8. FEED TECHNOLOGY

Can you recall ?

1. **The different types of feed fed to the animal**
2. **Methods of feed preservation**

8.1 PRESERVATION OF FORAGES

In our country, the availability of greens is limited to a particular season only. During the lean months of April to July, green forages are not available for feeding to the dairy animals, however, during Kharif season plenty of greens are available but excess greens are neither properly utilized nor preserved scientifically. Hence, when green forages are in plenty, they need to be conserved as either hay or silage to meet the demand during the lean season.

Remember... that

Green forages are preserved without reducing their palatability or nutritive value by converting them into hay or silage.

Besides the main advantage of feeding greens during the lean period in the form of hay or silage, preservation of greens has following advantages -

1. Hay making protects green forages of the pasture land from fire hazards.
2. Preserving large quantity of greens in limited space releases the land for the cultivation of other fodder-crops.
3. Such preservation retains higher proportion of nutrients more than keeping forages in the field which may have the risk of nutrients loss due to shattering or natural maturity of the forage.
4. Both hays as well as silages are more nutritious than their unpreserved counterparts.
5. During the process of preservation, harmful compounds present in the weedy plants are destroyed.

8.1.1 Hay making

Hay is defined as green forage dried up to 15 percent moisture level enough to inhibit the action of plant and microbial enzymes.

Crops suitable for hay making:

1. All thin and hollow stemmed legumes and grasses are best suited for hay making.
2. Forages like Oat, Lucerne, Berseem, Soybean, Jawar, Bajara, Cow peas and quality grasses like Marvel, Napier can form a good hay.

Methodology for hay making

1. There should be plenty of sunshine during the complete process of hay making.
2. The crop for hay making should be cut when it is in 50 percent flowering stage.
3. Keep it in the field for further 2 days with morning and evening turning till it achieves 60 percent DM.

Fig. 8.1 Lucerne hay

4. From 3rd day, keep the bundles of the partially dried forage on a structure of tripod for further drying. This tripod curing conserves the carotene more effectively and accelerates the drying action by increasing the total area of the exposure to the sun.

5. When the DM reaches to about 85 percent, the material is taken in the shed and stored in the form of heap or bails.

Remember...

Hay should not contain more than 15 per cent moisture.

Characteristics of good hay

1. It contains 15 per cent moisture.
2. It has typical aroma of the forage and it is palatable.
3. It is rich in carotene and calcium.
4. It contains 9 to 11per cent DCP and 50 to 60 per cent TDN.

Observe and try this :

1. Forage crops used for hay making in your area

2. Observe the process of hay making in your locality

8.1.2 Silage making

Silage is defined as green fodder preserved in more or less in its original form with a minimum deterioration of nutrients under anaerobic conditions for minimum 60 days.

Silage is a fermented feed resulting from the storage of high moisture crops, usually green forages, under anaerobic conditions in a structure known as a silo.

Do you know ?

- **Silage is the pickle for dairy animals**

Ensiling / Ensilage

It includes all physical and chemical changes that take place when forage with sufficient moisture is stored in a silo in the absence of air.

Fig. 8.2 Silage making

The entire ensiling process requires two to three weeks for converting forage into silage.

Remember...

If the lactic acid production is insufficient, butyric acid fermentation begins and quality deterioration occurs.

