

Walnut (*Juglan regia* L.) An Amazing Health Benefit and Multipurpose Crop to be Selected for Commercial Cultivation

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Abstract: Nut trees are a promising food resource but this potential is not adequately utilized world-over. Although the walnut has been appreciated since ancient times, commercial walnut orchards only started to be planted at the end of the last century. Nutritional security is a prime importance now-a-days. Walnut (*Juglans regia* L.) is the oldest fruit grown in the world. Nuts are nutrient dense foods and have been a regular constituent of mankind's diet since prehistoric times. In recent years there is a growing interest in nuts which provide health benefits and are alternative to medicine. It belongs to family Juglandaceae, have amazing health benefits. They are not only delicious but also a complete functional food because they not only provide nutritional but also medicinal health benefits. They are unique among nuts because they are loaded with omega -3 and omega-6 fatty acids, and various other bioactive compounds, antioxidants, fibre, vitamins, minerals, tocopherols and phytosterols. It provides food, medicine, shelter, timber, dye, tooth cleaning, lamp oil and many more benefits to mankind. Walnut oil is used for edible purposes, artist oil colours, varnishes and soap making. Walnut shell flour is used as ingredient in plastic pillars, battery cases, molding resin forms, industrial tile and as insecticide spreader. Walnut timber is used for furniture, carving and making butts of guns. Therefore, walnut is an amazing health benefit and multiple uses crop and to be planted scientifically after judicious selection of cultivar/variety. Moreover, walnut is not only an agricultural commodity, but its leaves, barks, stems, pericarps, fruits, flowers and ligneous membranes are all applied for different medicinal uses.

Keywords: Walnut, *Juglans regia* L., Health benefits, Omega- 3 fatty acids, Functional Food, Bioactive compounds, Antioxidants, Cultivars

INTRODUCTION

The establishment cost of walnut orchard is so high that the fruiting at an early stage is very much required. Nuts are one of the important and potent of all foods. They should be included regularly in our diet. The origin of word, 'nut' is derived from the Latin word 'nux' refers to fruit inside the shell, the nut kernel itself. Nuts are valuable food materials and have been used as such for a long time in many parts of world. Nuts are nutrient dense foods, rich in unsaturated fatty acids, bioactive compounds, high-quality vegetable protein, fibre, minerals, tocopherols,

phytosterols, and phenolic compounds etc. Because of their low water content they are concentrated food and also have been kept and handled well for a long time. They can withstand transportation, rough handling and low temperature. If kept cool they rarely spoil; otherwise they may deteriorate by becoming wormy, rancid or musty. Nuts can be marketed in shell or shelled. By virtue of their unique composition, nuts are likely to be beneficial and excellent health outcomes. Walnut belongs to category of having high fat content (Hill and Sharma, 1988). Walnut (*Juglans regia* L.) is the

most widespread tree nut distributed all over the world. The walnut trees botanical name *Juglans regia*, comes from the Romans. The word *juglas*, from the Latin, means 'the Acron of Jupiter' while *regia* refers to 'royalty'. Walnut has been described as 'doctrine of signatures', according to which the plants resembling various organs and features of the body made effective remedies especially for those parts of the body. The Greeks called walnuts *karyon*, or 'head', probably because the shell resembles the human skull and the kernel bears a resemblance to the brain. The Romans thought walnuts looked more like testicles. They consecrated the walnut tree to Jupiter, the king of the Roman gods, and called the nuts 'Glands of Jupiter' (condensed to *Juglans*). This gave rise to the walnut's scientific name, *Juglans regia*, literally, 'royal nut of Jupiter' (Stephen *et al.*, 2006). *Juglan regia* L. is a promising functional food which not only provides nutrition, but also has additional health benefits.

