Digestive Physiology of Farm Animals
Introduction

- Digestion - the process of breaking feed down into simple substances that can be absorbed by the body.
- Digestive System - the parts of the body involved in chewing and digesting feed.
- Absorption - the process of taking digested parts of feed into the bloodstream.
Introduction

Three (3) basic types of digestive systems:

- **Monogastric** – simple stomach.

- **Ruminant** – multi-compartmented stomach.

- **Poultry** – simple stomach, but very large and complex large intestine
Types of Digestive Systems

**Monogastrics**
- Dogs
- Pigs
- Cats
- Horses
- Human

**Ruminants**
- Beef Cattle
- Dairy Cattle
- Goats
- Sheep
- Deer

**Poultry**
- Chickens
- Turkeys
- Ostrich
Basic Functional Anatomy of the Digestive System

– Monogastrics –
Digestive Tract - Pig
Organs of the Digestive System
– Monogastrics –

- **Mouth**
  - Mechanical breakdown of foodstuffs by chewing (reduces particle size, increases surface area for action of enzymes).
  - Saliva added as a lubricant and, in some species, contains amylase to begin starch digestion.

- **Esophagus**
  - Tube connecting the mouth to the stomach.
Organs of the Digestive System
– Monogastrics –

- **Stomach**
  - Enzymatic digestion of proteins begins.
  - Foodstuffs reduced to liquid form.

- **Liver**
  - Center of metabolic activity in the body.
  - Major role in digestive process is to provide bile salts to small intestine (needed for digestion and absorption of fats).
Organs of the Digestive System
– Monogastrics –

**Gall Bladder**

- **Function:** Produces bile that aids in digestive process.
- **Description:** Sac like structure filled with greenish fluid. Located on the liver.
Organs of the Digestive System – *Monogasstrics* –

- **Pancreas**
  - Provides a potent mixture of digestive enzymes to the small intestine to help in digestion of fats, carbohydrates, and proteins.

- **Small Intestine**
  - 3 sections – duodenum, jejunum, ileum
  - Site of final stages of chemical enzymatic digestion.
  - Where almost all nutrients are absorbed.
Organs of the Digestive System
– Monogastrics –

- Large Intestine
  - 3 sections – cecum, colon, rectum
  - Site of water absorption from G.I. tract.
  - Bacterial fermentation occurs (production and absorption of volatile fatty acids).
    - Somewhat limited in monogastrics
  - Feces formed.
Basic Functional Anatomy of the Digestive System

– Ruminants –
Digestive Tract – Beef Cattle

- Esophagus
- Rumen
- Omasum
- Reticulum
- Abomasum
- Pancreas
- Liver
- Gall bladder
- Cecum
- Small intestine
- Large intestine
- Rectum
Digestive Tract – Beef Cattle
Organs of the Digestive System
– Ruminants –

★ Mouth, esophagus, liver, pancreas, gall bladder, small intestine, and large intestine have functions similar to monogastrics.

► Stomach
  ▶ Structure and function of the stomach is the major difference between monogastrics and ruminants.
  ▶ Multi-compartmented stomach – rumen, reticulum, omasum, abomasum.
## Parts of the Ruminant Stomach

### Rumen:
- Large, anaerobic fermentation vat.

### Rumen Capacity

<table>
<thead>
<tr>
<th>Species</th>
<th>Normal capacity</th>
<th>Maximum capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow (1000 lb)</td>
<td>25-30 gallons</td>
<td>55-60 gallons</td>
</tr>
<tr>
<td>Ewe (150 lb)</td>
<td>3-5 gallons</td>
<td>5-10 gallons</td>
</tr>
</tbody>
</table>
Parts of the Ruminant Stomach

- **Rumen** *(continued):*
  - Houses microorganisms.
    - Protozoa – 100,000 per gram of rumen fluid.
    - Bacteria/fungi – 100 million per gram of rumen fluid.
  - Functions of microorganisms.
    - Digest roughages to make Amino Acids.
  - Amino Acids absorbed in rumen.
Parts of the Ruminant Stomach

- **Rumen (continued):**
  - Lined with millions of papillae (short projections on wall of rumen) needed for absorption.
    - “Shag carpet” appearance
Parts of the Ruminant Stomach

Rumen (continued):

- Rumen saturated with gases and in constant motion.
- Contractions occur at a rate of 1-3 per minute.
  - Serve to mix contents, aid in mixing of gases, and move fluid and fermented feedstuffs into the omasum.

Taken from “Digestive Physiology of Herbivores”
http://arbl.cvmbs.colostate.edu/hbooks/pathphys/digestion/herbivores/
Parts of the Ruminant Stomach

■ **Rumination:**
  - Ruminants are well known for “cud chewing”.
  - Rumination involves:
    - ✓ Bolus of previously eaten foodstuff carried back into the mouth.
    - ✓ Fluid in bolus is squeezed out with the tongue and reswallowed. May be up to 6-7 times per Bolus.
    - ✓ Bolus is rechewed and reswallowed.
  - Rumination may occupy about 1/3 of a ruminant’s day.
Parts of the Ruminant Stomach

► Fermentation of foodstuffs in the rumen generates enormous quantities of gas.
  ✓ 30-50 liters per hour in adult cattle.
  ✓ 5-7 liters per hour in adult sheep or goats.

