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Revisão

Natural products inhibitors of the angiotensin converting enzyme (ACE). A review between 1980 - 2000

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RESUMO: "Produtos naturais inibidores da enzima conversora de angiotensina (ECA). Uma revisão entre 1980 - 2000". A inibição da Enzima Conversora da Angiotensina (ECA) é um alvo terapêutico moderno e eficaz no tratamento da hipertensão arterial. Na cascata enzimática que envolve o sistema renina-angiotensina, a ECA promove a remoção dos aminoácidos histidil-leucina da angiotensina I para formar o octapeptídio angiotensina II, a qual é fisiologicamente ativa em diversos sistemas, e considerado como um dos mais potentes vasoconstrictores endógenos conhecido. Portanto, uma racionalidade no tratamento da hipertensão seria administrar drogas ou compostos de origem natural que inibam seletivamente a ECA. O presente estudo constitui uma revisão da literatura sobre plantas e moléculas de origem natural com potencial anti-hipertensivo, baseado na inibição *in vitro* da ECA. A revisão referencia 321 plantas, partes usadas, tipo de extrato e se é ativo ou não. Inclui ainda o nome de 158 compostos isolados de plantas superiores, esponjas e algas marinhas, fungos e venenos de cobra. Alguns aspectos de pesquisa recente com produtos naturais direcionados à produção de drogas anti-hipertensivas também são discutidos. Nesta revisão 148 referências foram consultadas.

Unitermos: Enzima conversora da angiotensina, efeito anti hipertensivo, agentes hipotensivos.

ABSTRACT: Inhibition of Angiotensin Converting Enzyme (ACE) is a modern therapeutic target in the treatment of hypertension. Within the enzyme cascade of the renin-angiotensin system, ACE removes histidyl-leucine from angiotensin I to form the physiologically active octapeptide angiotensin II, one of the most potent known vasoconstrictors. Therefore, a rationale for treating hypertension would be to administer drugs or natural compounds which selectively inhibit ACE. The present work constitutes a review of the literature of plants and chemically defined molecules from natural sources with *in vitro* anti-hypertensive potential based on the inhibition of ACE. The review refers to 321 plants, the parts utilized, type of extract and whether they are active or not. It includes also the names of 158 compounds isolated from higher plants, marine sponges and algae, fungi and snake venom. Some aspects of recent research with natural products directed to produce anti-hypertensive drugs are discussed. In this review, 148 references were cited.

Keywords: Angiotensin converting enzyme, anti-hypertensive effect, hipotensive agents.

INTRODUCTION

The Sixth Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure defines hypertension as systolic blood pressure (SBP) of 140 mm Hg or greater, diastolic blood pressure (DBP) of 90 mm Hg or greater, or taking anti-hypertensive medication. The objective of identifying and treating high blood pressure is to reduce the risk of cardiovascular disease and associated morbidity and mortality. To that end, it is useful to provide a classification of adult blood pressure for the purpose of identifying high-risk individuals and to provide guidelines for treatment. The positive relationship between SBP and DBP and cardiovascular risk has long been recognized. This relationship is strong, continuous, graded, consistent, independent, predictive, and etiologically significant for those with and without coronary heart disease (Stamler, 1991, Flack et al., 1995). Therefore, although classification of adult blood pressure is somewhat arbitrary, it is useful to clinicians who must make treatment decisions based on a verification of factors including the actual level of blood pressure. Hypertension detection begins with proper blood pressure measurements. Repeated blood pressure measurements will determine whether initial elevations persist and require prompt attention or have returned to normal. According to the National Heart, Lung and Blood Institute (1997), heart disease and stroke remain the first and third leading causes of death, respectively, in the United States and impose an enormous financial and

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social burden on Americans. In particular, the continued high prevalence of hypertension and hypertension-related complications of stroke, heart failure, and end-stage renal disease in the southeastern United States makes these diseases a public health concern for all who reside in this region, particularly African Americans (Hall et al., 1997). Approximately 50 million adult Americans have hypertension and are still unaware that they have high blood pressure (Burt et al., 1995). In addition, most persons with hypertension have additional risk factors for cardiovascular disease (Furster; Pearson, 1996). Thus, prevention and treatment of hypertension and target organ disease remain important public health challenges that must be addressed as we enter the new millennium.

There are different way to treat the problem related to arterial hypertension. Treatment leading to lower levels may be useful, particularly to prevent stroke (Du et al., 1997), to preserve renal function (Lazarus et al., 1997) and to prevent or slow heart failure progression (Krumholz et al., 1997, Neaton et al., 1993). The goal may be achieved by lifestyle modification, alone or with pharmacological treatment.

Non-Pharmacological treatment of arterial hypertension

The main objective of hypertensive treatment is to reduce the high morbidity and mortality. As well as reducing the pressure, an important objective of treatment is to control other cardiovascular risk factors. Lifestyle modifications offer the potential for preventing hypertension, have been shown to be effective in lowering blood pressure, and can reduce other cardiovascular risk factors at little cost and with minimal risk (Appel et al., 1997). Even when lifestyle modifications alone are not adequate in controlling hypertension, they may reduce the number and dosage of anti-hypertensive medications needed to manage the condition (Neaton et al., 1993, Singer et al., 1995).

Pharmacological treatment of arterial hypertension

Reducing blood pressure with drugs clearly decreases cardiovascular morbidity and mortality. Protection has been demonstrated for stroke, coronary events, heart failure, progression of renal disease, progression to more severe hypertension, and all-cause mortality (Psaty et al., 1997, Moser; Hebert, 1996).

Actually, there are a lot of alternatives available to treat arterial hypertension, both in schemes of monotherapy and/or combined therapy. The efficacy, security and effects of the different drugs are fundamental criteria to be considered in choosing the anti-hypertensive treatment scheme for each patient. In Table 1 the conventional pharmacological anti-hypertensive medications are presented, further details see references.

Mechanism of anti-hypertensive effect based on the inhibition of the angiotensin converting enzyme (ACE)

The renin-angiotensin-aldosterone system plays a pivotal role in the maintenance of vascular tone *vis à vis* peripheral resistance. Renin produced from the juxtaglomerular apparatus of the kindney, splits angiotensinogen to produce the inactive decapeptide angiotensin I. The latter is then converted to the powerful octapeptide vasoconstrictor, angiotensin II by the action of angiotensin converting enzyme (ACE). Angiotensin II also stimulates the synthesis and release of aldosterone from the adrenal cortex, which increases blood pressure by promoting sodium retention (and thereby water retention) in the distal tubules (Ahnfelt-Ronne, 1991). Research suggests that angiotensin II stimulates the production of superoxide anion and hydrogen peroxide in the polymorphonuclear leucocytes, which inactivates the vasodilatory compounds endothelial derived vascular relaxing factor (nitric oxide – NO) and prostacyclin (PGI_2) (Kumar; Das, 1993). ACE also inactivates the vasodilating nonapeptide bradykinin, which theoretically contributes to the hypertensive effects of ACE activity (Ahnfelt-Ronne, 1991) (Figure 1).

Therefore, a good rationale for treating hypertension would be to administer drugs or natural compounds which selectively inhibit ACE. Such selective inhibitors would be capable of decreasing blood pressure and producing natriuresis and diuresis.

In a previous paper this research group has reviewed crude plant extracts and chemically defined molecules with potential antitumor activity for mammary (Moura et al., 2001), cervical (Moura et al., 2002) and

Main lifestyle modifications for hypertension prevention and management.

Main Lifestyle Modifications
- Lose weight if overweight.
- Limit alcohol intake
- Increase aerobic physical activity
- Reduce sodium intake to no more than 100 mmol per day
- Maintain adequate intake of dietary calcium and magnesium for general health
- Stop smoking
- Reduce intake of dietary saturated fat and cholesterol for overall cardiovascular health.

Table 1. Conventional anti-hypertensive medication

Drugs	References
Diuretics	Kaplan, 1996
Beta-blockers	Heintzen; Strauer, 1994
Alpha$_1$-blockers	Grimm, 1989; Lasagna, 2000
Alpha$_2$-adrenoceptor agonists	Wallin; Frisk-Holmberg, 1981
Calcium channel-blockers	Wenzel et al., 2000; Zannad, 2000
Angiotensin II receptor antagonists	Burnier; Maillard, 2001; Chung, 1999
Inhibitors of the angiotensin converting enzyme (ACE)	Waeber, 1998; Gustafsson et al., 1998

