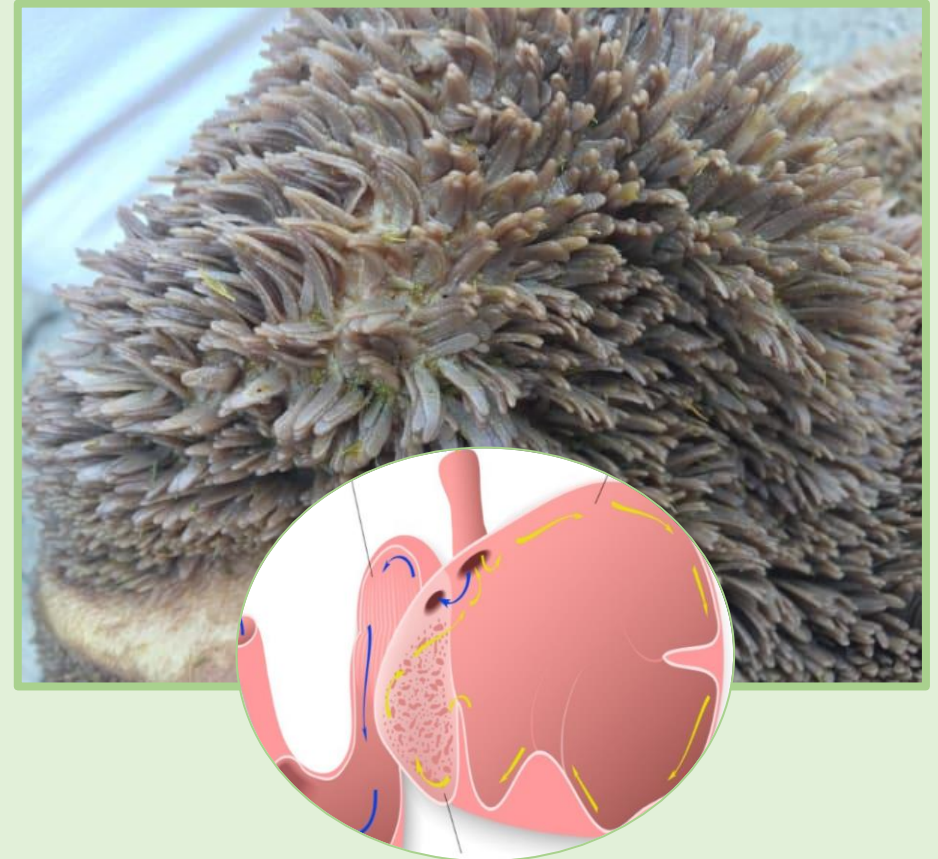


# RUMEN FERMENTATION

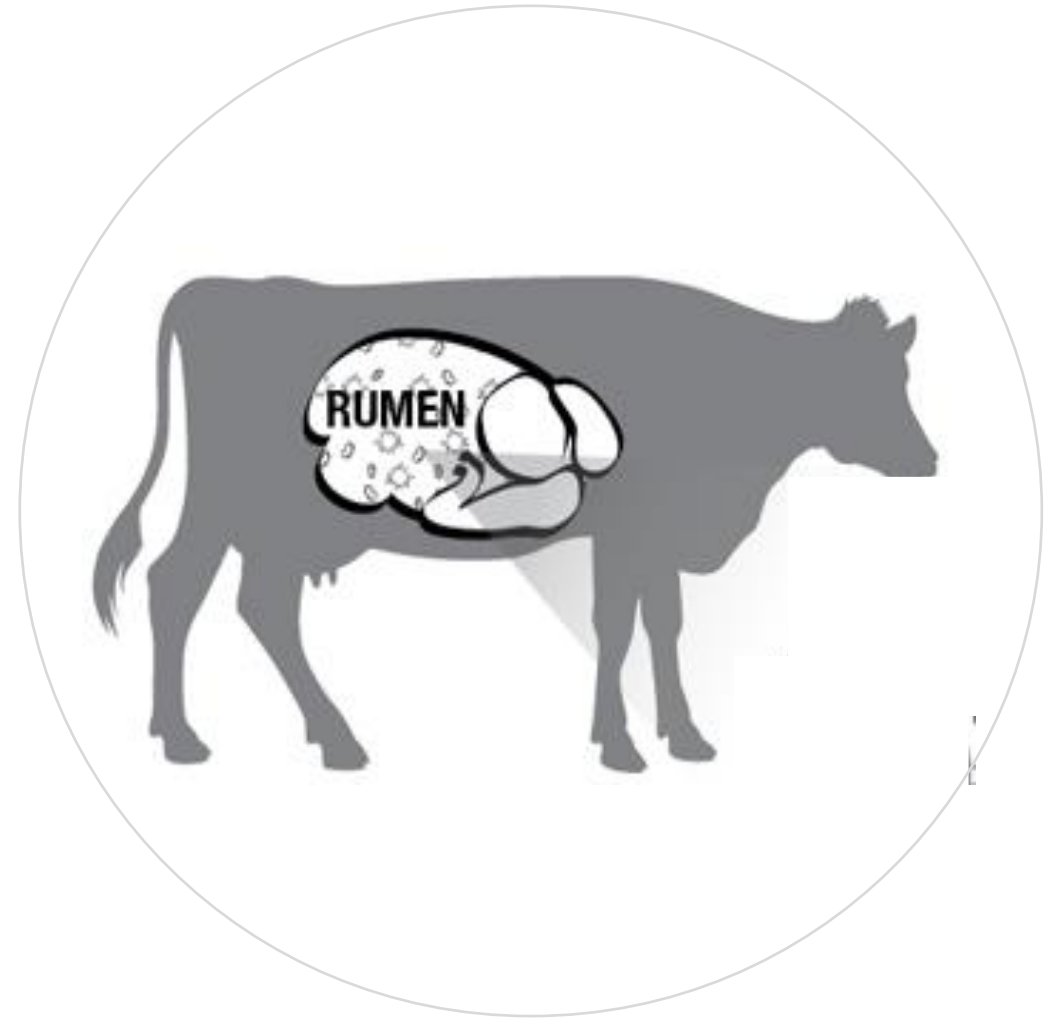
## (Level 1)

