LITERATURE REVIEW

2.1 Introduction

Many plants belonging to the *Cocculus hirsutus* family, Menispermaceae, have a history of medicinal use in systems of traditional medicine. The plant grows all over India, especially in dry regions. In India, it is known by various names in different regions (Kirtikar & Basu, 2005).

This chapter provides background information on the genera included in the present work, with emphasis on phytochemistry and pharmacological activity.

2.2 Phytochemical Literature Review of *Cocculus hirsutus*

The phytoconstituents present in *Cocculus hirsutus* (Merchant, 1962) includes isolation of alkaloids such as trilobine, Iso trilobine, coclaurine, magnoflorine and ginnol was reinvestigated and some new constituents were isolated trilobine, iso trilobine and protoquercitol (Ahmed & Tahir, 1986). Other alkaloids Hirsudiol (triterpenoid), Jamtine-N-oxide, Cohirsine, Cohirsinine(Isoquinoline alkaloid), (+)Syringaresinol and Oxypropiosyringon were isolated (Ahmad, Mohammad & Rasheed, 1987). Hirsutine (Tahir et al., 1991 and Rasheed et al., 1991) Cohirsinine (Viquaruddin & Tahir, 1991), Shaheenine (Rasheed, Khan & Zhadi, 1991), Cohirsitin (Viquaruddin & Iqbal S, 1992), Cohirstiline (Viquaruddin & Iqbal, 1992), Cohirstinne, Jamtinine (Ahmad & Iqbal, 1993), Haiderine (Viquaruddin & Iqbal, 1993) and Cohirstinine were isolated as an extended studies on *C. hirsutus* (Shaista, 1993). A minor Phenolic alkaloid corsutine was isolated (Yadav & Tripathi, 2005) 38 Preliminary analysis reveals presence of alkaloids, Flavanoids, fixed oils, fats, glycosides and Phytosterol in *Cocculus hirsutus* (Madhavan et al., 2010). Fractionation of crude aqueous extract of the aerial parts of *Cocculus hirsutus* lead to the isolation of b-sitosterol and 28-acetyl betulin (Iyer, Kumar & Parikh, 2011). Isolation of novel alkaloid from methanolic extract of the aerial parts of Cocculus hirsutus Linn. (Iyer et al., 2011). The methanolic
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extract of *C. hirsutus* leaves showed the presence of bioactive components like carbohydrates, steroids, alkaloids, glycosides, flavonoids, tannins and saponins. 32 bioactive compounds were identified from methanolic extract of the plant. The GC-MS results showed the presence of a number of bioactive phytocompounds like Quinic acid, 2,3,4,5- Tetrahydroxypentanal, Vitamin E, Linolenic acid, stearic acid, Phthalic acid, beta-sitosterol, campesterol, lupeol, betulin and squalene, all of which possessed a wide range of proven therapeutic uses (Kumar, Singh & Patni, 2014).

The review on ethnopharmacological properties of *Cocculus hirsutus* (Marya & Bothara, 2011), *Cocculus hirsutus*, a versatile herbal medicine (Tharun et al., 2012) and Medicinal Values of *Cocculus hirsutus* (L.) Diels: A Comprehensive Review (Patil et al., 2013) shows the importance of pharmacological and medicinal properties.

The major alkaloidal phytoconstituents present in *Cocculus hirsutus* are Cohirsine, Cohirsinine, Cohirstinine, Hirsutine, Shaheenine, Syringasesinol, Isotriboline, Triboline, Jamtinine and Haiderine. The other phytoconstituents like triterpenoid alcohol Hirsudiol, essential oil, β-sitosterol and gineol are also been reported.

