HANDBOOK OF ENZYME INHIBITORS

3rd, revised and enlarged Edition Part A H–Z

Helmward Zollner

Handbook of Enzyme Inhibitors

3rd, revised and enlarged edition

Part A
H–Z

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H. Zollner

Handbook of Enzyme Inhibitors

WILEY-VCH

To my sons Gernot and Johannes

Preface to the Third Edition

Ten years ago the First Edition was published comprising one volume with 1,000 enzymes and 2,000 inhibitors. The Third Edition has grown to four volumes with more than 19,000 inhibitors and 5,000 enzymes or isoenzymes emphasizing the importance of this field of research. Inhibitors have substantially contributed to our understanding of metabolic processes and of enzyme mechanisms and have made possible the labeling and mapping of active sites of enzymes. Moreover, inhibitors gained great interest as pharmaceuticals, pesticides, and herbicides.

This book is intended for biochemists, pharmacists, biologists, toxicologists, enzymologists, and other scientists working in related fields. Its aim is to provide rapid information on enzyme inhibitors and help to avoid mistakes that could be made due to limited knowledge about the side effects of an inhibitor, both in planning and interpreting experimental results.
A lot of effort was put into the standardization of enzyme names and inhibitor names as well as into the elimination of errors. The huge amount of data made this a tedious task. Particularly with inhibitor names and enzymes not yet classified and named by the nomenclature committee, and due to the fact that scientists most frequently use trivial names, standardization may not always have been perfect.
I would like to thank all persons who supported me and this work. I would also like to thank the publisher for their understanding and support as well as all those readers who made suggestions and proposals for improvement.

Graz, March 1999 H. Zollner

Preface to the Second Edition

The great demand for the *Handbook of Enzyme Inhibitors* – the first edition and a reprint are out of stock – and an enormous amount of new information were the impetus for the publisher and myself to edit a completely revised and updated version of this book. The organizational structure of the first edition was maintained, but the additional data have necessitated a division into two volumes, which, however, makes the text more manageable. The first volume contains an enzyme → inhibitor list, the second an inhibitor → enzyme list, glossary and EC numbers list.

A great deal of effort was put into the standardization of enzyme names and inhibitor names as well as into the elimination of errors. The huge amount of data made this a tedious task. Particularly with inhibitor names and enzymes not yet classified and named by the nomenclature committee, standardization may not always have been perfect.

I would like to thank the many colleagues who readily provided me with reprints of their papers and thus supported my work. I would like to mention Dr. G. Ranner who was a great help to me in compiling the data. I would also like to thank the publisher for their understanding and support as well as all those readers who made suggestions and proposals for improvement.

Graz, in June 1992 H. Zollner

Preface to First Edition

Inhibitors have substantially contributed to our understanding of metabolic processes and of enzyme mechanisms and have made possible the labeling and mapping of active sites of enzymes. Moreover, inhibitors gained great interest as pharmaceuticals and pesticides. In this handbook more than 5,000 inhibitors for about one thousand enzymes are listed. Two extensive lists are provided: (i) enzymes listed alphabetically, with their respective inhibitors, (ii) inhibitors listed alphabetically, with enzymes inhibited. Thus, it is made possible to search for an inhibitor of a particular enzyme *and* for the enzymes which are inhibited by a particular inhibitor. If available, the following data are given for all entries: *K*i value or effective concentration, the type of inhibition, the source of the enzyme and the substrate for which these parameters have been determined. This book is intended for biochemists, biologists, pharmacists, toxicologists, enzymologists and other scientists working in related fields. Its aim is to provide rapid information about enzyme inhibitors and to help avoid mistakes that could be made due to limited knowledge about the side effects of an inhibitor, both in planning of investigations and in interpreting the experimental results. The author would like to encourage the reader to make comments and critical suggestions concerning the presentation of the data and to bring possible errors to his attention. Because of the rapidly growing literature as well as the vast amount of data, the author is aware that the list of inhibitors is not complete. It would be greatly appreciated if the users would provide information about important inhibitors missing from the text (The author's address is given on p. IV). I am grateful to Prof. H. Esterbauer for stimulating discussions and wish to acknowledge the help of Dr. G. Ranner in correcting the manuscript and proof reading.

