

HERBAL ANTIOXIDANT AGENTS AND ITS PHARMACOLOGICAL AND MEDICINAL PROPERTIES



BY
Subha Ganguly

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PREFACE

The book provides the basic and prime information on the various dimensions of medicinal and pharmacology properties of traditional herbs and their importance in alternative medicine. Proper knowledge of the mode of pharmacological action and properties of the herbal drugs will provide a platform for its optimum application in disease cure. The hand book is dedicated to Students, researchers and professionals in the field of medicinal herbs and plants.

Author

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INTRODUCTION

Anantmool is scientifically known as *Hemidesmus indicus* which belongs to the family *Periploaceae* and is also called as *Periploca indica*. It is a perennial, slender, laticiferous, twining, wiry shrub. Leaves remain simple and opposite in arrangement, very variable from elliptic-oblong to linear lanceolate and 5-10 cm long. It is dark green in color with reticulate veins. Roots are cylindrical in shape about 1.5 -2 cm in diameter, aromatic, irregularly bent and twisted. There are numerous slender stems having thickened nodes. Fruits are slender and cylindrical, approximately 10 cm long. Flowers of the plant are greenish purple crowded in subsessile cymes with opposite axils. Seeds are black, 6 to 8 cm long. It is externally dark brown and internally yellowish brown in color.

Terpene lactone, 3-keto-lup-12-ene-21 to 28-olide from hexane soluble fraction of ethanol extract of stem of *Hemidesmus indicus* has been characterized. Lupanone, delta12-dehydrolupanyl-3beta -acetate, delta12-dehydrolupeol acetate, hexadecanoic acid, 4-hydroxy-3-methoxybenzaldehyde and 3-hydroxy-4- methoxybenzaldehyde were also isolated. Chloroform and alcohol extract of stem yields pregnane glycoside, emdine and hemidescine. Glycosides like-indicine and hemidine were also reported to be isolated from stem. Roots of *H. indicus* are reported to contain chemical constituents like essential oil containing β - sitosterol, stigmasterol and sarsapic acid. Hemidesmin 1, hemidesmin 2, alpha-amyrin, beta-amyrin, 80% of 2-hydroxy 4-methoxy benzaldehyde, a ketone, fatty acids, saponin, tannins, resinal fractions, resin acids, sterols, lupeol and 2-hydroxy-4-methoxy benzoic acid have been isolated and identified from roots of *H. indicus*. Flavonoid glycosides identified in flowers of *H. indicus*, are hyperoside, rutin and isoquercitin. The leaves of *H. indicus* contain tanins, saponins, coumarinolignoids like-hemidesmine, hemidesminine, cardiac glycosides and Flavonoids likerutin, hyperoside are also isolated from leaves of *H. indicus*.

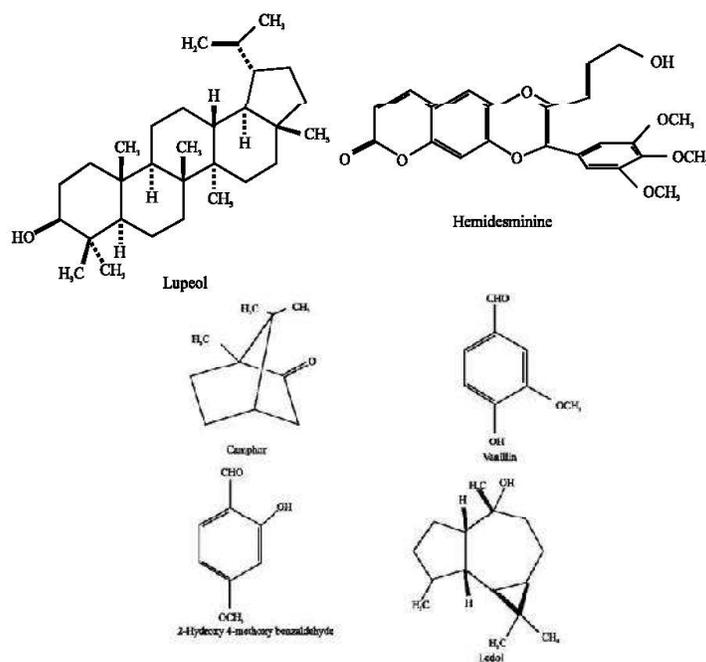


Fig: Chemical structure of different phytochemicals isolated from *H. indicus*

PHARMACOLOGICAL PROPERTIES OF THE PLANT

Immunomodulatory activity- The plant extract promotes the release of IgG by lymphocytes in vitro and also the ADA activity after 72 h of culture. Methanol: Iso- propyl alcohol: acetone extract of *H. indicus* shows an immunomodulatory activity related to IgG secretion and Adenosine deaminase (ADA) activity.

