ejpmr, 2025, 12(8), 425-431

SJIF Impact Factor 7.065

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Review Article

ISSN (O): 2394-3211

ISSN (P): 3051-2573

A SHORT REVIEW: POTENTIAL USE OF MEDICINAL PLANT GINKGO BILOBA

Ghotekar Tejaswini Ambadas*, Bhandare Siddhi Vijay and Pawar Dipali Ishwar

Matoshri Institute of Pharmacy Dhanore, Yeola, 423401.

***Corresponding Author: Ghotekar Tejaswini Ambadas**

Matoshri Institute of Pharmacy Dhanore, Yeola, 423401.

Article Received on 23/06/2025 **Article Revised on 14/07/2025** **Article Accepted on 03/08/2025**

❖ ABSTRACT

The Ginkgo tree, scientifically known as Ginkgo biloba, it is a oldest seed plants, commonly known as a "living fossil. And which is used to improve blood flow, prevent the formation of clots, bolster capillary structures, and safeguard neural cells in situations of reduced oxygen availability The active compounds in Ginkgo biloba extract, including terpenoids and flavonoids, exhibit anti-inflammatory and anti-asthmatic effects, aiding in the relief of bronchospasm. These compounds also possess skin-regenerative and wound-healing abilities, and studies have shown that they can enhance blood circulation, strengthen capillary walls and their elasticity, and protect nerve cells from damage caused by oxygen deficiency. This blend of ancient lineage, unique physiological attributes, and growth versatility contributes to the Ginkgo biloba's status as a remarkable specimen in the plant kingdom, cherished by both scientists and nature enthusiasts alike. The purpose of this publication is to examine research findings primarily from 2015 to 2022 regarding the chemical makeup of Ginkgo biloba, along with its biological effects, toxicity, and potential drug interactions. In summary, Ginkgo biloba stands out not only as a traditional medicinal herb but also as a symbol of the enduring wisdom of herbal medicine. Its leaves and nuts serve as valuable resources for addressing a wide array of health concerns, ranging from respiratory and cardiovascular issues to skin infections and alcoholism, underscoring its significance across centuries of therapeutic practice. Among its numerous applications, GBE is frequently employed in the treatment of respiratory conditions such as asthma and bronchitis, providing relief to those suffering from these chronic ailments. The leaves of the G. biloba plant are rich in flavonoids and terpenoids, compounds known for their anti-inflammatory and antioxidant effects, which contribute to the herb's ability to enhance respiratory function

❖ **KEYWORD:** Plant Description, Pharmacological Activities, Phytochemical Constituents Of Ginkgo Biloba's, Bio Activities Of Ginkgo Biloba.

❖ INTRODUCTION

The term ginkgo, which translates to "hill apricot" or "silver fruit" in Chinese, comes from the apricot-shaped, mature, yellow fruits of the ginkgo tree.[1] The definition of complementary and alternative medicine is "diagnosis, treatment and/or prevention which complements mainstream medicine by contributing to a common whole, by satisfying a demand not met by orthodoxy, or by diversifying the theoretical frameworks of medicine" (Ernst 2000).[2] Ginkgo biloba (Gb) is among the oldest seed plants, commonly known as a "living fossil." This towering tree can survive for more than 1000 years and can grow up to 40 m tall. Although it is originally from China, Gb is now grown globally. The extract from Gb leaves has been utilized in traditional Chinese medicine for hundreds of years to address circulatory issues, asthma, tinnitus, dizziness, and cognitive difficulties.[3] Ginkgo biloba, commonly referred to as the "maidenhair tree" or a "living fossil," is an ancient species of tree characterized by its unique fan-shaped leaves, recognized for its therapeutic applications and aesthetic appeal, and is the only extant representative of its botanical family.[4] Ginkgo extracts include active compounds that offer numerous health benefits. These extracts improve blood flow, prevent the formation of clots, bolster capillary structures, and safeguard neural cells in situations of reduced oxygen availability.[5] The Ginkgo Biloba L. tree species has a rich history of medicinal usage due to its numerous health advantages. Even after decades of research, scientists continue to explore G. biloba, focusing on its mechanisms and discovering new beneficial properties. The active compounds in Ginkgo biloba extract, including terpenoids and flavonoids, exhibit anti-inflammatory and anti-asthmatic effects, aiding in the relief of bronchospasm. These compounds also possess skin-regenerative and wound-healing abilities, and studies have shown that they can enhance blood circulation, reduce clot formation, strengthen capillary walls and their elasticity, and protect nerve cells from damage caused by oxygen deficiency.[6] The purpose of this publication is to examine research findings primarily from 2015 to 2022 regarding the