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)



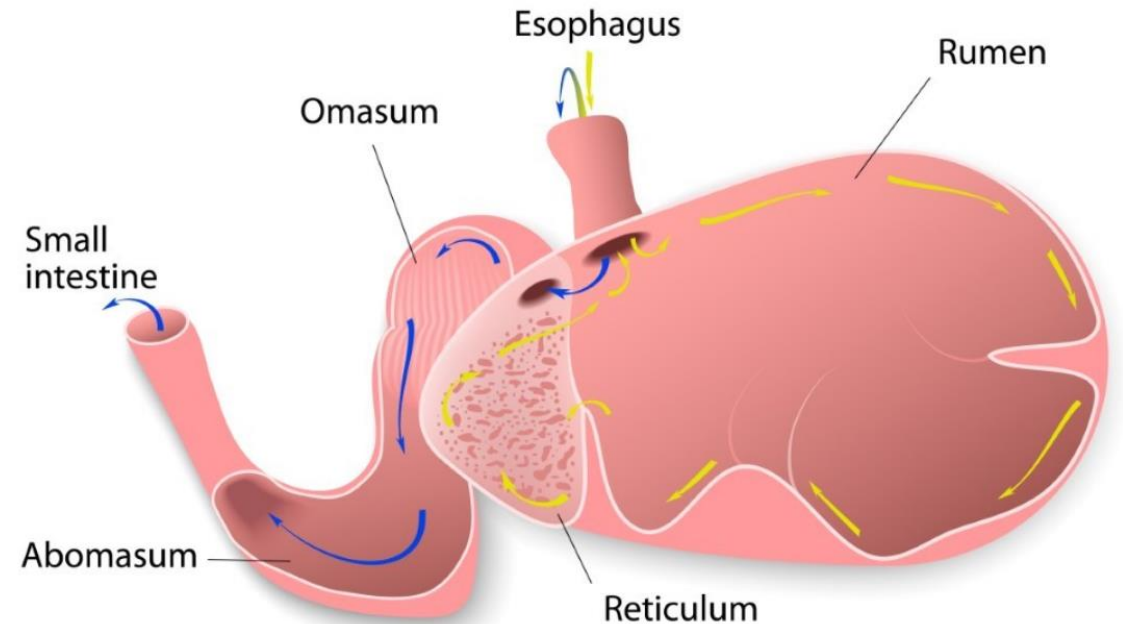
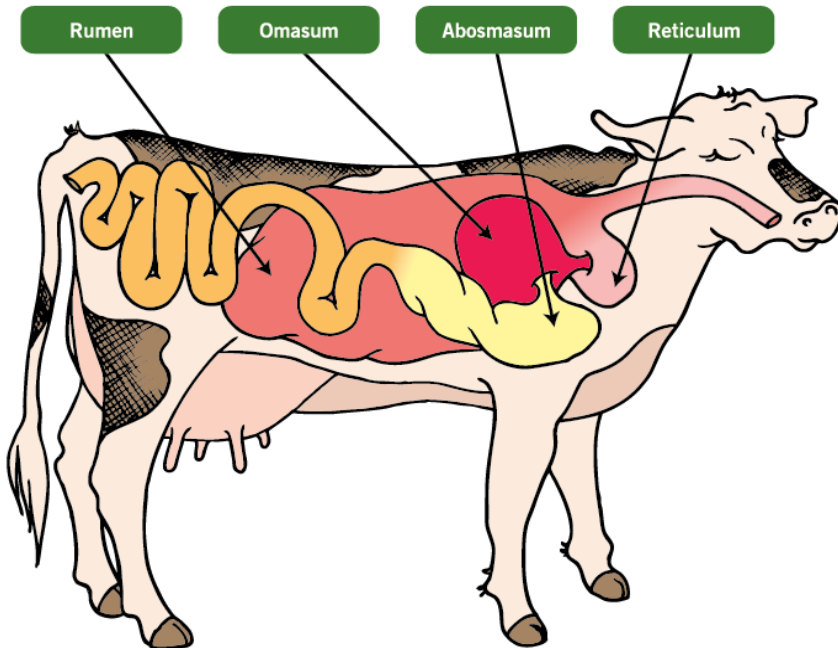
## 1. You will learn about (learning objectives):

- The rumen as one of the most important parts of the cow's digestive system.
- How the rumen functions and its ecosystem; rumen microorganisms.
- Fermentation processes in the rumen and factors affecting it.



## 2. Introduction

- A cow's digestive system consists the reticulum, omasum, abomasum, rumen and intestines.
- Major fermentation processes starts and occur in the rumen.
- Rumen fermentation process converts ingested feed into nutrients e.g. energy.
- The rumen depends on microorganisms for fermentation/digestion of feeds i.e., bacteria, protozoa, and fungi that coexist with the cow.

