WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 13, Issue 19, 1217-1226. Review Article ISSN 2277–7105

NUTRITIONAL VALUE, PHYTOCHEMISTRY AND PHARMACOLOGICAL ACTIVITIES OF WALNUT (*JUGLANS REGIA* L.): A REVIEW

Aaqib Ashraf[1], Khalid Rahim Wani[1]*, Sameena Khan[2] and Aazira Farooq[2]

[1]Assistant Professor, Department of Moalajat (Medicine), Kashmir Tibbia College, Hospital and Research Centre, Taleemabad Shilvath, Bandipora, Jammu and Kashmir, India.

[1*]Assistant Professor, Department of Ilaj bit Tadbeer (Regimenal Therapy), Kashmir Tibbia College, Hospital and Research Centre, Taleemabad Shilvath, Bandipora, Jammu and Kashmir, India.

[2]BUMS Final Year, Kashmir Tibbia College, Hospital and Research Centre, Taleemabad Shilvath, Bandipora, Jammu and Kashmir, India.

Article Received on
19 August 2024,

Revised on 09 Sept. 2024,
Accepted on 30 Sept. 2024

DOI:10.20959/wjpr202419-34108

***Corresponding Author**
Dr. Khalid Rahim Wani
Assistant Professor, Department of Ilaj bit Tadbeer (Regimenal Therapy), Kashmir Tibbia College, Hospital and Research Centre, Taleemabad Shilvath, Bandipora, Jammu and Kashmir, India.

ABSTRACT

One of the most extensively planted and economically farmed tree nuts in the world is walnuts. Among the most widely eaten oil nuts worldwide are walnuts. The nuts are high in fatty acids, phenolics, phytosterols, tocopherols, and carotenoids, and usually contain 40–70% oil. The edible drupaceous walnut is well-known around the world for its nutritive and health-promoting qualities. Published articles were surveyed using PubMed, Medline, Science Direct, Google Scholar, and other search engines to study walnuts. Pharmacological studies on *Juglans regia* L. have confirmed its antioxidant, anti-dyslipidemic, antidiabetic, anti-cancerous, anti-proliferative, anti-obesity, cardiovascular protective, antimicrobial, anti-inflammatory, cognitive, and gastroprotective activity. Traditionally, walnuts were being used to treat cough, stomach ailments, and cancer. This review aims to investigate the chemical composition, nutritional value and claimed pharmacological activity of walnuts. When dealing with this fruit, scientists, researchers, and other health experts will find it useful as a reference with the most recent information available.

KEYWORDS: Walnut; Juglans regia L.; Superfood; Phytochemicals.

INTRODUCTION

The World Health Organisation (WHO) estimates that 65–80% of people worldwide rely on traditional medicines to meet their basic medical needs.[1] In the present era, most individuals prefer medicines made from plant, leaf, fruit, or seed extracts due to the extremely low or non-existent side effects and place more emphasis on healthy eating.[2] Walnut *(Juglans regia* L.) also commonly known as Persian walnut, Circassian walnut, and English walnut, belongs to the Juglandaceae family. Walnut is an edible drupaceous nut recognized worldwide for its nutritious and health-beneficial properties. Walnuts are one of the world's oldest tree foods, having origins in Persia dating back to 7000 BC. Walnuts are one of the world's most extensively distributed and economically cultivated tree nuts. The walnut tree has been used for ages to treat various ailments.[3] There are roughly 20 species of Juglans in the genus Juglans, all of which produce edible nuts. The English or Persian walnut is the most commonly utilized species among these species.[4] The Western Himalayan region of India provides suitable agroclimatic conditions for producing high-quality walnuts. The Union Territory of Jammu and Kashmir in India produces a major share of an export-quality walnut and is the hub of the production of walnuts in India.[5] Walnuts are considered a "superfood" because they are high in alpha-linolenic acid (ALA), omega-3 fatty acid, antioxidants, phytochemicals, polyphenols, and fibers.[6]

METHODOLOGY

Juglans regia L. was surveyed for its morphology, nutritional values, phytochemical constituents, uses, and other related concepts from published articles. The internet sources for the information were also searched using the keywords *Juglans regia* L., Phytochemicals, etc. PubMed, Medline, Science Direct, Google Scholar, and other search engines were referred for the reported activities, and reviews about *Juglans regia* L. Papers from between 1978 and 2023 were included. The observations were noted, analyzed, and compared to collate the information that is only focused on *Juglans regia* L. in the form of this review study.

