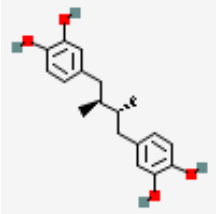
Masoprocol



PubChem CID:	71398
Chemical Names:	Masoprocol; Actinex; Meso-NDGA; Masoprocolum; Meso-Nordihydroguaiaretic acid; Masoprocolum [INN-Latin] More...
Molecular Formula:	$C_{18}H_{22}O_4$
Molecular Weight:	302.36488 g/mol
InChI Key:	HCZKYJDFEPMADG-TXEJJXNPSA-N
UNII:	7BO8G1BYQU
Modify Date:	2015-08-08
Create Date:	2005-06-24

Masoprocol is a potent lipoxygenase inhibitor that interferes with arachidonic acid metabolism. The compound also inhibits formyltetrahydrofolate synthetase, carboxylesterase, and cyclooxygenase to a lesser extent. It also serves as an antioxidant in fats and oils.

from MeSH

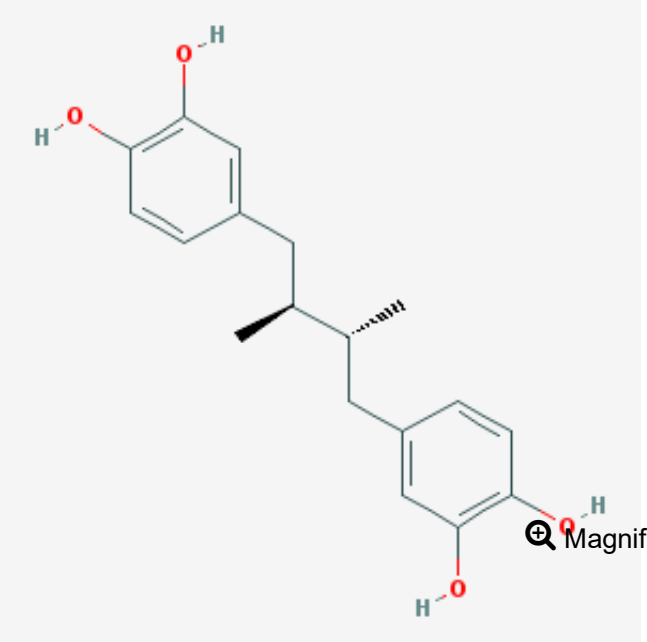
Masoprocol is a naturally occurring antioxidant dicatechol originally derived from the creosote bush Larrea divaricatta with antipromoter, anti-inflammatory, and antineoplastic activities. Masoprocol directly inhibits activation of two receptor tyrosine kinases (RTKs), the insulin-like growth factor receptor (IGF-1R) and the c-erbB2/HER2/neu receptor, resulting in decreased proliferation of susceptible tumor cell populations. This agent may induce apoptosis in susceptible tumor cell populations as a result of disruption of the actin cytoskeleton in association with the activation of stress activated protein kinases (SAPKs). In addition, masoprocol inhibits arachidonic acid 5-lipoxygenase (5LOX), resulting in diminished synthesis of inflammatory mediators such as prostaglandins and leukotrienes. It may prevent leukocyte infiltration into tissues and the release of reactive oxygen species.

Pharmacology from NCIt

Contents

1 2D Structure

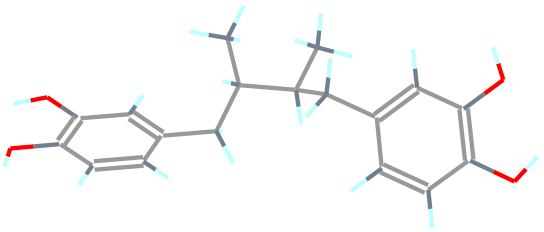
Search Download Get Image



from PubChem

2 3D Conformer

Search Download Get Image



Magnify

Show Hydrogens Show Atoms Interact

from PubChem

3 Names and Identifiers

3.1 Computed Descriptors

3.1.1 IUPAC Name

4-[(2S,3R)-4-(3,4-dihydroxyphenyl)-2,3-dimethylbutyl]benzene-1,2-diol

from PubChem

3.1.2 InChI

InChI=1S/C18H22O4/c1-11(7-13-3-5-15(19)17(21)9-13)12(2)8-14-4-6-16(20)18(22)10-14/h3-6,9-12,19-22H,7-8H2,1-2H3/t11-,12+