Several studies have showed several phytochemicals are responsible for the therapeutic activity of the *Cocculus hirsutus*. The plant of *C. hirsutus* has been reported to contain essential oil, β- sitosterol, ginnol, glycosides, sterols and alkaloids. The phytochemical studies showed the presence of bis-benzyl isoquinoline alkaloids; viz. shaheenine, cohirsinine, hirsutine, jamtine (jamitine- N-oxide, cohirsinine, dehydrocohirsinine, Cohirsitine and haiderine which are isolated from stem and roots (Guha et al., 1979). The alkaloids present in the leaves of *C. hirsutus* are D-trilobine and DL-coclaurine, isotrilobine, (+) syringaresinol and protoquericitol. Roots are reported for the presence of D-trilobine and coclaurine, sterols and resins. Chemical investigation of the roots and stems of *Cocculus hirsutus* has yielded a new phenolic alkaloid Corsutine.
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From the aqueous extract of dried aerial parts of *Cocculus hirsutus*, b-sitosterol, and 28-acetyl betulin were isolated. Ethanolic extract of whole plant showed the presence of ginnol, isoquinoline alkaloid d-trilobine, Cohirsinine, Jamtine, cohirsinine and hirsudiol. Cocsuline N-2-oxide was isolated from Cocculus hirsutus in 1984 (El-Shabrawy (El-Shabrawy et al., 1984). It was the first N-oxide which was reported in this species. A novel compound, 4-[C-rhamnosyl] methyl piperidine was isolated from the methanolic extract of *Cocculus hirsutus*. The alkaloid, hirsutine was isolated as a gum from the whole plant of *Cocculus hirsutus*.

**Structure of isolated compounds**

![Cohirsianine](image1.png)  
![Cohirsine](image2.png)  
![Haiderine](image3.png)  
![Jamtinine](image4.png)
2.2.1 Flavonoids

Flavonoids are a large class of natural polyphenol compounds of low molecular mass, widely distributed in plant world, where they perform several very important functions such as antioxidant and chelating properties (Bors et al., 1990), (Middleton & Teramura, 1993) & (Heim et al., 2002). Flavonoids have been shown to have a wide range of biological and pharmacological activities in in vitro studies., including anti-oxidation, anti-allergic (Yamamoto & Gaynor, 2001), anti-inflammatory (Yamamoto & Gaynor, 2001) & (Cazarolli et al., 2008), antioxidant (Cazarolli et al., 2008), antimicrobial & antibacterial (Cushnie & Lamb, 2011) & (Manner et al., 2013), antifungal and antiviral (Cushnie & Lamb, 2005) & (Friedman, 2007), anti-cancer (De Sousa et al., 2007) and anti-diarrheal activities (Schuier et al., 2005). In the human diet, they are most concentrated in fruits, vegetables, wines, teas and cocoa.

As they probably behave in plants as photoprotectors, besides the systemic actions exploited by flavonoids ingested with vegetables or food supplements, it has been suggested that they can be used as sunscreens (Choquenet et al., 2008). To be efficient in its photoprotective action, a sunscreen must have an absorption spectrum wide enough to cover as many of the wavelengths of the UV region as possible.

2.2.2 Rutin, Quercetin and Liquiritin

Rutin (RUT), Quercetin (QCT) and Liquiritin (LIQ) are flavonoid glycoside. Rutin is widely used in medicine for maintenance of capillary integrity. It possesses anti-inflammatory, antihepatotoxic (Cesarone et al., 1992), antiulcer (Clack et al., 1950), antiallergic and antiviral actions and some of them provide protection against cardiovascular mortality (Colergie Smith et al., 1980), (Hertog et al., 1993) & (Santhanamari & Alruwaili, 2015). It also has antioxidant activity and reduces low density lipoproteins [LDL] oxidation (Dewhalley et al., 1990).
There are very few numbers of papers were reported toward the detection of rutin in plants other than *Cocculus hirsutus* by UV-spectrophotometric method (Danila, 2008), (Hao et al., 2010) & (Pawar & Salunkhe, 2012).

There are very few numbers of papers were reported toward the detection of quercetin in plants other than *Cocculus hirsutus* by UV-spectrophotometric method (Hassan et al, 1999) & (Jelena et al., 2012).

