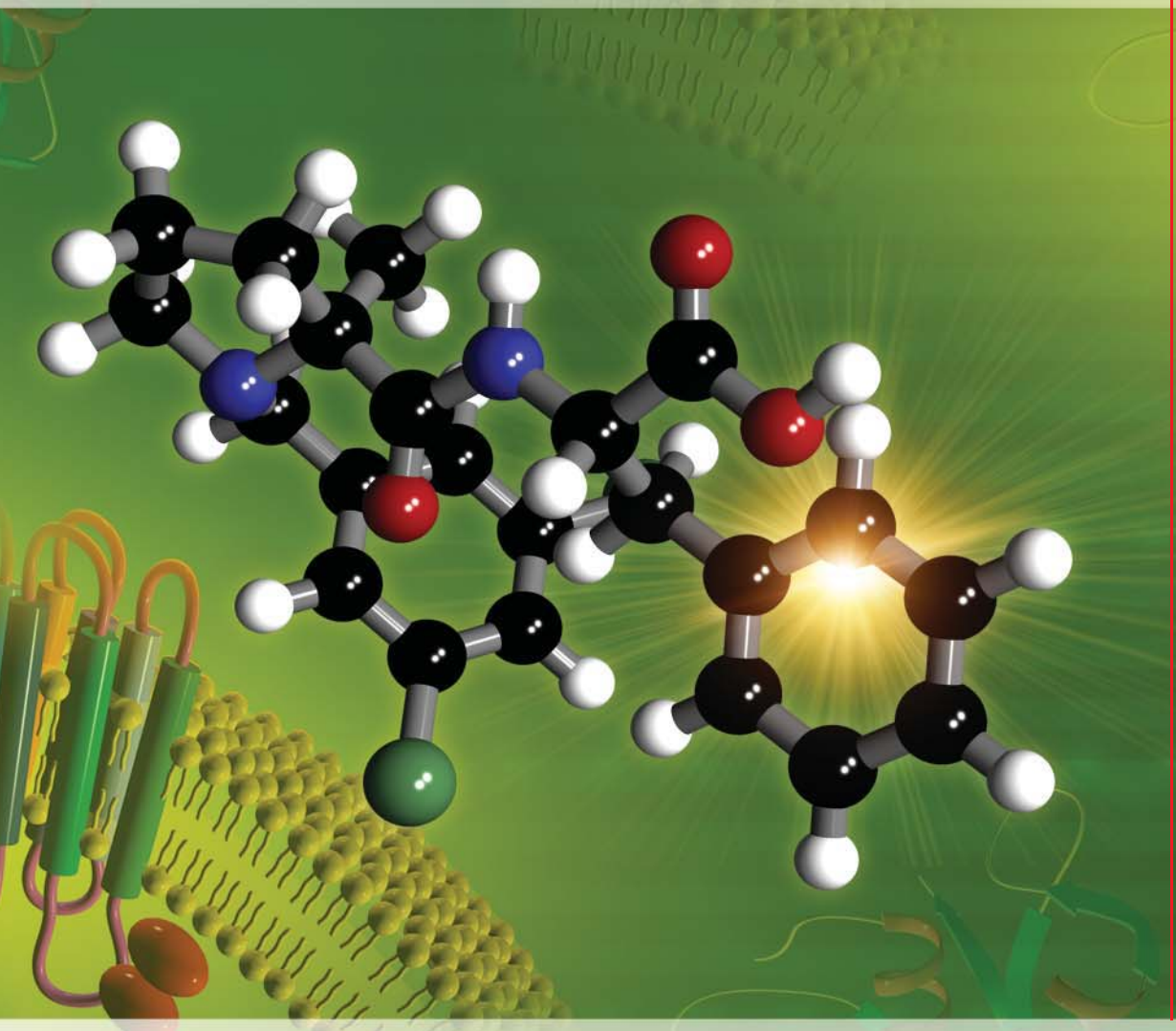
ChemFiles

Vol. 5 No. 12

Innovations in Peptide Synthesis and Conjugation

Tools for Drug Discovery



Proline Derivatives and Analogs

New Amino Acid Building Blocks

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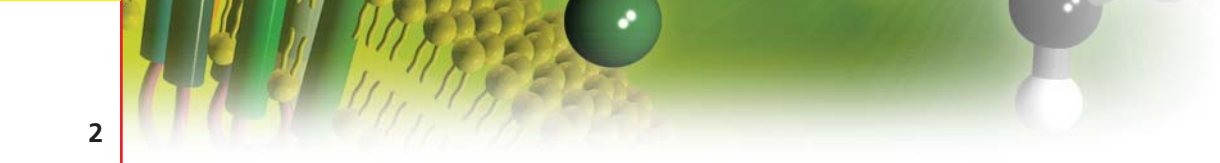

Introduction

Sigma-Aldrich is a leading supplier of products for peptide and peptidomimetic synthesis. The increasing relevance of the design of peptidomimetics and peptide analogs in the pharmaceutical industry prompted us to establish a really unique and comprehensive portfolio of unnatural amino acids that can be utilized as building blocks, conformational constraints, molecular scaffolds, or pharmacologically active compounds, giving access to a nearly infinite array of diverse structural elements for the development of new therapeutic drugs.

Sigma-Aldrich is pleased to introduce more than 60 recent additions to the portfolio of unnatural amino acid derivatives, building blocks, and selected polyethylene glycols (PEG's) in this *ChemFiles*.

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Content of this ChemFiles

1. Proline Derivatives and Analogs

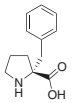
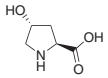
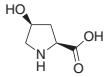
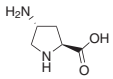
1.1 Introduction

