

REVIEW

An overview of *Pistacia integerrima* a medicinal plant species: Ethnobotany, biological activities and phytochemistry

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Abstract: *Pistacia integerrima* with a common name crab's claw is an ethnobotanically important tree native to Asia. Traditionally plant parts particularly its galls have been utilized for treatment of cough, asthma, dysentery, liver disorders and for snake bite. Plant mainly contains alkaloids, flavonoids, tannins, saponins and sterols in different parts including leaf, stem, bark, galls and fruit. A number of terpenoids, sterols and phenolic compounds have been isolated from *Pistacia integerrima* extracts. Plant has many biological activities including anti-microbial, antioxidant, analgesic, cytotoxicity and phytotoxicity due to its chemical constituents. This review covers its traditional ethnomedicinal uses along with progresses in biological and phytochemical evaluation of this medicinally important plant species and aims to serve as foundation for further exploration and utilization.

Keywords: *Pistacia integerrima*, bioactivities, phytochemistry, ethnobotany.

INTRODUCTION

Botany

Pistacia integerrima belonging to family Anacardiaceae is a dioecious tree native to Asia widely distributed in East Afghanistan, Pakistan, and North West & West Himalaya to Kumaon growing at an altitude of 800-1900m (Pant and Samant, 2010). Crab's claw and zebra wood are the common names for this medicinally important plant species however it has different vernacular names in Pakistan (shnai, khanjar, thoak) and India (kakroi, kakring, kakra, kakkar, kakar singhi, kakarsinghi) (Orwa *et al.*, 2009). *Pistacia integerrima* has single stem with many branches and large pinnately compound leaves. Leaves are up to 25cm long consisting of 2 to 6 pairs of lanceolate leaflets (fig. 2). Flowers are reddish in colour arranged in panicles. Globular fruits (4-6mm diameter) are purple to blue in colour (Padulosi *et al.*, 2002; Flora of Pakistan, 1969).

Pistacia integerrima is well pronounced due to galls present on the leaves and petioles. These galls are horn shaped, rugose and hollow formed due to insect attack of *Pemphigus* species. The galls are considered as store houses of secondary metabolites so have importance in indian traditional medicine system (Chopra *et al.*, 1982)

Ethnobotany

Pistacia integerrima is traditionally used against a number of remedies and is considered a plant having treatment of common diseases such as coughs, appetite, dyspeptic vomiting, phthisis, asthma and dysentery

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(Aggarwal *et al.*, 2006; Chopra *et al.*, 1986; Munir *et al.*, 2011; Pant and Samant, 2010; Khan *et al.*, 2012). Galls of *Pistacia integerrima* are bitter in taste, aromatic and used as expectorant as well as tonic. Roasted galls are taken with honey for cough asthma and diarrhoea in northern areas of Pakistan (Abbasi *et al.*, 2010). Furthermore galls are also used against hepatitis and other liver disorders in Pakistan (Uddin *et al.*, 2011). Galls in combination of other drugs are also used against snake bite and scorpion sting (Ahmad *et al.*, 2010). Bark of *Pistacia integerrima* is boiled in water and extract is used for jaundice and hepatitis in some regions of Pakistan (Islam *et al.*, 2006). Stem resin is used in wounds healing (Hussain *et al.*, 2007). Fruits are edible and also used against liver disorders (Abbasi *et al.*, 2009; Munir *et al.*, 2011) (table 1). Besides traditional medicinal uses *Pistacia integerrima* stem and branches are used as fuel wood, construction and ornamental wood in some regions of Pakistan (Hussain *et al.*, 2007; Jan *et al.*, 2008; Sher *et al.*, 2011). Leaves of *Pistacia integerrima* are used as fodder for cattle (Jan *et al.*, 2008).