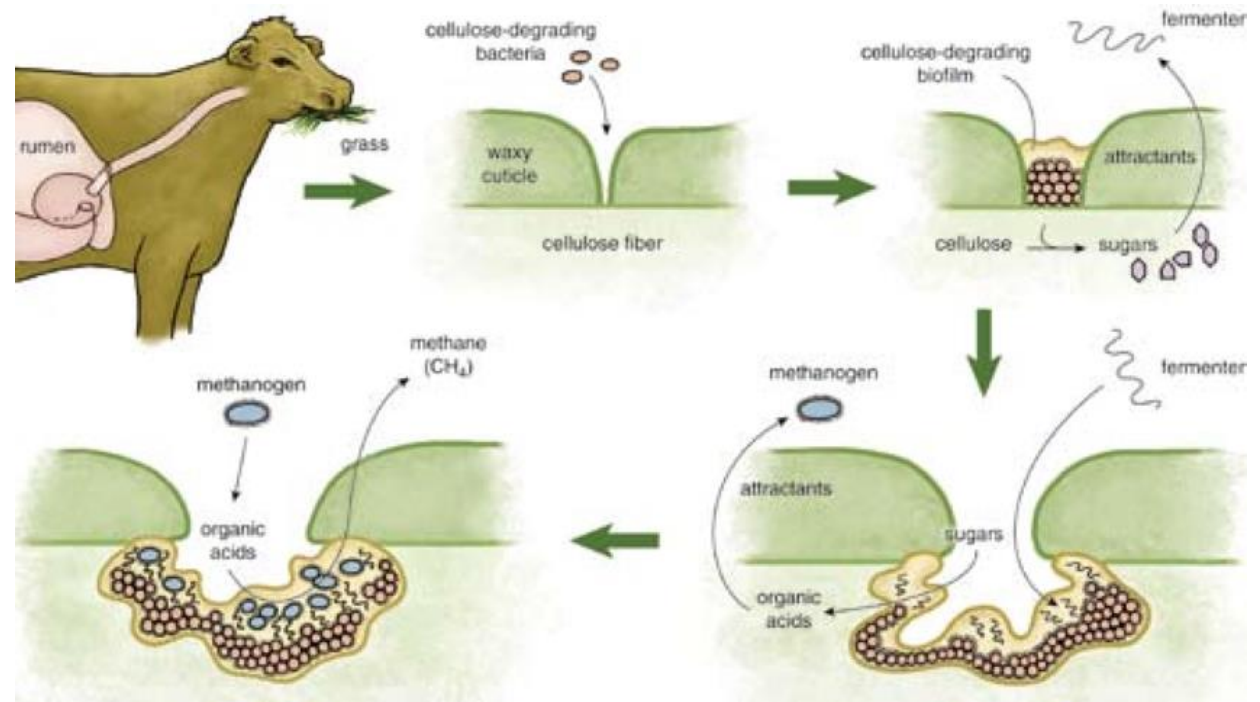


### 3. The rumen microorganisms

- These are grouped into two:
  - The slow-working fiber-digesters
  - The fast-working microorganisms

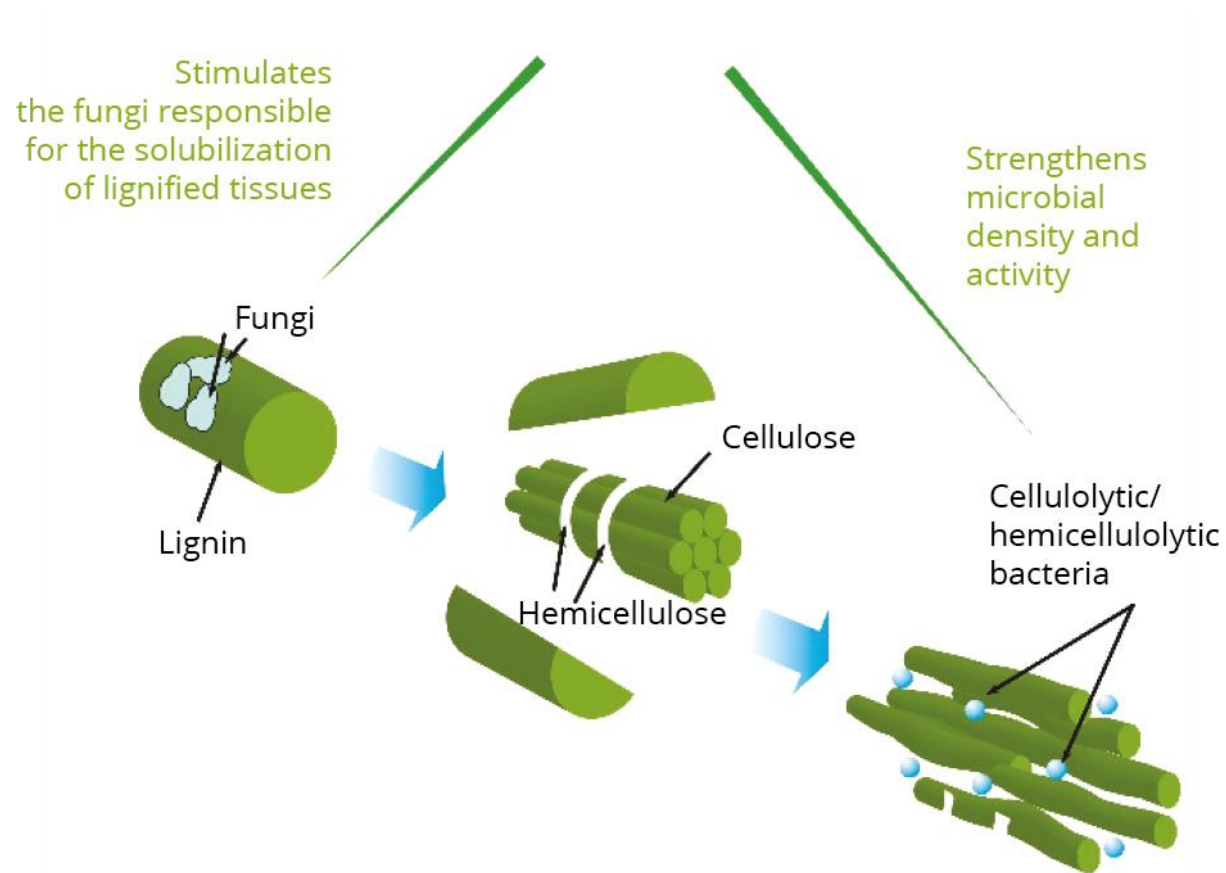
#### Bacteria

- The rumen bacteria have different functions depending on what they act on.



