

## REVIEW ARTICLE

# *Cannabis sativa*: An ancient wild edible plant of India

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## Abstract

*Cannabis sativa*, also known as *Cannabis indica* or Indian hemp, is an annual herb of the family Cannabinaceae. It has been used by humans throughout recorded history for its food, fiber and medicine. It is a native to Central Asia, and long cultivated in Asia, Europe and China. Plants yielding the drug seem to have been discovered in India, cultivated for medicinal purposes as early as 900 BC. Hindu devotees offered *Cannabis* to Shiva during religious ceremonies, and the herb continues to have a religious association in India. The medicinal use of *Cannabis* has very long history. However, the sociopolitical pressure led to decline the medicinal use of *Cannabis*. But despite its illegality, people have continued to obtain *Cannabis* in black market for self-medication. Together with coffee and tobacco, *Cannabis* is the most commonly used psychoactive drug worldwide, and it is the single most popular illegal drug. This review analyzes the diversity, botanical description, consumption and pharmacological studies along with medicinal uses of *Cannabis* among the human being throughout the world.

*Key words:* *Cannabis sativa*, *Cannabis indica*, Indian hemp, Bhang, Marijuana, Psychoactive

## Introduction

Wild edible plants play an important role in the food and nutritional security of large section of Indian population living in remote area. These plants are a good source of minerals and vitamins essential to take the edge off malnutrition of the tribal people living in harsh environments. The Himalayan Region of India is well known for biodiversity of wild edible plants especially consumed by local people in the form of food, medicine, fuel, fodder, timber, fiber and for other purposes (Samant et al., 1998a,b; Samant and Pant, 2006). However, it has been used by humans for at least 4,500 years. The various parts, such as roots, rhizomes, tubers, bulbs, leaves, seeds, flowers, fruits and barks of the plants are used for the above mentioned purposes. The most famous early users in the history of *Cannabis* were the Hindus of India, afterward it was spread with the Indo-Aryan culture to outside of India. It also grows naturally in Persia, Southern Siberia and in China. In Sanskrit

the plant is called *Vijaya* and in Hindi known as *bhang*. Since its discovery it has been used by millions of people for both inducing pleasure and for pain alleviation. Besides stimulant, exhilarant and sedative, the active principle of Indian hemp lies in the plant resin. Forty percent of this principle is used in the resinous hashish smoked by the wandering sects of India; 26 percent in the dried flower heads smoked in the villages of India as "*ganja*"; and only 10 percent in the ground green leaves used for the preparation of the bhang drink. *Cannabis sativa* found all over the India. It is commonly occurs in waste grounds, along road side and irrigation channels of gardens.

*Cannabis* yields more than 538 chemicals of various classes (ElSohly and Slade, 2005). The extensive literatures are available on *Cannabis* constituents (Turner et al., 1980; Ross and ElSohly, 1995; Grotenhermen and Russo, 2002). The most important classes are terpenoids, cannabinoids, hydrocarbons, sugars and related compounds, nitrogenous compounds, noncannabinoid phenols, flavonoids, fatty acids, simple acids, amino acids, simple ketones, simple esters and lactones, simple aldehydes, proteins, glycoproteins, and enzymes, steroids, elements, simple alcohols, pigments, vitamin (vitamin K). The principal use of Hemp in medicine is for easing pain and soothing influence in nervous disorders. It is useful in gout, neuralgia,

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rheumatism, insanity, insomnia etc. The action is almost entirely on the higher nerve centers. It can produce an exhilarating intoxication with hallucinations, and is widely used in Eastern countries as an intoxicant. The nature of its effect depends much on the environmental conditions and temperament of the individual. Its narcotic and anodyne properties were appreciated by Western medical men in the early years of the last century and were incorporated in the British and United States pharmacopoeias. As a narcotic, hemp is consumed by itself or as a beverage. It is more often used for smoking but excessive smoking is harmful and may cause insanity. The common name(s) of Indian hemp in different countries are Bang (Egypt), Bhang, Charas, Ganja (India), Bhango, Gaanjaa (Nepal), Canamo indico, Hachis, Marihuana (Spain), Canapa indica, Marijuana (Italy), Marihuana, Marijuana (France), Da ma cao, Da ma ren, Huo ma, Xian ma, (China), Dagga (South Africa), Indischer hanf, Marihuana (Germany), Hashas, Hind kinnabi (Turkey), Hampa, Marijuana (Sweden), Hash, Hemp, Indian hemp (United Kingdom), Kannabis (Finland), Kannabisu, Mashinin, Taima (Japan), Konopie, Marihuana (Poland), Marihana (Netherlands), Marihouava (Greece), Marihuana, Marijuana (Mexico), Marihuana (Hungary, Russia, United States), Porkanchaa (Thailand) and Qinnib, Til (Arab countries).