Proline is a non-polar proteinogenic amino acid that forms a tertiary amide when incorporated into peptides. It does not have a hydrogen on the amide group and therefore cannot act as a hydrogen bond donor. Proline is known as a classical breaker of both the α-helical and β-sheet structures in proteins and peptides. Nevertheless, it is widely distributed in the putative transmembrane domains of many protein transporters and channels, regions believed to be α-helical.[1]

Among the proteinogenic amino acids, proline plays a special role. In protein structures the planar peptide bond occurs predominantly in the *trans* conformation.[2] The proline residue restricts the conformational space of the peptide chain. However, due to the small free enthalpy difference between the *cis* and *trans* Xaa-Pro bond isomers of 2.0 kJ·mol^{-1} (compared to 10.0 kJ·mol^{-1} for other Xaa-non-Pro peptide bonds), there is a relatively high intrinsic probability of 30% *cis* conformation at RT and both *cis* and *trans* isomers are present in solution.[3,4]

The *cis/trans*-isomerization of peptide bonds on the N-terminal side of Pro residues plays a key role in the folding process of a protein because the rotational barrier of the *cis/trans*-isomerization is quite high (85,0 ± 10,0 kJ·mol^{-1}). Therefore, this interconversion is described to be one of the limiting steps of protein folding *in vitro* and *in vivo*.[5]
In nature there is a class of enzymes, the peptidyl-prolyl-*cis/trans*-isomerases (**PPIases**). They are able to catalyze protein folding by accelerating the isomerization of the Xaa-Pro-bond.[6–8]

Table 1. Proline Analog or Homolog Structures for the Restriction of the Xaa-Pro Imide Conformation