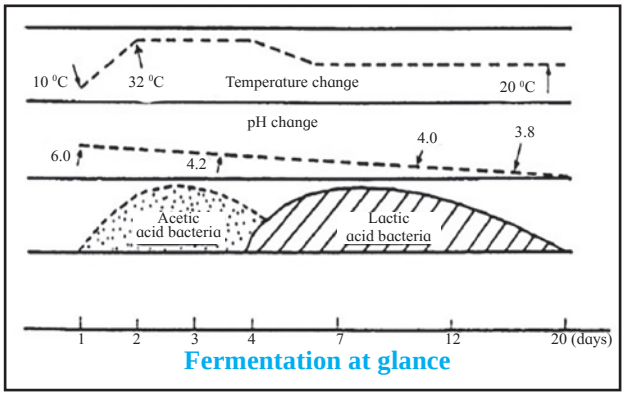


Fig. 8.3 Diagram showing the fermentation process of silage

Qualities of forage crops suitable for silage making

1. It should have minimum 30 to 35 percent dry matter and 8 to 10 percent soluble carbohydrates.

2. It should have pliable and soft stem which can be compressed properly to create anaerobic conditions.
3. Green maize, jawar, bajra, hybrid napier, oats and quality pasture grasses are best suited for silage making.
4. Leguminous forages such as lucerne, berseem or cow peas are not suitable for silage making because they contain high moisture, proteins and minerals.

Silos

Silo is an airtight to semi- airtight structure designed for the storage and preservation of high moisture feeds as silage.

Silos are of different types

1. Pit silos
2. Horizontal silos
3. Temporary silos

1. **Pit silos:** A pit silo is shaped like the tower silo, but inverted into the ground. It resembles a well. This type of silo can be made only in places where the water table is low enough (in semi- arid or in arid regions) that the silo will not fill with water.

Fig.8.4 Pit silo

Silo pit : is the chamber in which green fodder is kept in an airtight condition for converting it into silage.

- The pit may be round or trapezoid in shape.
- The pit is constructed on a well drained and elevated land.
- The inside walls of pits should be protected with concrete to avoid the entry of air and percolation of water.
- The size of the silo pit directly depends upon the quantity of green forage to be ensiled.

Advantages

1. They are never damaged by storm.
2. They require less reinforcing.

Disadvantages

1. They are dangerous, due to the frequent presence of suffocating Co_2.
2. Labour requirement is more in removing the silage.

Internet my friend

1. Collect the videos and PPT's about silage preparation

2. Collect the information about different types of silos

2.Horizontal Silos

They are of two types

1. Trench silos (below ground level)
2. Bunker silos (above ground level)

A.Trench Silo

- This type of silo can be constructed quickly at a comparatively low cost.
- It is most popular in areas where the weather is not too severe and where there is good drainage.
- A trench silo should be wider at the top than at the bottom, and the bottom should slope away from one end so that excess juices will drain off if material with high moisture content is ensiled.

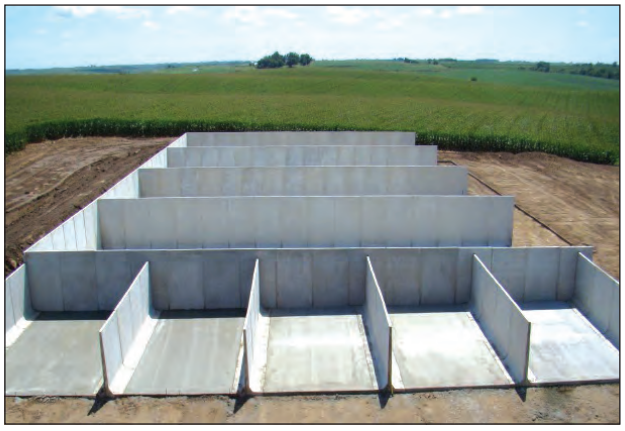


Fig. 8.5 Horizontal trench silo

Advantage

1. Low initial cost and ease of construction.

Disadvantages

1. It requires larger space to seal.
2. When filling is completed, the top should be carefully sealed by **polythene**, plastic or by wet straw mixed with mud or by saw dust to make it air tight.

B. Bunker silos : As a labour saving measure, bunker type of silos above the ground (for slightly recessed) usually with concrete floors are generally catching the attention of many farmers.

Fig. 8.6 Bunker silo

3. Temporary Silos :

Plastic Silage Bag: The bag silo is the one of the fastest growing silo types in dairy farming in India. Forages are ensiled at approximately the same moisture content as in bunker and pit silos while specialized equipment's are required.