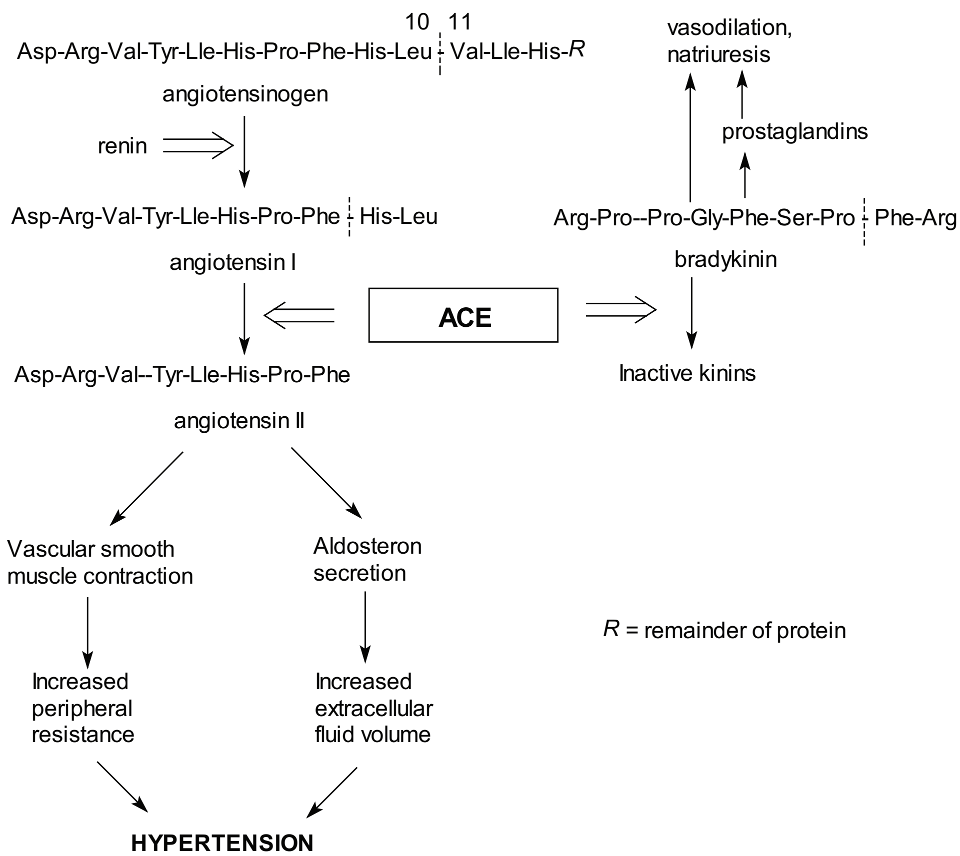

Figure 1. The suggested hypertensive mechanism of angiotensin. Adapted from Hansen et al., 1995 and Hansen et al., 1996a.

ovarian neoplasias (Silva et al., 2003), as inhibitors of HMG CoA reductase (Gonçalves et al., 2000), central analgesic activity (Almeida et al., 2001), employed in prevention of osteoporosis (Pereira et al., 2002), for the treatment of Parkinson's disease (Morais, 2003), with antileishmanial (Rocha et al., 2005), hypoglycemic (Barbosa-Filho et al., 2005), antiinflammatory activity (Falcão et al., 2005, Barbosa-Filho et al., 2006a) and inhibitors of the enzyme acetylcholinesterase (Barbosa-Filho et al., 2006b).

In this work we present such natural products, in other words, plant extracts, semi purified fractions, chemically defined molecules isolated from plants and metabolites from fungi that act specifically inhibiting the angiotensin converting enzyme (ACE), which is one of the most powerful known vasoconstrictors.

MATERIAL AND METHODS

The keyword for this revision was ACE (Angiotensin Converting Enzyme). We made a data search in the Chemical Abstracts, Biological Abstracts and the NAPRALERT (trademark, NAtural PRoducts ALERT) database at the Illinois University, Chicago. The specialized magazines referenced were than searched.

Table 2. Percentage inhibition of angiotensin converting enzyme (ACE) activity by *Euphorbia hirta* extracts at doses of 500 μg and 150 μg

Extract and dose	Mean percentage inhibition of ACE
Crude methanol	
150 μg	55.4 ± 0.02
500 μg	90.3 ± 0.50
Fraction at 150 μg	
Petroleum ether (non-polar compounds)	18.2 ± 2.5
Chloroform (medium polar)	43.7 ± 4.5
Methanol (polar)	48.6 ± 0.9
Water (very polar)	45.4 ± 1.8

RESULTS AND DISCUSSION

Plants which inhibit the angiotensin converting enzyme

Screening for anti-hypertensive effects in traditional medicines has been performed over many years and several animal models have been used (Villar et al., 1986). In western medicine, drug development has become increasingly more mechanistic in focus with the aim of excluding unwanted side-effects. The rationale behind this approach is to identify a molecular target (receptor or enzyme) which has an essential role in the regulation of the disease and then search for ligands, substrates or inhibitors of the target.

In the treatment of hypertension, inhibition of the angiotensin converting enzyme (ACE) is established as a modern therapeutic principle.

Elbl and Wagner (1991) introduced an *in vitro* assay for the detection of ACE inhibitors in plant extracts. This method is based on the ACE-catalyzed cleavage of the chromophore-fluorophore labelled substrate, dansyltriglycine, into dansylglycine, which is quantitatively measured by HPLC (high performance liquid chromatography). By using this technique, a number of plant species have been found to be active (Elbl; Wagner, 1991).

Williams et al. (1997) using another bioassay, but also involving ACE inhibition, verified that the leaves and stems of *Euphorbia hirta* inhibited the activity of angiotensin converting enzyme by 90% and 50% at 500 μg and 150 μg respectively using enzyme linked immunosorbent assay (ELISA). The data are presented in Table 2. The study also revealed that the most active ACE inhibitory compounds were present in the polar and very polar fractions of the medium.

The results of the literature survey are presented in Table 3, which lists the effects on angiotensin converting enzyme of 321 plant extracts. The plants are arranged in alphabetical order. Each entry gives the following information in sequence: botanical name, family, part used, type of extract or fraction, whether active or not and reference.

From these studies, is appears to be the possibe, using biomonitored phytochemical methods, to find out new substances potentially active, which may prove important for the development of new substances inhibitors of the angiotensin converting enzyme.

Chemically defined molecules inhibitors of the angiotensin converting enzymes

Synthetic drugs such as captopril (Ondetti et al., 1977) or teprotide (Ferreira, 1965), a nonapeptide isolated from the venom of *Bothrops jararacussu* with established ACE inhibiting activity are used as first line drugs in both secondary and primary hypertension. The rising cost of these and other imported anti-hypertensive drugs stimulates the evaluation of new products as a source of cheaper agents. Several classes of ACE inhibitory compounds were isolated from plants, for example, flavonoids (Wagner et al., 1991; Wagner; Elbl, 1992; Hansen et al., 1996b), xanthones (Chen et al., 1992), secoiridoids (Hansen et al., 1996a). For a comprehensive review of these compounds, see Hansen (1995).

The results of the literature are presented in Table 4, which lists the effects on angiotensin converting enzyme of 158 chemically defined molecules. The compounds are arranged in alphabetical order. Each entry gives the following information in sequence: chemical name, class, whether active or not and reference.

CONCLUSION

This revision focussed initially on the search for information about natural product inhibitors of the angiotensin converting enzyme (ACE). From the literature searched, 321 species of plants and 158 natural substances which inhibit ACE were identifed. These natural products may become important for human clinical treatments.

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Table 3. Plant extracts summary showing inhibition of angiotensin converting enzyme

Species	Family	Part used	Extract	Activity	Reference
Abrus cantoniensis	Fabaceae	Dried aerial	H_2O	Inactive	Han et al., 1991
Abutilon indicum	Malvaceae	Root	Acetone	Weak	Hansen, 1995
		Root	EtOH (95%)	Inactive	Hansen, 1995
		Root	H_2O	Weak	Hansen, 1995
Achyranthes aspera	Amaranthaceae	Aerial parts	Acetone	Weak	Hansen, 1995
		Aerial parts	EtOH (95%)	Active	Hansen, 1995
		Aerial parts	H_2O	Weak	Hansen, 1995
Achyranthes bidentata	Amaranthaceae	Dried root	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Achyranthes japonica	Amaranthaceae	Root	MeOH	Inactive	Oh et al., 1997
Achyranthes rubrofusca	Amaranthaceae	Aerial parts	Acetone	Weak	Hansen, 1995
		Aerial parts	EtOH (95%)	Weak	Hansen, 1995
Aconitum koreanum	Ranunculaceae	Tuber	MeOH	Inactive	Oh et al., 1997
Aconitum locznanum	Ranunculaceae	Root	MeOH	Inactive	Oh et al., 1997
Acorus gramineus	Araceae	Rhizome	MeOH	Inactive	Oh et al., 1997
		Dried rhizome	H_2O	Weak	Han, 1991
Actinidia arguta	Actinidaceae	Fruit	MeOH	Inactive	Oh et al., 1997
Actinostemma lobatum	Cucurbitaceae	Dried entire plant	MeOH-H_2O (1:1)	Active	Inokuchi et al., 1984
Agrimonia pilosa	Rosaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Ajuga decumbens	Lamiaceae	Dried entire plant	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Akebia sp.	Lardizabalaceae	Dried stem	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Albizia julibrissin	Fabaceae	Bark	MeOH	Inactive	Oh et al., 1997
		Dried bark	H_2O	Equivocal	Han, 1991
Alisma orientale	Alismataceae	Dried rhizome	MeOH-H_2O (1:1)	Inactiva	Inokuchi et al., 1984
		Dried rhizome	H_2O	Active	Han, 1991
		Rhizome	MeOH	Inactive	Oh et al., 1997
Allium sativum	Liliaceae	Fresh bulb	Lyophilized	Inactive	Sendl et al., 1992
Allium ursinum	Liliaceae	Fresh bulb	Lyophilized	Inactive	Sendl et al., 1992
		Fresh leaf	Lyophilized	Active	Sendl et al., 1992
Allophylus edulis	Sapindaceae	Branches	Hexane	Inactive	Arisawa et al., 1989
		Branches	$CHCl_3$	Inactive	Arisawa et al., 1989
		Branches	BuOH	Active	Arisawa et al., 1989
		Branches	EtOH (70%)	Active	Arisawa et al., 1989
		Branches	H_2O	Inactive	Arisawa et al., 1989
Anemarrhena asphodeloides	Liliaceae	Rizhome	MeOH	Inactive	Oh et al., 1997
Angelica acutiloba	Apiaceae	Dried root	EtOH (95%)	Active	Ham et al., 1996
		Dried root	Decoction	Active	Kanetoshi et al., 1993
Angelica gigas	Apiaceae	Dried root	EtOH (95%)	Active	Ham et al., 1996
		Root	MeOH	Weak	Oh et al., 1997
Angelica keiskei	Apiaceae	Dried leaf	EtOH (80%)	Active	Shimizu et al., 1999

