

BIOFILES

FOR LIFE SCIENCE RESEARCH

Issue 1, 2006



Kits for Quantitation of:

Albumin
Ammonia
ATP
Glucose, Fructose, and Sucrose
Glycerol & Triglyceride
Nitrate/Nitrite
Starch and Dietary Fiber

New Products

High Purity Cytochrome c
Dihydrofolate Reductase

Metabolite Libraries

Amino Acid Metabolites
Carbohydrate Metabolites

Stable Isotope Metabolites

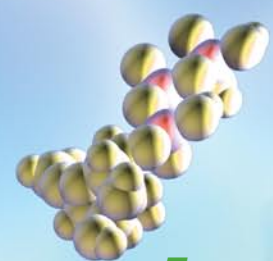
A detailed 3D molecular model of a cell membrane, showing a phospholipid bilayer with various proteins and receptors embedded within it. The model is rendered in vibrant colors, including purple, blue, and orange, against a light blue background.

Kits and Reagents
for Metabolomic and
Dietary Research

sigma-aldrich.com



SIGMA-ALDRICH



The Enzyme Explorer

Expanded Online Resources and New Products

The **Enzyme Explorer Indices** provide paths to find more than 3,000 enzymes/proteins, substrates, and inhibitors.

Product Highlights address specific new tools for your research.

The **Metabolic Pathways Resource** contains animated and static pathways with links to products and metabolite libraries.

Product Guides address the procedures and product ideas you need for applications such as protease inhibition, carbohydrate analysis, plasma chemistry, and kinase biology.

The **Assay Library** features over 600 detailed procedures for measuring enzyme activities and related metabolites. The Library is the result of over ten years of in-house process development by Sigma.

Access the original Enzyme Explorer and discover a new dimension in online resources.
sigma-aldrich.com/enzymeexplorer

ENZYME EXPLORER
 The most comprehensive source of enzymes, substrates, activators, and inhibitors

Search by name, application, specificity or EC number. The Enzyme Explorer also features detailed sites on metabolic pathways, protein kinases, protease specificity and inhibition, and glycoprotein analysis as well as new cell signaling, analytical and diagnostic enzymes and reagents.

- Application Index
- EC# / Class Index
- Inhibitor Index
- Substrate Index
- Cofactor Index
- Lectin Index

Key Resources

- Literature & Catalog Request
- Equipment, Supplies & Books
- Email to friend
- Satisfaction Survey
- Metabolic Pathways Graphical Resources

Assay Library

- Enzyme Assays by Enz. Name
- Enzyme Assays by EC#
- Enzyme Activator Assays
- Protease Inhibitor Assays

Drug Discovery & Cell Signaling Enzymes & Reagents

- Protein Arrays
- Intracellular Signaling Enzymes
- Apoptosis Enzyme Reagents
- Complement Proteins
- Cyclooxygenase Enzymes (COX)
- Chymase
- Histone Deacetylase Inhibitors
- HIV Protease
- Proteasomes & Other Intracellular Proteases
- MMP / ECM
- Nitric Oxide Metabolism Enzymes
- Phosphatase Inhibitors (Phos)

Nutrition and Metabolomics Resources

Metabolomics involves the study of all metabolites in a cell, tissue, or organism. The importance of metabolomic data has been increasingly recognized in many research areas. A detailed understanding of cellular functions and responses not only requires knowledge on the DNA, RNA, and protein level, it also requires the measurement of the products of enzymatic activities. Low-molecular weight metabolites constitute a complex network with enormous potential for practical applications. The analysis of how metabolic pathways are connected or not connected, both within a cell and between cell and environment, requires experimental methods at hand and metabolites in the bottle to quantify relationships. The involvement of key metabolites in different metabolic networks like amino acid, carbohydrate, nucleotide, and energy metabolism, utilization of cofactors and vitamins, biosynthesis,

degradation of secondary metabolites, and biodegradation of xenobiotic compounds is a characteristic feature of a living cell, illustrating the complex network of biochemical reactions that are tightly connected. (sigma-aldrich.com/metpath)

Although there are many structural classes of metabolites, several analytical developments point towards analysis of as many metabolites as possible by a single method. Whether by a single or by multiple analytical methods, the quantitative analysis of well-defined metabolites requires the availability of these compounds in order to proceed and define data standards for comparing different experiments. Our ability to provide both natural and stable-isotope-labeled (non-radioactive) metabolites is a unique contribution towards the rapid development of this exciting research area.

Kits for Nutrient & Metabolite Quantitation

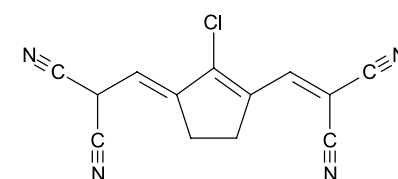
Enzymatic Kits and Reagents for the Quantitation and Characterization of Nutrients and Metabolites

Sigma manufactures several unique enzymatic-based kits for the quantitation of important nutrients and metabolites. These kits utilize spectrophotometric, fluorescent, bioluminescent, and gravimetric detection making them easy-to-use, yielding high sensitivity, and consistent results.

Albumin Fluorescence Assay Kit, Cat. No. 09753

The specific and sensitive determination of albumin in biological fluids is required in many areas of biomedical sciences. Assays suitable for the determination of low concentrations (<100 mg/L) of albumin in natural matrices are either nonspecific for albumin and determine total protein content (dye binding methods) or use complicated and costly procedures (e.g., immunoassays).

Albumin blue 580 (AB 580) is a fluorescent probe that is highly specific for albumin, with minimal binding to other proteins.¹ The Albumin Fluorescence Assay kit provides a robust, sensitive, and specific assay for albumin, and includes both human and bovine albumin references. The lower limit of detection is 0.4 mg/L albumin, with a recommended range of 1-200 mg/L. Sufficient for up to ~200 assays using 0.5 ml samples.



Albumin Blue 580

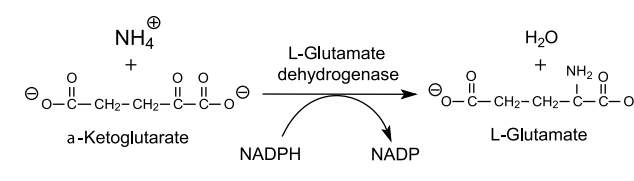
Reference

¹Kessler M.A., et al., Albumin blue 580 fluorescence assay for albumin. *Anal. Biochem.*, **248**, 180-182 (2000)

Ammonia Assay Kit, Cat. No. AA0100-1KT

sufficient for 100 assays

For the quantitative, enzymatic determination of ammonia in food and biological samples. Ammonia reacts with α -ketoglutaric acid and NADPH in the presence of L-glutamate dehydrogenase to form L-glutamate and NADP. The decrease in absorbance at 340 nm, due to the oxidation of NADPH, is proportional to the ammonia concentration. L-Glutamate dehydrogenase reacts specifically with ammonia. The Ammonia Assay Kit is recommended for the determination of ammonia concentrations in the range of 0.02-15 μ g/ml.



