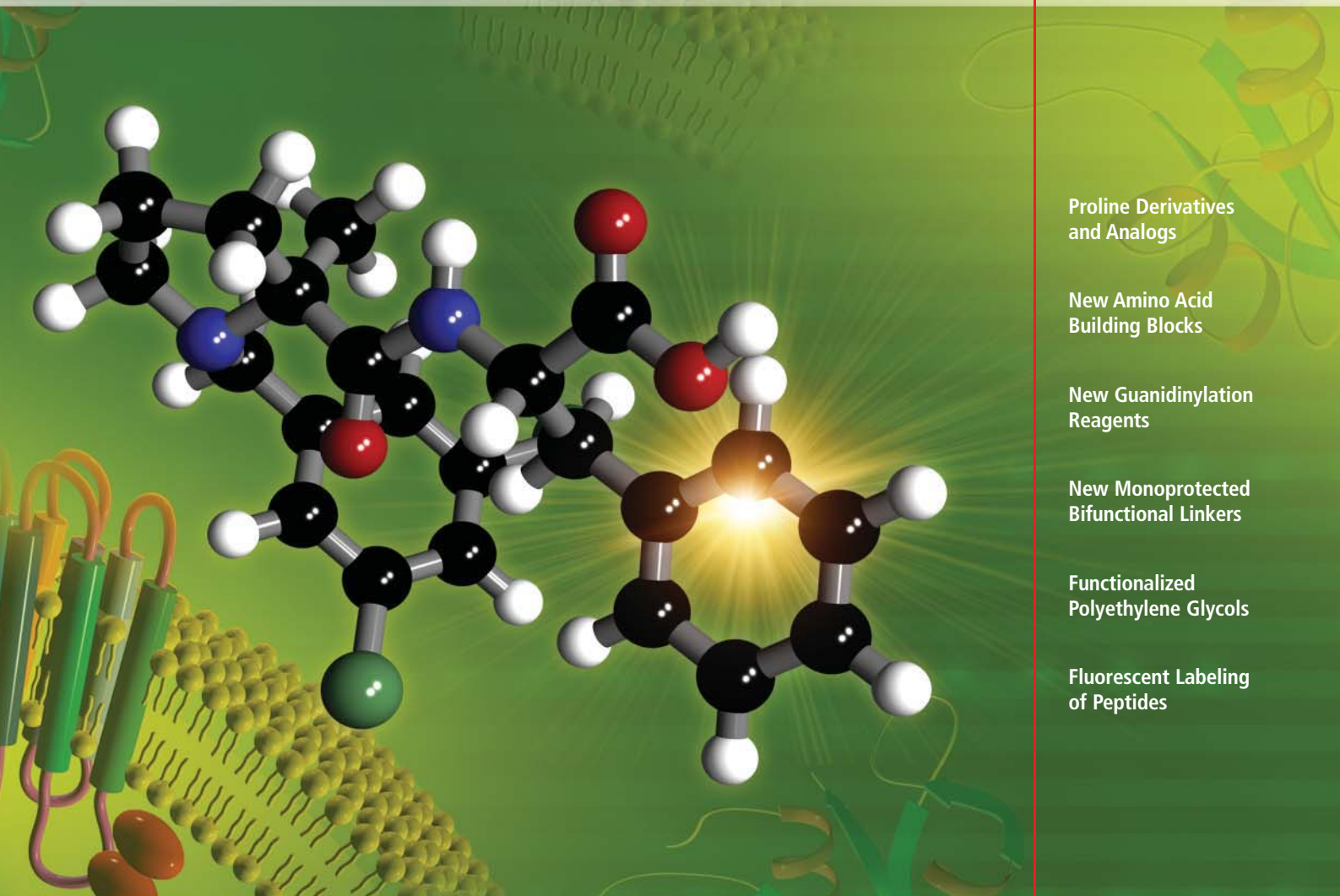


Innovations in Peptide Synthesis and Conjugation
Tools for Drug Discovery



Proline Derivatives
and Analogs

New Amino Acid
Building Blocks

New Guanidinylation
Reagents

New Monoprotected
Bifunctional Linkers

Functionalized
Polyethylene Glycols

Fluorescent Labeling
of Peptides

Introduction

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



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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 occurring, 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. pipercolic 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 $\alpha_v\beta_1$ 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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
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1.2 Proline Derivatives

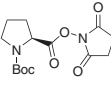
Boc-Pro-OH puriss., ≥99.0% T

$C_{10}H_{17}NO_4$	
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

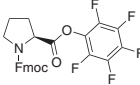
Boc-Pro-OSu purum, ≥98.0% N

$C_{14}H_{20}N_2O_6$	
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

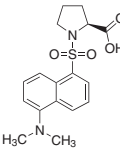
Z-D-Pro-OH 98%

$C_{13}H_{15}NO_4$	
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



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1.3 β^3 - Homoprolines

Boc- β^3 -Homopro-OH purum, $\geq 98.0\%$ TLC

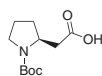
$C_{11}H_{19}NO_4$

MW: 229.27

[56502-01-3]

14982-250MG

14982-1G



250 mg

1 g

Fmoc-L- β^3 -Homopro-OH purum, $\geq 98.0\%$ HPLC

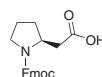
$C_{21}H_{21}NO_4$

MW: 351.4

[193693-60-6]

47912-250MG

47912-1G



250 mg

1 g

1.4 Prolines with Substituents in α -Position

Boc- α -Me-DL-Pro-OH purum, $\geq 96.0\%$ HPLC

$C_{11}H_{19}NO_4$

MW: 229.27

[203869-80-1]

68691-500MG



500 mg

α -Methyl-L-proline purum, $\geq 98.0\%$ TLC

$C_6H_{11}NO_2$

MW: 129.16

[42856-71-3]

17249-250MG

17249-1G



250 mg

1 g

Boc- α -propyl-DL-Pro-OH tech., $\geq 90\%$ HPLC

$C_{13}H_{23}NO_4$

MW: 257.33

[351002-88-5]

95566-500MG



500 mg

Boc- α -allyl-DL-Pro-OH purum, $\geq 96.0\%$ HPLC

$C_{13}H_{21}NO_4$

MW: 255.31

[315234-49-2]

58147-500MG



500 mg

Boc-(R)- α -allyl-Pro-OH purum, $\geq 98.0\%$ HPLC

$C_{13}H_{21}NO_4$

MW: 255.31

[144085-23-4]

06538-500MG-F



500 mg

Boc-(S)- α -allyl-Pro-OH purum, $\geq 98.0\%$ HPLC

$C_{13}H_{21}NO_4$

MW: 255.31

[706806-59-9]

06486-500MG-F



500 mg

L- β^3 -Homopro-OH HCl purum, $\geq 98.0\%$ TLC

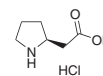
$C_6H_{11}NO_2 \cdot HCl$

MW: 165.62

[53912-85-9]

03768-250MG

03768-1G



250 mg

1 g

(R)- α -Allyl-proline hydrochloride purum, $\geq 98.0\%$ HPLC

$C_8H_{13}NO_2 \cdot HCl$

MW: 191.66

[177206-69-8]