Angelica koreana	Apiaceae	Rizhome	MeOH	Inactive	Oh et al., 1997
Angelica pubescens	Apiaceae	Dried root	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
			H_2O	Weak	Han et al., 1991
Angelica sinensis	Apiaceae	Dried root	H_2O	Equivocal	Han et al., 1991
Angelica species	Apiaceae	Dried root	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Angelica tenuissima	Apiaceae	Rizhome	MeOH	Inactive	Oh et al., 1997
Arctium lappa	Asteraceae	Dried fruit	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
		Dried fruit	H_2O	Equivocal	Han et al., 1991
		Seed	MeOH	Inactive	Oh et al., 1997
Areca catechu	Arecaceae	Dried seed	Chromatog. fraction	Active	Inokuchi et al., 1984
		Dried seed	MeOH-H_2O (1:1)	Active	Inokuchi et al., 1984
		Dried seed	Tannin fraction	Active	Inokuchi et al., 1996a
Arisaema amurense	Araceae	Rizhome	MeOH	Inactive	Oh et al., 1997
Arisaema consanguineum	Araceae	Dried rizhome	H_2O	Active	Han 1991
Aristolochia contorta	Aristolochiaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Aristolochia debilis	Aristolochiaceae	Dried root	H_2O	Active	Han 1991
Aristolochia manshuriensis	Aristolochiaceae	Dried stem	H_2O	Weak	Han 1991
		Stem	Acetone	Active	Hansen et al., 1995
		Stem	EtOH (95%)	Active	Hansen et al., 1995
		Stem	H_2O	Active	Hansen et al., 1995
Aristotelia chilensis	Elaeocarpaceae	Bark	EtOH (95%)	Active	Hansen et al., 1995
Artemisia apiaceae	Asteraceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Artemisia capillaris	Asteraceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
		Dried entire	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Asarum heterotropoides	Aristolochiaceae	Dried aerial	H_2O	Active	Han et al., 1991
Asarum sieboldii	Aristolochiaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
		Dried aerial	H_2O	Active	Han et al., 1991
Asarum sp.	Aristolochiaceae	Dried entire plant	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Asparagus cochinchenensis	Liliaceae	Dried root	H_2O	Inactive	Han et al., 1991
Astilbe chinensis	Saxifragaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Astragalus membranaceus	Fabaceae	Dried root	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Astragalus sinicus	Fabaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Atractylodes japonica	Asteraceae	Rhizome	$CHCl_3$	Weak	Oh et al., 1997
		Rhizome	H_2O	Weak	Oh et al., 1997
		Rhizome	MeOH	Weak	Oh et al., 1997
Atractylodes macrocephala	Asteraceae	Dried rhizome	H_2O	Equivocal	Han et al., 1991
Belamcanda chinensis	Iridaceae	Dried rhizome	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
		Dried root	H_2O	Equivocal	Han et al , 1991
Benincasa hispida	Cucurbitaceae	Seed	MeOH	Weak	Oh et al., 1997
Bistorta suffulta	Polygonaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Boehmeria nivea	Urticaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997

Boehmeria tricuspis	Urticaceae	Aerial parts	MeOH	Inactive	Ohet al., 1997
Boerhavia diffusa	Nyctaginaceae	Root	Acetone	Weak	Hansen et al., 1995
		Root	EtOH (95%)	Weak	Hansen et al., 1995
		Root	H_2O	Active	Hansen et al., 1995
Bupleurum falcatum	Apiaceae	Root	$CHCl_3$	Weak	Oh et al., 1997
		Root	H_2O	Inactive	Oh et al., 1997
		Root	MeOH	Weak	Oh et al., 1997
Camellia japonica	Theaceae	Flowers	MeOH	Inactive	Oh et al., 1997
Camellia sinensis	Theaceae	Green leaf	Acetone	Active	Cho et al., 1993
		Dried leaf	Acetone	Inactive	Mitane et al., 1996
Cardiospermum halicacabum	Sapindaceae	Aerial parts	Acetone	Weak	Hansen et al., 1995
		Aerial parts	EtOH (95%)	Inactive	Hansen et al., 1995
		Aerial parts	H_2O	Weak	Hansen et al., 1995
Cardus crispus	Asteraceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Carpesium abrotanoides	Asteraceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Carsella bursa-pastoris	Brassicaseae	Dried entire plant	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Cassia obtusifolia	Fabaceae	Dried seed	H_2O	Inactive	Han et al., 1991
Cassia sp.	Fabaceae	Dried seed	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Cayratia japonica	Vitaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Celastrus orbiculatus	Celastraceae	Root	MeOH	Inactive	Oh et al., 1997
Centella asiatica	Apiaceae	Aerial parts	Acetone	Active	Hansen et al., 1995
		Aerial parts	EtOH (95%)	Active	Hansen et al., 1995
		Aerial parts	H_2O	Active	Hansen et al., 1995
Centipeda minima	Asteraceae	Dried aerial	H_2O	Inactive	Han et al., 1991
Chenopodium album	Chenopodiaceae	Dried entire plant	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Chysanthenum indicum	Asteraceae	Flowers	MeOH	Inactive	Oh et al., 1997
Chysanthenum lavandulaefolium	Asteraceae	Dried flowers	H_2O	Active	Han et al., 1991
Cimicifuga foetida	Ranunculaceae	Dried rizhome	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Cimicifuga heracleifolia	Ranunculaceae	Rhizome	MeOH	Inactive	Oh et al., 1997
Cinnamomum cassia	Lauraceae	Bark	MeOH	Inactive	Oh et al., 1997
		Dried bark	Tannin fraction	Active	Inokuchi et al., 1984
		Dried twig	H_2O	Inactive	Han et al., 1991
Cinnamomum zeylanicum	Lauraceae	Dried bark	Chromatog. fraction	Active	Inokuchi et al., 1984
		Dried bark	MeOH-H_2O (1:1)	Active	Inokuchi et al., 1984
Cirsium japonicum	Asteraceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Citrus aurantium	Rutaceae	Dried fruit	H_2O	Inactive	Han et al., 1991
Citrus unshiu	Rutaceae	Frass	MeOH	Inactive	Oh et al., 1997
Clematis apiifolia	Ranunculaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Clematis chinensis	Ranunculaceae	Dried root	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Clematis heracleifolia	Ranunculaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Clematis mandschurica	Ranunculaceae	Root	MeOH	Inactive	Oh et al., 1997

Clerodendrum trichotomum	Verbenaceae	Aerial parts	MeOH	Weak	Oh et al., 1997
Cnidium officinale	Apiaceae	Rhizome	MeOH	Inactive	Oh et al., 1997
Cnidium sp.	Apiaceae	Dried rhizome	MeOH-H_2O (1:1)	Inactive	Inokuchi.et al., 1984
Coix lacryma-jobi	Poaceae	Dried seed	H_2O	Equivocal	Han et al., 1991
Collybia dryophila	Tricholomataceae	Dried organism	H_2O	Inactive	Melzig et al., 1996
Conopsis pilosula	Campanulaceae	Dried root	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Cornus officinalis	Cornaceae	Fruit	MeOH	Inactive	Oh et al., 1997
Cornus sp.	Cornaceae	Fresh fruit	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Corydalis ternata	Papaveraceae	Tuber	MeOH	Inactive	Oh et al., 1997
Corylus heterophyla	Betulaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Crataegus pinnatifida	Rosaceae	Dried fruit	H_2O	Active	Han et al., 1991
		Seed	MeOH	Inactive	Oh et al., 1997
		Flowers	Acetone	Inactive	Hansen et al., 1995
		Flowers	EtOH (95%)	Inactive	Hansen et al., 1995
		Flowers	H_2O	Weak	Hansen et al., 1995
Crataegus sp.	Rosaceae	Fresh fruit	MeOH-H_2O (1:1)	Active	Inokuchi et al., 1984
Cremastra variabilis	Orchidaceae	Tuber	MeOH	Inactive	Oh et al., 1997
Cupressus sempervirens	Cupressaceae	Dried fruit	Flavonoid fraction	Active	Meunier et al., 1987
Curculigo orchioides	Hypoxidaceae	Dried rizhome	H_2O	Inactive	Han et al., 1991
Cyathula officinalis	Amaranthaceae	Dried root	H_2O	Weak	Han et al., 1991
Cynostemma pentaphylla	Cucurbitaceae	Dried aerial	Infusion	Active	Chen et al., 1996
Cyperus rotundus	Cyperaceae	Dried rizhome	H_2O	Inactive	Han et al., 1991
Daedaleopsis confragosa	Polyporaceae	Dried organism	H_2O	Weak	Melzig et al., 1996
Dalbergia odorifera	Fabaceae	Dried wood	H_2O	Active	Han et al., 1991
Daphne genkwa	Thymelaeceae	Dried flowers	H_2O	Equivocal	Han et al., 1991
Dendrobium sp.	Orchidaceae	Dried organism	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Desmodium gangeticum	Fabaceae	Root	Acetone	Inactive	Hansen et al., 1995
		Root	EtOH (95%)	Active	Hansen et al., 1995
		Root	H_2O	Active	Hansen et al., 1995
Desmodium styracifolium	Fabaceae	Leaf + Stem	Acetone	Active	Hansen et al., 1995
			EtOH (95%)	Active	Hansen et al., 1995
			H_2O	Active	Hansen et al., 1995
Dianthus superbus	Caryophyllaceae	Dried seed	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Dichroa febrifuga	Saxifragaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Dictamnus dasycarpus	Rutaceae	Dried bark	H_2O	Inactive	Han et al., 1991
		Blood	MeOH	Inactive	Oh et al., 1997
Dioscorea opposita	Dioscoreaceae	Dried root	H_2O	Weak	Han et al., 1991
Diospyros kaki	Ebenaceae	Dried leaf	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
		Calix	MeOH	Inactive	Oh et al., 1997
Dipsacus asper	Dissacaceae	Dried root	H_2O	Equivocal	Han et al., 1991
Drynaria fortunei	Polypodiaceae	Rhyzome	H_2O	Equivocal	Han et al., 1991