For hazards and other information, please refer to the Sigma Biochemicals & Reagents for Life Science Research Catalog or www.sigma-aldrich.com

Kits for Nutrient & Metabolite Quantitation

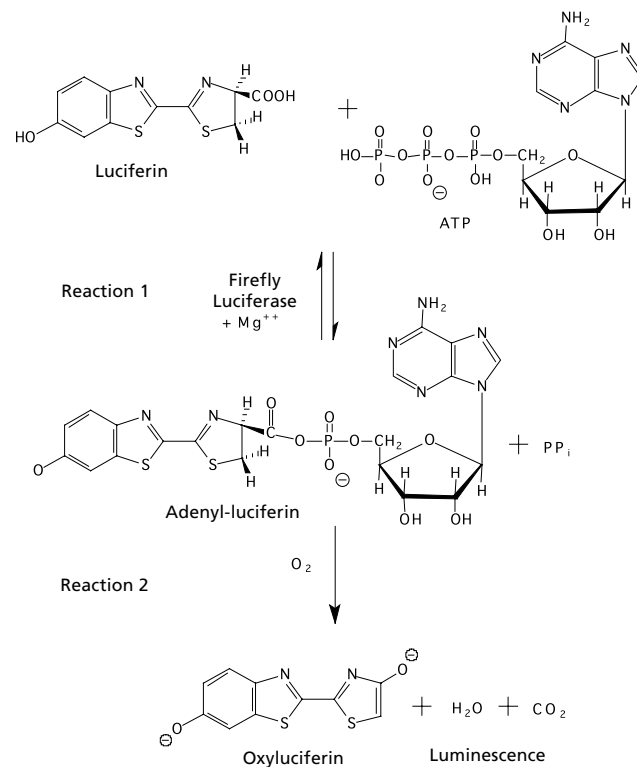
ATP Bioluminescent Assay Kit, Cat. No. FL-AA
For ATP determination in aqueous solutions

ATP Bioluminescent Somatic Cell Assay Kit, Cat. No. FL-ASC
For ATP determination in whole cells

Sigma Luciferase ATP Determination kits are effective for determining the ATP concentrations in samples ranging from 2×10^{-12} to 8×10^{-9} moles/liter for the FL-AA kit. The number of samples will vary depending on the sensitivity required. The ATP Somatic Cell Assay Kit can measure the ATP released by fewer than 10, or as many as 2×10^5 viable somatic cells (or a sample containing from 400 to 8×10^6 cells per ml). The number of samples will vary depending on the sensitivity required. Typically, a minimum of 40 samples (0.1ml) can be analyzed with each kit.

ATP is hydrolyzed and light is emitted when firefly luciferase catalyzes the oxidation of D-luciferin. Results are typically recorded using a luminometer.

Reaction (1) is reversible and the equilibrium preferentially forms adenylyl-luciferin. Reaction (2) is essentially irreversible. When ATP is the limiting reagent, the light emitted is proportional to the ATP present.



Total Dietary Fiber Assay Kit, Cat. No. TDF100A-1KT
sufficient for ~100 assays

For the determination of total dietary fiber. Uses a combination of enzymatic and gravimetric methods to analyze samples of dried, defatted foods to determine soluble fiber, protein, and ash content. This procedure is based on the method published by AOAC.¹

Reference:

¹Official Methods of Analysis, 16th ed., AOAC, Arlington, VA, Vol. II, Sec. 45.4.07, Method 985.29, 1105 (1997).

Total Dietary Fiber Assay Procedure

Heat stable α -Amylase, incubation at pH 6.0, 15 min., 95 °C

↓
Protease incubation at pH 7.5, 30 min., 60 °C

↓
Amyloglucosidase incubation at pH 4.5, 30 min., 60 °C

↓
Ethanol precipitation of Soluble Dietary Fiber

↓
Alcohol and acetone washes

↓
Drying

↓
Kjeldahl Protein Determination → Ash Determination
5 hours, 525 °C

↓
Calculation of Total Dietary Fiber

Dietary Fiber, Total, Assay Control Kit, Cat. No. TDFC10-1KT
sufficient for ~10 assays

Set of 6 standards for use as internal controls in conjunction with the Total Dietary Fiber Assay Kit (TDF100A)

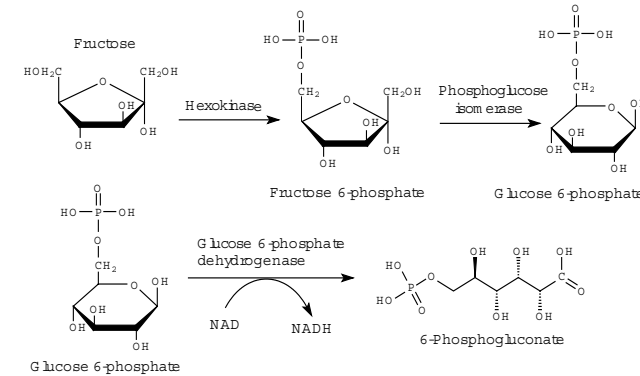


Visit the Nutrition Research & the Bioactive Nutrient Explorer at: sigma-aldrich.com/nutrition

Nutrient analysis, chemoprevention, bioavailability and nutrient interactions are emerging as pathways to understanding relationships between diet and health, disease and metabolism. The Bioactive Nutrient Explorer is designed to help you identify structurally related chemicals and locate compounds found in specific plant species.

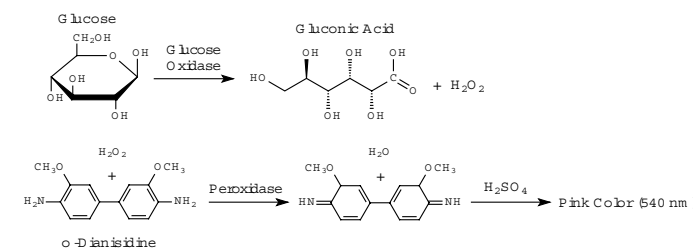
Fructose Assay Kit, Cat. No. FA20-1KT
sufficient for 20 assays

For the quantitative, enzymatic determination of fructose in food and other materials. Fructose is phosphorylated by ATP using hexokinase. Fructose 6-phosphate is then converted to glucose 6-phosphate by phosphoglucose isomerase. Glucose 6-phosphate is then oxidized to 6-phosphogluconate in the presence of NAD by glucose 6-phosphate dehydrogenase. During this oxidation, an equimolar amount of NAD is reduced to NADH. The consequent increase in absorbance at 340 nm is directly proportional to fructose concentration.



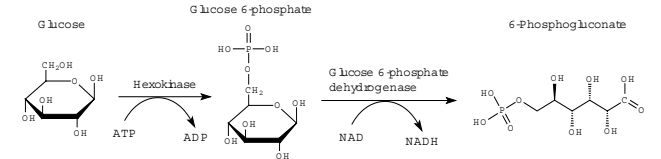
Glucose (GO) Assay Kit, Cat. No. GAGO20-1KT
sufficient for 20 assays

For the quantitative, enzymatic determination of glucose in food and other materials. Glucose is oxidized to gluconic acid and hydrogen peroxide by glucose oxidase. Hydrogen peroxide reacts with *o*-dianisidine in the presence of peroxidase to form a colored product. Oxidized *o*-dianisidine reacts with sulfuric acid to form a more stable colored product. The intensity of the pink color measured at 540 nm is proportional to the original glucose concentration.