Chapter	Structure	Name/(IUPAC Nomenclature)
1.4		α-methyl-L-proline (2*R*)-2-methyl-pyrrolidine-2-carboxylic acid
1.4		α-benzyl-L-proline (2*R*)-2-benzyl-pyrrolidine-2-carboxylic acid
1.5		*trans*-4-hydroxy-L-proline (2*S*,4*R*)-4-hydroxypyrrolidine-2-carboxylic acid
1.5		*cis*-4-hydroxy-L-proline (2*S*,4*S*)-4-hydroxypyrrolidine-2-carboxylic acid
1.5		*trans*-3-hydroxy-L-proline (2*S*,3*R*)-3-hydroxypyrrolidine-2-carboxylic acid
1.5		*cis*-3-hydroxy-L-proline (2*S*,3*S*)-3-hydroxypyrrolidine-2-carboxylic acid
1.6		*trans*-4-amino-L-proline (2*S*,4*R*)-4-aminopyrrolidine-2-carboxylic acid
1.7		3,4-dehydro-DL-proline (±)-3-pyrrolin-2-carboxylic acid
1.8		(2*S*)-aziridine-2-carboxylic acid
1.8		(2*S*)-azetidine-2-carboxylic acid
1.9		L-pipecolic acid (2*S*)-piperidine-2-carboxylic acid
1.10		4-oxa-L-proline (4*S*)-oxazolidine-4-carboxylic acid
1.10		3-thia-DL-proline thiazolidine-2-carboxylic acid
1.10		4-thia-L-proline (4*R*)-thiazolidine-4-carboxylic acid

1. Proline Derivatives and Analogs—Cont'd

Comparative studies performed with proline analogues revealed that the key step in the catalysis of the *cis/trans*-isomerization of a peptidyl-prolyl bond is a reduction of the double bond character of the planar, conjugated C–N amide bond. Any factor that can weaken the double bond character of the amide bond by destabilizing the planar peptide bond, or shifting the hybridization of the prolyl nitrogen from sp^2 to sp^3, is expected to accelerate the isomerization.[9,10]

In order to understand the relationship between imide bond geometry and bioactivity of peptides,[11,12] synthetic proline analogues have been developed that provide restrictions of the Xaa-Pro imide conformation. Such proline mimetics are based on ring substitutions with alkyl and aromatic groups, incorporation of heteroatoms into the ring, or the expansion or contraction of the proline ring (**Table 1**). Those analogues are promising candidates for conformational studies and for tuning the biological, pharmaceutical, or physicochemical properties of naturally occuring, as well as *de novo* designed, linear, and cyclic peptides.

Several proline analogs and homologs occur in nature. *Trans*-3-hydroxyproline and *trans*-4-hydroxyproline represent constituents of common proteins as a result of post-translational hydroxylation, especially in collagens.[13] Various 3- and 4-alkylated derivatives of proline and hydroxyproline as well as analogues with ring restrictions, such as aziridine-2-carboxylic acid and azetidine-2-carboxylic acid, and ring expansions, i.e. pipecolic acid, are found in natural products.[14,15] Derivatives such as L-azetidine-2-carboxylic acid, *cis*-4-hydroxy-L-proline, and 3,4-dehydro-DL-proline prevent pro-collagen from folding into a stable triple-helical conformation, thereby reducing excessive deposition of collagen in fibrotic processes and the growth of tumors.[16]

Thiazolidine-4-carboxylic acid thiaproline has also been incorporated into collagen model compounds[17,18] and other bioactive molecules such as thrombin inhibitors,[19] somatostatin,[20,21] dipeptidyl peptidase IV substrates,[22] angiotensin II,[23] HIV inhibitors,[24] ACE inhibitors,[25] and oxytocin.[26]

α-Methyl-proline is a bioactive molecule restoring normal levels of bone collagen type I synthesis.[27] It can be looked at as a conformationally constrained aminoisobutyric acid analog. The α-Methyl-proline residue has been inserted into morphiceptin to perform conformational studies on the bioactivity of the Xaa-Pro *cis-/trans*-isomers.[28] A α-methyl-proline containing potential dual $\alpha_4\beta_1$ integrin antagonist has been described recently.[29]

α-Benzyl-proline combines the conformational restrictions of a proline derivative with the electronic properties of phenylalanine. Spirolactams containing an α-benzyl-proline substructure have been synthesized as potential beta-turn mimetics.[30]

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1.2 Proline Derivatives

Boc-Pro-OH puriss., ≥99.0% T

$C_{10}H_{17}NO_4$
MW: 215.25
[*15761-39-4*]

15490-5G	5 g
15490-25G	25 g
15490-100G	100 g

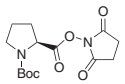
Boc-D-Pro-OH puriss., ≥99.0% T

$C_{10}H_{17}NO_4$
MW: 215.25
[*37784-17-1*]