► Belching is how ruminants get rid of fermentation gases:
  ✓ Anything that causes a hindrance to belching can be life threatening.
  ✓ Bloating can result in death from asphyxiation.
Parts of the Ruminant Stomach

- **Reticulum:**
  - Contains microorganisms (like the rumen).
  - Provides additional area for fermentation.
  - As fermentation by microorganisms proceed and feedstuffs are digested, smaller and more dense material is pushed into the reticulum (from which it along with microbe-laden liquid is ejected into the omasum).
Parts of the Ruminant Stomach

- **Reticulum** (*continued*):
  - Lining has a honeycomb structure.
    - Catches and holds hardware consumed by animal.
    - Hardware can be controlled with a rumen magnet.
Together the Rumen and the Reticulum make up over 85 percent of the Rumen Stomach.
Parts of the Ruminant Stomach

- **Omasum:**
  - A heavy, hard organ with a lining that has many folds (leaves).
  - Function: Contains papillae responsible for grinding roughage.
  - Description: Round, muscular part of stomach with many layers of tissue that squeezes feed and removes some liquid.
Parts of the Ruminant Stomach

- **Abomasum:**
  - The true, glandular stomach.
    - Secretes acids and functions very similarly to monogastric stomach.
  - Unique feature is that it secretes lysozyme.
    - Enzyme that efficiently breaks down bacterial cell walls.
    - Needed to break down the large quantities of bacteria that pass from the rumen.
Basic Functional Anatomy of the Digestive System

– Poultry –
Digestive Tract - Poultry
Organs of the Digestive System
– Poultry –

Specialized Organs in Poultry

- **Beak**
  - No lips, no teeth, and no chewing.

- **Crop**
  - Out-pocketing of the esophagus that provides storage for consumed food.
  - Foodstuffs moistened and softened (little if any digestion).
Organs of the Digestive System
– Poultry –

Specialized Organs in Poultry (continued)

- **Proventriculus**
  - Glandular stomach where the first significant amount of digestive juices are added.

- **Gizzard**
  - A muscular organ used to grind and break up food.
  - May contain grit (small stones) eaten by animal.
Organs of the Digestive System
– Poultry –

• Grit that is commonly added to chicken feed to aid in digestion.
Organs of the Digestive System

– Poultry –

• Feed has to be very high in nutrients due to the rapid movement through the digestive system.
Organs of the Digestive System
– Poultry –

Specialized Organs in Poultry (continued)

- Vent

  Common chamber into which the digestive, urinary, and reproductive tracts open.

  ✓ When fecal material is excreted, the vent folds back allowing the rectal opening of the large intestine to push out, closing the reproductive tract opening.
Specialized Poultry Organs

- **Crop**
- **Gizzard**
- **Proventriculus**
- **Vent**
Summary
Summary

There are three (3) basic types of digestive systems in farm animal species.

- Monogastric
- Ruminant
- Poultry

The type of digestive system influences the dietary foodstuffs the animal can effectively utilize.
• Horse Digestion
• Inside Poultry Digestion
• How animals get food
# Digestive Tract Capacities

<table>
<thead>
<tr>
<th></th>
<th>Sheep/Goats</th>
<th>Cattle</th>
<th>Swine</th>
<th>Horses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rumen</td>
<td>5-10 gal</td>
<td>55-60 gal</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Reticulum</td>
<td>1.5 qt</td>
<td>3-4 gal</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Omasum</td>
<td>1 pt</td>
<td>1-2 gal</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Abomasum</td>
<td>1.5 qt</td>
<td>3-4 gal</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Stomach</td>
<td>----</td>
<td>----</td>
<td>2 gal</td>
<td>2-3 gal</td>
</tr>
<tr>
<td>Small intestine</td>
<td>2.5 gal</td>
<td>17-18 gal</td>
<td>2.5 gal</td>
<td>12-15 gal</td>
</tr>
<tr>
<td><em>Small intestine length</em></td>
<td>85-90 ft</td>
<td>130 ft</td>
<td>60 ft</td>
<td>70 ft</td>
</tr>
<tr>
<td>Large intestine</td>
<td>1.5 gal</td>
<td>10 gal</td>
<td>3 gal</td>
<td>30-35 gal</td>
</tr>
</tbody>
</table>
THE END

Any questions?
Digestive System Paper

Introduction

Similarities: Ruminant and non-ruminant

Differences: Ruminant vs. non-ruminants

Differences: Poultry vs. Ruminant and Non-ruminants

Conclusion