Theme 2: Forage conservation

FERMENTATION PROCESS IN SILAGE

Level 2 – Part II

Topic	Training & information Content
2.1	Fodder conservation and storage
2.2	Estimating ideal time of harvesting
2.3	Guideline for silage making
2.4	Fermentation process in silage
2.5	Treatment of straw with Urea
2.6	Making of urea/molasses/mineral lick
2.7	Management of silage pit (feed out)
2.8	Estimating fodder supplies for dry season feeding & planning of feeding management

1. You will learn about (learning objectives):

- The trainee understand the different processes which influence the silage making
  - Fermentation – types, analysis
  - Silage additives
  - Quality of silage at farm level
  - Silage feed out

IMPORTANT

This module has two parts; this is part II – ensure you download Part I.

2. Types of fermentation: Secondary fermentation

- Very undesirable.
- Degradation of lactate by clostridial bacteria to acetic acid & butyric acid.
- Facilitated by high moisture contents & high pH.

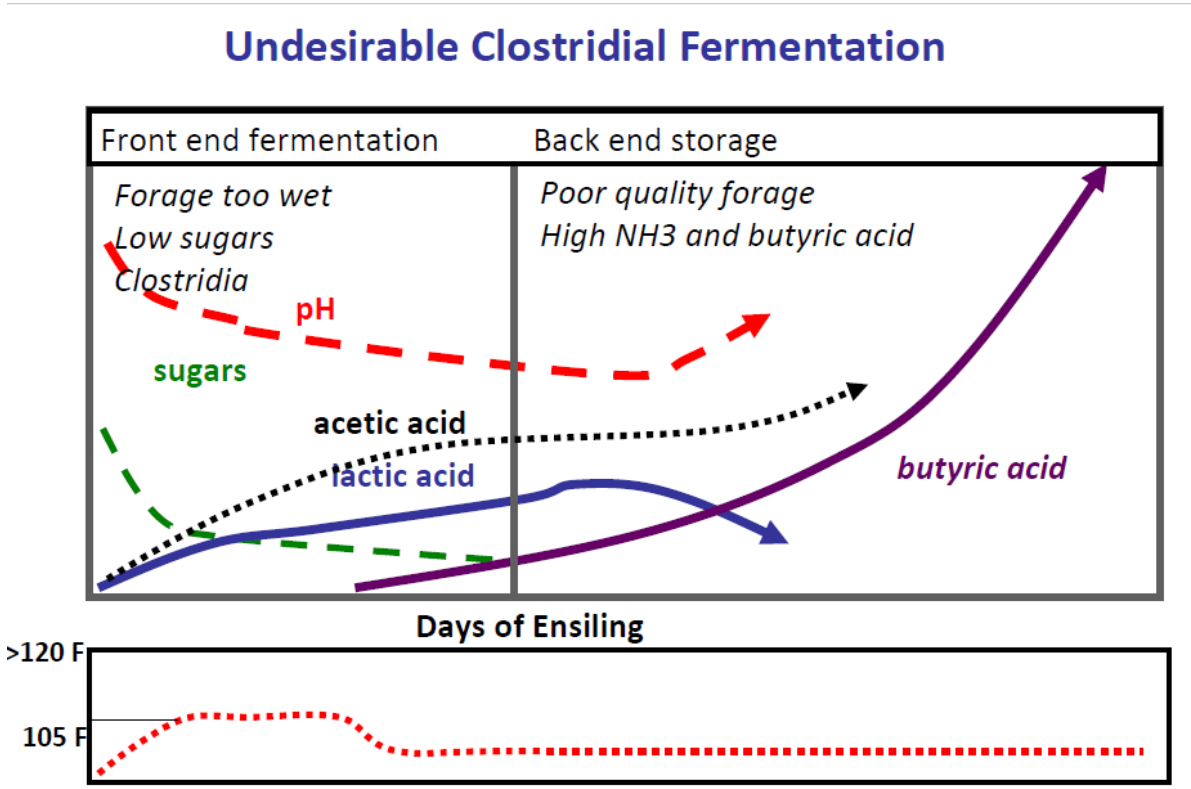
2.1 Secondary fermentation Cont'd:
Clostridia bacteria

- Clostridia bacteria are also present in the forage when it is mowed and are put in the silo.
- Clostridia bacteria consume forage carbohydrates (sugars), forage proteins, and lactic acid as their energy source and excrete butyric acid.
- Butyric acid is associated with spoilt or rotten silage.