06541-500MG-F



500 mg

(S)- α -Allyl-proline hydrochloride purum, $\geq 98.0\%$ HPLC

$C_8H_{13}NO_2$

MW: 155.19

[129704-91-2]

06594-500MG-F



500 mg

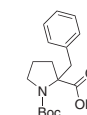
Boc- α -benzyl-DL-Pro-OH purum, $\geq 96.0\%$ HPLC

$C_{17}H_{23}NO_4$

MW: 305.37

[351002-72-7]

52969-500MG



500 mg

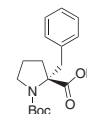
Boc-(R)- α -benzyl-Pro-OH purum, $\geq 99.0\%$ HPLC

$C_{17}H_{23}NO_4$

MW: 305.37

[706806-60-2]

47079-500MG-F



500 mg

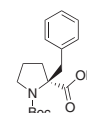
Boc-(S)- α -benzyl-Pro-OH purum, $\geq 97.0\%$ HPLC

$C_{17}H_{23}NO_4$

MW: 305.37

[706806-61-3]

76896-500MG-F

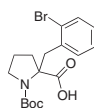


500 mg

1.4 Prolines with Substituents in α -Position—Cont'd**Boc- α -(2-bromobenzyl)-DL-Pro-OH purum, $\geq 96.0\%$ HPLC**C₁₇H₂₂BrNO₄

MW: 384.26

[351002-85-2]



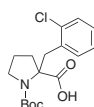
90682-500MG

500 mg

Boc- α -(2-chlorobenzyl)-DL-Pro-OH purum, $\geq 96.0\%$ HPLCC₁₇H₂₂ClNO₄

MW: 339.81

[351002-86-3]



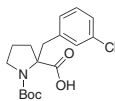
90683-500MG

500 mg

Boc- α -(3-chlorobenzyl)-DL-Pro-OH purum, $\geq 96.0\%$ HPLCC₁₇H₂₂ClNO₄

MW: 339.81

[351002-87-4]



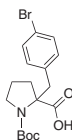
90684-500MG

500 mg

Boc- α -(4-bromobenzyl)-DL-Pro-OH purum, $\geq 96.0\%$ HPLCC₁₇H₂₂BrNO₄

MW: 384.26

[336817-91-5]



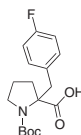
94866-500MG

500 mg

Boc- α -(4-fluorobenzyl)-DL-Pro-OH purum, $\geq 96.0\%$ HPLCC₁₇H₂₂FNO₄

MW: 323.36

[351002-78-3]



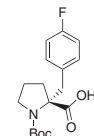
74082-500MG

500 mg

Boc-(R)- α -(4-fluorobenzyl)-Pro-OH purum, $\geq 98.0\%$ HPLC NEWC₁₇H₂₂FNO₄

MW: 323.36

[706806-64-6]



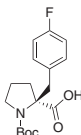
67420-500MG-F

500 mg

Boc-(S)- α -(4-fluorobenzyl)-Pro-OH purum, $\geq 98.0\%$ HPLC NEWC₁₇H₂₂FNO₄

MW: 323.36

[706806-65-7]



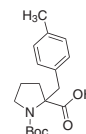
14931-500MG-F

500 mg

Boc- α -(4-methylbenzyl)-DL-Pro-OH purum, $\geq 96.0\%$ HPLCC₁₈H₂₅NO₄

MW: 319.4

[351002-82-9]



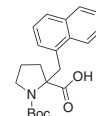
76501-500MG

500 mg

Boc- α -(1-naphthylmethyl)-DL-Pro-OH purum, $\geq 96.0\%$ HPLCC₂₁H₂₅NO₄

MW: 355.43

[351002-65-8]



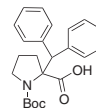
36748-500MG

500 mg

Boc- α -(diphenylmethyl)-DL-Pro-OH technical, $\geq 90\%$ HPLCC₂₃H₂₇NO₄

MW: 381.46

[351002-64-7]

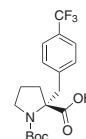


30763-500MG

500 mg

Boc-(R)- α -(4-trifluoromethylbenzyl)-Pro-OH purum, $\geq 98.0\%$ HPLC NEWC₁₈H₂₂F₃NO₄

MW: 373.37

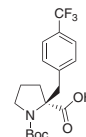


42004-500MG-F

500 mg

Boc-(S)- α -(4-trifluoromethylbenzyl)-Pro-OH purum, $\geq 98.0\%$ HPLC NEWC₁₈H₂₂F₃NO₄

MW: 373.37

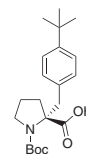


05199-500MG-F

500 mg

Boc-(R)- α -(4-tert-butylbenzyl)-Pro-OH purum, $\geq 97.0\%$ HPLC NEWC₂₁H₃₁NO₄

MW: 361.48

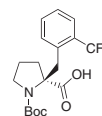


39793-500MG-F

500 mg

Boc-(S)- α -(4-tert-butylbenzyl)-Pro-OH purum, $\geq 98.0\%$ HPLC NEWC₂₁H₃₁NO₄

MW: 361.48



39166-500MG-F

500 mg



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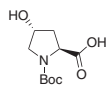
1.5 Hydroxyproline Derivatives

Boc-Hyp-OH purum, ≥98.0% TLC

C₁₀H₁₇NO₅

MW: 231.25

[13726-69-7]



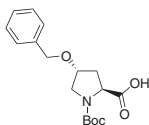
15544-5G	5 g
15544-25G	25 g

Boc-Hyp(Bzl)-OH purum, ≥98.0% HPLC

C₁₇H₂₃NO₅

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

C₂₀H₁₉NO₅

MW: 353.37

[88050-17-3]



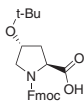
47686-1G	1 g
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Fmoc-Hyp(tBu)-OH purum, ≥98.0% HPLC

C₂₄H₂₇NO₅

MW: 409.47

[122996-47-8]



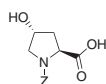
47517-1G-F	1 g
47517-5G-F	5 g
47517-25G-F	25 g

Z-Hyp-OH puriss., ≥99.0% T

C₁₃₀H₁₅NO₅

MW: 265.26

[13504-85-3]



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

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

C₇H₁₁NO₄

MW: 173.17

[33996-33-7]



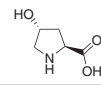
01192-10G-F	10 g
01192-50G-F	50 g

trans-4-Hydroxy-L-proline ≥99.0% NT

C₅H₉NO₃

MW: 131.13

[51-35-4]



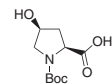
56250-5G	5 g
56250-25G	25 g
56250-100G	100 g

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

C₁₀H₁₇NO₅

MW: 231.25

[87691-27-8]



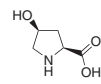
654019-1G	1 g
654019-5G	5 g

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

C₅H₉NO₃

MW: 131.13

[618-27-9]



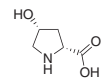
56248-50MG	50 mg
56248-250MG	250 mg
56248-1G	1 g

cis-4-Hydroxy-D-proline ≥99.0% NT

C₅H₉NO₃

MW: 131.13

[2584-71-6]



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

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

C₅H₉NO₃

MW: 131.13

[4298-08-2]