Echinops setifer	Asteraceae	Root	MeOH	Inactive	Oh et al., 1997
Eleuthecoccus divaricatus	Araliaceae	Dried stembark	BuOH	Active	Leem 1990
Eleuthecoccus gracilistylus	Araliaceae	Dried bark	H_2O	Weak	Han et al., 1991
		Dried root	H_2O	Equivocal	Han et al., 1991
Eleuthecoccus senticosus	Araliaceae	Dried stem	$CHCl_3$	Active	Takashari et al., 1993
Eleuthecoccus sessiliflorus	Araliaceae	Bark	MeOH	Inactive	Oh et al., 1997
Elsholtzia splendens	Lamiaceae	Dried aerial parts	H_2O	Weak	Han et al., 1991
Entada pursaetha	Fabaceae	Seed	Acetone	Weak	Hansen et al., 1995
		Seed	EtOH (95%)	Active	Hansen et al., 1995
		Seed	H_2O	Active	Hansen et al., 1995
Ephedra sinica	Ephedraceae	Dried aerial parts	Tannin fraction	Active	Inokuchi et al., 1985
Ephedra sp.	Ephedraceae	Dried entire plant	Chromatog. fraction	Active	Inokuchi et al., 1984
		Dried entire plant	MeOH-H_2O (1:1)	Active	Inokuchi et al., 1984
Epimedium alpinum	Berberidaceae	Dried aerial parts	Tannin fraction	Active	Inokuchi et al., 1985
Epimedium brevicornum	Berberidaceae	Not specified	H_2O	Active	Han et al., 1991
Epimedium macranthum	Berberidaceae	Dried entire plant	Chromatog. fraction	Active	Inokuchi et al., 1984
		Dried entire plant	MeOH-H_2O (1:1)	Active	Inokuchi et al., 1984
Equisetum hyemale	Equisetaceae	Dried stem	H_2O	Active	Han et al., 1991
Erythroxylum laurifolium	Erythroxylaceae	Dried leaf	EtOH (100%)	Active	Hansen et al., 1996b
Escallonia myrtioides	Grossulariaceae	Aerial parts	EtOH (96%)	Weak	Hansen et al., 1995
Eucommia ulmiodes	Eucommiaceae	Dried bark	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
		Dried bark	H_2O	Inactive	Han et al., 1991
Euodia officinalis	Rutaceae	Fruit	$CHCl_3$	Weak	Oh et al., 1997
		Fruit	H_2O	Inactive	Oh et al., 1997
		Fruit	MeOH	Weak	Oh et al., 1997
Euonymus alatus	Celastraceae	Bark	MeOH	Inactive	Williams et al., 1997
Eupatorium fortunei	Asteraceae	Dried aerial parts	H_2O	Equivocal	Han et al., 1991
Euphorbia hirta	Euphorbiaceae	Dried leaf	MeOH	Active	Williams et al., 1997
Euphorbia humifusa	Euphorbiaceae	Dried aerial parts	H_2O	Active	Han et al., 1991
Euphorbia kansui	Euphorbiaceae	Dried aerial parts	$CHCl_3$	Weak	Oh et al., 1997
		Dried aerial parts	H_2O	Inactive	Oh et al., 1997
		Dried aerial parts	MeOH	Weak	Oh et al., 1997
Euphoria longana	Sapindaceae	Dried fruit	H_2O	Weak	Han et al., 1991
Flammulina velutipes	Tricholomataceae	Dried organism	H_2O	Weak	Melzig et al., 1996
Fomes fomentarius	Polyporaceae	Dried organism	H_2O	Inactive	Melzig et al., 1996
Fomitopsis pinicola	Polyporaceae	Dried organism	H_2O	Inactive	Melzig et al., 1996
Forsythia suspensa	Oleaceae	Dried fruit	H_2O	Equivocal	Han et al., 1991
Fritillaria sp.	Liliaceae	Dried bulb	MeOH-H_2O (1:1)	Active	Inokuchi et al., 1984
Fuchsia magellanica	Onagraceae	Aerial parts	H_2O	Active	Hansen et al., 1995
Galium verum	Rubiaceae	Aerial parts	MeOH	Weak	Oh et al., 1997
Ganoderma lipsiense	Ganodermataceae	Dried organism	H_2O	Inactive	Melzig et al., 1996

Ganoderma lucidum	Ganodermataceae	Dried organism	H_2O	Weak	Han et al., 1991
Gardenia jasminoides	Rubiaceae	Dried fruit	$MeOH\text{-}H_2O$ (1:1)	Inactive	Inokuchi et al., 1984
		Fruit	MeOH	Inactive	Oh et al., 1997
		Drid fruit	H_2O	Equivocal	Han et al., 1991
Geastrum melanocephalum	Gestraceae	Dried organism	H_2O	Inactive	Melzig et al., 1996
Gentiana macrophylla	Gentianaceae	Dried root	$MeOH\text{-}H_2O$ (1:1)	Inactive	Inokuchi et al., 1984
		Dried root	H_2O	Equivocal	Han et al., 1991
Gentiana scabra	Gentianaceae	Root	MeOH	Inactive	Oh et al., 1997
Geranium core-core	Geraniaceae	Aerial parts	H_2O	Active	Hansen et al., 1995
Geranium wilfordii	Geraniaceae	Dried aerial parts	H_2O	Inactive	Han et al., 1991
Geum japonicum	Rosaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Glehnia littoralis	Apiaceae	Dried root	H_2O	Equivocal	Han et al., 1991
Glycyrrhiza uralensis	Fabaceae	Root	MeOH	Inactive	Oh et al., 1997
		Root	H_2O	Inactive	Han et al., 1991
Gunnera tinctoria	Gunneraceae	Leaf	BuOH	Active	Hansen et al., 1995
		Leaf	EtOAc	Active	Hansen et al., 1995
		Leaf	EtOH (95%)	Active	Hansen et al., 1995
Hedysarum polybotrys	Fabaceae	Dried root	H_2O	Active	Han et al., 1991
Helianthus tuberosus	Asteraceae	Aerila parts	MeOH	Inactive	Oh et al., 1997
Heterobasidion annosus	Polyporaceae	Dried organism	H_2O	Inactive	Melzig et al., 1996
Hexachlamys edulis	Myrtaceae	Leaf	$Acetone\text{-}H_2O$ (1:1)	Strong	Hansen et al., 1995
		Leaf	EtOH (95%)	Active	Hansen et al., 1995
Homalomena occulta	Araceae	Dried root	H_2O	Equivocal	Han et al., 1991
Houttuynia cordata	Saururaceae	Aerial parts	MeOH	Equivocal	Oh et al., 1997
		Entire plant	Acetone	Active	Hansen et al., 1995
		Entire plant	EtOH (95%)	Active	Hansen et al., 1995
		Entire plant	H_2O	Active	Hansen et al., 1995
		Dried aerial parts	H_2O	Equivocal	Han et al., 1991
		Dried entire plant	$MeOH\text{-}H_2O$ (1:1)	Inactive	Inokuchi et al., 1984
Inonotus obliqus	Hymenochaetaceae	Dried organism	H_2O	Inactive	Melzig et al., 1996
Inula japonica	Asteraceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
		Dried flowers	H_2O	Equivocal	Han et al., 1991
Jasminun azoricum	Oleaceae	Dried aerial parts	CH_2Cl_2	Active	Somanadhan et al., 1998
		Dried aerial parts	Chromatog. fraction	Active	Somanadhan et al., 1998
		Dried aerial parts	EtOAc	Active	Somanadhan et al., 1998
		Dried aerial parts	H_2O	Active	Somanadhan et al., 1998
Juncus effesus	Juncaceae	Tuber	MeOH	Inactive	Oh et al., 1997
		Aerial parts	MeOH	Inactive	Oh et al., 1997
Kalopanax pictus	Araliaceae	Bark	MeOH	Inactive	Oh et al., 1997
Knoxia valerianoides	Rubiaceae	Dried root	H_2O	Equivocal	Han et al., 1991
Koelreuteria paniculata	Sapindaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997