Colony of Clostridia bacteria

2.2 Clostridia affected silage

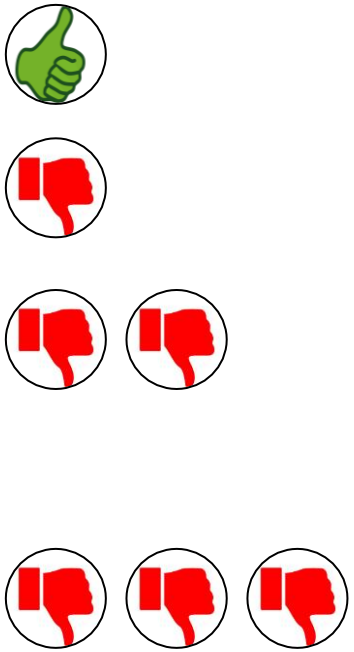
- Fermentation is dominated by clostridia bacteria
- More likely to occur when unwilted or lightly wilted forage material with low DM content is ensiled.
- Sugars and lactic acid are degraded by clostridia bacteria to butyric and acetic acid.
- Characterized by low lactic acid levels and (facilitated by) high pH
- Proteins and amino acids are extensively degraded
- Ammonia N levels are high as a percentage of total N (>15%)
- DM and energy losses can be significant (silages are less palatable or unpalatable to cattle and the utilization of N in these silages is poor)



3. Assessing quality of silage on the farm

Colour	Characteristics	Smell	On touching with hands	pH	Flieg score	Feeding
Pale yellow, light green to green brown, Olive	Normal colour range for grass, whole plant cereal and maize silage	Pleasant light sweet odour	Washing hands is not needed	3.6-3.8	81-100	Can be fed in large quantities
Brownish yellow	Normal colour range for wilted grass silages, Tendency for heavily wilted grass silages with restricted fermentation to be greener	Sweet & sour	Wash hands with cold water	3.9-4.2	61-80	Careful when feeding cows in milk
Dark brown	Some heating has occurred during storage or due to aerobic spoilage during feed out. Some loss in digestibility and heat damage of protein. More common in wilted silages	Strong pungent	Wash hands with hot water	4.3-4.5	41-60	Feed only to heifers
Dark brown and green	More extensive heating may also be some black patches of silage on the surface. High loss of digestibility and high proportion of protein is heat damaged and unavailable to the animal. Due to inadequate compaction delayed sealing of poor air exclusion. Usually accompanied by significant proportion of waste (mouldy) silage	Ammonia and putrid	Wash hands with hot water & soap	>4.6	<40	Feed heifers with caution

*Flieg score = 220 + (2 x DM% - 15) - 40 x pH



4. Chemical changes and losses during fermentation

- Sugars are fermented into volatile fatty (organic) acids (VFA) like lactic, acetic, propionic & butyric) acids by anaerobic microorganisms.
- The formation of the acids reduces the pH (target = 4)
- Protein is degraded into ammonia and NPN* (target =<100g ammonia/kg total Nitrogen)

* NPN = Non Protein Nitrogen

5. Fermentation analysis

- Analysis in terms of:

  i. High pH
  ii. Lactic Acid
  iii. Acetic Acid
  iv. Propionic Acid
  v. Butyric Acid
  vi. Ethanol
  vii. Ammonia