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

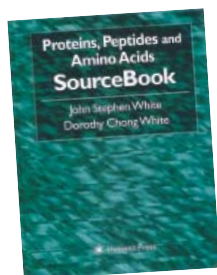
cis-3-Hydroxy-DL-proline purum, ≥97.0% TLC

C₅H₉NO₃

[4298-05-9]



56245-10MG	10 mg
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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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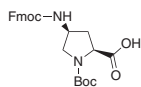
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1.6 4-substituted Proline Derivatives

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

$C_{25}H_{28}N_2O_6$

[174148-03-9]



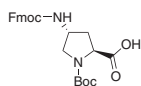
534404-1G

1 g

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

$C_{25}H_{28}N_2O_6$

[176486-63-8]



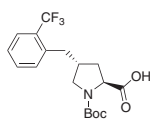
534390-1G

1 g

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

NEW

$C_{18}H_{22}F_3NO_4$



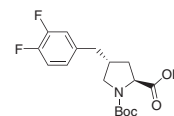
38455-500MG-F

500 mg

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

NEW

$C_{17}H_{21}F_2NO_4$



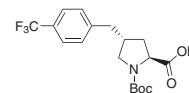
40372-500MG-F

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



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1.9 Proline Analogs with Ring Expansions—Pipelicolic Acids

DL-Pipelicolic acid purum, ≥99.0% NT

C₆H₁₁NO₂
[535-75-1]



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

L-Pipelicolic acid puriss., ≥99.0% NT

C₆H₁₁NO₂
[3105-95-1]



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

D-Pipelicolic acid puriss., ≥99.0% NT

C₆H₁₁NO₂
[1723-00-8]



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

Boc-Pip-OH purum, ≥99.0% HPLC

C₁₁H₁₉NO₄
[26250-84-0]



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

Boc-D-Pip-OH purum, ≥99.0% HPLC

C₁₁H₁₉NO₄
[28697-17-8]



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

Fmoc-Pip-OH purum, ≥98.0% HPLC

C₂₁H₂₁NO₄
[86069-86-5]



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

Fmoc-D-Pip-OH purum, ≥98.0% HPLC

C₂₁H₂₁NO₄
[101555-63-9]



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

1.10 Oxa- and Thia-Prolines

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

C₁₂H₁₃NO₅
[97534-82-2]



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

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

C₁₂H₁₃NO₅
[97534-84-4]



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

Thiazolidine-2-carboxylic acid 97%

C₄H₇NO₂S
[65126-70-7]



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

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

C₄H₇NO₂S
[34592-47-7]



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

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

C₉H₁₅NO₄S
[51077-16-8]



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

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

C₁₉H₁₇NO₄S
[133054-21-4]



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

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

C₄H₅NO₃S
[19771-63-2]



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

1.11 Prolinol Derivatives

L-Prolinol purum, ≥98.0% GC (sum of enantiomers)

C₅H₁₁NO

[23356-96-9]



81745-1ML

1 mL

81745-5ML

5 mL

D-Prolinol purum, ≥98.0% GC (sum of enantiomers)

C₅H₁₁NO

[68832-13-3]



81744-1ML

1 mL

81744-5ML

5 mL

N-Boc-L-prolinol purum, ≥97.0% GC

C₁₀H₁₉NO₃

[69610-40-8]



15498-1G

1 g

15498-5G

5 g

N-Boc-D-prolinol puriss., ≥99.0% TLC

C₁₀H₁₉NO₃

[83435-58-9]



15522-1G-F

1 g

N-Fmoc-L-prolinol purum, ≥98.0% HPLC

C₂₀H₂₁NO₃

[148625-77-8]



47384-500MG

500 mg

47384-2.5G

2.5 g

Z-L-Prolinol 97%

C₁₃H₁₇NO₃

[6216-63-3]



512966-1G

1 g

N-Methyl-L-prolinol purum, ≥99.0% GC (sum of enantiomers)

C₆H₁₃NO

[34381-71-0]



68890-1ML

1 mL

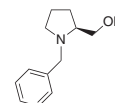
68890-5ML

5 mL

N-Benzyl-L-prolinol purum, ≥98.0% GC (sum of enantiomers)

C₁₂H₁₇NO

[53912-80-4]



13839-5G-F

5 g

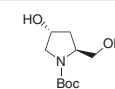
13839-25G-F

25 g

Boc-trans-4-hydroxy-L-prolinol 96%

C₁₀H₁₉NO₄

[61478-26-0]



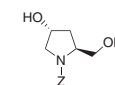
546992-1G

1 g

Z-trans-4-Hydroxy-L-prolinol

C₁₃H₁₇NO₄

[95687-41-5]



547085-1G

1 g

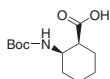
2. New Amino Acid Building Blocks

2.1 New cyclic β-Amino Acids

cis-2-(Boc-amino)-cyclohexanecarboxylic acid purum, ≥98.0% TLC

[63216-49-9]

NEW



36314-1G-F

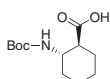
1 g

trans-2-(Boc-amino)-cyclohexanecarboxylic acid purum, ≥98.0% TLC

C₁₂H₂₁NO₄

[209128-50-7]

NEW



29293-1G-F

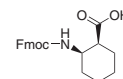
1 g

cis-2-(Fmoc-amino)-cyclohexanecarboxylic acid purum, ≥98.0% HPLC

C₂₂H₂₃NO₄

[194471-85-7]

NEW



29294-1G-F

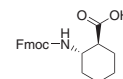
1 g

trans-2-(Fmoc-amino)-cyclohexanecarboxylic acid purum, ≥98.0% HPLC

C₂₂H₂₃NO₄

[381241-08-3]

NEW



28319-1G-F

1 g



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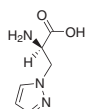
2.2 Unnatural Alanine and Cysteine Derivatives Obtained by Fermentation

Sigma-Aldrich offers a unique selection of unnatural amino acid derivatives in collaboration with WACKER Fine Chemicals. They have developed a fermentation process for the commercial production of the amino acid L-cysteine that represents an excellent platform for the biotechnological synthesis of enantiopure unnatural alanine and cysteine derivatives.

In addition to our portfolio of free alanine and cysteine derivatives, *N*^α-Boc and *N*^α-Fmoc-protected derivatives of 3-pyrazolyl-alanine and 3-triazolyl-alanine are now available to Sigma-Aldrich customers worldwide under this collaboration.