Graz, 1988 H. Zollner

Contents

Part A

Part B

User's Guide

This handbook consists of four listings: In the **Enzyme → Inhibitor List,** the enzymes are ordered alphabetically. Each entry is headed by the enzyme name and the EC number. For each enzyme the inhibitors (column 1), the type of inhibition (column 2), effective inhibitor concentrations or *K*i values (column 3), some comments (column 4), and the reference numbers (column 5) are given. The references are listed at the end of the enzyme entry. In the **Inhibitor → Enzyme List,** the inhibitors are listed alphabetically together with the enzymes they affect. For easy comparison of the effectiveness of the inhibitors, the type of inhibition and effective concentration or *K*i value is included. In the **Trivial Name → Synonyma or Systematic Names List,** common names of inhibitors as used in this handbook (see below) are listed alphabetically together with the respective systematic names. Finally, EC numbers of enzymes covered in this handbook (in ascending order) together with the recommended names (see below) are given in the **EC Numbers List.**

Enzyme names and EC numbers. The names recommended by the International Union of Biochemistry are used throughout (Enzyme Nomenclature 1992; Academic Press, San Diego, 1992). Names other than the recommended ones are generally not listed. If required, the reader should consult the EC Numbers List to identify recommended names. For enzymes which could not be assigned with certainty or which are not yet classified the name used in the paper cited was adopted; in such cases no EC numbers are listed.

Inhibitor names. Common names (synonyms) are frequently used instead of systematic names since the latter are often rather long and cumbersome. 15-Hydroxy-[[2-*O*-(3-methyl-1-oxobutyl)-3,4-di-*O*--sulpho-β-D-glucopyranosyl]oxy]-19-norkaur-16-en-18-oic acid dipotassium salt is really not a catchy name compared to its common name, atractyloside. The synonyms used are the common ones, as recommended by the Merck Index (Merck & Co., Inc. Rahaway 1983). The systematic names (chemical abstracts names) can be found in the Common → Systematic Inhibitor Names List.

Type of inhibition. In this column the type of inhibition is reported. C = competitive, NC = non-competitive, UC = un-competitive, MI = mixed type, pC = partial-competitive, IR = irreversible inhibition; SS = suicide substrate.

Effective concentration. This column contains either the percent inhibition or the *K*i or the *I*50 values. For the percent inhibition at a given inhibitor concentration, the first figure signifies the percent inhibition and the second figure signifies the concentration. In a few cases the concentration is also a percent value. *I*50 is the concentration needed for half-maximum inhibition. The *K*i values are inhibition constants as reported in the reference. No effort has been made to distinguish between the different modes of calculation. When both *K*i value and effective concentration are reported in the reference, the *K*i-value is given.

Comments. In the comment column the substrate for which the kinetic parameters were determined, the organism or tissue from which the enzyme was isolated, and some self-explanatory comments are given.

References. The conventional system of abbrevations has been adopted except for a few journals for which short hand notation is used. J.B.C. = J. Biol. Chem., B.B.A. = Biophys. Biochim. Acta, B.B.R.C. = Biochim. Biophys. Res. Commun., E.J.B. = Eur. J. Biochem., P.N.A.S. = Proc. Natl. Acad. Sci. U.S.A. When more than one paper was found dealing with the same subject, the latest is cited in which the reader can easily find earlier references.

Column heads. The information presented in both the Enzyme → Inhibitor and the Inhibitor → Enzyme List are largely self-explanatory. Hopefully, all the details required for the use of this handbook are given above. Thus, in order to save space column heads are omitted throughout the lists. However, a book-mark is provided on which the column heads for both lists are printed. By holding the appropriate side of the book-mark on top of the list referred to, the columns can be conveniently identified.