Wound healing activity- The alcoholic extract of *H. indicus* formulated as 5% and 10% ointment increase the rate of wound contraction and period of epithelization. Leaves of *H. indicus* possess marked wound healing activity and play a promising role in the treatment of wounds especially chronic wounds and in diabetic and cancer patients.

Antiulcer activity- Austin established the antiulcer activity of *H. indicus*. It acts by mucoprotective action and selectively inhibiting prostaglandins. Even standard drugs, like-omeperazole, rantidine have less mucoprotective activity than *H. indicus* have.

Anti-cancerous activity- *H. indicus* modulated many components of intracellular signaling pathways involved in cell viability and proliferation and altered protein expression, finally leading to tumor cell death, mediated by a loss of mitochondrial transmembrane potential and increased Bax/Bcl-2 ratio. *Hemidesmus* induces mitochondrial depolarization. *Hemidesmus* induces a significant Ca^{2+} raise through mobilization of intracellular Ca^{2+} stores. *H. indicus* have remarkable anticancer potentials against MCF7 Brest cancer cell lines. Methanolic extract of rhizomes of *H. indicus* could be an excellent drug for treating breast cancer. Cytotoxic effect against HT29 colon cancer cell line is also demonstrated by rhizomes of *H. indicus*. So, it can be used as a potential anticancer medicinal plant against colon cancer too. *H. indicus* methanolic root extract shows a significant cytotoxic activity against *Ehrlichia spp.*, ascites, tumors etc. Moreover, *Hemidesmus* significantly enhanced antitumor activity of 3 commonly used chemotherapeutic drugs methotrexate, 6-thioguanine, cytarabine. It indicates molecular basis of antileukemic effects of Anantmool.

Shetty et al. reported that radio-protective effect on lipid peroxidation in rat liver microsomes protected microsomal membrane by minimizing lipid peroxidation, which ultimately protect DNA from radiation effect. *H. indicus* is an effective chemo-preventive agent on skin and capable of betterment of cumene hydroperoxide induced cutaneous oxidative stress and further tumor promotion.

H. indicus proved to be a useful memory restorative agent in the treatment of dementia seen in the Alzheimer's disease and other neurodegenerative disorders. The *n*-butanol fraction of ethanolic *H. indicus* root extract significantly improved learning power and memory at mice.

Antioxidant and free radical scavenging activity- Antioxidant enzymes-SOD, CAT and GPx, as well as GSH levels in heart tissue decreased drastically after doxorubicin injection. *H. indicus* root extract, due to its antioxidant properties significantly reduced the oxidative stress and thereby toxicity induced by doxorubicin. Doxorubicin (Dox) is an anthracycline antibiotic widely used in the treatment of cancers including hematological malignancies, many carcinomas and soft tissue sarcomas. However, the clinical use is restricted due to its toxicities to cardiac tissues. The Dox-induced cardiotoxicity is shown to be mediated by lipid peroxidation, free radical formation, mitochondrial damage and decreased activity of $Na^{+}K^{+}$ ATPase.

70% methanolic extract of *H. indicus* root, which contains large amounts of flavonoids and phenolic compounds, exhibits high antioxidant and free radical scavenging activities. It also chelates iron and has reducing power. These in vitro assays indicate that the extract contains constituents that can be a significant source of natural antioxidant.

Anti-inflammatory effect- Comparative studies on anti-inflammatory activity of *H. indicus* are also done in carrageenan-induced rat paw oedema. The ethanolic extracts of roots exhibited significant anti-inflammatory activity at a dose of 350 mg/kg p.o. as compared to control. It is

found that ethyl acetate extract of *H. indicus* root shows much anti-inflammatory effect in acute and subacute inflammation. Oral administration of *H. indicus* root extracts exhibited a dose dependent antinociceptive activity in all models and it blocked both neurogenic and inflammatory pains.

Diuretic effect- Aqueous extract of *H. indicus* root caused an increase in urinary flow in rats. *H. indicus* along with aminoglycosides therapy, like- Gentamicin; is able to reduce nephrotoxicity at a significant level.