chemical makeup of Ginkgo biloba, along with its biological effects, toxicity, and potential drug interactions. Additionally, this publication includes a section that analyzes patents related to the innovative uses of Ginkgo biloba in the food and beverage industry.[7]

Fig. 1

Fig. 2

❖ PLANT DESCRIPTION

The Ginkgo tree, scientifically known as Ginkgo biloba, boasts a rich and fascinating lineage that stretches back millions of years. Fossil evidence has been uncovered in rock formations that date as far back as the Triassic period, an era that began approximately 250 million years ago. Some experts suggest that evidence of this remarkable plant may be found even earlier, in the Permian and Carboniferous layers of earth, which are known to contain numerous traces of ancient flora. Today, Ginkgo biloba continues to thrive in various environments, which has led botanists and paleobotanists alike to affectionately refer to it as a "living fossil." This designation highlights its unique status as one of the oldest surviving seed-bearing plants on the planet. The longevity of Ginkgo is particularly notable, as it offers a living snapshot of the Earth's botanical history and evolution.[8]

The anatomy of the Ginkgo plant is quite distinctive, with its saprophytic body structure resembling that of several conifer species, yet it exhibits characteristics all its own. Ginkgo trees typically grow in an ex-current manner, whereby their central stem or trunk continues to extend upward, allowing them to achieve impressive heights that can reach up to an astounding 30 meters. One of the key features of Ginkgo trees is their unique branching pattern, which can be quite irregular and uneven. The branches are classified as dimorphic, signifying the existence of two different types. The long shoots showcase unlimited growth potential and are often adorned with widely spaced leaves that help capture sunlight. In contrast, the dwarf shoots exhibit limited growth potential, appearing more compact and dense. These long shoots are capable of remarkable growth rates, yielding up to 50 centimeters of new growth in just one year, a testament to the Ginkgo's resilience and adaptability. Conversely, the maturity process for dwarf shoots is considerably prolonged, with the small shoots—measuring only 2-3 centimeters in length—potentially being several years old before they reach full development. Interestingly, the distinction between these two types of shoots is not always sharply defined. In fact, environmental factors or changes in the plant's growth conditions can lead to a long shoot gradually evolving into a dwarf shoot over time, demonstrating the Ginkgo's remarkable capacity to adapt to its surroundings. This blend of ancient lineage, unique physiological attributes, and growth versatility contributes to the Ginkgo biloba's status as a remarkable specimen in the plant kingdom, cherished by both scientists and nature enthusiasts alike.[7]

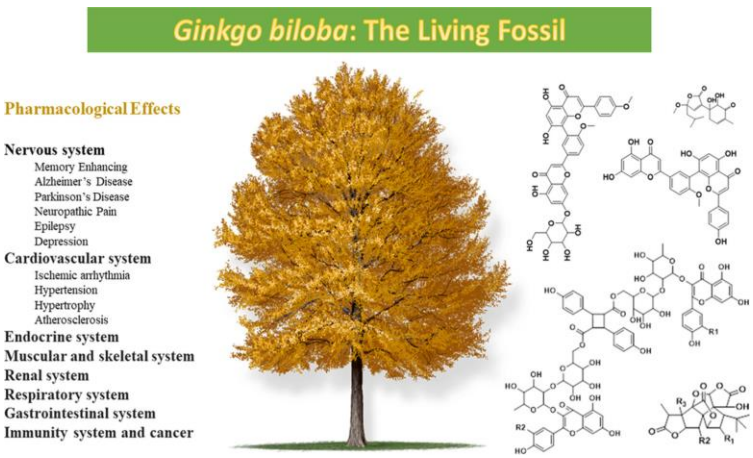

Fig. 3

❖ **Phytochemical Constituents of Ginkgo biloba's**

Flavonoids, glycosides and terpene lactones are said to be the main bioactive components of Ginkgo biloba leaves. 3 Differences in the quantity and arrangement of -OH groups account for variations across ginkgolide subtypes. The four five-member ringed species known as bilobalides include a carbocycle, three lactones, and a tert-butyl group. Chloride channel blockers, ginkgolides, and bilobalides are strong, selective GABA receptor antagonists that reduce inhibitory synaptic transmission in the adult central nervous system because of their structural resemblance to picrotoxinin.