History of Walnut

Walnuts (*Juglans regia* L.) are the plants of the family Juglandaceae. These are light demanding species, which have been protected from wind, and are also drought-tolerant. The point of origin for the Persian walnut (*Juglans regia* L.) lies in central Asia, where the tree grows in a wild and semicultivated state (Abhaya *et al.*, 2005). In pre-historic times, they spread to western China, Persia, and Europe. Walnuts were likely an important food gathered by early humans. The last glacial epoch greatly restricted the extent of Persian walnuts in Western Europe, but archaeologists have found their remains in southern France dating to 17,000 thousand years ago (Edward, 1914; William and James, 1985). Neolithic peoples cultivated walnuts by 7,000 years ago, but they were not widely cultivated in the Mediterranean until ancient Roman and Greek times, when economic factors contributed to their dispersion throughout Europe (Paul, 1979 and Sytze, 2000). Walnuts were an item of trade and amphora filled with walnut residue has been salvaged in sunken Roman ships in the Mediterranean (Wilson, 1987- 1988). Walnut trees have been cultivated for thousands of

years; therefore, trees are of different types and have varying origins. In the 4th century AD, the ancient Romans introduced the walnut crop into many European countries and till now they are growing walnut as one of the important crop. Throughout its history, the walnut tree has been highly revered; not because of having life span that of humans, but it provide food, medicine, shelter, timber, dye, tooth cleaning, lamp oil and many more benefits to mankind. Walnut oil is used for edible purposes, artist oil colours, varnishes and soap making. Walnut shell flour is used as ingredient in plastic pillars, battery cases, molding resin forms, industrial tile and as insecticide spreader. Walnut timber is used for furniture, carving and making butts of guns. Every part of plant is usable.

There are three different species of walnut tree: (a) the most familiar variety being *Juglans regia*, known as the Persian or English walnut. The variety grows to a height of 40-60 feet high and has a life span of about 60 years or more; (b) *Juglans nigra* or black walnut can grow to a height of 150 feet; with a nut bearing a more rounded shape. The black walnut tree is known to be centenarian, living for 100 years or longer and used as rootstock in commercial cultivation; and (c) *Juglans cinerea* refers to Butternut, or white walnut. The butternut tree averages about 30-50 feet in height and bears an oval or egg shaped nut and its life span varies from 50-75 years (Hill and Sharma, 1988).

Word / Indian Scenario

In 2019, Walnuts Production in Mexico was up 7.4% from a year earlier. Since 2014 China Walnuts Production rose 10.4% year on year totalising 2,521,504 Metric Tons. In 2019 Mexico was world number 5 in Walnuts Production. In 2019 Georgia was ranked number 28 in Walnuts Production totalising 6,600 Metric Tons, compared to 32 in 2018 (FAO 2020). Walnut (*Juglans regia* L.) is one of the most important temperate nuts grown in India. It is grown in Jammu & Kashmir, Arunachal Pradesh, Himachal Pradesh and Uttarakhand under rain fed and poor soil conditions in marginal lands. Jammu & Kashmir accounts for almost 98 per cent of the country's output. Walnut is an

important crop grown in Jammu & Kashmir. The state produces about 86,263 tonnes from an area of 61,723 hectares (Vigneshwara, 2011). Walnut is grown in Himachal Pradesh and Uttarakhand to a limited extent. In Himachal Pradesh, it is grown in a couple of some of the districts. India needs to bring in additional area under walnut cultivation to meet the projected walnut demand of around 75,000 tonnes by 2020 (Vigneshwara, 2011).

Nutritional Composition of Walnut

Many decades ago nuts were considered unhealthy due to their high fat content. However, this perception has changed over the past decade. Nuts are now often recommended because they have a healthy fatty acid profile and are high in protein, vitamins and minerals etc. Walnuts nutrient composition has been investigated by several investigators (Savage *et al.*, 2001; Amaral *et al.*, 2003 and Pereira *et al.*, 2008) from time to time. One serving i.e. about 28 g (one oz) or approximately 14 walnut halves contains 185 calories and 18.5 g of fat. While high in calorie and fat, walnut are low in saturated fat. Walnut contains 3.9 g carbohydrates per oz including 1.9 gm of fibre. The high fibre content of walnut contribute to health of digestive tract. Walnuts are also a good source of proteins (USDA, 2010).

Fatty Acids

Walnuts are rich in fatty acids. Walnuts contain between 52 - 70 per cent oil. More than 90 per cent of this oil contains unsaturated fatty acids and the oleic acid (a monounsaturated fatty acid) content ranges from 12-20 per cent. Walnuts are exceptional source of alpha-linolenic acid (ALA). They contain both omega - 3 and 6 fatty acids. Most people do not get enough omega-3 fats in the diet. Being unique among nuts, walnuts contain the highest amount of ALA, the plant based omega-3 fatty acid required by the human body (USDA, 2010). In fact, the omega-3 fatty acid content of walnuts is nearly 10 times greater than pecans, the next highest nut, and 40-500 times greater than other nuts. Peanuts contain negligible amounts, and almonds contain no omega-3 fatty acids (USDA, 2012). Walnuts are significantly higher in omega-3 fat than any other