Contents

Part A

Part B

H

HALOACETATE DEHALOGENASE 3.8.1.3

Ag^+				1
BENZOIC ACID	C	*K*i = 2.7 mM	PSEUDOMONAS SP.	2
p-CHLOROMERCURIBENZOIC ACID			PSEUDOMONAS SP.	2
DIFLUOROACETIC ACID	C	*K*i = 1.9 mM	PSEUDOMONAS SP.	2
N-ETHYLMALEIMIDE			PSEUDOMONAS SP.	2
GLYCOLIC ACID	C	*K*i = 450 µM	PSEUDOMONAS SP.	2
TRIFLUOROACETATE	C	*K*i = 2.1 mM	PSEUDOMONAS SP.	2

1 KAWASAKI, H., TONE, N., TONOMURA, K. AGRIC.CHEM.BIOL. 45, 35-42 (1981)
2 GOLDMAN, P. J.B.C. 240, 3434-8 (1965)

2-HALOACID DEHALOGENASE 3.8.1.2

Ag^+				1
Cd^{2+}		36% 1 mM	PSEUDOMONAS SP.	2
Cu^{2+}				1
Hg^{2+}				3
Mn^{2+}		54% 1 mM	PSEUDOMONAS SP.	2
Ni^{2+}		43% 1 mM	PSEUDOMONAS SP.	2
Pb^{2+}		16% 1 mM	PSEUDOMONAS SP.	2
Zn^{2+}		92% 1 mM	PSEUDOMONAS SP.	2

1 MOTOSUGI, K., ESAHI, N., SODA, K.OLT, B. AGRIC.CHEM.BIOL. 46, 837-8 (1982)
2 MOTOSUGI, K., ESAHI, N., SODA, K.OLT, B. J.BACTERIOL. 150, 522-7 (1982)
3 MOTOSUGI, K., ESAHI, N., SODA, K.OLT, B. ARCH.MICROBIOL. 131, 179-83 (1982)

HAMAMELOSE KINASE 2.7.1.102

ATP			KLUYVERA CITROPHILIA 627	1
HAMAMELOSE			KLUYVERA CITROPHILIA 627	1

1 BECK, E., WIECZOREK, J. REINECKE, W. E.J.B. 107, 485-9 (1980)

HAMMERHEAD RIBOZYME

NEOMYCIN				1

1 STAGE, T.K., HERTEL, K.J., UHLENBECK, O.C. RNA 1, 95-101 (1995)

HCG

OVOMUCOID DUCK				1

1 VALUEVA, T.A., KLADNITSKAYA, G.V., MOSOLOV, V.V. IMMUNOPHARMACOLOGY 32, 108-110 (1996)

HELICASE

ACLACINOMYCIN		*I*50 = 2.3 µM	SV40 T ANGIGEN	1
ACTINOMYCIN C1		*K*i = 2.9 µM	PEA CHLOROPLAST	2
CL 1065				3
DAUNORUBICIN		*K*i = 1.4 µM	PEA CHLOROPLAST	2
DAUNORUBICIN		*I*50 = 340 nM	SV40 T ANGIGEN	1
DOXORUBICIN		*I*50 = 460 nM	SV40 T ANGIGEN	1
ETHIDIUM BROMIDE		*K*i = 3 µM	PEA CHLOROPLAST	2
NOGALAMYCIN		*K*i = 1 µM	PEA CHLOROPLAST	2
NOGALAMYCIN		*I*50 = 360 nM	SV40 T ANGIGEN	1

1 BACHUR, N.R., LUN, L., SUN, P.M., et al. BIOCHEM.PHARMACOL. 55, 1025-1034 (1998)
2 TUTEJA, N., PHAN, T.N. B.B.R.C. 244, 861-867 (1998)
3 MAINE, I.P., SUN, D., HURLEY, L.H., et al. BIOCHEMISTRY 31, 3968-3975 (1992)