Biological activities

Researchers have been in continuous struggle to explore and find plants having a wide range of activities from antibiotic to anticancer and *Pistacia integerrima* represents one of those plants having broad-spectrum activities

Antimicrobial activity

There is an increase demand of anti-microbial natural products in present era due to increasing resistance of microbes for synthetic drugs as well as due to their bio

friendly nature. *Pistacia integerrima* is well known for its medicinal importance. Antibacterial and antifungal activity of *Pistacia integerrima* stem was determined however, less antibacterial activity and more antifungal activity was observed (Aqil and Ahmad, 2003). Crude and fractionated extracts of *Pistacia integerrima* stem was tested against different pathogenic bacteria. Crude extract showed maximum activity against *Pseudomonas picketti*. All fractions showed pronounced activity against *Salmonella setubal* and *Staphylococcus aureus*, however, maximum inhibition (19.66mm) was shown by aqueous fraction against *Bacillus subtilis* (Bibi *et al.*, 2011). Methanolic bark extract of *Pistacia integerrima* and solvent based fractions were subjected to anti-microbial activity and outstanding antibacterial activity was shown by ethyl acetate fraction against *Staphylococcus aureus*, however, extracts proved inactive for anti-fungal activity (Shafiq ur Rehman *et al.*, 2011).

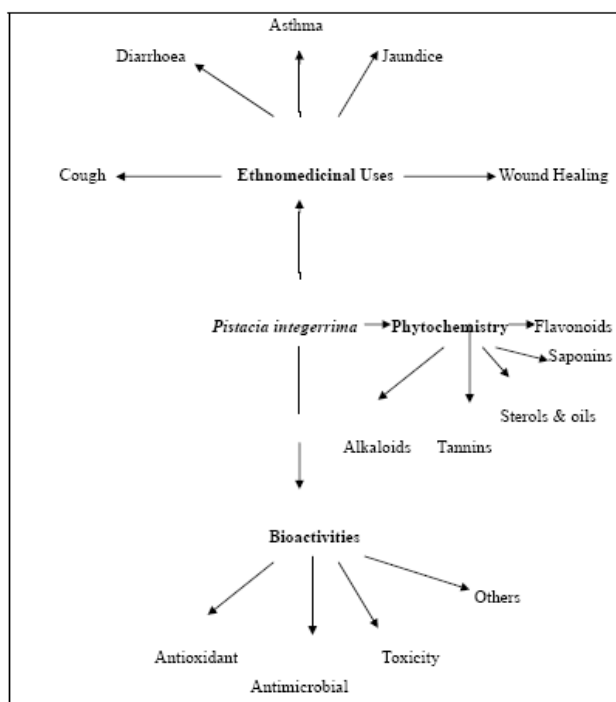


Fig. 1: Graphical Abstract: Ethnobotany, Bioactivities and Phytochemistry

Antioxidant activity

Plant based antioxidants played a vital role in curing oxidative stress damage in human beings. *Pistacia integerrima* was also found a good source of antioxidants due to its phenolic constituents. Antioxidant activity of *Pistacia integerrima* leaf and gall extract was studied and IC₅₀ values were found in the range of 19-33 (µg/ml) in the case of gall extract and 59-85 (µg/ml) for leaf extracts (Ahmad *et al.*, 2006). Significant radical scavenging and xanthine oxidase inhibitory activities were also observed in leaf extracts of *Pistacia integerrima* (Ahmad *et al.*, 2008).

