Jiaju Zhou

Handbook of Active Marine Natural Products

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Handbook of Active Marine Natural Products

Volume 3: Alkaloids, Part 1

DE GRUYTER

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Preface

The English edition *Handbook of Active Marine Natural Products* (*HAMNP*) *with 8 Volumes* is a selective version of the Marine Natural Products Dataset. The whole dataset was collected and developed by the Molecular Design Group, Institute of Process Engineering, Chinese Academy of Sciences during 1998–2016. Totally, it covers 19,722 entries of secondary metabolites from marine living things, where 8,350 compound entries have pharmacological activity data. The 8,350 compound entries were arranged into eight volumes to form the set of handbooks as follows:

Volume 1: Terpenoids, Part 1
Volume 2: Terpenoids, Part 2
Volume 3: Alkaloids, Part 1
Volume 4: Alkaloids, Part 2
Volume 5: Polyketides and Steroids
Volume 6: Aliphatic Metabolites
Volume 7: O-Heterocycles and Aromatics
Volume 8: Peptides and Others

This set of eight HAMNP books gathers the structure, origin, and bioactivity, as well as other relevant information, of 8,350 active marine natural products from 3,025 marine organisms.

The HAMNP handbooks represent a largest collection of active secondary metabolites from marine organisms, and all kinds of scientific data have been reorganized as well-formatted data so that the books became helpful to researchers as a convenient reference. The materials covered in these books include those through systematic collection up to 2012, and further accompanied with the latest data published in several core journals until 2016.

The work covered in these HAMNP books was accomplished in two phases. The initial phase ranged from 1998 to 2001 and the main phase from 2011 to 2018. In the original version of the dataset, more than 22,000 compounds have been collected, including duplicated compounds from different authors. The comprehensive data compilation process include data specification definition, cross-validation, assessment confirmation, identification of duplicated structures, and merging of relevant information, leading to the final accomplishment of the current 19,722 datasets.

In brief, the main compilation process of the HAMNP books is given as follows. First, collect the name list, origin, and structure of chemical compounds from successive annual reviews (see Core References R01 and R02 in Introduction) and literature reviews. Second, double-check the documents to verify and complete other information. Third, confirm the structural information and other types of data using orthogonal information from other sources with cross-validation methods. Fourth, the structures of more than 22,000 compounds are rechecked, and the information is integrated by manual identification and computer programs. Finally, the comprehensive information

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on the 19,722 compounds constitutes the dataset. Here, 8,350 active sets were picked up from the dataset to form the current HAMNP handbooks.

Three problems need to be solved to compile a multidisciplinary reference book. First, every definition and concept should be explicit when expanding knowledge, connotation, and extension included, without any research details. Second, the reliability assessment is essential for all kinds of data, because the devil is in the detail. Third, it is essential to search, identify, and integrate data of duplicated chemical compounds. Fortunately, well-developed software packages can help us automatically identify the majority of duplicated chemical compounds. The remaining issues can be resolved along with manual processing.

It is the guiding principle of the author to make the book to be pithy, thorough, precise, and intelligible. In fact, we always view ourselves as HAMNP's readers, with the exclusive objective to let readers gain the most useful knowledge in the shortest possible time.

The core contents and highlights of the HAMNP books are the "three diversities," that is, the diversity of chemical structures, the diversity of biological resources, and the diversity of pharmacological activities. In terms of chemical structure diversity, we refer to the classification system from references, then further improve and expand it based on the latest research and development to define our classification framework of structures. Once readers browse the contents of the books, the classification system is straightforward. For the diversity of biological resources, it is recommended to refer to Index 3 in each volume – Compound Marine Organism Source Index; and Index 4 in each volume – Compound Marine Source Sampling Geographic Location Index. For the diversity of pharmacological activities, it is recommended to refer to Index 5 in each volume – Compound Pharmacological Activity Index.

These HAMNP handbooks are expected to help readers who are engaged in research, in teaching, and in the development of marine natural products. It should also benefit college students, postgraduates, marine resource managers, and those who are interested in the chemistry and pharmacology of marine natural products. We would feel fortunate if it works as expected.

Jiaju Zhou
Institute of Process Engineering (IPE),
Chinese Academy of Sciences (CAS)
February 2019

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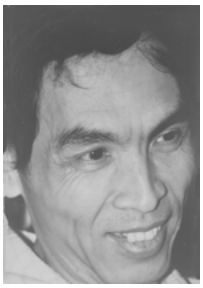
About the Author



Prof. Jiaju Zhou was born in October 1939 in Tianjin, China. He graduated from Rare Earth Inorganic Chemistry Specialty, Chemistry Department, Peking University, in 1963 under a six-year program. Before he retired in 2008, Zhou was the leader of Molecule Design Group, IPE, CAS. Zhou's areas of research include rare earth chemistry, mineral analytical chemistry, chemical industry process simulation (in IPE, CAS and UBC, Canada), design of crystal structural database (in OSRD, NIST, Gaithersburg, MD, USA), scientific database R&D, and computer-aided and artificial intelligence drug design. Zhou developed the first TCM database (TCMDB) with 23,033 entries. Since 2008, he has worked on Marine Natural Products project and has developed the Marine Natural Products Database (MNPDB) with 19,722 entries.

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Introduction

The *Handbook of Active Marine Natural Products* covers eight volumes. This book is *Volume 3: Alkaloids, Part 1*, which includes 1,162 active compounds.

Format of Compound Entry. A compound entry starts with a title line, which has two items: the compound's unique code (from 1 to 1,162 for volume 3) and the main name. The following seven items form the title line as a body, and the graphic structure is placed at the end:

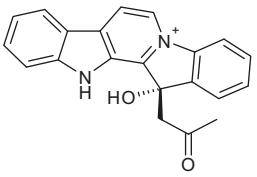
Title line (code number, main name)
A. Synonyms of the compound (if any)
B. Structural type
C. Formula (relative molecular mass)
D. Physicochemical properties
E. Marine source(s)
F. Pharmacological data (if any)
G. Reference(s)
Graphic structure

Chemical Names and A. Synonyms. Generally, a compound may have one scientific name and several trivial names. In the handbooks, based on original articles, we select one name as the "main name." The main name appeared at the title line of each compound entry. In most cases, a trivial name was selected as the main name, and in some cases, the main name is a scientific name. Any synonyms, if any, are presented after the title line as an item of the entry body.

B. Structural Type. Structural type is the second item, ordered by the contents order.

F. Normalization of Pharmacological Data. All of 1,162 MNP components in this book have pharmacological data, which are very valuable. Because different expressions are used for the same kind of data in different articles, we have to define and normalize thousands pharmacological terms, so that the data could be expressed in a unified way, and be easily understood by readers.

Stereochemistry in Graphic Structure. We protracted all compound structures down to atomic bond level, including complicated glycosides, with stereochemical information based on the data in the original papers. For example, the structure with full stereochemistry of compound 856 Homofascaplysin A is



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Let us further explain the data structure of source terms and pharmacological terms.

Source Terms

The source data of compound 856 Homofascaplysin A is:

Source:
Sponge *Hyrtios* cf. *erecta*
Sponge *Fascaplysinopsis reticulata*
Ascidian *Didemnum* sp. (Pratt Reef, Fiji)

The format is as follows (banding the English-type name and the Latin name together):

Source:
English-type name + Latin name of source 1 (sampling place, sampling season water depth, etc.)
English-type name + Latin name of source 2
English-type name + Latin name of source 3

Pharmacological Terms

The pharmacological terms in the handbooks are presented in a multilayered structure. In the top layer, there are more than 20 types of most important pharmacological activity terms. They are cytotoxic (*in vitro* anticancer), antineoplastic (*in vivo* anticancer), antibacterial, antifungal, antiviral, anti-HIV, anti-inflammatory, antioxidant, antimalarial, NO (nitric oxide) production inhibitors, enzyme inhibitors, cardiovascular activity, smooth muscle relaxant and stimulant, toxin and medium lethal dose (LD_{50}), and so forth. Readers need to be familiar with these Tope lever pharmacological terms (see Table 1).

For each term, there is a regulation about how to describe related pharmacological data. The following is an example. Under the subtitle "Pharm:" of compound 856 Homofascaplysin A, a set of multiple biodata is presented as follows:

Pharm:
Antiplasmodial (*Plasmodium falciparum* strain K1, IC_{50} = 14 ng/mL, control chloroquine, IC_{50} = 54 ng/mL, control artemisinin, IC_{50} = 1 ng/mL; chloroquine-susceptible *Plasmodium falciparum* strain NF54, IC_{50} = 24 ng/mL, chloroquine, IC_{50} = 4 ng/mL, artemisinin, IC_{50} = 2 ng/mL) (Kirsch, 2000);
cytotoxic (rat skeletal muscle myoblast L-6 cells, MIC = 1.1 µg/mL, mouse peritoneal macrophages, MIC = 30 µg/mL) (Kirsch, 2000);

Table 1: Twenty-Four Main Pharmacological Terms in Tope Lever.

Order in Index 5	Pharmacological Terms in Tope Lever
1	Anti-AD
2	Antibacterial
3	Antifungal
4	Anti-HIV
5	Anti-inflammatory
6	Antileishmanial
7	Antimalarial
8	Antineoplastic (in vivo)
9	Antioxidant
10	Antiplasmodial
11	Antitrypanosomal
12	Antituberculosis
13	Antiviral
14	Cardiovascular activity
15	Cell cycle inhibitor
16	Cell division inhibitor
17	Cell growth inhibitor
18	Cell adhesion inhibitor
19	Cytotoxic (in vitro)
20	Enzyme inhibitors
21	NO production inhibitors
22	Smooth muscle relaxant and stimulant
23	Toxin
24	Medium lethal dose (LD_{50})

antiplasmodial life stage-specific activity (*Plasmodium falciparum* strain W2-Mef, all live parasites, IC_{50} = 105 nmol/L, chloroquine, IC_{50} = 149 nmol/L, artemisinin, IC_{50} = 6.245 nmol/L; rings stage, IC_{50} = 0.55 nmol/L, chloroquine, IC_{50} = 174 nmol/L, artemisinin, IC_{50} = 5.92 nmol/L; trophozoite stage, IC_{50} = 252 nmol/L, chloroquine, IC_{50} = 162 nmol/L, artemisinin, IC_{50} = 6.46 nmol/L; schizont stage, IC_{50} = 94 nmol/L, chloroquine, IC_{50} = 80 nmol/L, artemisinin, IC_{50} = 5.91 nmol/L);
antibacterial (*Escherichia coli*, 50 µg/9 mm and *Bacillus megaterium*, 50 µg/11 mm) (Kirsch, 2000);
p56lck tyrosine kinase inhibitor (reduced to 8% at 0.6 mmol, and to 44% at 0.3 mmol/L) (Kirsch, 2000).

