowledge about the process of development of ruminant's digestive tract and factors influencing the same has been of great help in evolving economic & convenient system of calf rearing with solid food)

Feeding of Calf for the first three days :-

- The first milk produced by the cow is known as colustrum.
- Each calf should be given the required amount of colustrum of its dam as early as possible after birth.
- The feeding of colustrums is imp. because of the following →

① → The protein content of colustrums is 17%. as against only 3.5% in ordinary milk

- A major portion of the protein is globulin in nature.
- The globulins of colustrums contain antibodies which help the body system in fighting diseases and are called immunoglobulins (IgM, IgA):
- The new born calf has little or no reserve of antibodies (antibodies cannot pass through the placental membrans) and its intestinal wall permits the passage of whole globulin at least during the first 12 hours of its life.
- Later in life, intact proteins are not absorbed.

② The high content of vitamins (A, D and E) and minerals (Ca, Mg, Fe and P) help the calf to resist infections.

③ The laxative action of colustrum helps the calf in evacuating the accumulated faecal material from its intestine. The faecal matter if not excreted may undergo fermentation and release toxins, causing ill health or even death.

- The feeding schedules are based on body weights and average body weight gain of calves.
- The basis of calculation of milk allowance is that for the first three weeks it is 1/10th of the body weight for the next 2 weeks it is 1/15th and then it is given at 1/20th of the body weight.

Feeding schedule for calves upto 3 months of age:-

Age of Calf	Whole Milk	Calf Starter (first solid feed)	Good quality hay
1-3 days	Colustrum @ 1/10th BW in 3 feeds	-	-
4-7 days	Whole milk @ 1/10th BW in 3 feeds	-	-

8-14 days	Whole milk @ 1/10th BW	-	-
15-21 days	Whole milk @ 1/10th BW	A little	A little
22-35 days	Whole milk @ 1/15th BW	100 g	Ad lib
Upto 2 months	Whole milk @ 1/20th BW	250 g	Ad lib
2-3 months	Milk is gradually reduced and tapered	500 g	Ad lib

Artificial Colostrums :-

If colostrums is not available, artificial colostrums can be made as follows :-

Take 275 ml of warm water, add the contents of one raw egg (55g), 3 ml of Castor oil, 10,000 IU of vit A, 525 ml of warm whole milk and 80 mg of aureomycin (antibiotic); mix well and feed at 40°C.

- This is sufficient for one meal.
- The calf should be fed thus 3 times a day

System of feeding dairy Calves —

There are 4 common systems of feeding calves from the 3rd day until they are 9 weeks of age.

The systems are —

① Liberal milk feeding
② Using milk replacer
③ Limited milk feeding plus a dry calf starter
④ The nurse cow method.

① Liberal milk feeding :-

- Maximum growth can be observed when the calf is fed liberally on milk.
- The common procedure, when this system is followed, is to feed whole milk at a rate of 1/10th of BW for first 3 weeks and for next 2 weeks it is 1/15th and then it is given at 1/20th of the BW in 3-4 divided doses at equal interval.
- Whole Milk is generally providing adequate amount of vit. A.
- Addition of vit. A supplements when skim milk feeding is started will provide insurance against vit. A deficiency.

(2) Using milk replacers:-

- Milk replacer usually consists of a dry feed mixture (in gruel form) that reconstituted with warm water and fed as a replace of milk when milk demand for human consumption exceeds the availability of milk than calves cannot be fed with milk.
- Moreovers, it is not economical to feed milk to calves, if their costs are high.
- In these conditions, milk replacer can be fed to economize the calves rearing and sparing milk for human consumption.
- Composition of a milk replacer commonly used is given below :-

Dried skim milk	22.50 kg
Dried whey	4.50 kg
Distiller dried soluble	6.80 kg
Oat flour	2.30 kg
Dried butter milk	4.80 kg
Dextrose	3.20 kg
Dicalcium phosphate	0.90 kg
Trace minerals	0.23 kg
Auromycin	2.00 g
Vit D	3 lakh IU
Vit A	10 lakh IU

- For the first 5 days the calves should be fed with the cows milk.
- After that milk replacer should be fed twice daily.
- After the calves are 50 days old, the milk replacer may be gradually reduced and it may be discontinued when the calves are two months of age.