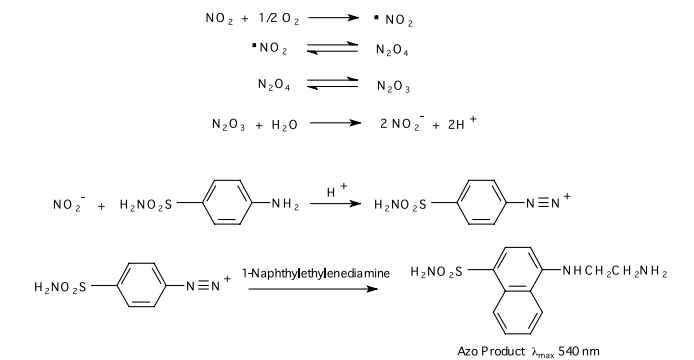
Glucose (HK) Assay Kit, Cat. No. GAHK20-1KT
sufficient for 20 assays

For the quantitative, enzymatic determination of glucose in food and other materials. Glucose is phosphorylated by hexokinase to form glucose 6-phosphate. Glucose 6-phosphate is then oxidized to 6-phosphogluconate in the presence of NAD by glucose 6-phosphate dehydrogenase. During this oxidation, an equimolar amount of NAD is reduced to NADH. The consequent increase in absorbance at 340 nm is directly proportional to glucose concentration.



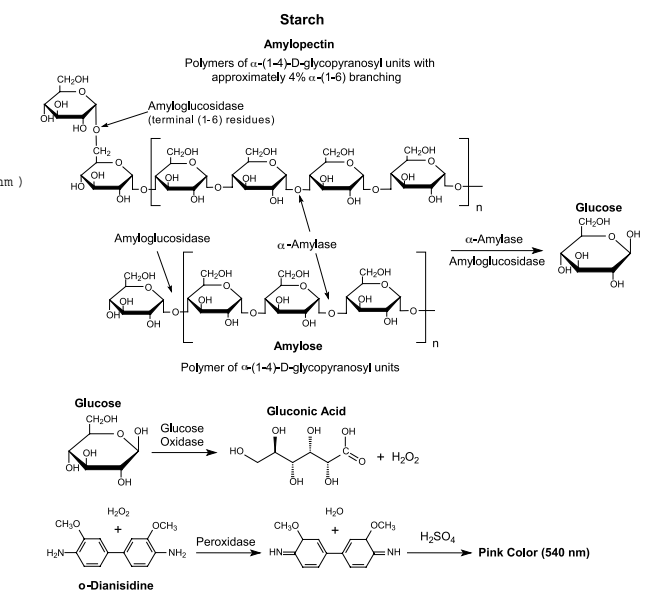
Nitrate/Nitrite Colorimetric Assay Kit, Cat. No. 23479-1KT-F

Based on the Griess assay, total NO, NO₂, and NO₃ metabolites are easily detectable using this kit. The NO₂/NO₃ Assay Kit contains indicator dyes, nitrate reductase, co-factor, buffer, and NO₂ and NO₃ standards. The NO₂ detection range is from 10 to 100 μ M.



Starch (GO/P) Assay Kit, Cat. No. STA20-1KT
sufficient for 20 assays

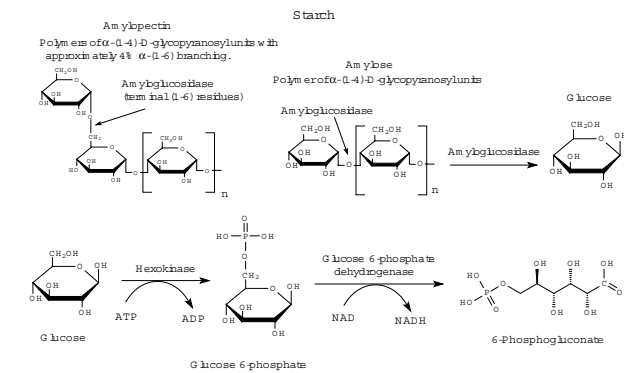
For the quantitative, enzymatic determination of starch in food and other materials. The hydrolysis of starch to glucose is catalyzed by α -amylase and amyloglucosidase. Glucose is oxidized to gluconic acid and hydrogen peroxide by glucose oxidase. Hydrogen peroxide reacts with *o*-dianisidine in the presence of peroxidase to form a colored product. Oxidized *o*-dianisidine reacts with sulfuric acid to form a more stable colored product. The intensity of the pink color measured at 540 nm is proportional to the original glucose concentration.



Kits for Nutrient & Metabolite Quantitation

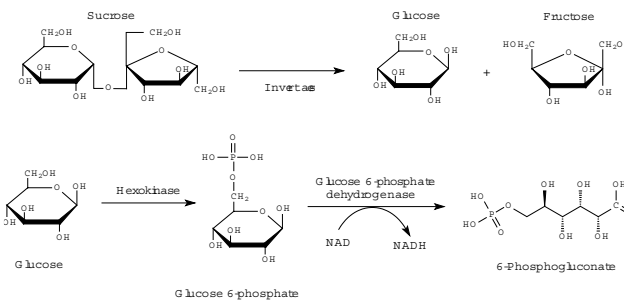
Starch (HK) Assay Kit, Cat. No. SA20-1KT
sufficient for 20 assays

For the quantitative, enzymatic determination of native starch in food and other materials. The hydrolysis of starch to glucose is catalyzed by amyloglucosidase. Glucose is phosphorylated by hexokinase. Glucose-6-phosphate is then oxidized to 6-phosphogluconate in the presence of NAD in a reaction catalyzed by glucose 6-phosphate dehydrogenase. The increase in absorbance at 340 nm is directly proportional to the glucose concentration.



Sucrose Assay Kit, Cat. No. SCA20-1KT
sufficient for 20 assays

For the quantitative, enzymatic determination of sucrose in food and other materials. Sucrose is hydrolyzed to glucose and fructose by invertase. Glucose and fructose are phosphorylated by hexokinase. Glucose 6-phosphate is then oxidized to 6-phosphogluconate in the presence of NAD in a reaction catalyzed by glucose 6-phosphate dehydrogenase. The increase in absorbance at 340 nm is directly proportional to sucrose concentration.



