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Ginkgo biloba "living fossil", wonderful medicinal plant- A Review

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Abstract

Ginkgo biloba: Ginkgo is among the oldest living species of trees on earth and for this reason some call it a "living fossil." Ginkgo flourished in large forests over 150 million years ago and almost became extinct during the last ice age. It belongs to the Family:Ginkgoaceae, the plant has a number of therapeutic properties and contains high levels of flavonoids and terpenoids. Over recent years, ginkgo supplements have become increasingly popular - they are currently among the top-selling herbal medications.

The leaf has been recommended for medicinal uses as early as 1509 and is still used in the form of teas. The extract of Ginkgo biloba (Gb) has been studied for its effectiveness in the treatment of Acrocyanosis, Alzheimer's disease, Cerebral atherosclerosis, Cerebral insufficiencies, Cochlear deafness, Dementia, Depression *ect.*

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INTRODUCTION

The Ginkgo tree is the only living representative of the order Ginkgoales, a group of gymnosperms composed of the family Ginkgoaceae. Because of deforestation, Ginkgo biloba (Gb) again became almost extinct, but is now being preserved by human cultivation. Ginkgo is grown for its ornamental value around the world, and is a common street tree in urban areas due to its resistance to pollution, pests, and disease (Hobbs, 1991., Huh and Staba, 1992). Ginkgo seed has been listed as a source of medicine since the early Chinese herbals. Nowadays, extracts of ginkgo leaves in the form of film-coated tablets, oral liquids or injectable solutions can be purchased in Europe and America. Lives as long as 1000 years has survived for over 250 million years ("Living Fossil") only tree to survive atomic blast in Hiroshima. Standardized extract from the leaves of the *Ginkgo biloba* tree, labeled EGb761, is one of the most popular herbal supplements. Extract from Gb leaves (fig-2) has been used in traditional Chinese medicine for centuries to treat circulatory disorders, asthma, tinnitus, vertigo, and cognitive problems. Today, Gb extracts are one of the most commonly taken phytomedicines globally. (Smith, *et al*, 2003). Ginkgo biloba extract (GBE) is approved in Germany for treatment of cerebral insufficiency (memory loss that occurs with conditions such as Alzheimer's and vascular or multi-infarct dementia, as well as other conditions), tinnitus (ringing in the ears), vertigo, and intermittent claudication (poor circulation to the lower legs).

History:

The name Ginkgo is thought to come from the Chinese word *sankyo* or *yin-kuo*, meaning "hill apricot" or "silve". The species name "biloba," meaning two lobes, refers to the unique two-lobed, fan-like leaves. Ginkgo have been used as both food and medicine for 1,000s of years. (Hobbs, 1991)

General Description:

1. Deciduous tree that grows 100 to 200 feet high with trunk diameter of 3 to 4 feet.
2. Lives as long as 1000 years

3. Has survived for over 250 million years ("Living Fossil")
4. Only tree to survive atomic blast in Hiroshima
5. Grown in cities because of resistance to insects, bacteria, viruses, pollution and age
6. Common in North America, Europe, and China
7. Leaves and seeds used for medicinal purposes



Fig-1, Ginkgo biloba cross section of tree trunk (source.MHNT)

Chemical constituents and active components

Leaves of the ginkgo tree contain over 40 active components; the two most therapeutic of these are called flavonoids and terpenoids. **Gb contains** the lipid phosphatidylserine.(Table-1 and fig-2).

Table: 1.The main constituents of Ginkgo biloba leaves

Class	Major chemical constituents
Terpenoids	Diterpenes: ginkgolides A, B, C, J (M is found in the root)
	Sesquiterpene: bilobalide Triterpenes: sterols
Flavonoids (flavone, flavonol glycosides, and aglycones)	kaempferol, quercetin, isorhamnetin, rutin, luteolin, delphinidin, myricetin
Biflavonoids	Sciadopitysin, ginkgetin, isoginkgetin, amentoflavone, bilobetin, 5'-methoxybilobetin
Organic acids	Benzoic acid derivatives (ginkgolic acid), N-containing acids
Polyprenols Others	di-trans-poly-cis-octadecaprenol, waxes, steroids, 2-hexenal, cardanols, sugars, catechins, proanthocyanidins, phenols, aliphatic acids, rhamnose