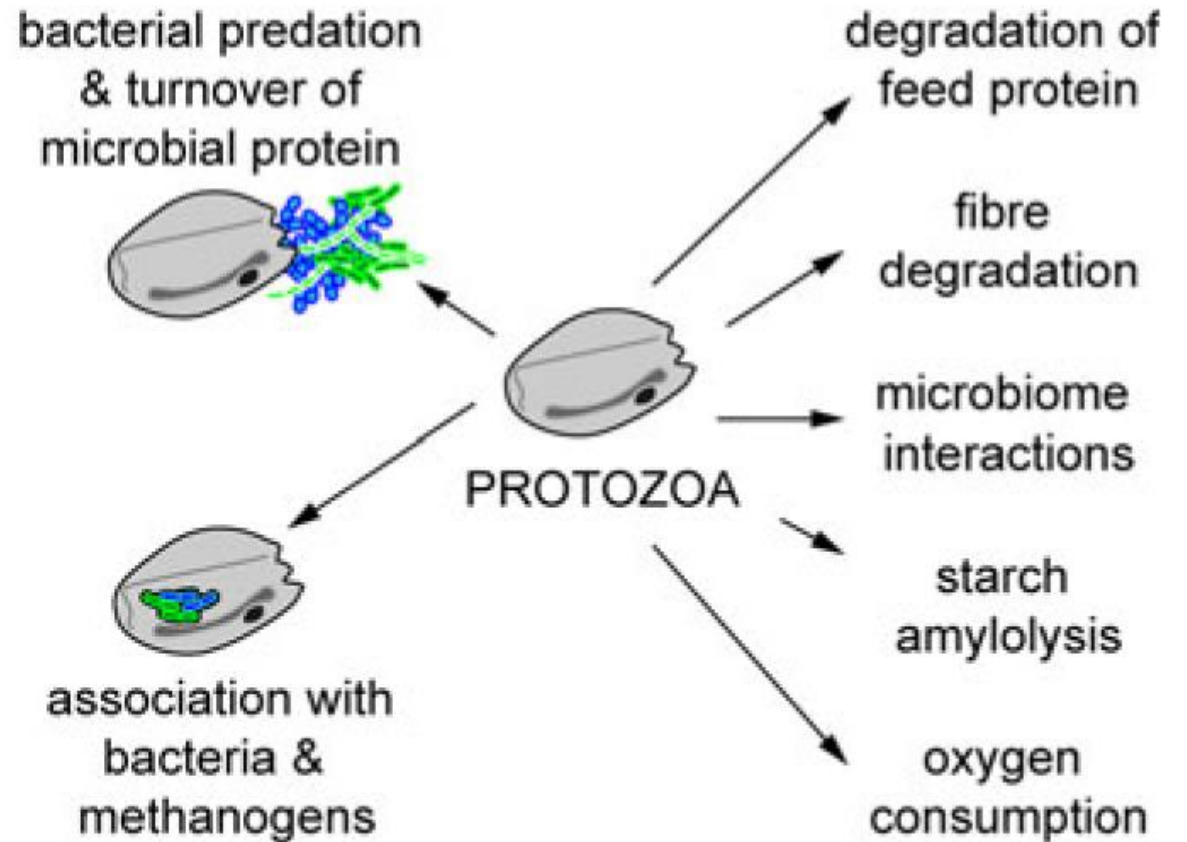
## 4. Rumen microorganisms: Fungi

- Fungi represent a small proportion in the rumen ecosystem.
- Rumen fungal populations are favored by the consumption of highly lignified fibrous forage.



## 5. Rumen microorganisms: Protozoa

- Protozoa digest and ferments cellulose, carbohydrates and protein.
- Protozoa also ingest bacteria and feeds particles.





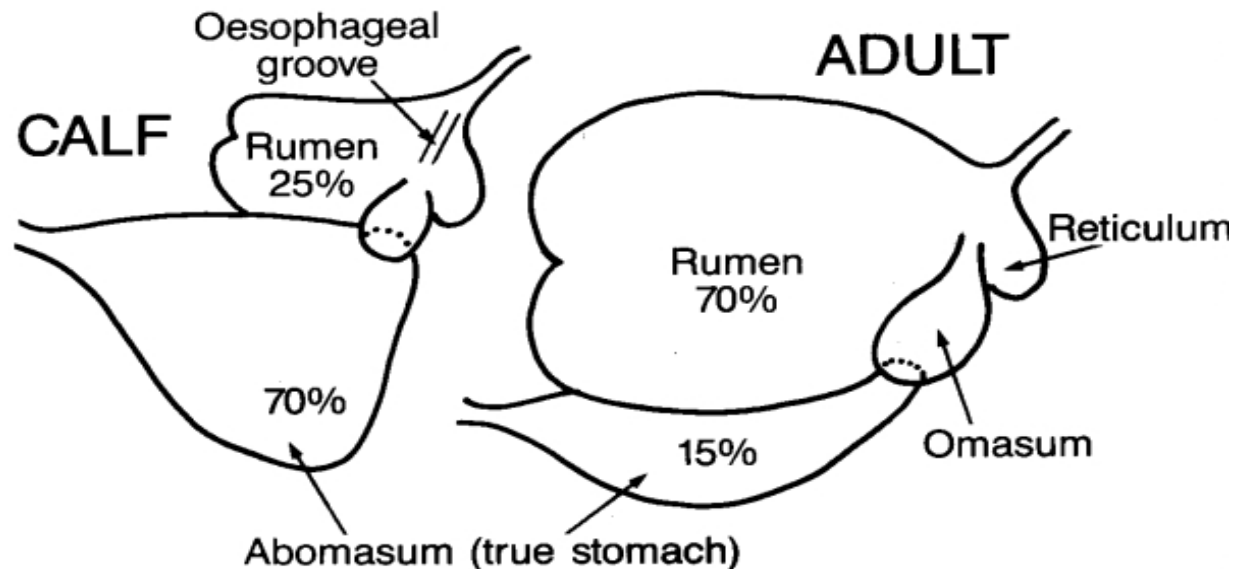
## 6. Features of the Rumen

- The interior surface of the rumen forms numerous papillae that vary in shape and size.
- Rumen is the largest chamber and has regular contractions to move food around for digestion.
- It also send foods particles back to the mouth for remastication (chewing cud).