from PubChem

3.1.3 InChI Key

HCZKYJDFEPMADG-TXEJJXNPSA-N

from PubChem

3.1.4 Canonical SMILES

CC(CC1=CC(=C(C=C1)O)O)C(C)CC2=CC(=C(C=C2)O)O

from PubChem

3.1.5 Isomeric SMILES

C[C@H](CC1=CC(=C(C=C1)O)O)[C@@H](C)CC2=CC(=C(C=C2)O)O

from PubChem

3.2 Other Identifiers

3.2.1 CAS

500-38-9

from DrugBank

3.2.2 EC Number

248-606-6

from ECHA

3.2.3 UNII

7BO8G1BYQU

from FDA/SPL Indexing data

3.3 Synonyms

3.3.1 MeSH Synonyms

1. (R*,S*)-4,4'-(2,3-Dimethylbutane-1,4-diyl)bispyrocatechol
2. Acid, meso-Nordihydroguaiaretic
3. Actinex
4. Dihydronorguaiaretic Acid
5. Masoprocol
6. meso Nordihydroguaiaretic Acid
7. meso-Nordihydroguaiaretic Acid
8. Nordihydroguaiaretic Acid
9. Nordihydroguaiaretic Acid, (R*,S*)-Isomer

from MeSH

3.3.2 Depositor-Supplied Synonyms

1. Masoprocol
2. Actinex
3. meso-NDGA
4. Masoprocolum
5. meso-Nordihydroguaiaretic acid
6. Masoprocolum [INN-Latin]
7. CHX 100
8. UNII-7BO8G1BYQU
9. Actinex (TN)
10. 27686-84-6
11. CHX-100
12. AC1Q7ACC
13. Masoprocol (USAN/INN)
14. Masoprocol [USAN:INN]
15. EINECS 248-606-6
16. Lopac-N-5023
17. Nordihydroguaiaretic acid (meso-form)
18. Lopac0_000877
19. meso-4,4'-(2,3-Dimethyltetramethylene)dipyrocatechol
20. BIDD:ER0127
21. AC1L2G
22. CHEMBI
23. CHEBI:7
24. Nordihyd
25. 1,2-Benz
26. C18H22(
27. TNP002(
28. ZINC00(
29. DB0017
30. NCGC0(

from PubChem

4 Chemical and Physical Properties

4.1 Computed Properties

Molecular Weight	302.36488 g/mol
Molecular Formula	$C_{18}H_{22}O_4$
XLogP3	4.3
Hydrogen Bond Donor Count	4
Hydrogen Bond Acceptor Count	4
Rotatable Bond Count	5
Exact Mass	302.151809 g/mol
Monoisotopic Mass	302.151809 g/mol
Topological Polar Surface Area	80.9 A^2
Heavy Atom Count	22
Formal Charge	0
Complexity	303
Isotope Atom Count	0
Defined Atom Stereocenter Count	2
Undefined Atom Stereocenter Count	0
Defined Bond Stereocenter Count	0
Undefined Bond Stereocenter Count	0
Covalently-Bonded Unit Count	1

from PubChem

4.2 Experimental Properties

4.2.1 Melting Point

185.5 °C

PhysProp

from DrugBank

4.2.2 LogP

5.8

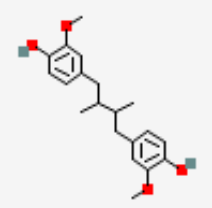
from DrugBank

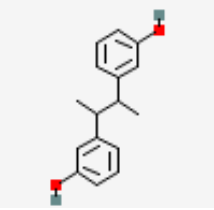
5 Related Records

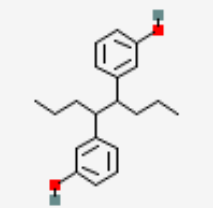
5.1 Related Compounds with Annotation

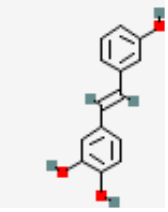
Download

Literature (5) 3D Structure (1) Bioactivities (53) Patents (200)