The format is as follows:

Pharm:
Term name 1 (formatted detail information)
Term name 2 (formatted detail information)
Term name 3 (formatted detail information)
Term name 4 (formatted detail information)
Term name 5 (formatted detail information)

Under the *term name Cytotoxic*, a set of multiple cytotoxic biodata is presented as follows:

Cytotoxic
rat skeletal muscle myoblast L-6 cells, MIC = 1.1 μg/mL,
mouse peritoneal macrophages, MIC = 30 μg/mL.

The format is as follows:

Term name (*in vitro/in vivo*,
target cancer cell 1, quantitative data,
positive control Compound, control's quantitative data (if any);
target cancer cell 2, quantitative data,
positive control Compound, control's quantitative data (if any);
brief description of related mechanism if any).

In order to standardize abbreviations of cancer cells, such as P_{388}, A549, HT29, MEL28, CCRF-CEM, DLD-1, we defined and used 438 cancer cell codes (CCC) in the handbooks. For explanations of these codes, please see "List of Cancer Cell Codes."

By means of the formatted and structuralized methods, we have normalized expressions of almost all the pharmacological data discussed in the books. For complete information in volume 3, of all 976 normalized pharmacological activity terms, please see "Index 5 Compound Pharmacological Activity Index."

In summary, these handbooks with eight volumes provide an integrated collection of 8,350 marine natural products' chemical components isolated from 3,025 marine organisms and a large amount of pharmacological activity data of these components. It might be used not only as a handbook to look for structures and bioactivities of marine natural products and marine organisms source information, but also as a fundamental platform for studying the marine natural products with a systematic and integrative approach.

Acknowledgments

First, as the author of those books, I would like to give my heartfelt thanks to Dr. David Lide and B.J. Lide, who were my directors 30 years ago when I worked in OSRD, NIST (former NBS), USA, in 1985–1986 for nine months. They gave me the rare opportunity to learn how to use a software platform and how to treat a complicated scientific information data system. It was my research experience in NBS that helped me to compile easily the current huge project on Marine Natural Products. At the same time, I also give my *sincere* thanks to my NBS's colleagues: Dr. John Rumble, Mrs. Geraldine Dalton, Mrs. Phoebe Fagan, and other OSRD members.

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9 Dr. Xianfeng He, Associate Professor, Scientific Researcher, EMMS Group, State Key Laboratory of Multiphase Complex Systems, Institute of Process Engineering, Chinese Academy of Sciences, Beijing 100190, China (data collection in the early stage)
10 Madam Guirong Xie, Associate Professor, Institute of Process Engineering, Chinese Academy of Sciences, Beijing 100190, China (part of data compilation)
11 Mr. Wucheng Tang, Engineer, Institute of Process Engineering, Chinese Academy of Sciences, Beijing 100190, China (part of original paper collection).

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How to Use the HAMNP Books

In essence, from data computerization point of view, scientific knowledge is the expression of interrelation between research objects in different types. During a long coastline without computer, people learn and spread scientific knowledge in traditional ways, including education, reading, and exchanging information with each other. In today's world, using computer's powerful functions, we have a new way to learn systematical, complete knowledge. In short, a study process in the new way is to *search and learn some relationships*. Next, we discuss concretely how to use the HAMNP books.

In these books, there are three kinds of data and three pairs of important relations. Three kinds of data are: (1) marine living sources (source); (2) secondary metabolites (compounds); and (3) pharmacological activities (pharm-activity). The three pairs of important relations are: (1) relationship between source and compounds; (2) relationship between compounds and pharm-activity; and (3) relationship between source and pharm-activity. In the case of asking questions, each relation has two directions; hence, together there are six types of questions:

Type 1: from known source to unknown compound
Type 2: from known compound to unknown source
Type 3: from known compound to unknown pharm-activity
Type 4: from known pharm-activity to unknown compound
Type 5: from known source to unknown pharm-activity
Type 6: from known pharm-activity to unknown source (Figure 1)

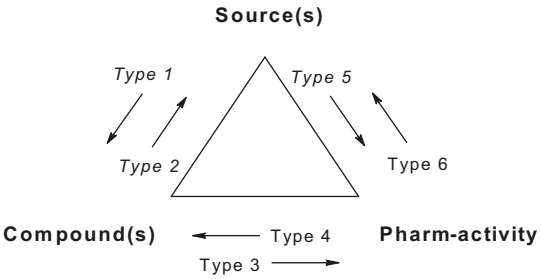

Figure 1: Kinds of Data and Six Types of Questions.

(1) An Illustration of Type 1 (and Type 3, Type 5) Question

Up to now, what alkaloids in volume 3 are isolated from sponges of genus *Agelas*? From index 3 of volume 3, one will get the following related data in detail:

Agelas cf. *nemoechinata* 507.
Agelas cf. *mauritiana* 449, 454, 471.

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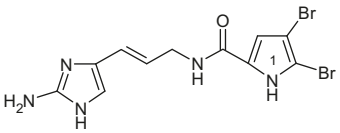
Since all of compounds 1–1162 in volume 3 are alkaloids, the following 57 compounds (64, 238, 239, 335, 336, 337, 338, 344, 345, 446, 449, 454, 460–464, 468–471, 474, 477–481, 483, 485, 487, 488, 490–507, 509–512, 516, 517, 519, and 1124) are answers to the current question.

Then, readers can enjoy studying these 57 compounds by reading the book, including their pharm-activity (question of types 3 and 5). For example, with entry 506 (*E*)-Oroidin, a reader will know that the compound had already been isolated from following sponges in genus *Agelas*:

Agelas conifera (Caribbean, yield = 2.1% dw),
Agelas dispar (Caribbean, yield = 4.2% dw),
Agelas clathrodes (Caribbean, yield = 2.1% dw),
Agelas longissima (Caribbean, yield = 4.1% dw),
Agelas sp. SS-1003 (off Seragaki, Okinawa),
Agelas oroides,
Agelas conifera,
Agelas longissima,
Agelas mauritiana,
Agelas clathrodes,
Agelas wiedenmayeri,
Agelas sceptrum,
and from other sponges *Axinella verrucosa*,

Axinella damicornis,
Hymeniacidon sp.,
Pseudaxinyssa cantharella,
Acanthella carteri and *Acanthella aurantiaca*.

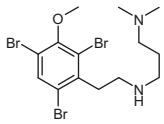
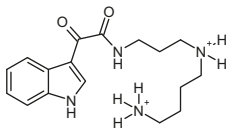
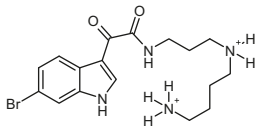
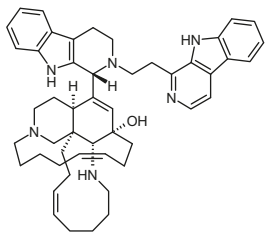
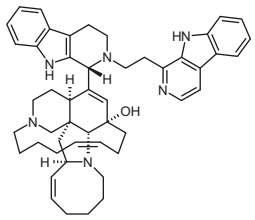
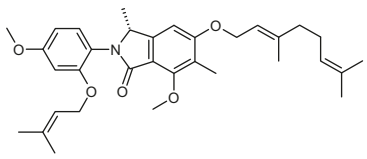
And (*E*)-Oroidin has the following pharmacological activities:
Antibacterial (*Micrococcus luteus*, MIC = 4.07 μg/mL;
Bacillus subtilis, MIC = 8.33 μg/mL;
Escherichia coli, MIC = 33.3 μg/mL);
antibacterial (*Staphylococcus aureus* ATCC 25923, IC_{50} = 0.96 μmol/L,
Staphylococcus aureus ATCC 9144, IC_{50} = 1.2 μmol/L,
Bacillus subtilis ATCC 6051, IC_{50} = 2.0 μmol/L,
Bacillus subtilis ATCC 6633, IC_{50} = 0.62 μmol/L,
Escherichia coli ATCC 11775, IC_{50} = 0.55 μmol/L,
Pseudomonas aeruginosa ATCC 10145, IC_{50} = 1.4 μmol/L);
antifungal (*Candida albicans* ATCC 90028, IC_{50} = 6.3 μmol/L);
protein phosphatase 2A inhibitor (IC_{50} = 50 μmol/L);
antibacterial (gram-positive and gram-negative bacteria, MIC ≈ 60 μg/mL, moderate);
adrenergic antagonist;
serotonin antagonist;
antimuscarinic;
antifoulant;
antihistaminic (gpg ileum, apparent affinity of antagonistic effect pD_2 = 4.02 ± 0.11, nonspecific noncompetitive effect);
IL-8 Rα receptor inhibitor (IC_{50} = 9.6 μmol/L);
IL-8 R*β* receptor inhibitor (IC_{50} = 10.8 μmol/L);
protein kinase C inhibitor (IC_{50} = 4.8 μmol/L);
antimalarial (*Plasmodium falciparum* K1 strain, IC_{50} = 3.9–7.9 μg/mL, MMOA: FabI inhibition).



(2) An Illustration of Type 4 (and Type 2, Type 6) Question

"What are isolated alkaloids in volume 3 with pharmacological activity antitrypanosomal? And what are their marine sources ?"

Table 2: Answer to the Above Type 4 Question.

Vol.	Code	Compound Name	Structure	Related Sources
3	8	Convolutamine I		Bryozoan *Amathia tortuosa* (Bass Strait, Tasmania, Australia)
3	10	Didemnidine A		Ascidian *Didemnum* sp. (Tiwai Pt, Southland, New Zealand)
3	11	Didemnidine B		Ascidian *Didemnum* sp. (Tiwai Pt, Southland, New Zealand)
.....	.....	.....	.....	.....
3	936	Zamamidine A		Sponge *Amphimedon* sp. SS-975 (Seragaki, Okinawa)
3	938	Zamamidine C		Sponge *Amphimedon* sp. (Seragaki, Okinawa)
3	1089	Mariline A_1		Marine-derived fungus *Stachylidium* sp. from sponge *Callyspongia* cf. *flammea* (location unspecified)

To browse Index 5 of volume 3, searching "Antitrypanosomal," the following results were obtained:

Antitrypanosomal, *Trypanosoma brucei brucei* 8, 93, 94, 901, 936, 938, 1089.
Antitrypanosomal, *Trypanosoma brucei rhodesiense* 10, 11, 876, 877.
Antitrypanosomal, *Trypanosoma brucei* selective 180, 181.
Antitrypanosomal, *Trypanosoma brucei* subsp. *rhodesiense* 852.

