Theme 3: Animal Nutrition and Feeding

ESTIMATING DRY MATTER INTAKE FOR VARIOUS BREEDS/AGE CATEGORIES OF DAIRY CATTLE IN THE TROPICS (Level 3)

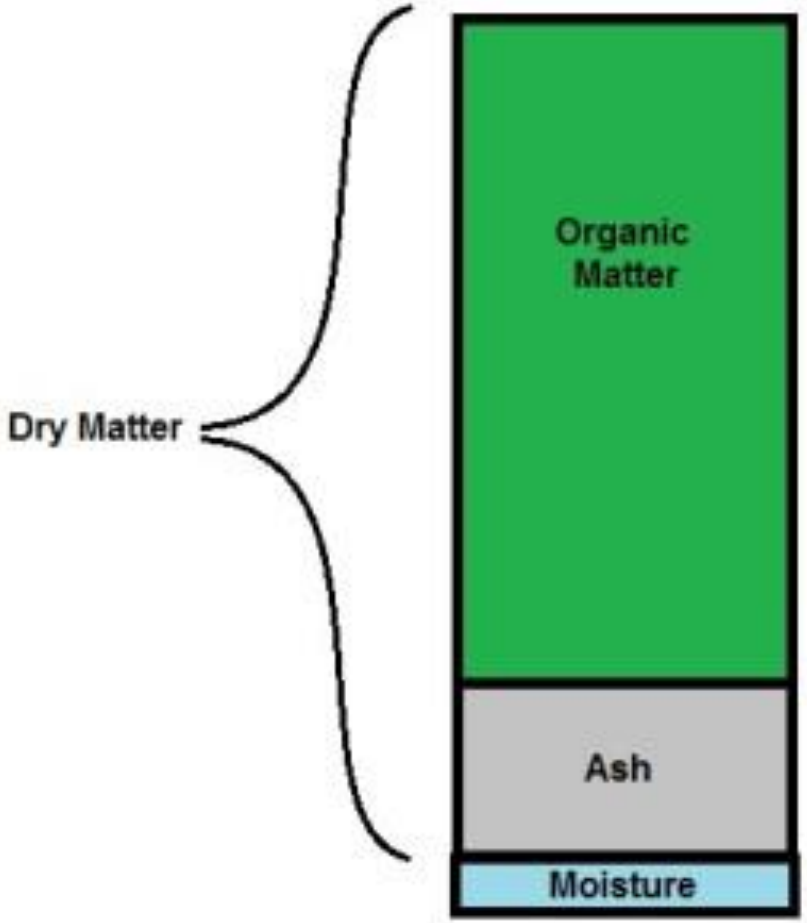
Topic	Training & information Content
3.1	Estimating feeding value of fodder & feed on dairy farms
3.2	Sampling feeds & forages/analysis interpretation
3.3	Estimating Dry Matter intake for various breeds/age categories of dairy cattle in the tropics
3.4	Reviewing feed intake, rumen fill, Body Condition Scoring (BCS)
3.5	Life weight estimation of cows
3.6	Rumen fermentation
3.7	Mineral & vitamin requirement, guidelines
3.8	Manure scoring and evaluation
3.9	Guidelines for ration calculations for various breeds, heifers, lactation stage (Rumen8)
3.10	Use of Rumen8 software for ration calculation
3.11	Optimization of ration with Rumen8
3.12	Feeding management guidelines
3.13	Feeding management of dry cows/close up
3.14	Feeding systems
3.15	Metabolic disorders
3.16	Scoring locomotion and hoof condition
3.17	Mycotoxin in dairy cattle nutrition
3.18	Heat stress in dairy cattle nutrition
3.19	Monitoring feeding management, using KPIs (based on Rumen8)

1. You will learn about (learning objectives):

- ❑ Meaning of dry matter (DM) in feeding.
- ❑ How to calculate dry matter intake (DMI).
- ❑ Dry matter intake requirement for cattle for different ages and breeds
- ❑ The factors affecting dry matter intake in dairy cows.

2. Background

- Dry matter intake (DMI) is the amount of feed a cow consumes per day on a moisture-free basis.
- The nutritive value of feeds and fodder is found in this dry matter part.
- Cows need nutrients for various body functions and requirements for each cow are dependent on various factors.
- Dry matter intake, therefore is the best way of determining amount of feed a cow can consume.
- DMI estimation goes a long way in balanced ration formulation.