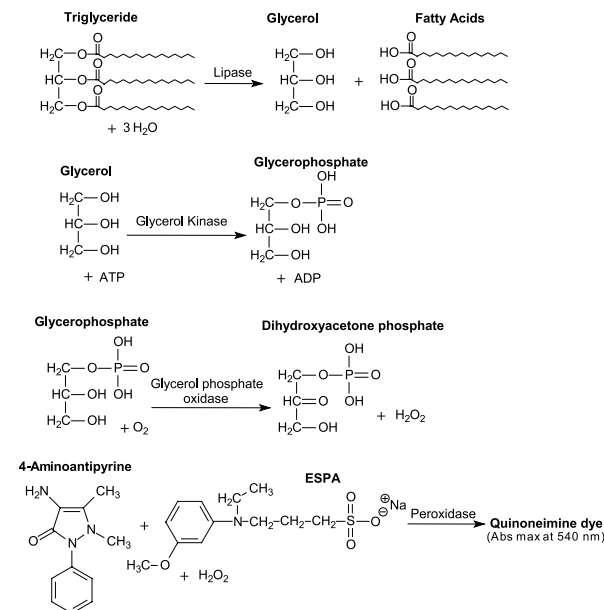
Serum Triglyceride Determination Kit, Cat. No. TR0100-1KT
sufficient for 250 assays

For the measurement of glycerol, true triglycerides, or total triglycerides in serum or plasma. Triglycerides are first hydrolyzed by lipoprotein lipase to glycerol and free fatty acids. Glycerol is then phosphorylated by ATP using glycerol kinase forming glycerol 1-phosphate. Glycerol 1-phosphate is then oxidized by glycerol phosphate oxidase to dihydroxyacetone phosphate and hydrogen peroxide. Peroxidase catalyzes the coupling of hydrogen peroxide with 4-aminoantipyrine and sodium N-ethyl-N-(3-sulfo-propyl) m-anisidine (ESPA) to produce a quinoneimine dye that shows an absorbance maximum at 540 nm. The increase in absorbance at 540 nm is directly proportional to triglyceride concentration of the sample. Many of the triglyceride reagents which are commercially available, do not differentiate between endogenous glycerol and glycerol derived by hydrolytic action of lipase on glycerides.

The kit also includes sufficient reagent for an additional 250 free glyceride tests for true triglyceride determination.

Free Glycerol Determination Kit, Cat. No. FG0100-1KT
1 kit sufficient for 1,000 reactions

Measures free, endogenous glycerol using coupled enzyme reactions and does not include initial lipase hydrolysis.



Components available separately:

Glycerol Standard G7793
Triglyceride Reagent T2449
Free Glycerol Reagent F6428

New! Metabolite Libraries

New 10 mg package sizes of Metabolite Standards

Individually packaged standards in autosampler vials for metabolomic analysis.

Choose your own components, and build a custom library online using the Sigma-Aldrich Metabolomics Web Resource.

Libraries Available — Choose From:

70 Amino Acids and Metabolic Intermediates

73 Carbohydrates and Metabolic Intermediates

Currently in Development

- Lipid Library
- Nucleotide Library
- Vitamin/Cofactor Library

Hundreds of other metabolites are available in standard packaging and can be found in the Sigma General Catalog or online (sigmaaldrich.com/metabolites).

Custom Packaging Capabilities

Sigma-Aldrich offers custom packaging of metabolite standards with vial content and container specifications to fit your specific requirements. Contact your SAFC sales representative for more details.

Amino Acid Metabolite Library

Metabolite	Cat. No.	Metabolite	Cat. No.
O-Acetyl-L-carnitine hydrochloride	A6706-10MG	DL-Homocysteine	H0501-10MG
O-Acetyl-L-serine hydrochloride	A6262-10MG	Homogentisic acid	H0751-10MG
*Adenosine 5'-phosphosulfate sodium salt	A5508-5MG	L-Homoserine	H6515-10MG
S-(5'-Adenosyl)-L-homocysteine	A9384-10MG	cis-4-Hydroxy-D-proline	H5877-10MG
L-Alanine	A7469-10MG	trans-4-Hydroxy-L-proline	H5534-10MG
β-Alanine	A9920-10MG	Hypotaurine	H1384-10MG
γ-Aminobutyric acid	A5835-10MG	L-Isoleucine	I7403-10MG
5-Aminolevulinic acid hydrochloride	A7793-10MG	α-Keto-γ-(methylthio)butyric acid sodium salt	K6000-10MG
Anthranilic acid	A8985-10MG	L-Leucine	L8912-10MG
L-Arginine	A8094-10MG	Lithium carbamoylphosphate dibasic	C5625-10MG
Argininosuccinic acid disodium salt	A5707-10MG	L-Lysine	L5501-10MG
L-Asparagine	A0884-10MG	L-Methionine	M5308-10MG
L-Aspartic acid	A8949-10MG	L-Methionine sulfoxide	M1126-10MG
Betaine aldehyde chloride	B3650-10MG	L-Ornithine monohydrochloride	O2375-10MG
Betaine hydrochloride	B7045-10MG	L-Phenylalanine	P5482-10MG
L-Carnitine hydrochloride	C0283-10MG	Phosphocholine chloride calcium salt tetrahydrate	P0378-10MG
L-Carnosine	C9625-10MG	Phosphocreatine disodium salt hydrate enzymatic	P7936-10MG
Choline chloride	C7017-10MG	O-Phospho-L-serine	P0878-10MG
Chorismic acid from <i>Enterobacter aerogenes</i>	C1761-10MG	Prephenic acid barium salt	P2384-10MG
L-Citrulline	C7629-10MG	L-Proline	P0380-10MG
Creatine	C0780-10MG	Sarcosine	S7672-10MG
Creatinine	C4255-10MG	L-Serine	S4500-10MG
L-Cystathionine	C7505-10MG	Shikimic acid	S5375-10MG
Cysteamine	M9768-10MG	Sodium 2-oxobutyrate	K0875-10MG
L-Cysteine	C7352-10MG	Sodium phenylpyruvate	P8001-10MG
L-Cystine	C7602-10MG	*O-Succinyl-L-homoserine	S7129-25MG
N,N-Dimethylglycine	D1156-10MG	Taurine	T0625-10MG
N-Formyl-L-methionine	F3377-10MG	L-Threonine	T8441-10MG
L-Glutamic acid	G8415-10MG	*N _ε ,N _ε ,N _ε -Trimethyllysine	T1660-25MG
L-Glutamine	G8540-10MG	Tryptamine	T2891-10MG
L-Glutathione, reduced	G4251-10MG	L-Tryptophan	T8941-10MG
Glycine	G7126-10MG	Tyramine hydrochloride	T2879-10MG
Histamine dihydrochloride	H7250-10MG	L-Tyrosine	T8566-10MG
L-Histidine	H6034-10MG	L-Valine	V0513-10MG
L-Histidinol dihydrochloride	H6647-10MG		
DL-Homocysteine	H4628-10MG		