## 7. Rumen function in young stock

- The very young calf has a single stomach (abomasum).
- Rumen development in calf starts from 3 weeks of age and continues into the 4<sup>th</sup> month.
- To aid rumen and rumen flora development, introduce fibrous feeds and concentrates to the calf in the **second week** after birth.



Undeveloped rumen (Day 0)



Developing rumen (Week 18)



Developed rumen (24 months)

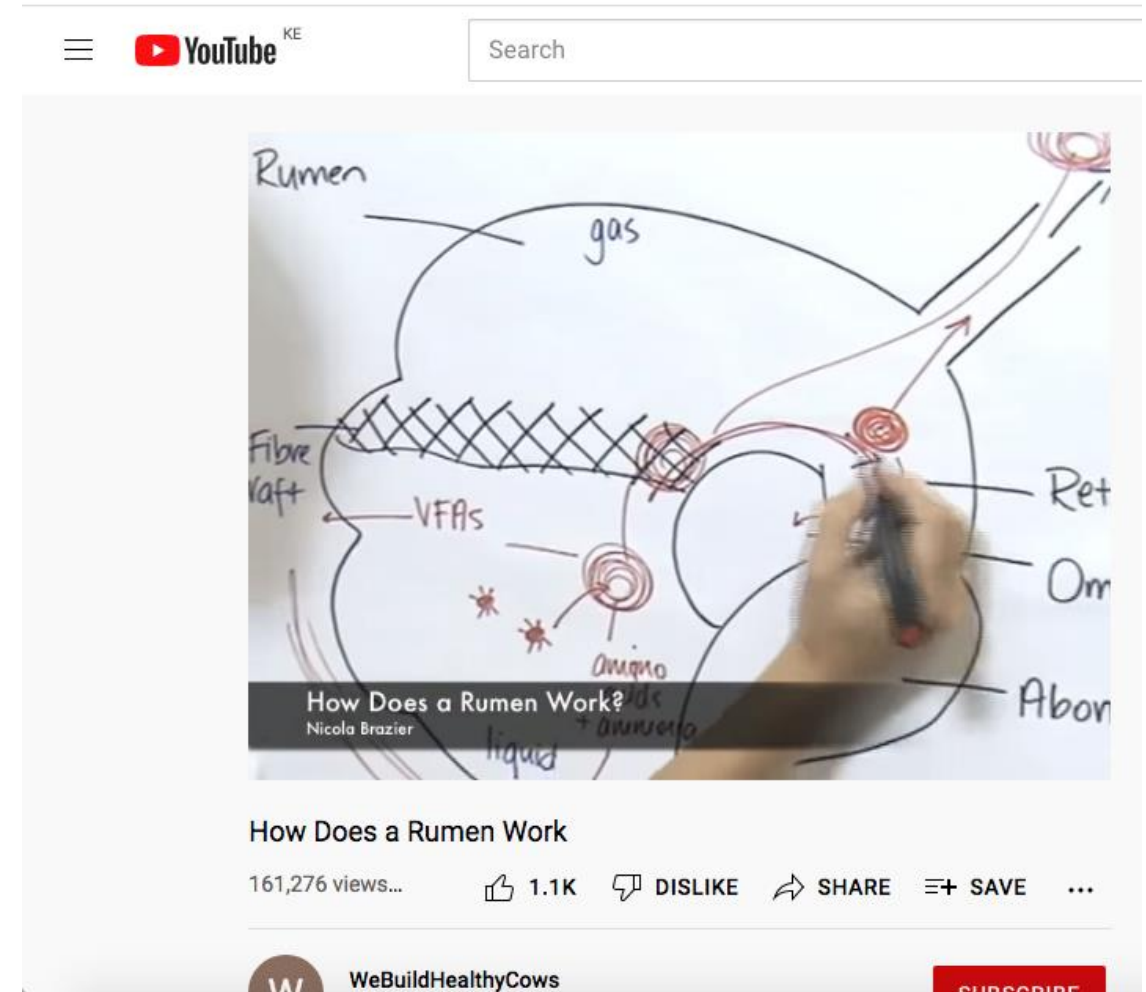


## 8. Rumen fermentation process

- The rumen microorganisms produce enzymes necessary for fermentation processes.
- This allows ruminants to efficiently obtain energy contained in forages. Some other final products are methane gas and excess ammonia.