3. Limited milk feeding plus a dry calf starter :-

- When calves are appox. 10 days old, they will start to eat dry feed.
- On many dairy farms where whole milk is sold, calves will be started on whole milk and gradually shifted to a calf starter.
- Good calf starters are nutritionally adequate and will supply sufficient amount of the various nutrients for growth and development of the calves.
- The dry calf starter should be made available to the calf at 10 days of age.
- An ideal calf starter contains about 20-23% DCP, 23-26% CP and 75% TDN.
- It is a solid feed consisting of ground grains, oil cakes, animal protein supplements

and brans fortified with vitamins, minerals and antibiotic feed supplements.
- Use of antibiotics helps in checking the occurrence of scour.

(4) Nurse Cow method :-

- Calves that are to be grown out rapidly for early sale may be put on a nurse cow.
- The method is more expensive but reduces the danger of digestive disturbances in the calves.
- Some time 2 or even 3 calves are placed on one cow.
- The usual practices are to turn the cow and calves together morning and evening so that the calves may nurse.
- Calves will start to eats tender hay at about 15 days of age.
- The feeding of roughages such as, good quality hay or leguminous green foods to calves as an early age has been found to cause early development of rumen functions.

Feeding of Calves from 3 to 6 months :-

- By knowing the nitrient requirement for growth of calves it is possible to calculate growth ration.
- At this stage calves are capable to eat about 2.75 kg dry matter per 100 kg BW through the feeding of good quality leguminous hay.
- At 3 months age rumen become fully functional and calf can utilize roughages & concentrates effectively.
- The feed for 3 months calf should be of good quality green fodder and concentrate mixture for acheiving better BW gain.
- If leguminous fodder is available, a low protein (14% CP) and high energy (70% TDN) concentrate mixture is to be fed.
- If non-leguminous fodder is fed, then concentrate mixture should be high protein (18-20% CP) and low TDN (60-65% TDN)

Feeding heifers from 6 months to one year age-

- At 6 month of age, the individual feeding is stopped.

- The male and female calves are seperated.
- The animals of same sex are reared in small groups.
- Proper feeding is necessary if heifers are to be prepared for breeding at the right age.
- Inadequate diet during this period of growth may reduce the milk production potential when they are in milking herd.
- Heifers will not allowed to be too fat, otherwise reproductive problems may occur.
- The composition of concentrate mixture will depend upon the quality of fodder available.
- The animals should be supplied the required quantity of ~~mixture~~ mineral mixture and common salt.
- When green fodder is not available, the calves should receive vit-A supplemented concentrate mixture.

Feeding of pregnant Cattle :-

- During the last 2 months of pregnancy animals should, therefore, be fed more

liberally so as to supply nutrients for the development of foetus and to keep the heifers in good condition for high production during their first lactation.

- Therefore, # during this period sufficient nutrients should be provided for the maintainence of body, BW gain, growth of foetus and under development.
- The pregnant heifers should be provided more amount of good quality forage and less concentrates to prevent fat deposition.
- Green fodder should be fed in sufficient amount as it is good source of Carotene.
- The green fodder has also laxative effect which is helpful for pregnant animals.
- If green fodder is not available, synthetic vit. A must be supplied through concentrate mixture.
- The mineral mixture and common salt should be supplied adequately.
- However, salt should be withdrawn from the diet of pregnant heifers close

to parturition.

- The dry pregnant cow of mature BW no need nutrients for the developing foetus, recouping the body weight loss that has occurred in the previous lactation and development of new lobulo-alveolar structures in the mammary gland.
- Cow

- Grain feeding should be started 4-6 weeks before calving, if no grain is fed during the dry period.
- Feeding of concentrate mixture before 2 weeks of calving is called challenge or lead feeding.
- Feeding of the concentrate mixture should be started initially at 500 g per day and increases it gradually at a level of 500 - 1000 g per 100 kg BW.

- High milk producing animals are fed increasing quantity of feed challenging them to produce at their maximum potential.
- This challenge feeding will condition the digestive system for the increased quantity of feed to provide sufficient nutrients to initiate lactation on a higher plan.
- To obtain healthier calves with minimum pre and post natal mortality, cows should be subjected to challenge feeding programme.

Steaming up:-

- During the later weeks of the dry period (14 days prior to calving) the rumen of the cow/buffalo should be prepared for the diet it is going to be fed in early lactation.
- Rumen microflora and fauna take 10-14 days to adjust to a new substrate i.e. post calving diet.
- Feeding large amount of concentrates before calving is necessary so that cow/buffalo

can store sufficient resources to be drawn on in early lactation. This proactive feeding is k/as steaming up.

- Feeding concentrates is helpful to stimulate the restoration of the rumen papillae which in turn increases post calving absorption from the rumen.