* NOT currently available in Autosampler vials



Visit us online at: sigmaaldrich.com/metpath

New! Metabolite Libraries

Carbohydrate Metabolite Library

Metabolite	Cat. No.
N-Acetyl-D-galactosamine	A2795-10MG
N-Acetyl-D-glucosamine	A8625-10MG
N-Acetyl-D-lactosamine	A7791-10MG
N-Acetyl-D-mannosamine	A8176-10MG
*N-Acetyl-neuraminic acid	A2388-10MG
Adenosine 5'-diphosphoglucose disodium salt	A0627-10MG
Adonitol	A5502-10MG
D-Allose	A6390-10MG
L-(+)-Arabinose	A3256-10MG
L-(-)-Arabitol	A3506-10MG
L-Ascorbic acid	A5960-10MG
D-(+)-Cellobiose	C7252-10MG
2-Deoxy-D-glucose	D8375-10MG
6-Deoxy-D-glucose	D9761-10MG
2-Deoxy-D-ribose	D5899-10MG
*2-Deoxyribose 5-phosphate sodium salt	D3126-25MG
Dihydroxyacetone phosphate dilithium salt	D7137-10MG
*2,3-Diphospho-D-glyceric acid pentasodium salt	D5764-25MG
Dulcitol	D0256-10MG
D-Erythrose 4-phosphate sodium salt	E0377-10MG
D-(-)-Fructose	F0127-10MG
D-Fructose 1,6-bisphosphate trisodium salt	F6803-10MG
D-Fructose 1-phosphate sodium salt	F1127-10MG
D-Fructose 6-phosphate disodium salt hydrate	F3627-10MG
L-(-)-Fucose	F2252-10MG
α-D-Galactosamine 1-phosphate	G5134-25MG
D-(+)-Galactosamine hydrochloride	G0500-10MG
D-(+)-Galactose	G0750-10MG
α-D-Galactose 1-phosphate dipotassium salt pentahydrate	G0380-10MG
D-Gluconic acid sodium salt	G9005-10MG
D-Glucosamine 6-phosphate	G5509-10MG
D-(+)-Glucosamine hydrochloride	G4875-10MG
D-(+)-Glucose	G7528-10MG
α-D-Glucose 1-phosphate disodium salt hydrate	G7018-10MG
D-Glucose 6-phosphate disodium salt hydrate	G7250-10MG
D-Glucuronic acid	G5269-10MG
Guanosine 5'-diphosphoglucose sodium salt	G7502-10MG

Metabolite	Cat. No.
myo-Inositol	I5125-10MG
*Isomaltose	I7253-100MG
α-Lactose monohydrate	L8783-10MG
*D(-)-Lyxose	220477-1G
D-(+)-Maltose monohydrate	M9171-10MG
D-Mannitol	M4125-10MG
D-Mannosamine hydrochloride	M4670-10MG
α-D-(+)-Mannose 1-phosphate dipotassium salt	M2152-10MG
D-Mannose 6-phosphate disodium salt hydrate	M6876-10MG
Melibiose	M5500-10MG
Palatinose	P2007-10MG
Phospho(enol)pyruvic acid monopotassium salt	P7127-10MG
6-Phosphogluconic acid trisodium salt	P6888-10MG
D-(-)-3-Phosphoglyceric acid disodium salt	P8877-10MG
D-Psicose	P8043-10MG
D-(+)-Raffinose pentahydrate	R0514-10MG
L-Rhamnose monohydrate	R3875-10MG
D-(-)-Ribose	R7500-10MG
D-Ribose 5-phosphate disodium salt hydrate	R7750-10MG
*D-Ribulose	R2762-100MG
D-Ribulose 1,5-bisphosphate sodium salt hydrate	R0878-10MG
D-Ribulose 5-phosphate sodium salt	R9875-10MG
Sodium pyruvate	P2256-10MG
D-Sorbitol	S1876-10MG
Stachyose hydrate from <i>Stachys tuberosa</i>	S4001-10MG
Sucrose	S9378-10MG
D-(-)-Tagatose	T2751-10MG
Trehalose 6-phosphate dipotassium salt	T4272-10MG
D-(+)-Trehalose dihydrate	T9531-10MG
Uridine 5'-diphosphogalactose disodium salt	U4500-10MG
Uridine 5'-diphosphoglucose disodium salt	U4625-10MG
Uridine 5'-diphosphoglucuronic acid trisodium salt	U6751-10MG
Xylitol	X3375-10MG
D-(+)-Xylose	X1500-10MG
D-Xylulose	X4625-10MG



The new Metabolomics Resource Center at: sigma-aldrich.com/metpath

Sigma-Aldrich is proud of our continuing alliance with the International Union of Biochemistry and Molecular Biology. Together we produce, animate, and publish the Nicholson Metabolic Pathway Charts, created and continually updated by Dr. Donald Nicholson. These classic resources can be downloaded from the Sigma-Aldrich Web site as PDF or GIF files at no charge. This site also features our metabolite libraries and kits for metabolite and dietary analysis.

Stable-Isotope Labeled Metabolites

Stable isotopically labeled products can provide accurate and non-radioactive *in vivo* studies of both nutrition and metabolism. Compounds labeled with stable isotopes like Carbon-13, Nitrogen-15, Deuterium, and others can be identified and measured using techniques such as MRI and MRS. We provide highly purified stable isotope labeled metabolic precursors and compounds for the study of energy utilization *in vivo*, brain metabolism, protein and glucose metabolism, metabolomics, fatty acid metabolism, and others.