Further, from the entry bodies of the 14 compounds, all their sources can be obtained (see Table 2).

In summary, by using three parts of the books – the contents (ordered by structural classifications), the text (8,350 compound entries in volumes 1–8), and the indexes – readers can easily gain well-formatted systematically related knowledge in multidisciplinary fields.

List of Abbreviations and Acronyms

[^{3}H]AMPA	[^{3}H]-1-amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid
[^{3}H]CGS-19755	*N*-methyl-D-aspartic acid (NMDA) receptor antagonist
[^{3}H]CPDPX	[^{3}H]-1,3-dipropyl-8-cyclopentylxanthine
[^{3}H]DPDPE	opioid peptide
[^{3}H]KA	[^{3}H]-kainic acid
‡	homonym mark
3Y1	rat fibroblasts
5-FU	5-fluorouracil
6-MP	6-mercaptopurine
6-OHDA	6-hydroxydopamine
AAI	antioxidant activity index (final DPPH concentration/EC_{50})
ABRCA	amphotericin B-resistant *Candida albicans*
$ABTS^{\bullet+}$	2,2′-azino-bis-(3-ethyl benzthiazoline 6-sulfonic acid), radical
ACAT	Acyl-CoA: cholesterol acyl transferase
ACE	angiotensin-converting enzyme
AChE	acetylcholinesterase
ACTH	adrenocorticotropic hormone
ADAM9	ADAM9 protease
ADAM10	ADAM10 protease
ADM	adriamycin
AGE	advanced glycation end products
AIDS	acquired immune deficiency syndrome
AKT	ribosomal protein
AKT1	protein kinase
ALK	protein kinase
AMPB	amphotericin B
AP-1	transcription factor
APOBEC3G	hmn innate intracellular antiviral factor (recombinant protein)
aq	aqueous solution
ARCA	amphotericin-resistant *Candida albicans*
ARK5	protein kinase
ATCC	American Type Culture Collection
ATPase	adenosine triphosphatase
Aurora-B	protein kinase
AXL	protein kinase
AZT	3′-azido-3′-deoxythymidine
BACE	β-secretase
BACE1	β-secretase
BCG	Bacille Calmette-Guérin
Bcl-2	a cell survival promoting factor
BoMC	further abbreviation on *Bioorg. Med. Chem.*
BoMCL	further abbreviation on *Bioorg. Med. Chem. Lett.*
bp	boiling point
c	concentration
CaMKIII	protein kinase
cAMP	cyclic adenosine monophosphate
CAPE	caffeic acid phenethyl ester

https://doi.org/10.1515/9783110655193-205

caspase-3	caspase-3 protein
CB	cytochalasin B
CC_{50}	IC_{50} of cytotoxicity (concentration of the 50% cytotoxic effect)
CCR5	chemokine receptor 5
CD	concentration required to double the specific activity
Cdc2	cyclin-dependent kinase
Cdc25	protein Cdc25 phosphatase
Cdc25a	protein phosphatase
Cdc25b	recombinant hmn phosphatase
CDDP	*cis*-diaminedichloroplatinum (cisplatin)
CDK	cyclin-dependent kinase
CDK1	protein kinase
CDK2	protein kinase
CDK4	protein kinase
CDK4/cyclin D1	cyclin-dependent kinase 4 (CDK4) in complex with its activator cyclin D1
P25	protein kinase
p25	protein kinase
CDK7	protein kinase
c-erbB-2	protein kinase
CETP	cholesteryl ester transfer protein
cGMP	cyclic guanylic acid, cyclic guanosine monophosphate
CGRP	calcitonin gene-related peptide
ChAT	choline acetyltransferase
CMV	CMV protease
CNS	central nervous system
COMPARE	COMPARE is an algorithm to analyze data
ConA	concanavalin A
COX-1	cyclooxygenase-1
COX-2	cyclooxygenase-2
CPB	further abbreviation on *Chem. Pharm. Bull.*
$cPLA_2$	cytosolic 85 kDa phospholipase
CPT	camptothecin
CRPF	chloroquine-resistant *Plasmodium falciparum*
CRPF FcM29	chloroquine-resistant *Plasmodium falciparum* FcM29
CSPF	chloroquine-sensitive *Plasmodium falciparum*
Cyp1A	aromatase cytochrome P450 1A
CYP1A	cytochrome P450 1A
CYP450 1A	cytochrome P450 1A
d	day
D	diameter (mm)
Delta	difference in $\log_{10}$ GI_{50} (mol/L) value of the most sensitive cell line and MG-MID value
DGAT	diacylglycerol acyltransferase
DHFR	dihydrofolate reductase
DMSO	dimethyl sulfoxide
DNA	deoxyribonucleic acid
DOX	doxorubicin
DPI	diphenylene indonium
DPPH	1,1-diphenyl-2-picrylhydrazyl free radical

DRPF	drug-resistant *Plasmodium falciparum*
DRS	drug-resistant *Staphylococcus* sp.
DSPF	drug-sensitive *Plasmodium falciparum*
DYRK1A	protein kinase
EBV	Epstein–Barr virus
EC	effective concentration
EC_{50}	medium effective concentration
ED_{50}	effective dose for 50%
ED_{50}	medium effective dose (sometimes for the medium effective concentration)
EGF	epidermal growth factor
EGFR	epidermal growth factor receptor
EL-4	lymphoma cell line with resistance to natural killer cells
ELISA	enzyme-linked immunosorbent assay
EPI	epirubicin
ERK	extracellular signal-regulated protein kinase
ESBLs	extended spectrum β-lactamase
EurJOC	further abbreviation on *Eur. J. Org. Chem.*
FAK	protein kinase
FBS	fetal bovine serum
FLT3	a protein tyrosine kinase
Flu-A	influenza virus type A
Flu-B	influenza virus type B
fMLP/CB	*N*-formyl-L-methionyl-L-leucyl-L-phenylalanine/cytochalasin B
FOXO1a	downstream target of PTEN tumor suppressor
fp	freezing point
FPT	farnesyl protein transferase
FRCA	fluconazole-resistant *Candida albicans*
FtsZ	a structural homolog of eukaryotic tubulin, a GTPase
FXR	farnesoid X receptor
GABA	γ-aminobutyric acid
GI_{50}	the concentration of sample necessary to inhibit the growth to 50% of the control
GlyR	glycine-gated chloride channel receptor
gp41	a transmembrane protein of HIV-1 (recombinant protein)
gpg	guinea pig
GPR12	G protein-coupled receptor 12; it can be a significant molecular target for treating a variety of neurological disorders
GRP78	molecular chaperone (chaperone)
GST	glutathione S-transferases
GTP	guanosine triphosphate
GU4	*Candida albicans*-sensitive GU4 strain
GU5	*Candida albicans*-resistant GU5 strain
h	hour
H1N1	influenza virus H1N1
H3N2	influenza virus H3N2
H5N1	influenza virus A H5N1
HBV	hepatitis B virus
HC_{50}	medium hemolytic concentration
HCMV	hmn cytomegalovirus

HCV	hepatitis C virus
HD	a positive control compound, no concrete explanation in original paper (J. Qin, et al, BoMCL, 2010, 20, 7152)
HER2	tyrosine kinase
HF	hypersensitivity factor
HIF-1	hypoxia inducible factor-1
HIV	hmn immunodeficiency virus
HIV-1	hmn immunodeficiency virus type 1
HIV-1 IIIB	hmn immunodeficiency virus type 1 IIIB
HIV-1 in	hmn immunodeficiency virus type 1 integrase
HIV-1 $_{RF}$	hmn immunodeficiency virus RF
HIV-1-rt	hmn immunodeficiency virus type 1 reverse transcriptase
HIV-2	hmn immunodeficiency virus type 2
HIV-rt	hmn immunodeficiency virus reverse transcriptase
HLE	hmn leukocyte elastase
HMG-CoA	3-hydroxy-3-methylglutaryl coenzyme A reductase
hmn	human
HNE	hmn neutrophil elastase
$HO^{\bullet}$	hydroxyl radical
hPPARd	hmn peroxisome proliferator-activated receptor delta
HSV	herpes simplex virus
HSV-1	herpes simplex virus 1
HSV-2	herpes simplex virus 2
hTopo I	hTopo I isomerase
HXB2	T-cell tropic viral strain
IC	inhibiting concentration
IC_{50}	median inhibiting concentration
IC_{90}	inhibiting concentration for 90%
IC_{100}	absolute inhibiting concentration
ICR	imprimting control region mouse
ID	inhibition diameter (mm)
ID_{50}	median inhibiting dose
IDE	insulin-degrading enzyme
IDO	indoleamine 2,3-dioxygenase
IFV	influenza virus
IgE	immunoglobulin E
IGF1-R	protein kinase
IgM	immunoglobulin M
IL	interleukin
IL-1	interleukin-1
IL-1α	interleukin-1α
IL-1β	interleukin-1β
IL-2	interleukin-2
IL-4	interleukin-4
IL-5	interleukin-5
IL-6	interleukin-6
IL-8	interleukin-8
IL-12	interleukin-12
IL-13	interleukin-13

IM	immunomodulator
IMPDH	inosine monophosphate dihydrogenase
IN	integrase
iNOS	inducible nitric oxide synthase
InRt	inhibitive rate
ip	intraperitoneal injection
iv	intravenous injection
IZ	inhibition zone (mm)
IZD	inhibition zone diameter (mm)
IZR	inhibition zone radii (mm)
JACS	further abbreviation on *J. Am. Chem. Soc.*
Jak2	Janus kinase 2
JCS Perkin I	further abbreviation on *J. Chem. Soc., Perkin Trans. I*
JMC	further abbreviation on *J. Med. Chem.*
JNK	c-Jun NH_2-terminal kinase
JNP	further abbreviation on *J. Nat. Prod.*
JOC	further abbreviation on *J. Org. Chem.*
KDR	a protein tyrosine kinase
KU-812	hmn basophilic granulocyte
LAV	T-cell tropic viral strain
LC_{50}	concentration at which only 50% of the cells are viable
LCV	lymphocyte viability
LD	lethal dose
LD_{100}	100% lethal dose
LD_{50}	medium lethal dose
LD_{99}	99% lethal dose
LDH	lactate dehydrogenase
LOX	lipoxygenase
LPS	lipopolysaccharide
LTB_4	leukotriene B_4
LTC_4	leukotriene C_4
LY294002	phosphatidylinositol-3-kinase inhibitor, used as a positive control in anti-inflammatory assay
MABA	microplate Alamar blue assay
MAGI test	also called single life cycle test, reflects only one round of infection
MAPKAPK-2	mitogen-activated protein kinase-activated protein kinase 2
MAPKK	mitogen-activated protein kinase kinase
MBC	minimum bactericidal concentration
MBC_{90}	minimum bactericidal concentration for 90%
$MBEC_{90}$	minimum biofilm eradication counts for 90%
MCV	poxvirus *Molluscum contagiosum* virus
MDR	multidrug resistance
MDR1	major facilitator superfamily 1; one type of efflux pump in *C. albicans*, which functions as an H^+-antiporter
MDRPF	multidrug-resistant *Plasmodium falciparum*
MDRSA	multidrug-resistant *Staphylococcus aureus*
MDRSP	multidrug-resistant *Streptococcus pneumoniae*
MEK1 wt	protein kinase
MET wt	protein kinase