HELICASE II

ACTINOMYCIN C		*I*50 = 12 µM	HUMAN	1
DAUNORUBICIN		*I*50 = 6.2 µM	HUMAN	1

ETHIDIUM BROMIDE		*I*50 = 8.4 μM	HUMAN	1
NOGALAMYCIN		*I*50 = 420 nM	HUMAN	1

1 TUTEJA, N., PHAN, T.N., TUTEJA, R., et al. B.B.R.C. 236, 636-640 (1997)

HEME OXYGENASE (DECYCLIZING) 1.14.99.3

AZIDE				1
2,4-BISGLYCOL DEUTEROPORPHYRIN IX ZINC		90% 100 nM	HUMAN KIDNEY MICROSOMES	2
CARBON MONOOXIDE				1
p-CHLOROMERCURIBENZOIC ACID		100% 1 mM	RAT LIVER	3
CYANIDE				1
L-CYSTEINE		67% 1 mM	RAT LIVER	3
DEUTEROPORPHYRIN 2,4-BIS GLYCOL ZINC		46% 20 nM	RAT BRAIN	4
DEUTEROPORPHYRIN 2,4-BIS GLYCOL ZINC		*I*50 = 20 nM	RAT LIVER	4
DEUTEROPORPHYRIN 2,4-BIS GLYCOL ZINC		40% 20 nM	RAT SPLEEN	4
DEUTEROPORPHYRIN IX ZINC				5
DITHIOTHREITOL		88% 10 μM	RAT LIVER	3
Hg^{2+}		67% 10 μM	CHICKEN LIVER	6
Hg^{2+}		100% 300 μM	RAT LIVER	3
p-HYDROXYMERCURIBENZOIC ACID				3
IODOACETAMIDE		39% 5 mM	RAT LIVER	3
IODOACETIC ACID				3
2-MERCAPTOETHANOL		81% 100 μM	RAT LIVER	3
MESOPORPHYRIN TIN		100% 3.3 μM	CHICKEN LIVER	6
PROTOPORPHYRIN COBALT	C	*Ki* = 82 nM	BOVINE LIVER	7
PROTOPORPHYRIN TIN	C	*Ki* = 33 nM	BOVINE LIVER	7
PROTOPORPHYRIN TIN		97% 3.3 μM	CHICKEN LIVER	6
PROTOPORPHYRIN TIN		76% 500 nM	HUMAN KIDNEY MICROSOMES	2
PROTOPORPHYRIN TIN		*Ki* = 17 nM	RAT INTESTINE	8
PROTOPORPHYRIN ZINC	C	*Ki* = 130 nM	BOVINE LIVER	7

1 KUTTY, R.K., MAINES, M.D. J.B.C. 257, 9944-52 (1982)
2 MARTASEK, P., SOLANGI, K., GOODMAN, A.I., et al. B.B.R.C. 157, 480-7 (1988)
3 MAINES, M.D., IBRAHIM, N.G. KAPPAS, K. J.B.C. 252, 5900-3 (1977)
4 VREMAN, H.J., LEE, O.K., STEVENSON, D.K. AM.J.MED.SCI. 302, 335-341 (1991)
5 GREENBAUM, N.L. KAPPAS, A. PHOTOCHEM.PHOTOBIOL. 54, 183-92 (1991)
6 BANKOVSKY, H.L., HEALEY, J.F. POHL, J. E.J.B. 189, 155-66 (1990)
7 YOSHINAGA, T., SASSA, S. KAPPAS, A. J.B.C. 257, 7778-85 (1982)
8 ROSENBERG, D.W., DRUMMOND, G.S. KAPPAS, A. PHARMACOLOGY 39, 224-9 (1989)

HEME POLYMERASE

AMODIAQUINE		*I*50 = 250 μM	PLASMODIUM FALZIPARUM TROPHOZO	1
CHLOROQUINE		*I*50 = 120 μM	PLASMODIUM FALZIPARUM TROPHOZO	1
EPIQUININE		*I*50 > 5 mM	PLASMODIUM FALZIPARUM TROPHOZO	1
QUINIDINE		*I*50 = 90 μM	PLASMODIUM FALZIPARUM TROPHOZO	1
QUININE		*I*50 = 300 μM	PLASMODIUM FALZIPARUM TROPHOZO	1

1 SLATER, A.F.G., CERAMI, A. NATURE 355, 167-169 (1992)

HEPARANASE

A 72363 C		*I*50 = 12 μM	B16-BL6 MELOMA CELLS	1
EVANS BLUE		*I*50 = 320 μM	HEPARAN SULPHATE, B16-BL6 CELLS	2
HEPARIN				3
SURAMIN	MIX	*Ki* = 48 μM	B16-BL6 MELANOMA	4
TRACHYSPIC ACID		*I*50 = 36 μM	B16-BL6 MELANOMA	5

