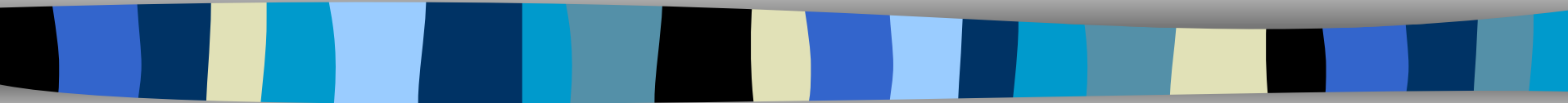


Nutrients



AG 240

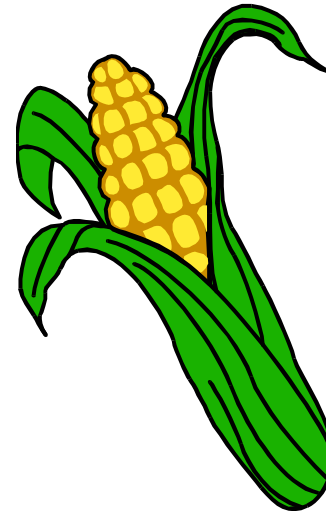


What are the 6 Nutrients

- Carbohydrates
- Proteins
- Fats/Oils (Lipids)
- Vitamins
- Minerals
- Water

Carbohydrates (CHO)

- Primary component of livestock feed
 - Referred to as “energy”



CHO Characteristics



- Structural part of plant
- Makes up 75% of plant's dry weight
- Largest portion of ruminant's diet
- Formed in photosynthesis
- Fermentation needed to digest cellulose



Types of Carbohydrates

<u>Type</u>	<u>Feedstuff</u>	<u>Function</u>
Starches	Corn	Energy source
Sugars	Molasses	Palatability
Cellulose	Hay	Cell Walls



Categories of Carbohydrates

■ Monosaccharide

– Simple Sugars

- Glucose, Fructose, Galactose

■ Disaccarides

– Two simple sugars

- Sucrose, Maltose, Lactose

■ Oligosaccharides

– Yields 3-6 monosaccharides when broken down



Categories of CHO con't

- Polysaccharide
 - Yields more than 6 simple sugars (monosaccharides)
- Mixed Polysaccharide
 - Mono and disaccarides
- Lignin
 - Not always considered to be a CHO



Closer look at Disaccarides

■ Sucrose

- 1 glucose + 1 fructose
- Table sugar (cane or beet)
- Sucrased is related enzyme

■ Maltose

- 2 glucoses
- Bread sugar
- Maltase is related enzyme



Disaccarides con't

■ Lactose

- 1 glucose + 1 galactose
- Milk sugar
- Lactase is related enzyme

■ Cellobiose

- 2 glucoses
- Cellulase is related enzyme



Types of Polysaccharides

■ Starch

- Stored in plants
- Alpha link of glucose
 - Amylase can break alpha links

■ Cellulose

- Beta linkage of glucose
 - Amylase can not break beta bond
 - Bacteria/micro-organisms can break beta bond
- Fibrous, tough, water insoluble material found in plant cell walls
- Makes up bulk of ruminant's diet



Digestive reactions

■ Fast reactions

– Starch $\xrightarrow{\text{Amylase}}$ Maltose $\xrightarrow{\text{Maltase}}$ 2 glucoses

■ Slow Reaction

– Cellulose $\xrightarrow{\text{cellulase}}$ Cellobiose $\xrightarrow{\text{cellulase}}$ 2 glucoses
» Produced by cellulolytic microbes



Types of Mixed Polysaccharides

- Hemicellulose
 - More digestible than cellulose
 - Still have beta linkage
- Pectins
 - More digestible than hemicellulose
 - Still has beta linkage
- Gums



Notes on Lignin

- Not always considered to be a CHO
- High % lignin decreases digestibility
- Found in plant walls (like stems)
 - Higher in legumes than grasses
 - Lignin content increases with age



Review Categories of CHO

- Monosaccharide
- Disaccarides
- Oligosaccharides
- Polysaccharide
- Mixed Polysaccharide
- Lignin



Functions of CHO

- Source of energy
- Source of heat when metabolized
- Building block (sugar)
- Can store in body as fat



CHO Deficiencies in body...