MG-MID	mean value of $\log_{10}$ GI_{50} (mol/L) over all cell lines tested
MIA	minimal inhibitory amounts (µg/disk)
MIC	minimum inhibitory concentration
MIC_{50}	minimal inhibitive concentration for 50%
MIC_{80}	minimal inhibitive concentration for 80%
MIC_{90}	minimal inhibitive concentration for 90%
MID	minimum inhibitory dose
min	minute
MLD	minimum lethal dose
MLR	mixed lymphocyte reaction
MMOA	molecular mechanism of action
MMP	matrix metalloproteinases
MMP-2	matrix metalloproteinase-2
MoBY-ORF	molecular barcoded yeast open-reading frame library method
mp	melting point
MPtpA	mycobacterial protein tyrosine phosphatase A
MPtpB	mycobacterial protein tyrosine phosphatase B
mPTPB	*Mycobacterium tuberculosis* protein tyrosine phosphatase B
MREC	methicillin-resistant *Escherichia coli*
MRSA	methicillin-resistant *Staphylococcus aureus*
MRSE	methicillin-resistant *Staphylococcus epidermidis*
MSR	macrophage scavenger receptor
MSSA	methicillin-sensitive *Staphylococcus aureus*
MSSE	methicillin-sensitive *Staphylococcus epidermidis*
MT1-MMP	membrane type 1 matrix metalloproteinase
MT4	MT4 cells containing HIV-1 IIIB virus
MTT	3-(4,5-dimethylthiazole-2-yl)-2,5-diphenyltetrazolium bromide
MTT assay	a cytotoxicity measurement method, tetrazolium-based colorimetric assay, see L. V. Rubinstein, et al., Nat. Cancer Inst., 82, 1113–1118 (1990)
mus	mouse
n	number of parallel experiments
nACh	nicotinic acetylcholine
NADH	reduced nicotinamide adenine dinucleotide
NDM-1	New Delhi metallo-β-lactamase-1
NEK2	protein kinase
NEK6	protein kinase
NF-κB	NF-κB serves as a central regulator of hmn immune, inflammatory, and antiapoptotic responses (Ghosh et al., 1998, Ann. Rev. Immunol, 16, 225–260)
NFRD	NADH-fumarate reductase
NGF	nerve growth factor
NMDA	*N*-methyl-D-aspartate
$NO^{\bullet}$	nitric oxide free radical
NPR	further abbreviation on *Nat. Prod. Rep*.
$O_2^{\bullet -}$	superoxide free radical
$ONOO^-$	peroxy nitrite free radical
ORAC	oxygen radical absorbance capacity
orl	oral
p24	p24 protein

P2Y receptors	one type of purine receptors which includes P1 (adenosine receptors) and P2 receptors [ionotropic P2X and metabotropic (G protein-coupled) P2Y]
$P2Y_{11}$ receptor	one of eight P2Y subtypes
P450	cytochrome P450
p56lck	tyrosine kinase
PAcF	platelet activating factor
PAF	platelet aggregation factor
PD	Parkinson's disease
pD_2 (= pEC_{50})	negative logarithm (–log *M*) of molar concentration required to produce 50% of the maximum response (EC_{50})
PDE5	phosphodiesterase 5
PDGF	platelet-derived growth factor
PfGSK-3	kinase
Pfnek-1	a NIMA-related protein kinase of *Plasmodium falciparum*
PfPK5	kinase
PfPK7	kinase
PGE_2	prostaglandin E2
PHK	primary hmn keratinocytes
PIM1	protein kinase
PK	protein kinase
PKA	protein kinase A
PKC	protein kinase C
PKC-ε	protein kinase C-ε
PKD	ribosomal protein
PKG	protein kinase G
PLA	phospholipase A
PLA_2	phospholipase A_2
PLCγ1	ribosomal protein
PLK1	protein kinase
PM	further abbreviation on *Planta Med*.
PMA (=TPA)	phorbol-12-myristate-13-acetate
PMNL	hmn polymorphonuclear leukocyte
PP	protein phosphatase
PP1	protein phosphatase PP1
PP2A	protein phosphatase PP2A
$pp60^{V\text{-}SRC}$	tyrosine kinase
PPAR	peroxisome proliferator-activated receptor
PPDK	pyruvate phosphate dikinase
PR	protease
PRK1	protein kinase
PRNG	penicillin-resistant *Neisseria gonorrhoeae*
PRSP	penicillin-resistant *Staphylococcus pneumoniae*
PTEN	tumor suppressor, an identified tumor suppressor gene located on hmn chromosome 10q23.3
PTK	protein tyrosine kinase
PTP1B	protein tyrosine phosphatase 1B, an important target for treatment of type II diabetes
PTPB	protein tyrosine phosphatase B
PTPS2	protein tyrosine phosphatase S2

PV-1	*Polio* virus
PXR	pregnane X receptor
QR	NAD(P)H: quinone reductase
Range	difference in $\log_{10}$ GI_{50} (mol/L) value of the most sensitive cell line and the least sensitive cell
rat	white rat
rbt	rabbit
RLAR	rat lens aldose reductase
RNA	ribonucleic acid
ROS	reactive oxygen species (involved in genesis of various cancers, arteriosclerosis, rheumatism, and aging)
RS321	code of a yeast
RSV	respiratory syncytial virus
RT	reverse transcriptase
RU	response unit of binding capacity to HIV-1 targets, 1 RU = 1 pg/mm^2
RyR1-FKBP12	RyR1-FKBP12 Ca^{2+} channel, a tetrameric heterodimeric channel protein (~2000 kDa) associated with smaller 12 kDa immunophilin FKBP12
S6	ribosomal protein
SAK	a protein kinase
SARS	severe acute respiratory syndrome
ScRt	scavenging rate
SF162	macrophage-tropic viral strain
SI	IC_{50} of testing cells/IC_{50} of HUVECs
SI	selective index = cytotoxic CC_{50}/target EC_{50}
SI	selective index = cytotoxic IC_{50}/target IC_{50}
SI	selective index = cytotoxic IC_{50}/target MIC
SI	selective index = cytotoxic TC_{50}/target IC_{50}
SIRT2	hmn sirtuin type 2 (a NAD^+-dependent cytoplasmic protein that is co-localized with HDAC6 on microtubules. SIRT2 has been shown to deacetylate α-tubulin and to control mitotic exit from the cell cycle)
sp.	species
spp.	species (plural)
SR	sarcoplasmic reticulum
SRB	sulforhodamine B assay
SRC	protein kinase
SV40	SV40 virus
Syn.	synonym
T/*C*	survival ratio [survival time of treated animal (*T*) was compared to that of control animal (*C*) expressed as a percent (*T*/*C*%)]
TACE	*α*-secretase (a serine protease)
Taq DNA polymerase	a DNA polymerase isolated from the thermophilic bacterium *Thermus aquaticus*
TBARS	thiobarbituric acid-reactive substance assay
TC_{50}	50% cytotoxic concentration
TEAC	Trolox equivalent antioxidant capacity
TGI	100% growth inhibition
TMV	tobacco mosaic virus
TNFα	tumor necrosis factor-α
TPA (=PMA)	12-*O*-tetradecanoyl phorbol 13-acetate

TPK	tyrosine protein kinase
TRP	transient receptor potential cationic channel
TRPA1	transient receptor potential cationic channel of subfamily A1
TRPV1	transient receptor potential cationic channel of subfamily V1
TRPV3	transient receptor potential cationic channel of subfamily V3
TXB_2	thromboxane B_2
TZM-bl	host cell in HIV-1 neutralization assay
USP7	a deubiquitylating enzyme hydrolyzing isopeptide bond at C-terminus of ubiquitin is an emerging cancer target
VCAM	vascular cell adhesion molecule
VCAM-1	vascular cell adhesion molecule-1
VCR	vincristine
VEGF	vascular endothelial growth factor
VEGF-A	vascular endothelial growth factor A
VEGFR2	tyrosine kinase VEGFR2
VE-PTP	protein phosphatase
VGSC	voltage-gated sodium channel
VHR	vaccinia open-reading frame H1-related protein phosphatase
Vif	viral infectivity factor of HIV-1
VP-16	etoposide (Sigma product), a positive control for cytotoxic assay
VRE	vancomycin-resistant *Enterococcus* sp.
VREF	vancomycin-resistant *Enterococcus faecium*
VSE	vancomycin-sensitive *Enterococcus* sp.
VSSC	voltage-sensitive sodium channel
VSV	*Vesicular stomatitis virus*
WST-8	2-(2-methoxy-4-nitrophenyl)-3-(4-nitrophenyl)-5-(2,4-disulfo-phenyl)-2*H*-tetrazolium, monosodium salt
XTT	sodium 3′-[1-(phenylaminocarbonyl)-3,4-tetrazolium] bis(4-methoxy-6-nitrobenzene)sulfonic acid
YU2-V3	viral strain

List of Cancer Cell Codes

This set of codes for 438 cancer cells, named as *CCC codes*, are defined and tried out in the books by the author. The codes of some normal cells are also listed below.