Nevertheless, bilobalides' strong effects are marginally less pronounced than those of ginkgolides. The pharmacological effects of ginkgo biloba extracts and ginkgolide B are diverse. However, one of their main functions is to serve as antagonists of platelet-activating factor (PAF), and they have also shown notable effects on disorders connected to dementia.[27]

❖ **Bio activities of Ginkgo Biloba**

Nephroprotection

Severe tubular cell damage and acute kidney malfunctions due to systemic and intrahepatic inflammation are diagnostic indicators of nephron inflammation. A significant increase in renal ROS levels indicated that oxidative damage was involved in hypertension-induced nephropathy. When given EGb extracts for its Ginkgetin aglycone fraction, 8–12 weeks old healthy adult C57BL/6 female mice showed reduced pro-inflammatory responses mediated by LPS (bacterial endotoxin), decreased incidence of renal injury, and inhibited renal cell apoptosis. Additionally, SIRT1 protein levels were elevated, and the activation of the pro-inflammatory NF-kB pathway was inhibited, conclud its alluring therapeutic roles in inducing nephroprotection.[28]

EGb 761's crucial role as an effective and noticeable antioxidant in hypertensive rats was confirmed when 180–200 g healthy adult Wistar male l-NAME-mediated hypertensive rat models were pre-treated with EGb extract at 100 mg/kg per day for four weeks. These models showed a gradual decrease in systolic blood pressure, renal tissue MDA (lipid peroxidation biochemical marker), and TNF-α levels in comparison to the control groups.[29]

Ginkgo biloba's preclinical studies as an anti-inflammatory, anti-platelet, neuroprotective, and anti-neoplastic drug are summarized in Table 2.

The table shows preclinical research on EGb 761, a Ginkgo biloba extract, in a variety of animal models, showing its intended activity and outcomes at the specified dose rate/concentration.

Ginkgo Biloba Preparations	Model for study	Dose rate/concentration	Targeted Activity	Result	Reference
Nephroprotection					
EGb 761 Extract	MCAO filament model in wild type knockout and Ho-Iknockouts	100 mg/kg/d EGb 761; 7 days	Transient ischemia, nephroprotection	Increased HO-I protein levels; Inhibitory effect on H2O2, Glutamate-induced excitotoxicity were observed in primary neuronal cultures of mouse.	[30]
EGb 761 Extract	Adult C57BL/6 male mice, 14 day adult C57BL/6 female mice	100 mg/kg/d E6b761; 6 mg/kg GA; 6 mg/kg GB; 10 mg/kg/d TFM; 6 mg/kg BB	Nrf2/HOI induction of CRMP2 pathway, neuroprotection	33% and 49% reduction in infarct volumes, enhanced sensory behavior	[31]
EGb 761 Extract	Sprague-Dawley (SD) rats	N = 44; 50-200 mg/kg EGb 761	Permanent focal and transient cerebral Ischemia	Increases protein expressions of HOI, Nrf2, GAPDH, CRMP2, B-actin. Neuritogenic effects.	[32]
Anti-neoplastic					
EGb 761 Extract	(200-250 gm) white albino rat	Single dose; 100 200 mg/kg/d EGb 761	Cisplatin drug induced cardiotoxicity and hepatotoxicity	Reduced cisplatin induced toxicity; substantial down regulation of CK, ALT, LDH	[33]
EGb 761 Extract	Experimental Guinea pig	100 mg/kg/d E6b761 for 8 days	Cisplatin drug induced ototoxicity	Reduced cisplatin induced ototoxicity	[34]