Phytochemicals, like flavonoids and polyphenols, terpenoids, coumarins and glycosides have antioxidant properties. Evaluation of antioxidant activity of methanolic extract of *H. indicus* root bark in *in vitro* and *ex vivo* models is done (like radical scavenging activity by DPPH reduction, superoxide radical scavenging activity in riboflavin/light/NBT system, nitric oxide radical scavenging activity in sodium nitroprusside/greiss reagent system and inhibition of lipid peroxidation induced by iron-ADP-ascorbate in liver homogenate and phenyl hydrazine induced haemolysis in erythrocyte membrane stabilization study).

Hepatoprotective activity- Biochemical parameters, like- Alkaline phosphatase (ALP), Serum glutamate oxaloacetate transaminase (SGOT), Serum glutamate pyruvate transaminase (SGPT) were found to be in normal range only after oral administration. Many phytoconstituents present in *H. indicus* are reported to possess hepatoprotective property, like phenolic compounds, glycosides, coumarins and saponins. Oral administration of 50% ethanolic extract of *H. indicus* significantly prevented rifampicin and isoniazid induced hepatotoxicity. CCl₄ and paracetamol induced hepatic damage can be cured up to an extent by *H. indicus* root extract.

Antivenom- It also neutralized *Naja kaouthia* venom induced lethality, cardiotoxicity, neurotoxicity and respiratory changes in experimental animals. Methoxy benzoic acid isolated from *H. indicus* root particularly has antivenom potential. *H. indicus* root extracts effectively neutralizes viper venom induced lethal, haemorrhagic, coagulant, anticoagulant and inflammatory activity. Lupeol acetate isolated from the root extract of Indian sarsaparilla *H. indicus* could significantly neutralize lethality, haemorrhage, defibrinogenation, edema, PLA₂ activity induced by *Daboia russellii* venom.

H. indicus possesses immunomodulatory and immunosuppressant activities. Phagocytosis was also decreased. Aqueous extract of *H. indicus* was orally administered at 2% concentration in mice. The mice were infected with *Mycobacterium leprae* from leprosy patients and it was observed that cutaneous hypersensitivity stimulation was delayed.

Anti-hyperglycemic effect- Diabetic rats show higher levels of glycosylated hemoglobin indicating their poor glycemic control. Treatment with *H. indicus* root extract showed a significant decrease in the glycosylated hemoglobin level, which could be due to improvement in glycemic control. Upon treatment with *H. indicus* root extract to diabetic rats, reduced level of glycogen content in muscle tissues was significantly improved. During diabetes, excess glucose present in the blood reacts with hemoglobin to form glycosylated hemoglobin. So, level of glycosylated hemoglobin is directly proportional to blood glucose level.

Antidiarrhoeal activity- Methanolic extract of *H. indicus* elicited significant anti-diarrhoeal activity than standard drugs. It was found that aqueous extract of *H. indicus* root increase water absorption and Na⁺K⁺ from jejunum. He also suggested that extract can be incorporated as a oral dehydrating salt solution (ORS) for its increasing efficacy.

Antimicrobial activity- Chloroform extract of *H. indicus* shows promising activity against the clinical isolates of *Helicobacter pylori*. *H. indicus* is traditionally used in Indian folk medicine for the treatment of various bacterial and fungal infections. The drug is found to be safe and effective against *Escherichia coli*, *Proteus*, *Klebsiella* and *Pseudomonas*. *H. indicus* shows maximum zone of inhibition against *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *E. coli*.

H. indicus demonstrates high activity against ES β L (extended spectrum β -lactamase) producing multidrug resistant enteric bacteria, when fractionated into acetone, ethyl acetate and methanol. The ethanolic extract and aqueous extract of the plant proves to be effective against *Corynebacterium diphtheriae*, *Diplococcus pneumoniae*, *Streptococcus viridans*, and *Streptococcus pyogenes*. *H. indicus* have a stronger and broader spectrum of antimicrobial activity against pathogenic microorganisms and extracts may be used to discover bioactive natural products that would serve as basic source for development of new antimicrobial compounds to overcome the increasing antibiotic resistance.

The chloroform and ethanol (95%) extracts of *H. indicus* shows antifungal activity against *Aspergillus niger*. "RENALKA" syrup [containing extracts of *Tribulus terrestris*, *Crataeva magna*, *H. indicus*, *Cyperus rotundus*, *Vetiveria zizanioides*, *Asparagus racemosus* and *Elletaria cardamomum* and Trikatu] is effective in curing and relieving the symptoms of infections in urinary tract.