293T	kidney epithelial cells
3T3-L1	murine fibroblasts
5637	superficial bladder cancer (cell)
786-0	hmn renal cancer (cell)
9KB	hmn *epidermatoid* nasopharyngeal carcinoma (cell)
A-10	rat aorta cells
A2058	hmn (cell)
A278	hmn ovarian tumor (cell)
A2780	hmn ovarian tumor (cell)
A2780CisR	hmn ovarian tumor (cell)
A2780/DDP	hmn ovarian tumor (cell)
A2780/Tax	hmn ovarian tumor (cell)
A375	hmn melanoma (cell)
A375-S2	hmn melanoma (cell)
A431	hmn epidermic cancer (cell)
A498	hmn renal cancer (cell)
A549	hmn nonsmall cell lung cancer (cell)
A549 NSCL	hmn nonsmall cell lung cancer (cell)
A549/ATCC	hmn nonsmall cell lung cancer (cell)
ACC-MESO-1	hmn malignant pleural mesothelioma (cell)
ACHN	hmn renal cancer (cell)
AGS	gastric adenocarcinoma (cell)
AsPC-1	hmn pancreatic cancer (cell)
B16	mouse melanoma (cell)
B16F1	mouse melanoma (cell)
B16-F-10	mouse melanoma (cell)
BC	hmn breast cancer (cell)
BC-1	hmn breast cancer (cell)
BCA-1	hmn breast cancer (cell)
BEAS2B	normal hmn lung bronchial cells
Bel7402	hmn liver cancer (cell)
BG02	normal hmn embryonic stem cells
BGC823	hmn gastric cancer (cell)
BOWES	hmn cells
BR1	DNA repair competent Chinese hamster ovary (cell)
BSC	normal monkey kidney cells
BSC-1	normal African Green Monkey kidney cells
BSY1	breast cancer (cell)
BT-483	hmn breast carcinoma (cell)
BT549	hmn galactophore cancer (cell)
BT-549	hmn breast cancer (cell)
BXF-1218L	hmn bladder cancer (cell)
BXF-T24	hmn bladder cancer (cell)
BXPC	hmn pancreas cancer (cell)

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BXPC3	hmn pancreas cancer (cell)
C6	rat glioma (cell)
C26	hmn colon carcinoma (cell)
C38	murine colon adenocarcinoma (cell)
CA46	hmn Burkitt's lymphoma (cell)
Ca9-22	hmn gingival carcinoma (cell)
CaCo-2	hmn epithelial colorectal adenocarcinoma (cell)
CAKI-1	hmn renal cancer (cell)
Calu	prostate carcinoma (cell)
Calu3	nonsmall cell lung cancer (cell)
CCRF-CEM	hmn T-cell acute lymphoblastic leukemia (cell)
CCRF-CEMT	leukemia (cell)
CEM	hmn leukemia (cell)
CEM-TART	T cells that express both HIV-1 tat and rev
CFU-GM	hmn/murine hematopoietic progenitor cells
CHO	Chinese hamster ovary cells
CHO-K1	subclone of normal Chinese hamster ovary cells
CML K562	chronic myelogenous leukemia (cell)
CNE	hmn nasopharyngeal carcinoma (cell)
CNE2	hmn nasopharyngeal carcinoma (cell)
CNS SF295	hmn brain tumor (cell)
CNXF-498NL	hmn glioblastoma cancer (cell)
CNXF-SF268	hmn glioblastoma cancer (cell)
Colo320	hmn colorectal cancer (cell)
Colo357	hmn colorectal cancer (cell)
Colon26	colorectal cancer (cell)
Colon38	mus colorectal cancer (cell)
Colon205	colorectal cancer (cell)
Colon250	colorectal cancer (cell)
CV-1	monkey kidney fibroblasts
CXF-HCT116	hmn colon cancer (cell)
CXF-HT29	hmn colon cancer (cell)
DAMB	hmn mammary carcinoma (cell)
DG-75	hmn B lymphocyte (cell)
DLAT	Dalton's lymphoma ascites tumor (cell)
DLD-1	hmn colorectal adenocarcinoma (cell)
DLDH	hmn colorectal adenocarcinoma (cell)
DMS114	hmn lung cancer (cell)
DMS273	hmn small cell lung cancer (cell)
Doay	hmn medulloblastoma (cell)
Dox40	hmn myeloma (cell)
DU145	prostate cancer (cell)
DU4475	breast cancer (cell)
E39	hmn renal carcinoma (cell)
EAC	Ehrlich ascites carcinoma (cell)
EKVX	hmn nonsmall cell lung cancer (cell)
EM9	topoisomerase I-sensitive Chinese hamster ovary (cell)
EMT-6	mouse tumor cells
EPC	carp epithelium (cell)

EVLC-2	SV40 large T-antigen immortalized hmn umbilical vein cells
F1	hmn amniotic epithelial cells
FADU	pharynx-sq cancer (cell)
Farage	hmn lymphoma (cell)
Fem-X	melanoma (cell)
Fl	hmn amniotic epithelial cell line
FM3C	mus mammary tumor (cell)
G402	hmn renal leiomyoblastoma
GM7373	bovine endothelial (cell)
GR-III	adenocarcinoma (cell)
GXF-251L	hmn stomach cancer (cell)
H116	hmn colorectal cancer (cell)
H125	hmn colorectal cancer (cell)
H441	hmn lung adenocarcinoma (cell)
H460	hmn lung cancer (cell)
H522	hmn nonsmall cell lung cancer (cell)
H1299	hmn lung adenocarcinoma (cell)
H1325	hmn nonsmall cell lung cancer (cell)
H1975	hmn cancer (cell)
H2122	hmn nonsmall cell lung cancer (cell)
H2887	hmn nonsmall cell lung cancer (cell)
H69AR	multidrug-resistant small cell lung cancer (cell)
H929	hmn myeloma (cell)
H9c2	rat cardiac myoblasts
HBC4	breast cancer (cell)
HBC5	breast cancer (cell)
HBL100	breast cancer (cell)
HCC366	hmn nonsmall cell lung cancer (cell)
HCC2998	hmn colorectal cancer (cell)
HCC-S102	hepatocellular carcinoma (cell)
HCT	hmn colorectal cancer (cell)
HCT8	hmn colorectal cancer (cell)
HCT15	hmn colorectal cancer (cell)
HCT29	hmn colon adenocarcinoma (cell)
HCT116	hmn colorectal cancer (cell)
HCT116/mdr+	overexpress mdr+ hmn colorectal cancer (cell)
HCT116/topo	resistant to etoposide hmn colorectal cancer (cell)
HCT116/VM46	multidrug-resistant colorectal cancer (cell)
HEK-293	normal hmn epithelial kidney cells
HEL	hmn embryonic lung fibrocytes
HeLa	hmn cervical epithelial carcinoma (cell)
HeLa-APL	hmn cervical epithelial cancer (cell)
HeLa-S3	hmn cervical epithelial cancer (cell)
Hep2	hmn liver carcinoma (cell)
Hep3B	hmn liver cancer (cell)
HepA	hmn liver cancer ascites (cell)
Hepa1c1c7	mus liver cancer (cell)
HepG	hmn liver cancer (cell)
HepG2	hmn liver cancer (cell)

HepG3	hmn liver cancer (cell)
HepG3B	hmn liver cancer (cell)
HEY	hmn ovarian carcinoma (cell)
HFF	hmn foreskin fibroblasts
HL60	hmn promyelocytic leukemia (cell)
HL7702	hmn liver tumor (cell)
HLF	hmn lung fibroblasts
HM02	hmn gastric adenocarcinoma (cell)
HMEC	hmn microvascular endothelial cells
HMEC1	hmn microvascular endothelial cells
HNXF-536L	hmn head and neck cancer (cell)
HOP-18	hmn nonsmall cell lung cancer (cell)
HOP-62	hmn nonsmall cell lung cancer (cell)
HOP-92	hmn nonsmall cell lung cancer (cell)
Hs578T	hmn breast cancer (cell)
Hs683	hmn oligodendroglioma (black dots) (cell)
HSV-1	nonmalignant cell
HT	hmn lymphoma (cell)
HT29	hmn colorectal cancer (cell)
HL60	M. Daferner, et al., Z. Naturforsch., Teil C, 1999, 54, 474
HT115	hmn colorectal cancer (cell)
HT460	hmn tumor (cell)
HT1080	hmn fibrosarcoma (cell)
HTC116	hmn acute promyelocytic leukemia (cell)
HTCLs	hmn tumors (cells)
HuCCA-1	hmn cholangiocarcinoma cancer (cell)
Huh7	hmn hepatoma (cell)
HUVEC	hmn umbilical vein endothelial cell
HUVECs	hmn umbilical vein endothelial cell
IC-2^{WT}	murine cell line
IGR-1	hmn melanoma (cell)
IGROV	hmn ovarian cancer (cell)
IGROV1	hmn ovarian cancer (cell)
IGROV-ET	hmn ovarian cancer (cell)
IMR-32	hmn neuroblastoma (cell)
IMR-90	hmn diploid lung fibroblasts
J774	mus monocyte/macrophage (cell)
J774.1	mus monocyte/macrophage (cell)
J774.A1	mus monocyte/macrophage (cell)
JB6 Cl41	mouse epidermal cells
JB6 P^{+}Cl41	mouse epidermal cells
JurKat	hmn leukemia (cell)
JurKat-T	hmn T-cell leukemia (cell)
K462	hmn leukemia (cell)
K562	hmn chronic myelogenous leukemia (cell)
KB	hmn nasopharyngeal carcinoma (cell)
KB16	hmn nasopharyngeal carcinoma (cell)
KB-3	hmn *epidermoid* carcinoma (cell)
KB-3-1	hmn *epidermoid* carcinoma (cell)

KB-C2	hmn carcinoma (cell)
KB-CV60	hmn carcinoma (cell)
KBV200	MDR nasopharyngeal carcinoma (cell)
Ketr3	hmn renal cancer (cell)
KM12	hmn colorectal cancer (cell)
KM20L2	hmn colorectal cancer (cell)
KMS34	hmn myeloma (cell)
KU812F	hmn leukemia (cell)
KV/MDR	multidrug-resistant cancer (cell)
KYSE30	hmn esophageal cancer (cell)
KYSE70	hmn esophageal cancer (cell)
KYSE180	hmn esophageal cancer (cell)
KYSE520	hmn esophageal cancer (cell)
L_{1210}	mouse lymphocytic leukemia (cell)
L_{1210}/Dx	doxorubicin-resistant L_{1210} (cell)
L363	hmn myeloma (cell)
L-428	leukemia (cell)
L5178	mouse lymphosarcoma (cell)
L5178Y	mouse lymphosarcoma (cell)
L-6	rat skeletal myoblasts (cell)
L929	mouse fibroblasts
LLC-PK_1	pig kidney cells
LMM3	mouse mammary adenocarcinoma (cell)
LNCaP	hmn prostate cancer (cell)
LO2	hmn liver cells
LoVo	hmn colorectal cancer (cell)
LoVo-DOX	hmn colorectal cancer (cell)
LOX	hmn melanoma (cell)
LOX-IMVI	hmn melanoma (cell)
LX-1	hmn lung cancer (cell)
LXF-1121L	hmn lung cancer (cell)
LXF-289L	hmn lung cancer (cell)
LXF-526L	hmn lung cancer (cell)
LXF-529L	hmn lung cancer (cell)
LXF-629L	hmn lung cancer (cell)
LXFA-629L	lung adenocarcinoma (cell)
LXF-H460	hmn lung cancer (cell)
M14	melanoma (cell)
M16	murine colon adenocarcinoma (cell)
M17	adriamycin-resistant breast cancer (cell)
M17-Adr	adriamycin-resistant breast cancer (cell)
M21	melanoma (cell)
M5076	ovarian sarcoma (cell)
MAGI	Hela-CD4-LTR-β-gal (indicator) cells containing HIV-1 IIIB virus
MALME-3	melanoma (cell)
MALME-3M	melanoma (cell)
MAXF-401	hmn breast cancer (cell)
MAXF-401NL	hmn breast cancer (cell)
MAXF-MCF7	hmn breast cancer (cell)

