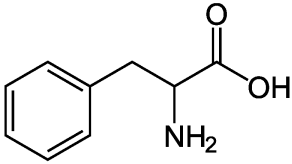
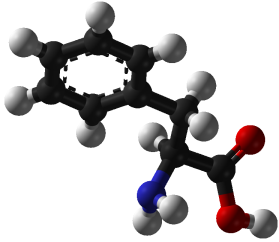


# Phenylalanine

Phenylalanine	
	
	
Identifiers	
CAS number	150-30-1 <sup>[1]</sup> (DL) ✓, 63-91-2 <sup>[2]</sup> (L)
PubChem	994 <sup>[3]</sup>
ChemSpider	5910 <sup>[4]</sup> ✓
UNII	8P946UF12S <sup>[5]</sup> ✓
DrugBank	DB00120 <sup>[6]</sup>
Properties	
Molecular formula	C <sub>9</sub> H <sub>11</sub> NO <sub>2</sub>
Molar mass	165.19 g mol <sup>-1</sup>
Acidity (pK <sub>a</sub> )	1.83 (carboxyl), 9.13 (amino) <sup>[7]</sup>
<span style="color: green;">✓</span> (what is this?) (verify) <sup>[8]</sup>	
Except where noted otherwise, data are given for materials in their standard state (at 25 °C, 100 kPa)	
Infobox references	

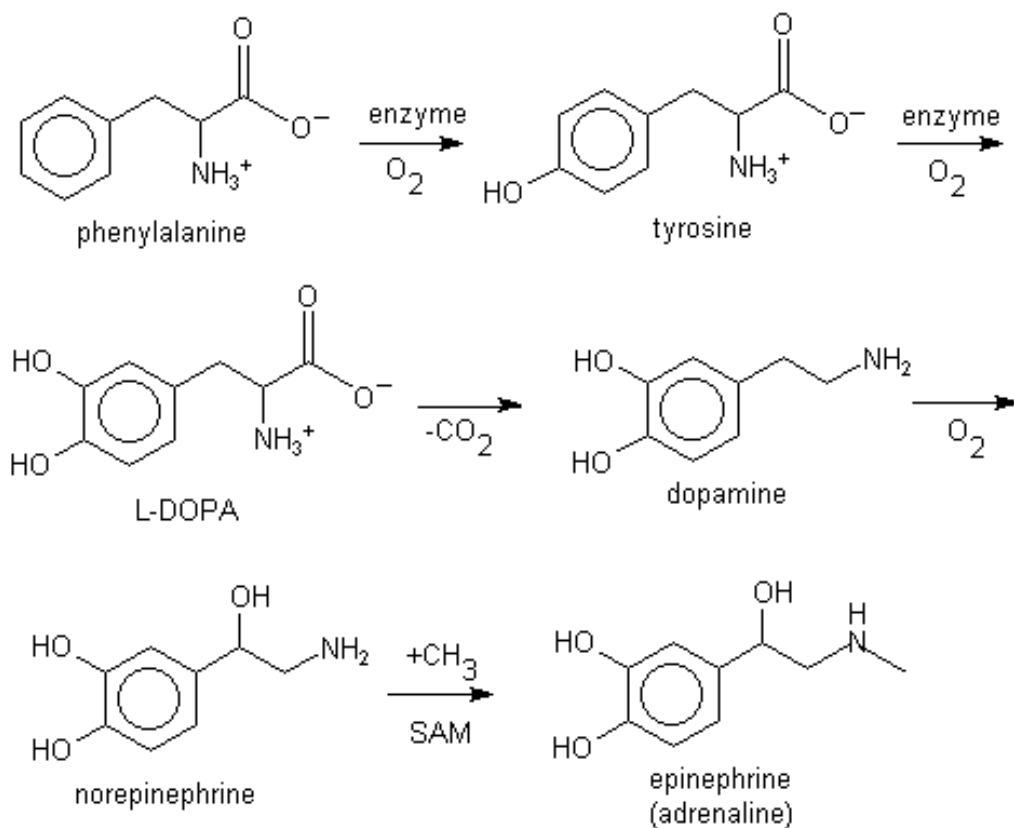
**Phenylalanine** (abbreviated as **Phe** or **F**)<sup>[9]</sup> is an  $\alpha$ -amino acid with the formula HO<sub>2</sub>CCH(NH<sub>2</sub>)CH<sub>2</sub>C<sub>6</sub>H<sub>5</sub>. This essential amino acid is classified as nonpolar because of the hydrophobic nature of the benzyl side chain. L-Phenylalanine (LPA) is an electrically neutral amino acid, one of the twenty common amino acids used to biochemically form proteins, coded for by DNA. The codons for L-phenylalanine are UUU and UUC. Phenylalanine is a precursor for tyrosine, the monoamine signaling molecules dopamine, norepinephrine (noradrenaline), and epinephrine (adrenaline), and the skin pigment melanin.

Phenylalanine is found naturally in the breast milk of mammals. It is used in the manufacture of food and drink products and sold as a nutritional supplement for its reputed analgesic and antidepressant effects. It is a direct precursor to the neuromodulator phenylethylamine, a commonly used dietary supplement.

## Other biological roles

L-Phenylalanine is biologically converted into L-tyrosine, another one of the DNA-encoded amino acids. L-tyrosine in turn is converted into L-DOPA, which is further converted into dopamine, norepinephrine (noradrenaline), and epinephrine (adrenaline). The latter three are known as the catecholamines.