Feeding of ~~Co~~ Cow after Calving :-

- After cal

Peri-Parturient (Transition) period :-

- The transition period (last three weeks before & the first three weeks after parturition) is a pivotal time in a dairy cow's lactation and most problems occur during this period.
- This period includes dry period when animal is pregnant but non-lactating and period of lactation when animal is ~~not~~ non-pregnant but lactating.
- During the transition period, feed intake is decreasing at a time when nutrient requirements are increasing.
- Increasing nutrient density of the transition cow is a solution to this problem.

Dry period :-

- The purpose of dry period is to allow the cow's udder, an opportunity to regenerate secretary tissue and to allow ~~the~~ the digestive system to recover from the stress of high levels of feed intake.
- Dry periods less than 45 days and greater than 60 days results in less production in the next lactation.

. Minimal concentrate supplements for dry cows are essential to help in maintaining rumen microbial population.

→ Dry matter intake during this period is about 2.0- 2.5% of BW.

→ In the early stages of the dry period cows are usually fed low energy diets and thus forages constitute the major portion of the dry cow diet.

→ As general rule dry cows should not be fed diets high in Ca and P, hence legume forage should be avoided.

→ 60 to 65% of the calf growth is in the last 60 days of gestation (before calf is born) hence, protein requirements of the developing calf increases and consequently, dry cows offered a protein containing high UDP content.

Lactation period :-

There are three main stages in the lactation cycle of the dairy cows →

(1) Early lactation (14-100 days)

At the beginning of this phase, cows will achieve peak milk production and feed intake is lagging behind.

During this period milk yield increases (peak

production) more rapidly than dry matter intake and cows are usually losing weight.

- The demand for energy is therefore higher than the amount of energy consumed.
- Rations for lactating dairy cows are usually formulated on the basis of protein (eg CP) and energy requirements.
- However, to achieve maximum production, dairy ration should be balanced for effective fibre, non-structural carbohydrates, ruminal undegraded protein and soluble protein.
- Mammary gland at 4 days post calving has increase demand for → Glucose → 2 times, Amino acid → 2 times, Fatty acid → 3 times

Monitoring Dry matter intake during Early lactation

- Each additional kg of dry matter consumed can support 2-2.5 kg more milk.
- Feed at least 40% of the ration dry matter at forage.
- Major ration changes should be avoided. To avoid any digestive problems (e.g. acidosis, depressed intake), concentrates should be added gradually at a rate of about 0.5 to 0.7 kg/day for the first two weeks.

- Protein is very critical during early lactation, as the amount of body protein that can be mobilized is very limited compared with body fat.
Thus in early lactation, a dietary protein content of 20-22% is recommended.
About 35-40% of dietary protein should be ruminally undegraded protein (UDP) while 30% should be soluble protein (RDP)

(2) Mid-lactation (100-200 days)-

- ~~At the beginning of this phase, cows will~~
- Mid-lactation period is the period from day 100 to day 200 after calving.
- By the beginning of this phase, cows must have achieved peak production (8-10 weeks after calving).
- Peak dry matter intake has also occured with no more weight losses.

→ The main target during this period is to maintain peak milk production as long as possible.

→ For each extra kg of milk at peak production, the average cow will produce 200-220 kg more milk for the entire lactation.

Thus the key strategy during mid lactation is to maximize dry matter intake.
For every two kg of expected milk production, cows should eat at least one kg of dry matter
→ Concentrates should not exceed 2.3% of body weight and sources of non-forage fibers such as distillers grains and cereal bran etc. can replace part of the starch in the ration to maintain a healthy rumen environment.

- Protein requirements during mid lactation are lower than in early lactation. Therefore rations for dairy cows in mid-lactation should contain 15-17% crude protein.

(3) Late lactation (200 - 305 days) —

- This phase may begin 200 days after calving till the cow dries off.
- During the period, milk yield continues to decline and so does feed intake.
- The cow also gains weight during this period to replenish the adipose tissue lost during early lactation.
- As lactation approaches to end, more of the increase in body weight is due to the increased size of the growing

foetus.
Sources of protein and energy are not very critical during this period.
Cheap rations can be formulated with non-protein nitrogen, non-conventional protein sources and readily fermentable carbohydrates such as molasses.

Major limitations —

Reduced feed intake

- As calving approaches, increase in size of foetus reduces the size of rumen and concentration of progesterone in blood decrease and those of estrogen increase.
- Reduced rumen size and high regulating estrogen are believed to be major factors that contributes to decreased dry matter intake (DMI) around calving.
- Dry matter intake starts to decrease a few weeks before parturition with the lowest level occurring at calving.
- DMI declines about 30% prior to calving and about 20-30% below peak lactation for the first few weeks post calving.