TRYPAN BLUE	*I*50 = 320 µM	HEPARAN SULPHATE, B16-BL6 CELLS	2

1 KAWASE, Y., TAKAHASHI, M., TAKATSU, T., et al. J.ANTIBIOT. 49, 61-64 (1996)
2 NAKAJIMA, M., DECHAVIGNY, A., JOHNSEN, C.E., et al. J.B.C. 266, 9661-6 (1991)
3 NAKAJIMA, M., IRIMURA, T., DI FERRANTE, N., et al. J.B.C. 259, 2283-90 (1984)
4 NAKAJIMA, M., DECHAVIGNY, A., JOHNSON, C.E., et al. J.B.C. 266, 9661-9666 (1991)
5 SHIOZAWA, H., TAKAHASHI, M., TAKATSU, T., et al. J.ANTIBIOT. 48, 357-362 (1995)

HEPARAN-α-GLUCOSAMINIDINE N-ACETYLTRANSFERASE 2.3.1.78

N-BROMOSUCCINIMIDE			3
CHITIN			2
CHITOSAN			2
p-CHLOROMERCURIBENZOIC ACID			2
DIETHYLDICARBONATE			3
DITHIOTHREITOL			2
Hg^{2+}			1
N-LAURYLSARCOSINE			2
2-MERCAPTOETHANOL			2
Zn^{2+}			1
ZWITTERGENT			2

1 POHLMANN, R., KLEIN, U., FROMME, H.G., et al. HOPPE-SEYLER'SZ.PHYSIOL.CHEM. 362, 1199-207 (1981)
2 BAME, K.J., ROME, L.H. METH.ENZYMOL. 138, 607-11 (1987)
3 BAME, K.J., ROME, L.H. J.B.C. 261, 10127-32 (1986)

HEPARAN N-SULFATASE

SURAMIN	55% 1 mM	RAT LIVER	1

1 CONSTANTOPOULUS G., REES, S., CRAGG, B.G., et al. P.N.A.S. 77, 3700-4 (1980)

HEPARIN LYASE 4.2.2.7

Cd^{2+}	*I*50 = 10 µM	FLAVOBACTERIUM HEPARINUM	1
Cu^{2+}	*I*50 = 10 µM	FLAVOBACTERIUM HEPARINUM	1
Fe^{3+}	*I*50 = 50 µM	FLAVOBACTERIUM HEPARINUM	1
Hg^{2+}	100% 10 µM	FLAVOBACTERIUM HEPARINUM	1
POLYVINYLSULPHATE			2

1 HOVINGH, P., LINKER, A. J.B.C. 245, 6170 (1970)
2 LINHARDT, R.J., COONEY, C.L., TAPPER, D., et al. APPL.BIOCHEM.BIOTECHNOL. 9, 41-55 (1984)

HEPARITIN-SULFATE LYASE 4.2.2.8

N-ACETYLHEPARIN	60% 10 mg/ml	FLAVOBACTERIUM	1
Ca^{2+}	1 mM	FLAVOBACTERIUM HEPARINUM	2
Cd^{2+}		FLAVOBACTERIUM	1
Cu^{2+}	1 mM	FLAVOBACTERIUM HEPARINUM	2
Hg^{2+}	1 mM	FLAVOBACTERIUM HEPARINUM	2
Zn^{2+}	1 mM	FLAVOBACTERIUM HEPARINUM	2

1 HOVINGH, P., LINKER, A. J.B.C. 245, 6170-5 (1970)
2 LIMKER, A. HOVINGH, P. METH.ENZYMOL. 28, 902 (1972)
2 LINKER, A. HOVINGH, P. METH.ENZYMOL. 28, 902 (1972)

HEPARITIN SULFOTRANSFERASE 2.8.2.12

ADENOSINE-3',5'-DIPHOSPHATE			1
p-CHLOROMERCURIBENZOIC ACID			2
Cu^{2+}			2
EDTA			3
Zn^{2+}			2

1 WEI, Z., SWIEDLER, S.J., ISHIHARA, M., et al. P.N.A.S. 90, 3885-8 (1993)
2 EISENAMN, R.A., BALASUBRAMANIAN, A.S., MARX, W. A.B.B. 119, 387-97 (1967)
3 BRANDAN, E., HIRSCHBERG, C.B. J.B.C. 263, 2417-22 (1988)

