Fodder Production and conservation

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Definition

Wikipedia

• **forage** is plant material (mainly plant leaves and stems) eaten by *grazing livestock*

• **Fodder** is any agricultural foodstuff used *specifically* to feed domesticated livestock

• **Roughage** is another term for *dietary fiber*. Fiber comes from the parts of plant-based foods your body cannot digest.
Properties

Roughage is bulky feed that has low weight (nutrients) per unit volume (weight).

- Pasture, range plants and plants fed green
- Dry forages and roughages (hay, straw, stover)
- Silages (maize, sorghum, legumes)
- Others (maize cobs, sugar cane bagasse, paper)
Common Kenya forages/Fodder
High Protein Fodder

- Lucerne
- Calliandra
- Mulberry
- Sesbania
- Desmodium
- Tithonia
Nutrient content of common fodders

• Nutrient content is dependent on:

• Age
  – deteriorates with age but there is a **threshold** between DM content/yield and CP content.

• Species- stem:leaf ratio
  – More leaf makes feed more nutritious
Moisture/Dry Matter

Banana stems

Rhodes hay

Napier grass
Crop residues
Crop Residues

• **Note:**
  – Very low CP
  – High in cellulose and other structural carbohydrates
  – Low in Ca and P
  – Carotene content is related to the green colour of the plant. Straw has nil Vit A.
  – B vitamins are absent.
The quality (nutritive value) of these residues is low:

<table>
<thead>
<tr>
<th></th>
<th>CP</th>
<th>CF</th>
<th>TDN</th>
<th>NEm</th>
<th>NEg</th>
<th>Ca</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat straw</td>
<td>4</td>
<td>42</td>
<td>40</td>
<td>0.86</td>
<td>0</td>
<td>0.2</td>
<td>0.08</td>
</tr>
<tr>
<td>Barley straw</td>
<td>4</td>
<td>42</td>
<td>46</td>
<td>0.99</td>
<td>0.1</td>
<td>0.3</td>
<td>0.05</td>
</tr>
<tr>
<td>Maize cobs</td>
<td>3</td>
<td>36</td>
<td>48</td>
<td>1.04</td>
<td>0.2</td>
<td>0.1</td>
<td>0.04</td>
</tr>
<tr>
<td>Maize stover</td>
<td>6</td>
<td>42</td>
<td>40</td>
<td>0.86</td>
<td>0</td>
<td>0.2</td>
<td>0.08</td>
</tr>
<tr>
<td>Lucerne</td>
<td>19</td>
<td>25</td>
<td>60</td>
<td>1.31</td>
<td>0.65</td>
<td>1.4</td>
<td>0.2</td>
</tr>
</tbody>
</table>

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Crop Residues

• The low quality roughages can be used for feeding ruminants and some extent horses. However, they are rarely adequate for any class of animal without supplementation.

• Due to their low digestibility, they reduce the VDMI and the animal can not consume enough to maintain its weight.
Effect of roughage quality on consumption, digestibility and rumen turnover rate.

<table>
<thead>
<tr>
<th>Item</th>
<th>Grass hay</th>
<th>Straw</th>
<th>Stover</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP</td>
<td>10.1</td>
<td>4.2</td>
<td>4.1</td>
</tr>
<tr>
<td>ADF</td>
<td>40.7</td>
<td>57.0</td>
<td>58.6</td>
</tr>
<tr>
<td><strong>Digestibility</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM</td>
<td>60.1</td>
<td>53.8</td>
<td>48.9</td>
</tr>
<tr>
<td>CP</td>
<td>54.1</td>
<td>9.5</td>
<td>12.5</td>
</tr>
<tr>
<td><strong>Consumption/d (kg DM)</strong></td>
<td>5.81</td>
<td>3.85</td>
<td>2.27</td>
</tr>
<tr>
<td><strong>Rumen turnover</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate/d</td>
<td>1.3</td>
<td>0.95</td>
<td>0.71</td>
</tr>
</tbody>
</table>
Crop Residues-Improvements

The ligno-cellulose complex consists of:

i. Lignin – unavailable as energy source
ii. A digestible energy part which can be utilized by microbes in rumen
iii. A fraction that is very resistant to bacteria action but becomes an energy source after treatment.

This fraction is of interest because it contains considerable energy which can be unlocked.

• Chemical treatment digest (breaks) the ligno-cellulose bonds to release this energy.
Crop Residues-Improvements

- Chemical treatment has received the most attention.
Crop Residues-Improvements

• Urea has been used for treatment.

• A solution of urea (fertilizer grade) is used.
  – The chopped material is soaked in 4% w/v solution and stored in airtight silos for 2 weeks.
  – The urea is broken by urease bacteria to ammonia when then acts on the forage.
Table 3. Cost of inputs (KSh. per kg of feed) and ME (KSh per MJ) for *Chloris gayana* hay (H), untreated *Zea mays* stover (US) and urea treated *Zea mays* stover (TS)

<table>
<thead>
<tr>
<th>Item</th>
<th>H</th>
<th>US</th>
<th>TS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase of feeds</td>
<td>6.00</td>
<td>1.88</td>
<td>1.88</td>
</tr>
<tr>
<td>Chopping</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>Urea for treatment</td>
<td>0</td>
<td>0</td>
<td>2.38</td>
</tr>
<tr>
<td>Labour for treating the stover</td>
<td>0</td>
<td>0</td>
<td>0.22</td>
</tr>
<tr>
<td>Plastic tubes and sisal strings for storing stover</td>
<td>0</td>
<td>0</td>
<td>9.50</td>
</tr>
<tr>
<td>Total cost of inputs</td>
<td>6.75</td>
<td>2.63</td>
<td>14.73</td>
</tr>
<tr>
<td>Cost of ME</td>
<td>0.87</td>
<td>0.35</td>
<td>1.36</td>
</tr>
</tbody>
</table>
PASTURE AND FODDER CONSERVATION

• Why conserve:

• Due to distribution of rainfall, pasture and fodder production is not continuous resulting in times of plenty and scarcity. The excess can be conserved for use in times of scarcity.
Fluctuations
PASTURE AND FODDER CONSERVATION

How to conserve:

– Reduce moisture content (store dry)
– Use chemical preservatives and store wet.
Hay

• Intent of hay making is to harvest the crop at more or less optimal stage of maturity in order to provide a maximal yield of digestible nutrients per unit of land without damage to the next crop.

