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A Review on Potency of Some Cucurbitaceae Indian Plants Against Antimicrobial Activities

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ABSTRACT

India is called the botanical garden of the world for its rich natural resources. Over 6000 plants in India are used in traditional, folklore and herbal medicine. Plants have a long history over thousands of years and still considered to be a promising source of medicine. The efficacy and safety of herbal medicines have turned the major pharmaceutical population towards medicinal plants research. The medicinal plants have very important place in the health and vitality of human beings as well as animals. As per the WHO estimates, about three quarters of the world‟s population currently use herbs and other traditional medicines to cure various diseases, including liver disorders. Hence, several phytomedicines (medicinal plants and herbal drugs) are now used for prevention and treatment of various liver diseases. Medicinal plants may serve as a vital source of potentially useful new compounds for the development of effective therapy to combat a variety of liver problems. Many herbs have been proven to be effectual as hepatoprotective agents and others. In view of increasing resistance to existing antimicrobial agents, herbal drugs arebeing looked as very important source for discovery of new agents for treating various ailments related to bacterial infections. In this review, information on potential use of some Indian Cucurbitaceae plants for various disease and antimicrobial activities are being discussed.

Keywords: Cucurbitaceae, Antimicrobial activity, Lagenaria, Trichosanthes

INTRODUCTION

Many researchers have paid attention towards the Cucurbitaceae family because the fruits, seeds and vegetables are traditionally consumed in various Ayurvedic preparations and confectionary. The family Cucurbitaceae includes a large group of plants which are medicinally valuable. It is a family of about 130 genera and about 800 species distribute mainly in tropical and subtropical regions of the world. The plants of the family are collectively known as cucurbits (Kocyan *et al.,* 2007). The important genera belonging to the family are *Trichosanthes, Lagenaria, Luffa, Benincasa, Momordica, Cucumins, Citrullus, Cucurbita, Bryonopsis and Corallocarpus* (Pandey, 1969).

Cucurbits are among the largest and most diverse plant families, cultivated worldwide in a variety of environmental conditions. The fruits of cucurbits are very useful in terms of human health, i.e. purification of blood, removal of constipation and good for digestion and give energy. Seeds or fruit parts of some cucurbits are reported to possess purgatives, emetics and antihelmintics properties due to the secondary metabolite cucurbitacins content (Rahman *et al.,* 2008 and Bisognin, 2002).

Cucurbitacins constitute a group of diverse triterpenoids substances which are well known for their bitterness and toxicity. The cucurbitacins are of great interest because of the wide range of biological activities they exhibit in plants and animals. They are predominantly found in the family Cucurbitaceae

but are also present in several other families of the plant kingdom (Guha *et al.*, 1975). A number of compounds of this group have been investigated for their cytotoxic, hepatoprotective, anti-inflammatory and cardiovascular effects (Dhiman *et al.*, 2012 and Miro, 1995).

Medicinal plants have very important place as they not only maintain the health and vitality of human beings and animals, but also cure several disease, including liver disorders without causing any toxicity. Over past few decades, herbal medicines have been accepted universally and they put the impact on both. World health and international trade. As per the WHO estimates, about three quarters of the world‟s population currently use herbs phytomedicines (medicinal plants or herbal drugs) and other traditional medicines for the treatment of various diseases (Pandey, 2011; Madhuri *et al.*, 2008; Madhuri *et al.*, 2009; Pandey *et al.*, 2008 and Pandey *et al.*, 2011). A number of edible plants have been traditionally used to cure illness. For example, bulbs of *Curcumin longa* Lin have been consumed to treat stomach ulcers and is believed to help prevent liver cancer (Fransworth, 1992). The fruits and leaves of *Momordica charantia* Linn have been consumed to cure symptoms of liver diseases (Itharat *et al.*, 2007). In addition, several studies have confirmed the medical properties of these edible plants. For example, curcumin extracted from *C. longa* has been reported to have anti-inflammatory and antioxidant properties and shows antiviral activity for HBV and hepatitis C virus (Buhrmann *et al.*, 2011; Kim *et al.*, 2009 and Kim *et al.*, 2010). Liver has a pivotal role in regulation of physiological process. It is involved in several vital functions such as metabolism, secretion and storage. The liver diseases are mainly caused by toxic chemicals (certain antibiotics, chemotherapeutics, peroxidised oil, aflatoxin, carbon tetrachloride, acetaminophen, chlorinated hydrocarbons, etc.) excess consumption of alcohol, infections and autoimmune disorders (Pandey, 2011; Pandey, 1980; Pandey, 1990 and Kumar *et al.*, 2011).