Phenylalanine uses the same active transport channel as tryptophan to cross the blood-brain barrier, and, in large quantities, interferes with the production of serotonin.



## In plants

Phenylalanine is the starting compound used in the flavonoid biosynthesis. Lignan is derived from phenylalanine and from tyrosine. Phenylalanine is converted to cinnamic acid by the enzyme phenylalanine ammonia-lyase.<sup>[10]</sup>

## Phenylketonuria

The genetic disorder phenylketonuria (PKU) is the inability to metabolize phenylalanine. Individuals with this disorder are known as "phenylketonurics" and must regulate their intake of phenylalanine. A (rare) "variant form" of phenylketonuria called hyperphenylalaninemia is caused by the inability to synthesize a coenzyme called bipterin, which can be supplemented. Pregnant women with hyperphenylalaninemia may show similar symptoms of the disorder (high levels of phenylalanine in blood) but these indicators will usually disappear at the end of gestation. Individuals who cannot metabolize phenylalanine must monitor their intake of protein to control the buildup of phenylalanine as their bodies convert protein into its component amino acids.

A non-food source of phenylalanine is the artificial sweetener aspartame. This compound, sold under the trade names "Equal" and "NutraSweet", is metabolized by the body into several chemical byproducts including phenylalanine. The breakdown problems phenylketonurics have with protein and the attendant build up of phenylalanine in the body also occurs with the ingestion of aspartame, although to a lesser degree. Accordingly, all products in Australia, the U.S. and Canada that contain aspartame must be labeled: "Phenylketonurics: Contains

phenylalanine." In the UK, foods containing aspartame must carry ingredient panels that refer to the presence of "aspartame or E951" <sup>[11]</sup> and they must be labeled with a warning "Contains a source of phenylalanine." These warnings are specifically placed to aid individuals who suffer from PKU so that they can avoid such foods.

Geneticists have recently sequenced the genome of macaques. Their investigations have found "some instances where the normal form of the macaque protein looks like the diseased human protein" including markers for PKU.<sup>[12]</sup>

## D- and DL-phenylalanine

The stereoisomer D-phenylalanine (DPA) can be produced by conventional organic synthesis, either as a single enantiomer or as a component of the racemic mixture. It does not participate in protein biosynthesis although it is found in proteins in small amounts - particularly aged proteins and food proteins that have been processed. The biological functions of D-amino acids remain unclear although some, such as D-phenylalanine, may have pharmacological activity.

DL-Phenylalanine (DLPA) is marketed as a nutritional supplement for its supposed analgesic and antidepressant activities. The reputed analgesic activity of DL-phenylalanine may be explained by the possible blockage by D-phenylalanine of enkephalin (endorphin) degradation by the enzyme carboxypeptidase A.<sup>[13]</sup> The mechanism of DL-phenylalanine's supposed antidepressant activity may be accounted for by the precursor role of L-phenylalanine in the synthesis of the neurotransmitters norepinephrine and dopamine. Elevated brain levels of norepinephrine and dopamine are thought to have an antidepressant effect. Also, as DL-phenylalanine inhibits endorphin degradation, this leads to an inhibition of GABA release in the ventral tegmental neurons (in the midbrain), which results in greater dopamine release. This can explain the analgesic. Following ingestion, D-Phenylalanine is absorbed from the small intestine and transported to the liver via the portal circulation. A small amount of D-phenylalanine appears to be converted to L-phenylalanine. D-Phenylalanine is distributed to the various tissues of the body via the systemic circulation. It appears to cross the blood-brain barrier less efficiently than L-phenylalanine, and so a small amount of an ingested dose of D-phenylalanine is not absorbed but excreted in the urine.

## Commercial synthesis

L-Phenylalanine is produced for medical, feed, and nutritional applications, such as aspartame, in large quantities by utilizing the bacterium *Escherichia coli*, which naturally produces aromatic amino acids like phenylalanine. The quantity of L-phenylalanine produced commercially has been increased by genetically engineering *E. coli*, such as by altering the regulatory promoters or amplifying the number of genes controlling enzymes responsible for the synthesis of the amino acid.<sup>[14]</sup>

## History

The genetic codon for phenylalanine was first discovered by J. Heinrich Matthaei and Marshall W. Nirenberg in 1961. They showed that by using *m*-RNA to insert multiple uracil repeats into the genome of the bacterium *E. coli*, they could cause the bacterium to produce a polypeptide consisting solely of repeated phenylalanine amino acids. This discovery helped to establish the nature of the coding relationship that links information stored in genomic nucleic acid with protein expression in the living cell.

## References

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- [2] <http://www.commonchemistry.org/ChemicalDetail.aspx?ref=63-91-2>
- [3] <http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?cid=994>
- [4] <http://www.chemspider.com/5910>
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- [6] <http://redpoll.pharmacy.ualberta.ca/drugbank/cgi-bin/getCard.cgi?CARD=DB00120>
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- [8] <http://en.wikipedia.org/wiki/%3Aphenylalanine?diff=cur&oldid=398783053>
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## External links

- Phenylalanine at ChemSynthesis (<http://www.chemsynthesis.com/base/chemical-structure-453.html>)
- Food Sources of Phenylalanine (<http://nutrient.javalime.com/nutrient.php/508>)

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