MCF	hmn breast cancer (cell)
MCF-10A	hmn breast epithelial (cell)
MCF7	hmn breast cancer (cell)
MCF7 Adr	drug-resistant hmn breast MCF7 cancer (cell)
MCF7/Adr	drug-resistant hmn breast MCF7 cancer (cell)
MCF7/ADR-RES	drug-resistant hmn breast cancer MCF7 (cell)
MCF12	hmn esophageal cancer (cell)
MDA231	hmn breast cancer (cell)
MDA361	hmn breast cancer (cell)
MDA435	hmn breast cancer (cell)
MDA468	hmn breast cancer (cell)
MDA-MB	hmn breast cancer (cell)
MDA-MB-231	hmn breast cancer (cell)
MDA-MB-231/ATCC	hmn breast cancer (cell)
MDA-MB-435	hmn breast cancer (cell)
MDA-MB-435s	hmn breast cancer (cell)
MDA-MB-468	hmn breast cancer (cell)
MDA-N	hmn breast cancer (cell)
MDCK	Madin–Darby canine (cell)
ME180	cervical cancer (cell)
MEL28	hmn melanoma (cell)
MES-SA	hmn uterine (cell)
MES-SA/DX5	hmn uterine (cell)
MEXF-276L	hmn melanoma (cell)
MEXF-394NL	hmn melanoma (cell)
MEXF-462NL	hmn melanoma (cell)
MEXF-514L	hmn melanoma (cell)
MEXF-520L	hmn melanoma (cell)
MG63	hmn osteosarcoma (cell)
MGC-803	hmn cancer (cell)
MiaPaCa	hmn pancreas cancer (cell)
Mia-PaCa-2	hmn pancreas cancer (cell)
MKN1	hmn gastric cancer (cell)
MKN7	hmn gastric cancer (cell)
MKN28	hmn gastric cancer (cell)
MKN45	hmn gastric cancer (cell)
MKN74	hmn gastric cancer (cell)
MM1S	hmn myeloma (cell)
Molt3	leukemia (cell)
Molt4	hmn T lymphocyte leukemia (cell)
Mono-Mac-6	mononuclear cells
MPM ACC-MESO-1	hmn malignant pleural mesothelioma
MRC-5	normal hmn diploid embryonic cells
MRC5CV1	SV40-transformed hmn fibroblasts
MS-1	mice endothelial cells
MX-1	hmn mammary carcinoma xenografts
N18-RE-105	neuronal hybridoma (cell)
N18-T62	mus neuroblastoma (cell)
NAMALWA	leukemia (cell)

NBT-T2 (BRC-1370)	rat bladder epithelial cells
NCI-ADR	hmn ovarian sarcoma (cell)
NCI-ADR-Res	hmn ovarian sarcoma (cell)
NCI-H23	hmn nonsmall cell lung cancer (cell)
NCI-H69	hmn lung cancer (cell)
NCI-H82	hmn lung cancer (cell)
NCI-H187	hmn small cell lung cancer (cell)
NCI-H226	hmn nonsmall cell lung cancer (cell)
NCI-H322M	hmn nonsmall cell lung cancer (cell)
NCI-H446	hmn lung cancer (cell)
NCI-H460	hmn nonsmall cell lung cancer (cell)
NCI-H510	hmn lung cancer (cell)
NCI-H522	hmn nonsmall cell lung cancer (cell)
neuro-2a	mouse neuroblastoma (cell)
NFF	nonmalignant neonatal foreskin fibroblasts
NHDF	normal hmn dermal fibroblasts
NIH3T3	nontransformed fibroblasts
NIH3T3	normal fibroblasts
NMuMG	nontransformed epithelial cells
NOMO-1	hmn acute myeloid leukemia
NS-1	murine cells
NSCLC	hmn bronchopulmonary nonsmall cell lung cancer
NSCLC HOP-92	hmn nonsmall cell lung cancer (cell)
NSCLC-L16	hmn bronchopulmonary nonsmall cell lung carcinoma
NSCLC-N6	hmn bronchopulmonary nonsmall cell lung cancer (cell)
NSCLC-N6-L16	hmn bronchopulmonary nonsmall cell lung carcinoma
NUGC-3	hmn gastric cancer (cell)
OCILY17R	hmn lymphoma (cell)
OCIMY5	hmn myeloma (cell)
OPM2	hmn myeloma (cell)
OVCAR-3	ovarian adenocarcinoma (cell)
OVCAR-4	ovarian adenocarcinoma (cell)
OVCAR-5	ovarian adenocarcinoma (cell)
OVCAR-8	ovarian adenocarcinoma (cell)
OVXF-1619L	ovary cancer (cell)
OVXF-899L	ovary cancer (cell)
OVXF-OVCAR3	ovary cancer (cell)
P_{388}	mus lymphocytic leukemia (cell)
P_{388}/ADR	P_{388} adriamycin-resistant (cell)
P_{388}/Dox	mus leukemia cells expressing resistance toward doxorubicin
P_{388}D1	mus macrophage cells
PANC1	hmn pancreas cancer (cell)
panc89	pancreatic cancer (cell)
PAXF-1657L	hmn pancreas cancer (cell)
PAXF-PANC1	hmn pancreas cancer (cell)
PBMC	hmn normal peripheral blood mononuclear cells
PC12	hmn lung cancer (cell)
PC-12	rat pheochromocytoma (cell)
PC3	hmn prostate cancer (cell)

PC3M	hmn prostate cancer (cell)
PC3MM2	hmn prostate cancer (cell)
PC-9	hmn lung cancer (cell)
PRXF-22RV1	hmn prostate cancer (cell)
PRXF-DU145	hmn prostate cancer (cell)
PRXF-LNCAP	hmn prostate cancer (cell)
PRXF-PC3M	hmn prostate cancer (cell)
PS (=P_{388})	PS system, P_{388} mouse lymphocytic leukemia (cell)
PV1	nonmalignant cell
PXF-1752L	mesothelioma cancer (cell)
QG56	hmn lung carcinoma (cell)
QGY-7701	hmn hepatocellular carcinoma (cell)
QGY-7703	hmn liver cancer (cell)
Raji	hmn EBV-transformed Burkitt's lymphoma B cell
RAW264.7	mouse macrophages
RB	hmn prostate cancer (cell)
RBL-2H3	rat basophilic cells
RF-24	papillomavirus 16 E6/E7 immortalized hmn umbilical vein cells
RKO	hmn colon cancer (cell)
RKO-E6	hmn colon cancer (cell)
RPMI7951	hmn malignant melanoma (cell)
RPMI8226	hmn myeloma (cell)
RXF-1781L	renal cancer (cell)
RXF-393	renal cancer (cell)
RXF-393NL	renal cancer (cell)
RXF-486L	renal cancer (cell)
RXF-631L	renal cancer (cell)
RXF-944L	renal cancer (cell)
S_{180}	mouse sarcoma (cell)
S_{180}A	sarcoma 180 ascite cells
SAS	hmn oral cancer
SCHABEL	mouse lymphoma cancer (cell)
SF268	hmn brain tumor (cell)
SF295	hmn brain tumor (cell)
SF539	hmn brain tumor (cell)
SGC7901	hmn gastric cancer (cell)
SH-SY5Y	hmn neuroblastoma (cell)
SK5-MEL	hmn melanoma (cell)
SKBR3	hmn breast cancer (cell)
SK-Hep1	hmn liver carcinoma (cell)
SK-MEL-2	hmn melanoma (cell)
SK-MEL-5	hmn melanoma (cell)
SK-MEL-28	hmn melanoma (cell)
SK-MEL-S	hmn melanoma (cell)
SK-N-SH	neuroblastoma (cell)
SK-OV-3	ovarian adenocarcinoma (cell)
SMMC-7721	hmn liver cancer (cell)

SN12C	hmn renal cancer (cell)
SN12k1	hmn renal cancer (cell)
SNB19	hmn brain tumor (cell)
SNB75	hmn CNS cancer (cell)
SNB78	hmn brain tumor (cell)
SNU-C4	hmn cancer (cell)
SR	leukemia (cell)
St4	gastric cancer (cell)
stromal cell	bone marrow stromal cells
SUP-B15	leukemia (cell)
Sup-T1	T-cell lymphoma cancer cells
SW480	hmn colorectal adenocarcinoma (cell)
SW620	hmn colorectal adenocarcinoma (cell)
SW1573	hmn nonsmall cell lung cancer (cell)
SW1736	hmn thyroid cancer (cell)
SW1990	hmn pancreatic cancer (cell)
T24	hmn liver cancer (cell)
T-24	hmn transitional bladder carcinoma (cell)
T47D	hmn breast cancer (cell)
THP-1	hmn acute monocytic leukemia (cell)
TK10	hmn renal cancer (cell)
tMDA-MB-231	hmn breast cancer (cell)
tsFT210	mouse cancer (cell)
TSU-Pr1	invasive bladder cancer (cell)
TSU-Pr1-B1	invasive bladder cancer (cell)
TSU-Pr1-B2	invasive bladder cancer (cell)
U251	CNS tumor/glioma (cell)
U266	myeloma (cell)
U2OS	hmn osteosarcoma (cell)
U373	glioblastoma/astrocytoma (cell)
U373MG	hmn brain cancer (cell)
U-87-MG	caucasian glioblastoma (cell)
U937	hmn monocytic leukemia (cell)
UACC-257	melanoma (cell)
UACC62	melanoma (cell)
UO-31	hmn renal cancer (cell)
UT7	hmn leukemia (cell)
UV20	DNA cross-linking agent-sensitive Chinese hamster ovary (cell)
UXF-1138L	hmn uterus cancer (cell)
V79	Chinese hamster (cell)
Vero	green monkey kidney tumor (cell)
WEHI-164	mus fibrosarcoma (cell)
WHCO1	hmn esophageal cancer (cell)
WHCO5	hmn esophageal cancer (cell)
WHCO6	hmn esophageal cancer (cell)
WI26	hmn lung fibroblasts
WiDr	hmn colon adenocarcinoma (cell)