nut, providing 2.5 grams per 1-ounce (28-gram) serving. Omega-3 fat from plants, including walnuts, is called alpha-linolenic acid (ALA). It's an essential fat, meaning you have to get it from your diet. According to the Institute of Medicine, adequate intake of ALA is 1.6 and 1.1 grams per day for men and women, respectively. Observational studies have shown that each gram of ALA you eat per day lowers your risk of dying from heart disease by 10%. Walnuts are a good source of the plant form of omega-3 fat, which may help reduce heart disease risk.

Sterols

Walnuts, like many plant products, contain no cholesterol. Nuts are cholesterol-free, but their fatty fraction contains sizeable amounts of chemically related noncholesterol sterols belonging to a heterogeneous group of compounds known as plant sterols (PS) or phytosterols (Segura *et al.*, 2006). They are non-nutritive components of all plants that play an important structural role in membranes, where they serve to stabilize phospholipids bilayer just as cholesterol does in animal cell membranes (Hartmann, 1998). Phytosterols interfere with cholesterol absorption and thus helps in lowering blood cholesterol when present in sufficient amounts in the intestinal lumen (Garrido *et al.*, 2008). The levels of sterols found in walnuts may be enough to exert a positive effect on human metabolism but this depends on the amount of walnuts eaten on a regular basis. Savage and Dutta (2002) observed that sterol levels found in different cultivars grown under similar conditions vary considerably.

Tocopherols (Vitamin E)

A large proportion of the fatty acids in walnuts are unsaturated and the oxidation of unsaturated lipid is linked to the appearance of unpleasant odours and flavours. The oxidation of the polyunsaturated fatty acids occurs slowly even in nuts stored under favourable conditions (Savage *et al.*, 2001). The vitamin E isomers provide some protection against oxidation of the unsaturated fatty acids. The measurement of vitamin E isomers is important due to their antioxidative and other positive

nutritional effects in human metabolism. So far the measurement of these isomers in walnut oil has not been well documented. Lavedrine *et al.* (1999) has presented some data on the vitamin E content of walnuts grown in France and the USA. They identified α , β tocopherol in fresh and stored walnuts and noted the significant losses that occurred after three months storage at 4°C. They identified α tocopherol as the main tocopherol in walnut oil (Savage *et al.*, 1999).

Amino Acids

Walnuts are an excellent source of protein ranging from 13.6 to 18.1 g crude protein/100 g dry matter (Savage, 2001). Walnuts contain a relatively low content of lysine and high levels of arginine (Ruggeri *et al.*, 1996). The high levels of arginine in walnuts have already been identified as a positive feature as arginine can be converted into nitric oxide, a potent vasodilator, which can inhibit platelet adhesion and aggregation (Sabaté and Fraser, 1993). A low ratio of lysine/ arginine in a protein has been identified as a positive feature in the reduction of the development of atherosclerosis in laboratory animals (Kritchevsky *et al.*, 1982).

Dietary Fibre

The total dietary fibre content of 12 different cultivars of walnuts harvested in New Zealand ranged from 3.1 to 5.2 g/ 100g dry matter (Savage, 2000). Lintas and Cappelloni (1992) were able to identify both insoluble and soluble fibre using the Prosky method (Prosky *et al.*, 1988). The insoluble fibre content of the nuts they analyzed ranged from 15.8 g/100g for macadamia nuts to 3.8 g/100g for pine nuts. In contrast the soluble fibre contents of nuts they analyzed appear to be quite low.

Vitamin and Minerals

Walnuts are also a good source of magnesium (44.79 mg/oz) and phosphorus (98.09 mg/oz)—both important minerals involved in the body's processes and necessary for achieving optimal wellness. Walnuts provide more than 10 per cent of the daily recommendation of magnesium and phosphorus as well. Walnuts also contain 450 mcg of copper per oz., over 20 per cent of the

daily intake of this mineral. Other micronutrients present in walnuts include vitamins C, E, B6 and K, folate, pantothenic acid, riboflavin, choline, betaine, niacin, calcium, iron, potassium, thiamin, zinc and selenium (Lavedrine *et al.*, 2000).

