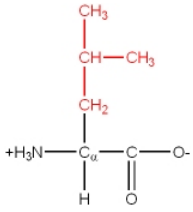
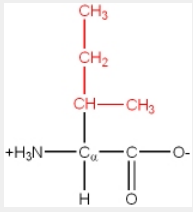
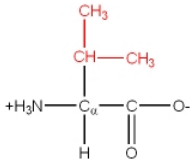
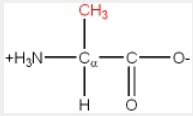
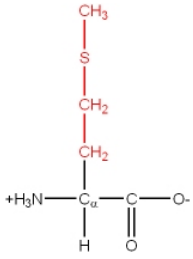
1.1: Nomenclature of Amino acids

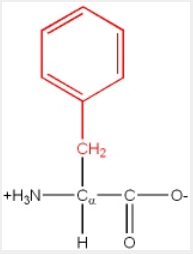
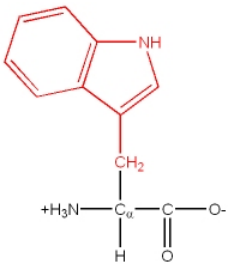
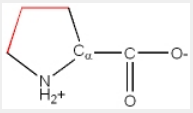
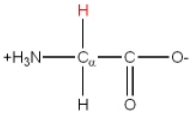
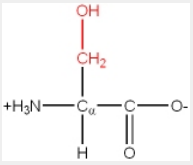
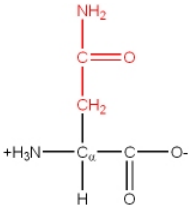
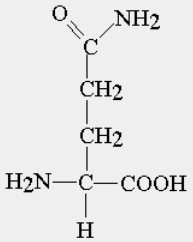
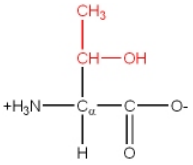
Common amino acids

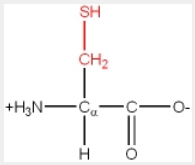
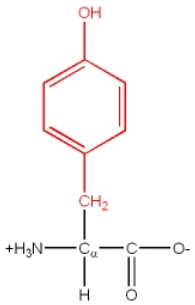
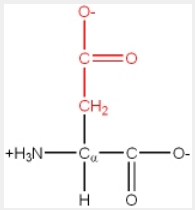
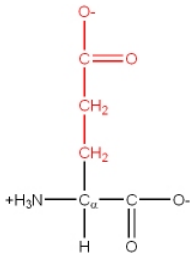
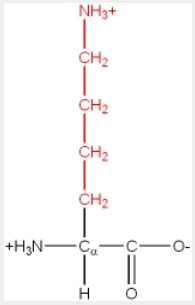
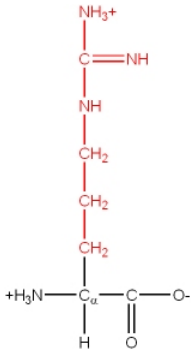
There are 20 common amino acids. They are composed of C, H, O, N and S atoms. They are structurally and chemically different, and also differ in size and volume. Some are branched structures, some are linear, some have ring structures. One of the 20 common amino acids is actually an imino acid. A typical grouping of their chemical nature is as follows:

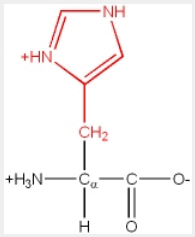
- Nonpolar (hydrocarbons and one sulfur-containing amino acid). Dispersion forces and hydrophobic effects predominate in their interactions. They cannot H-bond with water and these side chains have a characteristic hydrophobic effect in water.
- Polar uncharged. Contain functional groups that can H-bond with water and other amino acids. Include C, H, O, N and S atoms.
- Acidic. Contain a carboxylic acid functional group with a negative charge at neutral pH. Can H-bond with water, can form ionic interactions, and can also serve as nucleophiles or participate in acid-base chemistry.
- Basic. Nitrogen containing bases (e.g. guanidino, imidazole or amino groups) with a net positive charge at neutral pH. Can serve as proton donors in chemical reactions, and form ionic interactions.

The amino acids have a name, as well as a three letter or single letter mnemonic code:

Type	Name	R-group Structure
Nonpolar	Leucine Leu, L	
	Isoleucine Ile, I	
	Valine Val, V	
	Alanine Ala, A	
	Methionine Met, M	

Type	Name	R-group Structure
	Phenylalanine Phe, F	
	Tryptophan Trp, W	
	Proline Pro, P	
	Glycine Gly, G (note: sometimes included in polar group)	
Polar, uncharged	Serine Ser, S	
	Asparagine Asn, N	
	Glutamine Gln, Q	 glutamine
	Threonine Thr, T	

Type	Name	R-group Structure
	Cysteine Cys, C	
	Tyrosine Tyr, Y	
Acidic	Aspartic acid Asp, D	
	Glutamic acid Glu, E	
Basic	Lysine Lys, K	
	Arginine Arg, R	

Type	Name	R-group Structure
	Histidine His, H	

Uncommon amino acids

In addition to the 20 common amino acids, there are several uncommon ones found:

- Hydroxylysine and hydroxyproline. These are found in the protein collagen. Collagen is a fibrous protein made up of three polypeptides that form a stable assembly, but only if the proline and lysine residues are hydroxylated. (requires vitamin C for reduction of these amino acids to hydroxy form)
- Thyroxine, an iodinated derivative of tyrosine, found in thyroglobulin (produced by thyroid gland; requires iodine in diet)
- g-carboxyglutamic acid (i.e. glutamic acid with two carboxyl groups) found in certain blood clotting enzymes (requires vitamin K for production)
- N-methyl arginine and n-acetyl lysine. Found in some DNA binding proteins known as histones

Amino acid derivatives not found in proteins

Some amino acids are made that are not intended for incorporation into proteins, rather they have important functionalities on their own

1. Serotonin (derivative of tryptophan) and g-amino butyric acid (a derivative of glutamic acid) are both neurotransmitters
2. Histamine (derivative of histidine) involved in allergic response
3. Adrenaline (derivative of tyrosine) a hormone
4. Various antibiotics are amino acid derivatives (penicillin)

The Essential Amino Acids

Humans must include adequate amounts of 9 amino acids in their diet.

- Histidine
- Isoleucine
- Leucine
- Lysine
- Methionine (and/or cysteine)
- Phenylalanine (and/or tyrosine)
- Threonine
- Tryptophan
- Valine

These "essential" amino acids cannot be synthesized from other precursors. However, cysteine can partially meet the need for methionine (they both contain sulfur), and tyrosine can partially substitute for phenylalanine. Two of the essential amino acids, **lysine** and **tryptophan**, are poorly represented in most plant proteins. Thus strict vegetarians should ensure that their diet contains sufficient amounts of these two amino acids. 19 of the 20 amino acids listed above can exist in two forms in three dimensions.

Contributors

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Thumbnail: 3D model of L-tryptophan. Image used with permission (Public Domain; Benjah-bmm27).