### Botanical description

#### Classification

Kingdom	<i>Plantae</i>
Subkingdom	<i>Tracheobionta</i>
Superdivision	<i>Spermatophyta</i>
Division	<i>Magnoliophyta</i>
Class	<i>Magnoliopsida</i>
Subclass	<i>Hamamelididae</i>
Order	<i>Urticales</i>
Family	<i>Cannabaceae</i>
Genus	<i>Cannabis</i>
Species	<i>sativa</i>
Binomial name	<i>Cannabis sativa</i>

Indian hemp (*Cannabis sativa* L.) is an annual herb of the family *Cannabaceae* having erected stems growing from 3 to 10 feet or more high, very slightly branched and having greyish-green hairs (Figure 1). The leaves are palmate, with five to seven leaflets, numerous, on long thin petioles with acute stipules at the base, linear-lanceolate, tapering at both ends and the margins sharply serrate. The leaves of the plant are used as a drug to reduce excitement, irritation and pain as well as to induce deep sleep. The flowers are unisexual, the male in

axillary and terminal panicles, apetalous, with five yellowish petals and five poricidal stamens; the female flowers germinate in the axils and terminally, with one single-ovulate ovary. The fruit is small, smooth, light brownish-grey in colour, and completely filled by the seed. The form of the plant and the yield of drug, oil and fiber from it vary according to climate and particular variety. Varieties grown for the drugs are small, much branched with smaller dark green leaves; for fibers have long stalks, branch very little, and yield only small quantities of seed; for oil seed small, mature early, and produce large quantities of seed. Indian hemp is prepared in various forms. *Ganja* is smoked like tobacco; *Bhang* is the dried, larger leaves, broken or mixed with a few fruits. *Charas* is the resin which exudes spontaneously from the leaves, tops and stems.

### Origin, distribution and growth habit

*Cannabis sativa* was originally a native of Western and Central Asia. It has been cultivated since ancient times in Asia and Europe. It spread to the New World in post-Columbian times. *Cannabis sativa* has been cultivated for more than 4500 years for different purposes as mentioned above. Its medicinal value was discovered in India as *Ayurvedic medicine* and cultivated as early as 900 BC. In India cultivation of this plant is controlled and permitted only in the districts of Almora, Garhwal and Nainital (Uttarakhand, India) with small extent in Kashmir and Travancore. Germination of *Cannabis* seeds takes 12 hours to 8 days. After 2–4 days of germination, seed coat splits open and exposes the root and two circular embryonic leaves, cotyledons. Seedling phase lasts from 1-4 weeks and is the period of greatest vulnerability in the life cycle of the plant, requiring moderate humidity levels, medium to high light intensity, and adequate but not excessive soil moisture. In vegetative phase, it continues to grow vertically and produce new leaves. The sex is starting to reveal itself and along with the root system expands downwards. Plant development increases significantly in pre-flowering phase with production of more branches and nodes. Flowering phase varies from about 6-22 weeks and needs diminished light.

### Chemical constituents of *Cannabis sativa*

The chemical constituents of *Cannabis* represent almost all of the chemical classes, e.g., hydrocarbons, sugars, terpenes, steroids, flavonoids, nitrogenous compounds and amino acids. Out of these, the most specific class of *Cannabis* constituents is C<sub>21</sub> terpenophenolic

cannabinoids (Elsohly and Slade, 2005). In 1980 the total number of natural compounds identified in *Cannabis sativa* was 423 (Turner et al., 1980), in 1995 was 483 (Ross and ElSohly, 1995) and in 2005 was 489 (Elsohly and Slade, 2005). Out of 489 compounds, 70 were known as cannabinoids which is further classified into 11 categories (number known) such as Cannabigerol type (7), Cannabichromene type (5), Cannabidiol type (7),  $\Delta^9$ -trans-Tetrahydrocannabinol type (9),  $\Delta^8$ -trans-Tetrahydrocannabinol type (2), Cannabicyclol type (3), Cannabielsoin type (5), Cannabinol type (7), Cannabinodiol type (2), Cannabitrinol type (9) and Miscellaneous types (14). Besides cannabinoids the other constituents (419) are also classified into various chemical classes (number known) such as nitrogenous compounds (27), amino acids (18), proteins (3), enzymes (6), glycoproteins (2), sugars and related compounds (34), hydrocarbons (50), simple alcohols (7), simple aldehydes (12), simple ketones (13), simple acids (20), fatty acids (23), simple esters (12), lactones (1), steroids (11), terpenes (120), non-cannabinoid phenols (25), flavonoids (23), vitamins (1), pigments (2) and elements (9), (Turner et al., 1980; Ross and ElSohly, 1995; Elsohly and Slade, 2005). The details of these chemical constituents are out of this review scope.