Fig. 8.7 Plastic bag silo

Advantages

1. Less weather losses during filling compared to silo pit
2. Lower total annual costs
3. Low storage losses due spoilage
4. Higher quality silage
5. Safe to store

Methodology of silage making

1. Maize fodder at dough stage, jawar-bajra-oats-grasses at 50 percent flowering stage and hybrid napier at one meter-height stage are to be considered for ensiling
2. During the period of ensiling, fair weather conditions will ease the harvest, its transport and chaffing operations.
3. The fodder from maize, jawar, bajra and hybrid napier should be chaffed and oats be wilted for 6-8 hours before putting them into silo pit.
4. Ensiling involves operation of putting 'prepared' fodder into the silo pit, its proper trampling and finally proper sealing to protect the ensiled material from the entry of air and rains.
5. Common salt at 0.5 per cent and urea at 1 per cent level are added during trampling to improve the palatability and nitrogen content. For grass silage, molasses at 3 to 3.5 per cent is added to improve the sugar content.

6. The fodder chaffed by the chaff cutter is filled in the bamboo baskets (capacity 60-75 kg green chaff) is brought near the silo pit which is then filled in layer after layer. Each layer of about one feet thickness should be trampled properly by moving roller, men, tractor or bullocks depending upon the shape and size of the pit.
7. The pit should be filled in 3-4 feet above the ground level in a form of a heap and allowed to settle for 2 days.
8. Well settled heap-shaped ensiled material should be covered properly either by straw and smeared with a slurry of mud and dung or by polythene sheet (80 mm thick) in such a way that complete covering extends 3-4 feet from the rim of the silo pit. This will prevent the entry of air and water.
9. The ensiled material will get fermented under anaerobic conditions inside and quality silage will be ready for feeding after 60 days.

Internet my friend

Collect the information on different methods of silage making used in your area.

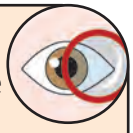
Table 8.1 Characteristics of silage depending on the quality

Sr. No.	Quality	Characteristics of silage
1	Very Good	• Taste is pleasing, not bitter or sharp • The pH is between 3.5 and 4.2. • The ammoniacal nitrogen is less than 10 per cent of the total nitrogen. • It is uniform in moisture content and green or brownish in colour. • It is free from butyric acid, moulds, sliminess and proteolysis.
2	Good	• The taste is acidic. • The pH is between 4.2 and 4.5. • The amount of ammoniacal nitrogen is 10-15 per cent of the total nitrogen. • There may be traces of butyric acid.
3	Fair	• It has little bit bad odour • The pH is between 4.5 and 4.8. • Ammoniacal nitrogen is 15-20 per cent of the total nitrogen. • Colour of silage varies between tobacco brown to dark brown. • The silage is mixed with a little amount of butyric acid. • There may be slight proteolysis along with some mould.
4	Poor	• It has a bad odour due to high butyric acid and high proteolysis. • It is less acidic with pH above 4.8. • The amount of ammoniacal nitrogen is more than 20 per cent. • Its colour tends to be blackish. • The silage may be infested with moulds. • This type of silage should not be fed to livestock

Remember...

Silage should not be fed to the calves below 6 months of age and breeding bull.

Observe and try this...



The crops suitable for silage making in your locality.

8.2 PROCESSING OF FEED STUFFS

The processing of feed increases the nutrients utilization from feeds and fodders in the animal system. This involves physical, chemical, biological and engineering techniques

Objectives of feed processing

1. To increase the economic value of a feedstuff.
2. To increase the feed efficiency by increasing the voluntary intake and thus the nutritive value.
3. To make the availability more of the nutrients through one or more methods.
4. To show the cumulative effect of nutrients in 'complete ration'.
5. To increase the palatability of the processed feedstuffs.

Methods of processing of feedstuffs

The feedstuffs, preferably meant for ruminants, are processed by applying various physical, chemical, biological and engineering techniques.