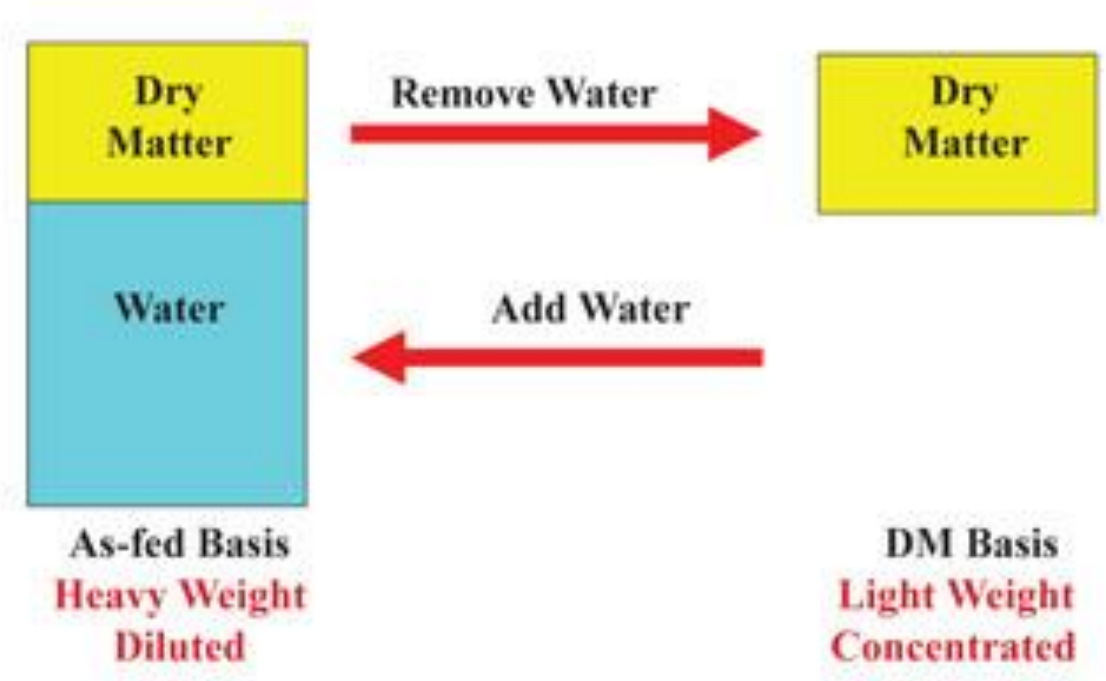


3. Dry matter intake (DMI)

- DMI must be estimated before an animal's ration is properly calculated and formulated.
- DMI is the level of feed intake that an animal actually consumes from a ration.
- This ration should contain the recommended energy content for the cow.
- It is important for DMI to be actually measured or accurately estimated.

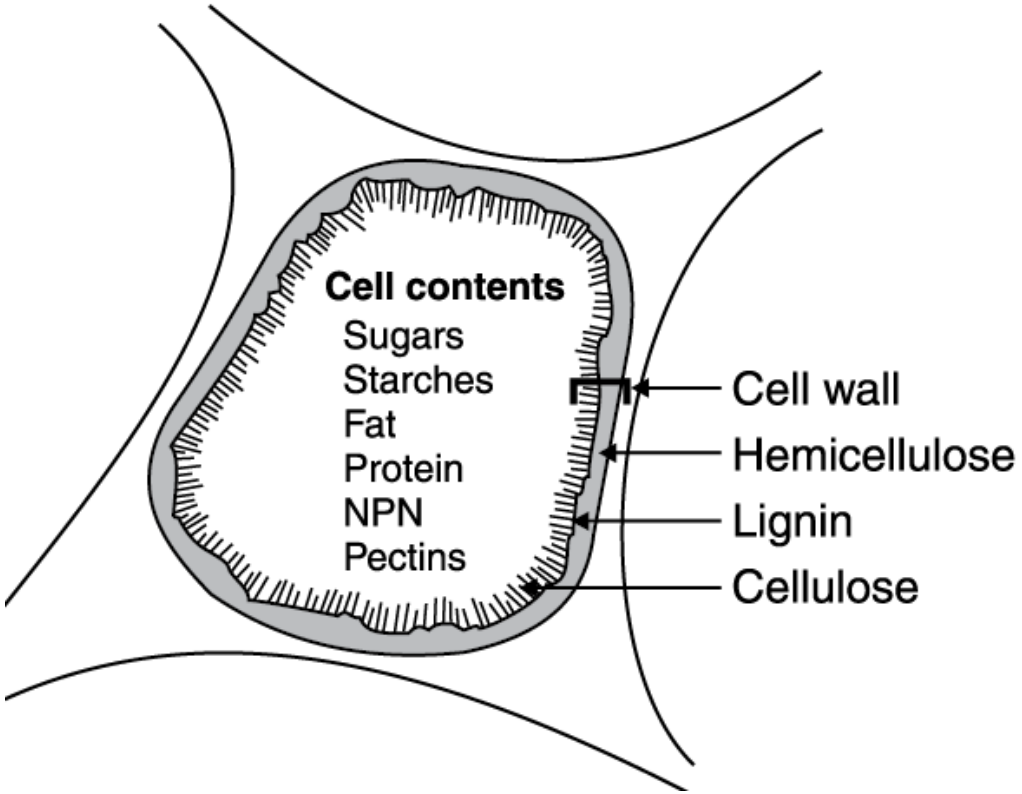
3.1 Dry matter intake (DMI) Cont'd…

- Underfeeding of nutrients restricts milk production and can affect the health of an animal.
- Overfeeding increases feed costs and result in excessive excretion of nutrients to the environment.
- Nutritive value of feed can be estimated as 'per kilogram (Kg) of feed' or as 'per Kg DM of feed'.
- For ruminants expressing feed intake as per Kg DM is advocated.
- The knowledge of DMI is used in formulating rations.