92517-1G-F	1 g
92517-5G-F	5 g

Boc-Pro-OSu purum, ≥98.0% N

$C_{14}H_{20}N_2O_6$
MW: 312.32
[*3392-10-7*]



15491-1G	1 g
15491-5G	5 g
15491-25G	25 g

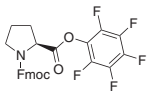
Fmoc-Pro-OH purum, ≥99.0% HPLC

$C_{20}H_{19}NO_4$
MW: 337.37
[*71989-31-6*]

47636-5G-F	5 g
47636-50G-F	50 g
47636-100G-F	100 g

Fmoc-Pro-OPfp purum, ≥96.0% HPLC

$C_{26}H_{18}F_5NO_4$
MW: 503.42
[*86060-90-4*]



47475-1G	1 g
47475-5G	5 g
47475-25G	25 g

Fmoc-D-Pro-OH purum, ≥98.0% TLC

$C_{20}H_{19}NO_4$
MW: 337.37
[*101555-62-8*]

47532-1G	1 g
47532-5G	5 g
47532-25G	25 g

Z-Pro-OH puriss., ≥99.0% T

$C_{13}H_{15}NO_4$
MW: 249.26
[*1148-11-4*]

97090-10G	10 g
97090-50G	50 g

Z-D-Pro-OH 98%

$C_{13}H_15NO4$
MW: 249.26
[*6404-31-5*]

860735-100MG	100 mg
860735-500MG	500 mg

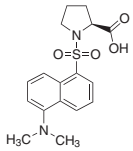
Ddz-Pro-OH purum, ≥99.0 % HPLC

$C_{17}H_{23}NO_6$
MW: 337.37

71215-1G	1 g
71215-5G	5 g

Dansyl-L-proline puriss., ≥99.0% TLC

$C_{17}H_{20}N_2O_4S$
MW: 348.42
[*1239-94-7*]



87778-250MG-F	250 mg
87778-1G-F	1 g

L-Proline ≥99.5% NT

$C_5H_9NO_2$
MW: 115.13
[*147-85-3*]

81709-25G	25 g
81709-100G	100 g
81709-500G	500 g

L-Proline ≥99.0% NT

$C_5H_9NO_2$
MW: 115.13
[*147-85-3*]

81710-10G	10 g
81710-50G	50 g
81710-250G	250 g

D-Proline puriss., ≥99.0% NT

$C_5H_9NO_2$
MW: 115.13
[*344-25-2*]

81705-1G	1 g
81705-5G	5 g
81705-25G	25 g

DL-Proline purum, ≥98.0% NT

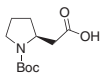
$C_5H_9NO_2$
MW: 115.13
[*609-36-9*]

81720-5G	5 g
81720-25G	25 g

1.3 β^3- Homoprolines

Boc-β^3-Homopro-OH purum, ≥98.0% TLC

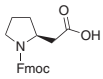
$C_{11}H_{19}NO_4$
MW: 229.27
[*56502-01-3*]



14982-250MG	250 mg
14982-1G	1 g

Fmoc-L-β^3-Homopro-OH purum, ≥98.0% HPLC

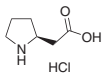
$C_{21}H_{21}NO_4$
MW: 351.4
[*193693-60-6*]



47912-250MG	250 mg
47912-1G	1 g

L-β^3-Homopro-OH HCl purum, ≥98.0% TLC

$C_6H_{11}NO_2 \bullet HCl$
MW: 165.62
[*53912-85-9*]



03768-250MG	250 mg
03768-1G	1 g

1.4 Prolines with Substituents in α-Position

Boc-α-Me-DL-Pro-OH purum, ≥96.0% HPLC

$C_{11}H_{19}NO_4$
MW: 229.27
[*203869-80-1*]

68691-500MG	500 mg

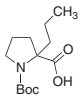
α-Methyl-L-proline purum, ≥98.0% TLC

$C_6H_{11}NO_2$
MW: 129.16
[*42856-71-3*]