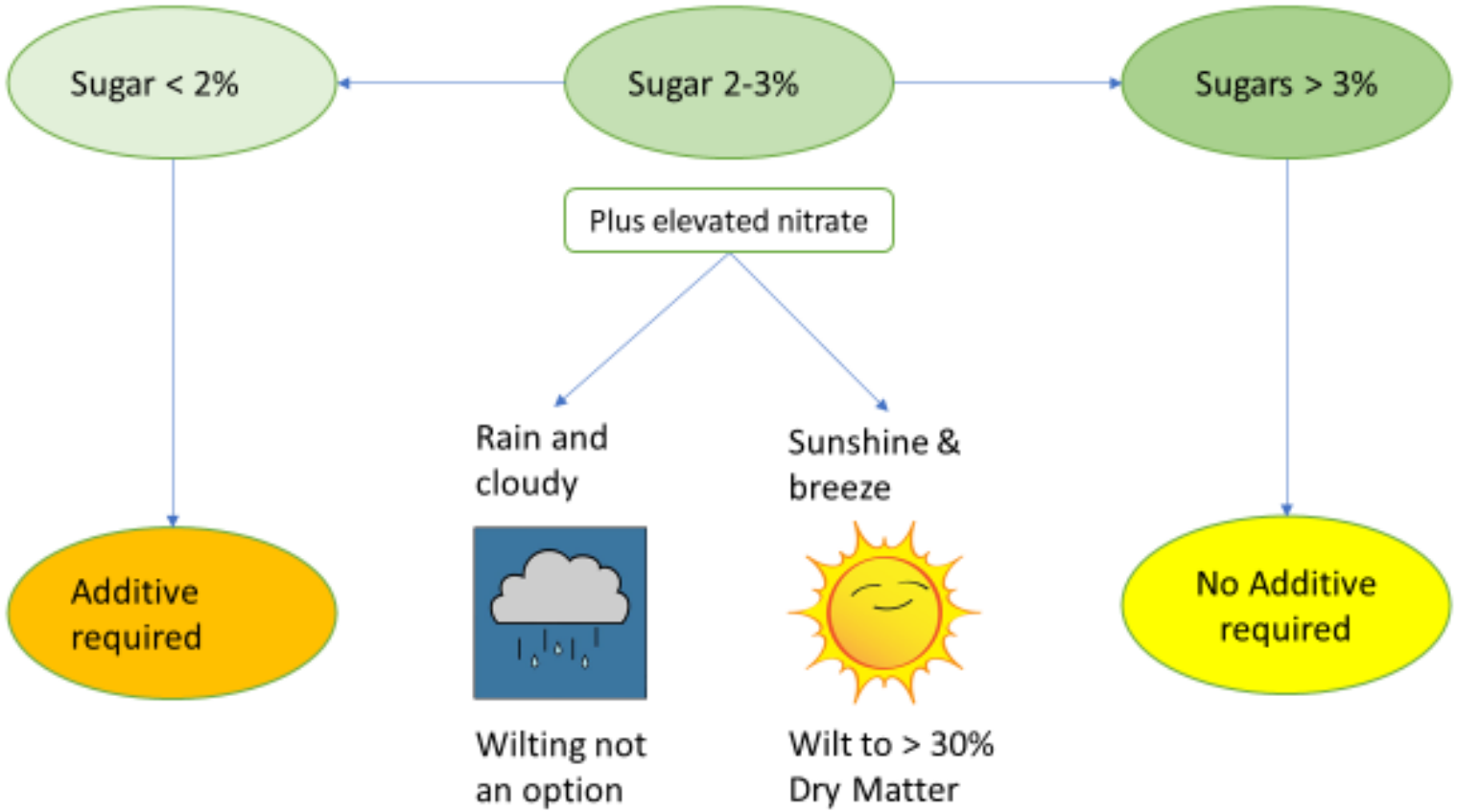
6. Silage additives

Use of additives to jump start fermentation

- Use of silage additives does not guarantee better preservation quality if silage making management is poor.
- What silage additives do is to increase lactic acid fermentation and lower pH.
- Examples of silage additives include silo guard, power start, bonsilage, ecosyl etc.

	Treated	Untreated
DM%	35%	35%
pH	3.9	4.5
Lactic Acid	85	20
Acetic Acid	10	9
Butyric Acid	0.1	8.1
Ammonia	5	14
Sugar	30	<11

6.1 When to use silage additives



6.2 Classifying Silage additives

- Silage additives can be classified into four main groups:

i. Molasses
   - Feed for bacteria
   - Good in combination with inoculants

ii. Acids
   - Suitable DM (dry matter) < 25% without sugar
   - Water (effluent) leaking out