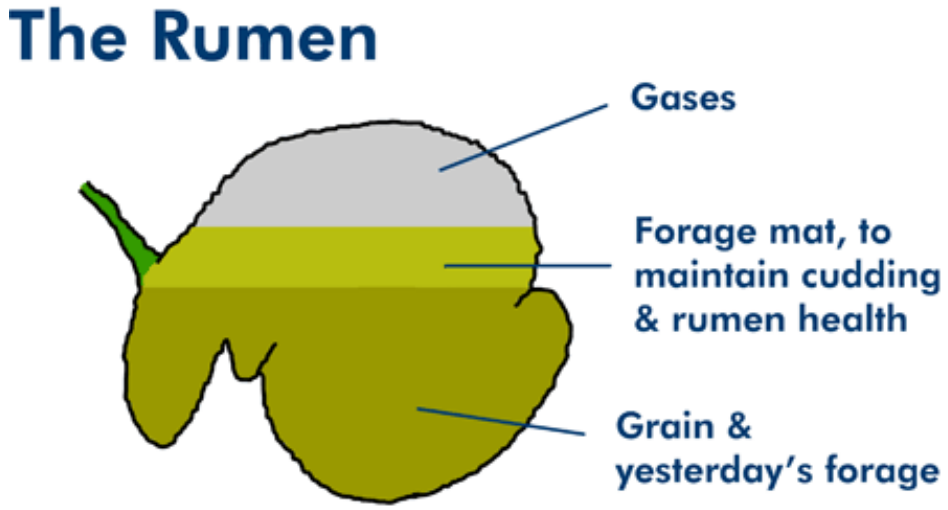
4. Components of Dry matter

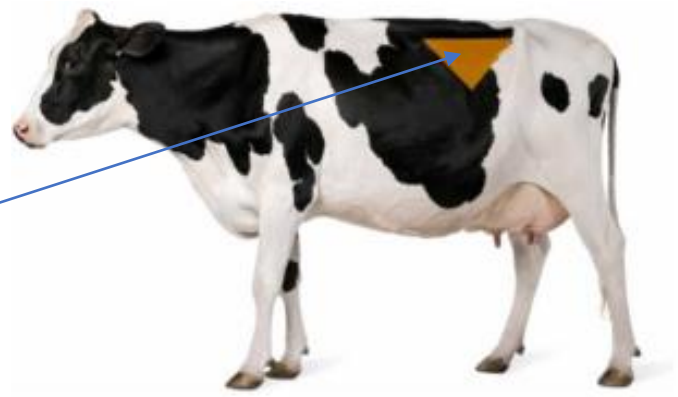
- Includes;
  i. Neutral Detergent Fiber (NDF)
  ii. Effective NDF (eNDF)
  iii. Non-fibrous carbohydrate (NFC)
  iv. Starch (carbohydrate)
  v. Sugar (carbohydrate)
  vi. Crude protein (CP)
  vii. Fats
  viii. Ash: Composed of all of the minerals in the feed.
    - Calcium (2% of ration DM), Copper, Phosphorus, etc.



5. Relation between Rumen fill and DMI

- The Rumen fill is defined as the total amount of liquid and dry matter in the rumen.
- It is also related to DMI, ration composition, digestibility, and the rate of feed passage.
- Rumen fill constitutes previous fed feeds, recent feeds, water and gases produced.
- Rumen being filled (rumen fill) doesn't mean nutritional requirement has been met.