3-(1-Pyrazolyl)-L-alanine purum, WACKER quality, ≥95.0% HPLC

C₆H₉N₃O₂
[2734-48-7]

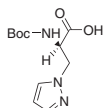


06993-1G-F

1 g

Boc-3-(1-pyrazolyl)-Ala-OH purum, WACKER quality, ≥97.0% HPLC

C₁₁H₁₇N₃O₄
[21012-18-0]

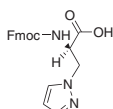


67387-500MG-F

500 mg

Fmoc-3-(1-pyrazolyl)-Ala-OH purum, WACKER quality, ≥97.0% HPLC

C₂₁H₁₉N₃O₄

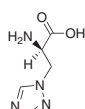


51916-500MG-F

500 mg

3-(1,2,4-Triazol-1-yl)-L-alanine WACKER quality, purum, ≥95.0% HPLC

C₅H₈N₄O₂
[4819-36-7]

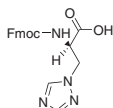


12227-1G-F

1 g

Fmoc-3-(1,2,4-triazol-1-yl)-Ala-OH purum, WACKER quality, ≥97.0% HPLC

C₂₀H₁₈N₄O₄

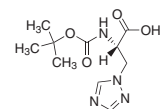


53229-500MG-F

500 mg

Boc-3-(1,2,4-triazol-1-yl)-Ala-OH purum, WACKER quality, ≥97.0% HPLC

C₁₀H₁₆N₄O₄

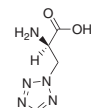


50996-500MG-F

500 mg

3-(2-Tetrazolyl)-L-alanine WACKER quality, purum, ≥95.0% HPLC

C₄H₇N₅O₂
[405150-16-5]

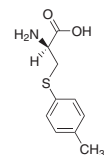


21682-1G-F

1 g

S-(4-Tolyl)-L-cysteine WACKER quality, purum, ≥95.0% HPLC

C₁₀H₁₃NO₂S



79256-1G-F

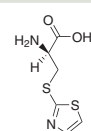
1 g

79256-5G-F

5 g

S-(2-Thiazolyl)-L-cysteine WACKER quality, purum, ≥95.0% HPLC

C₆H₈N₂O₂S₂
[405150-20-1]

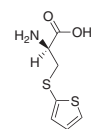


78904-1G-F

1 g

S-(2-Thienyl)-L-cysteine WACKER quality, purum, ≥ 95.0% HPLC

C₇H₉NO₂S₂
[405150-23-4]



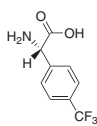
95631-1G-F

1 g

2.3 Miscellaneous New Amino Acid Building Blocks

4-(Trifluoromethyl)-L-phenylglycine purum, ≥98.0% HPLC NEW

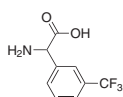
$C_9H_8F_3NO_2$
[144789-75-3]



16599-1G-F 1 g

3-(Trifluoromethyl)-DL-phenylglycine purum, ≥98.0% HPLC NEW

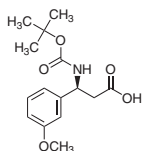
$C_9H_8F_3NO_2$
[242475-26-9]



53636-500MG-F 500 mg

(S)-Boc-3-methoxy-β-Phe-OH purum, ≥98.0% HPLC NEW

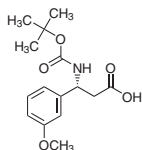
$C_{15}H_{21}NO_5$
[499995-77-6]



55894-500MG-F 500 mg

(R)-Boc-3-methoxy-β-Phe-OH purum, ≥98.0% HPLC NEW

$C_{15}H_{21}NO_5$
[500788-86-3]



52169-500MG-F 500 mg

L-Isoserine purum, ≥98.0% TLC NEW

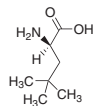
$C_3H_7NO_3$
[632-13-3]



06054-1G-F 1 g

L-α-Neopentylglycine purum, ≥98.0% TLC NEW

$C_7H_{15}NO_2$
[57224-50-7]

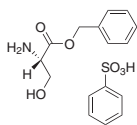


73489-1G-F 1 g

73489-5G-F 5 g

L-Serine benzyl ester benzenesulfonate purum, ≥98.0% HPLC NEW

$C_{10}H_{13}NO_3 \cdot C_6H_6O_3S$
[3695-68-9]

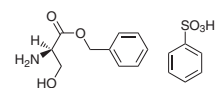


04934-5G-F 5 g

04934-25G-F 25 g

D-Serine benzyl ester benzenesulfonate purum, ≥98.0% HPLC NEW

$C_{10}H_{13}NO_3 \cdot C_6H_6O_3S$
[141527-77-7]



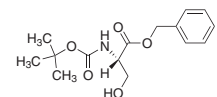
78568-5G-F 5 g

78568-25G-F 25 g

78568-100G-F 100 g

Boc-Ser-OBzl purum, ≥95.0% HPLC NEW

$C_{15}H_{21}NO_5$
[59524-02-6]

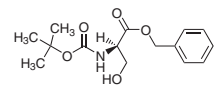


16726-1G-F 1 g

16726-5G-F 5 g

Boc-D-Ser-O-Bzl purum, ≥95.0% HPLC NEW

$C_{15}H_{21}NO_5$
[141527-78-8]

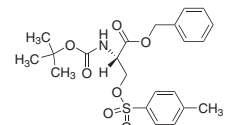


95029-1G-F 1 g

95029-5G-F 5 g

Boc-Ser(Tos)-OBzl purum, ≥97.0% HPLC NEW

$C_{22}H_{27}NO_7S$
[94882-74-3]

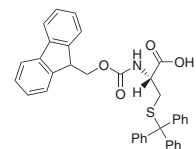


04106-1G-F 1 g

04106-5G-F 5 g

Fmoc-D-Cys(Trt)-OH purum, ≥ 98.0% HPLC NEW

$C_{37}H_{31}NO_4S$
[167015-11-4]

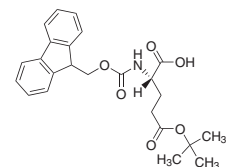


08503-1G-F 1 g

08503-5G-F 5 g

Fmoc-D-Glu(OtBu)-OH purum, ≥98.0% HPLC NEW

$C_{24}H_{27}NO_6$
[104091-08-9]



07697-1G-F 1 g

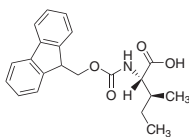
07697-5G-F 5 g



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2.3 Miscellaneous New Amino Acid Building Blocks—Cont'd

Fmoc-D-Ile-OH purum, ≥96.0% HPLC

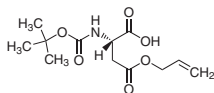
 $C_{21}H_{23}NO_4$


16905-1G-F	1 g
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Boc-Asp(OAllyl)-OH purum, ≥98.0% HPLC

 $C_{12}H_{19}NO_6$

[132286-77-2]

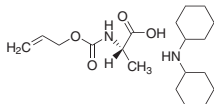


72814-5G-F	5 g
72814-25G-F	25 g

Alloc-Ala-OH DCHA salt purum, ≥98.0% NT

 $C_7H_{11}NO_4 \bullet C_{12}H_{23}N$

[115491-98-0]

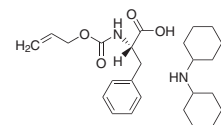


14829-5G-F	5 g
14829-25G-F	25 g
14829-100G-F	100 g

Alloc-Phe-OH DCHA salt purum, ≥97.0% HPLC

 $C_{13}H_{15}NO_4$

[110637-43-9]

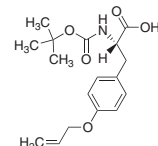


39398-5G-F	5 g
39398-25G-F	25 g

Boc-Tyr(Allyl)-OH purum, ≥98.0% HPLC

 $C_{17}H_{23}NO_5$

[127132-38-1]