Antioxidant Potential

Juglans regia L. exhibits greater antioxidant capacity than any other nuts (Wu *et al.*, 2004; Pellegrini, *et al.*, 2006). According to an evidence-based review, antioxidants help to protect from certain chronic diseases of aging, including cardiovascular, neurological and anticarcinogenic ailments due to their ability to control free radicals—known to negatively influence healthy aging (Ferrari, 2004). Walnuts contain many antioxidants (13.126 mmol/100 g). Walnuts have higher antioxidant activity than any other common nut.

This activity comes from vitamin E, melatonin and plant compounds called polyphenols, which are particularly high in the papery skin of walnuts. A preliminary, small study in healthy adults showed that eating a walnut-rich meal prevented oxidative damage of “bad” LDL cholesterol after eating, whereas a refined-fat meal didn't. That's beneficial because oxidized LDL is prone to build up in your arteries, causing atherosclerosis. Walnuts are an excellent source of antioxidants that can help fight oxidative damage in your body, including damage due to “bad” LDL cholesterol, which promotes atherosclerosis.

According to the study, a handful of walnuts have significantly more phenols than a glass of apple juice (117 mg), milk chocolate bar (205 mg), or a glass of red wine (372 mg) (Anderson *et al.*, 2001). Halvorsen *et al.* (2002) revealed that among common plant foods consumed worldwide, walnuts (*Juglans regia*) were ranked second only to rose hips (*Rosa canina*) in their antioxidant activity, as determined by the ferric reducing antioxidant power (FRAP) assay. Compared with other tree nuts, walnuts were also ranked highest when measured with the FRAP, total radical-trapping antioxidant parameter (TRAP), and Trolox equivalent antioxidant capacity (TEAC) assays (Pellegrini *et al.*, 2006). Most of this antioxidant activity can

be attributed to the polyphenolic constituents, including the ellagitannins, present primarily in the pellicle (Blomhoff *et al.*, 2006). Polyphenols isolated from walnuts, including ellagic acid monomers, polymeric tannins, and other phenolic compounds, are potent inhibitors of plasma and LDL oxidation in vitro (Anderson *et al.*, 2001), and have been found to decrease biomarkers of oxidative stress in diabetic mice (Fukuda *et al.*, 2004). Melatonin, another antioxidant constituent present in walnuts, has been positively correlated with increased plasma antioxidant capacity in rats (Reiter *et al.*, 2005). A limited number of human feeding trials, conducted in subjects at high risk for CVD, indicate that walnuts improve endothelial function (Ma *et al.*, 2010), and affect some measures of antioxidant status (Canales *et al.*, 2007), but not others (Davis *et al.*, 2007). Eder (2011) claimed that, 'eating a handful of walnuts contain almost twice as many antioxidants as an equivalent amount of any other commonly consumed nut'.

Anti-inflammatory effects of walnuts

Various researches data from Penn State University shows that substituting walnuts (37 g) and walnut oil (15 g) for half the fat found in the average American diet (typically 35 per cent total fat, 13 per cent saturated fat, 8 per cent PUFA) not only lowered cholesterol, LDL, and TG, but it also produced cardio protective anti-inflammatory effects after six weeks (Zhao *et al.*, 2004; 2007). In hyper cholesterolemic men and women this walnut-rich, ALA containing diet high in PUFA (13 per cent of calories) and low in saturated fat (8 per cent of calories) reduced levels of CRP, pro-inflammatory cytokines, and key cell adhesion molecules involved in the atherogenic process. This shows that walnut also have anti-inflammatory effects.

Walnuts as good mood foods

Walnuts are being considered as excellent good mood foods. Walnuts have long been thought of as a 'brain food' because of their wrinkled, bi-lobed (brain like) appearance. Walnuts are an excellent source of omega 3 essential fatty acids. In addition, walnuts contain good amounts of uridine. Walnuts also contain some

other compounds like vitamin B6, tryptophan, protein, and folic acid which contribute to a good mood. Higher blood levels of omega 3 fatty acids have been linked with better mood and lower rates of depression, while lower blood levels of omega 3 fatty acids have been associated with higher rates of depression and negative feelings. The standard dosage of omega 3 fatty acids recommended by many experts is one gram per day that may be obtained from about half an ounce of walnut (Thakur *et al.*, 2012).