Antiarthritis activity- *Hemidesmus indicus* root has protective activity against arthritis and the activity is might be attributed by presence of terpenes, sterols and phenolic compounds in hydroalcoholic root extract, as well as in ethyl acetate fraction.

PHYTOCHEMICAL PROPERTIES

Studies on steroids in cultured tissues and also mature plant of *H. indicus* was reported. Regeneration of *H. indicus* by organogenesis and somatic embryogenesis, induced from callus initiation from leaf and stem explants cultured on MS and B5 medium supplemented with 2,4-D, NAA, BA and Kinetin. Rooting was achieved in MS basal medium NAA and Kinetin (1 mg/L both). Micropropagation and production of 2-hydroxy-4-methoxy benzaldehyde from this root culture of *H. indicus*. Nodal explants of in vitro raised shoots subcultured in same medium. These shoot cultures were rooted in quarter salt strength of MS medium containing 9.8 μ M IBA. Somatic embryogenesis depended on explant type, growth regulator and callus age. Callus induced on MS medium containing 2,4-D and Kinetin (1mg/L) developed somatic embryos on half strength MS basal medium. Organogenesis was induced in callus cultured on MS medium containing NAA (2mg/L) and Kinetin (0.5mg/L), and subcultured on Kintetin (1.5-2 mg/L) and 10% coconut milk. Isolated shoots were then rooted in half strength MS basal medium.

Micropropagation was also achieved in MS basal medium supplemented with Benzyl adenine/BA (3mg/L). Addition of low concentration of ammonium nitrate increased shoot thickness and length of internode significantly. Regeneration of *H. indicus* plants from root segments was derived from seedlings. Formation of shoot bud from root segment failed to initiate from auxin and cytokinin individually, but shoot formation from proximal end of root segments was observed on medium with Cytokinin and α -NAA in 2-3 weeks. Highest number of shoot was produced on medium with 6- BAP at 3mg/L and α -NAA at 0.5mg/L. Rapid elongation of shoot bud was observed on half strength MS medium. Improvement in micropropagation of *H. indicus* is done by adding adenine sulphate. Excised shoot tips and nodal segments from field grown mature plant of *H. indicus* were used to establish *in vitro* clonal propagation. Selected nodal segments were cultured on MS with BA at a concentration of 0.1-4.0 mg/l. Maximum number of usable shoots was found in 1.0 mg/l BA with slight concentration 0.01 mg/l NAA. Higher concentrations of BA or NAA stimulate for considerable callusing at the cutting base which decreased shoot proliferation.

Multiple shoot induction from nodal segments and shoot tip of *H. indicus* in MS medium was supplemented with NAA, BA and Gibberelic acid. Micro-propagation of *H. indicus* is achieved through axillary bud culture. Highest shoot multiplication rate with 95% frequency was achieved in five weeks on MS medium supplemented with 1.15 μ M kintetin and 0.54 μ M NAA.

Somatic embryogenesis and plant regeneration from leaf cultures is possible on *H. Indicus*.

In vitro biosynthesis of antioxidants, like- lupeol, vanillin and rutin; is reported from *H. indicus* root culture. Its formulation may be therefore recommended for use as positive immunomodulator in normal and immunocompromized susceptible animals and birds. Production of phytochemicals, lupeol and rutin on shoot culture of *H. indicus* MS basal medium is supplemented with BAP and NAA. However, more sufficient researches are in demand to be carried out to establish the medicinal facts of the mentioned indigenous plants and fruits.

SUMMARY

H. indicus has long been used as a folk medicine and found to be an important ingredient in Ayurvedic and Unani preparations. This is a climbing vine plant found in Upper Gangetic plain, eastwards to Bengal and Sundarbans and from Central provinces to Travancore and South India. *H. indicus* root is sweet, cooling and demulcent. It is used as tonic, diuretic and aphrodisiac. Whole root and root-bark are useful in syphilis, leucoderma, hemicrania, rheumatism and in several liver and kidney disorders. Powdered root mixed with cow's milk treats scanty and highly colored urine and is used as a popular folk medicine.

The varying phytochemical contents of the *H. indicus* shrub make it a popular choice for folk medicine and also must be considered as the source for alternative medicine.

