Nutrients and Nutrient Requirements

Reminders....

- Lab this week and next week: AGAD21
- Bring a calculator and your NRC tables to labs

Nutrients..

- Definition
- Chemical Facts and Features
- Requirements

Nutrients...

- What is the definition of a nutrient?
  - Chemical component of a feed ingredient that is required for normal body function.

Nutrients...

- Definitions and Characteristics
  - Chemical molecules or elements used for:
    - Maintenance
    - Growth
    - Production
    - Reproduction

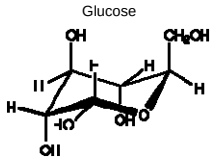
Nutrients...

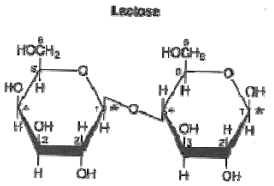
- Chemical classifications:

Nutrients...

- Chemical classifications:
  - Carbohydrates
  - Lipids
  - Proteins (amino acids)
  - Vitamins
  - Minerals
  - Water

Carbohydrates- $(CH_20)_n$





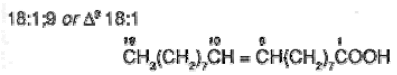
Carbohydrates...

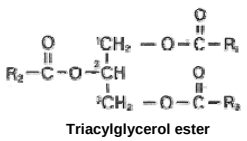
- Monosaccharides
  - Glucose, Fructose, Galactose
- Disaccharides
  - Maltose, Sucrose, Lactose
- Polysaccharides
  - Starch, Cellulose

Lipids...

- soluble in nonpolar organic solvents (as chloroform and ether)
- Contain C, H, and O (C,H > O)

Lipids...





Triacylglycerol ester

Lipids...

Table 1. Dietary fatty acids

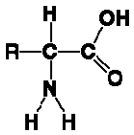
Saturated fatty acids
Stearic acid (18:0)
Palmitic acid (16:0)
Myristic acid (14:0)
Lauric acid (12:0)
Medium-chain fatty acids (8:0 and 10:0)
Monounsaturated fatty acids
Oleic acid (cis-18:1)
Elaidic acid (trans-18:1)
Polyunsaturated fatty acids
n-6 fatty acids
Linoleic acid (18:2)
n-3 fatty acids
Linolenic acid (18:3)
Eicosapentaenoic acid (EPA) (20:5)
Docosahexaenoic acid (DHA) (22:6)

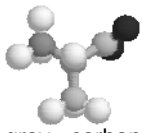
The first number indicates the number of carbon atoms; the second denotes the number of double bonds per molecule.

Proteins...

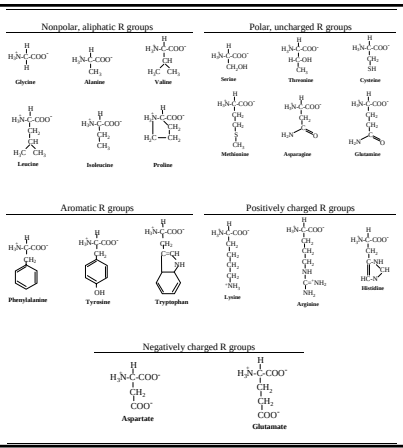
- Amino acids
  - Amino (NH_2) group and carboxyl (COOH) group, with asymmetric carbon (except glycine)

Amino Acids...

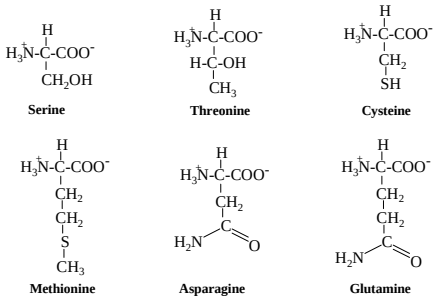




gray - carbon
white - hydrogen
blue – nitrogen
red - oxygen

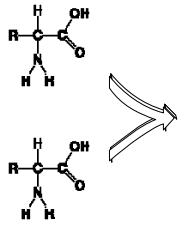


Polar, uncharged R groups



(C, H, O, N)

Protein...



Dipeptide + H_2O

Nutrients...

- Chemical classifications:
  - Carbohydrates
  - Lipids
  - Proteins (amino acids)

  Energy
  - Vitamins
  - Minerals
  - Water

Nutrients...

- Dietary Classifications:
  - **Nonessential-** raw materials consumes, animal synthesizes
  - **Essential-** consumes and used directly

Typically used to refer to amino acids and fatty acids

Nutrients Requirements...

- What is the definition of a nutrient?
  - Chemical component of a feed ingredient that is required for normal body function.

Dietary content | Physiologic Need

Nutrient Requirements...

- It is the physiologic need that we are concerned about meeting
- The diet content is the means by which we ensure the physiologic need is met
- If the need is not met, a nutrient deficiency will develop

Nutrient Requirements...

- There are ~40 nutrients which are nutritionally important. However, only a few are considered in diet formulation. Others are handled by premixes or practical ingredients.

Nutrient Requirements...

1. The dietary requirement is determined based on physiologic need.

2. The contribution of <u>each ingredient</u> toward the total dietary content of a given nutrient is counted in diet formulation.