	Animal model				
EGb 761 Extract	Excision and dead space wound male rat model	50 mg/kg/d E6b761	Effect of cyclophospamide	Reversal of wound healing suppressant activities of Cyclophosphamide	[35]
Ginkgo biloba seed polysaccharide (GSBP)	SMMC-7721 cell cultures	50 mg/kg/d 65BP (for 36h)	HepG2 cell lines, SMMC-7721 cells (Tumour cells	Cyclophosphamide Induction of apoptotic effects on SMMC-772) cells by GBSP	[36]

❖ Pharmacological Activities

Ginkgo biloba, often simply referred to as G. biloba, is a remarkable and time-honored medicinal herb that has been revered for its diverse range of therapeutic properties. This ancient plant has been an integral part of traditional medicine, particularly within Chinese herbal practices, for thousands of years, showcasing its enduring significance in the realm of natural remedies of the key preparations derived from Ginkgo biloba is Ginkgo Biloba Extract (GBE), which is widely recognized for its potential health.[9-10] Among its numerous applications, GBE is frequently employed in the treatment of respiratory conditions such as asthma and bronchitis, providing relief to those suffering from these chronic ailments. The leaves of the G. biloba plant are rich in flavonoids and terpenoids, compounds known for their anti-inflammatory and antioxidant effects, which contribute to the herb's ability to enhance respiratory function. Furthermore, the leaves of G. biloba have a long history of being utilized to address cardiovascular issues. Traditional practitioners have relied on this herb to improve blood circulation, reduce the risk of heart-related diseases, and support overall heart health. Additionally, G.biloba leaves are also employed in the management of various skin infections, utilizing their antibacterial and healing properties to aid in the recovery of affected areas. On the other hand, the nuts of the G. biloba plant have also been instrumental in traditional medicine, particularly in treating a variety of respiratory disorders. They have been commonly used to alleviate symptoms associated with asthma, chest pain, and persistent coughs, offering comfort to those who suffer from these conditions. In addition to these respiratory benefits, G. biloba nuts have been traditionally utilized to address bladder irritation, demonstrating their versatility in treating urological issues as well. Moreover, they have even found applications in the context of alcoholism, where they have been used as part of a holistic approach to support individuals seeking recovery. In summary, Ginkgo biloba stands out not only as a traditional medicinal herb but also as a symbol of the enduring wisdom of herbal medicine. Its leaves and nuts serve as valuable resources for addressing a wide array of health concerns, ranging from respiratory and cardiovascular issues to skin infections and alcoholism, underscoring its significance across centuries of therapeutic practice.[9-11]

1. Management Of Respiratory Conditions

Acute respiratory distress syndrome (ARDS), asthma, and chronic obstructive pulmonary disease (COPD) are linked to inflammation in the airways, with inflammatory processes playing a key role in the onset, progression, and prognosis of these diseases. The presence of neutrophils and other inflammatory cells worsens airway inflammation. In inflammatory environments, neutrophils are involved in two critical metabolic reactions: respiratory burst and chemotaxis. Wu et al. found that during pulmonary damage caused by lipopolysaccharide (LPS), both ginkgolide M (GM) and ginkgolide B (GB) were effective in reducing the clustering of inflammatory cells, including lymphocytes, neutrophils, and macrophages, while also alleviating cytological lung damage.[12] Tao et al. found that treatment with EGb 761 significantly reduced the production of interleukins (IL)-4, IL-5, IL-6, IL-8, IL-13, and tumor necrosis factor (TNF)-α in allergy model mice. Additionally, EGb 761 modulates the function of leukocyte elastase, a protein linked to blood coagulation issues, lung damage, and chronic bronchitis, while its components effectively diminished lung inflammation.[13]

2. Anticancer Effects

Cancer is a condition where certain cells in the body start to grow uncontrollably and can eventually spread to other parts. It is a worldwide issue, with the National Institutes of Health reporting that in 2016, 1.7 million new cancer cases were identified in the United States, resulting in 600,000 deaths, highlighting the urgent need for new cancer treatments. In their research, Ahmed et al. examined the effectiveness of Ginkgo biloba extract (GBE) on rats suffering from hepatocellular carcinoma (HCC). They found that GBE significantly improved the histological features of liver tissue, leading to reduced levels of alpha-fetoprotein (AFP), glypican-3 (GPC-3), and carcinoembryonic antigen (CEA) in HCC rats. This was achieved by enhancing the gene expression of inhibitor of growth (ING)-3 and reducing the gene expression of the transcription factor forkhead box protein 1 (FOXP1) in the liver.[14] When given to C57BL/6J mice, G. biloba exocarp extracts (GBEE) showed similar effects on the expression of various proteins, including Wnt3a, vascular endothelial growth factor (VEGF), and phosphorylated (p)-protein kinase B (Akt)/Akt. Another study by Han et al. showed the anti-Lewis lung cancer (LLC) efficacy of GBEE, which