### 2.3 HPLC and HPTLC

Simultaneous estimation of flavonoids such as rutin, liquiritin and quercetin by HPLC and HPTLC in plants other than *Cocculus hirsutus* were done alone or in combination and summarized in Table 2.1 and Table 2.2.

**Table 2.1: Comparison of Simultaneous estimation of Rutin, Liquiritin and Quercetin in plants other than *Cocculus hirsutus* by HPLC method.**

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Mobile Phase (V/V/V/V)</th>
<th>$\lambda_{\text{max}}$ (nm)</th>
<th>RUT ($R_t$)</th>
<th>LIQ ($R_t$)</th>
<th>QCT ($R_t$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Zu Y et al., 2006)</td>
<td>Methanol–acetonitrile–water (40:15:45, v/v/v) 1 % acetic acid</td>
<td>257&lt;br&gt;368</td>
<td>5.2</td>
<td>-</td>
<td>7.3</td>
</tr>
<tr>
<td>(Behnazet et al., 2013)</td>
<td>60:40 v/v mixture of methanol and 0.1% O-phosphoric acid in water</td>
<td>355.5&lt;br&gt;368</td>
<td>6.7</td>
<td>-</td>
<td>9.8</td>
</tr>
<tr>
<td>(Shanmugam et al., 2013)</td>
<td>Methanol: acetonitrile: water (10:10:75) containing 5% acetic acid</td>
<td>258</td>
<td>3.48</td>
<td>-</td>
<td>6.51</td>
</tr>
<tr>
<td>(Leonardo et al., 2013)</td>
<td>25 mM potassium dihydrogen o-phosphate pH4 and acetonitrile 70:30</td>
<td>230</td>
<td>2.8</td>
<td>-</td>
<td>7.4</td>
</tr>
<tr>
<td>(Subramanian et al., 2014)</td>
<td>THF: sodium dihydrogen phosphate buffer (pH 3) (40:60)</td>
<td>356</td>
<td>7.592</td>
<td>-</td>
<td>16.633</td>
</tr>
<tr>
<td>(Chang et al., 2010)</td>
<td>acetonitrile:25mM ammonium acetate pH 3 (40:60 v/v)</td>
<td>259</td>
<td>1.71</td>
<td>-</td>
<td>4.30</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Mobile Phase (V/V/V/V)</th>
<th>λmax (nm)</th>
<th>RUT (Rf)</th>
<th>LIQ (Rf)</th>
<th>QCT (Rf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Liu &amp; Yang, 2005)</td>
<td>1% aqueous acetic acid: Acetonitrile (30:70 to 95:5 gradiently)</td>
<td>280</td>
<td>-</td>
<td>17.1</td>
<td>5</td>
</tr>
<tr>
<td>(Seo et al., 2011)</td>
<td>water-formic acid (100:0.04, V/V) (pH 3) and (B) acetonitrile.</td>
<td></td>
<td>-</td>
<td>2.8</td>
<td>-</td>
</tr>
<tr>
<td>(Zhu et al., 2014)</td>
<td>Aq. acetic acid, acetonitrile with 1.0% (v/v) acetic acid (Gradient)</td>
<td>254</td>
<td>-</td>
<td>18.2</td>
<td>-</td>
</tr>
<tr>
<td>(Xu &amp; Chang, 2011)</td>
<td>Acetonitrile: 0.1 5% Phosphoric acid</td>
<td>276</td>
<td>-</td>
<td>16.5</td>
<td>25</td>
</tr>
<tr>
<td>(Seo et al., 2014)</td>
<td>Water with 1.0% (v/v) acetic acid (solvent A) and acetonitrile</td>
<td>254</td>
<td>-</td>
<td>14.2</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 2.2: Comparison of Simultaneous estimation of Rutin, Quercetin and Liquiritin in plants other than Cocculus hirsutus by HPTLC method.