Kuehneromyces mutabilis	Strophariaceae	Dried organism	H_2O	Inactive	Melzig et al., 1996
Lactarius deterrimus	Russalaceae	Dried entire plant	H_2O	Inactive	Melzig et al., 1996
Leonurus sibiricus	Lamiaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
		Dried entire plant	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Lepisorus thunbergianus	Polypodiaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Lespedeza capitata	Fabaceae	Dried leaf	Flavonoid fraction	Active	Wagner, Elbl, 1992
Lilium brownii	Liliaceae	Dried bulb	H_2O	Equivocal	Han et al., 1991
Lindera strychnifolia	Lauraceae	Dried root	H_2O	Weak	Han et al., 1991
Liriope platyphyla	Liliaceae	Tuber	MeOH	Inactive	Oh et al., 1997
Lonicera japonica	Caprifoliaceae	Flowers	MeOH	Inactive	Oh et al., 1997
		Dried flowers	H_2O	Weak	Han et al., 1991
Loranthus parasiticus	Loranthaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
		Dried entire plant	H_2O	Inactive	Han et al., 1991
Luffa aegyptiaca	Cucurbitaceae	Dried seed	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Lycium chinese	Solanaceae	Dried fruit	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
		Dried leaf	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
		Dried rootback	Not stated	Active	Yahara, et al., 1993
		Fruit	MeOH	Inactive	Oh et al., 1997
		Dried rootbark	$CHCl_3$	Active	Morota et al., 1987
		Dried rootbark	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Lycopus coreanus	Lamiaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Lygodium japonicum	Schizaeaceae	Dried aerial parts	H_2O	Active	Han et al., 1991
Lysimachia barystachys	Primulaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Machilus thunbergii	Lauraceae	Bark	$CHCl_3$	Active	Oh et al., 1997
		Bark	H_2O	Inactive	Oh et al., 1997
		Bark	MeOH	Active	Oh et al., 1997
Macrolepiota rhacodes	Lepiotaceae	Dried organism	H_2O	Weak	Melzig et al., 1996
Magnolia denusata	Magnoliaceae	Flowers	MeOH	Inactive	Oh et al., 1997
Magnolia sp.	Magnoliaceae	Dried bark	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
		Dried flowers	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Mahonia bealei	Berberidaceae	Dried leaf	H_2O	Equivocal	Han et al., 1991
Malus baccata	Rosaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Melia azedarach	Meliaceae	Fruit	MeOH	Inactive	Oh et al., 1997
Menispermum dauricum	Menispermaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Mentha arvensis	Lamiaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Meripilus giganteus	Polyporaceae	Dried organism	H_2O	Inactive	Melzig et al., 1996
Merremia tridentata	Convolvulaceae	Aerial parts	Acetone	Inactive	Hansen et al., 1995
		Aerial parts	EtOH (95%)	Active	Hansen et al., 1995
		Aerial parts	H_2O	Active	Hansen et al., 1995
Mormodica cochinchinensis	Cucurbitaceae	Dried seed	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
		Seed	MeOH	Inactive	Oh et al., 1997

Morus alba	Moraceae	Bark	$CHCl_3$	Inactive	Oh et al., 1997
		Dried bark	H_2O	Weak	Oh et al., 1997
		Dried fruit	H_2O	Equivocal	Han et al., 1991
		Dried leaf	MeOH	Weak	Oh et al., 1997
		Dried leaf	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
		Dried leaf	MeOH-H_2O (1:1)	Active	Inokuchi et al., 1984
Myristica fragrans	Myristicaceae	Seed	MeOH	Inactive	Oh et al., 1997
Nelumbo nucifera	Nymphaeaceae	Dried seed	H_2O	Inactive	Han et al., 1991
Notopterygium incisum	Apiaceae	Dried root	H_2O	Weak	Han et al., 1991
Oenothera biennis	Onagraceae	Seed	Seed oil	Active	Scholkens et al., 1982
Ophiopogon japonicus	Liliaceae	Dried root	H_2O	Equivocal	Han et al., 1991
Oplopanax elatus	Araliaceae	Root	MeOH	Inactive	Oh et al., 1997
Pachymia hoelen	Polyporaceae	Fruitbody	MeOH	Inactive	Oh et al., 1997
Paeonia albiflora	Paeoniaceae	Dried root	H_2O	Active	Han et al., 1991
Paeonia moutan	Paeoniaceae	Dried bark	Chromatog. fraction	Active	Inokuchi et al., 1984
		Dried bark	MeOH-H_2O (1:1)	Active	Inokuchi et al., 1984
		Dried bark	Tannin fraction	Active	Inokuchi et al., 1985
Paeonia obovata	Paeoniaceae	Root	MeOH	Inactive	Oh et al., 1997
Panax ginseng	Araliaceae	Rhizome + root	Polysacchar.fraction	Weak	Lee et al., 1996
		Dried root	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Panax pseudoginseng	Araliaceae	Dried root	H_2O	Equivocal	Han et al., 1991
Passiflora quadrangularis	Passifloraceae	Dried entire plant	H_2O	Active	Okamot et al., 1994
Patrinia scabiosaefolia	Valerianaceae	Dried root	H_2O	Weak	Han et al., 1991
Patrinia villosa	Valerianaceae	Root	MeOH	Inactive	Oh et al., 1997
Paxillus involutus	Paxillaceae	Dried organism	H_2O	Inactive	Melzig et al., 1996
Perilla frutescens	Lamiaceae	Aerial parts	$CHCl_3$	Weak	Oh et al., 1997
		Aerial parts	H_2O	Weak	Oh et al., 1997
		Aerial parts	MeOH	Weak	Oh et al., 1997
		Seed	MeOH	Weak	Oh et al., 1997
Persicaria senticosa	Polygonaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Peucedanum japonicum	Apiaceae	Root	$CHCl_3$	Inactive	Oh et al., 1997
		Root	H_2O	Inactive	Oh et al., 1997
		Root	MeOH	Weak	Oh et al., 1997
Phaeolus schweinitzii	Hymenochaetaceae	Dried organism	H_2O	Weak	Melzig et al., 1996
Phellodendron amurense	Rutaceae	Bark	MeOH	Inactive	Oh et al., 1997
Phlomis umbrosa	Lamiaceae	Root	MeOH	Inactive	Oh et al., 1997
Pholiota squarbosa	Strophariaceae	Dried organism	H_2O	Inactive	Melzig et al., 1996
Phryma leptosstachya	Phrymaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Phyllanthus niruri	Euphorbiaceae	Dried entire plant	Chromatog. fraction	Active	Ueno, et al., 1988
Picrasma quassioides	Simaroubaceae	Aerial parts	MeOH	Weak	Oh et al., 1997
Picrorhiza kurroa	Scrophulariaceae	Rhizome	MeOH	Inactive	Oh et al., 1997

Pinellia ternata	Araceae	Dried rhizome	H_2O	Active	Han et al., 1991
		Tuber	MeOH	Inactive	Oh et al., 1997
Pinus pinastre	Pinaceae	Dried bark	Flavonoid fraction	Inactive	Blaszo et al., 1996
Pinus tabulaeformis	Pinaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Piper futokadsura	Piperaceae	Dried aerial parts	H_2O	Active	Han et al., 1991
Piptoporus betulinus	Polyporaceae	Dried organism	H_2O	Inactive	Melzig et al., 1996
Pistacia lentiscus	Anacardiaceae	Dried aerial parts	Flavonoid fraction	Active	Sanz et al., 1993
Plantago asiatica	Plantaginaceae	Dried seed	H_2O	Equivocal	Han et al., 1991
		Entire plant	Acetone	Active	Hansen et al., 1995
		Entire plant	EtOH (95%)	Active	Hansen et al., 1995
		Entire plant	H_2O	Active	Hansen et al., 1995
Plantago sp.	Plantaginaceae	Dried leaf	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
		Dried seed	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Platycarya strobiliaceae	Juglandaceae	Fruit	MeOH	Inactive	Oh et al., 1997
Platycodon gradiflorum	Campanulaceae	Root	$CHCl_3$	Weak	Oh et al., 1997
		Root	H_2O	Weak	Oh et al., 1997
		Root	MeOH	Inactive	Oh et al., 1997
Pleurotus sajor-cajo	Polyporaceae	Fruitbody	Not stated	Active	Ikemizu et al., 1995
Polygala tenuifolia	Polygalaceae	Root	MeOH	Inactive	Oh et al., 1997
		Dried root	H_2O	Equivocal	Han et al., 1991
Polygonatum aviculare	Liliaceae	Dried aerial parts	Tannin fraction	Active	Inokuchi et al., 1985
		Dried entire plant	Chromatog. fraction	Inactive	Inokuchi et al., 1984
		Dried entire plant	MeOH-H_2O (1:1)	Active	Inokuchi et al., 1984
Polygonatum siribicum	Liliaceae	Dried rizhome	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
		Dried rizhome	H_2O	Inactive	Han et al., 1991
Polygonum multiflorum	Polygalaceae	Root	MeOH	Inactive	Oh et al., 1997
		Dried root	H_2O	Active	Han et al., 1991
Polygonum thunbergii	Polygalaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Polyporus squamosus	Polyporaceae	Dried organism	H_2O	Weak	Melzig et al., 1996
Poria cocos	Polyporaceae	Dried organism	H_2O	Equivocal	Han et al., 1991
Potentilla chinensis	Rosaceae	Dried aerial parts	Tannin fraction	Active	Inokuchi et al., 1985
Potentilla crytotaeniae	Rosaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Potentilla sp.	Rosaceae	Dried entire plant	Chromatog. fraction	Active	Inokuchi et al., 1984
		Dried entire plant	MeOH-H_2O (1:1)	Active	Inokuchi et al., 1984
Prunella vulgaris	Lamiaceae	Aerial parts	MeOH	Weak	Oh et al., 1997
		Dried aerial parts	H_2O	Weak	Han et al., 1991
		Dried inflores.	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Prunus mume	Rosaceae	Fruit	MeOH	Inactive	Oh et al., 1997
Pseudarthria hookeri	Fabaceae	Root	Acetone	Active	Hansen et al., 1995
		Root	EtOH (95%)	Strong	Hansen et al., 1995
		Root	H_2O	Weak	Hansen et al., 1995