17249-250MG	250 mg
17249-1G	1 g

Boc-α-propyl-DL-Pro-OH tech., ≥90% HPLC

$C_{13}H_{23}NO_4$
MW: 257.33
[*351002-88-5*]



95566-500MG	500 mg

Boc-α-allyl-DL-Pro-OH purum, ≥96.0% HPLC

$C_{13}H_{21}NO_4$
MW: 255.31
[*315234-49-2*]

58147-500MG	500 mg

Boc-(*R*)-α-allyl-Pro-OH purum, ≥98.0% HPLC NEW

$C_{13}H_{21}NO_4$
MW: 255.31
[*144085-23-4*]

06538-500MG-F	500 mg

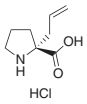
Boc-(*S*)-α-allyl-Pro-OH purum, ≥98.0% HPLC NEW

$C_{13}H_{21}NO_4$
MW: 255.31
[*706806-59-9*]

06486-500MG-F	500 mg

(*R*)-α-Allyl-proline hydrochloride purum, ≥98.0% HPLC NEW

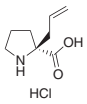
$C_8H_{13}NO_2 \bullet HCl$
MW: 191.66
[*177206-69-8*]



06541-500MG-F	500 mg

(*S*)-α-Allyl-proline hydrochloride purum, ≥98.0% HPLC NEW

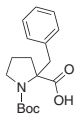
$C_8H_{13}NO_2$
MW: 155.19
[*129704-91-2*]



06594-500MG-F	500 mg

Boc-α-benzyl-DL-Pro-OH purum, ≥96.0% HPLC

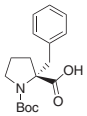
$C_{17}H_{23}NO_4$
MW: 305.37
[*351002-72-7*]



52969-500MG	500 mg

Boc-(*R*)-α-benzyl-Pro-OH purum, ≥99.0% HPLC NEW

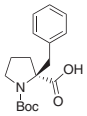
$C_{17}H_{23}NO_4$
MW: 305.37
[*706806-60-2*]



47079-500MG-F	500 mg

Boc-(*S*)-α-benzyl-Pro-OH purum, ≥97.0% HPLC NEW

$C_{17}H_{23}NO_4$
MW: 305.37
[*706806-61-3*]



76896-500MG-F	500 mg

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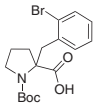
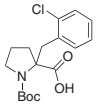
1.4 Prolines with Substituents in α-Position—Cont'd

Boc-α-(2-bromobenzyl)-DL-Pro-OH purum, ≥96.0% HPLC
$C_{17}H_{22}BrNO_4$
MW: 384.26
[*351002-85-2*]



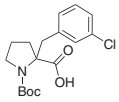
90682-500MG 500 mg

Boc-α-(2-chlorobenzyl)-DL-Pro-OH purum, ≥96.0% HPLC
$C_{17}H_{22}ClNO_4$
MW: 339.81
[*351002-86-3*]



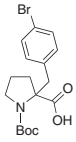
90683-500MG 500 mg

Boc-α-(3-chlorobenzyl)-DL-Pro-OH purum, ≥96.0% HPLC
$C_{17}H_{22}ClNO_4$
MW: 339.81
[*351002-87-4*]



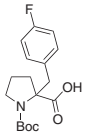
90684-500MG 500 mg

Boc-α-(4-bromobenzyl)-DL-Pro-OH purum, ≥96.0% HPLC
$C_{17}H_{22}BrNO_4$
MW: 384.26
[*336817-91-5*]



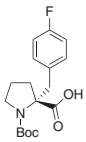
94866-500MG 500 mg

Boc-α-(4-fluorobenzyl)-DL-Pro-OH purum, ≥96.0% HPLC
$C_{17}H_{22}FNO_4$
MW: 323.36
[*351002-78-3*]