The word hepatitis comes from the Ancient Greek word “hepar” (root word hepat) meaning 'liver' and the Latin „itis‟ means inflammation. Hepatitis means injury to the liver with inflammation of the liver cells (Khan *et al.*, 2012 and Nordqvist, 2009).

Most of the hepatotoxic chemicals damage liver cells mainly by inducing lipid peroxidation and other oxidative damages in liver. Enhanced lipid peroxidation produced during the liver microsomal metabolism of ethanol may result in hepatitis and cirrhosis. It has been estimated that about 90% of the acute hepatitis is due to viruses. The major viral agents involved are Hepatitis B, A, C, D (delta agents), Eand G. A vaccine has become available for immunization against Hepatitis B virus (Kumar *et al.*, 2011). The hepatoprotective activity is probably due to the presence of flavonoids in all few herbal plants (Shaik *et al*., 2012).

Hepatotoxicity Inducing Agents

Several chemicals have been known to induce hepatotoxicity. Carbon tetrachloride (CCl4), galactosamine, d-galactosamine/lipopolysachharide (GalN/LPS), thioacetamide, antitubercular drugs, paracetamol, arsenic etc. are used to induce experimental hepatotoxicity in laboratory animals (Vishwanath *et al*., 2012). Herbal based therapeutics for liver disorders has been in use in India for a long time and has been popularized world over by leading pharmaceuticals. Despite the significant popularity of several herbal medicines in general and for liver diseases in particular, they are still unacceptable treatment modalities for liver diseases.

The limiting factors that contribute to this eventuality are

Lack of standardization of the herbal drugs;

Lack of identification of active ingredient(s)/principle(s);

Lack of randomized controlled clinical trials (RCTs) and
Lack of toxicological evaluation (Vishwanath *et al*, 2012 and Radha *et al*., 2005).
In the recent years, research on medicinal plants has attracted a lot of attentions globally. Large body of evidence has accumulated to demonstrate the promising potential of Medicinal Plants used in various traditional, complementary and alternate systems of treatment of human diseases. Plants are rich in a wide variety of secondary metabolites such as tannins terpenoids, alkaloids, flavonoids, etc. which have been found in vitro to have antimicrobial properties (Sher, 2009).
The non-availability and high cost of new generation antibiotics with limited effective span have resulted in increase in morbidity and mortality. Therefore, there is a need to look for substances from other sources with proven antimicrobial activity. Consequently, this has led to the search for more effective antimicrobial agents among materials of plant origin, with the aim of discovering potentially useful active ingredients that can serve as source and template for the synthesis of new antimicrobial drugs (Balkhande *et al*., 2013).

Table 1: Plant Parts Used for the Treatment of various disease

Family	**Botanical Name**	**Plant Part Used**
	Citrullus colocythis	Fruit
	Citrullus lanatus	Ripe fruit
	Cucumins sativus	Fruit
	Cucumins trigonus	Fruit
	Cuscuta reflexa	Whole plant
Cucurbitaceae	*Diplocyclos palmatus*	Whole plant
	Lagenaria siceraria	Leaves
	Luffa acutangula	Fruit
	Luffa echinata	Bark
	Momordica charantia	Leaf
	Trichosanthes cordata	Root