dihydroguaiaretic acid


NSC 297169


1,2-dipropyl-1,2-bis(3'-hy…


3,3',4-trihydroxysti

from PubChem

5.2 Related Compounds

Same Connectivity	7 records
Same Isotope	6 records
Same Parent, Connectivity	11 records
Same Parent, Isotope	10 records
Same Parent, Exact	5 records
Mixtures, Components, and Neutralized Forms	17 records
Similar Compounds	1329 records
Similar Conformers	32 records

from PubChem

5.3 Related Substances

All	71 records
Same	54 records
Mixture	17 records

from PubChem

5.4 Entrez Crosslinks

PubMed	446 records

from PubChem

6 Chemical Vendors

Refine/Analyze Download

Vendor/Supplier	Purchasable Chemical	PubChem SID
3B_SCI	3B1-003853	184529719
	3B3-033607	184537568
A&J Pharmtech CO., LTD.	AJ-08347	223519308
	ZB000699	223454768
Chembo	KB-239312	172888835
ABI Chem	AC1L2G35	104350366
	AC1Q7ACC	117616927
Chembase.cn	64	160963527
Aurum Pharmatech LLC	Z-3136	184816239
AKos Consulting & Solutions	AKOS016014015	163852927
Ark Pharm, Inc.	AK129790	163693552
ZINC	ZINC00012342	866655

from PubChem

7 Drug and Medication Information

7.1 Drug Indication

Used for the treatment of actinic keratoses (precancerous skin growths that can become malignant if left untreated).

from DrugBank

8 Pharmacology and Biochemistry

8.1 Pharmacology

Masoprocol is a novel antineoplastic agent. It is not known exactly how masoprocol works. Laboratory experiments have shown that masoprocol prevents cells similar to the ones found in actinic keratoses from multiplying. Masoprocol was withdrawn from the U.S. market in June 1996.

from DrugBank

Masoprocol is a naturally occurring antioxidant dicatechol originally derived from the creosote bush Larrea divaricatta with antipromoter, anti-inflammatory, and antineoplastic activities. Masoprocol directly inhibits activation of two receptor tyrosine kinases (RTKs), the insulin-like growth factor receptor (IGF-1R) and the c-erbB2/HER2/neu receptor, resulting in decreased proliferation of susceptible tumor cell populations. This agent may induce apoptosis in susceptible tumor cell populations as a result of disruption of the actin cytoskeleton in association with the activation of stress activated protein kinases (SAPKs). In addition, masoprocol inhibits arachidonic acid 5-lipoxygenase (5LOX), resulting in diminished synthesis of inflammatory mediators such as prostaglandins and leukotrienes. It may prevent leukocyte infiltration into tissues and the release of reactive oxygen species.

from NCIt

8.2 MeSH Pharmacological Classification

Antioxidants

Naturally occurring or synthetic substances that inhibit or retard the oxidation of a substance to which it is added. They counteract the harmful and damaging effects of oxidation in animal tissues. See a list of PubChem compounds matching this category.

from MeSH

Cyclooxygenase Inhibitors

Compounds or agents that combine with cyclooxygenase (PROSTAGLANDIN-ENDOPEROXIDE SYNTHASES) and thereby prevent its substrate-enzyme combination with arachidonic acid and the formation of eicosanoids, prostaglandins, and thromboxanes. See a list of PubChem compounds matching this category.

from MeSH

Lipoxygenase Inhibitors

Compounds that bind to and inhibit that enzymatic activity of LIPOXYGENASES. Included under this category are inhibitors that are specific for lipoxygenase subtypes and act to reduce the production of LEUKOTRIENES. See a list of PubChem compounds matching this category.

from MeSH

8.3 ATC Code

L01XX10 - Masoprocol < L01XX - Other antineoplastic agents < L01X - Other antineoplastic agents < L01 - Antineoplastic agents < L - Antineoplastic and immunomodulating agents More information...

from WHOCC

8.4 Absorption, Distribution and Excretion

Less than 1%-2% is absorbed through the skin over a 4-day period following application.