#### Edible parts and method of consumption

The plant parts which are consumed for various purposes are leaf, shoot and seed. It is used in the form of grain and in roasted mode. Seed may be used as raw or cooked. It can be dry and eaten as a condiment or made into cakes (Hedrick and Sturtevant, 1972; Harrington and Matsumura, 1974; Kunkel, 1984). The seed is quite tasty, but it is very difficult to separate from the husk. The seed contains about 27.1% protein, 25.6% fat, 7.4% carbohydrate, 6.1% ash. The leaves contain 0.215% carotene and used in soup (Duke, 1983). Along

with various methods of *Cannabis* consumption, smoking or oral consumption is much common. In general, it is considered that smoking produces more relaxing effect; in comparison to vapourising and eating which tend to be more intense in effects. For oral consumption, *Cannabis* or its extract must be sufficiently heated or dehydrated to cause decarboxylation of its most abundant cannabinoid, tetrahydrocannabinolic acid, into psychoactive tetrahydrocannabinolic acid (Cannabisculture.com). *Cannabis* can also be consumed as a *Cannabis* tea. In remote area, the use of *Cannabis sativa* is totally depends on traditional knowledge, which transmitted through family traditions basically through oral conversations. However, the knowledge on medicinal importance is available in written forms also in local scripts.

#### *Cannabis sativa* as a medicine

*Cannabis* was used as a medicine before the Christian era in Asia, particularly in India. The medicinal use of *Cannabis* has a very long history. It has been used for the treatment of various diseases since the Vedic Period. It is well known for various forms of non-formal medical treatments. The medicinal value of *Cannabis* includes intoxicant, analgesic, narcotic, stomachic, antispasmodic, anodyne, sedative etc. (Ben, 2006; Russo and Guy, 2006; Goutopoulos and Makriyannis, 2002). The *Cannabis* leaves alone have ability to cure more than 25 diseases (Kala et al., 2004). Seeds are used to treat tumors and cancerous ulcers. In the last 50 years there are more than 1000 publications describing various aspects of *Cannabis sativa* (Zuardi, 2006). Some of the important medicinal uses of *Cannabis* are given in table 1. Despite its medicinal value, *Cannabis* products must be used carefully as it can induce cognitive deficits and may be a risk factor for the onset of psychosis among susceptible youths (Pope et al., 2003; Arseneault et al., 2004).



Figure 1. *Cannabis sativa* (Plant, leaves and seeds).

Table 1. Medicinal use of *Cannabis sativa*.