- Dietary Ketosis
- Diabetes Mellitus



CHO, Plants and Animals

- Cereal grains are high in starches
 - Amylase can break down starch
- Forages are primarily cellulose
 - Microbes required to break down cellulose
- When the CHO level in the diet exceeds the ability of an animal to digest it....diarrhea may occur



CHO and VFAs

- VFAs are absorbed by rumen into bloodstream
- VFAs are metabolized into glucose in liver and other tissues



VFAs and CHO sources

<u>Diet</u>	<u>Acetic</u>	<u>Propionic</u>	<u>Butyric</u>
Roughage	65-85%	10-15%	5-15%
Concentrates	30-50%	30-60%	10-20%



Questions related to CHO

- Why do we feed Ionophores (Rumensin and Bovatec) ?
- Why are high corn diets fed in feedlots?
- Why are high roughage diets fed to lactating cows?



Fats/Oils (Lipids)

- Def: Organic substance insoluble in water
- Energy dense
 - 1 gm fat = 9.45 kcal of energy
 - 1 gm CHO = 4.2 kcal of energy
 - Thus fat is 2.25 more energy dense than CHO
- AKA Triglyceride
 - 3 fatty acids and a glycerol



Classification of Fats

- Saturated
- Unsaturated



Saturated Fats



- Definition:

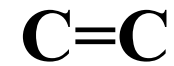
- All of the carbon atoms are associated with 2 Hydrogens connected with single bonds.

- Examples:

- Acetic
- Propionic
- Butyric
- Stearic



Unsaturated Fats



- Definition:

- One or more pairs of the C atoms attached by double bond; H is removed

- Examples:

- Linoleic
- Linolenic



Fats versus Oils

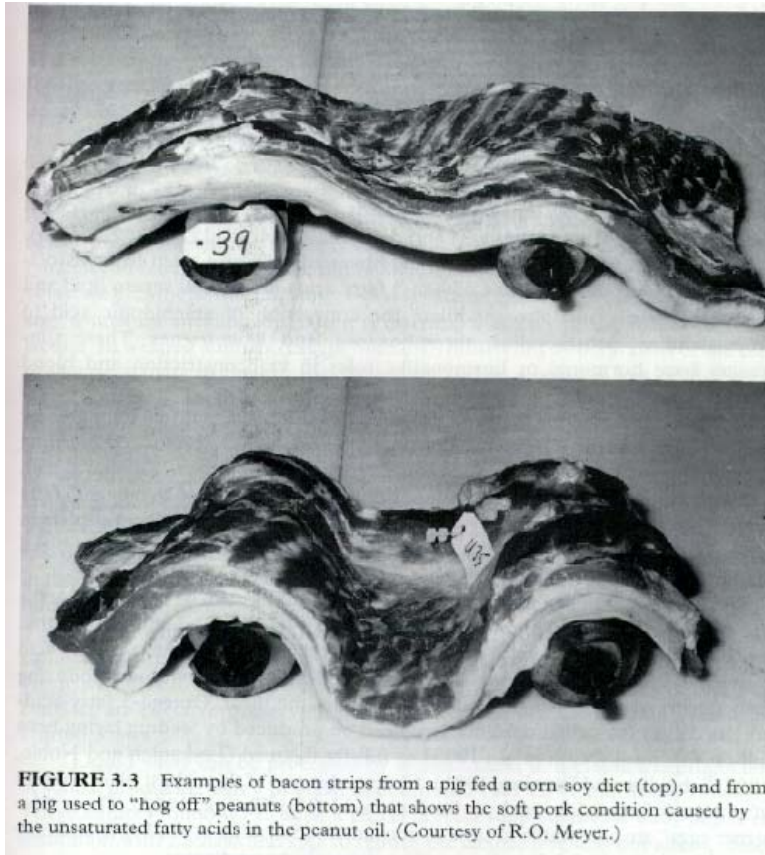
■ Fats

- Solid at room temp
- Contain saturated (long chain) fatty acids

■ Oils

- Liquid at room temp
- Contain unsaturated (short chain) fatty acids
- Absorbed more completely than fats

You are what you eat....