Negative energy balance –

- Energy balance (EB) is the difference b/w the energy consumed by the animal and the energy required by the animal.
- If EB is negative, the cow utilizes fat stores as an energy source and loses tissue weight and the animal is in negative energy balance (NEB).
- If EB is positive, the cow stores excess energy as fat and gains tissue weight.
- The greatest severity of the NEB experienced during early lactation when body reserves as mobilized to overcome the energy deficit results in some body weight loss.
- It has been suggested that the greater the level of milk production, the slower the cow is to first ovulation.
- As the demands for milk synthesis increase, reproductive functions may be depressed, & reproductive performance is compromised by the nutrient demands associated with high levels of production.

- Milk yield increase at a faster rate than energy intake.
- A cow producing 30 kg of milk per day uses at least 1.5 kg of blood glucose to synthesize milk lactose.
- The high demand of energy during this period of glucose shortage triggers a compensation proces of nutrient partitioning and adipose tissue mobilization and the energy requirements of the cow are satisfied by lipolysis and proteolysis.
- ~~Dec~~ Decrease in blood glucose and insulin concentration, and an increase in blood NEFA concentrations, accompanied by impairment of the immune system, making the cows more vulnerable to infections.
- These changes are associated with delay of the first visible signs of oestrus, an increase in the interval from calving to first ovulation, a decrease in conception rate, and a prolonged calving interval.
- It is possible that the increased blood

NEFA conc^n directly impairs ovarian function.

- It has been often recorded that where the severity of NEB (as measured by BCS loss) is exacerbated, the resultant fertility performance is reduced.
- It has also been reported that energy balance and dry matter intake (DMI) might affect plasma conc^n of progestrone which may interfere with follicle developement and maintainence of pregnancy.
- Hence an imp. part of nutritional management of dairy cows to ensure optimal fertility performance is to limit the extent & duration of NEB in early lactation.
- In well-fed cows, the negative balance of energy begin to improve at about 4 weeks of lactation. Recovers in energy balance from its most negative state may be a signal for initiation of ovarian activity. For this reason, nutritional strategies must be developed so that the high-producing cows will have every opportunity to maximize her energy intake without compromising on her needs for fibre. Concentrated sources of energy, such as whole cotton seed and ruminally inert fats & bypass protein along with enriched straw may be beneficial in early lactation.

Bypass Nutrient Technology

- The practice of feeding bypass protein and fat to dairy cows ~~to~~ is becoming common to promote higher milk production.
- Due to limitations of the dry matter consumption feeding of ration with low energy content can adversely affect the productive and reproductive performance of these animals. Hence ~~and~~ bypass nutrients are essential for the densification of nutrients along with normal diet.

Bypass protein → The rumen bypass protein are feed that have been treated or processed by various methods to decrease their ruminal degradation & increase the content of digestible ruminal undegraded protein.

- The main objective of protecting protein from ruminal degradation is to provide greater amount of essential amino acids to the productive ruminant.
- The earlier concept of feed the rumen microbes which in turn feed the ruminant animal is not valid and the need to provide UDP or bypass protein to ruminants arises under the following situations —

(1) In early lactation period of high yielding animal. (more than 15 l/day)
(2) In case of rapidly growing calves (1 kg/day)
(3) In case of animals thriving only on poor quality roughage so

- Sufficient quantity of microbial protein is not synthesized as this process is an energy dependent process.
- In all these secretions protein req. are ~~matched~~ met from microbial protein, synthesized in the rumen and the rumen bypass protein (UDP) which are absorbed at duodenum level.
- The ~~basic~~ concept behind ~~demands~~ bypass nutrient technology is that under normal condition there would be an excessive ~~depletion~~ generation of ammonia ~~and~~ in rumen from feed proteins and there may not be enough energy availabl in rumen to match that ammonia for its conversion into microbial protein.
- whereas the highly degradable ~~cost~~ cakes are protected from ruminal degradation, more amino acids which reach at lower tract and more supply of amino acids to the various body tissues ~~for~~ for synthesis

of milk proteins in mammary glands and partly for the synthesis of glucose in liver.

- This is an energy generating step and more glucose supply to mammary glands means more lactose synthesis and proportionate resulting in increase in milk volume.
- Only a few feeds are good sources of bypass protein (cotton seed cake, coconut cake, safflower sunflower, fish meal and maize grain)
- Feeds like linseed cake, ~~de~~ deoiled double rice bran, soyabean meal & lucena leaf meal are of medium protein degradability while mustard cake and groundnut cake are highly degradable cakes.

