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Phytological facets of extant maidenhair: *Gingko biloba* Linn

Abstract

The purpose of this review is to assess all the aspects of *Ginkgo biloba* L. for traditional medicines practitioners in Pakistan and abroad. It is a large tree with fan-shaped leaves. The leaves are commonly included in supplements and taken by mouth for memory problems. The ginkgo tree is thought to be one of the oldest living trees, dating back more than 200 million years. It is native to China, Japan, and Korea, but is also now grown in Europe and the United States. It seems to improve blood circulation, and might also act as an antioxidant to slow down changes in the brain.

Keywords: *Gingko biloba L.*, morphology, phytochemistry, Maidenhair, pharmacological effects

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Introduction

The fossil species must be ancient in relation to the current clade's time of genesis in order to qualify as a living fossil. Although they don't have to, living fossils typically come from lineages with few species. A living fossil's body plan may not change significantly from its distant relatives, but it is never the same species since genetic drift will always alter a fossil's chromosomal makeup. Stasis is observed in living fossils across extended geological timescales. It is a common misconception in popular literature that a "living fossil" has not changed much since the time of the fossil record, essentially lacking any morphological or molecular evolution. Scientific studies have consistently refuted these assertions.[1-3] Although the slightest outward alterations to extant fossils are incorrectly interpreted as proof against evolution, they actually represent stabilizing selection, an evolutionary process and may be the main driver of morphological evolution.[4]

One of these living fossils is *Ginko bilioba linn.* (GBL), which is commonly known as maidenhair. It is a native Chinese tree species. In the order Ginkgoales, which made its initial appearance more than 290 million years ago, it is the only surviving species. Very identical fossils to the extant species may be found in the Middle Jurassic, about 170 million years ago, and they belong to the genus Ginkgo.[5] Early human history saw the cultivation of this tree, which is still widely grown today (Table 1). The purpose of present study was to assess the various aspects of GBL that may help in prescribing practices of traditional medicines practitioners in Pakistan and abroad.

Table 1 Taxonomic position

Kingdom	Plantae
Subkingdom	Viridiplantae
Infrakingdom	Streptophyta
Superdivision	Embryophyta
Division	Tracheophyta
Subdivision	Spermatophytina
Class	Ginkgoopsida
Subclass	Ginkgooidae
Order	Ginkgoales
Family	Ginkgoaceae
Genus	Ginkgo L.
Species	*Ginkgo biloba* L.[6]

Materials and methods

Various electronic databases such as PubMed, Embase, Scopus, and Google Scholar were searched for keywords "*Ginkgo biloba*" or "ginkgo" in combination with "phytochemistry", "ethnobotany", "pharmacology" etc. to collect the relevant articles. There was no language restriction.

Findings

GBL and other species in the genus were formerly found all over the planet, but two million years ago, their range narrowed to include only a small portion of China. It was believed to be extinct in the wild for centuries, but it is currently confirmed to grow in the Tianmushan Reserve in Zhejiang province, eastern China, in at least two small locations.[7]

Morphology: Large trees, ginkgos typically grow to a height of 20–35 meters[8] however some specimens in China reach as high as 50 meters. The tree is typically deeply rooted, has an angular crown, long, rather erratic branches, and is resistant to extreme cold and windy weather. As a tree ages, its crown widens; young trees are frequently tall, slender, and sparsely branched. Ginkgos are woody; some have been reported to be over 2,500 years old. Their resistance to disease, their insect-resistant wood, and their capacity to produce aerial roots and sprouts all contribute to their longevity. Among seed plants, the leaves are distinct in that they have a fan-like morphology with veins that extend into the leaf blade, occasionally bifurcating (splitting), but never forming an anastomosing network. Dichotomous venation occurs when two veins continually split into two at the base of the leaf blade. Usually ranging from 5 to 10 cm (2 to 4 in), the leaves can occasionally reach a length of 15 cm (6 in). The leaves of the maidenhair fern, Adiantum capillus-veneris, have a pinnae-like appearance, which is whence the ancient popular name "maidenhair tree" originated. Ginkgos are highly valued for their rich saffron-colored autumn leaves.[9] Long shoot leaves are typically lobed or notch between veins, but only on the outer surface. They are borne on short, stubby spur shoots, where they are grouped at the tips, as well as on the tips of the faster-growing branch tips, where they are alternate and dispersed. With stomata on both sides, leaves are green on top and bottom. The leaves in autumn change to a vivid yellow color before dropping, sometimes in as little as one to fifteen days.[10]