Monogastrics are very sensitive to what kind of fats/oils are in their diet

Source: Livestock Feeds and Feeding (Cheeke)



Functions of Fats/Oils

- Dietary energy source
- Source of heat
- Insulation and protection of organs
- Source of essential fatty acids (EFA)
- Carrier for fat soluble vitamins
- Precursor of steroid hormones



Essential Fatty Acids (EFA)

- Def: Fatty acids that the animal requires but can not synthesize in adequate amounts
- Monogastric
 - 1% of diet
 - Linoleic and Linolenic
 - Corn and SBM are excellent sources
- Ruminant
 - No EFAs
 - Produced by micro-organisms



Final Notes on Fats/Oils

- Most plants have 2-8% fat
 - Soybean, cotton and sunflower seed have over 20%
- Animals can only handle 5% fat in diet
 - Range is generally 2-8%
- Digestibility can be as high as 80-90%
 - But....remember bacon picture



Protein Characteristics

- Only nutrient class that contains Nitrogen (N)
- Requirements highest in young animals
- Made up of Amino Acids
- Rumen microbes manufacture protein



Protein Terminology

- True protein
 - Protein composed only of amino acids
- Nonprotein nitrogen (NPN)
 - Not true protein in nature but contains N and can be converted to protein by bacteria
 - Urea is an example
- Crude protein
 - Protein composed of true protein and any other nitrogenous product



Protein Terminology con't

- Digestible protein (DP)
 - Portion of the CP which animal can digest
- Essential amino acid (EAA)
 - Those AA that are essential to the animal and must be supplied in the diet
- Nonessential amino acid
 - Those AA that are essential to the animal but are normally synthesized or sufficient in the diet.



Ruminants and Protein...

- Ruminants have the ability to convert low quality feed protein into higher quality microbial protein that better meets the animal's needs



Protein utilization by ruminant

- 60% of feed proteins are broken down into AA and then to ammonia (NH_3)
- 40% is not broken down and simply passes on through
 - This protein is called ‘bypass or escape’ protein



Feeding NPN

- Feed only to ruminants!!
- Sources
 - Urea and Anhydrous ammonia
 - Both are very soluble and convert to ammonia very quickly



Guidelines for NPN

- Be careful about how much we feed
 - Excess ammonia is absorbed from the rumen, converted to urea by liver and excreted by the kidneys
 - Ammonia buildup can sicken or kill animal
- Need to feed CHO with NPN
 - Needs carbon skeletons to create protein from NH_3



Essential Amino Acids

- Animal can't synthesize them fast enough to meet requirement, so must come from diet
- 0 essential AA for Swine; 12 for Poultry
- PVT TIM HALL



EAA- PVT TIM HALL

- Phenylalanine
- Valine
- Threonine
- Tryptophan
- Isoleucine
- Methionine
- Histidine
- Arginine
- Leucine
- Lysine



Specie notes on EAA

- Glycine - poultry EAA
- Proline - poultry EAA

- Mature pigs do not need
 - Histidine
 - Arginine
 - Leucine



Notes on EAA

- Most common missing AA
 - Lysine
 - Methionine
 - Tryptophan
- Why:
 - Corn and milo are low in these amino acids
 - Feed with SBM b/c contains these three AA



Final notes on Amino Acids

- Also have non-essential amino acids
- Ruminants can synthesize all of them in rumen
 - Only limiting AA is Lysine



Functions of Proteins

- Basic structural part of body
 - Collagen, keratin, blood protein
 - Building blocks of body: Hair, skin, muscle, blood, organs
- Body metabolism
 - Enzymes, Hormones, Immune system (antibodies are proteins), DNA
- Source of energy



Notes on Protein

- Most sources are 75-80% digestible
 - Varies with feedstuff
- Protein quality is less important to ruminant animals
- Quantity and quality of protein varies with feedstuff
 - Quantity (amount) decreases with age



Vitamins



Natural Sources of Vitamins

Vitamin	Source
A	Carotene rich plants; green leafy forages, hays or silages, yellow corn, whole milk; fish oils
D	Fish liver oils, sun-cured hay
E	Seed germ or germ oils; green forage or hay
K	Green forage; well cured hay; fish meal
thiamine-B1	Green forage; well cured hay; cereal grains; brewers yeast
riboflavin-B2	Green forages, hay or silage; milk products, meat or fish meal, distiller's products
Pantothenic acid	Brewer's yeast; liver meal; dehydrated alfalfa meal; fish soluble; most any feedstuff



The END!



Factors affecting rate of protein degradation

- Solubility of feedstuff protein
- Rate of passage