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AN OVERVIEW ON PHARMACOLOGICAL AND PHARMACOGNOSTIC STUDY ON *LYCIUM BARBARUM* (GOJI BERRY)

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ABSTRACT

Introduction: Goji berries (Lycium fruits) are often found in Asia, notably in China's northwest. A brief description of the fruits is provided, as well as growing instructions. Dried goji berries are traditionally boiled before being consumed. They're popular in Chinese soups and as a herbal tea. Goji berries are also used to make medicine, wine, and juice. Goji berries are high-antioxidant-potential fruits that reduce oxidative stress and provide a variety of health advantages, including reducing free radical damage to DNA, lipids, and proteins. The review's goal was to concentrate on the bioactive components and pharmacological qualities of goji berries, as well as the molecular mechanisms of action. Enhancing hemopoiesis, antiradiation, antiaging, anticancer, improving immunity, and preventing diabetes and cardiovascular disease are just a few of the health advantages of goji berries. In addition, we discuss the safety of Goji intake in terms of potentially dangerous constituents, allergic responses, and interactions with other substances. When compared to a single phytochemical, a complex combination of phytochemicals provides superior protection through synergistic and additive actions in fruits and herbal items.

KEYWORDS: *Lycium barbarum*, Solanaceae, Antioxidant, Anticancer, Immunostimulatory, carotenoids

INTRODUCTION

Lycium chinense and *Lycium barbarum* are two closely related plants that produce goji berries (Lycium fruits). They are mostly found in Asia, mainly in China's northwest. Lycium is a member of the Solanaceae family, which produces a variety of edibles, including yellow to red fruits such as potatoes, tomatoes, and eggplants. Both of these Lycium species are commonly known as wolfberry and goji berry. It's a 1-2 cm long berry with a sweet and tart flavour and a beautiful orange–red ellipsoid colour. It is sun-dried as a dried fruit after harvesting in late summer–early fall.[1][2]

Dried goji berries are traditionally boiled before being eaten. They're frequently seen in Chinese soups and herbal teas.[1] Furthermore, goji berries are utilised to make medicine, wine, and juice. Goji berry eating has been shown to improve pharmacological activities associated to the eyes, kidneys, and liver in populations. Goji berries can be used as a single herd or as a significant component in a formulation.[2][3]

Consumption of 10 g Lycium fruits twice day is one of the suggested therapies in the treatment of atrophic gastritis.

Goji berries are slowly becoming recognised as a useful food in several Asian nations as well as Europe. In western nations, they've also been sold as a health food. Because of its purported health-promoting characteristics, goji berries have lately grown in popularity as a "superfruit" in North America and Europe. Goji berries, for example, have been utilised to extend life and provide advantages to the liver, kidneys, and eyesight since ancient times. Goji berry

has been used as an essential item in a health-promoting diet for hundreds of years due to its rich medicinal benefits and chemical makeup.[2][3][4][5]

A BRIEF ACCOUNT- *LYCIUM BARBARUM*

Lycium barbarum is a deciduous woody shrub with a height range of 1–3 metres (3 ft 3 in – 9 ft 10 in). The branches of the shrub are narrow, and the side branches are frequently reduced to leafless spines.

Flower and Leaves

L. barbarum leaves and bloom emerge in an alternating pattern or in three-leaf bundles on the stalk. When fresh, each leaf is green, juicy, and lanceolate (spearhead-shaped), with rounded ends on occasion. Clustered leaves can grow to be 25 mm long, whereas single alternate leaves can grow to be 55 mm long. On the leaf axils, flowers occur in clusters of one to three, with pedicels of 6–15 mm in length. The calyx is a white tube with five or six radial triangular sepals that are shorter than the tube, about 10–12 mm long and 3–4 mm broad, sometimes 2–lipped, strongly twisted, and eventually torn by the swelling fruit. The lower side of the sepals is light (facing the branch), while the top side is deep mauve. Each bloom has five stamens with stalks that are longer than the anthers and are 3–8 mm long. The pistil is 8–11.5 millimetres in length. The anthers are longitudinally dehiscent.[6][7][8]

