Course 2851 Principles of Metabolism
Metabolism and endocrinology programme, Karolinska Institutet

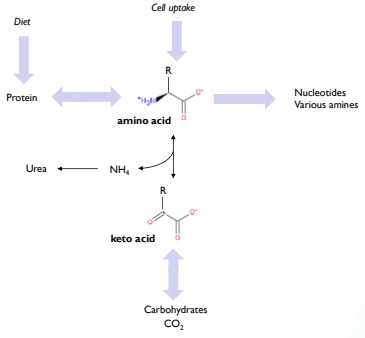
Lecture 12

Amino acids and nutrient starvation

Roland Nilsson, Ph.D

Department of Medicine, Solna
Center for Molecular Medicine
Karolinska Institutet

Amino acid metabolism, overview



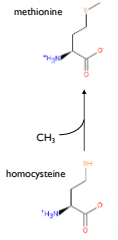
Essential *vs.* nonessential amino acids

Depends on context.

Nonessential
Alanine
Arginine
Aspartic acid
Cysteine
Glutamic acid
Glutamine
Glycine
Proline
Serine
Tyrosine
Asparagine

Essential
Histidine
Isoleucine
Leucine
Lysine
Methionine
Phenylalanine
Threonine
Tryptophan
Valine

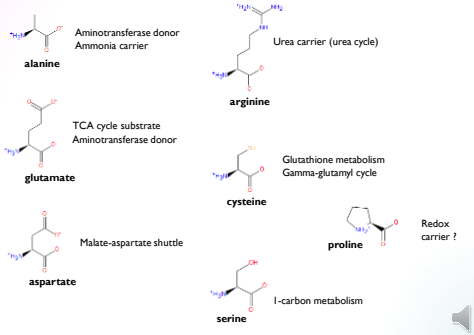
Methionine – essential?



Reeds, J Nutr 130:835S-1840S, 2000

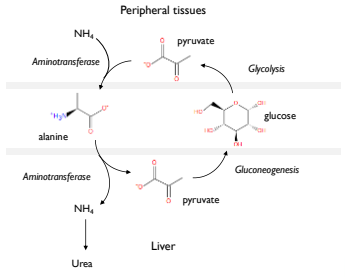
"Central" amino acids are nonessential

For "important" amino acids, synthesis pathways have been retained



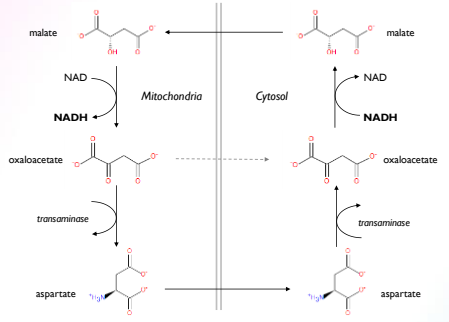
Alanine is an important nitrogen carrier

Glucose-alanine cycle

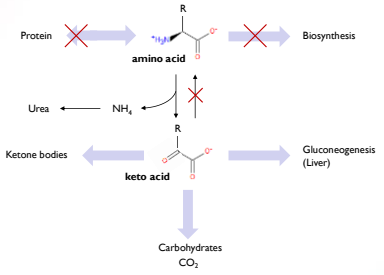


Malate-aspartate shuttle

Transfering NADH into mitochondria

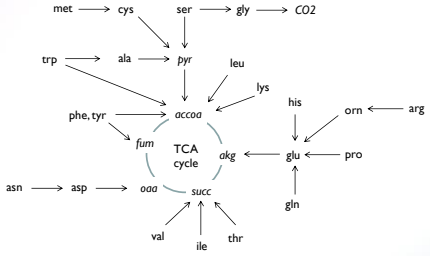


Amino acids during nutrient starvation



Catabolism pathways, overview

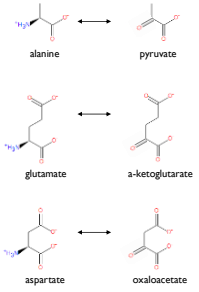
All amino acids can be catabolized to CO2 and NH4.



Keto acids of amino acids

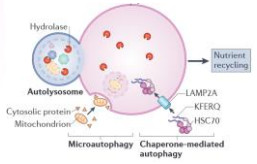
Often helps "locate" an amino acid in metabolism

Examples:



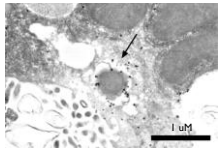
Autophagy

Cellular process of self-consumption



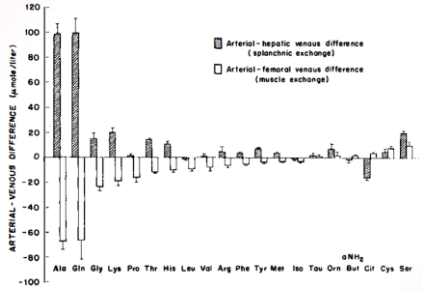
Kaur & Debnath, Nat Rev Mol Cell Biol 16:461-472, 2015.

Autophagosome in a mouse hepatocyte after 24h nutrient starvation



Mizushima, Mol Biol Cell 15:1101—1111, 2004.

Amino acid transformations in muscle



Felig, Ann Rev Biochem 44:933—955, 1975.

Handling nitrogen: the urea cycle

An ammonia waste disposal system