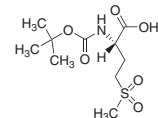


78539-1G-F	1 g
78539-5G-F	5 g

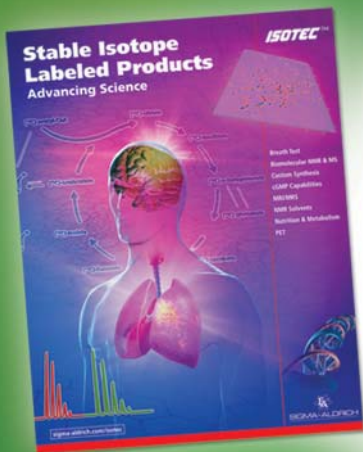
Boc-Met(O₂)-OH purum, ≥98.0% GC

 $C_{10}H_{19}NO_6S$

[60280-45-7]



49874-1G-F	1 g
49874-5G-F	5 g



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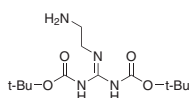
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- New Application Notes and Literature References
- Cross References, SKU and Packaging Identifiers

3. New Guanidinylation Reagents

2-(2-Aminoethyl)-1,3-di-Boc-guanidine technical, ≥90% HPLC

 $C_{13}H_{26}N_4O_4$

[203258-44-0]

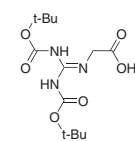


84190-1G-F	1 g
84190-5G-F	5 g

1,3-Di-Boc-2-(carboxymethyl)guanidine purum, ≥97.0% HPLC

 $C_{13}H_{23}N_3O_6$

[158478-76-3]



84656-500MG-F	500 mg
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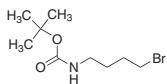
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4. New Monoprotected Bifunctional Linkers

4.1 New Protected Aminoalkyl Bromides

4-(Boc-amino)butyl bromide technical, ≥90% AT NEW

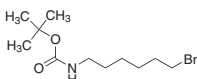
$C_9H_{18}BrNO_2$
[164365-88-2]



90303-500MG-F	500 mg
90303-2.5G-F	2.5 g

6-(Boc-amino)hexyl bromide purum, ≥97.0% GC NEW

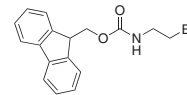
$C_{11}H_{22}BrNO_2$
[142356-33-0]



89171-500MG-F	500 mg
89171-2.5G-F	2.5 g

2-(Fmoc-amino)ethyl bromide purum, ≥95.0% AT NEW

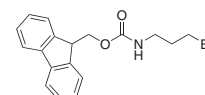
$C_{17}H_{18}BrNO_2$



74291-1G-F	1 g
74291-5G-F	5 g

3-(Fmoc-amino)propyl bromide purum, ≥97.0% HPLC NEW

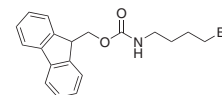
$C_{18}H_{18}BrNO_2$



76061-1G-F	1 g
76061-5G-F	5 g

4-(Fmoc-amino)butyl bromide purum, ≥95.0% CHN NEW

$C_{19}H_{20}BrNO_2$

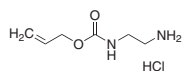


73431-1G-F	1 g
73431-5G-F	5 g

4.2 New Mono-Alloc-Protected Diamines

N-Alloc-ethylenediamine hydrochloride purum, ≥98.0% AT NEW

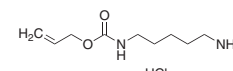
$C_6H_{12}N_2O_2 \cdot HCl$



51036-1G-F	1 g
51036-5G-F	5 g

N-Alloc-1,5-pentanediamine hydrochloride purum, ≥98.0% AT NEW

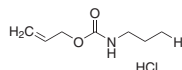
$C_9H_{18}N_2O_2$



44911-1G-F	1 g
44911-5G-F	5 g

N-Alloc-1,3-propanediamine hydrochloride purum, ≥97.0% AT NEW

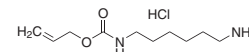
$C_7H_{14}N_2O_2 \cdot HCl$



43303-1G-F	1 g
43303-5G-F	5 g

N-Alloc-1,6-hexanediamine hydrochloride purum, ≥97.0% AT NEW

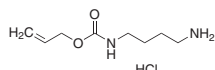
$C_{10}H_{20}N_2O_2 \cdot HCl$
[184292-16-8]



69285-1G-F	1 g
69285-5G-F	5 g

N-Alloc-1,4-butandiamine hydrochloride purum, ≥98.0% AT NEW

$C_8H_{16}N_2O_2 \cdot HCl$



04667-1G-F	1 g
04667-5G-F	5 g



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5. Functionalized Polyethylene Glycols (PEG's)

5.1 Introduction

The chemical modification of biologically active compounds, such as peptides, proteins, antibody fragments, aptamers, enzymes, and small molecules with polyethylene glycol (referred to as "PEGylation"), is an effective method to tailor molecular properties to particular applications. The PEG moiety within such conjugates provides, for example, water solubility, biocompatibility, and flexibility. PEGylation of a therapeutic agent can prolong the half-life of the drug in the circulation, reduce its immunogenicity and antigenicity, prevent biological degradation by reducing proteolysis and finally, alter the pattern of drug distribution.^{1,2} After the first therapeutic PEG-protein conjugate (PEG-adenosine deaminase, PEG-ADA³) had been approved by the FDA in 1991, a large number of PEG-protein conjugates had been described for therapeutic use against a range of diseases.^{4,5}

PEG-enzyme complexes found application in biotechnology because they increase the solubility, stability, and activity of the enzymes in hydrophobic organic solvents.^{4,6}

Further important applications of functionalized polyethylene glycols:

- Preparation of graft polymeric supports for Solid-Phase Peptide Synthesis (SPPS)⁷
- Introduction of solubilizing handles in SPPS⁸
- Soluble polymer supports for Peptide Synthesis^{9,10}
- Soluble polymer supports for Organic Synthesis¹¹
- Introduction of hydrophilic amino acids in Peptide Synthesis¹²

- Preparation of PEG-ligand conjugates for affinity partitioning of macromolecules¹³
- Preparation of PEG-coated surfaces¹⁴
- Linking of macromolecules to surfaces¹⁵
- Synthesis of targetable polymeric drugs¹⁶
- Preparation of PEG-glycoprotein conjugates¹⁷
- Preparation of PEG-cofactor adducts for bioreactors¹⁸

Sigma-Aldrich offers a broad portfolio of PEG reagents with molecular weights up to 20 kDa for efficient PEGylations. Numerous homobifunctionalized, heterobifunctionalized, and mono-methoxy endcapped monofunctionalized linear PEG's are available in high quality. We provide polyethylene glycols activated for the most widely used conjugations to primary amines or thiols. The introduction of different protecting groups leads to extremely useful macromolecular cross-linking agents and spacers.

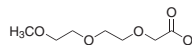
Please take a look at our unique series of monodisperse polyethylene glycols with an oligomer purity of more than 90–95%. Sigma-Aldrich homo- and heterobifunctional PEG products (n=5-18) with high oligomer purity are superior reagents for drug delivery formulations, affinity labeling, protein engineering, surface modification, combinatorial chemistry, and any product development whenever accuracy and control are essential.