Table 8.2 Processing of feedstuffs

Processing of Feedstuffs

Physical methods

1. Watering & pelleting
2. Chaffing
3. Grinding
4. Milling
5. Irradiation
6. Soaking in water
7. Boiling in water
8. Steam treatment under pressure

Physico-chemical methods (Combination of Physical and Chemical treatments)

1. NaOH + pelleting
2. Steam & NaOH

Chemical methods

(a) Alkali treatment

1. Sodium hydroxide
2. Potassium hydroxide
3. Calcium hydroxide
4. Ammonium hydroxide

(b) Ammonia treatment

1. Gaseous ammonia
2. Aqueous ammonia
3. Urea molasses

(c) Alkali+Urea treatment : NaOH/Urea

(d) Acid treatment

1. Sulphuric acid, 2. Nitric acid

(e) Salt treatment

1. Sodium chloride
2. Sodium carbonate

(f) Gases treatment

1. SO_2
2. Chlorine

Biological methods

1. Cultures
2. Mushrooms
3. Enzymes

1. Physical methods

Do you know ?

1. **Different methods used for processing of feedstuffs.**
2. **The best method used for feed precessing.**
3. **Advantages of feed processing.**

i) Soaking

1. Small sized grains which could not be ground properly should be soaked in fresh and clean water and fed.
2. The demerit of dustiness in grinding the grains is overcome by soaking them in water.
3. Soaked feeds should not be kept for more than 3 hours during summer and 6 hours during the winter otherwise they will first become stale and will be prone for fungus / mould development.

Fig. 8.8 Soaking of seed

4. Bajra grains and some dusty feed mixtures are soaked and fed.
5. Chopped straw is soaked in water overnight. Softens the straw leading to increased intake.
6. Soaking the straw for overnight in 1:1 ratio with water reduces dustiness and improves the palatability, DM intake and nutrient utilization.

Try this...

Soak bajara grains and observe changes

ii) Chaffing

1. Chaffing decreases the particle size.
2. It increases surface area for action of rumen microbes and thus increase digestibility.

Fig. 8.9 Chaffing of green fodder

3. It provides more sites for the cellulytic enzymes of the rumen.

iii) Grinding

1. Grains with hard kernels and large size are generally ground roughly so that the inner contents are available for digestion.
2. Fine grinding of such grains should be avoided as the grains ground into flour cannot be consumed by the animals effectively.

Fig. 8.10 Grinding machine

3. Fine grinding results in increase in propionic acid content in the gut which results in narrowing the ratio between acetate to propionate, a factor responsible for reduction in milk fat content.
4. Maize, jawar, legumes are ground and fed either solely or in mixture.
5. Grinding reduces particle size to 0.1 to 0.3 cm.

iv) Steam pressure

1. Straw treated with Steam at pressure of 21.1 kg/cm^2 for 10 to 30 seconds causes rupture of ligno- cellulosic bonds to a certain extent and makes cellulose available for microbial action.
2. Disadvantage is that it increases rumen flow rate, decreases retention time in the rumen resulting in low milk fat syndrome.

iv) Pelleting

1. Pelleting increases the palatability of feed and thereby improves the feed intake.
2. It increases feeding value of roughages.
3. It increases the density of feed thereby it reduces the storage space.