Fruit

L. barbarum, the most common type of goji berry, produces a beautiful orange-red, ellipsoid fruit with a diameter of 1–2 cm (0.39–0.79 in). The fruiting calyx is split deeply once or twice. The number of seeds in each berry varies widely depending on the cultivar and fruit size, ranging from 10 to 60 per berry. The seeds are yellowish, about 2 mm long, 1 mm wide, and have a compressed embryo.[8]

OCCURRENCE AND CULTIVATION

Lycium barbarum has been farmed in China for about 600 years, on the Yellow River's luxuriant aggradational floodplains. It is still commonly produced in north-central China's Ningxia Hui Autonomous Region, with 200,000 acres concentrated in Zhongning County as of 2005. The region produced 13,000 tonnes of goji berries in 2001, accounting for 42% of the country's total output. The plant is also cultivated in the Xinjiang Uyghur Autonomous Region in western China. The only therapeutic grade ("superior-grade") wolfberries utilised by traditional Chinese medicine practitioners are *L. barbarum* berries.[8] To minimise erosion and recover irrigable soils from desertification, *L. barbarum* is planted along Ningxia's borders with three deserts. *Lycium barbarum* has been utilised for hedging in the United Kingdom since the 18th century, notably in coastal locations. The scarlet berries attract a wide variety of British birds.

The plant is still thriving in UK hedgerows. The Department for Environment, Food and Rural Affairs announced a project to improve regulations protecting traditional countryside hedgerows on January 15, 2003, naming the Duke of Argyll's Tea Tree as one of the species growing in Suffolk Sandlings, Hadleigh, Bawdsey, near Ipswich, and Walberswick as one of the species growing there. It is illegal to bring mature *Lycium barbarum* plants into the UK from most countries outside of Europe because they may carry diseases that affect Solanaceae crops such as potatoes and tomatoes.

Lycium barbarum was introduced to Australia and has since become naturalised in the south-eastern coastal and sub-coastal regions, as well as being designated an environmental weed in Victoria and Tasmania. It may be found in disturbed regions, natural bushland, and riverbanks, where dense thickets can form. A similar plant

Figure 1: Fresh Goji Berry

Figure 2: Dried Goji Berry

from Africa, *Lycium ferocissimum*, overlaps and is occasionally confused with it.

CHEMICAL COMPOSITION

The goji berry is known as a "superfruit" for a reason. Wolfberries contain a variety of nutrients with biological activity, including polysaccharide complexes, carotenoids, phenylpropanoids, and others, as mentioned below. The polysaccharide complex is the most significant and abundant group of compounds in Goji fruits.[9][10][11]

They are found in the water-soluble form of highly branched *L. barbarum* Polysaccharides (LBP) with a molecular weight of 8–214 kDa and make about 5–8% of the total dry mass of the fruits. Monosaccharides are made up of six different types: arabinose, rhamnose, xylose, mannose, galactose, glucose, galacturonic acid, and eighteen amino acids. Carotenoids are the second main group of physiologically active components present in Goji that have health-promoting properties.[13]

They give the berries their unique orange-red colour. They account for 0.03–0.5% of the dry matter in the fruits. Zeaxanthin is one of the most common carotenoids discovered in Goji, accounting for 31–56 percent of the total carotenoid pool. It is found in the form of dipalmitin zeaxanthin. The best natural source of dipalmitin zeaxanthin is reported to be goji. There are also lower levels of beta-carotene, neoxanthin, and cryptoxanthin. Phenylpropanoids are bioactive compounds with significant antioxidant potential. According to an investigation of antioxidant activity and phenylpropanoids in numerous medicinal Chinese herbs, the goji berry possesses 22.7 mg of antioxidant activity and phenylpropanoids. The most common were quercetin-3-O-rutinoside, kaempferol-3-O-rutinoside, chlorogenic acid, caffeic acids, caffeoylquinic acid, and p-coumaric acid.[13]

Table 1: Scientific Classification *Lycium barbarum*

Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids
Order:	Solanales
Family:	Solanaceae
Genus:	Lycium
Species:	*L.barbarum*