MATERIAL AND METHODS

Origin and Habitat

Walnut is an edible drupaceous nut recognized worldwide for nutritious and health-beneficial properties. Walnuts are botanically classified under angiospermic Juglandaceace family. Walnuts are native to Central Asia, Eastern Europe, and North America. The earliest

description of walnut is reported to be in Encyclopaedia Britannica which dates back to 1567.[7] Walnuts are habitual to sunny climates in summers and moderate winters. However, the trees grow well in cool and dry conditions with optimum rainfall greater than 80 cm.[8]

Morphological Characteristics

Walnut trees are large and deciduous growing up to 15–40 m having a thick stem and large canopy (18 m wide) and can be as wide as 2–4 feet as shown in Fig no. 1. The leaves are pinnate with 4–9 leaflets which are arranged alternatively and 2-inch in length. Walnut fruit develops from female flowers singly or in bunches of 2–3 m along the shoot. The walnut tree bears flowers from April to June. The fruit is covered with a green leathery husk which encloses a wrinkled brown shell as shown in fig no. 2. The shell has two compartments that contain round ½–2-inch brown edible fruit within. Overall, the nut is ranged from 2 to 3 inches in diameter. The nut ripens between September and October. Ripening softens the husk and turns it black. Originally, the fruit is covered in green, leathery, semi-fleshy, inedible husk whose removal reveals the wrinkled and brown walnut shell, which is in two halves and encloses the kernel.[9]

Fig no. 1: Walnut Tress.

Fig no. 2: Walnut with covering.

Synonyms

Its synonyms are Walnut (English), Akhrot (Hindi), Doon (Kashmiri), and Gardgani (Unani). The Latin name for the walnut was nux Gallica, Gallic nut. But now it's Juglans regia which is derived from the name Jovis glans which translates to Jupiter's Acorn.[9]

Taxonomical Classification

Over 100 species of walnut have been selected for their nut quality, but the most commercially available varieties are, J. regia, J. nigra, J. California, J. Hinsii, and J. rupestris.[10] Juglans mainly consist of four varieties viz., Rhyso- caryon (black walnut),

Cardiocaryon (Japanese, Manchurian, Chinese walnuts), Trachycaryon (Butternut), and Juglans (J. regia). Hull dehiscence occurs at maturity in Juglans regia, which distinguishes it from the other varieties.[11]

NUTRITIONAL VALUE

Walnuts are a nutrient-dense food due to their high fat, protein, vitamin, and mineral profiles.[7] The Major Constituents of walnuts per 100g according to USDA 2015 are presented in Table 1.[12-18]

Table 1: Nutritional value per 100 gm of walnut.

Constituents	Values
Energy	2,738 kJ
Carbohydrates	13.71
Starch	0.06
Sugars	2.61
Dietary fiber	6.7
Fat	65.21
Saturated	6.126
Monounsaturated	8.933
Polyunsaturated	47.174
Protein	15.23
Water	4.07
Iron	2.91 mg
Magnesium	158 mg
Manganese	3.414 mg
Phosphorus	346 mg
Potassium	441 mg
Sodium	2 mg (0 %)
Zinc	3.09 mg (33 %)
Vitamin A equiv.	1 µg
Beta-carotene	12 µg
lutein zeaxanthin	9 µg
Vitamin A	20 IU
Thiamine (B1)	0.341 mg (30%)
Riboflavin (B2)	0.15 mg (13%)
Niacin (B3)	1.125 mg (8%)
Pantothenic acid (B5)	0.570 mg (11%)
Vitamin B6	0.537 mg (41%)
Folate (B9)	98 µg (25%)
Vitamin C	1.3 mg (2%)
Vitamin E	0.7 mg (5%)
Vitamin K	2.7 µg (3%)