HEPAROSAN-N-SULFATE-GLUCURONATE 5-EPIMERASE 5.1.3.17

ADENOSINE 3′-PHOSPHATE 5′-SULPHATE			HUMAN SKIN FIBROBLASTS	1
CHONDROITIN SULPHATE			HUMAN SKIN FIBROBLASTS	1
DERMATAN SULPHATE			HUMAN SKIN FIBROBLASTS	1
DEXTRAN SULPHATE			HUMAN SKIN FIBROBLASTS	1
HEPARIN			HUMAN SKIN FIBROBLASTS	1
KCl			HUMAN SKIN FIBROBLASTS	1
Mn^{2+}			HUMAN SKIN FIBROBLASTS	1
NaCl			HUMAN SKIN FIBROBLASTS	1

1 MALMSTRÖM, A., ABERG, L. BIOCHEM.J. 201, 489-93 (1982)

HEPATOCYTE GROWTH FACTOR ACTIVATOR

HEPATOCYTE GROWTH FACTOR ACTIVATOR INHIBITOR				1

1 SHIMOMURA, T., DENDA, K., KITAMURA, A., et al. J.B.C. 272, 6370-6376 (1997)

HESPERINIDASE

3-HYDROXYMETHYL-6-EPICASTANOSPERMINE			ASPERGILLUS NIGER	1

1 ZHOU, P.Z., SALLEH, H.M., HONEK, J.F. J.ORG.CHEM. 58, 264-266 (1993)

HEXADECANAL DEHYDROGENASE (ACYLATING) 1.2.1.42

Hg^{2+}				1

1 JOHNSON, R.C., GILBERTSON, J.R. J.B.C. 247, 6991-8 (1972)

HEXADECANAL REDUCTASE 1.3.1.27

Ag^{+}				1
Ca^{2+}				1
p-CHLOROMERCURIBENZOIC ACID				1
N-ETHYLMALEIMIDE				1
Hg^{2+}				1

1 MIYAMURA, N., MATSUI, H., TAHARA, S., et al. AGRIC.BIOL.CHEM. 48, 185-92 (1984)

HEXOBARBITAL OXIDASE (CYT P 450)

PRIMAQUINE	NC	*K*i = 44 μM	RAT LIVER MICROSOMES	1

1 SUKHUMANAN, T., SUPHAKAWANICHI, W. THITHAPANDHA, A. BIOCHEM.PHARMACOL. 39, 212-6 (1990)

HEXOKINASE 2.7.1.1

ACETIC ACID			RAT LIVER	1
N-ACETYLGLUCOSAMINE	C	*K*i = 100 μM	GLUCOSE, RABBIT RED BLOOD CELLS, NC MgATP Ki = 450 μM	2
Al^{3+}				3
ALLICIN				4
N-(m-AMINOBENZOYL)-D-GLUCOSAMINE		*K*i = 200 μM	YEAST	5
AMP				6
N-(3-BROMOBENZOYL)GLUCOSAMINE	C	*K*i = 24 μM	GLUCOSE, YEAST	7
CARDIOLIPIN				8
CHLORIDE	NC		GLUCOSE, RAT LIVER	1
CITRIC ACID			ASPERGILLUS NIGER	9
L-CYSTAMINE			BRAIN	10
N-(6,7-DIDEOXY-D-GLUCO-HEPTOPYRANOS-7-YL)-2[(ADENOSINE-5′-PHOSPHORYL)PHOSPHONO]ACETAMIDE	C	*K*i = 200 μM	GLUCOSE, YEAST	11
DIHYDROGRIESENIN		72% 1 mM	YEAST	12
2,3-DIPHOSPHOGLYCERATE				13
DISULFIRAM			CALF BRAIN	14
DISULPHIDES			MAMMALIAN	15
5,5′-DITHIO-BIS(2-NITROBENZOIC ACID)			BRAIN	16