Watch video:

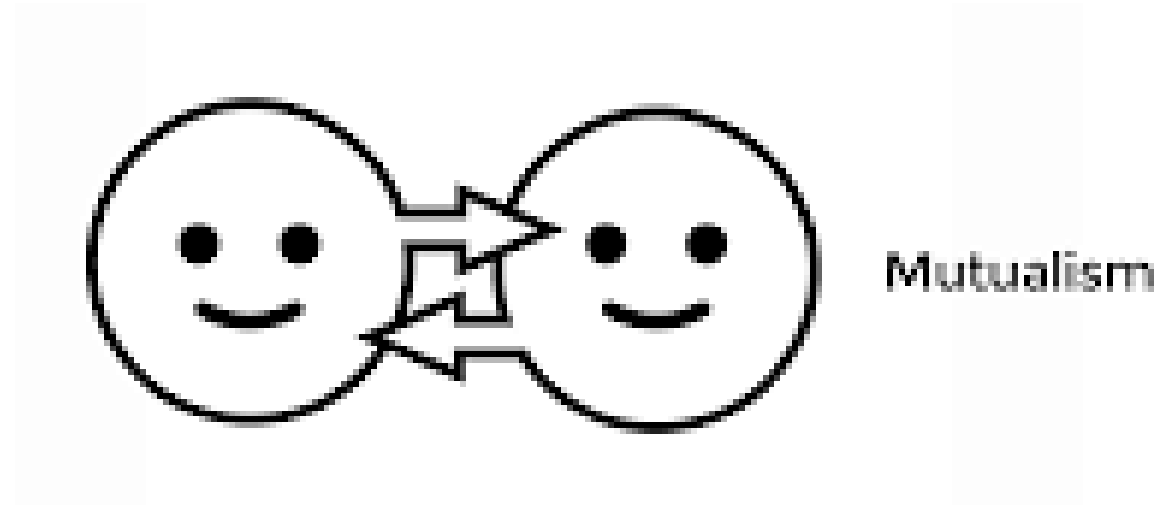
<https://www.youtube.com/watch?v=muf8ZA3F2mA>



The image shows a YouTube video player interface. At the top, there is a search bar and the YouTube logo. The video content is a hand-drawn diagram of the rumen, showing the flow of material from the mouth through the rumen, reticulum, omasum, and abomasum. The diagram is labeled with 'Rumen', 'gas', 'Fibre left', 'VFAs', 'Ammonia', 'Ret', 'Om', and 'Abom'. A hand is visible in the foreground, holding a pen and pointing to the diagram. Below the video, the title 'How Does a Rumen Work?' is displayed, along with the channel name 'Nicola Brazier'. The video has 161,276 views, 1.1K likes, and options for dislike, share, and save. The channel name 'WeBuildHealthyCows' is visible at the bottom, along with a 'SUBSCRIBE' button.

## 9. The symbiotic relationship

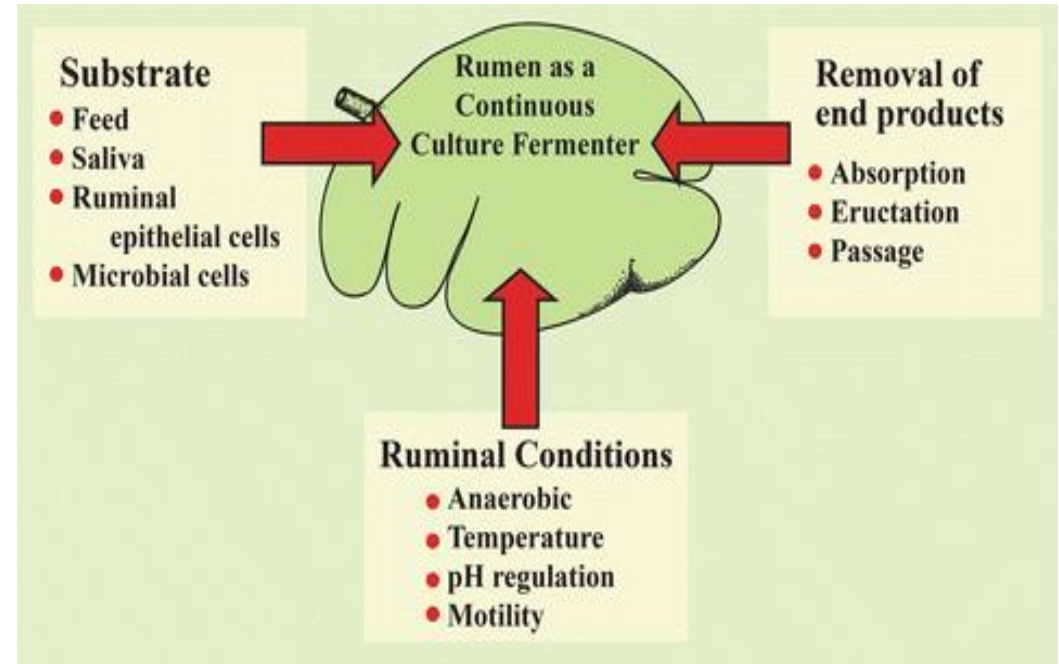
- Interaction between microorganisms and the host animal results in a symbiotic/mutual relationship.
- The host feeds on plant fibers, which can only be degraded by the rumen microorganisms.



## 10. Microorganisms coexisting conditions

The microorganisms co-exist under the following conditions:

- i. The chewing of cuds and saliva.
- ii. The quality, nutrients and consistency of feeds.
- iii. The rumen temperature.
- iv. The rumen pH levels and regulation.
- v. The anaerobic conditions (no oxygen in the rumen).