PHYTOCHEMICAL CONSTITUENTS

Walnuts are a rich source of phytochemicals. Walnut kernels serve as an excellent source of a wide variety of flavonoids, phenolic acids, related polyphenols, and antioxidants. The oil of walnut kernel contains major fatty acids, such as oleic acid, linoleic acid, and linolenic acids, which are widely used in the cosmetic industry as they contain moisturizing and antioxidant properties.[7] Ellagic acid and its derivatives like ellagitannins reduce the risk of heart-related disorders. Catechin and flavonoids have good antioxidant potential. Melatonin in walnuts is a neurohormone that maintains the sleep cycle and reduces oxidative stress. The main phytochemicals reported in walnuts are phenolic acid, flavonoid, tannins, and tilbens (1, 2 diarylethenes).[19] Hydrolysable tannins are esterified with hexahydoxydiphenic acid and gallic acid. Walnuts contain strictinin (a tannin).[20]

PHARMACOLOGICAL ACTIVITIES

walnuts have been found to exhibit a wide range of pharmacological effects, which can be divided into the following categories due to the presence of several bioactive components.

Anti-oxidatant activity: Walnut is a healthy nut containing alpha-linolenic acid in its lipid fraction and polyphenolics with significant antioxidant capabilities in its skin. Walnut skins are strong free radical scavengers and may be useful in lowering oxidative stress.[21]

Antimicrobial and Antifungal activity: Methanolic extracts of Juglans regia were found to be potent against all Candida strains and they may be useful in the treatment of oral candidiasis.[22] The antimicrobial activity of the walnut green husk aqueous extract was investigated using an agar streak dilution method based on radial diffusion against Gram-negative (Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumonia), Gram- positive (Bacillus subtilis, Bacillus cereus, Staphylococcus aureus), and fungi (Candida albicans, Cryptococcus neoformans). The results indicated that all of the extracts tested inhibited Gram-positive bacteria, with Staphylococcus aureus being the most susceptible, with a minimum inhibitory concentration (MIC) of 0.1 mg/ml. Only two of the examined extracts reduced the development of Pseudomonas aeruginosa and none of the extracts decreased the growth of fungus regarding antibacterial efficacy against Gram-negative bacteria.[23]

Anti-diabetic activity: It was first discovered that walnut leaves contain a chemical that kills parasites, making them potentially useful in the treatment of TB and diabetes. Several additional studies have found that infusing walnut leaves with olive leaves or infusing walnut

leaves alone can reduce blood glucose levels in diabetic individuals. The mechanism behind the reduction in glucose levels caused by walnut extract administration may be due to increased insulin release from the remaining β-cells of the pancreas, increasing insulin sensitivity, emulate β -cells, by interfering with the absorption of carbohydrates obtained from the diet, particularly in the small intestine, and thus increasing glucose uptake via. Insulin-dependent glucose transporter or peripheral glucose transporter.[24,25]

Anti-hypertensive activity: Eating walnuts lowers diastolic, systolic, and mean arterial pressure. Flavonoids have been shown to produce the relaxation of constricted muscle (e.g. aortic smooth muscle) driven by non-adrenaline activity and potassium chloride. The presence of flavonoids and phenolic chemicals accounts for the majority of its hypotensive action.[25]

Anti-cancerous activity: Walnut has pharmacological actions in a variety of severe chronic illnesses, according to the majority of research, cancer is one of these disorders, and it is caused by the active components in plants such as quinones, polyphenols, essential fatty acids, and proteins. Juglans regia extract has been discovered to contain ellagitannins, which have anti-cancer and anti-inflammatory activities.[26]

Immunological activity[27]

Analgesic activity: In rats, the nociceptive effect of an alcohol extract of Juglans regia leaves (0.5, 1, and 1.5 mg/kg) was investigated alone and in conjunction with morphine. In the acute phase of the formalin test, an alcohol extract of walnut leaves at a concentration of 1.5 mg/kg reduced nociception significantly, and this effect was dose-dependent. Furthermore, rats given a combination of morphine and alcohol extract demonstrated increased nociception, particularly in the acute phase of the formalin test, as compared to rats given either drug separately. Against a carrageenan-induced hind paw edema model in mice, ethanolic extracts of Juglans regia leaves displayed a strong anti-inflammatory effect (as powerful as indomethacin) without causing any gastrointestinal damage.[28]