▸ *from DrugBank*

8.5 **Mechanism of Action**

Although the exact mechanism of action is not known, studies have shown that masoprocol is a potent 5-lipoxygenase inhibitor and has antiproliferative activity against keratinocytes in tissue culture, but the relationship between this activity and its effectiveness in actinic keratoses is unknown. Masoprocol also inhibits prostaglandins but the significance of this action is not yet known.

▸ *from DrugBank*

9 Toxicity

9.1 Toxicological Information

9.1.1 Toxicity Summary

Symptoms of overdose or allergic reaction include bluish coloration of skin, dizziness, severe, or feeling faint, wheezing or trouble in breathing.

from DrugBank

10 Literature

10.1 Depositor Provided PubMed Citations

Depositor Provided PubMed Citation Count

446 records

from PubChem

10.2 NLM Curated PubMed Citations

All NLM Curated PubMed Citations

References by MeSH Subheading

- administration and dosage
- adverse effects
- analogs and derivatives
- analysis
- antagonists and inhibitors
- blood
- chemical synthesis
- chemistry
- diagnostic use
- isolation and purification
- metabolism
- pharmacokinetics
- pharmacology
- poisoning
- standards
- therapeutic use
- toxicity

from PubChem

11 Patents

11.1 Depositor-Supplied Patent Identifiers

Refine/Analyze Download

1 to 10 of 2,747 **1** 2 3 ... 275 Relevance

Patent	Submitted	Granted
Dihalopropene compounds insecticides containing them as active ingredients, and intermediates for their production [US6214835]		2001-04-10
Treatment of HPV induced cancer using in situ application of two nordihydroguiaretic acid derivatives, tetramethyl NDGA M4N and tetraglycinal NDGA G4N [US6214874]		2001-04-10
Pesticidal compositions [US6221885]		2001-04-24
Photosensitive resin, resist based on the photosensitive resin, exposure apparatus and exposure method using the resist, and semiconductor device obtained by the exposure method [US6225019]		2001-05-01
Cockroach controlling compositions [US6225344]		2001-05-01
Ester compounds [US6225495]		2001-05-01
Methods of regulating skin appearance with vitamin B3 compound [US6238678]		2001-05-29
Dihalopropene compounds, insecticidal/acaricidal agents containing same, and intermediates for their production [US6268313]		2001-07-31
Substituted benzopyran derivatives for the treatment of inflammation [US6271253]		2001-08-07
Conjugates of dithiocarbamate disulfides with pharmacologically active agents and uses therefor [US6274627]		2001-08-14

from PubChem

12 Biomolecular Interactions and Pathways

12.1 DrugBank Interactions

DrugBank Interactions: 1 of 2	
Target	Arachidonate 5-lipoxygenase More information...
Action	inhibitor
General Function	Involved in oxidoreductase activity, acting on single donors with incorporation of molecular oxygen, incorporation of two atoms of oxygen
Gene Name	ALOX5
GenBank Gene	J03600
GenBank Protein	187193
References	1. Audouin C, Mestdagh N, Lassoie MA, Houssin R, Henichart JP: N-Aminoindoline derivatives as inhibitors of 5-lipoxygenase. Bioorg Med Chem Lett. 2001 Mar 26;11(6):845-8. Pubmed 2. Lambert JD, Meyers RO, Timmermann BN, Dorr RT: Pharmacokinetic analysis by high-performance liquid chromatography of intravenous nordihydroguaiaretic acid in the mouse. J Chromatogr B Biomed Sci Appl. 2001 Apr 15;754(1):85-90. Pubmed 3. Azadzoi KM, Heim VK, Tarcan T, Siroky MB: Alteration of urothelial-mediated tone in the ischemic bladder: role of eicosanoids. Neurourol Urodyn. 2004;23(3):258-64. Pubmed 4. West M, Mhatre M, Ceballos A, Floyd RA, Grammas P, Gabbita SP, Hamdheydari L, Mai T, Mou S, Pye QN, Stewart C, West S, Williamson KS, Zemlan F, Hensley K: The arachidonic acid 5-lipoxygenase inhibitor nordihydroguaiaretic acid inhibits tumor necrosis factor alpha activation of microglia and extends survival of G93A-SOD1 transgenic mice. J Neurochem. 2004 Oct;91(1):133-43. Pubmed 5. Jeon SB, Ji KA, You HJ, Kim JH, Jou I, Joe EH: Nordihydroguaiaretic acid inhibits IFN-gamma-induced STAT tyrosine phosphorylation in rat brain astrocytes. Biochem Biophys Res Commun. 2005 Mar 11;328(2):595-600. Pubmed 6. Chen X, Ji ZL, Chen YZ: TTD: Therapeutic Target Database. Nucleic Acids Res. 2002 Jan 1;30(1):412-5. Pubmed