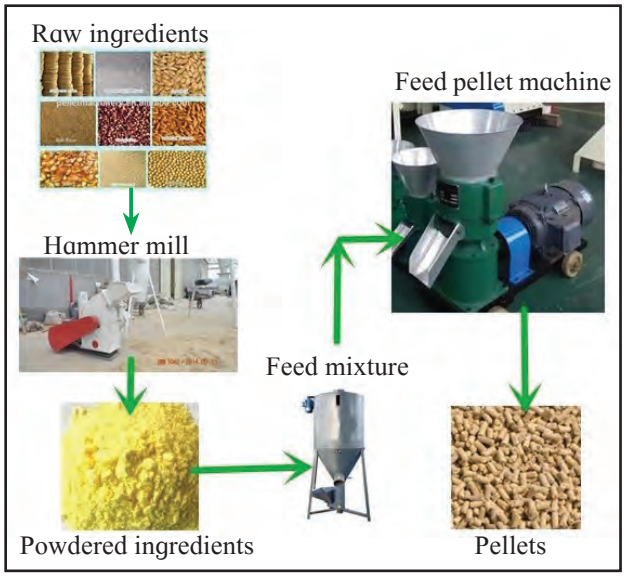


Fig. 8.11 Pellet making machine

4. It reduces the feed wastage and it does not allow the animal for selective feeding.
5. Particle size is reduced to 0.1 to 0.3 cm and pelleted through 1-2 cm diameter.
6. Retention time of feed in the rumen enhances digestion

2. Chemical methods

i) Acid treatment

1. Straw is soaked in dilute sulphuric/Nitric acids for a specified period of time, washed with water drained and fed to the animals.
2. It causes rupture of ligno- cellulose bonds and makes cellulose available for microbial action.
3. It is not popular due to the corrosive action of acids.

ii) Alkali treatment

1. Straw is treated with alkali viz., NaOH, NH_4OH, CaOH, KOH, urea.
2. When straw is exposed to the alkali the ester linkages between lignin and cellulose / hemicellulose are hydrolysed causing the cellulose / hemicellulose to be available for digestion by microbes.

iii) NaOH treatment

1. **Beckman process:** Straw is soaked for 1-2 days in dilute solution of NaOH (15-30 g / litre), washed to remove excess alkali and fed to the animals.
2. **Dry method:** Straw is chopped and sprayed with NaOH 300g/ litre (170 litre / tons of straw)

iv) Ammonia treatment

1. Anhydrous form or concentrated solution is used @ 30 to 35 kg/ tons of straw.

2. Straw is stacked, ammonia solution is sprayed over the straw, kept covered for 20 days and then fed to the animals.
3. This method not only increases the digestibility of the straw but it also increases the nitrogen content of it.
4. Most of the ammonia is lost by volatilization on opening the stack.
5. Sometimes there is formation of toxic imidazoles from reactions between ammonia and sugars leads to dementia (Bovine bonkers)

v) Urea molasses treatment

Materials required

1. A source of NPN compound: it may be fertilizer grade urea or biuret.
2. Easily available and cheap source of energy. it may be low quality jaggary or molasses
3. Water drum
4. The substrate i.e. dry fodder
5. A 50' x 50' floor space in a spreading and drying 'shed' protected against rains and sun
6. Miscellaneous items like barrel, buckets, water fountain and spreading unit

Procedure

1. Spread 1′ thick bed of the available straw (minimum 500 kg) over the floor of the 'shed'.
2. Dissolve 20 kg of urea or biuret and about 50 to 75 kg jaggary or molasses(as per the availability) + 10 kg mineral mixture and 5 kg common salt in 400 litres of clean water by stirring the mixture well till all get dissolved in the water completely.
3. With the help of bucket, pour the mixture into the water fountain.
4. Spray the fountain mixture over the straw evenly.
5. Follow second spraying immediately.
6. Repeat the process of spraying 4-5 times, folding the whole treated straw upside down.
7. After completion of spraying, stack the 'treated' straw and cover it by gunny bags or plastic bags completely to prevent the entry of air into the stack and loss of ammonia.