Prevention of cardiovascular diseases: Walnut extract had a direct influence on cholesterol, triglyceride, and LDL-C cholesterol levels in hyperlipidaemic rats. Walnut leaf extract can lower triglycerides and blood cholesterol while raising HDL values (good cholesterol). The lipid-lowering impact of Persian walnut oil (encapsulated in 500 mg capsules, 3 g/day, for 45 days) in the community of southern Iran was evaluated in a randomized, double-blind case-

control study. Lipid profiles were evaluated before the trial began, on days 15, 30, and 45 following the start, and 15 days after the study ended Plasma. TG concentrations dropped by 19% to 33% of baseline. Other tested parameters showed no statistically significant changes.[29]

CONCLUSION

According to scientific studies and research, eating walnuts regularly may have beneficial therapeutic or nutraceutical benefits in the prevention of several diseases. Walnuts are a great source of vitamins, minerals, phytochemicals, and dietary fiber. Several epidemiological studies have related walnut consumption to a reduced risk of chronic diseases, including diabetes, asthma, cancer, and cardiovascular disease. Walnuts are considered a "superfood" because they are high in alpha-linolenic acid (ALA), omega-3 fatty acid, antioxidants, phytochemicals, polyphenols, and fibers. Studies conducted on animals and in vitro have shown that walnuts have strong antioxidant activity, which may account for their ability to reduce the risk of chronic diseases. They may also inhibit the growth of cancer cells, reduce lipid oxidation, and lower cholesterol. There is sufficient data to support some of the health-related effects, but a more thorough study is still required. To incorporate the therapeutic qualities of the various walnut components in herbal medicine globally and minimize the toxic effects, further research and study on phytopharmacological properties should be conducted in depth. It will bring about benefits for the economy in addition to protecting human health.

ACKNOWLEDGMENT

I am very thankful to all the authors for their inspiration, guidance, and cooperation in helping me to compile this work.

CONFLICT OF INTEREST: The authors report no conflict of interest.

REFERENCES

1. Khan F, Ansari AN, Nayab M. Application of hot medicated fomentation for pain alleviation in non-specific low back pain - a randomized controlled clinical trial. Journal of Bodywork and Movement Therapies, 2023 Jul; 35: 196–201. doi:10.1016/j.jbmt.2023.04.075

2. Chakraborty A, Deb JS, Saha M, Chatterjee S. Apple seeds: phytochemistry, medicinal property, and toxicology. Int J Pharm Sci & Res, 2023; 14(3): 1038–45. doi: 10.13040/IJPSR.0975-8232.
3. Gupta A, Behl T, Panichayupakaranan P. A review of phytochemistry and pharmacology profile of Juglans regia. Obesity Medicine, 2019 Dec 1; 16: 100142.
4. McGranahan, G., Hand Leslie, C.: Walnuts (Juglans). Acta Hortic., 1990; 290: 905–951.
5. Hassan, G.A., Bilal, A.T., Ahmad, T.A., Wani, S., Irshad, N.: Economic and ethno-medicinal uses of Juglans regia L. in Kashmir Himalaya. UJAHM, 2013; 1(3): 64–67.
6. Hayes D, Angove MJ, Tucci J, Dennis C. Walnuts (Juglans regia) chemical composition and research in human health. Critical reviews in food science and nutrition, 2016 Jun 10; 56(8): 1231-41.
7. Fatima, T., Umbreen, S., & Zameer Hussain, S. (2018). Nutritional and health benefits of walnuts. Journal of Pharmacognosy and Phytochemistry, 7(2): 1269.
8. Alasalvar, C., & Shahidi, F. (Eds.). (2008). Tree nuts: Composition, phytochemicals, and health effects. CRC Press.
9. Ça ˘glarırmak, N. (2003). Biochemical and physical properties of some walnut genotypes (Juglans regia, L.). Food/Nahrung, 47(1): 28–32.
10. Mitra, S. K., Rathore, D. S., & Bose, T. K. (1991). Walnut. Temperate fruits (Vol. 27, pp. 377–414). Horticulture and Allied Publishers, Chakraberia Lane, Calcutta, India.
11. Manning, W. E. (1978). The classification within the Juglandaceae. Annals of the Missouri Botanical Garden, 65: 1058–1087.
12. Ozkhan Gulcan, Koyuncu M Ali 2005. Physical and chemical composition of some walnut (Juglans regia L) genotypes grown in Turkey (free). Grasasy Aceites (Consejo Superior de Investigaciones Cien tíficas), 56(2): 141–146.
13. Crews, C., Hough, P., Godward, J., Brereton, P., Lees, M., Guiet, S., & Winkelmann, W. (2005). Study of the main constituents of some authentic hazelnut oils. Journal of Agricultural and Food Chemistry, 53(12): 4843–4852.
14. Prasad, R. B. N. (1994). Walnuts and Pecans. In Encyclopedia of food science, food, technology and nutrition, 4828–4831.
15. Savage, G. P. (2001). Chemical composition of walnuts (Juglans regia L.) grown in New Zealand. Plant Foods for Human Nutrition, 56(1): 75–82.
16. Hu, F. B., Stampfer, M. J., Manson, J. E., Rimm, E. B., Colditz, G. A., Rosner, B. A., & Willett, W. C. (1998). Frequent nut consumption and risk of coronary heart disease in women: Prospective cohort study. BMJ, 317(7169): 1341–1345.