In tree leaves 50-70% of total nitrogen may be present as bypass protein however presence of tannin bind the protein irreversibly and rendered indigestible in GI tract.

If the feed is broken down quickly and flow out of the rumen slowly then most of the protein will be broken

down in the rumen.
- If the feed is broken down slowly and feed flows out of the rumen more quickly then little if any of the protein will be degraded.

#Natural bypass feed ingredients –

Feed ingredient	% bypass (UDP)
(1) Cottoseed meal	43
(2) Groundnut meal	20
(3) Soyabean meal	35
(4) Sunflower meal	40
(5) Wheat	35
(6) Wheat bran	29
(7) Maize	52

Methods to protect protein – → Heat treatment → Formaldehyde → Tannic acid treatment

(1) Heat treatment :-
- Heating causes denaturation of protein and this may be beneficial because of ~~residues~~ reduced rumnial degeration partly by blocking reactive sites for microbial proteolytic enzymes and partly by reducing protein solubility.
- Heat developed during expeller process of oil seed extraction and extrusion cooking

is beneficial to ruminants.

(2) Formaldehyde Treatment —

- Also effective
- The optimum level appears to be 0.5 - 1.5% of the CP for concentrate diet and 1.3 - 2% for hay.

(3) Protection of Amino acids —

- Protected A.A. are nowdays, added to diets, as feed additives.
- Several laboratories have devised encapsulation procedures to protect amino acids from ruminal degradation without impairing their intestinal release and absorption
- Protection is given by coating or mixing methionine for ex - with a combination of fats or fatty acids and sometimes by addition of Carbonates, Kaolin, lecithin, glucose or other products.
- Another method of protection is structural manipulation of amino acids. e.g → Glycosylation which make the A.A. resistant to ruminal degradation.
- DL - 2 - Hydroxy - 4 (methyl thio) butanoic acid (HMB, methionine hydroxy analog) coated with Ca - Soaps of palm fatty acids was found to be inert in the rumen and was used

as a source of methionin for high producing cows.

Bypass fat –

- Increasing starch content in the ration carries the risk of ruminal acidosis which in turn adversely affects milk production and milk fat.
- Inclusion of unprotected fat in the rations of ruminants is also not recommended since, fats with low MP are already liquid in the rumen and can depress rumen fibre digestion, which is the most imp. activity of rumen microbes.
- This problem can be easily overcome by feeding protected lipids to ruminants.
- The scientific alternative for meeting the energy demands of milking animals particularly in early lactation is bypass fat supplementation.

Manufacture of rumen protected fats –

Rumen protected fats have been developed based upon 2 types of mechanisms –

(1) One is based upon the melting point of fatty acids –

- Rumen protected fats products containing saturated

fats are manufactured with saturated or hydro-genated fatty acids.

- These fatty acids remain in a solid state at environmental temp's but melt at temps abov 50-55°C.
- So these fats remain in solid state at the rumen temp of 38-39°C are are insoluble in the ruminal liquid.
- They remain inert in the rumen and are digested in the small intestine.
- But this type of bypass fat is relatively less digestible due to the high proportion of saturated fatty acids.

(2) fatty acids Ca salts —

- In order to maximise fat digestibility in the ruminant's small intestin while protecting the fat in the rumen, bypass fat products composed of Ca salts of fatty acids which were developed on the basis of saponification of fatty acids.
- These are aka Ca soaps.
- These compounds are formed of saturated and unsaturated fatty acids joined to Ca ions to form salts.

- The rumen protection mechanism here is based upon the acidity level or pH of the rumen and small intestine.
- The Ca salts remain intact (little or no dissociation of Ca soaps ~~should~~ would be expected, as the pKa is b/w 4 & 5) is the neutral acidity of rumen (6.2-6.8 pH) and remain insoluble in the ruminal liquid but dissociate in an acid environment (pH 2-3) of the abomasum and the fatty acids are "freed".
- The free fatty acids are soluble and are absorbed in the intestine more efficiently (upto 95%)

→ Apart from these two methods, a method first developed about 25 years ago involved the encapsulation of an emulsion of oil by formaldehyde treated proteins.

Dietary Cation - Anion Difference (DCAD) -

- Recent theory for feed formulation is based on electrolyte balance to prevent various metabolic diseases

- Dietary electrolytes can be classified as either anions or cations.
- Anions have a negative charge :- Cations have a positive charge.
- The charge carried by these electrolytes affects acid - base balance and ultimately body homeostasis.
- Important dietary cations are Na, K, Ca & Mg :- imp dietary anions are Cl, S & P.
- Dietary cation - anion difference (DCAD) typically includs two cations [K, Na] & two anions [Cl. & S]
- Physiologically DCAD influences the animal's acid - bas homeostasis, Ca status around calving & mineral element utilization.