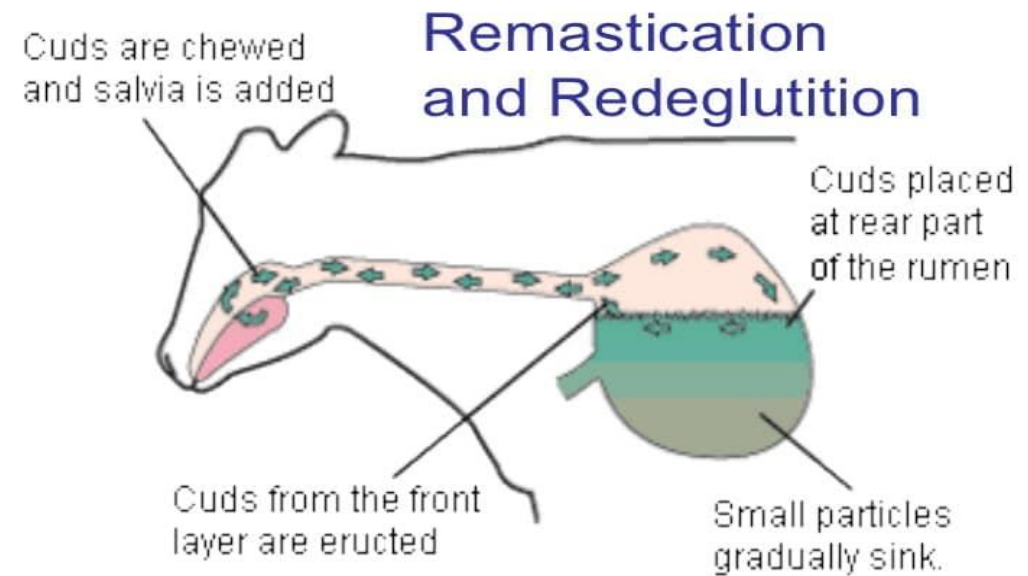


\*Motility = Movement, contraction  
\*Eructation = Belching

## 11. Rumination/chewing of cud

- Food stored in the rumen is sent back up to the mouth through the esophagus to be re-chewed.
- This further reduces feed particle size, enhancing microbial function and feed passage.
- The produced saliva buffers the rumen to enhance microbial growth and development.

Remastication = Repeated chewing of the cud  
Redeglutition = Swallowing food





## 12. Effective fiber content in feeds

- Effective fiber, which forms the rumen material is required for optimal microbe production.
- These effective fiber stimulates cud chewing and production of saliva for buffering the rumen pH.



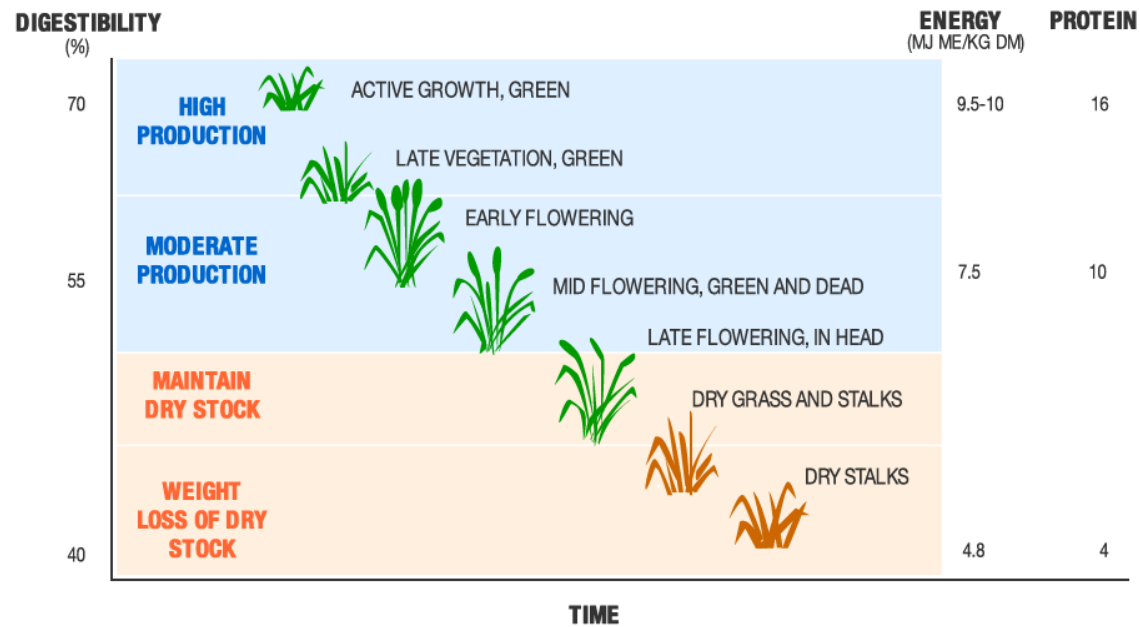
Lucerne hay



Boma Rhodes grass hay

## 13. Fibre digestibility

- Feeds such as concentrates and lush forage (young vegetative stage) contain lower amounts of fiber.
- The easily digestible fiber builds up the quick working 'floating' microorganisms population, causing feed to move more quickly through the rumen and digestive system, which triggers intake of more feed.



Lush forage



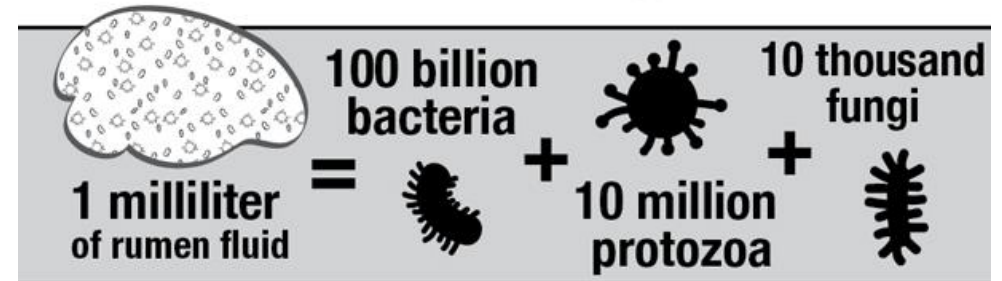
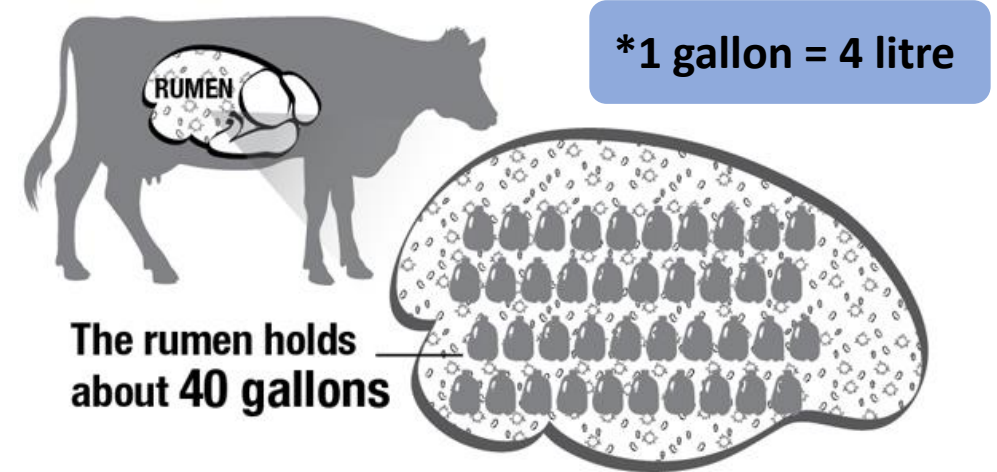
## 13.1 Fibre digestibility Cont'd...