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Mobile Phase (V/V/V/V)</th>
<th>λmax (nm)</th>
<th>RUT (Rf)</th>
<th>QCT (Rf)</th>
<th>LIQ (Rf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Jain et al., 2009)</td>
<td>Methanol-Water-Formic acid (40:57:3)</td>
<td>254</td>
<td>0.07</td>
<td>0.17</td>
<td>-</td>
</tr>
<tr>
<td>(Pawar &amp; Salunkhe 2012)</td>
<td>Ethyl acetate: Formic acid: Acetic acid: Water (10:1.1:1.1:0.6)</td>
<td>254</td>
<td>0.03</td>
<td>0.76</td>
<td>-</td>
</tr>
<tr>
<td>(Rao, 2013)</td>
<td>Toluene: Ethyl Acetate: Methanol(5:3:2)</td>
<td>254</td>
<td>0.17</td>
<td>0.65</td>
<td>-</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Mobile Phase (V/V/V/V)</th>
<th>(\lambda_{\text{max}}) (nm)</th>
<th>RUT (R(_f))</th>
<th>QCT (R(_f))</th>
<th>LIQ (R(_f))</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Prajapati et al., 2013)</td>
<td>Toluene: Ethyl acetate: Methanol: Formic acid (8:8:3:1)</td>
<td>254</td>
<td>0.13</td>
<td>0.75</td>
<td>-</td>
</tr>
<tr>
<td>(Jayaveera et al., 2010)</td>
<td>Ethyl acetate: Dichloromethane: formic acid: Glacial acetic acid: Water (10:2.5:1:1:0.1, v/v/v/v/v)</td>
<td>366</td>
<td>0.13</td>
<td>0.93</td>
<td>-</td>
</tr>
<tr>
<td>(Sajeeth et al., 2010)</td>
<td>Ethyl acetate: Glacial acetic acid: Formic acid: Water (100:11:11:25)</td>
<td>366, 280</td>
<td>0.34</td>
<td>0.98</td>
<td>-</td>
</tr>
</tbody>
</table>

2.4 Pharmacological Literature Review

Almost all the parts of this plant have medicinal values and are used traditionally in treating various ailments like eczema, lymphadenopathy, abdominal disorders. In the recent days this has been employed in the formulation of pharmaceutical products which has drawn the attention of formulation researchers in exploring several other uses of *Cocculus*. The following pages will focus on the pharmacological activities exerted by the *Cocculus hirsutus*.

2.4.1 Larvicidal activity

The larvicidal activity of various extracts of Cocculus hirsutus was determined. About all the extracts showed moderate mosquito larvicidal activity but the leaf methanol extract of Cocculus hirsutus exposed highest larval mortality effect (Elango et al., 2009).

2.4.2 Anti-ulcer activity

The ethanolic leaves extract of Cocculus hirsutus showed the best anti-ulcer activity (Rao et al., 2011).

2.4.3 Anti-inflammatory and analgesic activity

The methanolic leaf extract of *Cocculus hirsutus* possess peripheral and central analgesic activity in animal model. The leaf extract shows in-vitro anti-
inflammatory activity on HRBC and in-vivo anti-inflammatory activity on acute and chronic anti-inflammatory models in rats. The aerial parts of the plant possesses anti-inflammatory activity and also support that the traditional use of this plant in rheumatic condition. The roots of *Cocculus hirsutus* also possess anti-inflammatory and analgesic properties. The aerial parts of the plant possesses anti-inflammatory activity and also support that the traditional use of this plant in rheumatic condition. These result also commensurate with earlier reported phytochemicals of *Cocculus hirsutus* i.e. essential oil, β-sisitosterol, ginnol, glycosides, sterol and alkaloids. Thus the presence of sterols, alkaloids and glycosides in various extracts might suppress the formation of bradykinin and prostaglandin and exhibit significant anti-inflammatory property (Nayak & Singhai 1993) (Sarvankumar et al., 2011), (Abdul et al., 2012).