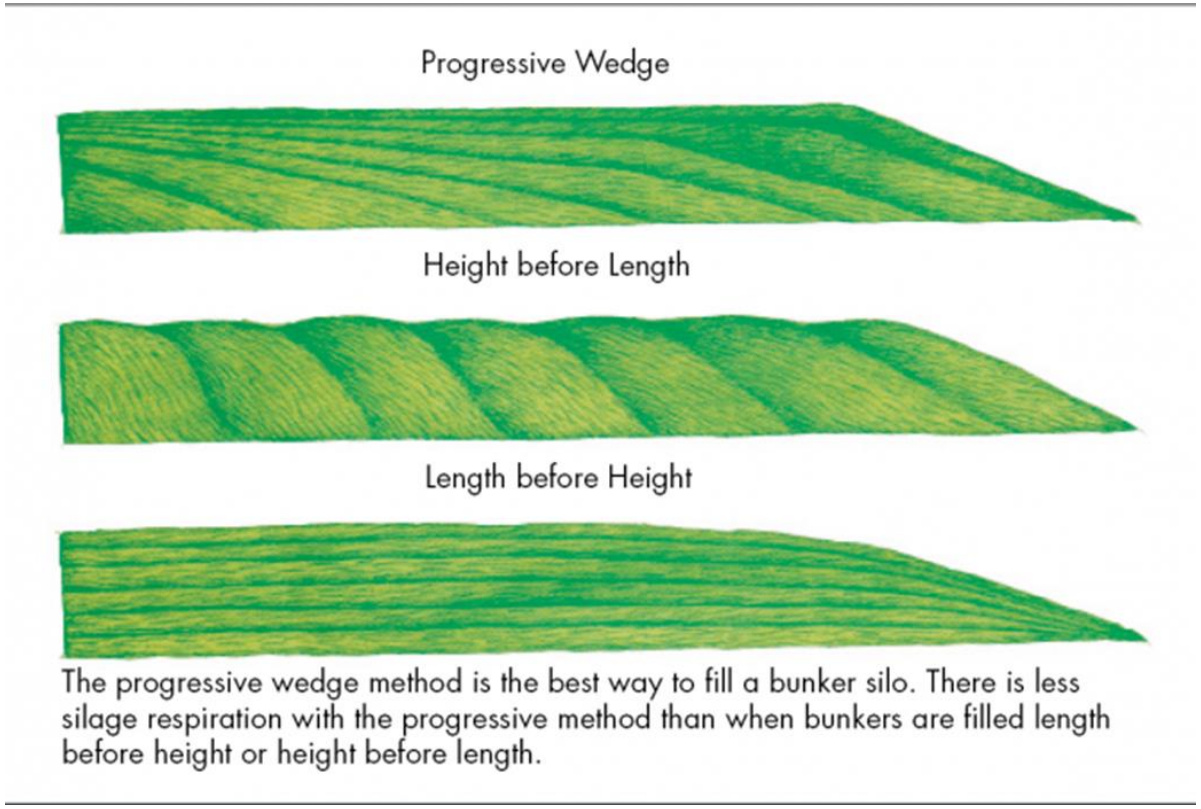
iii. Conservatives
   - Suitable for prevention of heating/fungi
   - Potassium sorbate / benzoates

iv. Inoculants/Enzymes
   - Bacteria using sugar for acid production
   - Best: Hetero-fermentative: Lactic/acetic

7. How to avoid aerobic spoilage in silage

- Includes:

  - tight sealing of silo
  - good compaction
  - filling the clamp/silo/pit fast
  - filling feed materials in thin layers
  - narrow clamp
  - wait for opening 45-60 days minimum
  - management of silo ‘face’
  - keep silage pit ‘face’ tidy
  - keep the polythene sheet away from the silage pit ‘face’ at feed out
  - ensure feeding with speed at feed out



The progressive wedge method is the best way to fill a bunker silo. There is less silage respiration with the progressive method than when bunkers are filled length before height or height before length.

7.1 How to avoid aerobic spoilage Cont'd…

Silage face management

- Silage face management is one of the most common reasons of secondary fermentation since exposure to air is huge and constant in this area.

8. Silage fermentation problems during feed out

- Increased water activity in feeds (due to rainfall during wilting or adding water to the silage or ration) will raise the potential for microbial growth and feed spoilage. Wild, spoilage yeast species are the first microbial contaminant to take hold in a spoiling TMR (Total Mixed Ration).

- Yeast are prevalent throughout East Africa, with humid and wet climates being more prone to yeast challenges.