Precautions

1. Dirty water should not be used to dissolve urea and molasses,
2. The 'solution' should be sprinkled uniformly and thoroughly over each of the layers to prevent localized concentrations of urea which may have toxic effects.
3. Stacking should be done thoroughly and compact by trampling.
4. The stack should be properly covered from all sides.
5. The stacked treated straw should be stored for 3-4 weeks to allow the physiochemical reactions to complete inside the stack.
6. Before feeding, the treated straw should be exposed for an hour to remove the smell of ammonia gas.
7. It should not be given to young animals below 6 months of age.
8. Adequate drinking water should be made available

Feeding rate : For dry animals @ 5 to 6 kg and for milking animals @ 4 to 5 kg; however, these animals be fed with required and balanced ration.

vi) Urea - molasses mineral block (UMMB)

The UMMB licks supply most of the nutrients generally deficient in straw-based diet. These are urea, molasses, mineral supplements, common salt and brans/cakes. Gaur gum powder, sodium bentonite and lime were used as binding agents. The range of different ingredients that can be used in the UMMB formulation under various climatic condition is as follows.

Table 8.4 Composition of UMMB

Ingredients	Parts/100 kg Mixture
Molasses	36.0
Rice bran	38.0
Urea	10.0
Cement (Gaur gum powder, sodium bentonite and lime)	8.0
Salt	1.9
Dicalcium phosphate	2.0
Trace minerals	0.1
Water	4.0
Total	100.0

It has been observed that the UMMB licks increased straw by 53 % and reduced the concentrate requirement by 40 % and proved economic in lactating as well as growing cattle.

Fig. 8.12 Urea molasses mineral block (UMMB)

3. Biological treatment

i) Enzyme treatment

- Pre-treatment of straw with lignase
- Addition of lactobacillus culture

8.3 RUMEN BYPASS NUTRIENT TECHNOLOGY

Can you recall ?

- **Bypass protein and bypass fat**
- **Benefits of feeding by pass fat**

Bypass nutrients are the nutrient fractions which escape the rumen fermentation, gets fermented at a lower degree in the rumen and became available at the lower part of the gastrointestinal tract for the subsequent digestion and absorption.

Do you know ?

Whole oil seeds, when fed without processing except drying have natural bypass fat properties due to their hard outer seed coat, which protects the internal fatty acids from lipolysis and biohydrogenation in rumen.

Nutrients like protein and fats that escape rumen fermentation partially and digested and absorbed in the small intestine. This concept is useful not only for better utilization of nutrients but also minimize the ruminal fermentation losses thereby reducing the wastage of nutrients into the environment.

8.3.1 Bypass fat

Dietary fat which is not degraded in upper part of digestive tract (rumen) of animal but gets digested in lower alimentary tract is known as bypass fat.

Advantages of feeding bypass fat

1. It is rich source of energy
2. Improves negative energy balance.
3. Enhances milk production and persistency of lactation.
4. Increase reproductive efficiency after calving.
5. Decreases metabolic disorders such as ketosis, acidosis and milk fever.

6. Increases productive life of animals.
7. Improves general body condition and prevents postpartum weight loss.
8. Protects from heat stress

8.3.2 Bypass proteins

In order to increase the efficiency of protein utilization from the highly degradable cakes, which needs to be protected from excessive ruminal degradation and can be used as bypass protein, so that the amino acids from these protein feeds are absorbed intact in the intestines of the animal.

1. **Naturally protected proteins :** in some feed resources the proteins are protected naturally
   - **a.** *Lower degradable protein :* Maize gluten meal, cottonseed cake, fish meal, coconut cake and maize grain.
   - **b.** *Medium degradable protein :* Linseed cake, deoiled rice bran and soybean meal.
   - **c.** *Highly degradable protein :* Mustard cake and Groundnut cake (GNC).
2. **Chemical treatment (Formaldehyde)**

1. It is most widely used chemical treatment for the protection of protein developed by Ferguson in 1967.
2. In this method 3-4 kg of commercial formalin (37-40per cent) per 100 kg of CP or 1-1.2 g formalin / 100g CP is used.
3. Formalin binding to the proteins by formation of methylene bridge makes them resistant to microbial attachment.