References

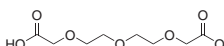
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5.2 Functionalized Oligoethylene Glycols

2-[2-(2-Methoxyethoxy)ethoxy]acetic acid technical, ≥90% GC


$C_7H_{14}O_5$	
[16024-58-1]	
64732-250ML	250 mL
64732-1L	1 L

3,6,9-Trioxaundecanedioic acid technical, ~90% T


$C_8H_{14}O_7$	
[13887-98-4]	
92893-50ML	50 mL
92893-250ML	250 mL

5.3 High Oligomer Purity PEG's, n = 5–18

Octaethylene glycol ≥95% oligomer purity

$C_{16}H_{34}O_9$		NEW
[5117-19-1]		
15879-1G-F	1 g	
15879-5G-F	5 g	

Dodecaethylene glycol ≥95% oligomer purity

$C_{24}H_{50}O_{13}$		NEW
[6790-09-6]		
05094-1G-F	1 g	
05094-5G-F	5 g	

O-Methyl-heptaethylene glycol ≥95% oligomer purity

$C_{15}H_{32}O_8$		NEW
[4437-01-8]		
41749-1G-F	1 g	

O-Methyl-undecaethylene glycol ≥95% oligomer purity

$C_{23}H_{48}O_{12}$		NEW
[114740-40-8]		
16603-500MG-F	500 mg	

O,O'-Bis(2-aminoethyl)octadecaethylene glycol ≥95% oligomer purity

$C_{40}H_{84}N_2O_{19}$		NEW
06703-1G-F	1 g	

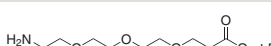
O,O'-Bis(2-carboxyethyl)dodecaethylene glycol ≥95% oligomer purity

$C_{30}H_{58}O_{17}$		NEW
94704-1G-F	1 g	

[2-[2-(Fmoc-amino)ethoxy]ethoxy]acetic acid purum, ≥95.0% HPLC

$C_{21}H_{23}NO_6$	
[166108-71-0]	
95003-500MG-F	500 mg

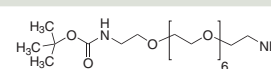
tert-Butyl-12-amino-4,7,10-trioxadodecanoate technical, ≥80% NT

$C_{13}H_{27}NO_5$	
[252881-74-6]	
83060-1G-F	1 g
83060-5G-F	5 g

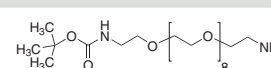
O-(2-tert-Butyloxycarbonyl)ethyl)dodecaethylene glycol ≥95% oligomer purity

$C_{31}H_{62}O_{15}$		NEW
08453-500MG-F	500 mg	

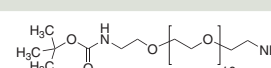
O-(2-Aminoethyl)-O'-[2-(Boc-amino)ethyl]hexaethylene glycol ≥90% oligomer purity

$C_{21}H_{44}N_2O_9$	
[206265-98-7]	
70023-500MG-F	500 mg

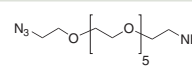
O-(2-Aminoethyl)-O'-[2-(Boc-amino)ethyl]octaethylene glycol ≥90% oligomer purity

$C_{25}H_{52}N_2O_{11}$	
79141-500MG-F	500 mg

O-(2-Aminoethyl)-O'-[2-(Boc-amino)ethyl]decaethylene glycol ≥90% oligomer purity

$C_{29}H_{60}N_2O_{13}$	
77090-500MG-F	500 mg

O-(2-Aminoethyl)-O'-(2-azidoethyl)pentaethylene glycol ≥90% Oligomer purity

$C_{14}H_{30}N_4O_6$	
76172-500MG-F	500 mg

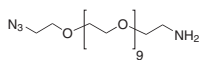
O-(2-Aminoethyl)-O'-(2-azidoethyl)heptaethylene glycol ≥90% oligomer purity

$C_{18}H_{38}N_4O_8$	
76318-500MG-F	500 mg



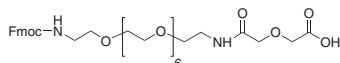
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5.3 High Oligomer Purity PEG's, n = 5–18—Cont'd

**O-[2-(Aminoethyl)-O'-(2-azidoethyl)nonaethylene glyco
≥90% oligomer purity**C₂₂H₄₆N₄O₁₀

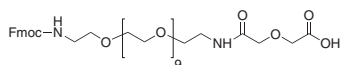
77787-500MG-F

500 mg

**O-[2-(Fmoc-amino-ethyl)-O'-(2-(diglycolyl-amino)ethyl]
hexaethylene glycol ≥90% oligomer purity**C₃₅H₅₀N₂O₁₃

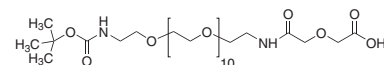
79632-500MG-F

500 mg

**O-[2-(Fmoc-amino-ethyl)-O'-(2-(diglycolyl-amino)ethyl]
nonaethylene glycol ≥90% oligomer purity**C₄₁H₆₂N₂O₁₆

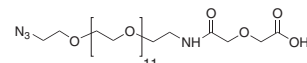
76708-500MG-F

500 mg

**O-[2-(Boc-amino-ethyl)-O'-(2-(diglycolyl-amino)ethyl]
decaethylene glycol ≥90% oligomer purity**C₃₃H₆₄N₂O₁₇

79898-500MG-F

500 mg

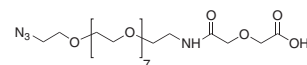
**O-(2-Azidoethyl)-O'-(2-(diglycolyl-amino)ethyl]
undecaethylene glycol ≥90% oligomer purity**C₃₀H₅₈N₄O₁₆

78691-500MG-F

500 mg

**O-(2-Azidoethyl)-O-[2-(diglycolyl-amino)ethyl]
heptaethylene glycol ≥90% oligomer purity**C₂₂H₄₂N₄O₁₂

[846549-37-9]



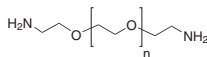
71613-500MG-F

500 mg

5.4 Homobifunctional PEG's

Polyoxyethylene bis(amine) 2000

[24991-53-5]



14501-250MG

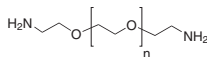
250 mg

14501-1G

1 g

Polyoxyethylene bis(amine) 3000

[24991-53-5]



14502-250MG

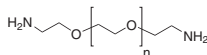
250 mg

14502-1G

1 g

Polyoxyethylene bis(amine) 6000

[24991-53-5]



14504-250MG-F

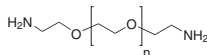
250 mg

14504-1G-F

1 g

Polyoxyethylene bis(amine) 10000

[24991-53-5]



14508-250MG

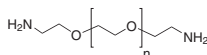
250 mg

14508-1G

1 g

Polyoxyethylene bis(amine) 20000

[24991-53-5]



14509-250MG-F

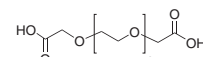
250 mg

14509-1G-F

1 g

Poly(ethylene glycol) diacid 600

[39927-08-7]



81324-250ML

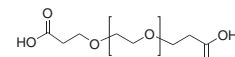
250 mL

81324-1L

1 L

α,ω-Bis(2-carboxyethyl)polyethylene glycol 2000

[74558-41-1]



14565-250MG

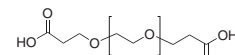
250 mg

14565-1G

1 g

α,ω-Bis(2-carboxyethyl)polyethylene glycol 3000

[74558-41-1]



14567-250MG

250 mg

α,ω-Bis(2-carboxyethyl)polyethylene glycol 6000

[74558-41-1]