Clinical microbiologists have two reasons to be interested in the topic of antimicrobial plant extracts. First it is very likely that these phytochemicals will find their way into the arsenal of antimicrobial drugs prescribed by the physicians; several are already being tested in humans. Scientists realize that the effective life span of any antibiotic is limited, so new sources especially plant sources are also being investigated. Second the public is becoming increasingly aware of the problems with the over prescription and misuse of traditional antibiotics. In addition many people are interested in having more autonomy over their medical care. A multitude of plants compounds (often of unreliable purity) is readily available over the counter from herbal suppliers and national food stores and the self medication with these substances is a common practice to certain extent (Sher, 2009).
The minimum inhibitory concentrations (MICs) can be determined. Evidently there are no scientific studies about effect of root extracts against pathogenic microorganisms (Balkhande *et al*., 2013).
Detailed survey made on all important *Cucurbitaceae* plants in respect of Hepatitis and antimicrobial activity. It is found that the information is available only on plants named: *Trichosanthes, Lagenaria, Luffa, Benincasa, Momordica, Cucumins, Citrullus* and *Cucurbita, Bryonopsis*. Furthermore, information on antimicrobial activity on plant *Trichosanthes, Lagenaria, Momordica* and *Bryonopsis* are available.

Therefore in present review, we have projected description of antimicrobial activity of these selected plants.

Momordica charantia

Momordica charantia, belonging to the family *Cucurbitaceae*, is a successful medicinal and vegetable plant for human health and one of the most promising plants. This plant has a number of potential biological and pharmacological activities including anti-diabetic, anti-opacity, anticancer, hypoglycemic, antifertility activities.

Bitter gourd commonly called "Karela" in India; consist of number of constituents which contribute to nutritional value of the plants. Bitter gourd (*Momordica charantia*), a vegetable indigenous to tropical regions of Asia, belongs to the *Cucurbitaceous* family, contains an array of biologically active photochemical. These include triterpenes, proteins and steroids. Fruit and seeds of bitter gourd are traditionally used as medicinal herbs as, anti-HIV, anti-ulcer, anti-inflammatory, anti-leukemic, antimicrobial, anti-diabetic, and anti-tumor, to name a few (Amira *et al*., 2013 and Mazza *et al*., 2001). Bitter gourd has some interesting biological and pharmacological activities, e.g. anticancer, antiviral, antibacterial, analgesic, anti-inflammatory, hypotensive, anti-fertility, hepatotoxicity and antioxidant (Young *et al*., 2009).

Antimicrobial Activity of Momordica charantia

Extracts of various plant parts of *Momordica charantia*, including leaf, fruit and seeds have been investigated and found to be pharmacologically active against microbes. A leaf, in addition to whole plant extracts have been shown to have anti-HIV activity (Sharma *et al*., 2011). *Bacillus subtilis, Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus* are inhibited by the extracts of chloroform and ethanol (95%) of dried fruit (Sharma *et al*., 2011).

Anti HIV Agents

Bitter gourd has also been suggested as a treatment for AIDS, but the evidence thus far is too weak to even mention. Laboratory tests suggest that compounds in bitter gourd might be effective for treating HIV infection. As most compounds isolated from bitter gourd that impact HIV have either been proteins or glycoprotein (Lectins), neither of which are well-absorbed, it is unlikely that oral intake of bitter gourd will slow HIV in infected people (Kumar *et al*., 2010).

Bryonopsis laciniosa

Bryonopsis laciniosa is a shrub known as "Shivlingi" in India and it is used commonly as an aperient medicine and tonic. *B. laciniosa* belongs to the Cucurbitaceae family and traditional healers use the leaves and the seeds of this plant for treatment of fevers. It is also taken in impotency and used as a tonic. Whole plant is used to treat adenopathy, ague, asthma, bronchitis, carbuncles, cholera, colic, consumption, convulsions, cough, delirium, fertility, headache, megalospleny, paralysis, phthisis, snake bite.

Antimicrobial activity of ethanolic extract of the leaf, stem, seed and fruit of an Indian medicinal plant, *Bryonopsis laciniosa*, used traditionally as potent medication in healing several ailments such as adenopathy, ague, asthma, bronchitis, cholera, colic, consumption, convulsion, cough, fertility and phthisis was tested against different pathogenic microorganisms by agar well diffusion method. Leaf and stem extracts of *B. Laciniosa* exhibited antimicrobial activity against different Gram positive and Gram

negative bacteria. Evidently there are no scientific studies about this plant on activities against pathogenic microorganism. Therefore, the objective of this study was to investigate the antimicrobial activity of this plant (Bonyadi *et al*., 2009).