Nutrition & Metabolic Studies

Cat. No.	Product Name	Atom %	Cat. No.	Product Name	Atom %
48,785-6	Acetic acid-2,2,2-d ₃	99	45,243-2	Dodecanedioic-d ₂₀ acid	98
49,170-5	Acetyl-1- ¹³ C-L-carnitine • HCl	99	33,378-6	L-DOPA-ring-d ₃	98
61,746-6	Acetyl-d ₃ -L-carnitine • HCl	98	49,252-3	Equilin-2,4,16,16-d ₄	98
58,672-2	L-Alanine-1- ¹³ C,3,3,3-d ₃	99 ¹³ C; 99D	52,495-6	Estrone-2,4,16,16-d ₄ 3-sulfate sodium	95
48,986-7	L-Alanine-1- ¹³ C	99	48,920-4	Estrone-2,4,16,16-d ₄	95
48,994-8	L-Alanine-3- ¹³ C	99	48,564-0	Ethyl acetoacetate-1,3- ¹³ C ₂	99
48,987-5	L-Alanine- ¹³ C ₃	99	48,926-3	Ethyl acetoacetate-1,2,3,4- ¹³ C ₄	99
60,468-2	L-Alanine-2,3- ¹³ C ₂	99	48,927-1	Ethyl acetoacetate-3- ¹³ C	99
48,584-5	L-Alanine-2,3,3,3-d ₄	98	48,929-8	Ethyl acetoacetate-4- ¹³ C	99
48,677-9	L-Alanine-2- ¹³ C	99	48,565-9	Ethyl acetoacetate-2,4- ¹³ C ₂	99
48,586-1	L-Alanine-2-d	98	49,257-4	Ethyl acetoacetate-3,4- ¹³ C ₂	99
48,992-1	L-Alanine-3,3,3-d ₃	99	58,761-3	D-Fructose-1,6- ¹³ C ₂	99
45,453-2	L-Alanine-d ₇	98	41,555-3	D-Fructose-1- ¹³ C	99
48,793-7	Algal fatty acids- ¹³ C	99	58,762-1	D-Fructose- ¹³ C ₆	99
60,927-7	4-Aminobutyric acid- ¹⁵ N	98	49,214-0	D-Fructose-2- ¹³ C	99
61,558-7	4-Aminobutyric acid-2,2,3,3,4,4-d ₆	97	48,872-0	D-Fructose-6,6-d ₂	98
61,745-8	4-Aminobutyric acid-2,2-d ₂	98	60,539-5	D-Fructose-6- ¹³ C	99
58,675-7	5-Aminolevulinic acid-5- ¹³ C • HCl	99	60,601-4	Fumaric acid- ¹³ C ₄	99
60,908-0	L-Arginine-(guanidinoimino- ¹⁵ N ₂) • HCl	98	60,607-3	Fumaric-2,3- ¹³ C ₂ acid	99
57,986-6	L-Asparagine-4- ¹³ C • H ₂ O	99	49,507-7	D-Galactose-1-d ₁	98
57,979-3	L-Aspartic acid-1,2- ¹³ C ₂	99	29,704-6	D-Glucose-1- ¹³ C	99
48,998-0	L-Aspartic-2,3,3-d ₃ acid	98	38,937-4	D-Glucose- ¹³ C ₆	99
60,489-5	L-Aspartic-2- ¹³ C acid	99	45,318-8	D-Glucose-1,2- ¹³ C ₂	99
60,770-3	L-Aspartic-2- ¹³ C, ¹⁵ N acid	99 ¹³ C; 98 ¹⁵ N	31,081-6	D-Glucose-1-d ₁	98
49,118-7	β-Estradiol-16,16,17-d ₃	98	31,082-4	D-Glucose-2-d ₁	98
48,536-5	Caffeine-trimethyl- ¹³ C ₃	99	28,265-0	D-Glucose-6,6-d ₂	98
48,857-7	Cholesterol-2,2,3,3,4,4,6-d ₆	97	60,522-0	L-Glutamine-1,2- ¹³ C ₂	99
48,858-5	Cholesterol-3,4- ¹³ C	99	60,516-6	L-Glutamine- ¹³ C ₅	99
61,555-2	Choline-1,1,2,2-d ₄ bromide	98	30,606-1	Glycerol(d-d ₃)	98
61,554-4	Choline-1,1,2,2-d ₄ chloride	98	45,452-4	Glycerol-1,1,2,3,3-d ₅	98
60,926-9	Choline- ¹⁵ N chloride	98	49,263-9	Glycerol-1,3- ¹³ C ₂	99
61,553-6	Choline bromide-d ₃ (trimethyl-d ₉ , 1,1,2,2-d ₄)	98	48,947-6	Glycerol- ¹³ C ₃	99
61,552-8	Choline bromide-d ₉ (trimethyl-d ₉)	98	48,948-4	Glycerol-2- ¹³ C	99
48,859-3	Choline bromide (methyl- ¹³ C ₁)	99	48,951-4	Glycerol Tri(oleate-1- ¹³ C)	99
49,205-1	Choline chloride-d ₉ (trimethyl-d ₉)	98	42,590-7	Glycerol Tri(palmitate-1- ¹³ C)	99
60,608-1	Citric acid- ¹³ C ₆	99	61,696-6	Glycerol Tri(palmitate-d ₃₁)	98
48,860-7	Citric acid-1,5- ¹³ C ₂	99	27,942-0	Glycine-1- ¹³ C	99
49,207-8	Citric-2,4- ¹³ C ₂ acid	99	28,382-7	Glycine- ¹³ C ₂	99
56,992-5	Creatine-(guanidino- ¹³ C) monohydrate	99	29,929-4	Glycine- ¹⁵ N	98
60,492-5	Creatine-(methyl- ¹³ C) monohydrate	99	33,645-9	Glycine-2,2-d ₂	98
61,624-9	Creatine-(methyl-d ₃) monohydrate	98	27,943-9	Glycine-2- ¹³ C	99
48,861-5	Creatinine-methyl- ¹³ C	99	17,583-8	Glycine-d ₅	98
48,544-6	Creatinine-methyl-d ₃	98	33,760-9	Glycocholic acid-(glycine-1- ¹³ C) monohydrate	99
61,612-5	Decanoic-10,10,10-d ₃ acid	99	33,761-7	Glycocholic acid-(glycine- ¹³ C ₂) monohydrate	99
48,866-6	Decanoic-d ₁₉ acid	98	48,957-3	Guanidine-d ₅ deuteriochloride	98
60,854-8	Deuterium oxide- ¹⁸ O	98D; 50 ¹⁸ O			

Stable-Isotope Labeled Metabolites

Nutrition & Metabolic Studies (cont.)