INTRODUCTION

Zingiber officinale is a plant native to India, which has been largely employed as flavoring agent in flavorful dishes such as curries and sweets such as cakes and biscuits, alcoholic beverages. Ginger is a well known herbal medicine, which is usually used in traditional medicine in all over the world. Many pharmacological activities of ginger are antiemetic, antidiabetic, analgesic, antiarthritic, anticancer, antioxidant, antiulcer, antimicrobial, anti-inflammatory immunomodulatory and cardiovascular activities. The pungency of the ginger is due to gingerols and shogaols. The main components of ginger are the aromatic essential oils, antioxidants and the pungent oleo-resin. These aromatic or pungent compounds have been identified as the phenylalkylketones, known as gingerols, shogaols, and zingerone.

Ginger (*Zingiber officinale*) belongs to *Zingiberaceae* family (Kadnur and Goyal, 2005). It is a perennial herbaceous plant (Gupta and Sharma, 2014). It is commonly used as a spice and a medicinal plant (Ali *et al.*, 2008). The part of the plant used is rhizome. The plant produces an orchid like flower with petals that are greenish yellow streaked with purple colour. Ginger (*Zingiber officinale* (L.) Roscoe) has been used as a spice for over 2000 years (Bartley and Jacobs, 2000). Ginger contains up to 3% of an essential oil that causes the fragrance of the spice (Nweze *et al.*, 2004). In India, and in other countries with hot and humid climates, ginger is eaten daily and is a well-known remedy for digestion problems (Ernst and Pittler, 2006).

PHYTOCHEMICAL PROPERTIES

All major active ingredients of Ginger, such as zingerone, gingerdiol, zingibrene, gingerols and shogaols, are known to possess anti-oxidant activities (Chrubasik *et al.*, 2005). This antioxidant activity in ginger is due to the presence of polyphenol compounds (6-gingerol and its derivatives) (Herrmann, 1994). The chief active constituents of ginger are Volatile oil (zingiberene, curcumene, farnesene, zingiberol, D-camphor), Shogaols, Diarylheptanoids, Gingerols, Paradol, Zerumbone, 1-Dehydro-(10) gingerdi-one, Terpenoids and Ginger flavonoids (Baliga *et al.*, 2012). Aroma or pungency which is derived from key chemical components such as volatile essential oils and non-volatile pungent compounds oleoresin (Famurewa *et al.*, 2011). These compounds give ginger its characteristic hot sensation (Wohlmut *et al.*, 2005). Ginger including terpenes and oleoresin which called ginger oil. Ginger also constitutes volatile oils approximately 1% to 3% and non-volatile pungent components oleoresin (Zick *et al.*, 2008). Phenylalkylketones or vanillyl ketones of ginger include 6-gingerol 8- gingerol and 10-gingerol, 6-shogaol, 8- shogaol, 10-shogaol and zingerone. 6-paradol, 6- and 10-dehydrogingerdione and 6- and 10-gingerdione have also been identified (Chrubasik *et al.*, 2007). The essential oil and oleoresin of *Zingiber officinale* exhibited significant antioxidant and anti-microbial activities (Bellik, 2014). In the fresh ginger rhizome, the gingerols were identified as the major active components and gingerol [5-hydroxy-1-(4-hydroxy-3-methoxy phenyl) decane-3-one] is the most abundant constituent in the gingerol series. The many beneficial effects of ginger are supposed to be due to the presence of bioactive phytochemicals like gingerols, shogaols, paradols, gingerdiols, and zingerone (Baliga *et al.*, 2013). Ginger may stimulate the conversion of cholesterol into bile acids, an important pathway of eliminating cholesterol from the body (Srinivasan and Sambaiah., 1991). Ginger significantly lowered lipid peroxidation by maintaining the activities of antioxidant enzymes such as superoxide dismutase, catalase and glutathione peroxidase in rats (Ahmed *et al.*, 2000). When ginger was included in animal diets, it was found that there was a considerable increase in the pancreatic and intestine lipase (Platel and Srinivasan, 2000).

PHARMACOLOGICAL PROPERTIES

Ginger is the herbal treatment for colds and other viral infections, poor appetite, digestive problems, arthritis and headache (Ghayur *et al.*, 2005). Ginger and its constituents have antiemetic, antithrombotic, anti-inflammatory and antioxidant effects (Khaki *et al.*, 2009). The major pharmacological activity of ginger appears to be due to gingerol and shogaol (Duke and Beckstrom, 1999).