Lagenaria siceraria

Lagenaria siceraria, commonly known as Bottle gourd, belonging to the family *Cucurbitaceae* called as "Lauki". Fruits and seeds of *Lagenaria siceraria* have been extensively studied for their pharmacological activity. *Lagenaria siceraria* is one of the excellent fruit for human being made and gifted by the nature having composition of all the essential constituents that are required for normal and good human health (Habibur, 2003). Seeds are also used in dropsy, worm infection and as nutritive.

In Ethiopian traditional medicine, *Lagenaria siceraria* is widely used for treatment of skin disorders. Goji evaluated antimicrobial activity of methanolic extracts of the leaves, seeds, and fruit-flesh of *L. siceraria* using the agar-well diffusion method. *Lagenaria siceraria* extract to show activity against *Pseudomonas aeruginosa* and *Streptococcus pyogenes*, but not against clinical isolates of *S. aureus* and *Escherichia coli*. Thus *Lagenaria siceraria* can be used to treat various skin disorders (Badmanaban and Patel, 2010 and Goji *et al.*, 2006).

Trichosanthes cucumerina

Trichosanthes cucumerina, the fruit of which is mainly consumed as a vegetable. It is commonly called asSnake gourd, Viper gourd, Snake tomato and long tomato. It is used in the treatment of headache, fever, abdominal tumors and skin allergy.

Seeds have antibacterial, anti-spamodic and insecticidal properties. Antimicrobial activities of petroleum ether, chloroform, ethyl acetate and methanol extract of the leaves gives activity against various pathogenic bacteria such as *Bacillus cereus, Enterobacter faecalis, Salmonella paratyphi, Staphylococcus aureus and Escherichia coli* by agar well diffusion method. The antimicrobial potency of this plant extract is due to the presence of phenolic compounds flavonoids and carotenoids (Reddy *et al*., 2010).

The anatomical and physicochemical studies of *Coccinia indica* was done by Hussain *et al*., (2011) and observed the presence of tannins, steroids, flavonoids, glycosides, saponin, alkaloids, proteins, amino acids and acidic compounds.

Gunjan *et al.,* (2010) has made a review of pharmacognonstical study of *Coccinia indica* and opined that fruit extract has significant anti diabetic properties.

Pharmacognonstical studies of *Coccinia indica* was carried by Sutar *et al*., (2010) and they detected the alkaloids, carbohydrates, glycosides, flavonoids, tannins and saponins.

Khatun *et al.,* (2012) has studied phytochemical screening and antimicrobial activity of *Coccinia cordifolia* and noticed the presence of compounds like flavonoids, saponins, tannins and terpenoids. The plant shows activity against *Shigella dysenteriae, Escherichia coli* and *Staphylococcus aureus.*

The antimicrobial activity of seed *Momordica charantia* was studied by Mahmood *et al*., (2012) and noticed that aqueous seed extract shows antimicrobial activity against *Pseudomonas multocida, Salmonella typhi* and *L. bulgaricus* and ethanol seed extract showed significant antimicrobial activity against *S. aureus, M. luteus, E. coli* and *S. epidermidis* and *L. bullgaricus* and petroleum ether extract were effective against *S. aureus*.

Phytochemical analysis and antimicrobial activity of *Kedrostis foetidissima* was studied by Vasantha *et al.,* (2012) and detected presence of flavonoids and steroids in leaf extract. The flavonoids, tannins,

triterpenoids, phenols, steroids, glycosides and cardiac glycosides was detected in the chloroform, methanol and acetone extract but saponin was detected only in methanol and acetone extract.

Experimental studies of anti-hepatotoxic effect of *Trichosanthes tricuspidata* by Vidyasagar (2012) revealed the presence of carbohydrates, proteins, alkaloids, glycosides and flavonoids which shows anti-hepatotoxic effect. In physico-chemical analysis they noticed that drugs were free of impurities like silica, carbonates, phosphates etc.

Poovendran *et al.*, (2011) has performed the antimicrobial assay of *Coccinia grandis* against *E. coli* and noticed that ethanol extract exhibit maximum activity whereas aqueous leaf extract and acetone extract does not show any antimicrobial activity.