GAFRININ		81% 1 mM	YEAST	12
GEIGERININ		50% 1 mM	YEAST	12
GLUCOSE-1,6-DIPHOSPHATE				17
GLUCOSE-6-PHOSPHATE			GLUCOSE, YEAST, NC MAMMALIAN	18
GLUTATHIONE OXIDIZED			MgATP, RABBIT RED BLOOD CELLS	2
GRIESENIN		62% 1 mM	YEAST	12
4',5,7-HYDROXY-3,6-METHOXYFLAVONE		54% 8 μG/ml	EATC MITOCHONDRIA	19
4-HYDROXYPENTENAL				20
2-(p-HYDROXYPHENYL)-2-PHENYLPROPANE		*I*50 = 550 μM	CRITHIDIA FASCICULATA	21
IODIDE	NC		GLUCOSE	1
IVALIN		72% 1 mM	YEAST	12
LAURIC ACID		*I*50 = 1 mM		22
MERLASOPROL		*I*50 = 5.4 mM	CRITHIDIA FASCICULATA	21
Mg^{2+}	C	*K*i = 9 μM	MgATP, RABBIT RED BLOOD CELLS	2
Mg^{2+}/ATP	C	*K*i = 25 μM	GLUCOSE, RABBIT RED BLOOD CELLS	2
MYRISTIC ACID		*I*50 = 2.4 mM		22
N-(3-NITROBENZOYL)GLUCOSAMINE	C	*K*i = 45 μM	GLUCOSE, YEAST	7
PALMITOYL-CoA	C		GLUCOSE, RAT LIVER	1
PHOSPHATE				17
PHOSPHATIDYLINOSITOL				8
PHOSPHATIDYLSERINE				8
o-PHTHALALDEHYDE			YEAST	23
D,L-PROPRANOLOL		63% 50 μM	HUMAN LENS	24
D,L-PROPRANOLOL		60% 40 μM	YEAST	24
PROTEIN INHIBITOR DEPENDENT ON FRUCTOSE 2,6-BISPHOSPHATE				25
QUERCETIN		70% 8 μG/ml	EATC MITOCHONDRIANOT SOLUBLE ENZYME	19
REGULATORY PROTEIN			RAT LIVER	1
SURAMIN		*I*50 = 210 μM	HUMAN BRAIN	26
SURAMIN		*I*50 = 24 μM	TRYPANOSOMA BRUCEI	27
SURAMIN		*I*50 = 220 μM	YEAST	27
THIOGLUCOSE				28
TREHALOSE-6-PHOSPHATE	C	*K*i = 40 μM	GLUCOSE, RAT BRAIN	29
TREHALOSE-6-PHOSPHATE	C	*K*i = 5 μM	FRUCTOSE, YARROWINA LIPOLYTICA	29
UDP				6
UMP				6
VANADATE OLIGOMERS				30
VERMEERIN		69% 1 mM	YEAST	12
D-XYLOSE				31

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HEXOKINASE 1 2.7.1.1

ADP			SOLANUM TUBEROSUM	1
TREHALOSE-6-PHOSPHATE	C	*Ki* = 200 µM	GLUCOSE, SACCHAROMYCES CEREVISIAE	2

1 RENZ, A., STITT, M. PLANTA 190, 156-65 (1993)
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HEXOKINASE 2 2.7.1.1

ADP		*Ki* = 3.5 mM	RAT SKELETAL MUSCLE	1
ADP			SOLANUM TUBEROSUM	2
GLUCOSE-1,6-DIPHOSPHATE		*Ki* = 3 µM	RAT SKELETAL MUSCLE	1
GLUCOSE-6-PHOSPHATE		*Ki* = 15 µM	RAT SKELETAL MUSCLE	1
PHOSPHATE		*Ki* = 5.3 mM	RAT SKELETAL MUSCLE	1
TREHALOSE-6-PHOSPHATE	C	*Ki* = 40 µM	GLUCOSE, SACCHAROMYCES CEREVISIAE	3

1 EASTERBY, J.S., QADRI, S.S. METH.ENZYMOL. 90, 11-5 (1982)
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HEXOKINASE PI 2.7.1.1