Pseudarthria viscida	Fabaceae	Root	Acetone	Weak	Hansen et al., 1995
		Root	EtOH (95%)	Active	Hansen et al., 1995
		Root	H_2O	Active	Hansen et al., 1995
Psoralea corylifolia	Fabaceae	Dried fruit	H_2O	Weak	Han et al., 1991
Pueraria lobata	Fabaceae	Dried root	H_2O	Weak	Han et al., 1991
		Root	Acetone	Weak	Hansen et al., 1995
		Root	EtOH (95%)	Active	Hansen et al., 1995
Pueraria pseudo-hisuta	Fabaceae	Dried root	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Pulsatilla chinensis	Ranunculaceae	Dried aerial parts	H_2O	Inactive	Han et al., 1991
Pyrola japonica	Pyrolaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Pyrrosia lingua	Polypodiaceae	Entire plant	Acetone	Active	Hansen et al., 1995
		Entire plant	EtOH (95%)	Active	Hansen et al., 1995
		Entire plant	H_2O	Active	Hansen et al., 1995
Quinchamalium chilense	Santalaceae	Aerial parts	EtOH (95%)	Active	Hansen et al., 1995
Ranunculus japonicus	Ranunculaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Rauvolfia serpentina	Apocynaceae	Dried root	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Rehmannia glutinosa	Scrophulariaceae	Dried root	H_2O	Weak	Han 1991
Rheum palmatum	Polygonaceae	Dried rhizome	Tannin fraction	Active	Inokuchi et al., 1985
		Rhizome	MeOH	Weak	Oh et al., 1997
Rheum sp.	Polygonaceae	Dried rhizome	Chromatog. fraction	Active	Inokuchi et al., 1984
		Dried rhizome	MeOH-H_2O (1:1)	Active	Inokuchi et al., 1984
Rosa multiflora	Rosaceae	Fruit	MeOH	Inactive	Oh et al., 1997
Salvia miltiorrhiza	Lamiaceae	Dried root	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
		Root	MeOH	Inactive	Oh et al., 1997
Sanguisorba officinalis	Rosaceae	Dried root	MeOH-H_2O (1:1)	Active	Inokuchi et al., 1984
Sapium sebiferum	Euphorbiaceae	Root	MeOH	Inactive	Oh et al., 1997
Sasa borealis	Poaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Saussurea lappa	Asteraceae	Dried root	MeOH-H_2O (1:1)	Active	Inokuchi et al., 1984
		Root	MeOH	Inactive	Oh et al., 1997
Schinus latifolius	Anacardiaceae	Bark	BuOH	Active	Hansen et al., 1995
		Bark	EtOAc	Active	Hansen et al., 1995
		Bark	EtOH (95%)	Active	Hansen et al., 1995
		Bark	EtOH- H_2O (7:3)	Active	Hansen et al., 1995
Schizonepeta tenuifolia	Lamiaceae	Dried aerial parts	H_2O	Equivocal	Han et al., 1991
Scrophularia ningpoensis	Scrophulariaceae	Dried root	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
		Root	MeOH	Inactive	Oh et al., 1997
Scutellaria baicalensis	Lamiaceae	Dried root	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
		Root	$CHCl_3$	Weak	Oh et al., 1997
		Root	H_2O	Weak	Oh et al., 1997
		Root	MeOH	Weak	Oh et al., 1997

Sedum sarmentosum	Crassulaceae	Entire plant	Acetone	Active	Hansen et al., 1995
		Entire plant	EtOH (95%)	Active	Hansen et al., 1995
		Entire plant	H_2O	Active	Hansen et al., 1995
Sida acuta	Malvaceae	Root	Acetone	Active	Hansen et al., 1995
		Root	EtOH (95%)	Weak	Hansen et al., 1995
		Root	H_2O	Active	Hansen et al., 1995
Sida cordifolia	Malvaceae	Root	Acetone	Active	Hansen et al., 1995
		Root	EtOH (95%)	Weak	Hansen et al., 1995
		Root	H_2O	Active	Hansen et al., 1995
Sida retusa	Malvaceae	Root	Acetone	Active	Hansen et al., 1995
		Root	EtOH (95%)	Weak	Hansen et al., 1995
		Root	H_2O	Active	Hansen et al., 1995
Sigesbeckia orientalis	Asteraceae	Dried aerial parts	MeOH	Inactiv	Oh et al., 1997
		Rhizome	H_2O	Weak	Han et al., 1991
Smilax china	Liliaceae	Rhizome	MeOH	Inactive	Oh et al., 1997
Sinomenium acutum	Menispermaceae	Dried root	H_2O	Active	Han et al., 1991
		Rhizome	MeOH	Inactive	Oh et al., 1997
		Rhizome + stem	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Solanum nigrum	Solanaceae	Dried aerial parts	H_2O	Active	Han et al., 1991
Solidago virgaurea	Asteraceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Sophora flavescens	Fabaceae	Root	MeOH	Inactive	Oh et al., 1997
Sophora japonica	Fabaceae	Flower	MeOH	Inactive	Oh et al., 1997
Sophora subprostata	Fabaceae	Dried root	H_2O	Weak	Han et al., 1991
		Root	MeOH	Inactive	Oh et al., 1997
Sorbus amurensis	Rosaceae	Bark	MeOH	Inactive	Oh et al., 1997
Sparganium stoloniferum	Sparganiaceae	Dried root	H_2O	Weak	Han et al., 1991
		Rhizome	MeOH	Inactive	Oh et al., 1997
Spatholobus suberectus	Fabaceae	Dried stem	H_2O	Inactive	Han et al., 1991
Stemona japonica	Stemonaceae	Root	MeOH	Inactive	Oh et al., 1997
Stemona sessilifolia	Stemonaceae	Dried root	H_2O	Inactive	Han et al., 1991
Stephanandra incisa	Rosaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Strychnos nux-vomica	Loganiaceae	Seed	MeOH	Inactive	Oh et al., 1997
Styrax japonicus	Styracaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Symplocos chinensis	Syplocaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Taraxacum mongolicum	Asteraceae	Aerial parts	$CHCl_3$	Weak	Oh et al., 1997
		Aerial parts	H_2O	Inactive	Oh et al., 1997
		Aerial parts	MeOH	Weak	Oh et al., 1997
		Dried flowers	H_2O	Equivocal	Han et al , 1991
Taxus cuspidata	Taxaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Thuja orientalis	Cupressaceae	Dried seed	H_2O	Inactive	Han et al., 1991
		Leaf	MeOH	Inactive	Oh et al., 1997

Torilis japonica	Apiaceae	Fruit	$CHCl_3$	Weak	Oh et al., 1997
		Fruit	H_2O	Inactive	Oh et al., 1997
Torreya nucifera	Taxaceae	Seed	MeOH	Inactive	Oh et al., 1997
Trachomitum venetum	Apocynaceae	Dried entire plant	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Trachycarpus exelsus	Aracaceae	Dried leaf	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
Trametes hirsuta	Polyporaceae	Dried organism	H_2O	Inactive	Melzig et al., 1996
Trametes versicolor	Polyporaceae	Dried organism	H_2O	Inactive	Melzig et al., 1996
Trichosanthes kirilowii	Cucurbitaceae	Dried fruit	H_2O	Active	Han et al., 1991
		Root	MeOH	Inactive	Oh et al., 1997
Tricholoma populinum	Tricholomataceae	Dried organism	H_2O	Inactive	Melzig et al., 1996
Tricholoma portentosum	Tricholomataceae	Dried organism	H_2O	Inactive	Melzig et al., 1996
Tricholopsis rutilans	Tricholomataceae	Dried organism	H_2O	Inactive	Melzig et al., 1996
Triumfetta rhomboidea	Tiliaceae	Root	Acetone	Weak	Hansen et al., 1995
		Root	EtOH (95%)	Active	Hansen et al., 1995
		Root	H_2O	Active	Hansen et al., 1995
Tropaeolum majus	Tropaeolaceae	Dried aerial	H_2O	Weak	Han et al., 1991
Tussilago farfara	Asteraceae	Dried flowers	H_2O	Inactive	Han et al., 1991
Ulmus parvifolia	Ulmaceae	Root	MeOH	Inactive	Oh et al., 1997
Uncaria rhynchophylla	Rubiaceae	Dried branchets	MeOH-H_2O (1:1)	Active	Inokuchi et al., 1984
		Root	Acetone	Active	Hansen et al., 1995
		Root	EtOH (95%)	Active	Hansen et al., 1995
		Root	H_2O	Active	Hansen et al., 1995
Vaccaria segatalis	Caryophyllaceae	Dried seed	H_2O	Weak	Han et al., 1991
Verbena officinalis	Verbenaceae	Dried aerial parts	H_2O	Equivocal	Han et al., 1991
Veronicastrum sibiricum	Scrophulariaceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Viburnum opulus	Caprifoliaceae	Dried bark	EtOH-H_2O (1:1)	Active	Jonader et al., 1989
Vitis vinifera	Vitaceae	Dried fruit	Flavonoid fraction	Active	Meunier et al., 1987
Volvariella speciosa	Pluteaceae	Dried organism	H_2O	Weak	Melzig et al., 1996
Xanthium sibiricum	Asteraceae	Dried seed	H_2O	Equivocal	Han et al., 1991
Xanthium strumarium	Asteraceae	Dried fruit	MeOH-H_2O (1:1)	Inactive	Inokuchi et al., 1984
		Fruit	MeOH	Inactive	Oh et al., 1997
Xylaria polymorpha	Xylariaceae	Dried organism	H_2O	Inactive	Melzig et al., 1996
Youngia japonica	Asteraceae	Aerial parts	MeOH	Inactive	Oh et al., 1997
Zathoxylum piperitum	Rutaceae	Fruit	MeOH	Inactive	Oh et al., 1997
Zingiber officinale	Zingiberaceae	Rhizome	MeOH	Inactive	Oh et al., 1997
Ziziphus jujuba	Rhamnaceae	Fruit	MeOH	Weak	Oh et al., 1997
Ziziphus spinosa	Rhamnaceae	Dried seed	MeOH-H_2O (1:1)	Inactive	Oh et al., 1997