### 2.4.4 Hepatoprotective activity

The antihepatotoxic activity of the plant checked and it was found that methanolic extract of *Cocculus hirsutus* has hepatoprotective activity against hepatotoxicant like CCl4 and ethanol and its activity is comparable with the standard drug silymarin. The antioxidant and hepatoprotective effects of *C. hirsutus* could be due to presence of phytochemicals like B-sitosterol, trilobine, isotrilobine, (+)-syringaresionol, protoquercitol, ginnol, alkaloids and glycosides (Noorani, Mulla & Patil 2010), (Noorani et al., 2010), (Thakare et al., 2010).

### 2.4.5 Antihyperglycemic activity

The aqueous extract of leaves of *C. hirsutus* showed the antihyperglycemic activity. The antihyperglycemic potential of aqueous extract of *C. hirsutus* may be due to lowering of serum glucose level in diabetic mice and increased glucose tolerance. The extract also prevents loss of body weight in diabetic mice. The methanolic extract of Cocculus hirsutus also possess an anti-diabetic principle and may be used in diabetic treatment.
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(Badole et al., 2006), (Ganapaty & Vijay, 2006), (Palsamy & Malathi, 2007), (Sangameswaran, & Jayakar, 2007), (Malviya et al., 2010).

2.4.6 Antimicrobial activity

The antimicrobial activity of the roots of Cocculus hirsutus indicate that the ethanolic extract and crude alkaloidal fraction have significant antimicrobial activity against the test microorganisms. Present findings support the applicability of Cocculus hirsutus in traditional systems for its claimed uses like fever, inflammation, urinary and vaginal infectious diseases. The extracts of C. hirsutus showed significant antimicrobial activity and this could be due to the presence of alkaloids, tannins, saponins, flavonoids, coumarins and sugars revealed in preliminary phytochemical screening. The Cocculus hirsutus plant extracts have great potential as antimicrobial components against microorganisms and they can be used in the treatment of infectious diseases caused by resistant microorganisms. The methanol and aqueous extract of Cocculus hirsutus extract showed this activity. The profound presence of tannins which makes the flavour of the extract of Cocculus hirsutus like a tea. Hence in near future we can use the leaves of Cocculus hirsutus an alternative source for the commercial tea. The wound healing assay showed the aqueous extract of Cocculus hirsutus having potential wound healing activity. The wound healing activity of the methanol extract could be due to the individual or combined effect of the above phytoconstituents. Due to the presence of phenolic compounds in the plant, it is used as antimicrobial, preventive infection and enhances healing (Nayak & Singhai 2003), (Satish et al., 2010), (Abiramasundari et al., 2011), (Kalirajan et al., 2012).

2.4.7 Antioxidant activity

The ethanol extract from the aerial parts of Cocculus hirsutus Diels has significant antioxidant activity which can be comparable to the standards. This effect may be due to the presence of plant phytoconstituents like flavonoids, antioxidant vitamins like vitamin C & vitamin E and phenolic

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compounds which are found in the preliminary phytochemical analysis. The ethanol extract of the leaves showed strongest free radical scavenging activity (Somya et al., 2003), (Mon et al., 2011), (Panda et al., 2011).

2.4.8 Antipyretic activity

The polyphyto leaf extract of *Cocculus hirusutus* and *Maytenus marginata* showed significant decrease in body temperature. It reveals that it could be used as anti-pyretic (Sandhya & Vineela 2012).

2.4.9 Anti-arthritic activity

The methanolic and aqueous extract of roots of *Cocculus hirsutus* showed anti-arthritic effect in rats. The body weight loss that was found during the arthritic condition was corrected on treatment with methanolic extracts of root of *Cocculus hirsutus* Linn. The methanolic extracts were more effective than aqueous extracts. The methanolic extracts of roots of *C. hirsutus* have a promising anti-arthritic activity since it was active in both the inflammation models and adjuvant. The increased body weight during treatment of standard drug and methanolic extracts may be due to the restoration of absorption capacity of intestine. The ethanolic extract of *Cocculus hirsutus* leaves possess anti-arthritic activity in dose-dependent manner Anti-arthritic activity of *Cocculus hirsutus* may be due to the presence of phytoconstituents like triterpenoids, flavonoids and saponins (Baranwal, Irchhaiya & Alok, 2012), (Tirkey & Tiwari 2012).