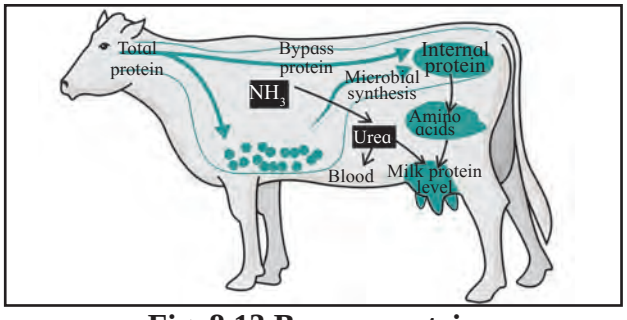


Fig. 8.13 Bypass protein

4. The method is also low cost and feasible.

Advantages

1. Efficient source of protein for ruminants
2. Increases availability of essential amino acids
3. Improvement in milk production
4. Improvement in fat and SNF per cent
5. Better growth in young animals
6. Improvement in reproduction efficiency
7. Better resistance against diseases

8.4 FEEDING OF TOTAL MIXED RATION (TMR)

Dairy rations must contain good-quality forages and concentrate mixture to provide, energy, protein, minerals and vitamins. Feeds must be fed in the right amount and combination to provide a balance of nutrients avoiding excesses or deficiencies.

Remember...

A TMR or total mixed ration is a method of feeding cows that combines forages, grains, protein feeds, minerals, vitamins and feed additives into a single feed mix.

Advantages of TMR feeding

1. Minimizes the selective consumption of feeds by cows.

Fig. 8.14 Total mixed ration (TMR)

2. Reduces the risk of digestive upsets.
3. Stabilizes rumen pH and optimizes rumen digestion.

4. Maximizes rumen fermentation and the production of rumen bacteria.
5. Optimizes milk production and keeps cows healthy.
6. Reduces the work of feeding cows and saves labour costs.
7. Provides more control and accuracy of the feed amounts fed than when feeds are fed as separate ingredients.
8. Small amounts of low quality forages or unpalatable feed ingredients can be successfully fed.
9. Easy to measure daily feed intake of cows.
10. Minimizes feed wastage and reduces the cost of feeding as correct amounts of feed and nutrients can be fed.
11. Grain mixtures can be liberally fed to high producers without overfeeding the cows in late-lactation or lower-producing cows, resulting in more efficient use of feeds.

Disadvantages of feeding TMR

1. To correctly feed a TMR, a mixer is required. Feed mixers with weighing equipment are expensive.
2. Dry forages such as hay or straw are not mixed very well in some TMR mixers.
3. Dairy farms need to group cows to effectively utilize TMR feeding.
4. Cows are fed as a group and cows in the group should be as uniform in milk production and body weight as possible.
5. The equipment must have the capability to thoroughly blend the feed ingredients.
6. The mixer-wagon, preferably mobile, must be capable of accurately weighing each ingredient

Try this...

Visit livestock feed manufacturing company near to you

8.5 COMPLETE FEED BLOCK

A complete feed block has been defined as a system of feeding all ingredients including roughages, processed and mixed uniformly, to be made available *ad lib* to the animals in form of single block.

Fig. 8.14 Complete Feed Block

Advantages

1. Provides a balanced ration to ruminants
2. Feed blocks require lesser storage space
3. Feed blocks are trouble free and easier to transport
4. Less feed wastage
5. Improves productive and reproductive performance
6. Better health status of animal
7. Development of Feed Banks as pre-disaster management measure
8. Better utilization of non-conventional feed ingredients

Disadvantages

1. This method is expensive and requires machinery
2. Requires technical expertise

8.6 HYDROPONIC FODDER PRODUCTION

Hydroponics fodder is a method of growing green fodder without soil in an environmentally controlled houses or machines.

Remember...

Hydroponics is Greek word. Hydro means water and ponics means working.

When hydroponics is used for cultivation of green fodder, seed, water and sunlight are the only inputs that are required as the green fodder is fed to the animals after about 7-10 days of plant growth, which is achieved using the energy reserves of the seed itself.

Maize, barley, oats, wheat, cowpeas, etc., are commonly cultivated using hydroponics to produce high quality nutritious green fodder for dairy animals.