Cat. No.	Product Name	Atom %	Cat. No.	Product Name	Atom %
61,595-1	Palmitic acid-16,16,16-d ₃ acid	99	48,967-0	Palmitic-2,2-d ₂ acid potassium salt	99
48,970-0	Hexanoic acid-1- ¹³ C	99	49,275-2	Palmitic-2- ¹³ C acid	99
48,889-5	DL-3-Hydroxybutyric-1,3- ¹³ C ₂ acid sodium salt	99	36,689-7	Palmitic-d ₃₁ acid	98
49,231-0	DL-3-Hydroxytetradecanoic-2,2,3,4,4-d ₅ acid	98	57,681-6	Palmitoyl-1- ¹³ C-L-carnitine • HCl	99
49,281-7	Indole-3-acetic-2,2-d ₂ acid	97	64,432-3	Palmitoyl- ¹³ C ₁₆ -L-carnitine • HCl	99
58,638-2	Lauric acid-1,12- ¹³ C ₂	99	49,303-1	Phenacetin (ethoxy-2- ¹³ C)	99
58,615-3	Lauric acid-1,2,3,4- ¹³ C ₄	99	58,949-7	L-Proline-1- ¹³ C	99
58,605-6	Lauric acid-1,2- ¹³ C ₂	99	60,487-9	L-Phenyl- ¹³ C ₆ -alanine	99
57,968-8	Lauric acid-2- ¹³ C	99	61,587-0	L-Phenyl-d ₅ -alanine	98
29,216-8	Lauric acid-1- ¹³ C	99	49,010-5	L-Phenylalanine- ¹⁵ N	98
48,560-8	Lauric acid-12,12,12-d ₃	98	49,014-8	L-Phenyl-d ₅ -alanine-2,3,3-d ₃	98
48,663-9	Lauric acid-12- ¹³ C	99	49,011-3	L-Phenylalanine-2- ¹³ C	99
48,916-6	Lauric acid-2,2-d ₂	98	49,012-1	L-Phenylalanine-3- ¹³ C	99
45,140-1	Lauric-d ₂₃ acid	98	49,009-1	L-Phenylalanine-1- ¹³ C	99
60,490-9	L-Leucine-1,2- ¹³ C ₂	99	60,848-3	Sodium pyruvate-3- ¹³ C, d ₃	99 ¹³ C; 50-60D
49,005-9	L-Leucine-1- ¹³ C	99	60,535-2	D-Ribose-1- ¹³ C	99
49,006-7	L-Leucine-1- ¹³ C, ¹⁵ N	99 ¹³ C; 98 ¹⁵ N	31,083-2	D-Ribose-1- ¹³ C	99
34,096-0	L-Leucine- ¹⁵ N	98	31,084-0	D-Ribose-2- ¹³ C	99
49,294-9	L-Leucine-2,3,3,4,5,5,6,6,6-d ₁₀	98	63,409-3	L-Selenomethionine (methyl- ¹³ C)	99
48,681-7	L-Leucine-2- ¹³ C	99	49,015-6	L-Serine-1- ¹³ C	99
48,682-5	L-Leucine-5,5,5-d ₃	99	27,929-3	Sodium acetate-1- ¹³ C	99
60,574-3	Linolenic acid- ¹³ C ₁₈	99	29,804-2	Sodium acetate-1- ¹³ C, d ₃	99D; 99 ¹³ C
60,896-3	L-Lysine-2- ¹⁵ N • HCl	98	28,201-4	Sodium acetate- ¹³ C ₂	99
49,018-0	Maleic-2,3- ¹³ C ₂ acid	99	29,911-1	Sodium acetate- ¹³ C ₂ , d ₃	99D; 99 ¹³ C
49,298-1	Maleic-2,3- ¹³ C ₂ anhydride	99	29,908-1	Sodium acetate-2- ¹³ C, d ₃	99D; 99 ¹³ C
49,019-9	Malonic acid-1,3- ¹³ C ₂	99	37,238-2	Sodium bicarbonate- ¹³ C	99
49,020-2	Malonic acid- ¹³ C ₃	99	49,159-4	Sodium 4-methylvalerate-1- ¹³ C	99
27,944-7	Malonic-2- ¹³ C acid	99	61,620-6	D-Sorbitol-1,1,6,6-d ₄	98
45,461-3	D-Mannitol-1- ¹³ C	99	48,918-2	D-Sorbitol-1- ¹³ C	99
60,534-4	D-Mannose-2- ¹³ C	99	29,916-2	Stearic acid-1- ¹³ C	99
29,914-6	L-Methionine- ¹³ C (methyl- ¹³ C)	99	49,039-3	Stearic acid-18,18,18-d ₃	98
29,915-4	L-Methionine- ¹³ C, d ₃ (methyl- ¹³ C, d ₃)	99D; 99 ¹³ C	49,315-5	Stearic-2,2-d ₂ acid	98
30,061-6	L-Methionine-d ₃ (methyl-d ₃)	98	44,824-9	Stearic- d ₃₅ acid	98
48,771-6	2-Keto-4-methylpentanoic acid-1- ¹³ C sodium salt	99	60,541-7	D-Sucrose- ¹³ C ₁₂	99
49,158-6	4-Methylvaleric-1- ¹³ C acid	99	49,133-0	2-Aminoethanesulfonic acid- ¹⁵ N	98
49,245-0	(±)-Mevalonolactone-1,2- ¹³ C ₂	99	49,342-2	Tetracosanoic acid-1- ¹³ C	99
49,246-9	(±)-Mevalonolactone-1- ¹³ C	99	60,568-9	Myristic acid- ¹³ C ₁₄	99
48,660-4	(±)-Mevalonolactone-2- ¹³ C	99	49,090-3	Thiourea- ¹³ C, ¹⁵ N ₂	99 atom % ¹³ C; 98
49,086-5	Myristic acid-1,2- ¹³ C ₂	99	48,706-6	Thymine-d ₄ (methyl-d ₃ ,6-d ₁)	98
49,087-3	Myristic acid-1- ¹³ C	99	48,980-8	L-Tyrosine-2,3,5,6-d ₄	98
36,688-9	Myristic-d ₂₇ acid	98	48,582-9	L-Tyrosine-2,6-d ₂	98
49,316-3	Octanoic acid-1,2,3,4- ¹³ C ₄	99	48,981-6	L-Tyrosine-3,5-d ₂	98
44,821-4	Octanoic-d ₁₅ acid	99	48,984-0	L-Tyrosine-3,3-d ₂	98
49,042-3	Oleic acid -1- ¹³ C	99	48,985-9	L-Tyrosine-3- ¹³ C	99
60,613-3	Oleic acid-9,10-d ₂	98	48,982-4	L-Tyrosine-1- ¹³ C	99
49,043-1	Oleic acid- ¹³ C ₁₈	99	48,979-4	L-Tyrosine (ring- ¹³ C ₆)	99
29,212-5	Palmitic acid-1- ¹³ C	99	31,683-0	Urea- ¹⁵ N ₂	98
48,961-1	Palmitic acid-1,2,3,4- ¹³ C ₄	99	49,016-4	L-Valine-1- ¹³ C	99
48,966-2	Palmitic-2,2-d ₂ acid	98	48,602-7	L-Valine-2,3,4,4,4,5,5,5-d ₈	98
			60,309-0	Water- ¹⁸ O	95
			33,208-9	Water- ¹⁸ O	10
			60,744-4	Zinc acetate-1- ¹³ C, d ₃ dihydrate	99 ¹³ C; 99D

New Products

New proteins manufactured by Sigma

High Purity Cytochrome c from Equine Heart, Cat. No. C2867

purity ≥ 99% by SDS-PAGE

This cytochrome c product is prepared from equine heart using trichloroacetic acid by a modification of a published method. The trichloroacetic acid method reduces the amount of superoxide dismutase (SOD) present, but tends to cause dimerization or acid-modified structures of cytochrome c. In contrast, preparations using acetic acid may have slightly higher amounts of SOD, but a lower proportion of dimeric cytochrome c.

The product is supplied as a lyophilized powder. The final step before lyophilization is extensive dialysis against 6 mM ammonium hydroxide, which is volatile under lyophilization conditions, so the final product should not contain any buffer salts. The product is mainly the oxidized form of the protein. The reduced form of cytochrome c can be prepared with either sodium dithionite or sodium ascorbate, followed by gel filtration.

Dihydrofolate Reductase, Cat. No. D6566

human, recombinant expressed in *E.coli*

Dihydrofolate Reductase (DHFR), a key enzyme in thymidine synthesis, catalyzes the NADPH dependent reduction of dihydrofolate (DHF) to tetrahydrofolate (THF) and, at much lower rate, the conversion of folate to THF. The reaction product, THF, is an essential cofactor in the conversion of deoxyuridylate (dUMP) to deoxythymidylate (dTMP) by thymidylate synthetase. Therefore, DHFR is a critical enzyme in DNA synthesis and has become a target for drug development and cancer therapy. The variations between DHFR from different sources has enabled the development of species selective DHFR inhibitors, such as trimethoprim (antibacterial and antifungal), pyrimethamine (antiprotozoal), and methotrexate, MTX, (antineoplastic, antipsoriatic, and anti-inflammatory).

Human DHFR is an 186 amino acid protein with an apparent molecular weight of 25 kDa. It is 30% homologous to the *E. coli* protein and up to 70% homologous to vertebrate proteins. The human DHFR gene, as well as other mammalian DHFR genes, overcomes the inhibitory effects of methotrexate by the mechanism of gene amplification or by amino acid mutagenesis.

This product is supplied as a solution in 10 mM Tris-HCl, pH 8.0, with 1 mM EDTA, 0.5 mM DTT, 5 μM NADPH, protease inhibitors, and 50% glycerol.

The Enzyme Explorer at: sigma-aldrich.com/enzymeexplorer

The Enzyme Explorer has become one of the biotech industry's leading Web tools for enzyme related resources and products. The Enzyme Explorer features indices for identifying enzymes, substrates, inhibitors and cofactors, as well as a library of assay procedures, and application guides for specific areas of enzyme related research.

Other related Sigma-Aldrich resources include *Cell Signaling*, *Obesity*, *Cancer*, *Isotec™ Stable-Isotope Enriched Metabolites* and *Supelco® Discovery® HPLC columns and equipment*.