2.4.10 Anthelmintic activity

The petroleum ether, ethyl acetate and methanol fractions of *Cocculus hirsutus* showed anthelmintic activity against adult earthworms. The anthelmintic activity of all fractions of C. hirsutus may be due to the presence of polyphenolic compounds (Imran, Shah & Mahjabin 2011).

2.4.11 Anti-urolithiasis effect

The ethanolic extract of leaves of *Cocculus hirsutus* (L.) Diels showed beneficial effect against urolithiasis by decreasing calcium oxalate crystals and
prevent crystal deposition in kidney tubules in sodium oxalate induced urolithiasis model in rat (Patel et al., 2008).

2.4.12 Immunomodulating activity

The methanol and aqueous extracts of the plant of *Cocculus hirsutus* are capable to strengthen the immune system. Both the extract and their fractions modulate immune responses significantly as they increase the phagocytes index, modulate the phagocytic functions of macrophages and phagocytes, which means they have a profound effect over the innate immunity. They also modulate the function of cytotoxic T-cell, that produces delayed type hypersensitivity immune response, which gives a better protection against viruses and tumors. They also increase the antibody titer, which means modulation of humoral immunity (Rastogi et al., 2008).

2.4.13 Diuretic and laxative activity

The aqueous extract of aerial parts showed significant diuretic activity and laxative effect in rats. The water soluble fraction of ammoniacal extract of *Cocculus hirsutus* was reported to have central sedative, hypotensive, bradycardiac, cardiotonic, spasmolytic and slight anti-convulsant actions in test animals (Ganapathy et al., 2002).

2.4.14 Anti-convulsant activity

Aqueous soluble fraction of the ammonical ethanol extract of stem and roots showed positive results as an anticonvulsant in albino rats (Kumar et al., 2012).

2.4.15 Anti-tumour activity

The ethanol extract of the leaves of *Cocculus hirsutus* showed anti-tumour activity (Mon, Maw, Oo, 2011).

2.4.16 Repellant, ovicidal and oviposition deterrent activity

The n-hexane, ethyl acetate, acetone, methanol and chloroform extracts of leaves of *Cocculus hirsutus* L. Diels (Menispermaceae) were tested for the repellent, ovicidal, and oviposition-deterrent activities against filarial vector *Culex tritaeniorhynchus* Giles. The various extracts showed anti-filarial
activity. From this, we can see the ray of hope that products and isolated principles from *Cocculus hirsutus* responsible for anti-filaria action, can be investigated further to achieve lead molecules in the search of novel herbal drugs to treat filariasis. (Elango et al., 2010), (Gandhi et al., 2010), ((Bhanu et al., 2011).

2.4.17 Fertility activity

The leaves of *Cocculus hirsutus* improved the sterility in man when used in proper dosage form. *Cocculus hirsutus* leaf extract showed good therapeutic results in n-hexane, ethyl acetate, acetone, methanol and chloroform extracts of leaves (Kumar et al., 2012).

2.5 Ayurvedic uses

According to Ayurveda, *C.hirsutus* L. Diels is known as Chilahinta. Root smell is sweetish and pungent, lessen bile and burning sensation, enrich blood. It is used in diseases of urinary system. According to Unani system of medicine, it is antipyretic, tonic, lessens thirsty, good for fractures, and useful in tubercular glands related problems. It is well known herb used as first aid remedy in minor injuries. It alleviates *kapha* and *vata* doshas. It is used as *deepanee, pachanee* and *raktdoshagni*. It possesses light, oily and slimy attributes. It has a special potency as a detoxifier (Ayurvedic Pharmacopoeia of India, 2001), (Indian Herbal Pharmacopoeia, 2002).

2.6 Traditional medicinal uses

The roots and leaves of *C.hirsutus* have great medicinal value and are used both, internally as well as externally for medicinal purpose.