Process

1. **Seed :** Dry the seeds under direct sunlight one day prior to seed washing. Remove broken seeds and dirt's from the seeds and store seeds in a dry and safe place.
2. **Washing of seed :** Take good quality seeds in a washing chamber/ tub. Wash the seeds with proper scrubbing by hand and keep for settling for 5 minutes. Remove the light weight floating seeds.
3. **Seed soaking :** Allow the seed to soak for about 4 -8 hours.
4. **Seed germination/ sprouting :** Transfer the soaked seeds in clean dry fumigated wet gunny bag for sprouting. Keep the seeds loaded gunny bags away from direct sunlight and sprinkle water on gunny bag every 2-3 hours so that the gunny bag remains wet.
5. **Loading seeds in trays and racking :** Ensure that the trays are clean, washed with cleaning solution & are free from any dust / dirt etc. About 1 to 1.25 kg of soaked maize seed is spread out on to each plastic tray. Place the tray in rack in proper arrangement. Spray water intermediately to maintain the relative humidity about 70 per cent. Ensure that all trays receive sufficient water.

Fig. 8.15 Hydroponic maize fodder production

6. **Harvesting :** At the end of 7-8 days the seeds have germinated and have formed plants measuring about 15-20 cm in height. The tray resembles a mat with the roots intermingled and seeds intact. About 5 to 7 kg succulent fodder is produced from each kg of maize. Wash the trays in clean water and then in cleaning solution before reusing it for the next cycle.

Advantages

1. No land/ soil is required.
2. Less water is required.
3. Labour required is less.
4. The green fodder is available within short time, (7-8 days).
5. The yield is not influenced by environment.
6. No interculturing viz. weeding is required.
7. The succulent nutritious green fodder is available throughout the year.

Table 8.5 Chemical composition of hydroponic maize fodder

Parameters	percent content
Dry matter (on fresh basis)	18.30
Crude protein	13.30
Crude fiber	6.37

Q.1. Fill in the blanks

1. Hay should not contain more than ..... moisture.
2. ..... a system of feeding all ingredients including roughages, processed and mixed uniformly, to made available *ad lib* to the animals in form of single block.
3. Hydroponic maize fodder contain ..... per cent crude protein.
4. ..... increases the palatability of feed and thereby improves the feed intake.
5. Chemical treatment (Formaldehyde) procedure for bypass proteins is developed by .....

Q.2 Match the following

Group A	Group B
1. Physical methods	a. pH 3.5 and 4.2.
2. Good Silage	b. pH 4.5 and 4.8
3. Very Good Silage	c . pH 4.2 and 4.5
4. Formaldehyde	d. Soaking in Water
5. TMR	e. By pass fat
	f. Mixing of all required nutrients

Q.3 State true or false

1. Silage is the pickle for dairy animals.
2. Silage should be fed to the calves below 6 months of age and breeding bull.
3. Mustard cake contain highly degradable protein.
4. NaOH + pelleting is physical method of processing of feedstuff.
5. TMR mixers can reduce the work of feeding cows and save labour costs.

Q.4 Answer in brief

1. Write objectives of feed processing.
2. Give examples of naturally protected proteins.
3. Why hay is stored in the form of stack or bail ?
4. What are the forage quality required for hay making.
5. Give difference between very good silage and fair silage.

Q.5 Answer the following questions

1. Write concept of complete feed block.
2. Explain urea treatment method of feedstuff processing.
3. Enlist the qualities of forage crops suitable for silage making
4. Give advantages of TMR feeding.
5. Give advantages of hydroponic fodder production.

Q.6 Answer in detail

1. Write in detail method of silage making.
2. Enlist method of processing feedstuff with example. Explain grinding method.
3. Write in detail procedure of urea molasses treatment.
4. Explain in detail process of hydroponic fodder production.
5. Enlist the different types of silos. Explain in detail Pit silos.