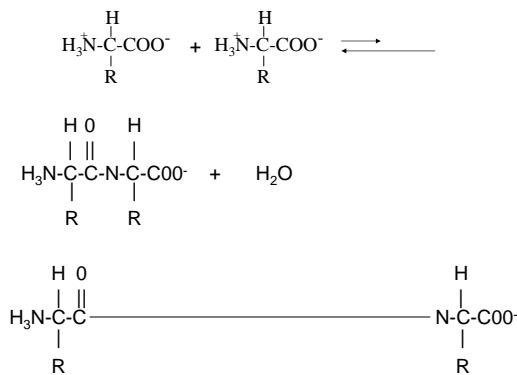


Proteins and Amino Acids

Protein

- ✖ Feed ingredients contain various proteins that are digested to provide amino acids for the animal
- ✖ Nutrient requirements are for amino acids, not CP
- ✖ Therefore, a diet which appears adequate in CP, can be deficient in one or more amino acids



EAA vs. NEAA

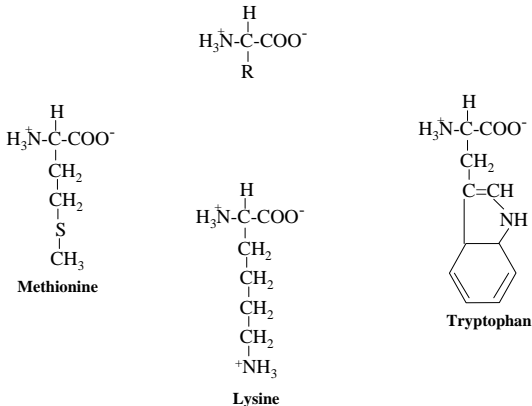
- ✖ Essential amino acids cannot be produced or cannot be produced in sufficient quantity to meet the nutritional need of the animal.
- ✖ Therefore, they must be supplied in the diet.

Are NEAA needed?

- ◆ They serve as a sources of carbon skeletons and amino nitrogen

AA Classification

- ✖ Amino acids are classified by their R group
 - Nonpolar, aliphatic R groups
 - Gly, Ala, Val, Leu, Ile, Pro
 - Polar, uncharged R groups
 - Ser, Thr, Cys, Met, Asp, Gln
 - Aromatic R groups
 - Phe, Tyr, Trp
 - Positively charged R groups
 - Lys, Arg, His
 - Negatively charged R groups
 - Asp, Glu



☼ Stomach

- HCL (parietal cells)
 - denature
- Pepsinogen (chief cells)
 - Pepsinogen \rightarrow Pepsin
- Pepsin- hydrolyzes peptide bonds, particularly between aromatic amino acids

*Pancreatic secretions

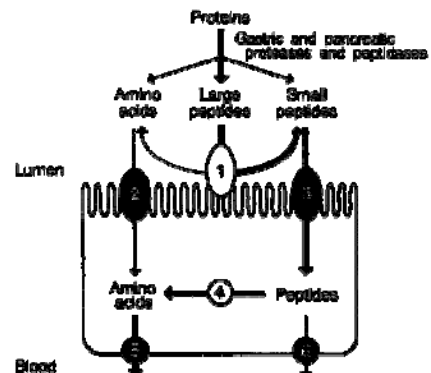
- **Proteolytic enzymes**
 - **Endopeptidases**
 - Trypsinogen → Trypsin
 - Carboxyl side of Lys and Arg
 - Chymotrypsinogen → Chymotrypsin
 - Carboxyl side of aromatic AA and AA with large hydrophobic residues (eg. Met)
 - Proelastase → Elastase
 - Carboxyl side of smaller non-polar AA

Trypsinogen is converted to trypsin by brush border membrane bound enterokinase

✱ Pancreatic secretions

- **Proteolytic enzymes**
 - Exopeptidases
 - Procarboxypeptidase A → Carboxypeptidase A
 - terminal aromatic/ branched chain
 - Procarboxypeptidase B → Carboxypeptidase B
 - terminal Arg/Lys
- **Membrane bound**
 - Enterokinase
 - Aminopeptidase- 1 AA at a time from N-terminal
 - Dipeptidase- 2 AA at a time from N-terminal

- ✖ Amino acids can be absorbed as free amino acids or as di- and tri-peptides
- ✖ Amino acids/peptides are absorbed across the brush border membrane
- ✖ Amino acids may be used by the absorptive cell or transported into the bloodstream
- ✖ Transport into the blood from the GI lumen involves apical and basolateral transporters



Absorption of free AA

※ Transporters in the brush border membrane:

TABLE 1. Classification of amino acid transport systems in the brush border membrane of the small intestine

Transport system	Substrates	Dependence on Na ⁺ gradient	Involvement of other ions
B	Dipolar α-amino acids	Yes	None
B [±]	Dipolar α-amino acids Basic amino acids Cysteine	Yes	None
b [±]	Dipolar α-amino acids Basic amino acids Cysteine	No	None
y ⁺	Basic amino acids	No	None
IMINO	Imino acids	Yes	Cl ⁻
β	β-Amino acids	Yes	Cl ⁻
X _{AG}	Acidic amino acids	Yes	K ⁺

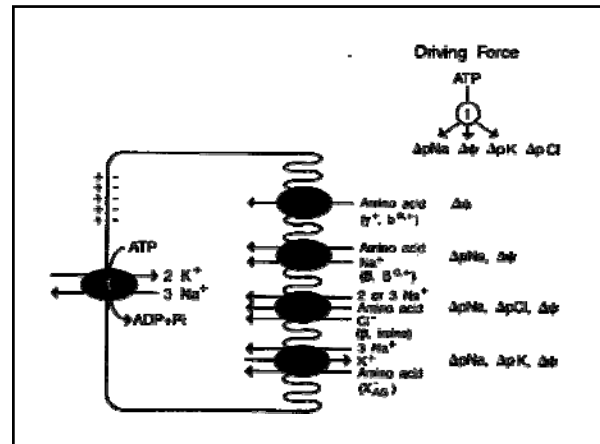
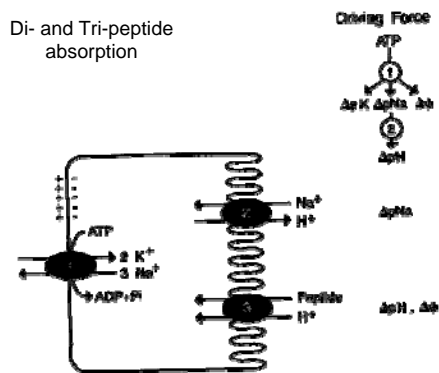


TABLE 2. Classification of amino acid transport systems in the basolateral membrane of the small intestine

Transport system	Substrates	Dependence on Na ⁺ gradient
A	Dipolar α-amino acids	Yes
ASC	Imino acids	Yes
asc	Three- and four-carbon dipolar amino acids	No
L	Three- and four-carbon dipolar amino acids	No
y ⁻	Bulky, hydrophobic, dipolar amino acids Basic amino acids	No

Di- and Tri-peptide absorption



Transport efficiency....

※ Is the transport of free amino acids or peptides across the apical membrane more energy efficient?

Amino Acid and Peptide Transporters

- ※ The concentration of peptide transporters is greatest in the proximal small intestine and decreases as you proceed to the distal ileum
- ※ The concentration of amino acid transporters is least in the proximal small intestine and increase as you proceed towards the distal ileum