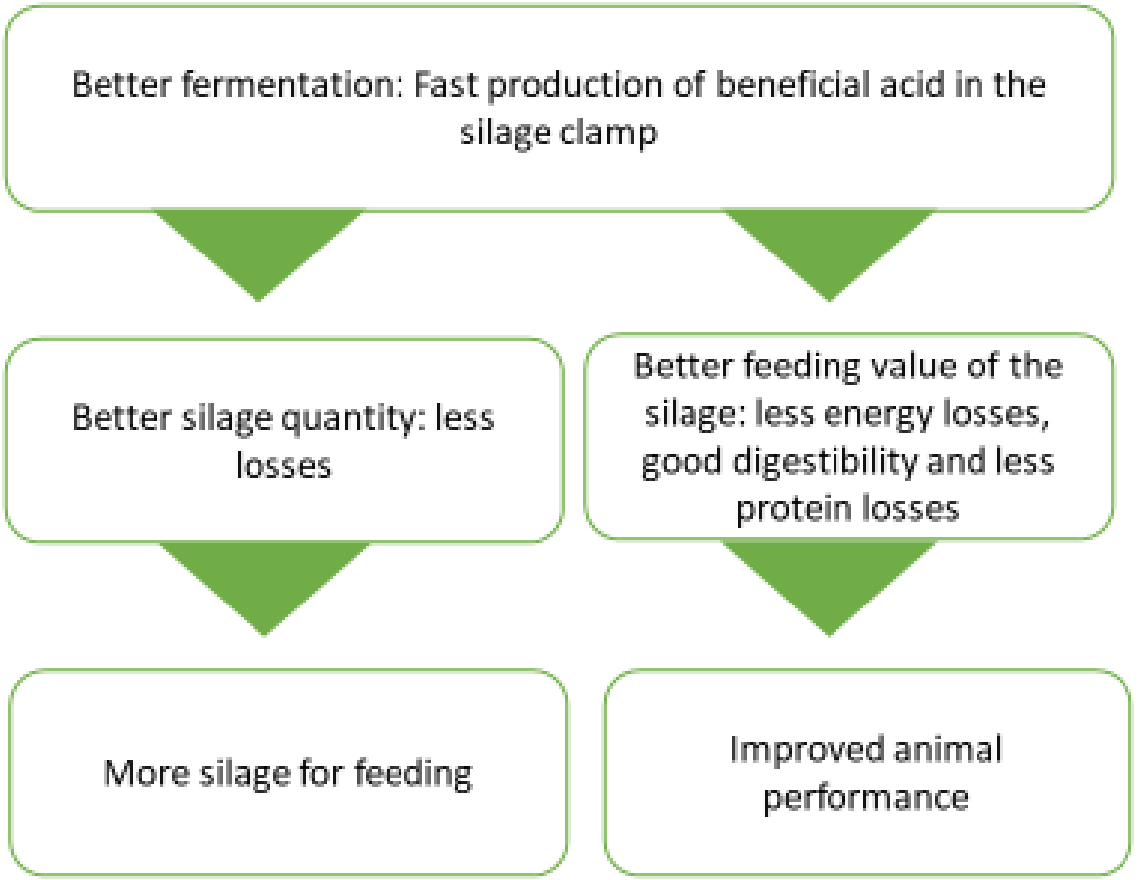
Pineapple peelings

8.1 Silage fermentation problems during feed out Cont'd…

- One of the best ways to check for yeast growth is checking temperatures at the feed bunk and doesn't involve much cost, if any.
- Checking your ration's temperature any temperatures greater than roughly 5°C above environmental temperature are indicative of microbial growth and spoilage.
- TMR or feed temperatures can be checked with a digital thermometer (several inches under the surface), an infrared thermometer (after kicking away the top several inches of TMR), or a more advanced infrared camera.

9. Good fermentation – improved animal performance

- Changes do occur in the nutritive value of forages after the fermentation process is complete. These changes may help partially explain why dairy cows produce more milk or silages fermented longer than 3 months from harvest.
- The fermentation process takes 10 days to 3 weeks for completion. Silage should not be fed until after this process is completed for the best milk production and feed intake.
- To extend clamp/silo life, minimize the exposure of fermented feed to oxygen at the silo face.



10. Take home messages

- When applying concepts from this module on the farm regarding the fermentation process for silage;

    1. Harvest forages for ensiling at the ideal dry matter and stage of maturity; ensure rapid filling and intense compaction of silages, and airtightly seal and cover silos with soil – all these directly impact the fermentation process.
    2. Well fermented silages result in reduced dry matter losses, more feed being available for feeding dairy cows, and a higher quality feed (more lactic acid) which could improve feed intake, milk production, and profitability.

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