limited in vitro LLC cell growth by regulating catenin and Wnt3a expression in a dose-dependent manner. Lung cancer metastasis was inhibited by GBEE via lowering the levels of p-Akt/Akt, VEGF, VEGF receptor (VEGFR), and β-catenin protein expression. Similar decreases in VEGF and VEGFR2 mRNA levels imply that GBEE inhibits tumor angiogenesis, which has anticancer benefits. The suppression of the Wnt, catenin, and VEGF signaling pathways was linked to the underlying processes of these results.[15]

3. Effects of Antidementia

The majority of EGb 761 clinical trials focus on improving memory and cognition, but some focus on dementia, specifically dementia presentations that involve a progressive loss of memory and cognition, such as frontotemporal dementia, Lewy body dementia, and vascular dementia. EGb 761 may be utilized to treat a variety of dementia etiologies due to its ability to inhibit amyloid development and toxicity, regulate excitotoxic glutamatergic neurotransmission, and function as a radical scavenger.[16]

4. Effects of Anti-Obesity

By changing how the central nervous system (CNS) regulates food consumption and peripheral metabolism, high-fat diets contribute to the pathophysiology of obesity by increasing insulin tolerance, causing weight gain, and causing other metabolic abnormalities.[17]

It was discovered that administering GBE helped people lose weight. The difference between the amount of food that was given and the amount that was left over the course of a day was used to calculate the amount of food consumed. Insulin receptor (IR), lipid receptor R1 (Adipo R1), IL-10, and Akt phosphorylation all showed large increases in gene expression, which may have triggered the insulin signaling cascade. On the other hand, NF-κB p65 phosphorylation and TNF-α levels decreased. GBE's anti-inflammatory properties can lessen the adverse consequences of consuming an excessively high-fat diet by lowering TNF-α levels in retroperitoneal fat deposits.[18]

5. Anti-lipidemic effect

Increased low-density lipoprotein cholesterol (LDL-C), decreased high-density lipoprotein cholesterol (HDL-C), and elevated TG levels are the hallmarks of dyslipidemia. Furthermore, obesity and insulin resistance have been linked to hyperlipidemia. In a different investigation, G. biloba (10 mg/kg/day) therapy considerably raised HDL-C levels while drastically lowering TG and plasma cholesterol levels in male rabbits when compared to the control group. Moreover, G. biloba has been shown to increase glutathione (GSH) levels and decrease MDA levels in aortic tissue.[19]

6. Cardiovascular Disease Treatment

The effects of G. biloba seeds on cholesterol metabolism were first investigated by Mahadevan et al., who looked at how different parts of the seeds, such as whole seeds, water-soluble fraction, and lipid-soluble fraction, mediated lipid metabolism and the prevention of cardiovascular disease.[20] According to in vitro research, G. biloba seeds can affect the production of apolipoprotein B and the LDL receptor, which can alter the liver's blood cholesterol levels. Whole seeds raised blood cholesterol levels while decreasing hepatic cholesterol levels in vivo. It is possible that the lipid-soluble part of G. biloba seeds could be employed to minimize the risk of heart disease because it decreased hepatic cholesterol levels while increasing serum cholesterol levels. Mice fed a high-fat diet demonstrated the benefits of ginkgo seed ethanol extract. When compared to untreated animals, the ethanolic extract significantly reduced the weight of epididymal adipose tissue and adipocyte size, successfully preventing fat accumulation and lowering mice's overall body weight.[21]

7. Effects of Antihypertensive

Acute coronary syndromes, persistent heart failure, and stroke are among the major issues that can result from hypertension, a progressive illness.[22] Pathophysiological etiologies linked to the development of hypertension include inflammation, oxidative stress, autoimmune vascular dysfunction, and dysregulation of the renin-angiotensin system.[23]

