Introduction

Livestock Feeding

- Change in “What We Do”
  - Nomadic → Agrarian → Urban
- <2% of US population involved in producing food
- Changes in way livestock are fed
  - Knowledge continues to increase
  - Land Grant Institutions
  - Private companies

Per Capita Food Expenditures

<table>
<thead>
<tr>
<th>Year</th>
<th>Tons/Hectare</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>66/67</td>
<td>1.61</td>
<td>508.9</td>
</tr>
<tr>
<td>76/77</td>
<td>2.02</td>
<td>692.0</td>
</tr>
<tr>
<td>86/87</td>
<td>2.45</td>
<td>822.4</td>
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<tr>
<td>94/95</td>
<td>2.76</td>
<td>858.4</td>
</tr>
<tr>
<td>98/99</td>
<td>2.86</td>
<td>894.4</td>
</tr>
</tbody>
</table>

1 Million Metric Tons

World Course Grain Production

Per Capita Food Expenditures

Production Efficiency

<table>
<thead>
<tr>
<th>Year</th>
<th>Feed/lb Gain</th>
<th>lb Milk/year</th>
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</thead>
<tbody>
<tr>
<td>1965</td>
<td>3.2</td>
<td>8,522</td>
</tr>
<tr>
<td>1976</td>
<td>3.2</td>
<td>10,354</td>
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<tr>
<td>1986</td>
<td>3.0</td>
<td>13,031</td>
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<tr>
<td>1994</td>
<td>2.8</td>
<td>15,704</td>
</tr>
<tr>
<td>1999</td>
<td>2.6</td>
<td>17,771</td>
</tr>
</tbody>
</table>
**Farm Gate Meat Price vs Retail Price**

**Digestive Systems**
- Classification of digestive systems
  - Ruminant
  - Nonruminant
- GI tract is indicative of the type of diet that will be consumed
  - avian is short and simple
  - swine have ability to consume some fiber
  - horses survive and do well on roughages
  - ruminants are well suited for high fiber diets

**Ruminants**
- Ruminants
  - extensive pregastric fermentation
  - products of digestion
  - Ruminants utilize and perform much better on low quality diets compared to monogastrics.

**Nutrients**
- **Water**
  - Most important nutrient
  - Assume that animals have access to good-quality water supply
- **Carbohydrates**
  - Primary component found in feeds: 70–80% of plant material
  - Primary function is energy

**Nutrients**
- **Carbohydrates**
  - No requirement for CHO
  - Starch, cellulose, and hemicellulose
  - Nonruminants digest starch better than ruminants in SI.
  - Fiber digestors - ruminants > horses > swine > poultry

**Nutrients**
- **Protein**
  - Found in the highest concentration, except water, in all animals
  - Proteins are chains of amino acids
    - Essential and nonessential amino acids
    - Limiting amino acid
  - Protein and Ruminants
    - Do not have dietary requirement for amino acids (Why?)
### Nutrients

- **Lipids**
  - Most forages/grains contain 3%
  - Linoleic and linolenic are essential fatty acids

- **Minerals**
  - Macrominerals (% of diet): Ca, P, Mg, S, Na, K, Cl
  - Microminerals (parts per million; PPM): Co, Cu, Fe, I, Mn, Se, Zn

- **Vitamins**
  - Fat soluble: A, D, E, and K
  - Water soluble: B's and C
  - Ruminants - only concerned with A, D, and E

- **Energy**
  - Although energy is not a nutrient, it is required in the highest amount in animal diets
  - Energy is derived from the oxidation of CHO, protein, and fat

### Feeding Standards

- Published by various committees of the National Research Council (NRC)
- Feeding standards expressed as quantity (g, kg, lbs., Mcal) of nutrients required per day or % of diet
- Atwater (1878) – “The right feeding of livestock is not merely a matter of so much hay and grain, but rather of so much water, protein, etc., of which they are composed”

### Feed Consumption Effect on Dietary Nutrient Density

- Atwater pointed out that an animal has a requirement for a specified amount of a specific nutrient
  - Suppose a feedlot steer requires 11% crude protein (CP) and consumes 10 kg dry matter (1.1 kg CP)
  - Suppose intake was only 9 kg, need 12.2% CP for same performance (1.1 kg CP/9 kg x 100)

### Functions of Nutrients

- Maintenance - no net gain or loss of nutrients
- Growth
- Lactation
- Reproduction
- Work