Goji berries contain 1.0–2.7 percent free amino acids, the most prevalent of which being proline. Taurine and betaine have also been verified to be present. Goji fruits also include vitamins including thiamine, riboflavin, and ascorbic acid with its glucosidic precursor (2-O—D-glucopyranosyl). Goji contains organic acids such as citric acid, malic acid, fumaric acid, and shikimic acid. The most common fatty acids are palmitic acid, linoleic acid, and myristic acid.[13]

PHARMACOLOGICALACTIVITY

Antioxidant Properties

The antioxidant properties of goji berries are intimately linked to their kinds and total concentration of bioactive substances. These compounds can exhibit antioxidant effects in a variety of ways, including radical scavenging activities toward reactive species via hydrogen atom transfer or electron donation, metal chelation, or interactions with other antioxidants. Flavonoids' antioxidant effect is influenced by the number of hydroxyl groups on the B ring of their structure. The scavenging action of flavonoids with two hydroxyl groups in the B ring in an orthogonal configuration was greater. Furthermore, flavonoids with single bonds between C2 and C3 have superior antioxidant properties than those with double bonds, owing to their greater molecular flexibility.[14]

Flavonoids have metal ion chelating and reducing properties in addition to radical scavenging. Anthocyanins prevent free radical chain reactions by donating hydrogen atoms to extremely reactive free radicals. The scavenging action of anthocyanins, like that of other flavonoids, is proportional to the quantity of hydroxyl groups. Different phenolic components in the goji berry can have antioxidant effects that are synergistic, additive, or rarely antagonistic. These interactions are generally concentration-dependent and are caused by the interactions of phenolic compounds with various free radicals. Furthermore, flavonoids and other phenolics have been shown to boost the production of antioxidant enzymes including catalase, glutathione peroxidase, and superoxide dismutase (SOD), as well as inhibit the creation of reactive oxygen species.[14]

The pulp of goji berries contributes the most to antioxidant capabilities in seeds and entire fruits due to its high phenolic content. The anti-lipid peroxidation activity, reducing capacity, and radical scavenging activity of goji polysaccharides (LBPs) against the superoxide anion were

all observed. The antioxidant activity was comparable to that of butylated hydroxytoluene (BHT), a synthetic antioxidant. compared the antioxidant activity of neutral polysaccharides (LBPN) and three acidic polysaccharides isolated from the goji berry to crude polysaccharide (CP), crude extract of polysaccharide (CE), deproteinated polysaccharide (DP), and deproteinated and dialyzed polysaccharide (DPD) (DDP). Except for CE and DDP, most polysaccharide components have efficient scavenging radical activity at high concentrations.[14]

When compared to other polysaccharide fractions, DDP and CE had lesser reducing power, while LBPN and CE had weak metal ion chelating activity. Different approaches have been utilised to measure the antioxidant activity of goji berry due to the structural variety of bioactive components and their varied mechanisms of antioxidant action.[14]

Hypoglycaemic Effects

Many studies have been carried out to determine how Goji affects the way the body manages carbohydrates. Luo et al. [2004] looked at the relationship between supplementing with various polysaccharide fractions of Goji fruit and blood glucose levels. Blood glucose levels were used to study the effects of *L. barbarum* formulations in alloxan-induced diabetic rabbits. Significant hypoglycaemic effects were identified as decreased blood glucose levels (3.9 mmol/L). The experiment's findings were unmistakable. After 10 days of therapy, all Goji formulations resulted in significantly lower blood glucose levels in the examined animals, showing that there was a significant hypoglycaemic impact. Furthermore, purified polysaccharide fractions had a greater hypoglycaemic impact than water decoction and crude polysaccharide fractions, showing that *L. barbarum* polysaccharides were key bioactive components in the hypoglycaemic effect.[13][15]