17. Juranovi´c Cindri´c, I., Zeiner, M., & Hlebec, D. (2018). Mineral composition of elements in walnuts and walnut oils. International Journal of Environmental Research and Public Health, 15(12): 2674.
18. Lavedrine, F., Zmirou, D., Ravel, A., Balducci, F., & Alary, J. (1999). Blood cholesterol and walnut consumption: A cross-sectional survey in France. Preventive Medicine, 28(4), 333–339. Logan, A. C. (2004). Lipids in health and disease, 3: 25.
19. Muradoglu, F., Oguz, H. I., & Yildiz, K. (2010). Some chemical composition of walnut (Juglans regia L.) selections from Eastern Turkey. African Journal of Agricultural Research, 5(17): 2379–2385.
20. Martínez, M. L., Labuckas, D. O., Lamarque, A. L., & Maestri, D. M. (2010). Walnut (Juglans regia L.): Genetic resources, chemistry, by products. Journal of the Science of Food and Agriculture, 90(12): 1959–1967.
21. Samaranayaka AG, John JA, Shahidi F. Antioxidant activity of English walnut (Juglans regia L.). Journal of Food Lipids, 2008 Aug; 15(3): 384-97.
22. Delaviz H, Mohammadi J, Ghalamfarsa G, Mohammadi B, Farhadi N. A review study on phytochemistry and pharmacology applications of Juglans regia plant. Pharmacognosy reviews, 2017 Jul; 11(22): 145.
23. Amaral JS, Alves MR, Seabra RM, Oliveira BP. Vitamin E composition of walnuts (Juglans regia L.): A 3-year comparative study of different cultivars. Journal of agricultural and food chemistry, 2005 Jun 29; 53(13): 5467-72.
24. Mohammadi J, Saadipour K, Delaviz H, Mohammadi B. Anti-diabetic effects of an alcoholic extract of Juglans regia in an animal model. Turkish Journal of Medical Sciences, 2011; 41(4): 685-91.
25. Joukar S, Ebrahimi S, Khazaei M, Bashiri A, Shakibi MR, Naderi V, Shahouzehi B, Alasvand M. Co-administration of walnut (Juglans regia) prevents systemic hypertension induced by long-term use of dexamethasone: a promising strategy for steroid consumers. Pharmaceutical biology, 2017 Jan 1; 55(1): 184-9.
26. Meshkini A, Tahmasbi M. Antiplatelet aggregation activity of walnut hull extract via suppression of reactive oxygen species generation and caspase activation. Journal of Acupuncture and Meridian Studies, 2017 Jun 1; 10(3): 193-203.
27. Dzidziguri D, Rukhadze M, Modebadze I, Bakuradze E, Kurtanidze M, Giqoshvili V. the study of the immune corrective properties of greek walnut (Juglans regia L.) septa on the experimental model of leukopenia. Georgian medical news, 2016 Mar; 1(252): 84-9.

28. Mokhtari M, Shariati M, Sadeghi N. Effect of alcohol extract from leave Juglans regia on antinociceptive induced by morphine in formalin test. Medical Science Journal of Islamic Azad University-Tehran Medical Branch, 2008 Jul 10; 18(2): 85-90.
29. Zibaeenezhad MJ, Rezaiezadeh M, Mowla A, Ayatollahi SM, Panjehshahin MR. Antihypertriglyceridemic effect of walnut oil. Angiology, 2003 Jul; 54(4): 411-4.