- The mature forages have a higher fiber content and lower soluble carbohydrates (sugar and starch) content.
- This builds up the slow-working, fiber-digesting microorganisms hence causes feed to move more slowly through the digestive system.



## 14. Importance of ration consistence

- When feed is changed suddenly, the microbe population in the rumen changes and a new balance between the different types of bacteria will be established.
- Therefore regular diet change is not optimal.

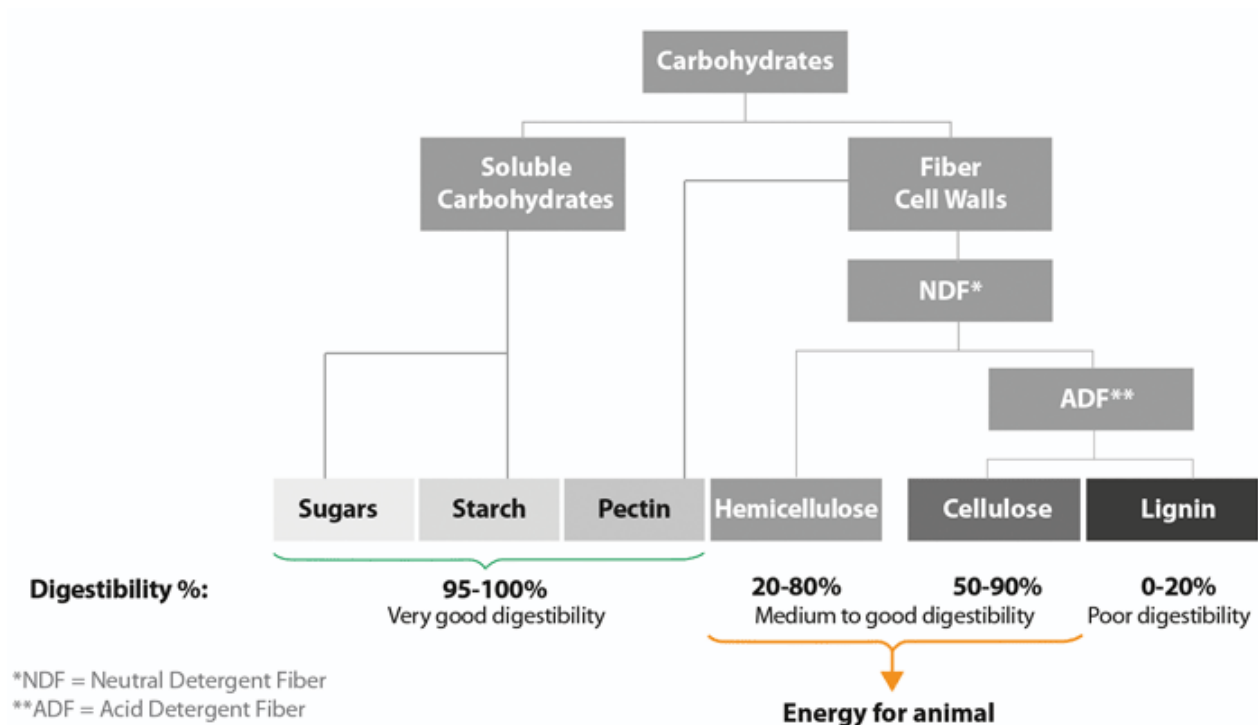


**$\geq 1,000,000,000,000,000$   
rumen bugs per cow**



## 15. Energy as an essential nutrient for microorganisms

- Most of the energy needed for microorganisms to grow and multiply is sourced from:
  - Sugars (e.g. lush forages, molasses and citrus pulp)
  - Starch (e.g. cereal grains and agro-industrial by products)
  - Digestible fiber (e.g. forages, cottonseed hulls, palm kernel extract and brewer's grain).



## 16. Protein as an essential nutrient for microorganisms

- Microorganisms use both true protein (e.g. protein meal & pastures) and non-protein nitrogen (e.g. urea).
- Feeding excessive amounts of protein to cows is not good for their health (and not cost effective).



Lucerne pellets

## 17. Minerals as essential nutrients for microorganisms

- Minerals are essential for microorganisms to grow and multiply.
- Young stock should be introduced to minerals and salts as early as the first week.
- These minerals are important for a healthy rumen development in young stock.



## 18. Water for microorganisms function

- Cows can drink depending on their milk production level so should always have free access to water 24hours.

**Further reference:** Module on water supply and demand.





## 19. Indicators of poor rumen health

- Low milk production, milk fat & protein ratio reduction.
- Increase in liquid/thin manure.
- Drop in both weight and body condition of cows.
- General cow performance drops such as reproductive performance.