The equation for calculating the DCAD for a diet is —

$$[Na + K] - [Cl + S] = DCAD \text{ in } mEq/kg$$

Cation exceeds anion → Metabolic alkalosis
Anion exceeds cation → Metabolic acidosis.

- Metabolic alkalosis is due to a high

cation - anion balance in diet, which increases pH in the blood.

- As pH rises, the tissue response to parathyroid hormone decreases.
- The desensitizing in bone prevents bone resorption and in the kidney the resorption is reduced.
- Following this, the kidney fail to produce 1,25-dihydroxy vit-D, which prevents the increase of intestinal absorption of Ca.
- In the end, the metabolic alkalosis hinders all imp. systems for restoring Ca homeostasis and thereby the cow is less able to reverse hypocalcemia on her own.
- Anions promotes a more acidic metabolic state (lower blood pH) that is associated with a reduced incidence of milk fever.
- A cow adjusts to a lower blood pH by buffering the acidic condition.
- Buffering the blood is done by the cow through mobilization of Ca phosphate from bones.
- When a lower pH is achieved by feeding

- Monitor cow urine when using anion products, urine pH is a reasonable indicator of the effectiveness to affect acid - base & Ca status.

Nutrient req. & feeding of goat :-

Feeding habit -

- Goat rearing is followed as an occupation by large section of small farmers and land less labourers.
- In rural areas so called poor man's cow allover the world because they produce milk as main product while fibre, skin, manure are other products of economic importance
- Goat milk contains lower fat % (3%) as compared to cattle and buffaloes with smaller fat globules.
- The special feeding habits of the goats enable them to meet their nutritional requirement in adverse feeding conditions in which quality and quantity of feeds available are inadequate for other livestock under free range or extensive condition.

- Goats are considered selective ~~for~~ feeders with preference ~~for~~ to browse.
- Productivity of grazing livestock is related to combined effect of environment, internal metabolic adjustment and level of nutrition.
- Under semi-intensive conditions in addition to grazing, supplementation with the harvested green fodder and concentrate ration becomes necessary.
- Under confinement of intensive conditions, roughage feeding with concentrate are to be provided.
- The amount of feed to be fed depends upon its BW, milk yield and physiological status of animals.
- About 2/3rd req. of energy for mature goat should be met through roughage.
- Half of the roughage should be leguminous and rest half green grasses or tender tree leaves.
- They have ability to survive and thrive in environment where vegetation is extremely ~~sa~~ scarce.
- Basically, the goats are browsers and thrive

in the areas richer in bushy plants where they get enough opportunity of browsing proteinous feeds and fodders like green legumes or their hay.

- Since goat is a ruminant, legumes or their hays are preferred by goats.
- Regarding concentrates, goats will willingly take crushed corn, barley and oat grains.
- They also relish oil cake like groundnut cake, til cake & rapeseed cake etc.
- Top feeds include fodder trees, bushes & shrub constitute a ~~wider~~ vital source of protein to supplement the high fibre provided by grasses and a source of fodder to maintain mainly goat & sheep during critical periods.
- Goats have special feeding habits which are different from other ruminants —

(1) Due to rusting and hardy qualities they enable them to withstand with dry environment much better than other livestock.

(2) Goats require very less quantity of feed when compared with dairy cow feed

(1/5th to 1/8th as compared to dairy cow).

③ Dairy goats provide stable income to farmer inspite of all adverse condition through milk, meat, ~~height~~ hide (skin) and manure.

Manure is a good source of fertilisers as it contains nutrients in high quantity leads to increasing soil fertility.

④ A large variety of tree leaves serve as promising feed resources of goat.

- Goats are fond off leguminous fodder, they don't relish fodder like silage or straw, sorghum, maize etc.
- In general, goat will refuse any kind of food which has be soiled by itself or by any other animal.
- In case of goat, it can distinguish bitter, sweet, salty or sour taste & have high tolerance for bitter taste than cattle.
- Goat kids rumen is not developed at birth which became fully functional at 3-4 months but young kids start picking grasses at 2-3 weeks of age.
- Digestive efficiency of goat is more efficient to digest crude fibre & lignin.