Argentina

SIGMA-ALDRICH DE ARGENTINA, S.A.
Tel: 54 11 4556 1472
Fax: 54 11 4552 1698

Australia

SIGMA-ALDRICH PTY., LIMITED
Free Tel: 1800 800 097
Free Fax: 1800 800 096
Tel: 612 9841 0555
Fax: 612 9841 0500

Austria

SIGMA-ALDRICH HANDELS GmbH
Tel: 43 1 605 81 10
Fax: 43 1 605 81 20

Belgium

SIGMA-ALDRICH NV/SA.
Free Tel: 0800-14747
Free Fax: 0800-14745
Tel: 03 899 13 01
Fax: 03 899 13 11

Brazil

SIGMA-ALDRICH BRASIL LTDA.
Tel: 55 11 3732-3100
Fax: 55 11 3733-5151

Canada

SIGMA-ALDRICH CANADA LTD.
Free Tel: 800-565-1400
Free Fax: 800-265-3858
Tel: 905-829-9500
Fax: 905-829-9292

China

SIGMA-ALDRICH CHINA INC.
Tel: 86-21-6386 2766
Fax: 86-21-6386 3966

Czech Republic

SIGMA-ALDRICH S.R.O.
Tel: +420 246 003 200
Fax: +420 246 003 291

Denmark

SIGMA-ALDRICH DENMARK A/S
Tel: 43 56 59 10
Fax: 43 56 59 05

Finland

SIGMA-ALDRICH FINLAND
Tel: (09) 350 9250
Fax: (09) 350 92555

France

SIGMA-ALDRICH CHIMIE S.à.r.l.
Tel appel gratuit: 0800 211 408
Fax appel gratuit: 0800 031 052

Germany

SIGMA-ALDRICH CHEMIE GmbH
Free Tel: 0800-51 55 000
Free Fax: 0800-649 00 00

Greece

SIGMA-ALDRICH (O.M.) LTD
Tel: 30 210 9948010
Fax: 30 210 9943831

Hungary

SIGMA-ALDRICH Kft
Tel: 06-1-235-9054
Fax: 06-1-269-6470
Ingyenes zöld telefon: 06-80-355-355
Ingyenes zöld fax: 06-80-344-344

India

SIGMA-ALDRICH CHEMICALS
PRIVATE LIMITED
Telephone
Bangalore: 91-80-4112-7272
New Delhi: 91-11-4165-4255
Mumbai: 91-22-2570-2364
Hyderabad: 91-40-5584-5488
Fax
Bangalore: 91-80-4112-7473
New Delhi: 91-11-4165-4266
Mumbai: 91-22-2579-7589
Hyderabad: 91-40-5584-5466

Ireland

SIGMA-ALDRICH IRELAND LTD.
Free Tel: 1800 200 888
Free Fax: 1800 600 222
Tel: 353 1 4041900
Fax: 353 1 4041910

Israel

SIGMA-ALDRICH ISRAEL LTD.
Free Tel: 1-800-70-2222
Tel: 08-948-4100
Fax: 08-948-4200

Italy

SIGMA-ALDRICH S.r.l.
Telefono: 02 33417310
Fax: 02 38010737
Numero Verde: 800-827018

Japan

SIGMA-ALDRICH JAPAN K.K.
Tokyo Tel: 03 5796 7300
Tokyo Fax: 03 5796 7315

Korea

SIGMA-ALDRICH KOREA
Tel: 031-329-9000
Fax: 031-329-9090

Malaysia

SIGMA-ALDRICH (M) SDN. BHD
Tel: 603-56353321
Fax: 603-56354116

Mexico

SIGMA-ALDRICH QUÍMICA, S.A. de C.V.
Free Tel: 01-800-007-5300
Free Fax: 01-800-712-9920

The Netherlands

SIGMA-ALDRICH CHEMIE BV
Tel Gratis: 0800-0229088
Fax Gratis: 0800-0229089
Tel: 078-6205411
Fax: 078-6205421

New Zealand

SIGMA-ALDRICH PTY., LIMITED
Free Tel: 0800 936 666
Free Fax: 0800 937 777
Tel: 61 2 9841 0500
Fax: 61 2 9841 0500

Norway

SIGMA-ALDRICH NORWAY AS
Tel: 23 17 60 60
Fax: 23 17 60 50

Poland

SIGMA-ALDRICH Sp. z o.o.
Tel: 061 829 01 00
Fax: 061 829 01 20

Portugal

SIGMA-ALDRICH QUÍMICA, S.A.
Free Tel: 800 202180
Free Fax: 800 202178
Tel: 21 9242555
Fax: 21 9242610

Russia

SIGMA-ALDRICH RUS, LLC
Tel: +7 (095) 621-5828/6037
Fax: +7 (095) 975-4792

Singapore

SIGMA-ALDRICH PTE. LTD.
Tel: 65-67791200
Fax: 65-67791822

South Africa

SIGMA-ALDRICH
SOUTH AFRICA (PTY) LTD.
Free Tel: 0800 1100 75
Free Fax: 0800 1100 79
Tel: 27 11 979 1188
Fax: 27 11 979 1119

Spain

SIGMA-ALDRICH QUÍMICA, S.A.
Free Tel: 900 101376
Free Fax: 900 102028
Tel: 91 661 99 77
Fax: 91 661 96 42

Sweden

SIGMA-ALDRICH SWEDEN AB
Tel: 020-350510
Fax: 020-352522
Outside Sweden Tel: +46 8 7424200
Outside Sweden Fax: +46 8 7424243

Switzerland

SIGMA-ALDRICH CHEMIE GmbH
Swiss Free Call: 0800 80 00 80
Tel: +41 81 755 2828
Fax: +41 81 755 2815

United Kingdom

SIGMA-ALDRICH COMPANY LTD.
Free Tel: 0800 717181
Free Fax: 0800 378785
Tel: 01747 833000
Fax: 01747 833313
SAFC (UK): 01202 712305

United States

SIGMA-ALDRICH
P.O. Box 14508
St. Louis, Missouri 63178
Toll-Free: (800) 325-3010
Call Collect: (314) 771-5750
Toll-Free Fax: (800) 325-5052
Tel: (314) 771-5765
Fax: (314) 771-5757

Internet

sigma-aldrich.com

World Headquarters

3050 Spruce St., St. Louis, MO 63103
(314) 771-5765
sigma-aldrich.com

Order/Customer Service (800) 325-3010 • Fax (800) 325-5052

Technical Service (800) 325-5832 • sigma-aldrich.com/techservice

Development/Bulk Manufacturing Inquiries SAFC™ (800) 244-1173

The SIGMA-ALDRICH Group

©2006 Sigma-Aldrich Co. All rights reserved.
SIGMA, SAFC, SAFC™, SIGMA-ALDRICH, ISOTEC, ALDRICH, FLUKA, and SUPELCO are trademarks belonging to Sigma-Aldrich Co. and its affiliate Sigma-Aldrich Biotechnology, L.P. Riedel-de Haën® trademark under license from Riedel-de Haën GmbH. Sigma brand products are sold through Sigma-Aldrich, Inc. Sigma-Aldrich, Inc. warrants that its products conform to the information contained in this and other Sigma-Aldrich publications. Purchaser must determine the suitability of the product(s) for their particular use. Additional terms and conditions may apply. Please see reverse side of the invoice or packing slip.



SIGMA-ALDRICH

*Accelerating Customers' Success
through Leadership in Life Science,
High Technology and Service*

IRW
00358-502820
0046