from DrugBank

DrugBank Interactions: 2 of 2	
Enzyme	Cytochrome P450 2J2
Action	inhibitor
General Function	Secondary metabolites biosynthesis, transport and catabolism
Specific Function	This enzyme metabolizes arachidonic acid predominantly via a NADPH-dependent olefin epoxidation to all four regioisomeric cis-epoxyeicosatrienoic acids. One of the predominant enzymes responsible for the epoxidation of endogenous cardiac arachidonic acid pools
Gene Name	CYP2J2
GenBank Gene	U37143
GenBank Protein	18254513

References	Preissner S, Kroll K, Dunkel M, Senger C, Goldsobel G, Kuzman D, Guenther S, Winnenburg R, Schroeder M, Preissner R: SuperCYP: a comprehensive database on Cytochrome P450 enzymes including a tool for analysis of CYP-drug interactions. Nucleic Acids Res. 2010 Jan;38(Database issue):D237-43. Epub 2009 Nov 24. Pubmed

from DrugBank

13 Biological Test Results

13.1 BioAssay Results

Refine/Analyze Download

1 to 10 of 366 **1** 2 3 … 37 Relevance

Activity	Substance	BioAssay
inactive Potency	50106727	qHTS Assay for Inhibitors of the ERK Signaling Pathway using a Homogeneous Screening Assay; Stimulation with EGF [AID: 1454]
inactive Potency: 19.9526μM	50106727	qHTS Assay for Identifying the Cell-Membrane Permeable IMPase Inhibitors: Potentiation with Lithium [AID: 1457]
active Potency: 12.9953μM	90341429	qHTS Assay for Small Molecule Inhibitors of Mitochondrial Division or Activators of Mitochondrial Fusion [AID: 485298]
inactive Potency	50106727	qHTS Assay for Enhancers of SMN2 Splice Variant Expression [AID: 1458]
inactive Potency	90341429	qHTS Assay for NPC1 Promoter Activators [AID: 485313]
inactive Potency: 19.9526μM	90341429	qHTS of Trypanosoma Brucei Inhibitors: LOPAC Validation [AID: 624147]
inactive Potency	90341429	qHTS of Nrf2 Activators: LOPAC Validation [AID: 624149]
active Potency: 0.631μM	90341429	qHTS for Inhibitors of Glutaminase (GLS): LOPAC Validation [AID: 624146]
inactive	11111541	qHTS Assay for Spectroscopic Profiling in Resorufin Spectral Region [AID: 588]
inactive	11111540	qHTS Assay for Spectroscopic Profiling in Resorufin Spectral Region [AID: 588]

from PubChem

14 Classification

14.1 Ontologies

14.1.1 MeSH Tree

Refine/Analyze Download

1 to 1 of 1	List View	Tree View
Masoprocol		

from MeSH

14.1.2 ChEBI Ontology

Refine/Analyze Download

1 to 1 of 1	List View	Tree View
masoprocol		

from ChEBI

14.1.3 Gene Ontology: Biological Process

Refine/Analyze Download

1 to 10 of 29 **1** 2 3	List View	Tree View
alpha-galactosidase [Homo sapiens]		
heat shock protein HSP 90-alpha isoform 2 [Homo sapiens]		
vitamin D3 receptor isoform VDRA [Homo sapiens]		
Arachidonate 15-lipoxygenase B		
AR protein [Homo sapiens]		
cellular tumor antigen p53 isoform a [Homo sapiens]		
regulator of G-protein signaling 4 [Homo sapiens]		
GLS protein [Homo sapiens]		