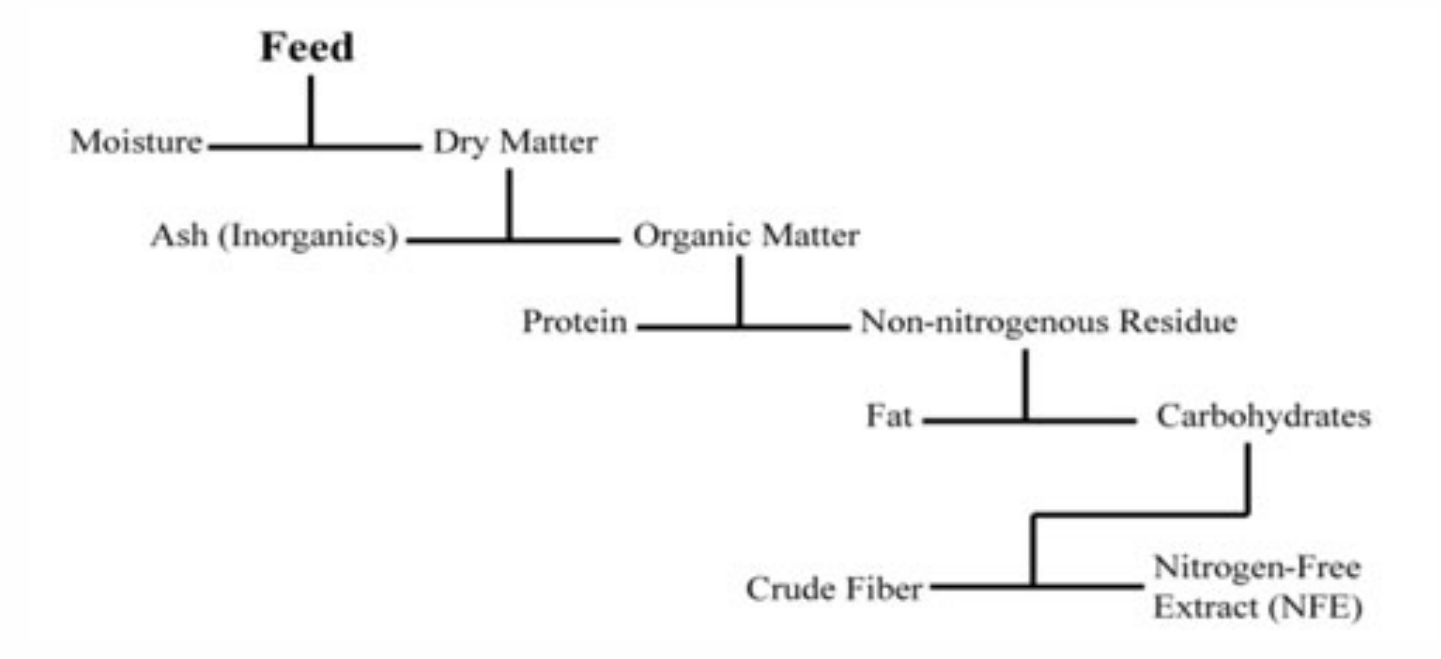




Observe triangle to estimate rumen fill score

6. Dry matter (DM) contents fed to cows

- DM content is what remains after all the moisture is removed from a feed. However, it is impossible to get rid of all the moisture in feed.
- Fresh pasture has high water content and will have a lower percentage of dry matter content.
- Dry feeds have lower moisture content. Examples; hay, grains/concentrates.
- DM is an indicator of the amount of nutrients that are available to the animal in a particular feed.
- DM constitute of several components of organic and inorganic matter.



7. Calculating Dry Matter Intake

- Depending on data available, DMI is equated to either;

DMI = 3 % of animal live weight

OR

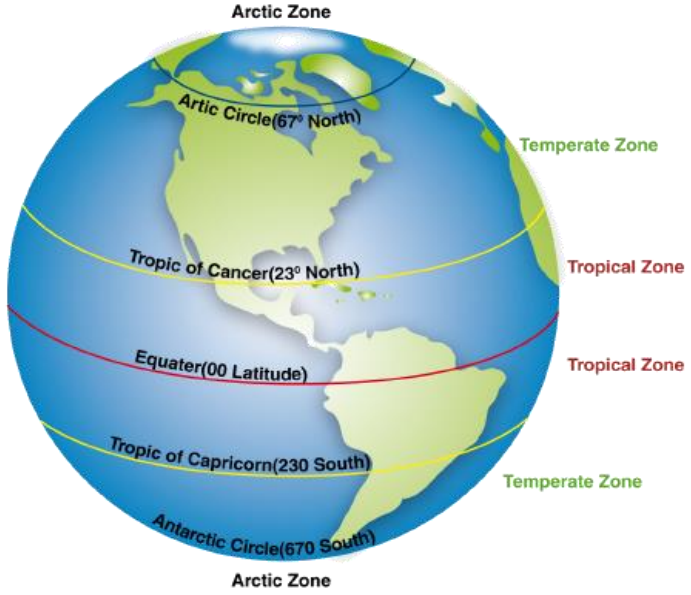
DMI = Quantity of feed consumed × DM of feed

OR

DMI = 120/NDF%

7.1 Calculating Dry Matter Intake Cont'd…

- Cows that are fed purely on tropical forage content may not achieve a DMI of 3% of the cows live weight.
- On tropical forages/rations in the formula (DMI = 120/NDF%), the factor 120 may be substituted by 130.
- Tropical forage has more fiber than temperate forages.
- The temperate forages have more nutrients content (e.g. sugars) than the tropical forages.
- East Africa region is in the tropical region.



8. Dry Matter content in different feeds & forage

- Comparing different forages without using the percent of dry matter as a baseline would be impossible for ruminants.
- The DM of fermented feeds (haylage and silage) often is underestimated because of the volatile fermentation products utilized by the animal.
- DM is also important in determining how forage will preserve when stored by baling or ensiling.
- Farmers are advised to reduce the moisture content in forage before preservation. This can be done by wilting forages (silage making), sun drying (hay) or artificial drying (Lucerne pellets).

9. Example of DMI Calculation

- To meeting DMI and nutrient targets for cattle, DMI (Kg) should be determined.
- If total DM intake is unknown, use the rules of thumb for DM intake.

Example:

A 600 kg cow will need at least 18 kg of DM per day.

that is;

Daily DM intake: 600 kg × (3% ÷ 100) = 18 kg DM/day

Formula:

$$\frac{Dry\ Sample\ Weight\ (g)}{Wet\ Sample\ Weight\ (g)} \times 100 = \%\ Dry\ Matter$$

$$100\% - \%\ Dry\ Matter = \%\ Moisture$$

Example:

$$\frac{85\ g}{100\ g} \times 100 = 85\%\ Dry\ Matter$$

$$100\% - 85\% = 15\%\ Moisture$$

10. Estimate dairy DMI of feed (kg)

- The DMI of some feeds (such as grains, hay and silage) can be calculated by weighing the amount offered per cow.
- Then use their DM% to calculate the DMI of each feed.
- To estimate pasture intake (grazing system case), subtract the known intakes of concentrates, hay and silages from estimated total DMI.