- Rumen metabolism with ammonia & TVFA is highest in goat & lowest in cattle. Intermediate in sheep.
- The BMR and thyroxine production in goats are higher than sheep and cattle. That is the reason that goats require somewhat greater maintainence ration than recommended in sheep and cattle.
- Goats have early age of maturity, short gestation period, milk production at early age i.e. within 10-12 months when fed well ~~within 10-12 mon~~ and properly managed than other livestock.
- Goats are prolific breeds; the number of kid born of a time slight slight double or triple.
- Kidding occurs 3 times in 2 years.

Nutrient req. of goat :-

- Mostly the goats are kept with sheep in mixed flock where sheep graze the grass cover and goats browse the shrubs. So they do not compete for feeds.
- Pasture or forage are the cheapest feed source for both goat & sheep producti

- Dry matter intake in
  - Indian goat → 35-80 gm / metabolic BW in kg ($W^{0.75}$)
  with the mean of 70 gm per kg $W^{0.75}$ (3.2 % of BW)
- The DMI in the goats varies a/c to the energy density of the diet and physical character of the diet.
- DM in the growing kids ranges b/w 35 - 50 gm / $W^{0.75}$ BW, whereas in lactating (eg. Jamnapari goat) it ranges b/w 100 - 140 gm / $W^{0.75}$ BW

Meat goat → 4% of BW

Dairy goat → 4-6% (≈5%) of BW

Nutrient req. for maintainence —

- The DCP and CP req. is 112 gm & 260 gm per 100 kg BW.
- Energy req. vary from 113 - 125 Kcal ME/kg metabolic BW.
- An average of 119 Kcal of ME / kg met BW is taken to calculate the energy req. for mature goat.

- A small breed of 30 kg have required 980 gm DM, 543 gm TDN and 52 gm DCP. as maintainence ration whereas a large breed of 45 kg BW have 1362 gm DM, 756 gm TDN & 72 gm DCP as maintainence requirement.

Feeding of goat on the basis of several feeding trial

- It has been observe that DMI of goat is higher in comparison to large farm animal which is about 3-4% of live wt.
- A balanced feeding programme for goats should contain forage, hay, grains & browse ~~one~~ Shrubs plants.

Common feed & fodders —

- Babool, Neem, Peepal, Mango, ~~Aud~~ Mulberry, prosopis & banayan → Top feed / Trees leaves.
- Grasses → ~~Cenchrus~~ Cenchrus Ciliaris, ~~Centrus~~ Cenchrus setigerus, paragrass, napier & Guinea.
- Legume Forage → Stylosanthes hamata, S. Scabra, butterfly pea etc.
- Legume fodder → Barseem leaves & Cowpea

- Cereal fodder → Maize, oats
- Dry feeds → Dry pods of babool, prosopis Juliflora,
- Cereal straw, legume straw, Gram husk and waste.

Creep feeding –

Creep is an enclosed area where kid & lamb are kept

Nutritive req. & feeding of Sheep –

- Sheep possess a unique ability to survive on natural vegetation, shrubs, grazing land & farm waste product like residue on the field. with their small muzzle and split upper lips.
- They can nibble tiny blades of vegetation which cannot be eaten by large animals
- Rarely sheep are kept on grains & cultivated fodders.
- Supplementation of concentrate containing grains, cakes and agro-industrial byproducts is necessary for maximising production from sheep.
- Production of wool, mutton, skin & manure provide source of income to the sheep keepers and milk from sheep is of limited importance.
- Most of the sheep breeds are well adapted to hot climate, long migration, tropical diseases poor nutrition & shortage of drinking water. for maintaining the healthy flock of sheep attention to their feeding and management is required.
- The common leguminous green feeds like cow-pea, barseem, lucerne are all relished by sheep.

Nutrient req. of sheep (ICAR-2013)

The dry matter req. is 76 gm/kg $W^{0.75}$ or 25-40 gm/kg live wt

DCP req. is 2.97 gm/kg $W^{0.75}$ while TDN & ME req. are 27.3 gm & 98 Kcal/kg $W^{0.75}$

- Stall fed sheep can easily consume 2.5-3 kg DM/head/day from good quality forage.
- Sheep may consume 15% more DM on pasture than when fed in the stall for same feed.

Nutrient req. of growing lambs (ICAR-2013)

Mineral req. of growing lamb (ICAR-2013)

Nutrient req. for milk production in sheep (ICAR 2013)

#Mineral req. for lactation in sheep (gm/dry wt) (ICAR 2013)

#Nutrient req. of sheep for wool production (ICAR 1998)

#Minerals & vitamins requirements —

- Minerals play imp. role in digestion, maintainence of osmotic pressure in diff. body fluids & wool growth.
- Under certain conditions, sheep may suffer from a deficiency of trace ~~mineo~~ elements, this is true because sheep remain mostly on all roughage ration about 5 milligm of Cu/head/day is sufficient to take care of Cu deficiency
- Supplementation of 0.5 kg of $CuSO_4$, 15 gm $CoSO_4$ or Chloride, 100 kg of salt may be sufficient to supplement for the deficient areas.
- Other minerals Zn & S are also imp

Methionine is first limiting amino acid in microbial protein for both growth of wool & weight gain followed by lysine & threonine.