Antioxidant:

Ginger is a strong anti-oxidant substance and may either mitigate or prevent generation of free radicals. Ginger, which is the underground stem or rhizome of the plant *Zingiber officinale Roscoe*, contains polyphenol compounds (6-gingerol and its derivatives), which have a high antioxidant activity (Herrman, 1994).

Antiemetic:

Powdered ginger root in the dose used was found to be effective in reducing nausea and vomiting induced by low dose cyclophosphamide in combination with drugs causing mild emesis (Sontakk *et al.*, 2003).

Anti-inflammatory and Analgesic:

The active constituents of ginger comprise gingerols and shogaols have the anti-inflammatory and analgesic properties of ginger (Ali *et al.*, 2008). Ginger could be used as anti-inflammatory agent and thus as anti-pain (Thomson *et al.*, 2002).

Anti-ulcer:

The phenolic content in aqueous extract of ginger is reported to have potential ulcer preventing ability, aqueous extract of ginger will also reduce free radicals damage during ulceration. Hence, ginger is used as ulcer preventive agent (Nanjundaiah *et al.*, 2011).

Anti-cancer:

Ginger anticancer properties are attributed to the presence of certain pungent vallinoids, like [6]-gingerol and [6]-paradol, and some other constituents like shogaols, zingerone etc. [6]-gingerol may be useful for preventing or treating angiogenesis-dependent human diseases such as cancer (Kim *et al.*, 2005).

Digestive:

The active component of ginger is reported to stimulate digestion, absorption, relieve constipation and flatulence by increasing muscular activity in the digestive tract. Ginger has been used as a digestive aid and for ailments caused by cold, damp weather for at least 2500 years (Kemper, 1999).

Cardio protective:

It stimulates blood circulation throughout the body by powerful stimulatory effect on the heart muscle and by diluting blood (Mowrey and Clayton, 1982).

Anticlotting:

Ginger reduced the formation of proinflammatory prostaglandins and thromboxane thus lowering the clotting ability of the blood (Meena, 1992).

Antibacterial, Antiviral, Antifungal and Antiparasitic:

Ginger extract (10 mg/kg) intraperitoneally had a dose dependent anti-microbial activity against *Pseudomonas aeruginosa*, *Salmonella typhimurium*, *Escherichia coli* and *Candida albicans* (Jagetia *et al.*, 2003). Ginger is effective in the control of a range of bacterial, viral, fungal and parasitic diseases (Agrawal *et al.*, 2001).

Immunomodulatory: Ginger is effective as an immunomodulatory agent in animals and fish and helps to reduce the losses caused by diseases in aquaculture (Nya and Austin, 2009).

Gastrointestinal activities:

Zingiber officinale is traditionally used to treat inflammatory gastrointestinal disorders. Ethanolic extract of dried rhizomes of ginger displayed protective effects against acetic acid-induced ulcerative colitis in rats (El-Abhar *et al.*, 2008).

Antiarthritic:

Alcoholic and Aqueous extracts of *Zingiber officinale* possess a significant anti-arthritic activity against formaldehyde induced arthritis model (Prakash *et al.*, 2016).

Antidiabetic:

At a dose of 500 mg/kg, raw ginger was significantly effective in lowering serum glucose, cholesterol and triacylglycerol levels in the ginger-treated diabetic rats compared with the control diabetic rats (Al-Amin *et al.*, 2006). By improving insulin sensitivity it reduces fasting blood glucose and improves serum insulin level (Behera and Yadav, 2013).

Hypoglycaemic activity:

Ginger juice exhibits hypoglycaemic activity in both normal and streptozotocin (STZ)-induced diabetic rats (Akhani *et al.*, 2004).

CONCLUSION

Ginger is consumed worldwide as a spice and flavoring agent and is featured to have many medicinal properties such as cardioprotective, antiinflammatory, antimicrobial, antioxidant, antiulcer, anticlotting and anticancer properties etc. The ginger is also used as growth promoter and as an immunostimulant.

Chapter 3 POMEGRANATE FRUIT

INTRODUCTION

Pomegranate in Hindi is called Anar and Beejpur in Sanskrit. It is being in wide application for thousands of years as a curative against many diseases across different cultures and civilizations. The fruit possess tremendous nutritional values and medicinal health benefits. In India the root, bark, flowers, fruit and leaves of the Pomegranate are used in traditional ayurvedic therapy and medicinal applications. The plant bears the fruits from September to February in the the Northern Hemisphere and during March to May in Northern hemisphere. The fruit has multivarious applications in food processing industries in meal garnishes, smoothies, baking, cooking, juice blends and in alcoholic beverages.