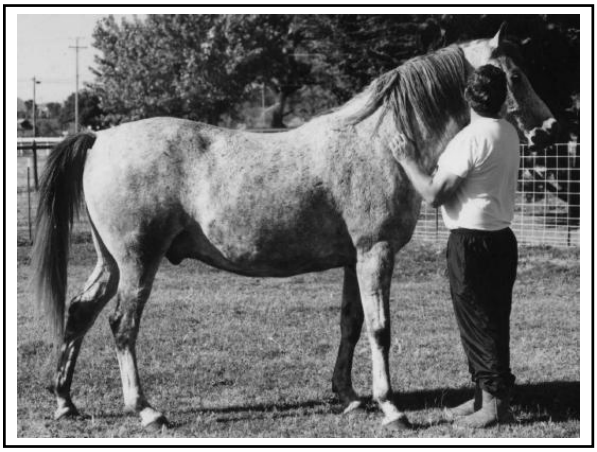
Nutrient Requirements...

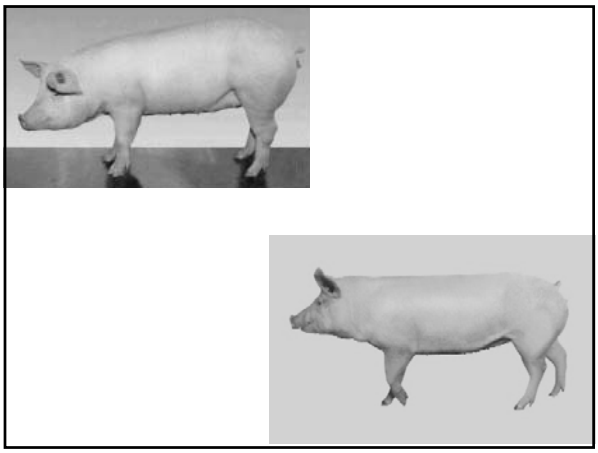
A. Classifications common to animal industries:

1. **Maintenance: maintain body function without gain or loss of body weight.**
2. **Production: level of nutrient intake necessary to support processes beyond maintenance.**
   - **a. growth**
   - **b. production of eggs, hair or wool**
   - **c. lactation**
   - **d. work**
   - **e. reproduction**

Nutrient Requirements...

a. Genetics
b. Injury
c. Disease
d. Activity
e. Environment
f. Feed quality





Nutrient Requirements...

B. Expressing nutrient requirements for diet formulation.

1. **g per day or (total intake per quantity of another nutrient)**
2. **percentage of diet**
3. **units**

Nutrient Requirments...

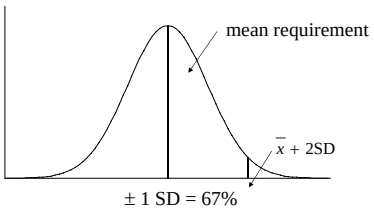
C. Practical considerations

1. **Meat animals are typically fed in groups. Therefore, it is impossible to feed *each* animal to its specific requirement.**

Nutrient Requirements...

a. Genetics
b. Injury
c. Disease
d. Activity
e. Environment
f. Feed quality

Within Group and Group-to-Group



± 1 SD = 67%
± 2 SD = 97.5%

Nutrient Requirements...

- The objective for food animals is to feed nutrients at concentrations that provide optimal performance and cost per unit of gain/production for the majority of the population.

Nutrient Requirements...

- Recreation or companion animals - health and performance are key drivers, and feed intake can easily be adjusted on an individual basis.
- Stages of growth have very different nutrient requirements.

Nutrient Requirements...

D. Interrelationships and "sparing"

1. Glycine, Serine (avian species)

	0-3	**3-6**	**6-8**
Glycine + Serine	1.25	1.14	0.97

The requirement for <u>either</u> amino acid can be met by the other; glycine is synthesized but the rate is insufficient.

Nutrient Requirements...

2. Methionine, Cystine

	0-3	**3-6**	**6-8**
Methionine	0.50	0.38	0.32
Methionine+cystine	0.90	0.72	0.60

The requirement for cystine can be met by methionine, or a combination of methionine and cystine; the methionine requirement <u>must</u> be met by methionine.

Nutrient Requirements...

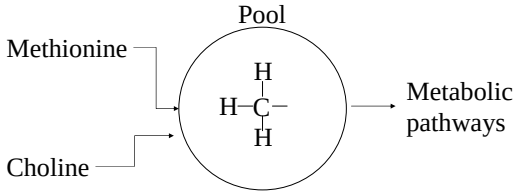
3. Phenylalanine, Tyrosine: as with methionine and cystine.

4. Tryptophan, Niacin

Tryptophan can be converted to niacin, and will alleviate symptoms of a niacin deficiency.

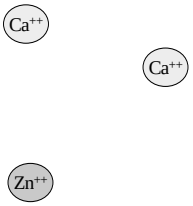
5. Methionine, Choline: labile methyl group of methionine *spares* choline (methionine is NOT converted to choline).

Nutrient Requirements...



Nutrient Requirements...

- Bioavailability...



Bioavailability...

	Body Weight (kg)					
	3–5	5–10	10–20	20–50	50–80	80–120
Phosphorus, total (%)	0.70	0.65	0.60	0.50	0.45	0.40
Phosphorus, available (%)	0.55	0.40	0.32	0.23	0.19	0.15

Bioavailability...

- Corn
  - Phosphorus, total (%) = 0.28
  - Bioavailability of Phosphorus (%) = 14
- *Available P =*
  - *0.14*.28=0.039% aP*