GLS protein [Homo sapiens]

cytochrome P450 2C9 precursor [Homo sapiens]

15-hydroxyprostaglandin dehydrogenase [NAD(+)] isoform 1 [Homo sapiens]

from Gene Ontology

14.1.4 **Gene Ontology: Cellular Component**

Refine/Analyze Download

1 to 10 of 12 **1** 2 **List View** Tree View

heat shock protein HSP 90-alpha isoform 2 [Homo sapiens]

ataxin-2 [Homo sapiens]

chromobox protein homolog 1 [Homo sapiens]

15-lipoxygenase, partial [Homo sapiens]

15-hydroxyprostaglandin dehydrogenase [NAD(+)] isoform 1 [Homo sapiens]

aldehyde dehydrogenase 1 family, member A1 [Homo sapiens]

alpha-galactosidase [Homo sapiens]

M-phase phosphoprotein 8 [Homo sapiens]

thyroid hormone receptor beta isoform 2 [Rattus norvegicus]

cellular tumor antigen p53 isoform a [Homo sapiens]

from Gene Ontology

14.1.5 **Gene Ontology: Molecular Function**

Refine/Analyze Download

1 to 10 of 31 **1** 2 3 4 **List View** Tree View

heat shock protein HSP 90-alpha isoform 2 [Homo sapiens]

alpha-galactosidase [Homo sapiens]

AR protein [Homo sapiens]

Arachidonate 15-lipoxygenase B

cellular tumor antigen p53 isoform a [Homo sapiens]

vitamin D3 receptor isoform VDRA [Homo sapiens]

cytochrome P450 2C9 precursor [Homo sapiens]

regulator of G-protein signaling 4 [Homo sapiens]

Thrombopoietin [Homo sapiens]

GLS protein [Homo sapiens]

from Gene Ontology

14.1.6 **KEGG: ATC**

Refine/Analyze Download

1 to 1 of 1 **List View** Tree View

Masoprocol (USAN/INN)

from KEGG

14.1.7 **KEGG: Antineoplastics**

Refine/Analyze Download

1 to 1 of 1 **List View** Tree View

Masoprocol (USAN/INN)

from KEGG

14.1.8 **WIPO IPC**

Refine/Analyze Download

1 to 10 of 3,614 **1** 2 3 … 362 **List View** Tree View

A61P11/04 - for throat disorders

A61P11/06 - Antiasthmatics

A61P11/08 - Bronchodilators

A61P11/10 - Expectorants

A61P11/14 - Antitussive agents

A61P11/16 - Central respiratory analeptics

A61P13/00 - Drugs for disorders of the urinary system

A61P13/02 - of urine or of the urinary tract, e.g. urine acidifiers

A61P13/08 - of the prostate

A61P13/10 - of the bladder

from WIPO

14.1.9 **WHO ATC Classification System**

Refine/Analyze Download

1 to 1 of 1 **List View** Tree View

L01XX10 - Masoprocol

from WHO ATC Code

14.2 **Substance Categorization Classification**

Download

- Bioassay Screening Results (14)
- Biological Properties (15)
- Chemical Reactions (2)
- Database Vendor (3)
- Journal Publishers (3)
- Metabolic Pathways (1)
- NIH Molecular Libraries (11)
- Patents (5)

- Physical Properties (2)
- Substance Vendors (12)
- Theoretical Properties (3)
- Toxicology (2)