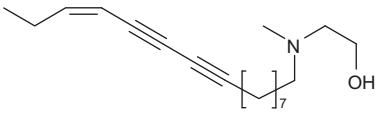
WMF	hmn prostate cancer (cell)
XF498	hmn CNS cancer (cell)
XRS-6	topoisomerase II-sensitive Chinese hamster ovary (cell)
XVS	topoisomerase II-sensitive CHO cell
ZR-75-1	hmn breast cancer (cell)

1 Amine Guanidine and Amide Alkaloids

1.1 Amine Alkaloids

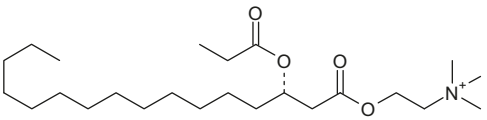
1 Calcareous sponge *Leucetta* Acetylenic Alkaloid

Type: Acyclic amines. $C_{19}H_{31}NO$ Source: Calcareous sponge *Leucetta* sp. (0.088%, depth of 50 m, Kume I., Okinawa). Pharm: Cytotoxic (NBT-T2, IC_{50} = 2.5 μg/mL). Ref: I. Hermawan, et al, Mar. Drugs, 2011, 9, 382



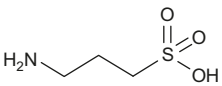
2 Homopahutoxin

Type: Acyclic amines. $C_{24}H_{48}NO_4^{1+}$ Source: Boxfish *Ostracion immaculatus*. Pharm: Haemolytic. Ref: N. Fusetani, et al, Toxicon, 1987, 25, 459



3 Homotaurine

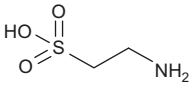
3-Amino-1-propanesulfonic acid; Tramiprosate Type: Acyclic amines. $C_3H_9NO_3S$ Needles (EtOH aq), mp 290–292 °C, dec 270–271 °C. Source: Red alga *Grateloupia lividia*, red algae spp., green alga *Cladophora densa*. Pharm: Anti-AD (inhibits amyloid A fibril formation and deposition, Using in treatment of Alzheimer's disease and cerebral amyloid angiopathy); anti-AD clinical trial (clinical trial is going on: NCT00314912 Last verified, July 2007 Bellus Health Inc., Title: Open-Label Extension of the Phase III Study With Tramiprosate (3APS) in Patients With Mild to Moderate AD. Study Design: Randomized, double-blind, placebo-controlled, parallel-group study conducted at 67 study centers across the United States and Canada. Purpose: Evaluate the long-term safety. Secondary Outcome Measures: To provide additional long-term data on the efficacy of Tramiprosate (3APS). No significant treatment effect). Ref: CRC Press, DNP on DVD, 2012, version 20.2 | P. Russo, et al, Mar. Drugs, 2016, 14, 5 (review)



https://doi.org/10.1515/9783110655193-001

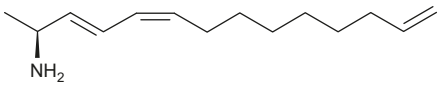
4 Taurine

Aminoethylsulfonic acid Type: Acyclic amines. $C_2H_7NO_3S$ Monoclinic prismatic rods with sharp taste, mp 328 °C, mp 320–325 °C (dec). Source: Green algae *Caulerpa okamurai, Caulerpa racemosa, Chlorodesmis comosa, Codium adherens, Codium fragile* and *Enteromorpha linza*, sponges *Calyx nicaeensis* and *Geodia gigas,* mussel (blue mussel) *Mytilus edulis*, eulamellibranch *Macrocallista nimbosa*, prosobranch *Turbo stenogyrus,* marine vestimentarian worm *Riftia pachyptila,* terrestrial higher plants (e.g. leguminous seedlings). Pharm: Adjunct in treatment of hypercholesterolaemia; metabolic regulator; intermedium in metabolism of cysteine; LD_{50} (mus, scu) = 6000 mg/kg. Ref: CRC Press, DNP on DVD, 2012, version 20.2



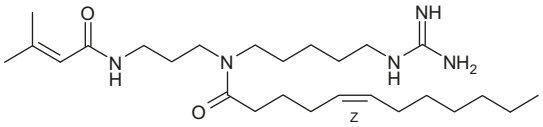
5 (2*S*,3*E*,5*Z*)-3,5,13-Tetradecatrien-2-amine

Type: Acyclic amines. $C_{14}H_{25}N$ Viscous pale yellow oil, $[\alpha]_D^{25}$ = +17.8° (*c* = 1, $CHCl_3$) (95% e.e.). Source: Ascidian *Pseudodistoma novaezelandiae*. Pharm: Cytotoxic. Ref: N. B. Perry, et al, Aust. J. Chem., 1991, 44, 627 | D. Enders, et al, Liebigs Ann. Chem., 1993, 551



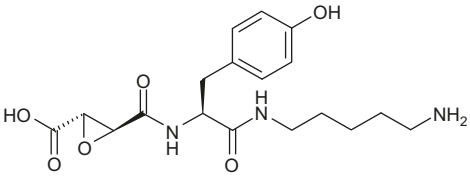
6 Acarnidine C

Type: Polyamines. $C_{26}H_{49}N_5O_2$ Source: Sponge *Acarnus erithacus*. Pharm: Antiviral; antimicrobial. Ref: J. -W. Blunt, et al, Tet. Lett., 1982, 23, 2793



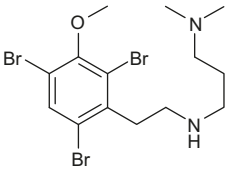
7 Cathestatin C

Type: Polyamines. $C_{18}H_{25}N_3O_6$ Source: Marine-derived fungus *Microascus longirostris* SF-73 from an unidentified sponge (New Zealand). Pharm: Cysteine proteases inhibitor (papain, IC_{50} = 20.0 nmol/L, Cathepin B, IC_{50} = 114.3 nmol/L, Cathepin L, IC_{50} = 11.1 nmol/L). Ref: C. -M. Yu, et al, J. Antibiot., 1996, 49, 395



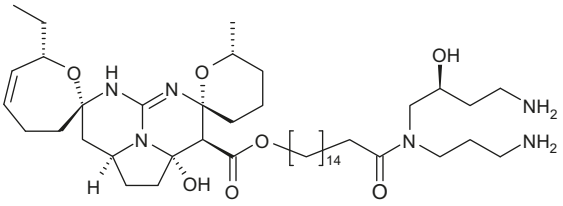
8 Convolutamine I

Type: Polyamines. $C_{14}H_{21}Br_3N_2O$ Source: Bryozoan *Amathia tortuosa* (Bass Strait, Tasmania, Australia). Pharm: Cytotoxic (HEK-293); antitrypanosomal (*Trypanosoma brucei brucei*). Ref: R. A. Davis, et al, BoMC, 2011, 19, 6615



9 Crambescidin 816

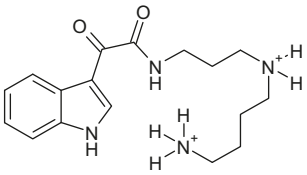
Type: Polyamines. $C_{45}H_{80}N_6O_7$ Oil, $[\alpha]_D^{25} = -20.4°$ (c = 0.4, MeOH). Source: Sponges *Crambe crambe* and *Batzella* sp. Pharm: Cytotoxic (cortical neurons, almost complete cell death at 1 µmol/L (86.3 ± 6.8)%); cytotoxic (L_{1210}, 0.1 µg/mL, cell growth inhibition 98%); antiviral (HSV-1, 1.25 µg/well, complete inhibition with diffuse cytotoxicity); Ca^{2+} antagonist; ichthyotoxin. Ref: E. A. Jares-Erijman, et al, JOC, 1991, 56, 5712; 1993, 58, 4805 | R. G. S. Berlinck, et al, JNP, 1993, 56, 1007 | S. G. Bondu, et al, RSC Advances, 2012, 2, 2828



10 Didemnidine A

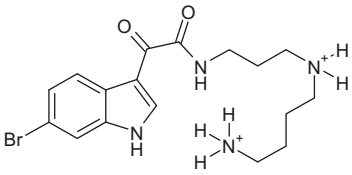
Type: Polyamines. $C_{17}H_{26}N_4O_2^{2+}$ Brown oil. Source: Ascidian *Didemnum* sp. (Tiwai Pt., Southland, New Zealand). Pharm: Antitrypanosomal (*Trypanosoma brucei rhodesience*, IC_{50} = 59 µmol/L, control Melarsoprol, IC_{50} = 0.01 µmol/L; *Trypanosoma cruzi*, IC_{50} = 130 µmol/L, control Benznidazole, IC_{50} = 1.35 µmol/L); antileishmanial (*Leishmania donovani*, IC_{50} > 180 µmol/L, control Miltefosine, IC_{50} = 0.52 µmol/L); antiplasmodial (*Plasmodium falciparum* K1, IC_{50} = 41 µmol/L,

control Chloroquine, IC_{50} = 0.20 μmol/L); cytotoxic (L-6 rat skeletal myoblast cell line, IC_{50} = 24 μmol/L, control Podophyllotoxin, IC_{50} = 0.01 μmol/L). Ref: R. Finlayson, et al, JNP, 2011, 74, 888



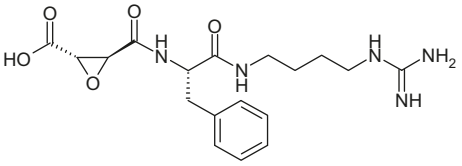
11 Didemnidine B

Type: Polyamines. $C_{17}H_{25}BrN_4O_2^{2+}$ Brown oil. Source: Ascidian *Didemnum* sp. (Tiwai Pt., Southland, New Zealand). Pharm: Antitrypanosomal (*Trypanosoma brucei rhodesience*, IC_{50} = 44 μmol/L, control Melarsoprol, IC_{50} = 0.01 μmol/L; *Trypanosoma cruzi*, IC_{50} = 82 μmol/L, control Benznidazole, IC_{50} = 1.35 μmol/L); antileishmanial (*Leishmania donovani*, IC_{50} > 160 μmol/L, control Miltefosine, IC_{50} = 0.52 μmol/L); antiplasmodial (*Plasmodium falciparum* K1, IC_{50} = 15 μmol/L, control Chloroquine, IC_{50} = 0.20 μmol/L); cytotoxic (L-6 rat skeletal myoblast cell line, IC_{50} = 25 μmol/L, control Podophyllotoxin, IC_{50} = 0.01 μmol/L). Ref: R. Finlayson, et al, JNP, 2011, 74, 888