Feeding of Preweaned lamb—

- upto 12 weeks of age, lamb suckling the mother should be supplemented with creep mixture
- Lamb is to be fed creep feed of high quality q/c to appetite from 10 days of age to weaning at 90 days to promote growth during early age and rumen developement.
- The amount of creep feed consumed inversely proportional to ewes milk production.
- The composition of few creep mixtures are given in following table

Ingredient	I (%)	II (%)	III (%)
Maize flour	67	50	30
Barley	—	17	37
Groundnut Cake	10	10	10
Wheat Bran	10	10	10
fish meal	10	10	10
Common salt	1	1	1
Mineral mixture	2	2	2
Total	100	100	100

imp.

Creep feeding (Def.)

- The creep is a small enclosure in a sheep pen having opening just wide enough for lambs to pass in, while the ewes are kept back.
- The practice of providing supplemental feed to nursing lambs is called creep feeding.
- Lamb is to be fed creep feed of high quality a/c to appetite from 10 days of age to weaning at 90 days to promote growth during early age and rumen development.
- The amt of creep feed consumed is inversly proportional to the ewes milk production.
- Feeding of this creep mixture has given a growth rate of 110 - 130 gm / head / day upto 90 days of age.

⇒ Composition of creep feed -

- Maize 40, groundnut cake 30, wheat bran 10, Dorb (Deoiled rice bran) 12 parts, Molasses 5 Mineral mix 2 Salt 1 part fortified with vitamin A, B & D and antibiotic feed supplement.
- DCP is around 17% and TDN 73%.

Feeding of Growing & finishing lamb -

- when good quality of fodder is available then the concentrate req. is less but in absence of good quality fodders where lambs are kept on mature grass like straw & stover, the concentrate req. is more in this condition.
- The following quantities of concentrate may be fed.

BW (kg)	Good quality fodder ad-lib + Concentrate mix (gm/day)	Poor quality rough ad-lib + Conc. mix (gm/day)
10-15	50	300
16-25	100	400
26-35	150	600

Composition of Concentrate mix -

Ground nut Cake	32
Wheat Bran	40
Maize flour	25
Mineral mixture	2
Salt	1

Finisher ration (20-30 kg BW)

① Under Intensively reared condition -

→ By supplying 700-900 gm ration having 70% concentrate & 30% roughage, the req. may fulfill.

② Semi-Intensive range Condition -

→ The roughage part will take care by the usual grazing.

→ During lean periods, 150 gm of conc. mix. may be fed.

→ Mineral mixture, common salt and adequate Vit-A should always be supplied

System of sheep rearing -

① Extensive rearing of sheep -

→ ~~Go~~ Grazing the sheep in the entire pasture and living them for there for the whole season is not prescribed to make the best use of the grasses.

→ Rotational grazing should be practiced under which the pasture land should be divided by temporary fences into several sections.

→ The animals are then moved from one section to another.

→ By the time the entire pasture is grazed, the first section will have sufficient grass

cover to provide second grazing.
- Parasitic infestation can be controlled to a great extent.
- Further it helps to provide quality fodder (Immature) for most part of the year.
- Under rotational grazing system it is advisable to graze the lambs first on a section & then brings in ewes to finish up the feed left by the lambs.

② Semi Intensive & Intensive System of rearing –
- Because of the decline in quality & quantity of the pasture, now semi-intensive & intensive system of rearing are also adopted.
- Under semi-intensive system, sheep are allowed to graze for 8-12 hrs a day & then offered home-made / commercial concentrate mixture.
- Sometime total mixed ration are offered including legume straw & gram husk.
- In peri-urban areas, intensive system of rearing (stall feeding) is preferred.

Feeding of adult sheep –
- Free choice maintainence quality fodder

like oat. grass, maize + 100 gm conc. mixture may be fed.

- If leguminous roughages are offered in sufficient amt the feeding of conc. may be stopped ~~may~~ for non-productive stock
- Little straw may be provided with such roughages as to prevent digestive disorders
- It is better to feed than hays of these fodder
- In absence of good quality fodder, straw & stover may be fed ad-lib along with 400 gm of conc. mixture.
- A minimum 3% fat in ration is essential