Medicinal use	Reference
Anthelmintic	Bhattarai, 1992
Anticancer activity against cancer cell lines	Tariq and Reyaz, 2012a
Antimicrobial activity	Tariq and Reyaz, 2012b
Anti-nausea and Anti-vomiting	Sallan et al., 1975
Antispasmodic, anodyne and narcotic	Anon, 1931
Aphrodisiac	Waddell et al., 1980
Apoptosis	Lee et al., 2008
As a hallucinogen and for rheumatism	Saha et al., 1961
As a parturifacient	Ahmad, 1957
As an abortifacient	Saha et al., 1961
Antiseptic and to treat swelling of sprained joints	Bhattarai, 1993
As an antispasmodic and anodyne	Asprey and Thornton, 1955
As an aphrodisiac	Lewis and Elvin-Lewis, 1977
As an emmenagogue	Saha et al., 1961; Berhault, 1974
As an insect repellent	Nayar, 1955
As narcotic, antispasmodic and analgesic	Anon, 1898
Decoction of the seed used for migraine and cancer	Duke and Ayensu, 1985
Decrease fertilizing capacity	Schuel et al., 1987
Decrease testosterone metabolism	Watanabe et al., 2005
For asthma	Simon and Lamla, 1991
For burns	Jain and Puri, 1984
For cuts, boils and blisters	Singh and Maheshwari, 1994
For diabetes	Tucakov, 1978; Morrison and West, 1982
For diabetes, hysteria and sleeplessness	Rajurkar and Pardeshi, 1997
For dysentery	Bhattarai, 1992
For inflammation	Rana and Datta, 1997
Fresh leaves used for hemorrhoids	Singh et al., 1996
Fruit used externally for skin diseases	Rao, 1981
Hallucinogen	Diaz, 1977
In diarrhea	Manandhar, 1993
In indigestion	Sahu, 1984
In rheumatoid arthritis, epilepsy and cholera	Zagari, 1992
Increase amorous prowess of women	Nahas, 1981
Induce abortion	Hunte, 1975
Narcotic	Bellakhdar, et al., 1991
Psychotropic	Anon, 1946
Reduce abdominal pain, neuralgia and coughing	Zagari, 1992
Relieve menstrual pain	Tatkon, 1976
Relieve pain of dysmenorrhea	Lockmi, 1982
To clear the blood and for rheumatism.	Li, 1974
To eliminate cough and bronchitis	Lal and Yadav, 1983
To induce abortion, labor, and menstruation	Woo et al., 1981
To relieve muscular pains	Giron et al., 1991
Treatment of dyspepsia and gonorrhoea	Sahu, 1984
Treatment of malaria	Asprey and Thornton, 1955
Unripe fruit induce sleep	Shah, 1982

### Use of *Cannabis sativa* in Ayurvedic medicine

India is a country of faith and mysticism, and Ayurveda is a system of medicine used by the Indian traits. *Cannabis* was bound to religions in India especially in the Hindu as well as in numerous other minority religions (Kaplan, 1969). Ayurvedic system of medicine is based on a conceptual medical system which depends on balancing three functional

elements of human body viz. *Vayu* (air), *Pitta* (fire) and *Kapha* (water and earth). As per Ayurveda, good health depends on equilibrium between these three factors and imbalance may cause disease. In India, the properties and use of *Cannabis sativa* were described by many ayurvedic physicians before thousands of years. The earliest written reference was found in the *Atharvaveda*, dating to about 1500

BC (Grierson, 1894). In the *Sushruta Samhita* (verses of Sushruta) *Cannabis* was recommended for phlegm and diarrhea (Grierson, 1894). For the first time Dhanavantari, founder member of Ayurveda, prepared a medical glossary on the quality and effect of *Cannabis*. According to his description, the quality of *Cannabis* is sharp, heating and light; and also stimulates delusions and slows speech. In Ayurveda *Cannabis* was also used as a leisure drug and as a component in various preparations such as minute quantity in a synergistic formula can aid digestion. Jadgish N Vaidya, Director of Maharishi Ayurvedic Programs at Lancaster Health Center, Massachusetts says that ‘Recreational use of marijuana creates ama’. It impairs digestion and intellect, it upsets hormonal balances, and it can be addictive, in the traditional view of Ayurveda. Using *Cannabis* from an Ayurvedic perspective causes imbalance to the mind. Scientific research indicates that loss of mental stability is one of the significant side-effect from recreational use of *Cannabis*. In Ayurveda the Sanskrit term ‘Unmaada’ means a profound impairment of judgment, perception and clarity. Unmaada is characterized by distortion of the mind, intellect, consciousness, memory, behavior and conduct. The 18<sup>th</sup> century Persian medical text *Makhzan-al-Adwiya*, written by M. Husain Khan, was extremely influential in the Unani Tibbi, or Arabic-tradition medicine on the subcontinent. In this text, *Cannabis* was described in its various preparations as an intoxicant, stimulant and sedative (O’ Shaughnessy, 1843). The medical use of Indian hemp was introduced to the West in the 19<sup>th</sup> century as the use of *Ganjah* and *Bangie* as intoxicants, in diarrhea treatment and in hemorrhoids is reported by Ainslie in 1813 (Ainslie, 1813).

The modern Ayurvedic properties of *Cannabis* as described by Chopra and Chopra (1957) are: *paphahari* (promoting loosening and elimination of phlegm), *grahini* (promoting retention and binding the bowels), *pachani* (promoting digestion), *ushna* (promoting heat), *pitala* (exciting the flow of bile), *modavardhani* (promoting happiness), *vagvardhani* (stimulating the digestive fire), *dipani* (stimulating appetite), *ruchya* (promoting taste), *nidraprada* (hypnotic). Dwarakanath listed 48 modern Ayurvedic and eight Unani Tibbi formulas containing *Cannabis* for a wide range of indications (Dwarakanath, 1965). A recent survey on consumption of Bhang at Varanasi (formerly Banaras, India) reported 90% improvement in sleep and in marital adjustment (Chaturvedi et al., 1991). The majority of Ayurvedic claims for *Cannabis* from India are fully corroborated by modern

scientific and clinical investigation. In fact, the modern-day *Cannabis* researchers have acknowledged the integral role that Indian culture has played in understanding the biochemistry of *Cannabis*.