Example;

A 600 kg cow can be fed on:

- 6.7 kg grain (90% DM) as-fed basis
- 13.3 kg maize silage (30% DM) as-fed basis
- Kikuyu grass pasture (grazed)

10.1 Estimate dairy DMI of feed (kg) Cont'd…

From the example, calculations for DMI for individual feeds is as follows;

- Grain DM intake:
  - 6.7 kg as-fed x (90% DM ÷ 100)
    = 6 kg DM/day.

- Silage DM intake:
  - 13.3 kg as-fed x (30% DM ÷ 100)
    = 4 kg DM/day.

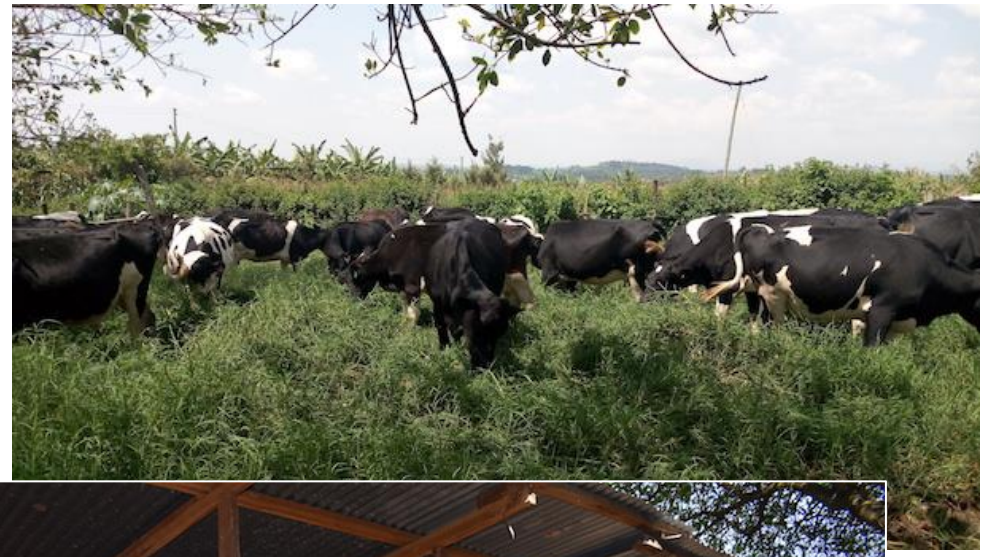
- If a 600 kg cows should eat 18kg DM/day then:
  Expected DM of grazed Kikuyu grass = 18-(6-4)
  = 8kg DM /20% = 40kg as fed of grazed kikuyu.

11. Factors affecting Dry matter intake in cows

i. Animal factors
   - Breed of the cow
   - Weight
   - Age
   - Stage of lactation and milk production levels
   - Health of the cow
   - Cow behaviour and eating habits

ii. Environmental factors, e.g. that causes heat stress.

To estimate pasture intake (grazing system case), subtract the known intakes of concentrates, hay and silages from estimated total DMI.



11.1 Factors affecting DMI of the cows Cont'd…

iii. Feed factors and Farm management;

- Feeds access/availability to the cow
- Feed quality
- Moisture content in the feed
- Neutral detergent fiber (NDF) percentage in the feed
- Feeding frequency and sequence
- Forage to concentrate ratio in the ration
- Water quality and accessibility.

12. Different DM requirements for various breeds of cows

- DMI vary in various breeds due to the following components;
  - Average milk production levels
  - Average butter fat content in milk
  - Average protein content in their milk
  - Average mature weight
  - Different physiological status

- Due to these, every breed has different DMI requirements.

Different breeds of cattle

12.1 Different DM requirements for various breeds of cows Cont'd: Friesian breed

- **Potential yield:** 20-25 litres milk/day, 3.6% butter fat.
- **Average body size:** Large (550-600 kg)
- **Description:** Black and white short haired coat, short horns.

- Example of the estimated DMI of Friesian cattle is as follows;

DMI = 3% of animal live weight
= 3% of 650kg for mature Friesian cattle
= 19.5kg of DMI