Po-Chuen Chan,¹ Qingsu Xia,² and Peter P. Fu², 2011

History Folk Use and Pharmacology:

Valued for medicinal properties in China for thousands of years ~2800 BC. The major chemical components include flavonoids and terpenoids, these are antioxidants, flavonol and flavone glycosides, lactone derivatives (ginkgolides), bilobalide, ascorbic acid, catechin, iron-based superoxide, 6-hydroxykinuretic acid, protocatechuic acid, shikimic acid, sterols and vanilic acid. (Fig-4). This article brings to light the major active components present in Gb along with their biological activities that may be important from the pharmacological point of view. The fruits are prepared by fermentation and cooking and are considered a delicacy during weddings and feasts. The nuts (fig-3) are boiled as a tea used to treat lung weakness and congestion (especially asthma), wheezing, coughing, vaginal candidiasis, frequent urination, cloudy urine, and excess mucus in the urinary tract.

1. Relieves symptoms of asthma and cough

2. Used the leaves to treat chilblains (symptoms of frostbite)
3. Made leaves into a tea which was sprayed into the throat for asthma
4. Improves circulation to all vital organs
5. Balanced action on arterial and venous systems
6. Tonic effects during vasomotor paralysis
7. Relaxant effects during vasomotor spasm.
8. Dual action important because in a single action drugs, i.e.
Vasodilators can aggravate ischemic conditions by deflecting blood and oxygen away from ischemic areas via dilation of healthy areas
9. Enhances oxygen utilization and glucose uptake in the brain.
The extract of Gb has been studied for its effectiveness in the treatment of Acrocyanosis, Alzheimer's disease, Cerebral atherosclerosis, Cerebral insufficiencies, Cochlear deafness, Dementia, Depression, Menopause, Peripheral and cerebral circulatory stimulation, Peripheral vascular disease, Raynaud's syndrome, Retinopathy, Senility, Short-term memory loss, Tinnitus, Vascular Diseases, and Vertigo.(Smith , *et al*,2003. _Alzheimer's disease. www.encyclopedia.com, 2006, Jordan L. Holtzman, 2013).

Health benefits:

Gb was first used for its medicinal properties in Ancient China. The Chinese took Ginkgo for its claimed cognitive benefits and to alleviate symptoms of asthma, they also ate ginkgo nuts because of their "strengthening" properties.



Fig-2, Ginkgo leaves in autumn



Fig-3, Ginkgo seeds

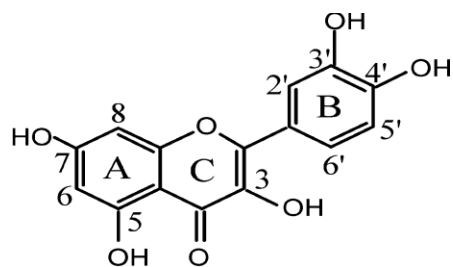
Phytochemicals and uses

The plant has a number of therapeutic properties and contains high levels of flavonoids and terpenoids, these are antioxidants that provide protection against oxidative cell damage from harmful free radicals (fig-4). Ginkgo biloba extract (GBE) is collected from the dried green leaves of the plant and is available as liquid extracts, capsules, and tablets. The dried leaves of the plant can also be used to make tea. Leaves of the ginkgo tree contain over 40 active components; Ginkgo contains the lipid phosphatidylserine – vital for the normal functioning of all body cells and abundant in the brain, its involvement in nerve cell functions such as nerve transmission. Ginkgo also contains terpenoids, substances which help to ‘thin’ the blood. Ginkgo contains terpenoids which reduce the stickiness of platelets, constituents of blood that encourage blood clotting. When blood is exposed to air, platelets break apart to plug the wound, helping prevent major blood loss. But, because sticky blood is harder for your heart to pump around your body, the result can be hypertension (high blood pressure). Hypertension is the single biggest risk factor for stroke.(Chang ., *et al*,1999). Hypertension is a major risk factor for heart attack, and migraine headaches. Ginkgo encourages better blood flow around the body – including to the brain. Studies suggest a connection between ginkgo and improved memory. Today, Ginkgo extract is enjoying world-wide popularity as a botanical medicine. In Germany, Ginkgo leaf extract is one of the most popular single botanicals prescribed, with 5.24 million prescriptions written in 1988 alone (Chang , *et al*, 1997., Huh, *et al*,1992, Smith, *et al*, 2004.,Chuen Chan., *et al.*, 2007). In the United States, Ginkgo extract recently stepped into the "herbal spotlight," primarily due to heavy media coverage following an article in an American Medical Association journal on the possible benefits of Ginkgo extract in Alzheimer’s patients (Le Bars *et al.*, 2000, Colciaghi, *et al.*, 2004, Evans, 2000).