from PubChem

15 Information Sources

1. Masoprocol from DrugBank DB00179 http://www.drugbank.ca/drugs/DB00179
2. Masoprocol from NCIt C701_1513 http://ncit.nci.nih.gov/ncitbrowser/ConceptReport.jsp?dictionary=NCI_Thesaurus&ns=NCI_Thesaurus&code=C701
   NCI Thesaurus (NCIt) provides reference terminology for many systems. It covers vocabulary for clinical care, translational and basic research, and public information and administrative activities.
3. DrugBank DB00179 interaction #1 http://www.drugbank.ca/drugs/DB00179#targets
4. DrugBank DB00179 interaction #2 http://www.drugbank.ca/drugs/DB00179#enzymes
5. FDA/SPL Indexing data 7BO8G1BYQU http://www.fda.gov/ForIndustry/DataStandards/StructuredProductLabeling/ucm377913.htm
6. WHOCC 3255 http://www.whocc.no/atc/
7. ECHA 248-606-6 http://echa.europa.eu/
8. PubChem http://pubchem.ncbi.nlm.nih.gov
   Data deposited in or computed by PubChem
9. Masoprocol from MeSH 68009637 http://www.ncbi.nlm.nih.gov/mesh/68009637
10. MeSH Tree from MeSH DescTree http://www.nlm.nih.gov/mesh/meshhome.html
    MeSH (Medical Subject Headings) is the NLM controlled vocabulary thesaurus used for indexing articles for PubMed.
11. ChEBI Ontology from ChEBI OBO http://www.ebi.ac.uk/chebi/userManualForward.do#ChEBI%20Ontology
    The ChEBI Ontology is a structured classification of the entities contained within ChEBI.
12. ATC from KEGG br08303 http://www.genome.jp/dbget-bin/www_bget?brite:br08303
    Anatomical Therapeutic Chemical (ATC) classification
13. Antineoplastics from KEGG br08308 http://www.genome.jp/dbget-bin/www_bget?brite:br08308
    Antineoplastics
14. biological process from Gene Ontology GO_ROOT_486550 http://amigo.geneontology.org/amigo/term/GO:0008150
    *The Gene Ontology (GO) http://www.geneontology.org/ project provides a controlled vocabulary of terms for describing the functions of gene products, and is divided into three domains. Each term in the biological processes domain, shown here, represents recognized series of events, or a collection of molecular events with a defined beginning and end. Mutant phenotypes often reflect disruptions in biological processes. The terms below apply to the **gene/protein target(s) tested by the BioAssay**.*
15. cellular component from Gene Ontology GO_ROOT_486551 http://amigo.geneontology.org/amigo/term/GO:0005575
    *The Gene Ontology (GO) http://www.geneontology.org/ project provides a controlled vocabulary of terms for describing the functions of gene products, and is divided into three domains. The cellular components domain, shown here, describes locations, at the levels of subcellular structures and macromolecular complexes. An example of a cellular component is the nuclear inner membrane, with the synonym inner envelope. Generally, a gene product is located in or is a subcomponent of a particular cellular component. The terms below apply to the **gene/protein target(s) tested by the BioAssay**.*
16. molecular function from Gene Ontology GO_ROOT_486552 http://amigo.geneontology.org/amigo/term/GO:0003674
    *The Gene Ontology (GO) http://www.geneontology.org/ project provides a controlled vocabulary of terms for describing the functions of gene products, and is divided into three domains. Each term in the molecular functions domain, shown here, represent a protein's jobs or abilities. These may include transporting things around, binding to things, holding things together and changing one thing into another. This is different from the biological processes the gene product is involved in, which involve more than one activity. The terms below apply to the **gene/protein target(s) tested by the BioAssay**.*
17. International Patent Classification 2015 from WIPO IPC http://www.wipo.int/classifications/ipc/
    The World Intellectual Property Organization (WIPO) International Patent Classification (IPC) provides for a hierarchical system of language independent symbols for the classification of patents and utility models according to the different areas of technology to which they pertain.
18. ATC Code from WHO ATC Code ATCTree http://www.whocc.no/atc/
    In the World Health Organization (WHO) Anatomical Therapeutic Chemical (ATC) classification system, the active substances are divided into different groups according to the organ or system on which they act and their therapeutic, pharmacological and chemical properties.
19. Antioxidants from MeSH 68000975 http://www.ncbi.nlm.nih.gov/mesh/68000975
20. Cyclooxygenase Inhibitors from MeSH 68016861 http://www.ncbi.nlm.nih.gov/mesh/68016861
21. Lipoxygenase Inhibitors from MeSH 68016859 http://www.ncbi.nlm.nih.gov/mesh/68016859