Toxicity and other activities

Pistacia integerrima is placed in ayurvedic anticancer plant medicines (Aggarwal *et al.*, 2006). Fractionated stem extract of *Pistacia integerrima* has proved cytotoxic against breast cancer cell line MCF-7 (Bibi, 2011). Bark extract of *Pistacia integerrima* and its solvent based fractions were also subjected to phytotoxic studies and ethyl acetate fraction inhibited *Lemna minor* significantly (90%) followed by chloroform and methanol fraction suggesting their phytotoxic composition (Shafiq ur Rehman *et al.*, 2011). Galls of *Pistacia integerrima* were reported to have significant analgesic and anti-inflammatory activity (Ansari and Ali, 1996). Galls were found more potent than leaves as far as analgesic and anti-inflammatory activities were concerned however no acute toxicity was found in oral administration of extracts (Ahmad *et al.*, 2010). Galls of *Pistacia integerrima* were also known to lower uric acid content in mice in a dose dependent manner (Ahmad *et al.*, 2006). Aqueous extract of *Pistacia integerrima* was found effective in the treatment of hepatic injury in CCl₄ treated rats (Khan *et al.*, 2004). *Pistacia integerrima* galls and leaves extracts have proved anti-nociceptive and analgesic on mice with no apparent acute toxicity on oral administration (Ahmad *et al.*, 2010). Bark extract of plant has also proved to have analgesic and anti gastrointestinal motility effect (Ismail *et al.*, 2012).



Fig. 2: *Pistacia Integerrima*: Leaves and galls

Phytochemical evaluation

Importance of phytochemicals as candidate for drug development is understood (Gurumurthy *et al.*, 2008). Phytochemicals can also act as a source of precursors for synthetic drugs (Jack and Okorosaye-Orubite, 2008). Galls of *Pistacia integerrima* gained special attention of phytochemists due to their traditional medicinal uses, however stem, bark, and leaf were also investigated phytochemically. Generally *Pistacia integerrima* contain different phytochemicals including alkaloids, flavonoids, tannins, saponins, sterols and essential oils. Phytochemical analysis of *Pistacia integerrima* leaf was carried out and was found to contain carotenoids, triterpenoids, catechins and flavonoids (Ansari *et al.*, 1993; Ansari *et al.*, 1994). Uddin *et al.* (2011a) investigated qualitative phytochemical comparison between galls, bark leaf and root extracts of *Pistacia integerrima*. Screening study revealed presence of alkaloids, terpenoids, flavonoids and tannins in galls extract, terpenoids and flavonoids in bark and leaves

Table 1: Ethnomedicinal importance of *Pistacia integerrima*

Parts	Administration mode / form	Ethnomedicinal Use	Reference
Stem/Branches	Topical	Stem resin as wound healer	Hussain <i>et al.</i> , 2007
Bark	Decoction	Hepatitis & Jaundice	Islam <i>et al.</i> , 2006
Galls	Roasted galls with honey taken Orally	Cough, asthma and diarrhoea, Hepatitis, Snake bite, Scorpion sting	Abbasi <i>et al.</i> , 2010 Uddin <i>et al.</i> , 2011 Ahmad <i>et al.</i> , 2010
Fruits	Raw form, Fresh fruits crushed in water and taken orally	Edible, Jaundice, and hepatitis	Munir <i>et al.</i> , 2011 Abbasi <i>et al.</i> , 2009.

while roots of *Pistacia integerrima* were found to contain terpenoids and tannins. Fruits of *Pistacia integerrima* reported to possess tannins, essential oil, resin, pistacienoic acid, triterpene alcohol and triterpenoic acid (Prajapati *et al.*, 2006). Methanol extract and its ethyl acetate fraction of *Pistacia integerrima* were found to contain phenolics and flavonoids (Joshi and Mishra, 2009).