Table 4. Chemically defined natural compounds showing inhibition of angiotensin converting enzyme

Chemical name	Class	Source	Activity	Reference
Actinomadura antibiotic 15B1	Proteid	*Actinomadura* sp.	Active	Kido et al., 1984
Actinomadura antibiotic 15B2	Proteid	*Actinomadura* sp.	Active	Kido et al., 1984
Actinomyces antibiotic 1582	Proteid	*Actinomyces* sp.	Active	Kido, et al., 1985
Actinomyces antibiotic K-26	Proteid	*Actinomyces* sp.	Active	Yamato et al., 1986
Afzelin	Flavonoid	*Erythroxylum laurifolium*	Active	Hansen et al., 1995
Alismol	Sesquiterpene	*Alisma orientale*	Inactive	Yamahara et al., 1989
Ancovenin	Proteid	*Streptomyces* sp.	Active	Kido et al., 1983
		Streptomyces sp.	Active	Wakamiya et al., 1985
Angiotensin compound	Proteid	*Vipera aspis aspis*	Active	Komori et al., 1990
Anisomelic acid	Diterpene	*Anisomeles indica*	Weak	Momose et al., 1994
Anisomelic acid, 4-methylene-5-oxo	Diterpene	*Anisomeles indica*	Inactive	Arisawa et al., 1986
Arginine, L	Proteid	Commercial	Active	Higashi et al., 1995
Arrivacin A	Sesquiterpene	*Ambrosia psilostachya*	Active	Chen et al., 1991
Arrivacin B	Sesquiterpene	*Ambrosia psilostachya*	Active	Chen et al., 1991
Arphamenine B	Alkaloid	*Chromobacterium violaceum*	Inactive	Aoyagi et al., 1986
Aspergillomarasmine A	Proteid	*Aspergillus oryzae*	Active	Mikami et al., 1983
Aspergillomarasmine B	Proteid	*Aspergillus oryzae*	Active	Mikami et al., 1983
Asperoside	Cardenolide	*Eucommia ulmoides*	Active	Yamadaki et al., 1992
Astragalin	Flavonoid	*Diospyros kaki*	Active	Kameda et al., 1987
Atractylenolide I	Sesquiterpene	*Atractyloides japonica*	Inactive	Sakurai et al., 1993
Atractylenolide III	Sesquiterpene	*Atractyloides japonica*	Inactive	Sakurai et al., 1993
Atractylodinol	Oxygen heterocycle	*Atractyloides japonica*	Active	Sakurai et al., 1993
Atractylone	Sesquiterpene	*Atractyloides japonica*	Inactive	Sakurai et al., 1993
Bergenin	Coumarin	*Allophylus edulis*	Inactive	Arisawa et al., 1989
Bestatin	Proteid	*Streptomyces olivoreticuli*	Inactive	Aoyagi et al., 1986
Capsianoside A	Diterpene	*Capsicum* spp.	Active	Yahara et al., 1990
Capsianoside C	Diterpene	*Capsicum* spp.	Active	Izumitani et al., 1990
Capsianoside I	Diterpene	*Capsicum* spp.	Weak	Yahara et al., 1990
Capsianoside II	Diterpene	*Capsicum* spp.	Inactive	Yahara et al., 1990
Catechin, (+)	Flavonoid	*Allophylus edulis*	Active	Cho et al., 1993
		Allophylus edulis	Inactive	Inokuchi et al., 1996b
Catechin, *epi* (-)	Flavonoid	*Allophylus edulis*	Inactive	Inokuchi, et al., 1996b
		Areca catechu	Inactive	Arisawa, et al., 1989
Catechin-3-*O*-gallate, *epi* (-)	Flavonoid	Korean green tea	Active	Cho et al., 1993
		Korean green tea	Active	Uchida et al., 1987
Cochinmicin I	Proteid	*Microbispora* sp.	Inactive	Lam et al., 1992
Cochinmicin II	Proteid	*Microbispora* sp.	Weak	Lam et al., 1992
Cochinmicin III	Proteid	*Microbispora* sp.	Weak	Lam et al., 1992
Corilagin	Tannin	*Phyllanthus niruri*	Active	Ueno et al., 1988

Coriolic acid, (DL)	Lipid	*Frittilaria verticillata*	Active	Niitsu et al., 1987
Cycloanisomelic acid, 4,7-oxy	Diterpene	*Anisomeles indica*	Inactive	Arisawa et al., 1986
Cymene, allo	Monoterpene	Commercial	Weak	Okamura et al., 1992
Cytosporin A	Oxygen heterocycle	*Cytospora* sp.	Active	Stevens-Miles et al., 1996
Cytosporin B	Oxygen heterocylle	*Cytospora* sp.	Weak	Stevens-Miles et al., 1996
Cytosporin C	Oxygen heterocycle	*Cytospora* sp.	Weak	Stevens-Miles et al., 1996
Daphnodorin A	Flavonoid	*Daphne odora*	Active	Takai et al., 1999
Daphnodorin B	Flavonoid	*Daphne odora*	Active	Takai et al., 1999
Daphnodorin C	Flavonoid	*Daphne odora*	Inactive	Takai et al., 1999
Dimorphecolic acid, *alpha*	Lipid	*Lycium chinense*	Active	Morota et al., 1987
Dimorphecolic acid, *alpha* (DL)	Lipid	*Frittilaria verticillata*	Active	Niitsu et al., 1987
Dimorphecolic acid, *beta* (DL)	Lipid	*Frittilaria verticillata*	Active	Niitsu et al., 1987
Doratomyces antibiotic WF-10129	Proteid	*Doratomyces putredinis*	Active	Ando et al., 1987
Ellagic acid	Coumarin	*Phyllanthus niruri*	Active	Ueno et al., 1988
Evocarpine	Alkaloid	*Evodia rutaecarpa*	Active	Lee et al., 1998
Excelsioside	Iridoid	*Flaxinus excelsior*	Inactive	Hansen et al., 1996a
Fagopyrum tripeptide	Proteid	*Fagopyrum* sp.	Active	Koyama et al., 1993
Fangchinolium hydroxide	Alkaloid	*Stephania tetrandra*	Active	Ogino et al., 1986
Fenfangjine F	Alkaloid	*Stephania tetrandra*	Active	Ogino et al., 1998
Fenfangjine G	Alkaloid	*Stephania tetrandra*	Inactive	Ogino et al., 1998
Fenfangjine H	Alkaloid	*Stephania tetrandra*	Active	Ogino et al., 1998
Fenfangjine I	Alkaloid	*Stephania tetrandra*	Active	Ogino et al., 1998
Ficus oligopeptide FLP-1	Proteid	*Ficus carica*	Active	Maruyama et al., 1990
Ficus oligopeptide FLP-2	Proteid	*Ficus carica*	Active	Maruyama et al., 1990
Ficus oligopeptide FLP-3	Proteid	*Ficus carica*	Active	Maruyama et al., 1990
Ficus peptide FLP-1	Proteid	*Ficus carica*	Active	Maruyama et al., 1989
Ficus peptide FLP-2	Proteid	*Ficus carica*	Active	Maruyama et al., 1989
Ficus peptide FLP-3	Proteid	*Ficus carica*	Active	Maruyama et al., 1989
Fisetin	Flavonoid	Commercial	Active	Lin et al., 1994
Gallic acid	Benzenoid	*Phyllanthus niruri*	Active	Ueno et al., 1988
Gallocatechin, (+)	Flavonoid	Korean green tea	Active	Cho et al., 1993
Gallocatechin, *epi* (-)	Flavonoid	Korean green tea	Active	Cho et al., 1993
Gallocatechin, *epi*, 3-*O*-gallate (-)	Flavonoid	Korean green tea	Active	Uchida et al., 1987
Gallocatechin-3-*O*-gallate (-), *epi* (-)	Flavonoid	Korean green tea	Active	Cho et al., 1993
Geraniin	Tannin	*Phyllanthus niruri*	Active	Ueno et al., 1988
		Alophylus edulis	Active	Arisawa et al., 1989
Glu-Asn-Trp, P	Proteid	*Trimeresurus flavoviridis*	Inactive	Maeda et al., 1993
		Trimeresurus okinavensis	Inactive	Maeda et al., 1993
Glu-Gln-Trp, P	Proteid	*Trimeresurus flavoviridis*	Inactive	Maeda et al., 1993
		Trimeresurus okinavensis	Inactive	Maeda et al., 1993