14569-250MG

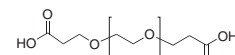
250 mg

14569-1G

1 g

α,ω-Bis(2-carboxyethyl)polyethylene glycol 10000

[74558-41-1]

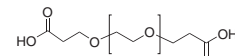


14571-250MG

250 mg

α,ω-Bis(2-carboxyethyl)polyethylene glycol 20000

[74558-41-1]



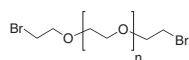
14573-250MG

250 mg

5.4 Homobifunctional PEG's—Cont'd

O,O'-Bis(2-bromoethyl)polyethylene glycol 2000

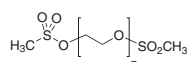
[76779-16-3]



14551-250MG	250 mg
14551-1G	1 g

Polyethylene glycol dimesylate 2000

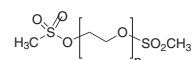
[52410-74-9]



17891-1G	1 g
17891-5G	5 g

Polyethylene glycol dimesylate 4000

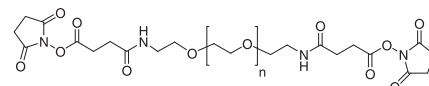
[52410-74-9]



17896-1G	1 g
17896-5G	5 g

O,O'-Bis[2-(N-Succinimidyl-succinylamino)ethyl]polyethylene glycol 2000

[186020-53-1]

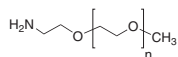


15961-250MG-F	250 mg
15961-1G-F	1 g

5.5 Monofunctional PEG's

Methoxypolyethylene glycol amine 750

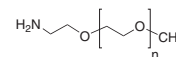
[80506-64-5]



07964-250MG	250 mg
07964-1G	1 g

Methoxypolyethylene glycol amine 20000

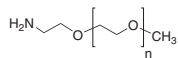
[80506-64-5]



07966-250MG	250 mg
07966-1G	1 g

Methoxypolyethylene glycol amine 2000

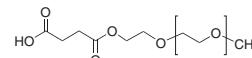
[80506-64-5]



06676-250MG	250 mg
06676-1G	1 g

O-Methyl-O'-succinylpolyethylene glycol 2000

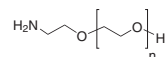
[31961-02-1]



17928-1G-F	1 g
17928-5G-F	5 g

O-(2-Aminoethyl)polyethylene glycol 3000

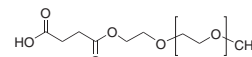
[32130-27-1]



07969-250MG	250 mg
07969-1G	1 g

O-Methyl-O'-succinylpolyethylene glycol 5000

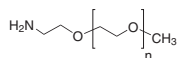
[31961-02-1]



17929-1G-F	1 g
17929-5G-F	5 g

Methoxypolyethylene glycol amine 5000

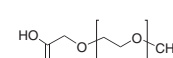
[80506-64-5]



92192-1G-F	1 g
92192-5G-F	5 g

Methoxypolyethylene glycol acetic acid 5000

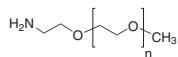
NEW



70718-1G-F	1 g
70718-5G-F	5 g
70718-25G-F	25 g

Methoxypolyethylene glycol amine 5000

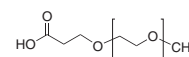
[80506-64-5]



06679-1G	1 g
06679-5G	5 g

Methoxypolyethylene glycol propionic acid 5000

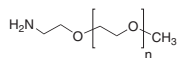
NEW



88908-1G-F	1 g
88908-5G-F	5 g
88908-25G-F	25 g

Methoxypolyethylene glycol amine 10000

[80506-64-5]



07965-250MG	250 mg
07965-1G	1 g

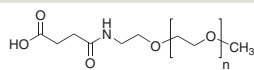


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5.5 Monofunctional PEG's—Cont'd

O-[2-(3-Succinylamino)ethyl]-O'-methyl-polyethylene glycol 20000

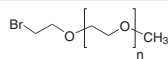
[92450-99-2]



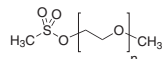
21954-250MG	250 mg
21954-1G	1 g

O-(2-Bromoethyl)-O'-methylpolyethylene glycol 20000

[92450-98-1]

**Polyethylene glycol monomethyl ether mesylate 2000**

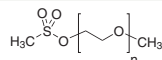
[175172-61-9]



17894-1G	1 g
17894-5G	5 g

Polyethylene glycol monomethyl ether mesylate 5000

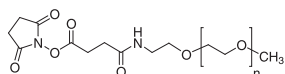
[175172-61-9]



17893-1G	1 g
17893-5G	5 g

O-[(N-Succinimidyl)succinyl-aminoethyl]-O'-methylpolyethylene glycol 2000

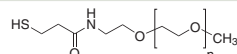
[92451-00-8]



41214-250MG-F	250 mg
41214-1G-F	1 g

O-[(N-Succinimidyl)succinyl-aminoethyl]-O'-methylpolyethylene glycol 5000

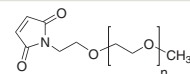
[92451-00-8]



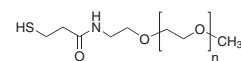
49543-250MG-F	250 mg
49543-1G-F	1 g

Methoxypolyethylene glycolmaleimide 5000

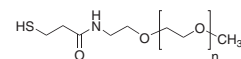
[99126-64-4]



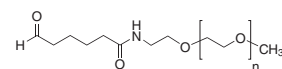
63187-1G	1 g
63187-5G	5 g

O-[2-(3-Mercaptopropionylamino)ethyl]-O'-methylpolyethylene glycol 5000

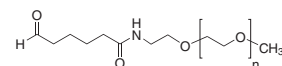
11124-250MG-F	250 mg
11124-1G-F	1 g

O-[2-(3-Mercaptopropionylamino)ethyl]-O'-methylpolyethylene glycol 20000

63753-250MG	250 mg
63753-1G	1 g

O-[2-(6-Oxocaproylamino)ethyl]-O'-methylpolyethylene glycol 2000

54369-250MG-F	250 mg
54369-1G-F	1 g

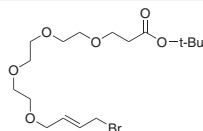
O-[2-(6-Oxocaproylamino)ethyl]-O'-methylpolyethylene glycol 5000

41964-250MG-F	250 mg
41964-1G-F	1 g

5.6 PEG Handles and Soluble Polymer Supports for Synthesis

tert-Butyl trans-17-bromo-4,7,10-,13-tetraoxa-15-heptadecanoate (Hycron linker) purum, ≥95% ATC₁₃H₃₁BrO₆

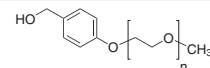
[166668-33-3]



96823-1G-F	1 g
96823-5G-F	5 g

O-[4-(Hydroxymethyl)benzoyl]-O'-methyl-polyethylene glycol 5000

[175233-46-2]



17359-1G-F	1 g
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6. Fluorescent Labeling of Peptides

Labeling peptides with fluorescent dyes or other labels provides powerful tools for the investigation of biological relevant interactions like receptor-ligand-binding,¹⁻³ protein structures,⁴⁻⁶ and enzyme activity. Fluorescence energy transfer (FRET) between a donor and an acceptor label is widely applied for such investigations. It can be determined by a number of different methods, e.g., quenching and other intensity measurements, donor or acceptor depletion kinetics, and fluorescence lifetime or emission anisotropy measurements.³⁻¹³ A variety of enzyme substrates have been designed and used,¹⁴⁻²² partially based on quenching of emission through a second label, that is eliminated through the separation of label and quencher by cleavage of substrate.