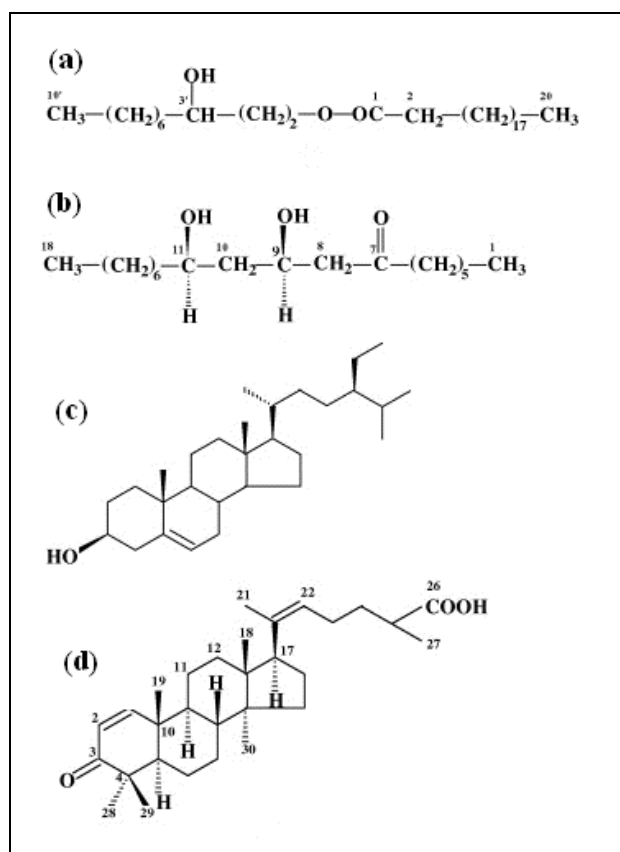


Fig. 3: Compounds isolated from galls of *Pistacia integerrima*. (a) Hydroxydecanyl arachidate, (b) Octadecan-9, 11-diol-7-one, (c) β -Sitosterol, (d) Pisticialanstenenoic acid

Steam distilled oils were isolated from galls of *Pistacia integerrima*. Investigation revealed that oil possesses CNS depressant activity (Ansari *et al.*, 1993). GC MS analysis of galls and bark oil revealed a large number of volatile components where bark oil consist of 82% whereas galls 91% monoterpenes. Main constituents of

galls oil were found as β -pinene, sabinene, α -pinene and limonene while terpinen-4-ol, α -terpinol, α -pinene in bark oil (Ansari *et al.*, 1998). Atta-ur-Rahman (2000) isolated lanostanes from galls proved highly potent anti-inflammatory even in minute quantities. Pistacienoic acids, was determined using simplified methods by HPLC and HPTLC (Chauhan *et al.*, 2002).

Different isolation studies were conducted on galls extract of *Pistacia integerrima* and led to purification of hydroxydecanyl arachidate, octadecan-9, 11-diol-7-one, β -sitosterol and pisticialanstenenoic acid (fig. 3) (Ahmad *et al.*, 2010 a & b), phenolic constituents characterised as 14'-phenoxytetradecanyl 3,5-dihydroxy benzoate (pistiphloro-gluciny ester) 2, 4'-phenoxy-*n*-butyl-1'-(3-oxy-5-hydroxy) benzoic acid (pistaciaphenyl ether) 3 and 3'-(1,3-dihydroxy-5-phenoxy-1',5'-dimethoxybenzene (pisticiphloro-gluciny ester) (Ahmad *et al.*, 2011). Furthermore ethyl gallate was isolated from galls of *Pistacia integerrima* and suggested good for anti-inflammatory diseases (Mehla *et al.*, 2011).

Farman (2005) studied the polyphenolic contents in the leaves of *Pistacia integerrima*. Betasitosterol in addition to a new compound was isolated from cytotoxic chloroform and ethyl acetate fraction of methanol stem extract (Bibi, 2011). Pistagremic acid was isolated from whole plant extract of *Pistacia integerrima* and exhibited significant leishmanicidal activity (IC (50): $6.71 \pm 0.09 \mu\text{M}$) against *Leishmania major* (DESTO) promastigotes in comparison to standard compound amphotericin (Uddin *et al.*, 2011b).

CONCLUSION

In conclusion *Pistacia integerrima* is a good candidate for new drug development inspite of wide range of its phytochemicals and bioactivities supported from its traditional uses. There is a dire need to further explore and standardize this medicinally important species up to clinical trials and approval.

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