Numerous animal models have demonstrated G. biloba's antihypertensive properties. By preventing renal NO overproduction and lowering IL-6 and TNF-α levels in kidney tissue, EGb 761 demonstrated hypotensive and renoprotective effects in a study of rats with damaged kidneys.[24]

8. Impact on Reduction of Inflammation

Inflammation is a complicated biochemical process that disrupts tissue homeostasis. Numerous chemical, mechanical, or physical causes might result in either acute or chronic inflammation.[25] Inflammation is typically brought on by tissues and migratory cells producing substances such as histamine, prostaglandins (PGs), leukotrienes (LTs), bradykinin, PAF, and IL.[26]

❖ CONCLUSION

Ginkgo Biloba is a potential herbs having immeasurable beneficial quality in different aspect have been used by our anticancer. It has significant role to destroy diseases cancer, asthma as well as other systems.The Gingko Biloba take a unique place in the traditional herbs based remedies and also economical growth of the nation.

❖ REFERENCE

1. McKenna DJ, Jones K, Hughes K. Efficacy, safety, And use of Ginkgo biloba in clinical and preclinical Applications. Altern Ther Health Med., 2001; 7: 70, 86, 88–90.
2. Maryam Akaberi a, Hamed Baharara a, Mohammad Sadegh Amiri b, Ali Tafazoli Moghadam c,

