Feed Processing Technology

Anuraga Jayanegara
Outline

A. Course design and contract
   - Introduction
   - Physical properties of feeds
   - Chemical properties of feeds
   - Physical and mechanical processing
   - Chemical processing
   - Biological processing
   - Feed evaluation
   - Feed quality assurance

B. Introduction to feed processing technology
About me

Short CV:
• Anuraga Jayanegara
• Bojonegoro, 2 June 1983
• Married (27 July 2005; 22 years old; 1 wife & 3 children)
• 2003: BSc (Bogor Agric. Univ., Indonesia)
• 2008: MSc (Univ. Hohenheim, Germany)
• 2010: PgDip (Polytech. Univ. Catalunya, Spain)
• 2011: PhD (Swiss Fed. Inst. Tech. Zurich, Switzerland)
• 2013: Internat. training dairy nutrition (Ghent Univ., Belgium)

International teaching experience:
• ETH Zurich, Switzerland (2010-2011): Tropical Animal Nutrition
• Ghent University, Belgium (2013): Dairy Nutrition
• Mie University, Japan (2015): Feed Science
Course design and contract:
Feed Processing Technology
B. Introduction to feed processing technology

Why processing feeds/feedstuffs?

1. Maintaining or improving nutritive value: increasing digestibility and nutrient accessibility
2. Preventing spoilage
3. Isolating specific components from feeds
4. Detoxifying poisons or anti-nutritive factors
5. Improving handling efficiency, reducing wastage
## Tropical feed resources

<table>
<thead>
<tr>
<th>Pastures &amp; Fodder</th>
<th>Crop residues</th>
<th>Agroindustrial by-products</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Grasses</td>
<td>• Straws / Stovers</td>
<td>• Starch sources</td>
</tr>
<tr>
<td>• Legumes</td>
<td>• Legume hays</td>
<td>• Oil sources</td>
</tr>
<tr>
<td>• Browse</td>
<td>• Horticulture residues</td>
<td>• Animal meals</td>
</tr>
<tr>
<td>• Multi-purpose plants</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Some examples

<table>
<thead>
<tr>
<th>Pastures &amp; Fodder</th>
<th>Crop residues</th>
<th>Agroindustrial by-products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elephant grass</td>
<td>Rice straw</td>
<td>Dried cassava</td>
</tr>
<tr>
<td>King grass</td>
<td>Maize stover</td>
<td>Rice bran</td>
</tr>
<tr>
<td>Leucaena</td>
<td>Bagasse</td>
<td>Soybean meal</td>
</tr>
<tr>
<td>Indigofera</td>
<td>Oil palm frond</td>
<td>Groundnut meal</td>
</tr>
<tr>
<td>Gliricidia</td>
<td></td>
<td>Copra meal</td>
</tr>
<tr>
<td>Cassava leaves</td>
<td></td>
<td>Palm kernel meal</td>
</tr>
<tr>
<td>Papaya leaves</td>
<td></td>
<td>Cocoa pod</td>
</tr>
<tr>
<td>Katuk leaves</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Elephant grass
Leucaena
Indigofera
Cassava leaves
Paddy rice by-products

Rice straw

Rice bran
Palm and coconut

Oil palm (*Elais Guineensis*)

Palm oil

Coconut oil

Copra → Coconut oil (about 60% fat)

Palm kernel oil

kernel : 48% fat
Oil palm frond

- leaflets
- petiole
- fruits
- stem

Department of Nutrition and Feed Technology
Cocoa by-products

Cocoa pod
## Characteristics of tropical feeds

<table>
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<th>Agroindustrial By-products</th>
<th>Pastures &amp; fodder</th>
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<tbody>
<tr>
<td>• Fed directly, residues from processing</td>
<td>• Whole plants exclusively for animal feed</td>
<td>• Residues from ripe plants</td>
</tr>
</tbody>
</table>

**Energy & protein content**

**Cell wall content**

Pastures and fodder: may contain considerable amount of plant secondary compounds such as tannins and/or saponins
Quality comparison between tropical and temperate grasses
Influence of age on yield and digestibility of tropical grasses
Fig. 0.4. Food shelf life (storage stability) as a function of water activity (according to Labuza, 1971)
Classification – based on types of process

1. Physical processing
   - Drying (pengeringan)
   - Heating (pemanasan)
   - Soaking (perendaman)
   - Boiling (perebusan)
   - Steam (pengukusan)
   - Irradiation

2. Mechanical processing
   - Chopping (pencacahan)
   - Grinding (penggilingan)
   - Pengupasan (peeling)
   - Extruding
   - Pelleting
   - Crumbling
   - Cubing
   - Flaking
   - Baling
   - Wafering
   - Micronizing
   - Popping
3. Chemical processing
- Acid treatment
- Alkali treatment
- Ammonation
- Use of animal manure for processing feed

4. Biological processing
- Mould (fungi)
- Yeast
- Bacteria
- Silage
- Enzyme
- Probiotic and prebiotic
Some selected processing techniques

Cubing
The process of compressing cut hay into small square cubes

Advantages:
- Easier to store and handle
- Eliminates dust
- Reduces selectivity by animals
- Can also be used with roughage/concentrate mixture
Pelleting
The process of forcing a ground, moist feed through a die and compressing it, then cutting at certain lengths; These can vary in length and diameter

Advantages:
- Easier to store and handle
- Less bulky
- Reduces dusts
- Reduces selectivity by animals
Crumbles

Crumbles are pelleted feeds that have been further reduced into granular form.
Block

In the block form, feed is compressed into a single mass that holds its form (usually a square or rectangle).

Blocks are most commonly used to supplement minerals or protein to animals in the pasture.
Ensilage process
Silage can be made from grain corn, grass, legumes, grass-legume mixtures, etc.

Advantages:
- A wide variety of crops can be used
- Harvesting and feeding can be mechanized to reduce labor
- Less field and harvest losses than hay
- Less possibility of weather damage
- Can be stored for long periods of time
- Decreased selectivity by animals
- Highly palatable

Disadvantages:
- Requires specific equipment and storage facilities
- Bulky
- Requires skilled management
Thank you for your attention!