Lipid-lowering Properties

The impact of polysaccharide fractions supplemented high fat diet on total cholesterol, LDL and HDL fractions, and triglyceride levels was studied in mice. Mice given polysaccharide fractions supplemented high-fat diets had lower total cholesterol, LDL-cholesterol, and triglyceride levels, as well as higher HDL-cholesterol levels, as compared to mice fed high-fat diets without polysaccharide fractions [Li, 2007]. Cui et al. [2011] found the same results.[13][15]

Immunostimulatory and Anticancer Activity

Compounds found in Goji fruits have been used in traditional Chinese medicine to prevent the beginning and progression of cancer. Goji also has immunostimulant properties. Compounds found in Goji berries have been shown to have pro-apoptotic and antiproliferative effect against cancer cells in several studies. Goji polysaccharide fractions were found to significantly suppress the formation of transplantable sarcoma in mice, as well as boost macrophage phagocytosis and antibody release by spleen cells, according to Gan et al. Furthermore, as compared to the unaffected control group, spleen lymphocyte proliferation was increased. Goji polysaccharide fractions were also discovered to significantly decrease lipid peroxidation in mice and prevent liver cancer cell growth [Zhang et al., 2005]. Polysaccharide fractions have also been shown to have anticancer effects by Mao et al. They used G0/G1 phase arrest to demonstrate the anticancer impact of L. barbarum polysaccharides on colon cancer cells.[13][15]

Protective Effect of Vision

LBPs have been shown to have ocular neuroprotective properties due to their blend of highly branched polysaccharides and proteoglycans. Goji berries, which possess a unique carotenoid profile, have a high concentration of carotenoid metabolites, with zeaxanthin accounting for over 60% of the total carotenoids in the fruit. Carotenoids are the principal natural pigments that give many fruits and vegetables their yellow, red, and orange hues. They also have a variety of biological effects, such as the antioxidant activity of pro-vitamin A.[15]

LBPs are the active ingredients that may help with vision. In a partial optic nerve transection (PONT) paradigm, researchers investigated the impact of LBPs (1 mg/kg) on localised alterations in rat retinal function. Sprague-Dawley rats provided the multifocal electroretinograms (mfERG). A significant reduction in the amplitudes of the primary positive component (P1) and photopic negative response (PhNR) of mfERG was seen in all retinal areas one week later. Prior to PONT, feeding with LBPs retained retinal functioning. At week 4, all mfERG responses in the superior retina were within normal limits, whereas most of the inferior retinal responses had significantly increased. The ganglion cell layer and outer retina were impacted by secondary degeneration in the retina's ventral region. By modulating the signal from the outer retina, LBPs altered the functional decrease produced by PONT.[15]

Effects on the Nervous System

In an experimental investigation that included a human clinical trial, goji berries were found to have a neuroprotective effect. Glutamate is excitotoxic and has been linked to a variety of neurodegenerative illnesses, including Parkinson's disease and Alzheimer's disease. As a result, lowering glutamate toxicity is thought to be a therapeutic option for patients suffering from neurodegenerative illnesses.[15]

CONCULSION

For hundreds of years, the Goji berry has been used as a significant component of a health-promoting diet in traditional Chinese medicine. In recent years, wolfberries have attracted a lot of interest in the Western world. Goji items, such as dried fruits, tea, beer, juice, sweets, and supplements, may be found at health food stores. *L. barbarum* is a plant that has the potential to be grown in Europe. The primary goal of this review was to compile and provide the most up-to-date information on Goji fruit's health-promoting characteristics. The goji berry contains a variety of bioactive chemicals with significant antioxidant potential. Goji fruits have a wide range of biological activities and are thought to provide a variety of health benefits. Wolfberry may be a beneficial supplement in the prevention of affluence disorders including diabetes, cardiovascular disease, and cancer. Goji is a toxin-free dietary supplement; nevertheless, because of the high degree of cross-reactivity between wolfberry and peach and tomato, the dangers should be considered in those with food allergies. Anticoagulation treatment is a contraindication to using Goji berry and any product containing wolfberry because of dangerous herb-drug interactions that boost pharmacological performance. Animal models have been employed in the bulk of published research. The outcomes have been quite encouraging and promising. However, more study with a bigger number of experiments using a larger number of animals, as well as experiments including human subjects, is required.

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