12.2 Different DM requirements for various breeds of cows Cont'd: Jersey breed

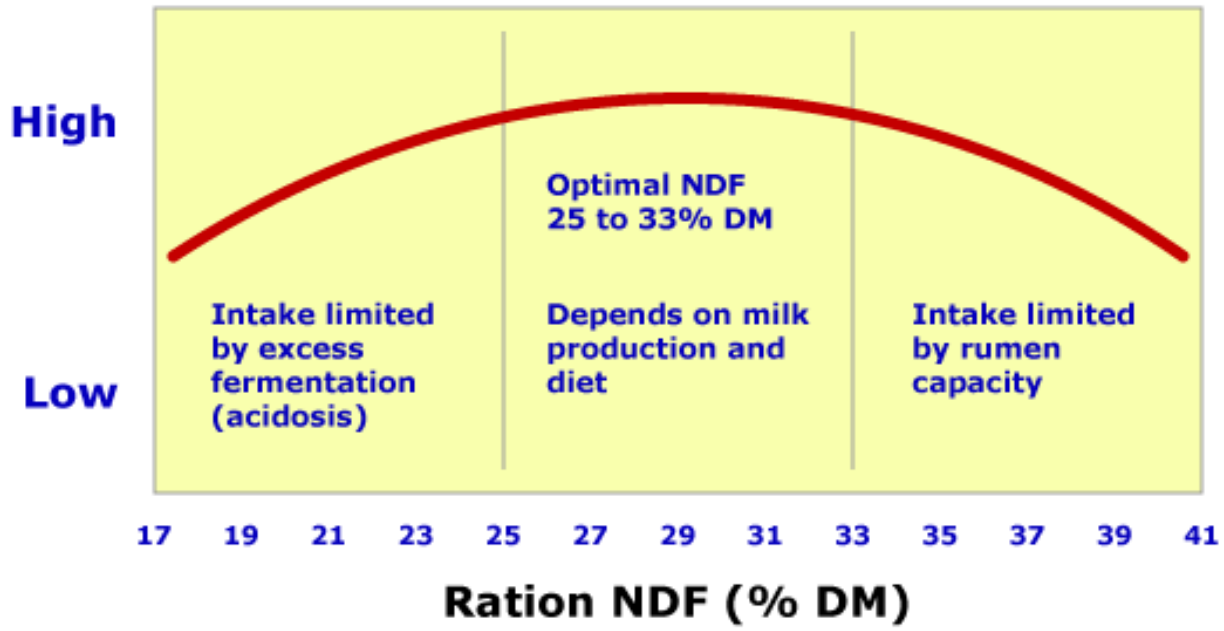
- Jersey cattle are typically light brown, grey to dull black and might have white patches. Jersey cattle have a black nose bordered by an almost white muzzle.
- **Average yield:** 22 litres/day and 6.3% butter fat.
- **Average body size:** Small - medium (350 Kg)

- Example of the estimated DMI of Jersey cattle is as follows;

DMI = 3% of animal live weight
= 3% of 350kg for mature Jersey cattle
= 10.5kg of DMI

13. How Neutral detergent fibre (NDF) affects DMI

- NDF in forages and the total ration influence DMI.
- Basically the more fibrous the less the intake since the cow's rumen gets full fast.
- Rations need to be balanced i.e. to contain sufficient and effective NDF for healthy rumen function.
- Rations with a high fiber content slow down digestion which limits feed intake.



13.1 How Neutral detergent fibre (NDF) affects DMI Cont'd…

- There are three rules of thumb for determining NDF intake:
  i. Optimum intake is achieved when NDF content of the total ration is within a range of 28% to 34% of total ration DM.
  ii. Maximum NDF intake from forage should equal 1% of the cow´s body weight.
  iii. Maximum intake of NDF in the total ration should equal 1.3% of the cow's body weight in the tropics.

14. Using Neutral Detergent Fibre (NDF) to predict DMI

- An accurate way of measuring dry matter intake is using the Neutral Detergent Fibre (NDF) value.

- To get this figure you can use an ‘average’ value from a feed nutrient analysis table or ideally use the value obtained from a feed analysis you have taken.

- The base equation is as follows:

  130/NDF of the feed = % of body weight used to determine the dry matter intake of that feed.

14.1 Using NDF to predict DMI Cont'd…

- If we have Lucerne hay and the feed test report states the NDF value as 33.8%. How much Lucerne hay can a 300 kg Jersey consume a day?

130/33.8 (NDF) = 3.8% of body weight as dry matter
= 300 x 3.8%
= 11.4 kg DM/day consumed