- Juice of leaves coagulates in water and forms mucilage which is used externally as cooling medicine in eye problems and soothing application in prurigo, eczema, impetigo and dyspepsia.
- When juice is sweetened with sugar, it is given in acute gonorrhea. Decoctions of the root is mixed with long pepper is used in chronic rheumatism and syphilitic cachexia.
- The combination of roots of *C. hirsutus* and *Caesalpinia crista* (latakaranja) seed, matted in water is given orally to alleviate the abdominal pain.
- Decoctions in combinations with sugar and ginger are used in bilious dyspepsia. Roots rubbed with bonduc nuts in water are given for stomach problems especially in children.
- A decoction the fresh roots, with a few heads of pepper, in goat’s milk, is administered for rheumatic and old veneral pains; half a pint every morning is the dose. It is reckoned heating, laxative and sudorific.
- In the Konkan, the roots, rubbed with nuts, are administered as a cure for belly-ache in children. In bilious dyspepsia, they are given in 6 massa doses, with ginger and sugar. The root is generally used as a refrigerant, and also as a gentle laxative. It has been extensively used as an alternative in chronic rheumatic and veneral diseases.
- In Sind, the roots and leaves are used in headache and neuralgic pains (Murray). The juice of the leaves mixed with water, has the property of coagulating into a green jelly-like substance, which is taken internally, sweetened with sugar, as cure for gonorrhea.
- In Baluchistan, the mucilage is used to cure spermatorrhoea, taken in milk; it is used for coughs and to put on to sore eyelids and to soften breasts (Hughes- Buller). (Indian Herbal Pharmacopoeia, 2002), (Kirtikar & Basu, 2005).
- Root is bitter and used as alterative, laxative, demulcent, tonic, diuretic, antiperiodic in fever, in malaria, joint pains, in treatment of skin diseases constipation and kidney problems.

### 2.7 Other uses

- The juice of leaves used externally as cooling and smoothing agent in prurigo, eczema and impetigo.
- A decoction of the leaves is taken for eczema, dysentery and urinary problems. Leaves and stem are used for treating eye diseases.
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To treat gonorrhea, the appropriate dose is – Leaf juice administered in 2 spoonfuls with a glass of sugar water twice a day for 10-15 days.

To treat syphilis – Leaf juice administered in 2 spoonful with a glass of sugar water twice a day for 15 days (Nadkarni, 1982), (Madhu & Naik, 2009).

2.8 Inorganic profile and anti-nutritional values of *Cocculus hirsutus*

Looking at the medicinal values of *C. hirsutus*, the study was aimed to estimate the inorganic constituents and anti-nutritional value for safe use. Essential bulk metal ions were observed to be dominant where potassium was highest while phosphorus was lowest. The decreasing order of essential trace metals ions was Fe>Cu>Zn>Ni>Co>Cr. Among the antinutritional components, oxalic acid was 25.32 mg/100 g, while that of phytic acid was 0.280 mg/100 g, on fresh weight basis (Gupta et al., 2005), (Khan et al., 2012).

2.9 Mucilage of *Cocculus hirsutus* Leaf Powder as Gel Base

The leaf powder of *Cocculus hirsutus* yielded high % of mucilage. This mucilage used as a gelling agent. The prepared in which mucilage of *C. hirsutus* leaf powder used as gel base and ssmarkedeted available Flurbiprofen gels are evaluated for all the parameters such as pH, stability, viscosity, skin irritation, drug content, anti inflammatory activity test and in-vitro diffusion test. Both results were well co-related. From the results, it has been observed that, the amount of drug released from the prepared gel is more than that of marketed gel. It can be concluded that this prepared test gel is more efficient than marketed gel (Rao et al., 2010).
2.10 Summary

The *Cocculus hirsutus* have been used as medicinal plants or spices. This review gives extensive information about the chemistry and pharmacology of this plant. Traditionally, also it is used as medicines.

Since the family clearly produces compounds with interesting pharmacological action, investigation of little known species should prove rewarding.