ATP				1

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HEXOKINASE PIIM 2.7.1.1

ATP				1

1 KOPETZKI, E., ENTIAN, K.-D. E.J.B. 146, 657-62 (1985)

L-HEXONATE DEHYDROGENASE

AL 03152		*I*50 = 2.2 nM	RAT KIDNEY	1

1 PARK, Y.H., MAYER, P.R., BARKER, R., et al. PHARMACEUT.RES. 10, 593-597 (1993)

HEXOSE OXIDASE 1.1.3.5

ACETIC ACID			CHONDRUS CRISPUS	1
AZIDE			CHONDRUS CRISPUS	1
Ba^{2+}				2
BENZOIC ACID				3
Cu^{2+}				2
CYANIDE			CHONDRUS CRISPUS	1
DIETHYLDITHIOCARBAMATE			CHONDRUS CRISPUS	1
GA^{3+}				2
GALACTURONIC ACID				2
GLUCURONIC ACIDS				2
Hg^{2+}				2
HYDROXYLAMINE			CHONDRUS CRISPUS	1
PROPIONIC ACID				3

PYRUVIC ACID			CHONDRUS CRISPUS	1

1 IKAWA, M. METH.ENZYMOL. 89, 145-9 (1983)
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3 BEAN, R.C., HASSID, W.Z. J.B.C. 218, 425-36 (1956)

HEXOSE-1-PHOSPHATE GUANYLYLTRANSFERASE 2.7.7.29

GDP-MANNOSE	C	*Ki* = 170 nM	GDP-GLUCOSE, CALF LIVER	1
MANNOSE-1-PHOSPHATE	C	*Ki* = 47 μM	GDP-GLUCOSE, CALF LIVER	1

1 HANSEN, R.G., VERACHTERT, H., RODRIGUEZ, P. BASS, S.T. METH.ENZYMOL. 8, 269-6 (1966)

3-HEXULOSE PHOSPHATE SYNTHASE

Ca^{2+}			METHYLOMONAS MIT	1
Cu^{2+}			METHYLOMONAS MIT	1
Hg^{2+}			METHYLOMONAS MIT	1
Ni^{2+}			METHYLOMONAS MIT	1

1 SAHM, H., SCHÜTTE, H. KULA, M.R. METH.ENZYMOL. 90, 319-23 (1982)

HEXULOSE 6-PHOSPHATE SYNTHASE

Co^{2+}		49% 1 mM	METHYLOMONAS CAPSULATUS	1
Cu^{2+}		24% 1 mM	METHYLOMONAS CAPSULATUS	1
Ni^{2+}		64% 1 mM	METHYLOMONAS CAPSULATUS	1

1 QUAYLE, D.R. METH.ENZYMOL. 90, 314-9 (1982)

HIGH-MANNOSE-OLIGOSACCHARIDE β-1,4-N-ACETYLGLUCOSAMINYLTRANSFERASE 2.4.1.197

DITHIOTHREITOL				1
EDTA				1
Mg^{2+}				1

1 SHARKEY, D.J., KORNFELD, R. J.B.C. 264, 10411-9 (1989)

HhaI METHYLASE

5-FLUOROCYTOSINE IN DNA	SSI			1

1 OSTERMAN, D.G., DE PILLIS, G.D., WU, J.C., et al BIOCHEMISTRY 27, 5204-10 (1988)

HIPPURATE HYDROLASE 3.5.1.32

Ag^{+}				1
p-CHLOROMERCURIBENZOIC ACID				1
Cu^{2+}				1
α,α′-DIPYRIDYL				2
EDTA				1
Fe^{2+}				1
Fe^{3+}				2
Hg^{2+}				1
8-HYDROXYCHINOLINE				1
Mn^{2+}				2
Ni^{2+}				2
o-PHENANTHROLINE				2
Zn^{2+}				2

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HISTAMINE N-METHYLTRANSFERASE 2.1.1.8

S-ADENOSYLHOMOCYSTEINE				1
S-ADENOSYLMETHIONINE				1
ALCURONIUM		61% 10 μM	HISTAMINE, RAT KIDNEY	2
9-AMINOACRIDINE		*I*50 = 370 nM	HISTAMINE, BOVINE BRAIN	3
9-AMINOACRIDINE		*I*50 = 2.8 μM	HISTAMINE, RAT BRAIN	4