• To make good hay, the moisture content of the herbage must be reduced to a point low enough to allow for storage without marked nutritional changes.
Hay

- Normally, moisture content of green herbage may range from 60-85% depending on species and maturity. At hay making, the moisture content has to be reduced to about 15%.
- Hay making can be mechanized (tractor, mower and baler) or simplified using a hay box for small scale farmers.
Hay

• Box measures 85(length) X 55(width) X 45cm (depth) and is open on both sides. If well pressed the box will make an average bale of 20kg.

• Common forages used for hay making include: Rhodes grass and Lucerne
Hay

Losses in hay making:

• It is impossible to cut, dry and transport hay into storage without losses.
• It is however possible to harvest more nutrient units per unit of land than would be obtained during grazing.
• Losses occur as a combination of:
  – Physical loss (incomplete recovery of harvested herbage)
  – Enzymatic activity of harvested forage
  – Oxidative losses during drying
  – Water damage.
Hay

- **Hay quality:** Can be done by Visual assessment:
  - leafy,
  - colour (green indicates good curing, high carotene),
  - odourless,
  - no foreign material.
  - Weight

- **MAKE SURE FARMERS DO NOT BUY STRAW IN NAME OF HAY**
SILAGE

- an excellent means of preserving high moisture crops during periods when:
  - drying is not feasible (grasses and legumes)
  - or for crops which would deteriorate in quality if allowed to dry (maize or sorghum fodder).

- Silage is the material produced by a **controlled anaerobic fermentation** of material of high moisture.
SILAGE

• The fermentation is controlled by formation of organic acids, mainly lactic, by bacteria that grow on the herbage or by direct addition of acids or other preservatives.

• In whatever case, the fermentation and storage must be in an oxygen-limiting atmosphere otherwise the material decays to an inedible and frequently toxic material.
SILAGE

Ideal crop for silage making

a) Should contain and **adequate level of fermentable substrates in form of water soluble carbohydrates**

b) Should have a relatively low buffering capacity

c) Have DM content in the fresh crop above 200g kg\(^{-1}\)

d) It should ideally posses a physical structure, which will allow it to compact readily in the silo after harvesting.
SILAGE

- Crops not fulfilling these requirements may require pre-treatment such as:
  - Field wilting
  - Fine chopping (the degree of chopping will depend on several factors but generally 20-25 mm is advised)
  - Use of additives.
SILAGE

- The silage starts to warm up immediately due to oxidative enzymatic reactions of the plant (oxidation of soluble carbohydrates).
- The temperature of the silo should range between 29-30°C.
- Too hot would mean the compaction is not complete and presence of aerobic bacteria and too cold would be due to high moisture content due to lack of wilting.
**SILAGE**

- The **total herbage DM** conserved as silage is lower than that conserved as hay but due to high ME and DCP in silage, the nutrient levels are high.

- The aroma of silage is sometimes used to gauge its quality.
  - A strong butyric acid odour -like rancid butter - is not desirable. This happens with very wet silage and lack of preservative.
SILAGE

• Wilting:
  – Reduces affluent flowing from silo.
  – Reduces the amount of load into silo and increases feeding value of the silage.

• The most effective method of ensuring no air enters the silage is to cover with plastic sheeting.
SILAGE

Losses

• In the field during cutting.
  – Losses due to respiration during wilting will be about 2% per day and if it rains there may be loss due to leaching.

• Respiration in the silo continues until the pH has fallen enough to inactivate the plant enzymes or supply of oxygen is exhausted. Formic acid can be added to speed up lowering of pH.
SILAGE

• Loss due to surface deterioration can be virtually eliminated by proper sealing.

• Overheating due to poor sealing gives a brown product, which may smell like tobacco resulting in severe damage to proteins.

• Effluent losses (2-10%)- Seepage moisture contain soluble and highly digestible nutrients and should be avoided by wilting the herbage.
Additives are used to improve silage preservation by ensuring that lactic acid bacteria predominate the fermentation phase.
SILAGE

Three main classes:

– Fermentation stimulants (bacterial innoculants and enzymes)

– Substrate or nutrient sources (grains, molasses, urea or ammonia)
SILAGE

• Can be used when:
  
  – Insufficient soluble carbohydrates (legumes, napier, crop residues)
  
  – Prevent loss of silage carbohydrate
SILAGE

Chemical standards to assess silage:

– pH - <4.2
– Butyric acid concentration <0.2%
– Ammonia N <11% of total N
– Lactic acid concentration 3-13% of DM
– Optimum temp (27-38°C)


**SILAGE**

- **Methods of ensiling:**
  - Polythene bags, polythene tubes
  - Underground: (wedge or pit)
  - Above ground: towers, wedge.
Fodder marketing

• Can be sold
  – Green
  – Hay
  – Silage

• Whatever form one buys, the question is whether one gets value for money
Fodder marketing

• Always consider:
  – Weight
  – DM content
  – Quality

• Remember you are buying nutrients not weight.
Thank you