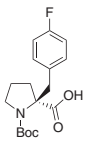
74082-500MG 500 mg

Boc-(*R*)-α-(4-fluorobenzyl)-Pro-OH purum, ≥98.0% HPLC NEW
$C_{17}H_{22}FNO_4$
MW: 323.36
[*706806-64-6*]



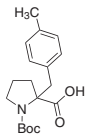
67420-500MG-F 500 mg

Boc-(*S*)-α-(4-fluorobenzyl)-Pro-OH purum, ≥98.0% HPLC NEW
$C_{17}H_{22}FNO_4$
MW: 323.36
[*706806-65-7*]



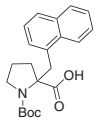
14931-500MG-F 500 mg

Boc-α-(4-methylbenzyl)-DL-Pro-OH purum, ≥96.0% HPLC
$C_{18}H_{25}NO_4$
MW: 319.4
[*351002-82-9*]



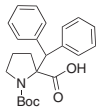
76501-500MG 500 mg

Boc-α-(1-naphthylmethyl)-DL-Pro-OH purum, ≥96.0% HPLC
$C_{21}H_{25}NO_4$
MW: 355.43
[*351002-65-8*]



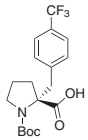
36748-500MG 500 mg

Boc-α-(diphenylmethyl)-DL-Pro-OH technical, ≥90% HPLC
$C_{23}H_{27}NO_4$
MW: 381.46
[*351002-64-7*]



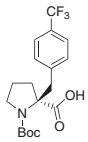
30763-500MG 500 mg

Boc-(*R*)-α-(4-trifluoromethylbenzyl)-Pro-OH purum, ≥98.0% HPLC NEW
$C_{18}H_{22}F_3NO_4$
MW: 373.37



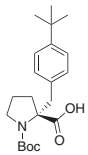
42004-500MG-F 500 mg

Boc-(*S*)-α-(4-trifluoromethylbenzyl)-Pro-OH purum, ≥98.0% HPLC NEW
$C_{18}H_{22}F_3NO_4$
MW: 373.37



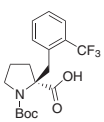
05199-500MG-F 500 mg

Boc-(*R*)-α-(4-*tert*-butylbenzyl)-Pro-OH purum, ≥97.0% HPLC NEW
$C_{21}H_{31}NO_4$
MW: 361.48



39793-500MG-F 500 mg

Boc-(*S*)-α-(4-*tert*-butylbenzyl)-Pro-OH purum, ≥98.0% HPLC NEW
$C_{21}H_{31}NO_4$
MW: 361.48

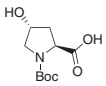


39166-500MG-F 500 mg

1.5 Hydroxyproline Derivatives

Boc-Hyp-OH purum, ≥98.0% TLC

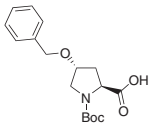
$C_{10}H_{17}NO_5$
MW: 231.25
[*13726-69-7*]



15544-5G	5 g
15544-25G	25 g

Boc-Hyp(Bzl)-OH purum, ≥98.0% HPLC

$C_{17}H_{23}NO_5$
MW: 321.37
[*54631-81-1*]



15535-1G	1 g
15535-5G	5 g
15535-25G	25 g

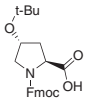
Fmoc-Hyp-OH purum, ≥98.0% HPLC, sum of enantiomers

$C_{20}H_{19}NO_5$
MW: 353.37
[*88050-17-3*]

47686-1G	1 g

Fmoc-Hyp(*t*Bu)-OH purum, ≥98.0% HPLC

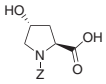
$C_{24}H_{27}NO_5$
MW: 409.47
[*122996-47-8*]



47517-1G-F	1 g
47517-5G-F	5 g
47517-25G-F	25 g

Z-Hyp-OH puriss., ≥99.0% T

$C_{130}H_{15}NO_5$
MW: 265.26
[*13504-85-3*]



96310-5G	5 g
96310-25G	25 g

N-Acetyl-L-hydroxyproline puriss., ≥99.0% T

$C_7H_{11}NO_4$
MW: 173.17
[*33996-33-7*]