Amirhossein Sahebkar d e, Seyed Ahmad Emami f, Ginkgo biloba: An updated review on pharmacological, ethnobotanical, and phytochemical studies, pharmacological Research, December 2023; 9: 100331.
3. S. Mahadevan, Y. Park, Journal of Food Science / Volume 73, Issue 1/p. R14-R19, Multifaceted Therapeutic Benefits of Ginkgo biloba L.: Chemistry, Efficacy, Safety, and Uses First published, 12 December 2007.
4. Ginkgo biloba Extracts: A Review of the Pharmacokinetics Of the Active Ingredients Christian Ude , Manfred Schubert-Zsilavecz , Mario Wurglics Published online: 24 May 2013, Springer International Publishing Switzerland 2013, Clin Pharmacokinet, 2013; 52: 727–749.
5. Ginkgo Biloba Tran Nguyen; Talal Alzahrani, Author Information and Affiliations Authors Tran Nguyen1; Talal Alzahrani2. Affiliations 1 George Washington University Hospital 2 Taibah University, Last Update: July 3, 2023.
6. A review on: Medicinal properties of ginkgo biloba, Shoheb S Shaikh[1], Designation : Principal, Nachiket S Dighe[1], Dept. of Pharmaceutical Chemistry, Bhagwant University Ajmer, Rajasthan I
7. The Potential of Ginkgo biloba as a Source of Biologically Active Compounds-A Review of the Recent Literature and Patents, Patrycja Biernacka, Iwona Adamska and Katarzyna Felisiak Submission received: 11 April 2023 / Revised: 28 April 2023/Accepted: 5 May 2023 / Published: 9 May 2023
8. *Ginkgo biloba*: An updated review on pharmacological, ethnobotanical, and phytochemical studies Author links open overlay panel Maryam Akaberi [a], Hamed Baharara [a], Mohammad Sadegh Amiri [b], Ali Tafazoli Moghadam[c], Amirhossein Sahebkar[d e], Seyed Ahmad Emami [f,], December 2023; 9: 100331.
9. Noor-E-Tabassum 1, Rajib Das 1, Mashia Subha Lami 1, Arka Jyoti Chakraborty 1, Saikat Mitra 1, Trina Ekawati Tallei 2,3, Rinaldi Idroes 4, Amany Abdel-Rahman Mohamed 5, Md Jamal Hossain 6, Kuldeep Dhama 7, Gomaa Mostafa-Hedeab 8, Talha Bin Emran 9, Evid Based Complement Alternat Med., 2022 Feb 28; 2022: 8288818. Doi: 10.1155/2022/8288818, Ginkgo biloba: A Treasure of Functional Phytochemicals with Multimedicinal Applications Copyright and License information PMCID: PMC8901348 PMID: 35265150
10. Eisvand F., Razavi B. M., Hosseinzadeh H. A review of Ginkgo biloba's impact on metabolic syndrome. Research on Phytotherapy, 2020; 34(8): 1798–1811. 10.1002/ptr.6646 is the doi. [PubMed] [DOI] [Google Scholar]
11. Mahadevan S., Park Y. Ginkgo biloba L.'s many medicinal advantages: chemistry, effectiveness, safety, and applications, 2008; 73: R14–9. Journal of Food Science, doi: 10.1111/j.1750-3841.2007.00597.x. [DOI] [Med] [Google Scholar]
12. Tao Z., Jin W., Ao M., Zhai S., Xu H., Yu L. Evaluation of the anti-inflammatory activities of the active ingredients of Ginkgo biloba for the treatment of lung illnesses. Food & Function, 10:2209–2220, 2019. 10.1039/c8fo02506a is the doi. [DOI] [Med] [Google Scholar]
13. Zhou G., Wu F., Shi W., et al. One of the key components of ginkgolides that helps reduce lung damage brought on by lipopolysaccharides is ginkgolide B. Pharmacotherapy & Biomedicine = Biomedecine & Pharmacotherapie., 2016; 81: 71–78. 10.1016/j.biopha.2016.03.048 is the doi. [DOI] [Med] [Google Scholar]
14. El-Mezayen H. A., El-Toumy S. A., Ahmed H. H., Shousha W. G., Sayed A. H., Ramadan A. R. The anticancer activity of ginkgo biloba leaf extract in rodents has been demonstrated by biochemical and molecular data, 2017; 64: 25–33. Acta Biochimica Polonica. 10.18388/abp.2015_1200 is the doi. [DOI] [Med] [Google Scholar]
15. In Lewis lung cancer, exocarp extracts from Ginkgo biloba suppress angiogenesis and its effects on the Wnt/β-catenin-VEGF signaling pathway (73). Han D., Cao C., Su Y., et al., 2016; 192: 406–412; Journal of Ethnopharmacology. 10.1016/j.jep.2016.09.018 is the doi. [DOI] [Med] [Google Scholar]
16. Current views on the protective effects of ginkgo biloba in neurological and cerebrovascular illnesses were presented by Nash K. M. and Shah Z. A. doi: 10.4137/IMI.S25054; Integrative Medicine Insights, 2015; 10: 1–9. [DOI] [Free article from PMC] [Med] [Google Scholar]
17. Hosseinzadeh H., Eisvand F., and Razavi B. M. A review of Ginkgo biloba's impact on metabolic syndrome. Research on Phytotherapy, 2020; 34(8): 1798–1811. 10.1002/ptr.6646 is the doi. [PubMed] [DOI] [Google Scholar]
18. Hirata B. K., Banin R. M., Dornellas A. P., et al. In obese rats' retroperitoneal adipose tissue depot, ginkgo biloba extract reduces inflammation and enhances insulin signaling. Inflammation Mediators, 2015; 2015: 419106. 10.1155/2015/419106 is the doi. [DOI] [Free article from PMC] [Med] [Google Scholar]
19. Liu H. C., Wu S. J., Huang W. C., Liou C. J., and Chen Y. L. HepG2 cells' lipid buildup brought on by oleic acid was decreased by ginkgolide C., 2018; 26. Saudi Pharmaceutical Journal doi: 10.1016/j.jsps.2018.07.006. [DoI] [PMC free article] [PubMed] [Scholar]
20. Mahadevan S., Park Y. Ginkgo biloba L.'s Multiple Therapeutic Benefits: Chemistry, Safety, Effectiveness, and Applications. Food Science Journal, 2008; 73: 14–9. doi: 10.1111/j.1750-3841.2007.00597.x. [DoI] [PubMed] [Scholar]
21. Wang H. Y., Zhang Y. Q. Ginkgo biloba seeds' primary active ingredients, detoxification method, and possible application in functional health foods. doi: 10.1016/j.jfca.2019.103247, Journal of Food