15. Age factor in estimation of DMI

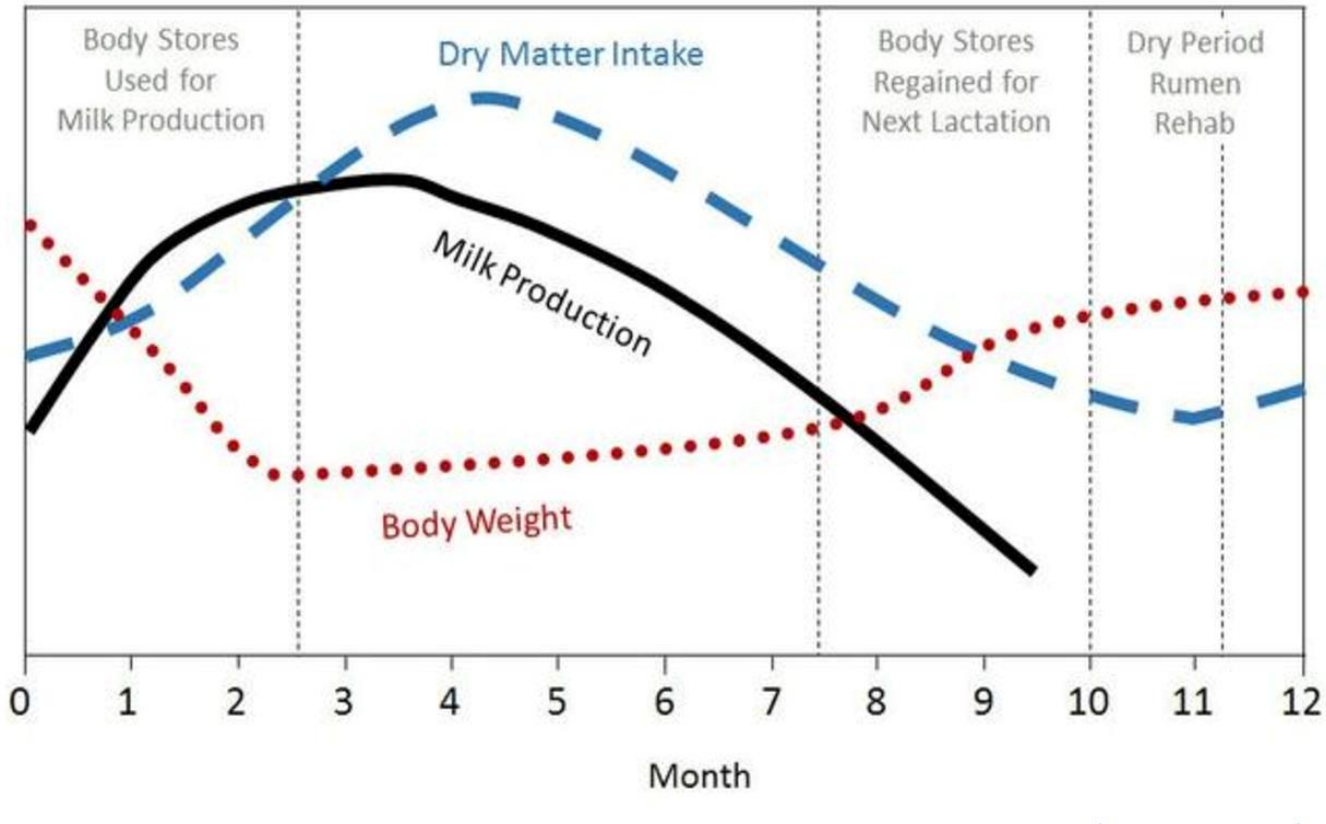
- Young stock feed requirement is calculated differently compared to mature cow.
- Before 4 months the rumen is underdeveloped so calves tend to feed less DMI than after weaning when the rumen is functional.
- As heifers grow, their requirements change the feeding levels.
- Matching the type of feed and its composition to a heifer's nutritional requirements is key to meeting growth targets.

15.1 Age factor in estimation of DMI Cont'd...

- Before weaning, the rumen capacity of calves are limited, hence high energy, high protein rations with less fibre content are critical.
- Their feed requirement is different in every stage of young stock; weaners, yearlings and bulling heifers.
- It is more important to consider the nutrient density in this stage.

16. Stage of lactation and level of milk production in DMI

- Cows consume feeds to meet their nutrient requirement (energy, protein etc).
- DMI can be driven by stage of lactation and level milk production.
- Milk production (energy expenditure) usually peaks 4 to 8 weeks postpartum.
- Peak DMI (energy intake) lags until 10 to 14 weeks postpartum.
- This determines nutrient content in the DMI required by individual cow.



17. Health of the cow in determining DMI

- Animal's health status is often associated with changes in feeding behavior.
- When DMI is not enough over longer time (underfeeding) the cow’s health declines.
- Illnesses affect DMI by reducing feed intake. Some forms of illness are likely to reduce appetite especially at the onset of disease.
- Common diseases such as metabolic disorders, mastitis, clinical lameness, endometritis and more cause low DMI.

18. Feed & farm management factors affecting DMI

- Access to feed affects maximal DMI. This is when cows have access and adequate time for eating.
- Behavior at the feed bunk is often affected by social dominance affecting intake in some cows.
- Feeding method factor: Comparison of DMI in a total mixed ration (TMR) with individual/single ingredient feeding. TMR is recommended because nutrients can be effectively supplied by feeding TMR without the cow selecting feed.

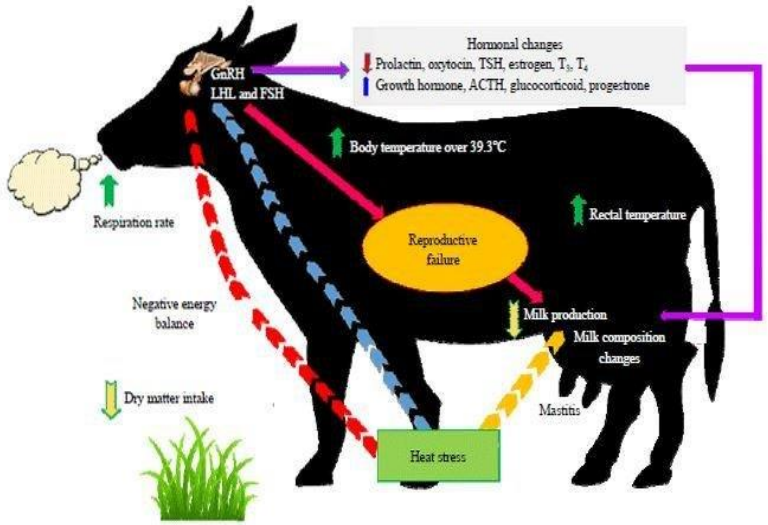
18.1 Feed & farm management factors affecting DMI Cont'd…

- Increasing the frequency of offering feeds to cows increases DMI per day.
- Feed quality and palatability; These are affected by the freshness, molds, spoilage, taste, moisture and temperature of the feeds.
- The moisture content in the feeds may affect the feed intake of the cow.