Glu-Lys-Trp, P	Proteid	*Trimeresurus flavoviridis*	Weak	Maeda et al., 1993
		Trimeresurus okinavensis	Weak	Maeda et al., 1993
Gossypol	Sesquiterpene	*Gossypium* sp.	Active	Krassnigg et al., 1984
Kaempferol-3-*O*-galloyl-glucose	Flavonoid	*Diospyros kaki*	Active	Kameda et al., 1987
Kapakahine A	Proteid	*Cribrochalina olemda*	Inactive	Yeung et al., 1996
Lanosten (20-R)	Triterpene	*Schinus molle*	Active	Olafsson et al., 1997
Lanosten (20-S)	Triterpene	*Schinus molle*	Active	Olafsson et al., 1997
Ligstroside	Iridoid	*Ligustrum japonicum*	Inactive	Hansen et al., 1996a
Ligustaloside B	Monoterpene	*Ligustrum japonicum*	Inactive	Hansen et al., 1996a
Liriodendrin	Lignan	*Eucommia ulmoides*	Active	Yamadaki et al., 1992
Lyciumin A	Proteid	*Lycium chinense*	Active	Yahara et al., 1989
		Lycium chinense	Active	Morita et al., 1996
Lyciumin B	Proteid	*Lycium chinense*	Active	Yahara et al., 1989
		Lycium chinense	Active	Yahara et al., 1993
Microginin	Proteid	*Microcystis aeruginosa*	Active	Okino et al., 1993
Microginin 299-C	Proteid	*Microcystis aeruginosa*	Inactive	Ishida et al., 1998
Microginin 299-D	Proteid	*Microcystis aeruginosa*	Inactive	Ishida et al., 1998
Micromonospora ACE K-13	Proteid	*Micromonospora halophytica*	Active	Kase et al., 1987
Molihuaside A	Iridoid	*Jasminum azoricum*	Active	Somanadhan et al., 1998
Monocrotaline	Alkaloid	*Crotalaria* sp.	Inactive	Lafranconi et al., 1983
		Crotalaria sp.	Active	Molteni et al., 1984
Morroniside	Iridoid	*Sambucus nigra*	Inactive	Hansen et al., 1996a
Muracein A	Proteid	*Nocardia orientalis*	Active	Singh et al., 1984
Muracein B	Proteid	*Nocardia orientalis*	Active	Singh et al., 1984
Muracein C	Proteid	*Nocardia orientalis*	Active	Singh et al., 1984
Myrcene	Monoterpene	Comercial	Active	Okamura et al., 1992
Myriceron-cafeoyl-ester	Triterpene	*Myrica cerifera*	Inactive	Fujimoto et al., 1992
Nicotinamide	Proteid	Soy sauce	Active	Kinoshita et al., 1993
		Corchorus olitorius	Active	Kimoto et al., 1998
Nonanoic acid, 8(*S*)-amino-2(*R*)-methyl-7-oxo	Proteid	*Streptomyces* sp.	Inactive	Parnas et al., 1996
Norathyriol	Xanthone	*Trypterospermum lanceolatum*	Active	Sutter ; Wang, 1993
Octadeca-10-*trans*-12-*cis*-15-*cis*-trienoic acid, 9-hydroxy	Lipid	*Lycium chinensis*	Active	Morota et al., 1987
Octadeca-9-*trans*-11-*trans*-dienoic acid, 13-hydroxy	Lipid	*Fritillaria verticillata*	Active	Niitsu et al., 1987
Oleacein	Iridoid	*Olea europaea*	Active	Hansen et al., 1996a
Oleoside	Iridoid	*Olea europaea*	Weak	Hansen et al., 1996a
		Olea lancea	Weak	Hansen et al., 1996a
Oleoside-11-methyl ester	Iridoid	*Olea europaea*	Weak	Hansen et al., 1996a
		Olea lancea	Weak	Hansen et al., 1996a

Oleuropein	Iridoid	*Olea europaea*	Weak	Hansen et al., 1996a
		Olea lancea	Weak	Hansen et al., 1996a
Ovatodiolide	Diterpene	*Anisomeles indica*	Inactive	Arisawa et al., 1986
		Anisomeles indica	Inactive	Momose et al., 1994
Ovatodiolide, 4,5-deoxy	Diterpene	*Anisomeles indica*	Inactive	Arisawa et al., 1986
Ovatodiolide, 4,5-epoxy	Diterpene	*Anisomeles indica*	Weak	Momose et al., 1994
Pepstatin	Proteid	Comercial	Active	Aoyagi et al., 1986
Peptide P	Proteid	*Bothrops jararacussu*	Active	Ferreira et al., 1992
Phenacein	Alkaloid	*Streptomyces tanashiensis*	Active	Bush et al., 1984
Phthalide, 3-*N*-butyl	Misc lactone	*Aoium graveolens*	Inactive	Tsi et al., 1997
Polysaccharide HS-142-1	Carbohydrate	*Aureobasidium* sp.	Inactive	Morishita et al., 1991
Procyanidin B-1	Flavonoid	*Lespedeza capitata*	Active	Wagner et al., 1992
Procyanidin B-2, 3,3'-di-*O*-gallate	Flavonoid	Korean green tea	Active	Uchida et al., 1987
Procyanidin B-3	Flavonoid	*Lespedeza capitata*	Active	Wagner et al., 1992
Procyanidin B-3, 3-*O*-gallate	Flavonoid	Korean green tea	Active	Cho et al., 1993
Procyanidin B-5, 3,3'-di-*O*-gallate	Flavonoid	Korean green tea	Active	Uchida et al., 1987
Procyanidin B-6	Flavonoid	*Lespedeza capitata*	Active	Wagner et al., 1992
Procyanidin C-1, 3,3',3''-tri-*O*-gallate	Flavonoid	Korean green tea	Active	Uchida et al., 1987
Procyanidin C-2	Flavonoid	*Lespedeza capitata*	Active	Wagner et al., 1992
Pycnidione	Oxigen heterocycle	*Phoma* sp.	Inactive	Harris et al., 1993
Pycnogenol	Flavonoid	*Pinus maritima*	Active	Packer et al., 1999
Quercetin-3-*O*-(2''-*O*-galloyl)-glucoside	Flavonoid	*Diospyros kaki*	Active	Kameda et al., 1987
		Diospyros kaki	Active	Arisawa et al., 1989
Quercetin-3-*O*-*beta*-D-glucoside	Flavonoid	*Allophylus edulis*	Active	Arisawa et al., 1989
Quercitrin	Flavonoid	*Erythroxylum laurifolium*	Active	Hansen et al., 1996b
Quercitrin, iso	Flavonoid	*Diospyros kaki*	Active	Kameda et al., 1987
Quinolone, 1-methyl-2-[(*cis*-4-*cis*-7)-4,7-trideca-dienyl]	Alkaloid	*Evodia rutaecarpa*	Active	Lee et al., 1998
Quinolone, 1-methyl-2-[pentadeca-*cis*-6-*cis*-9-dienyl]	Alkaloid	*Evodia rutaecarpa*	Active	Lee et al., 1998
Sambacein I	Iridoid	*Jasminum azoricum*	Active	Somanadhan et al., 1998
Sambacein II	Iridoid	*Jasminum azoricum*	Active	Somanadhan et al., 1998
Sambacein III	Iridoid	*Jasminum azoricum*	Active	Somanadhan et al., 1998
Sambacoside A	Iridoid	*Jasminum azoricum*	Active	Somanadhan et al., 1998
Sollasin C	Sesquiterpene	*Poecillastra sollasi*	Active	Killday et al., 1993
Sollasin D	Sesquiterpene	*Poecillastra sollasi*	Active	Killday et al., 1993
Streptomyces antibiotic A-58365-A	Alkaloid	*Streptomyces chromofuscus*	Active	Mynderse et al., 1985
		Streptomyces chromofuscus	Active	Mynderse et al., 1984
		Streptomyces chromofuscus	Active	O'Connor et al., 1985
Streptomyces antibiotic A-58365-B	Alkaloid	*Streptomyces chromofuscus*	Active	Mynderse et al., 1985
		Streptomyces chromofuscus	Active	Mynderse et al., 1984

Streptomyces antibiotic WS-7338-B	Proteid	*Streptomyces* sp.	Weak	Miyata et al., 1992
Streptomyces antibioticWS-9826-A	Proteid	*Streptomyces violaceusniger*	Weak	Hashimoto et al., 1992
Syringin	Phenylpropanoid	*Eucommia ulmoides*	Active	Yamadaki et al., 1992
Taxol	Diterpene	*Taxus brevifolia*	Active	Sauru et al., 1995
Terpinene, *alpha*	Monoterpene	Comercial	Weak	Okamura et al., 1992
Terpinene, *gamma*	Monoterpene	Comercial	Weak	Okamura et al., 1992
Terpineol, *alpha*	Monoterpene	Comercial	Weak	Okamura et al., 1992
Tetradeca-*trans*-6-*trans*-12-diene-8,10-diyne-1,3-diol	Alkenyne	*Atractylodes japonica*	Inactive	Sakurai et al., 1993
Tetradeca-*trans*-6-*trans*-12-diene-8,10-diyne-1,3-diol diacetate	Alkenyne	*Atractylodes japonica*	Inactive	Sakurai et al., 1993
Tetrandrine, (+)	Alkaloid	*Stephania tetrandra*	Active	Ogino et al., 1987a
Tetrandrine-2*N*-*beta*-oxide	Alkaloid	*Stephania tetrandra*	Active	Ogino et al., 1987b
Variecolin	Sesterterpene	*Aspergillus variecolor*	Active	Hensens et al., 1991
Veratridine	Alkaloid	*Veratrum* sp.	Active	Ball et al., 1986
Vicenin 2	Flavonoid	*Allophylus edulis*	Active	Arisawa et al., 1989
Vitexin	Flavonoid	*Allophylus edulis*	Active	Okamot et al., 1994
		Allophylus edulis	Active	Arisawa et al., 1989
Vitexin, iso	Flavonoid	*Allophylus edulis*	Active	Arisawa et al., 1989
Vitexin-2’’-*O*-*alpha*-L-rhamnoside	Flavonoid	*Allophylus edulis*	Active	Arisawa et al., 1989
Xanthone, 1,3,5,6-tetrahydroxy	Xanthone	*Tripterospermum lanceolatum*	Active	Chen et al., 1992
Xanthone, 1,3,6,7-tetrahydroxy	Xanthone	*Tripterospermum lanceolatum*	Weak	Chen et al., 1992
Xanthone, 2,3,6,7-tetrahydroxy	Xanthone	*Tripterospermum lanceolatum*	Weak	Chen et al., 1992
Xanthone, 3,4,5,6-tetrahydroxy	Xanthone	*Tripterospermum lanceolatum*	Weak	Chen et al., 1992
Xanthone, 3,4,6,7-tetrahydroxy	Xanthone	*Tripterospermum lanceolatum*	Active	Chen et al., 1992