Phytochemistry: The main constituents found in the leaf extracts of GBL are found to be terpene lactones (Ginkgolide B, Ginkgolide A, Bilobalide,Ginkgolide C, Ginkgolide J) and flavonoids (Quercetin, Quercetin-3-β-D glucoside, Rutin, Kaempferol, Quercetin, Isorhamnetin).[11]

Pharmacological actions: GBL exhibits different pharmacological properties that are summarized in Table 2.

Table 2 Pharmacological actions of *Ginkgo biloba* L

Body system	Pharmacological effect
Nervous System	• GBL has been used in Alzheimer disease and cognitive dysfunction in vascular dementia by reducing plasma superoxide dismutase activity and protecting the hippocampal CA1 neuron that enhances cognitive performance. Studies have also examined the role of GBL in treatment of depression and other psychiatric disorders.[12-15]
Cardiovascular System	• GBL has been used to observe pressure wave reflection and blood pressure. It increases stiffness index and reduces peripheral augmentation index after 2 hours of treatment and the same was observed after consumption of high-carbohydrate meal.[16,17]
Liver	• GBL has been shown to increase cerebral blood flow but individual lobar regions did not show any significant change in post-consumption of the GBL analysis. • Hepatoprotective effects of GBL extracts have been well analyzed against methotrexate induced hepatic damage in animal studies. The GBE administration reversed biochemical alterations and improved liver histopathology.[18,19] • GBL has potential effects for protecting against liver Ischemic/Reperfusion injury characterized by its anti-apoptotic, anti-necrotic, and anti-inflammatory properties, that makes contributions to the exploration of therapeutic strategies in the liver damage.
Eye	• Ocular examination performed after the GBL treatment revealed increased mean blood flow, volume and velocity at almost all the points and significant increase in blood volume was observed in superior basal and superior temporal neuroretinal rim areas while significant increase in blood velocity was observed in areas of the inferior temporal neuroretinal rim and superior temporal peripapillary area.[20,21] • Prolonged administration of GBL for 10 weeks brings about changes in retinal constituents.
Respiratory System	• Ginkgolide-B substantially inhibited ovalbumin-induced oeosinophils in lung tissue and mucus hyper-secretion by goblet cells in the airways. This suggests that Ginkgolide-B may be useful for the treatment of asthma.[22,23] • GBL biflavones have been found to inhibit the activity of leukocyte elastase. This in turn implicates GBL as a functional food for the treatment of airway inflammation.
Integumentary System	• GBL is used against skin ravages and signs of aging. It protects the skin from skin barrier damage and erythema due to UV radiations.[24]
Sexual Dysfunction	• GBL has limited positive effects on sexual function of men as well as women.[25,26]

Pharmacotherapeutics: GBL is used to improve quality of life in mild dementia and (age-associated) cognitive impairment. Once more serious problems have been ruled out by a physician, traditional herbal medicinal products are used to relieve the sensation of cold hands and feet and heaviness in the legs that are linked with minor circulation disorders. There have been reports of specific organ bleeding (ocular, nasal, brain, and gastrointestinal hemorrhages). Headache, lightheadedness, diarrhea, abdominal pain, nausea, and vomiting are typical adverse effects.[27]

Posology*:* The adult dose is 120-240mg once a day which should last for at least 8 weeks. However, the physician will rule out the other causes if he finds out no improvement after 3 months.[27]

Study conclusion & recommendations

GBL is a tree indigenous to People Republic of China and has been cultivated due to its beneficial effects since long. It is also known as 'Living Fossil' due to its ancient order. Its various plants parts are used in traditional Chinese medicines, however, recent research mainly focuses on ginkgo extract. These extracts are used in supplements that are associated with various health claims related to memory functions and blood problems. Raw ginkgo seed causes intoxication so it must be cooked before use. People with a history of angina should use the seed with cautions. The herb is safe at the normal suggested dosage. However, there are reports of few patients who became allergic to the herb and suffered various side effects. Traditional practitioners must take all necessary measures while prescribing the GBL.

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None.

Conflicts of interest

Authors declare no conflict of interest.

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