19. Other environmental factors affecting DMI

- The DMI of lactating cows is affected by environmental conditions outside the thermal neutral zone (4 to 22°C).
- The DMI decreases when ambient temperature exceeds 25°C, cattle experiences heat stress.
- Heat stress causes low DMI, 10 to 35% reduction in milk production and metabolic disorders.
- Providing clean water, shade and proper ventilation are critical in lowering incidences of heat stress.

Further reference: Module on Heat stress in dairy cattle nutrition.



20. Water intake affecting DMI

- Drinking water is important in cooling the cow's body during heat stress and quenching its thirst.
- The water quality and accessibility determines water and feed intake.
- Low water intake discourages feed intake and affect DMI.
- A mature dairy cow can consume more than 100 litres per day of water depending on level of milk production.
- Moisture in feeds influences intake of water.

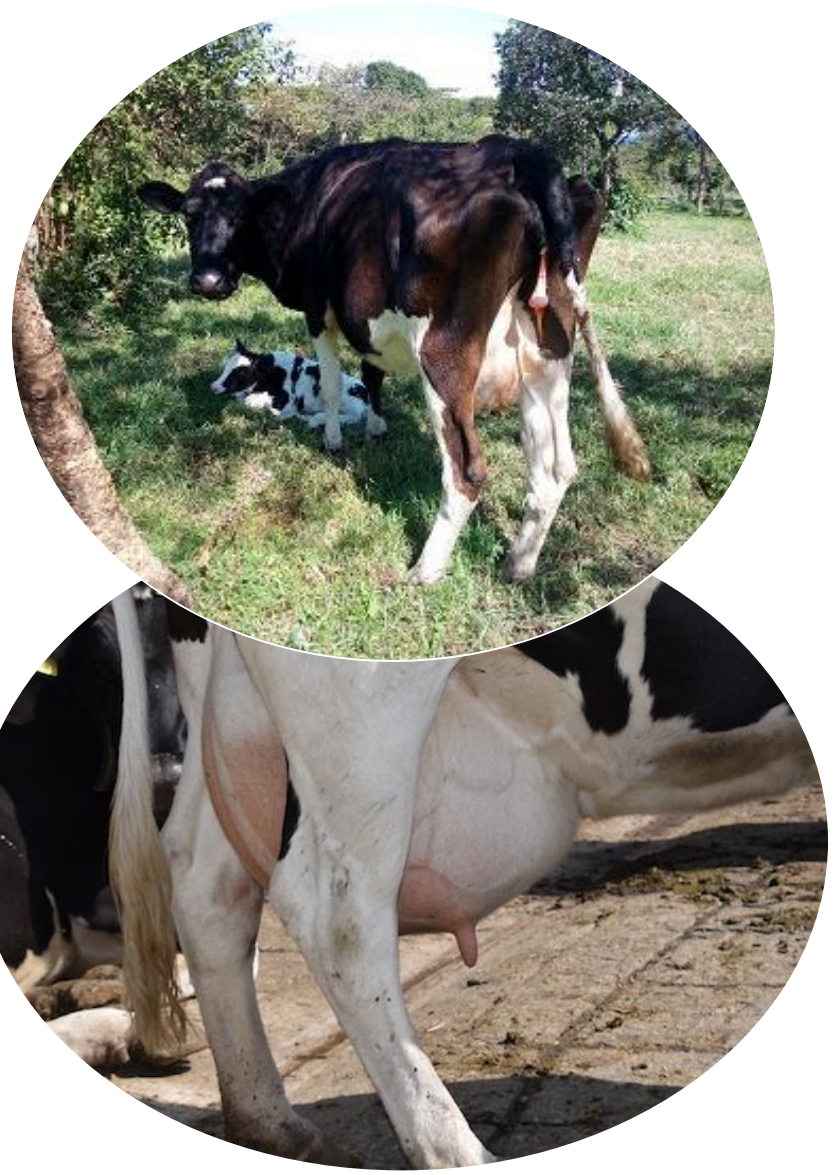
21. Importance of meeting the cow's DMI requirement

i. It minimizes metabolic disorders, weight loss and improves reproductive performance.

ii. A dairy cows tends to improve milk production, have stable health and body condition.

iii. Helps a farmer to meet his/her target in the dairy enterprise hence profitability.

In other words, when the ratio of nutrients absorbed is incorrect, negative metabolic-feedback impacts DMI.



22. Take home messages: Summary

1. DMI content is important since all nutritional requirements of the animal are made on a DM basis.
2. Identifying/estimating the dry matter intake of a cow helps to formulate a balanced ration.
3. Total mixed ration helps dairy cows achieve maximum dry matter intake.
4. Grouping cows according to their nutrient requirements can reduce the variation in DMI among cows within the group.
5. Feeding a cow on the right amount DM content is advantagious in maintaining the rumen function for a healthy cow.

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