01192-10G-F	10 g
01192-50G-F	50 g

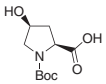
trans-4-Hydroxy-L-proline ≥99.0% NT

$C_5H_9NO_3$
MW: 131.13
[*51-35-4*]

56250-5G	5 g
56250-25G	25 g
56250-100G	100 g

N-Boc-*cis*-4-Hydroxy-L-proline 97%

$C_{10}H_{17}NO_5$
MW: 231.25
[*87691-27-8*]



654019-1G	1 g
654019-5G	5 g

cis-4-Hydroxy-L-proline puriss., ≥99.0% NT

$C_5H_9NO_3$
MW: 131.13
[*618-27-9*]

56248-50MG	50 mg
56248-250MG	250 mg
56248-1G	1 g

cis-4-Hydroxy-D-proline ≥99.0% NT

$C_5H_9NO_3$
MW: 131.13
[*2584-71-6*]

56246-250MG	250 mg
56246-1G	1 g

trans-3-Hydroxy-L-proline purum, ≥98.0% NT

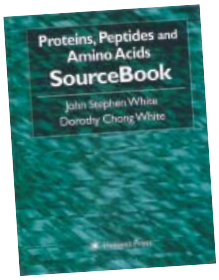
$C_5H_9NO_3$
MW: 131.13
[*4298-08-2*]

56244-100MG	100 mg
56244-500MG	500 mg

cis-3-Hydroxy-DL-proline purum, ≥97.0% TLC

$C_5H_9NO_3$
[*4298-05-9*]

56245-10MG	10 mg



P0868 **Proteins, Peptides and Amino Acids SourceBook**

J. S. White and D. C. White. Humana Press: Totowa, NJ, 2002, 1080pp. Hardcover.

Building on the success of their Source Book of Enzymes, the authors have assembled a catalog of over 26,000 commercially available proteins, peptides, and amino acids. All are arranged alphabetically and by sequence for fast access, and are replete with technical details and vendor information. Compounds can be easily located by either directly searching the appropriate section by chemical name or by consulting the general index by name, synonym, or derivative formula. The data covers sequence, sequence modification, chemical derivatives, preparation form, purity, composition, activity, functionality, as well as applications and literature references.

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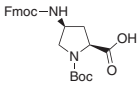
1.6 4-substituted Proline Derivatives

N-Boc-*cis*-4-*N*-Fmoc-amino-L-proline 97%

$C_{25}H_{28}N_2O_6$

[*174148-03-9*]

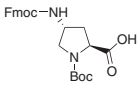


534404-1G	1 g

N-Boc-*trans*-4-*N*-Fmoc-amino-L-proline 97%

$C_{25}H_{28}N_2O_6$

[*176486-63-8*]

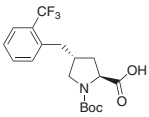


534390-1G	1 g

Boc-(*R*)-4-[2-(trifluoromethyl)benzyl]-Pro-OH purum, ≥98.0% HPLC

NEW

$C_{18}H_{22}F_3NO_4$

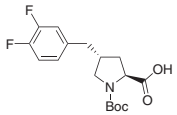


38455-500MG-F	500 mg

Boc-(*R*)-4-(3,4-difluorobenzyl)-Pro-OH purum, ≥97.0% HPLC

NEW

$C_{17}H_{21}F_2NO_4$

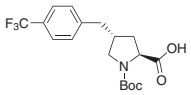


40372-500MG-F	500 mg

Boc-(*R*)-4-[4-(trifluoromethyl)benzyl]-Pro-OH purum, ≥98.0% HPLC

NEW

$C_{18}H_{22}F_3NO_4$



01336-500MG-F	500 mg

1.7 Dehydroprolines

3,4-Dehydro-DL-proline ≥99.0% T

$C_5H_7NO_2$

[*3395-35-5*]

30900-250MG	250 mg
30900-1G	1 g

3,4-Dehydro-L-proline ≥99.0% TLC

$C_5H_7NO_2$

[*4043-88-3*]