Composition and Analysis, 2019; 83. [DOI] [Google Scholar]
22. Hypertension: A Worldwide View.
23. Zhang B., Li J., Mei D., Yan F., and Zuo W. Research on aging-related disorders using extract from ginkgo biloba leaves has advanced. Age and illness, 2017; 8(6): 812–826. The value is 10.14336/ad.2017.0615. [DoI] [PMC free article] [PubMed] [Scholar]
24. Farghaly H. S. M., Abdel-Zaher A. O., El-Refaiy A. E. M., and Abd-Eldayem A. M. Rats' kidney damage caused by hypertension and hypercholesterolemia is prevented by the standardized extract of ginkgo biloba (EGb761): insights into the underlying mechanisms. The doi is 10.1016/j.biopha.2017.08.078. Biomedicine & Pharmacotherapy, 2017; 95. [DoI] [PubMed] [Scholar]
25. An review of the pharmacological views on inflammation and the genus curcuma was presented by Rahaman M. M., Rakib A., and Mitra S. Plants, 2021; 10(1): 1–19. The doi is 10.3390/plants10010063. [DoI] [PMC free article] [PubMed] [Scholar]
26. The mechanism of action of anti-inflammatory medicines and inflammation (Vane J., Botting R.,). 89–96 in The FASEB Journal, 1987; 1(2). doi: 10.1096/fasebj.1.2.3111928. [DoI] [PubMed] [Scholar]
27. S. Ding, E. Dudley, S. Plummer, J. Tang, R.P. Newt on, A.G. Brenton, Quantitative determination of major active components in Ginkgo biloba dietary supplements by liquid chromatography/mass spectrometry
28. C.C. Ng, R.K. Duke, T. Hinton, G.A. Johnston, GABAA receptor cysteinyl mutants and the ginkgo terpenoid lactones bilobalide and ginkgolides, Eur. J. Pharmacol., 2016; 777: 136-146. 10.1016/j.ejphar.2016.03.0079.
29. A.O. Abdel-Zaher, H. Farghaly, A. El-Refaiy, A.M. Abd-Eldayem, Protective effect of the standardized leaf extract of Ginkgo biloba (EGb761) against hypertension-induced renal injury in rats Clin. Exp. Hypertens. (N. Y., N. Y.: 1993), 2018; 40 (8): 703-714, 10.1080/10641963.2018.1425421.
30. Saleem, H. Zhuang, 5. Biswal, Y. Christen, S. Doré Ginkgo biloba extract neuroprotective action is dependent on heme oxygenase I in ischemic reperfusion brain injury Stroke, 2008; 39(12): 3389-3396, 10.1161/STROKEAHA108.5234807.
31. S.E. Nada, Z.A, Shah, Preconditioning with Ginkgo biloba (EGb 7618) provides neuroprotection through HOI and CRMP2 Neurobiol. Dis., 2012; 46(1): 180-189, 10.1016/j.nbd.2012.01.0067, View PDFView article
32. E.J. Lee, H.Y. Chen, T.S. Wu, T.Y. Chen, I.A. Ayoub, K.I. Maynard, Acute administration of Ginkgo biloba extract (EGb 761) affords neuroprotection against permanent and transient focal cerebral ischemia in Sprague-Dawley rats , J. Neurosci, Res., 2002; 68(5): 636-645.
33. Hasan Alhaddad , MULTIPLE PROTECTIVE EFFECTS OF Ginkgo biloba AGAINST HEPATIC AND CARDIAC TOXICITY INDUCED BY CISPLATIN IN RATS Int. J. Compr. Pharm., 2015; 6(1).
34. Miguel Angelo Hyppolito, José Antônio A. De Oliveira, Maria Rossato, Francisco Holanda, Cisplatin ototoxycity and otoprotector to cilliated cells by Ginkgo biloba extract: Anatomic and eletrophisiologic study, ISSN: 0034-7299 ,DataRevista Bras, De, Otorrinolaringol., 2003; 69 (Issue: 4): 504-511. 10.1590/50034-729920030004000117
35. K.L, Bairy, S.B. Ganesh, M.S. Adiga, A. Shalini, Impaired Wound Healing Due to Cyclophosphamide (CLP) Alleviated by Supplemental Ginkgo biloba (GB), Б(1), 2006; 31-34. <https://doi.org/10.18311/jnr/2006/2767)
36. Q. Chen, G.W. Yang, L.G. An, Apoptosis of hepatoma cells SMMC-7721 induced by Ginkgo biloba seed polysaccharide World J. Gastroenterol., B., 2002; (5): 832-836, 10.3748/wjgv8.15.832