Labeled peptides can be prepared by either modifying isolated peptides or by incorporating the label during solid-phase synthesis. Three strategies are used to label peptides with dyes:

- (1) Labeling during synthesis of peptide. Dyes that are not damaged by unblocking procedures are incorporated onto the amino terminus of the peptide chain.
- (2) Synthetic peptides can be covalently modified on specific residues and labels incorporated following synthesis.
- (3) Synthetic peptides may be covalently labeled by amine- or thiol-reactive protein labels.

Fluorophores can be conjugated to the N-terminus of a resin-bound peptide before other protecting groups are removed and the labeled peptide is released from the resin. Amine-reactive fluorophores are used in about 5-fold molar excess relative to the amines of the immobilized peptide. Reactive fluorescein, sulforhodamine B, tetramethylrhodamine, coumarin, eosin, dabcy, dabsyl, or biotin labels, as well as several of our

new atto labels, should be stable enough to resist the harsh deprotection conditions. Dabcy has been frequently used as quencher. Another possibility is the use of fluorescence or chromophore labeled amino acids to incorporate labels at specific sites of peptides.

Labeling can also be achieved indirectly by using a biotinylated amino acid. If, for example, Fmoc-Lys(biotinyl)-OH, no. 73749 is used in peptide synthesis, the biotin group allows specific binding of streptavidin or avidin-conjugate to that site. A variety of fluorophores are available as (strept)avidin conjugates, a selection of our products are listed in **Table 2**.

Following the routine synthesis procedure, peptides can also be labeled by practically all labels used for protein labeling. This means mainly amine reactive labels, or thiol reactive labels, if a cysteine has been used for the peptide. Whereas the common standard procedures for protein labeling are based on aqueous solutions of target proteins, labeling peptides in organic solvents like DMSO or DMF requires specific modifications. Use of triethylamine can be added to ensure that the target amino groups of the peptide are deprotonated, which is required for the labeling procedure.

Table 1 shows a selection of our fluorescent labels. If you are looking for different spectral properties, or other functionalities (e.g., thiol label), please have a look at our catalog (capture "Fluorescent probes") or visit our homepage.

Table 1. Amine reactive fluorescent labels

Cat. No.	Name	Excitation Max.	Emission Max.	Package Size
64949-25MG 64949-100MG	7-Methoxycoumarin-3-carboxylic acid <i>N</i> -succinimidyl ester	328	393	25 mg 100 mg
57672-1G-F	1,5-I-AEDANS (<i>N</i> -(Iodacetaminoethyl)-1-naphthylamin-5-sulfonsäure)	341	471	1 g
36801-25MG 36801-100MG	<i>N</i> -Succinimidyl 7-(diethylamino)coumarin-3-carboxylate	430	482	25 mg 100 mg
92846-1MG-F 92846-5MG-F	5-Carboxyfluorescein <i>N</i> -succinimidyl ester	492	525	1 mg 5 mg
52352-1MG-F 52352-5MG-F	6-Carboxyfluorescein <i>N</i> -succinimidyl ester	492	516	1 mg 5 mg
41969-5MG-F	5-Carboxy-X-rhodamine <i>N</i> -succinimidyl ester	492	520	5 mg
44617-5MG-F	6-Carboxy-X-rhodamine <i>N</i> -succinimidyl ester	492	516	5 mg
53048-1MG-F 53048-5MG-F	5-Carboxy-tetramethylrhodamine <i>N</i> -succinimidyl ester	543	575	1 mg 5 mg
88997-1MG-F 88997-5MG-F	6-Carboxy-tetramethylrhodamine <i>N</i> -succinimidyl ester	543	575	1 mg 5 mg
42024-1KT-F	Fluorescent orange 548 reactive	548	565	5 vials for labeling 1 mg protein each
62164-1KT-F	Fluorescent red 646 reactive	640	666	5 vials for labeling 1 mg protein each
53404-1MG-F	Atto 465 NHS ester	449	503	1 mg
41698-1MG-F	Atto 488 NHS ester	501	523	1 mg
00379-1MG-F	Atto 495 NHS ester	499	535	1 mg
77810-1MG-F	Atto 520 NHS ester	525	545	1 mg
88793-1MG-F	Atto 532 NHS ester	532	553	1 mg
92835-1MG-F	Atto 550 NHS ester	554	576	1 mg
72464-1MG-F	Atto 565 NHS ester	563	592	1 mg
79636-1MG-F	Atto 590 NHS ester	598	634	1 mg
07376-1MG-F	Atto 647 NHS ester	645	673	1 mg
76245-1MG-F	Atto 655 NHS ester	665	690	1 mg



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6. Fluorescent Labeling of Peptides—Cont'd

Table 2. Fluorescent streptavidin conjugates

Cat. No.	Name	Excitation Max.	Emission Max.	Package Size
56304-1MG-F	Atto 565-Streptavidin	563	592	1 mg
40709-1MG-F	Atto 590-Streptavidin	598	634	1 mg
56767-1MG-F	Atto 610-Streptavidin	605	646	1 mg
02744-1MG-F	Atto 655-Streptavidin	665	690	1 mg
16630-1MG-F	Atto 680-Streptavidin	680	702	1 mg
04307-500UG-F	Streptavidin-C-Phycocyanin	600	640	500 µg
61707-500UG-F	Streptavidin C-Phycocerythrin	575	545	500 µg

Table 3. Quenchers

Cat. No.	Name	Absorption Max.	Package Size
09278-25MG-F	DABCYL-N-succinimidylester	453	25 mg
09278-100MG-F			100 mg
42220-500MG	3,5-Dinitrophenyl isocyanate	348	500 mg
61683-1MG-F	Atto 540 Q NHS ester	540	1 mg
44756-1MG-F	Atto 580 Q NHS ester	580	1 mg
53988-1MG-F	Atto 612 Q NHS ester	612	1 mg

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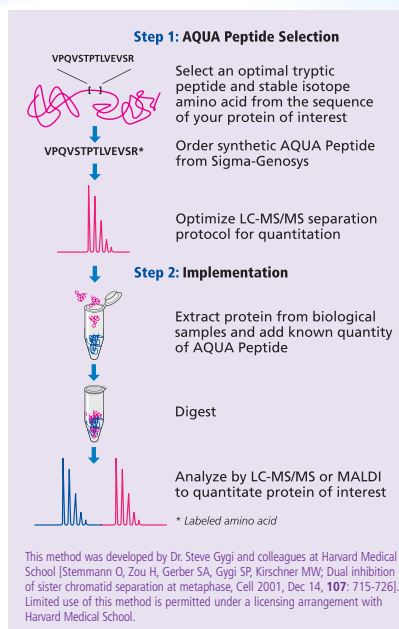
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(1) Gerber, S. A.; Rush, J.; Stemman, O.; Kirschner, M. W.; Gygi, S. P. *Proc. Natl. Acad. Sci. U.S.A. (PNAS)* **2003**, *100*, 6940.



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