Harvesting and post harvesting of walnut

Nuts are collected in the months of September and October. After collecting, these are cleaned, washed and dried by spreading them on sheets or floor. Sometimes in order to improve the appearance of nuts, these are bleached with either alkali or acid solution. Nuts which fall down with their husks intact are generally second-grade. After removal of the husks, cleaning and drying, they should be stored and marketed separately to fetch a higher price. Delay in drying causes rapid loss in nut quality and makes walnuts susceptible to the mold. Drying of nuts stabilizes the product's weight and prolongs storage life. Walnuts are stored in gunny bags in a small ventilated room free from excess humidity. For export purpose, these are packed in double gunny bags. Walnuts are consumed in the winter season, so the problem of their shelf life is seldom felt. The quality of nut meat, however, deteriorates due to darkening and rancidity which are affected by air, moisture, heat and light.

Walnut storage and handling : Walnuts kept in their shell have a shelf life of 12 months when stored in a cool, dry environment. An unopened package of shelled walnuts has a similar shelf life. Opened packages and chopped walnuts should be kept refrigerated or frozen in an airtight container for no longer than 6 to 12 months.

Marketing

Walnuts are marketed as nuts or kernels. These arrive into the market from September month onwards and the kernels follow two to three weeks afterwards; the peak arrival season being from November to January. Walnuts produced in Himachal Pradesh and Uttarakhand are

consumed almost locally, whereas in Jammu & Kashmir the produce is brought to the assembly market in Jammu, which is the biggest market for walnuts in India. Efforts have been made to assemble quality nuts in Shahia market of Chakrata hill (Dehradun) and send to Delhi market. The nuts in the market are roughly sorted out and empty, stony, highly blighted, shriveled, moldy and darkened nuts removed. Thin shelled nuts are packed in wooden boxes, while medium-shelled nuts are packed in gunny bags. The product then moves either to the commission agents or the exporters' godowns. On a global basis, walnuts rank second behind almonds in tree nut production. According to the FAO (2020) statistics, China leads production with 2521,000 t, followed by the USA (592,390 t), Iran (321,074 t) and Turkey (225,000 tonnes). India is an important world producer of walnut. According to the 2019-2000 statistics, India ranks 11th in world walnut production yielding approximately 34.127 tonnes. China leads the world production of walnuts, followed by the US, Iran, Turkey, Mexico, Ukraine, Chile, Uzbekistan, Romania, France and India (Ranked 11th). In 2010, China accounted for 33.33 per cent of global walnut production. Moreover, walnut is not only an agricultural commodity, but its leaves, barks, stems, pericarps, fruits, flowers and ligneous membranes are all applied for different medicinal uses in China.

Uses of Walnut

In view of the increasing production of walnut globally, there is a need for an increased utilization of the walnut, especially the nutritious walnut kernel, Thakur and Singh (2013). Besides walnut oil and protein, it contains 12 ~16 per cent carbohydrates, 1.5 ~ 2.0 per cent cellulose, 1.7 ~ 2.0 per cent mineral (Lavedrine *et al.*, 2000; Prasad, 2003; Savage, 2000; Sze-Tao and Sathe, 2000b; Wardlaw, 1999; Gharibzahedi *et al.*, 2011). Other proposed benefits of walnuts include magnesium, copper, folic acid, potassium, fibre and vitamin E (Anderson *et al.*, 2001).

CONCLUSION

In the present scenario human beings are constantly in search of new food resources that

can prove to be a complete health food as well as profitable. Walnut have been the first health food to receive a health claim from FDA. This review aims to explore all the health benefits and nutraceutical potential of walnut so that complete awareness can be generated. This nut has immense potential to contribute to nutrition, dietary, culinary and food sector diversification with income generation and nutraceutical potential. Health benefits of walnuts are being accentuated to rise in shell walnut consumption all over the country. In recent five years, consumption of in shell walnut has increased. As a result, walnut germplasm is open for international researchers. Collaborative researches could be implemented for collection and protection of walnut germplasm, determining the effects of walnut consumption on human nutrition and on human health. Owing to the increasing health benefits of nuts and the readiness with which nut-bearing trees can be grown in non-agricultural land, considerable attention is being directed to them with a view of improvement. Although nuts clearly have many health benefits but their potential is still not aware to each and every human being. Consequently, more research needs to be conducted includes in vitro, animal, and clinical studies to further add to our understanding of the health effects of walnuts and the underlying mechanisms involved.

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