The pomegranate fruit is botanically known as *Punica granatum*, The small plant is a deciduous shrub bearing fruits and is categorized under the family Lythraceae. It attains a height between 5 and 8 m. Nutritional Importance Nutritionally pomegranate seeds are rich source of Vitamin C, Vitamin K and folate. It acts as an rich source of dietary fibre and are edible in nature. It also supplies micronutrients to the feeders. The seed oil contains puniic acid (65.3%), palmitic acid (4.8%), stearic acid (2.3%), oleic acid (6.3%), and linoleic acid (6.6%). Juice The pomegranate juice contains abundant phytochemicals like polyphenols, including the hydrolyzable tannins called ellagitannins. The fruit juice is red in color for the presence of anthocyanins, such as delphinidin, cyanidin, and pelargonidin glycosides. As the fruit ripens there is an increase in the redness in its juice. It is always recommended to consume the whole fruit by chewing rather than having the processed and packaged juice sterilized by pasteurization, as it leads t the decline in food value. Peel The peel of the pomegranate contains as much as three times the total amount of polyphenols, which includes catechins, galocatechins condensed tannins and prodelphinidins as compared to the fruit pulp. The higher phenolic content of the peel yields extracts for use in dietary supplements and food preservatives.

Medicinal Properties

Cancer: Pomegranates consist of advanced level of antioxidants called flavenoids. These flavenoids are thought to be effective in counteracting various cancer radials. Regular intake of the fruit juice lessens the high risk of prostate and breast cancer and in combating the existing cancer cells in the body.

Heart Problems: Regular intake if the fruit helps in maintaining good blood flow in the body. It also decreases the risks of cardiac arrests and heart strokes.

Stomach Disorder: Pomegranates peel, bark and leaves are effectively employed for the curing of digestive disorders leading to diarrhea. Pomegranate juice is also used for treatment of dysentery and cholera. Osteoarthritis: Pomegranate acts as a remedy in the cure of illness triggered in various forms, like atherosclerosis and osteoarthritis caused by the thickening and solidifying of the arterial walls and in cartilage and joints.

Diabetes: The juice of pomegranate helps in the prevention of coronary illnesses in diabetic patients. Dental Care: Pomegranate juice possesses antibacterial and antiviral properties which are used effectively in the reduction of incidences of dental plaque.

Anemia: Pomegranate seed extract supplies iron to blood and thus, helps in decreasing the occurrence of anemic symptoms including weakness, fatigue, and hear loss.

Other Proven Uses

The other advantages of pomegranate fruit include reduction in the occurrence of premature infants and it is also beneficial for the expected mothers to avoid having low weight infants during birth. Among the elder people, regular intake of pomegranate reduces the likelihood of creating Alzheimer's disease. It helps in controlling aging issues thereby sustaining youthful and glowing skin. During menopause period, consumption of pomegranate allows a woman to overcome from her depression interval. It is a good natural aphrodisiac and improves sperm count and semen quality. The pomegranate flower, juice, rind and tree bark also possess astringent properties and are valuable for a wide range of purposes, such as stopping nose bleeds and gum bleeds and in treating hemorrhoid.

CONCLUSION

Pomegranate seed (of specific fruit strains) is also used as eye drops as it is believed to slow the development of cataracts. Pomegranate is used as a gargle for a sore throat, and it is applied to the epidermis to cure hemorrhoid flare-ups. It cleanses and clarifies oral cavity, throat, esophagus stomach and chest.

Chapter 4 GREEN TEA

Introduction

Green tea is originated from China and India and is potentially recommended by the clinicians for its potential health benefits to human beings. Since ancient times, tea stands amongst the most popular beverage globally. An estimate shows that nearly 78% of the tea consumed worldwide is black and only about 20% is green. Except the herbal tea, all other types of tea are brewed from the dried leaves of *Camellia sinensis* bush. The type of tea is determined by the level of oxidation of the leaves. Green tea is prepared from the unoxidized leaves which determine its health promoting effects. It contains the major portion of polyphenols and antioxidants. Christopher Ochner, PhD, a research scientist in nutrition at the Icahn School of Medicine at Mount Sinai Hospital has performed meticulous researches on this fact. Green tea contains natural chemicals called polyphenols which are believed to be potential anti-carcinogenic and anti-inflammatory factors.