Dhiman *et al*., (2012) has enumerated some important plants of the family Cucurbitaceae plants are: *Momardica charantia*, *Cucurbita pepo*, *Cucurbita andreana*, *Cucurbita ficifolia*, *Cucumis sativus*, *Cucumis melo*, *Citrullus colocynthis*, *Luffa echinata*, *Trichosanthes kirilowili*, *Lagenaria siceraria*, *Benicasa hispida* etc.

The pharmacognonstical review of *Coccinia grandis* was performed by Tamilselvan *et al*., (2011) and noticed that presence of steroids in petroleum leaf extract and detected the compounds like tannins, glycoside, proteins, amino acid, saponins and alkaloids in studied extracts.

The Antibacterial activity of *Coccinia grandis* leaf extract in different organic solvents were studied by Sivaraj *et al.*,(2011) against some selected bacterial spp. and concluded that the ethanolic leaf extract exhibits maximum activity against *S. aureus, B. cereus, E. coli, E .pneumonia* and *S. pyrogens*.

Arawwawala *et al*., (2011) has noticed antibacterial activity of *Trichosanthes cucumerina* in hot water extract and cold ethanolic extract against *Staphylococcus aureus*, *Streptococcus pyrogenes, Escherichia coli* and *Pseudomonas aeruginosa* and observed that water extract showed significant activity against *S. aureus, S. pyrogenes, E. coli, P. aeruginosa*. The cold water extract has higher antibacterial activity than the hot water extract.

Gopalakrishnan *et al.,* (2012) has performed antimicrobial activity of *Cucumis trigonus* fruits and observed that the petroleum ether and chloroform extracts does not show any activity while the ethanolic extract showed more activity than the benzene and aqueous extracts against *Candida albicans, Aspergillus flavans, Klebsiella aeruginosa, Pseudomonas aeruginosa* and *Bacillus subtilis*.

Bhattacharya *et al.,* (2010) has evaluated antifungal and antibacterial activity of *Coccinia grandis* and observed that the antifungal activity on *Candida albicans* and *Aspergillus niger* and antibacterial activity was observed on gram positive bacteria like *Bacillus subtilis, Staphylococcus aureus, Escherichia coli* and *Salmonella typhi*.

In vitro anti-oxidant and anti-inflammatory activity of *Coccinia grandis* was studied by Ashwini *et al.,* (2012) and noticed that the ethanol and methanol extract has significant antioxidant property.

Antimicrobial activity and phytochemical screening of the fruit extracts of *Coccinia indica* was evaluated by Syed *et al.,* (2009) and reveals that the presence of phytochemicals like alkaloid, steroid, tannins, saponins, phenols, glycosides, and triterpenoids. Petroleum ether extract was the most active and showed considerable antibacterial activity against all tested gram positive and gram negative bacteria. Least activity was in chloroform extract.

Photochemistry, Pharmacognosy and pharmacological study of *Lagenaria siceraria* was carried out by Kubde *et al.*, (2010) and observed the fruit extract contain cucurbitacins, showing antioxidant activity.

Rastogi and Malhotra (1991) and Duvey *et al*., (2012) has observed that *Trichosanthes tricuspidata* contains Cucurbitacins as an active ingredient and enumerated its medicinal uses.

Khare (2007) noticed that *Trichosanthes tricuspidata* contain Cucurbitacins, it possess anti-tumor, anti-inflammatory, anti- asthmatic, anti-fertility, anti-microbial and anti-hermitic properties.

Phytopharmacological review of *Lagenaria siceraria* was undertaken by Shah *et al.*, (2010). The phytochemical study shows bitter fruit contains cucurbitacins B, D, G and H. The leaves contain cucurbitacins B, D, and traces of E. fruit having anti hyperlipidemic, analgesic and anti-inflammatory, diuretic, antioxidant activity.

Deore *et al.*, (2009) were studied *in vitro* antioxidant activity and quantitative estimation of phenolic content of *Lagenaria siceraria*. Phytochemical screening of the crude ethanolic extract of fruit revealed the presence of flavonoids, saponins, glycosides and phenolic compounds which bears antioxidant activity.