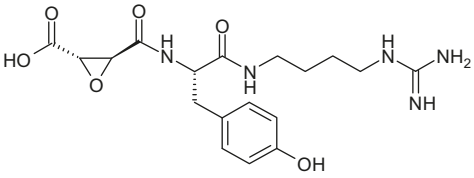
12 Estatin A

Type: Polyamines. $C_{18}H_{25}N_5O_5$ Needles + $1H_2O$, mp 223–225 °C (dec), $[\alpha]_D^{24}$ = +41.8° (*c* = 0.6, H_2O). Source: Marine-derived fungus *Microascus longirostris* from an unidentified sponge. Pharm: Proteases inhibitors (Cysteine proteases: Cathepsin L, IC_{50} = 0.004 μg/mL; Cathepsin B, IC_{50} = 0.270 μg/mL; Papain, IC_{50} = 0.130 μg/mL; Ficin, IC_{50} = 0.032 μg/mL; Bromelain, IC_{50} = 0.600 μg/mL; Serine proteases: Trypsin, IC_{50} > 100 μg/mL; Chymostatin, IC_{50} > 100 μg/mL; Metal protease: Thermolysin, IC_{50} > 100 μg/mL; Aspartic protease: Cathepsin D, IC_{50} > 100 μg/mL). Ref: J. -T. Woo, et al, Biosci., Biotechnol., Biochem., 1995, 59, 350



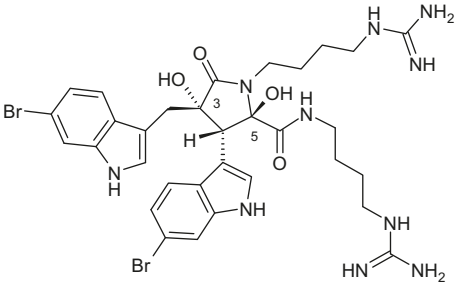
13 Estatin B

Type: Polyamines. $C_{18}H_{25}N_5O_6$ Needles + $1H_2O$, mp 217–218 °C (dec), $[\alpha]_D^{24}$ = +46.8° (*c* = 0.2, 0.1 M HCl). Source: Marine-derived fungus *Microascus longirostris* from an unidentified sponge. Pharm: Proteases inhibitors (Cysteine proteases: Cathepsin L, IC_{50} = 0.006 µg/mL; Cathepsin B, IC_{50} = 0.320 µg/mL; Papain, IC_{50} = 0.180 µg/mL; Ficin, IC_{50} = 0.038 µg/mL; Bromelain, IC_{50} = 0.260 µg/mL; Serine proteases: Trypsin, IC_{50} > 100 µg/mL; Chymostatin, IC_{50} > 100 µg/mL; Metal protease: Thermolysin, IC_{50} > 100 µg/mL; Aspartic protease: Cathepsin D, IC_{50} > 100 µg/mL). Ref: J. -T. Woo, et al, Biosci., Biotechnol., Biochem., 1995, 59, 350



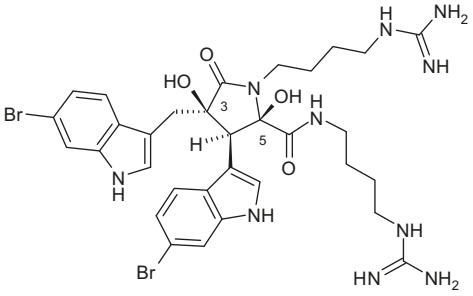
14 Eusynstyelamide A

Eusynstyelamide Type: Polyamines. $C_{32}H_{40}Br_2N_{10}O_4$ Source: Ascidian *Eusynstyela misakiensis*, ascidian *Eusynstyela latericius* (Great Barrier Reef). Pharm: Inhibitor of neuronal nitric oxide synthase (*n*NOS) (IC_{50} = 41.7 µmol/L); inhibitor of pyruvate phosphate dikinase (PPDK) (IC_{50} = 19 mmol/L). Ref: J. C. Swersey, et al, JNP, 1994, 57, 842 (Eusynstyelamide) | D. M. Tapiolas, et al, JNP, 2009, 72, 1115 | M. Tadesse, et al, JNP, 2011, 74, 837



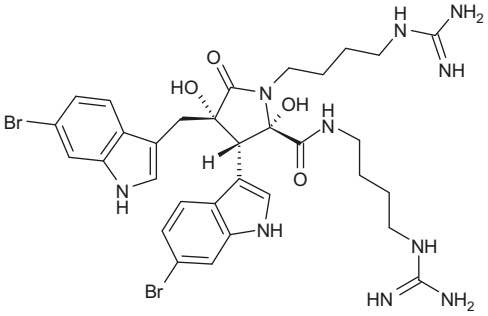
15 Eusynstyelamide B

Type: Polyamines. $C_{32}H_{40}Br_2N_{10}O_4$ Pale yellow oil. Source: Ascidian *Eusynstyela latericius*, ascidian *Eusynstyela latericius* (Great Barrier Reef). Pharm: Inhibitor of neuronal nitric oxide synthase (*n*NOS) (IC_{50} = 4.3 μmol/L); inhibitor of pyruvate phosphate dikinase (PPDK) (IC_{50} = 20 mmol/L); cytotoxic (MDA-MB-231, potent cell cycle inhibitor); inhibits proliferation of LNCaP cells (G2 phase); topoisomerase II inhibitor (in LNCaP cells); antibacterial (*Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Corynebacterium glutamicum*, and MRSA, for Eusynstyelamide B, D, E and F, IC_{50} between 6.25 μmol/L and >50 μmol/L). Ref: D. M. Tapiolas, et al, JNP, 2009, 72, 1115 | M. Tadesse, et al, JNP, 2011, 74, 837 | M. Liberio, et al, Eur. J. Cancer, 2013, 49 (Suppl. 2), S177 | M. Liberio, et al, Mar. Drugs, 2014, 12, 5222



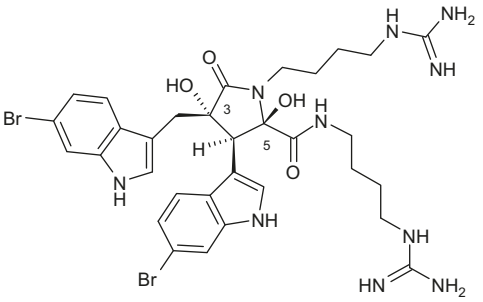
16 *ent*-Eusynstyelamide B

Type: Polyamines. $C_{32}H_{40}Br_2N_{10}O_4$ Source: Bryozoan *Tegella* cf. *spitzbergensis* (Bear I., North Atlantic). Pharm: Antibacterial (*Staphylococcus aureus*); antifungal (*Candida albicans*, modest). Ref: M. Tadesse, et al, JNP, 2011, 74, 837



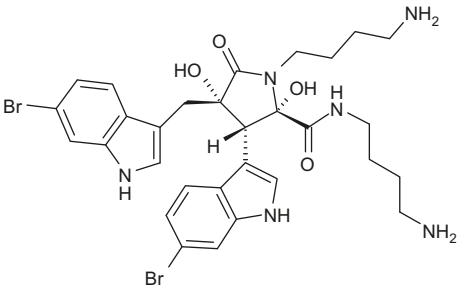
17 Eusynstyelamide C

Type: Polyamines. $C_{32}H_{40}Br_2N_{10}O_4$ Pale yellow oil, $[\alpha]_D^{19}$ = +17° (*c* = 0.1, MeOH). Source: Ascidian *Eusynstyela latericius*, ascidian *Eusynstyela latericius* (Great Barrier Reef). Pharm: Inhibitor of neuronal nitric oxide synthase (*n*NOS) (IC_{50} = 5.8 µmol/L). Ref: D. M. Tapiolas, et al, JNP, 2009, 72, 1115



18 Eusynstyelamide D

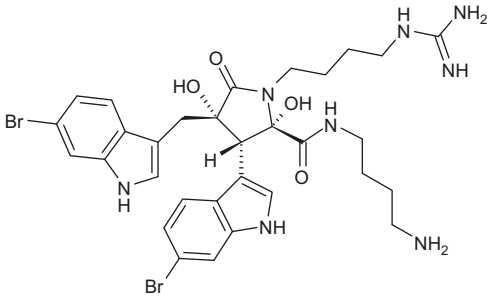
Type: Polyamines. $C_{30}H_{36}Br_2N_6O_4$ Source: Arctic bryozoan *Tegella* cf. *spitzbergensi*s (Bear I., North Atlantic). Pharm: Antibacterial (*Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Corynebacterium glutamicum*, and MRSA, for Eusynstyelamide B, D, E and F, IC_{50} between 6.25 µmol/L and >50 µmol/L); cytotoxic (melanoma cell line A2058). Ref: M. Tadesse, et al, JNP, 2011, 74, 837



19 Eusynstyelamide E

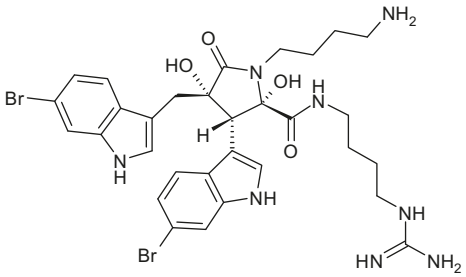
Type: Polyamines. $C_{30}H_{38}Br_2N_8O_4$ Source: Arctic bryozoan *Tegella* cf. *spitzbergensi*s (Bear I., North Atlantic). Pharm: Antibacterial (*Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Corynebacterium glutamicum*, and MRSA, for Eusynstyelamide B, D, E and F, IC_{50} between 6.25 µmol/L and >50 µmol/L);cytotoxic

(A2058); antifungal (*Candida albicans,* modest). Ref: M. Tadesse, et al, JNP, 2011, 74, 837



20 Eusynstyelamide F

Type: Polyamines. $C_{30}H_{38}Br_2N_8O_4$ Source: Arctic bryozoan *Tegella* cf. *spitzbergensis* (arctic, Bear I., North Atlantic). Pharm: Antibacterial (*Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Corynebacterium glutamicum*, and MRSA, for Eusynstyelamide B, D, E and F, IC_{50} between 6.25 μmol/L and > 50 μmol/L); Ref: M. Tadesse, et al, JNP, 2011, 74, 837



21 *Fromia monilis* Alkaloid

Type: Polyamines. $C_{23}H_{49}N_3O_3$ $[\alpha]_D$ = +3.5°. Source: Starfishes *Fromia monilis* and *Celerina heffernani* (New Caledonia). Pharm: Anti-HIV-1 (cells CEM 4 infacted by HIV-1, CC_{50} = 2.7 μg/mL). Ref: E. Palagoano, et al, Tetrahedron, 1995, 51, 3675