Green tea is also used in traditional Chinese and Indian alternative medicinal therapy for controlling wound bleeding, proper regulation of digestion, improvement of mental and cardiac health and also in ailments of liver, type 2 diabetes and in Alzheimer's disease. It gives radical results for weight loss too in obese patients.

Proven and possible health benefits of green tea Cancer:

As per the reports of National Cancer Institute, green tea consumption regulates and prevents benign tumor growths for the presence of enormous quantity of polyphenols in it. It also decreases the risks of pancreatic cancer and gastric cancer. Green tea consumption boosts the overall health of breast, bladder, ovaries, colorectum, esophagus, lungs, prostate and skin. Researches have proved that the polyphenols act against the oncogenic cells. FDA has approved green tea extract ointments for topical application on genital warts for its treatment.

Heart Disease: American Medical Association has proved that green tea consumption on regular basis reduces mortality among human beings due to cardiovascular failures. Researchers have proved that green tea contains catechins and polyphenolic compounds that are thought to exert numerous protective effects, particularly on the cardiovascular system. The catechins are antioxidants possibly help with fighting and preventing cell damage.

Lowers cholesterol: Regular intake of green tea acts significantly against the rise in the concentration of LDL or bad cholesterol in circulating blood.

Stroke: Regular green tea consumption decreases the incidences of stroke according to a research published by the lead author Yoshihiro Kokubo, M.D., Ph.D in the journal Stroke: Journal of the American Heart Association. **Calorie:** In general, green tea contains a relatively small amount of caffeine (approximately 20-45 mg), compared with black tea which contains about 50 mg and coffee with 95 mg per cup. Brewed green tea without the addition of sugar acts as a zero calorie beverage. The caffeine present in green tea depends upon the infusing time period and the quantity of tea infused in a particular time.

Polyphenols: Epigallocatechin-3-gallate (EGCG) is the extensively investigated bioactive polyphenol in green tea which is the most effective free radical eliminator. Green tea is approximately 20% to 45% polyphenols by weight, of which 60% to 80% are catechins such as EGCG. **Forms of green tea:** Commercially green tea is made available in various servings like bottled and sweetened with sugar or with artificial flavoring agents in single tea bags, as loose-leaf and as instant-powder. Green tea supplements are also manufactured as capsules or liquid extracts. **Precautions and risks associated with green tea:** As green tea has many advantages, but it has some contraindications too for adults who suffer from insomnia, anxiety, irritability, nausea or gastric upset stomach. Patients who are on anticoagulant drugs such as Coumadin or

warfarin should have green tea with caution due to its vitamin K content. Green tea intake with stimulating drugs increases heart rate and blood pressure. Conclusion In particular, pregnant or breastfeeding women having cardiac ailments or high blood pressure, stomach ulcers, or anxiety disorders with kidney or liver problems are suggested not to consume green tea supplements or extracts in any form.

INTRODUCTION

The chili pepper also known as chilli grows on plants of the family, *Solanaceae*. The intensity of the flavor in chilli peppers when ingested is due to the presence of capsaicin (8-methyl-N-vanillyl-6-nonenamide) and several other related group of chemicals called capsaicinoids.

The origin of chilli peppers is from Mexico. They were transported to the Asian subcontinent by the Portuguese navigators during the 16th century. After ingestion, the capsaicinoids bind with pain receptors in the mouth and throat that are responsible for sensing heat. After activation the receptors the brain responds to the burning sensation by increasing perspiration, raising the heart rate and by releasing the endorphins. Research has proved that capsaicin alters the pattern of utilization of energy by the body cells through ATP hydrolysis. The "heat" of chili peppers is measured in Scoville heat units (SHU), which is a measure of the extent of chilli extract dilution when added to sugar syrup before its heat becomes undetectable to a panel of tasters; the more it has to be diluted to be undetectable, 2.

MEDICINAL AND NUTRITIONAL PROPERTIES

Red chillies are nutritionally enriched with vitamin C and small amounts of carotene (provitamin A). Yellow and especially green chilies contain a considerably lower amount of both substances. Peppers are also a rich source of Vit. B-complex and especially Vit. B₅ particularly. These are rich source of iron, magnesium and potassium. The high content of vitamin C content substantially increases the utilization of non-heme iron from the beans and grains.

SUMMARY

British Medical Journal has published a population study where it is indicated that the human who consume spicy foods and more of chilli peppers are less likely to suffer from cardiac ailments, cancer and/or diabetes.

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