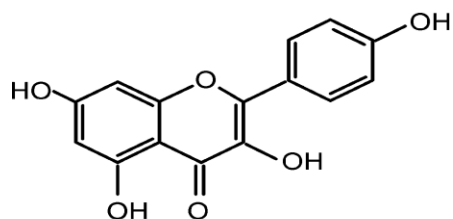
Gb is one of the most widely used and studied herbal products, and in Germany and China, it is the most commonly prescribed herbal medication. Because of the Dietary Supplement Health and Education Act of 1994, the United States Food and Drug Administration (FDA) does not regulate dietary supplements, including herbs, for safety or efficacy.

Chemical Composition: Gb leaf extract contains flavonol and flavone glycosides, lactone derivatives (ginkgolides), bilobalide, ascorbic acid, catechin, iron-based superoxide, 6-hydroxykinuretic acid, protocatechuic acid, shikimic acid, sterols and vanilic acid. The major classes of active ingredients are the ginkgolides and bilobalides (also known as terpenes) and the flavonoids.

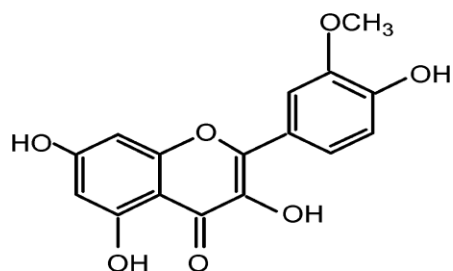
The ginkgo seeds contain a potentially toxic substance, ginkgotoxin (4-O-methoxypyridoxine), which has anti-vitamin B6 activity and inhibits GABA formation, which can potentially lead to convulsions and loss of consciousness, treatment of cancer, intestinal worms, gonorrhea, leukorrhea etc. The ginkgo tree roots have a greater concentration of the active ingredients. Commercial manufacturers use the Gb leaves to extract the active ingredients. The standardization of Gb leaf extract products is done by the active ingredients: flavones, ginkgolides and bilobalides.(Colciaghi, *et al*, 2004).



Quercetin



Kaempferol



Isorhamnetin

Fig-4.Flavonoids

Reported Uses: Since ancient times, Ginkgo biloba has been used for medicinal purposes. In the oldest Chinese Materia Medica (2800 B.C.), Gb was recommended for asthma, swelling of the hands and feet, coughs, vascular disorders, aging and for the brain. Since 1965, Gb has been used in Europe for the treatment of cerebral insufficiency and peripheral vascular disease for the reported uses of Gb.

1. Extracts from the leaves of Gb, a gymnospermous tree from China, improve capillary blood flow and improve memory and some aspects of brain function. The active components are diterpenes.

Conclusion;

Ginkgo biloba, also known as the maidenhair tree, is one of the oldest species of trees on the planet. Use of Gb can be traced back centuries in Chinese traditional medicine. It appears to be highly potential and had remained unexplored for their bioactive phytochemicals. Flavonoids etc. The available literature on phytochemicals and biological and pharmaceutical properties activities are very impressive. Very less information is available on the commercial Gb products in the market. Most widely-used herbal treatment for cognitive functions memory, learning, alertness Alzheimer's and it is approved in Germany for dementia treatment. Dua, *et al* (2009) had reported the role of traditional medicine in neuro psychopharmacology and other uses. Ginkgo is also known as a "brain herb." (Ginkgo biloba|University of Maryland Medical Center umm.edu/health/medical/altmed/herb/ginkgo-biloba#ixzz3SaZoPAXi, University of Maryland Medical Center). Now a days many pathogens developing multiple drug resistant, so in such conditions phytochemicals and antioxidants are highly beneficial.

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