30890-10MG	10 mg
30890-50MG	50 mg

1.8 Proline Analogues with Ring Restrictions—Aziridine- and Azetidine-2-Carboxylic Acids

Lithium L-aziridine-2-carboxylate purum, ≥97.0% NT dried material

$C_3H_4LiNO_2$

[*67413-27-8*]

11558-50MG	50 mg
11558-250MG	250 mg

L-Azetidine-2-carboxylic acid purum, ≥98.0% NT

$C_4H_7NO_2$

[*2133-34-8*]

11542-500MG	500 mg
11542-2.5G	2.5 g

1-Boc-L-azetidine-2-carboxylic acid purum, ≥98.0% TLC

$C_9H_{15}NO_4$

[*51077-14-6*]

78324-500MG-F	500 mg

1-Fmoc-(*S*)-azetidine-2-carboxylic acid purum, ≥97.0% HPLC

$C_{19}H_{17}NO_4$

[*136552-06-2*]

70238-500MG-F	500 mg

1.9 Proline Analogs with Ring Expansions—Pipecolic Acids

DL-Pipecolic acid purum, ≥99.0% NT

$C_6H_{11}NO_2$
[*535-75-1*]

80618-25G	25 g
80618-100G	100 g

L-Pipecolic acid puriss., ≥99.0% NT

$C_6H_{11}NO_2$
[*3105-95-1*]

80615-100MG	100 mg
80615-500MG	500 mg

D-Pipecolic acid puriss., ≥99.0% NT

$C_6H_{11}NO_2$
[*1723-00-8*]

80617-100MG	100 mg
80617-500MG	500 mg

Boc-Pip-OH purum, ≥99.0% HPLC

$C_{11}H_{19}NO_4$
[*26250-84-0*]

15558-1G	1 g
15558-5G	5 g

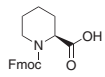
Boc-D-Pip-OH purum, ≥99.0% HPLC

$C_{11}H_{19}NO_4$
[*28697-17-8*]

75748-250MG	250 mg
75748-1G	1 g

Fmoc-Pip-OH purum, ≥98.0% HPLC

$C_{21}H_{21}NO_4$
[*86069-86-5*]



09777-250MG	250 mg
09777-1G	1 g

Fmoc-D-Pip-OH purum, ≥98.0% HPLC

$C_{21}H_{21}NO_4$
[*101555-63-9*]

73418-250MG	250 mg
73418-1G	1 g

1.10 Oxa- and Thia-Prolines

(*S*)-(–)-3-(Boc)-4-oxazolidinecarboxylic acid 98%

$C_{12}H_{13}NO_5$
[*97534-82-2*]

469467-1G	1 g
469467-5G	5 g

(*R*)-(+)-3-(Boc)-4-oxazolidinecarboxylic acid 98%

$C_{12}H_{13}NO_5$
[*97534-84-4*]

469475-1G	1 g
469475-5G	5 g

Thiazolidine-2-carboxylic acid 97%

$C_4H_7NO_2S$
[*65126-70-7*]

467995-1G	1 g
467995-5G	5 g

L-4-Thiazolidinecarboxylic acid purum, ≥99.0% T

$C_4H_7NO_2S$
[*34592-47-7*]

88400-10G	10 g
88400-50G	50 g

(*R*)-Boc-4-thiazolidinecarboxylic acid puriss. p.a., ≥99.0% HPLC

$C_9H_{15}NO_4S$
[*51077-16-8*]

95471-1G-F	1 g
95471-5G-F	5 g

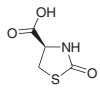
(*R*)-Fmoc-4-thiazolidinecarboxylic acid puriss., ≥99.0% HPLC

$C_{19}H_{17}NO_4S$
[*133054-21-4*]

94703-1G-F	1 g
94703-5G-F	5 g

(*R*)-(–)-2-Oxothiazolidine-4-carboxylic acid purum, ≥97.0% T

$C_4H_5NO_3S$
[*19771-63-2*]



75951-1G	1 g
75951-5G	5 g