Erasto and Mbwambo (2009) made HPTLC profile of *Lagenaria siceraria* fruits and noticed that it has high DPPH radical scavenging effect at all concentrations. The ethyl acetate extract shows more activity more activity than rest of the samples.

Pawar *et al.*, (2009) were evaluated central nervous system activity of different leaf extracts of *Lagenaria siceraria.* In their study, three extracts of leaves, petroleum ether, chloroform and methanol were used to study the CNS depressant activity in several animal models. In phytochemical screening the flavonoids, steroid, alkaloid, tannin, and saponin were detected.

Nutritive value of *Lagenaria sphaerice* seed from south Eastern Nigeria was studied by Chinyere *et al.*, (2009).

The antibacterial activities of *Coccinia grandis* was evaluated by Farrukh *et al*., (2008) and noticed that water extract of leaves and ethanol extract of stem showed high activity against *Shigella boydi* and *Pseudomonas aeruginosa* respectively.

Tomori e*t al.*, (2007) were evaluated the antibacterial activity of ethanolic fruit extract of *Lagenaria breviflora*. Tang *et al*., (2010) observed antimicrobial activity of sphingolipids isolated from stems of Cucumber (*Cucumis sativus*).

The change in mineral contents in fruit occurs due to infection of rot fungal pathogens in ivy gourd (*Coccinia indica*) which results in reducing the nutritional value Chatage and Bhale (2012).

Modgil *et al*., (2004) were determined carbohydrate and mineral content of Chyton (*Sechium edule*) and *Lagenaria siceraria.* Both plants were analyzed for their carbohydrate content viz, crude fiber, reducing sugar, non-reducing sugar and different dietary fiber constituents like NDE, ADF, legine, Cellulose and hemicelluloses and minerals.

Hossain *et al.*, (2012) were evaluated anti-inflammatory activity and determination of total flavonoids and tannin contents of *Lagenaria siceraria* root.

The phytochemical screening and antimicrobial activity of *Cucurbita pepo* was carried out by Chonoko and Rufai (2011).

Dewanjee *et al.*, (2007) has studied antimicrobial activity of crude extract from
Coccinia grandis and noticed that they are active against selected micro-organisms.

Bajpai *et al., (*2012) has performed HPTLC of *Cucurbita maxima* seed and observed that the presence of steroids, carbohydrates, unsaturated fatty acids and saturated fatty acids in the seed extract.

Phytochemical investigation of seed of *Cucumis callosus* was done by Chand *et al.*, (2012), and noticed the presence of alkaloids, proteins, carbohydrates, flavonoids, glycosides, saponins and tannins in alcohol and water extracts.

The nutritive and medicinal property of Cucurbits were recorded by Rahman *et al.*, (2008) and observed that the cultivated cucurbits are the good sources of vitamins and minerals.

Kirtikar and Basu (1987) reported that *Diplocyclos palmatus* was distributed throughout India, the annual climber with bright red fruit have high medicinal value.
Chopra and Chopra (1956) reported that *Diplocyclos palmatus* is used as an antidote against snake bite and inflammation.
Gupta and Wagh (2014) has studied phytochemistry, pharmacology and folklore use of *Diplocyclos palmatus* and noticed the presence of alkaloids, flavonoids, tritrpenoids, saponins, steroids, proteins and resins. The plant has anti-inflammatory properties.
Saboo *et al*., (2013) were evaluated phytochemical detection and anticancer potential of chloroform root extract of *Trichosanthes tricuspidata*.
Deshpande *et al*., (2008) were evaluated the ethanolic fruit extract of *Lagenaria siceraria* against the disorders where free radicals play a major role in pathogenesis.

Conclusion

The medicinal plants play an important role in the health and vitality of humans and animals lives. Medicinal and vegetable plants are recommended for the essential source of nutrition and the prevention of human disease including cancer and diabetes that they have to offer. Several medicinal plants are now prevalent for treatment of various liver diseases. From the study it can be concluded that Cucurbitaceae plants have potential against Hepatitis and furthermore, it also gives antimicrobial activities. These plants can be further use for therapeutic uses. Further study needs for the development of new drugs for treatment of various disease which gives antimicrobial activity against pathogenic bacteria.

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