### Pharmacological studies in human

There are lots of literatures available on pharmacological activities and clinical trials of *Cannabis sativa* by using various model animals. In the following table one can find pharmacological studies of *Cannabis* on human (Table 2).

Table 2. Pharmacological studies of *Cannabis sativa* in human.

Pharmacological study	Reference
Allergenic effect	Singh and Kumar, 2003
Analgesic effect	Burstein et al., 2004
Anticancer activity	Tariq and Reyaz, 2012a
Antidepressant-like actions	El-Alfy et al., 2010
Antidiuretic activity	Burton, 1979
Antiemetic	Dansak, 1997
Anti-inflammatory activity	Zurier et al., 2009
Anti-tumor activity	Contassot et al., 2004
Appetite enhancing	Plasse et al., 1991
Bronchoconstrictor activity	Vidal et al., 1991
Cell death with shrinkage of neurons	Ameri, 1999
Central nervous system depressant activity	Krejci, 1958
Digital necrosis	Launay, 2000
Gynecomastic effect	Daniels and Layer, 2003
Hemagglutinin activity	Hardman et al., 1983
Histamine release stimulation	Vidal, 1991
Hyperglycemic activity	Podolsky et al., 1971
Immunomodulatory effect	Kraft and Kress, 2004
Inflammatory effect	Boyce and Quigley, 2002
Mitogenic effect	Thorburn, 1975
Myocardial infarction	McLeod et al., 2002
Pancreatic effect	Grant and Gandhi, 2004
Pancreatic toxicity	Dabby, 1985
Psoriatic effect	Zhu et al., 1981
Reproductive effect	Middleman et al., 1997; Saso, 2002; Park et al., 2004
Sexual headache	Alvaro et al., 2002
Spermicidal effect	Hong et al., 1982
Suicidal effect	Wilcox and Anthony, 2004
Tumor-promoting effect	Richter et al., 1995

### Future scenario

The clinical research on *Cannabis* was restricted for a long time due to its illegality. The past two decades have seen renewed and concerted interest in the therapeutic potential of *Cannabis*. Recent scientific studies on cannabinoid receptors in the brain and body, which respond pharmacologically to *Cannabis*, have explored its applications in every area of medicine. While *Cannabis* remains illegal under federal law in the United States, 13 states have made available the medical use of *Cannabis* under their state laws. For the first time in 1996 the medical use of *Cannabis* was re-legalized by California State for its therapeutic use and began laboratory experiment. The latest to legalize medical use of *Cannabis* is New Mexico, where 1742 patients are authorized to possess dried *Cannabis* as a medication. Recently in December 2007 the Ministry of Social Affairs and Health, Finland also sought to clarify legislation on prescribing *Cannabis* to victims of chronic pain. The psychoactive effect of THC is one of the best-studied biological activities in the world. This discovery opened up possibilities to exploit *Cannabis*-based products for medical use. Despite the pharmaceutical preparations of *Cannabis*, the use of its natural form for medicinal purposes has also progressed recently. *Cannabis* should not be known only for its psychoactive agent but also be recognized as strongest fibers provider and source of some nutritious edible oils. As a medicinally active plant, *Cannabis* has been used worldwide for millennia, making it one of the oldest known medicinal plants. Out of various classes of compounds found in *Cannabis*, including flavonoids and alkaloids, most of these constituents have not yet been properly characterized for biological activity. Therefore, the *Cannabis* plant could be called a 'neglected pharmacological treasure trove' (Mechoulam, 2005). However, an increasing number of pharmaceutical companies have started to pick up the idea of (synthetic) cannabinoids and their antagonists as therapeutic drugs. At present a number of preparations based on the biological activities of the cannabinoids are already available. A considerable number of cannabinoid-based medicines are expected to enter the market in the coming years. Also, there is still plenty of work to understand the potential of the *Cannabis* plant. A future with *Cannabis* based medicines therefore seems very likely, and a further understanding of *Cannabis* as a medicine through scientific research is warranted.

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