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## *Conium maculatum*: A review

**Farah-Saeed, Mansoor Ahmad and Syed Mahboob Alam**

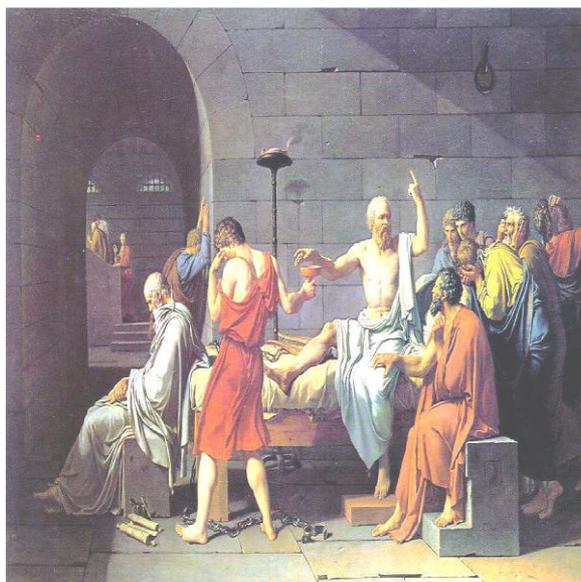
**Abstract**

*Conium maculatum* belonging to family Apiaceae. It is one of the most poisonous species among higher plants. This plant is native to Europe, Asia, North Africa, North America, Australia, and New Zealand. Its major chemical constituents are piperidine alkaloids. Apart from that flavonoids, coumarins, polyacetylenes, vitamins, essential oils and non-volatile oils. *Conium maculatum* extract and its alkaloidal fractions have been found to have significant pharmacological activities in low doses. While in high doses (above 20mg/kg) toxicity and teratogenicity is reported. In the current work, pharmacognostic, phyto-chemical, pharmacological, medicinal and toxicological effects of *Conium maculatum* were reviewed.

**Keywords:** Macroscopic, microscopic, therapeutic efficacy, toxic effects

**Introduction****Historical background of *Conium maculatum***

Larsson (2004) [1] in his detailed description of history and effects of *Conium maculatum* has mentioned about the theology and philosophy of Socrates along with his trial and execution. The Greek philosopher Socrates in year 399 B.C. was sentenced to drink cock tail of poison hemlock mixed with opium. Socrates was prosecuted by a person called Meletus. Socrates asked his pupil, Plato to record the symptoms of poisoning. Symptoms of poisoning as described by Plato included: inability to carry weight of the body therefore, he was laid down; in the beginning, cold sensation in feet; heaviness and numbness of body; numbness of body that gradually travelled upwards; swallowing and speech was affected in the end, followed by agonal convulsions and death. The charge against Socrates was transgression. The more itemized arguments that Socrates was thought to be sinful were that he did not recognize the gods of the city, invented new divine things and was charged to corrupt the youth (Larson, 2004; Holm, 1997) [1-2].

**Geographical distribution and Botany**

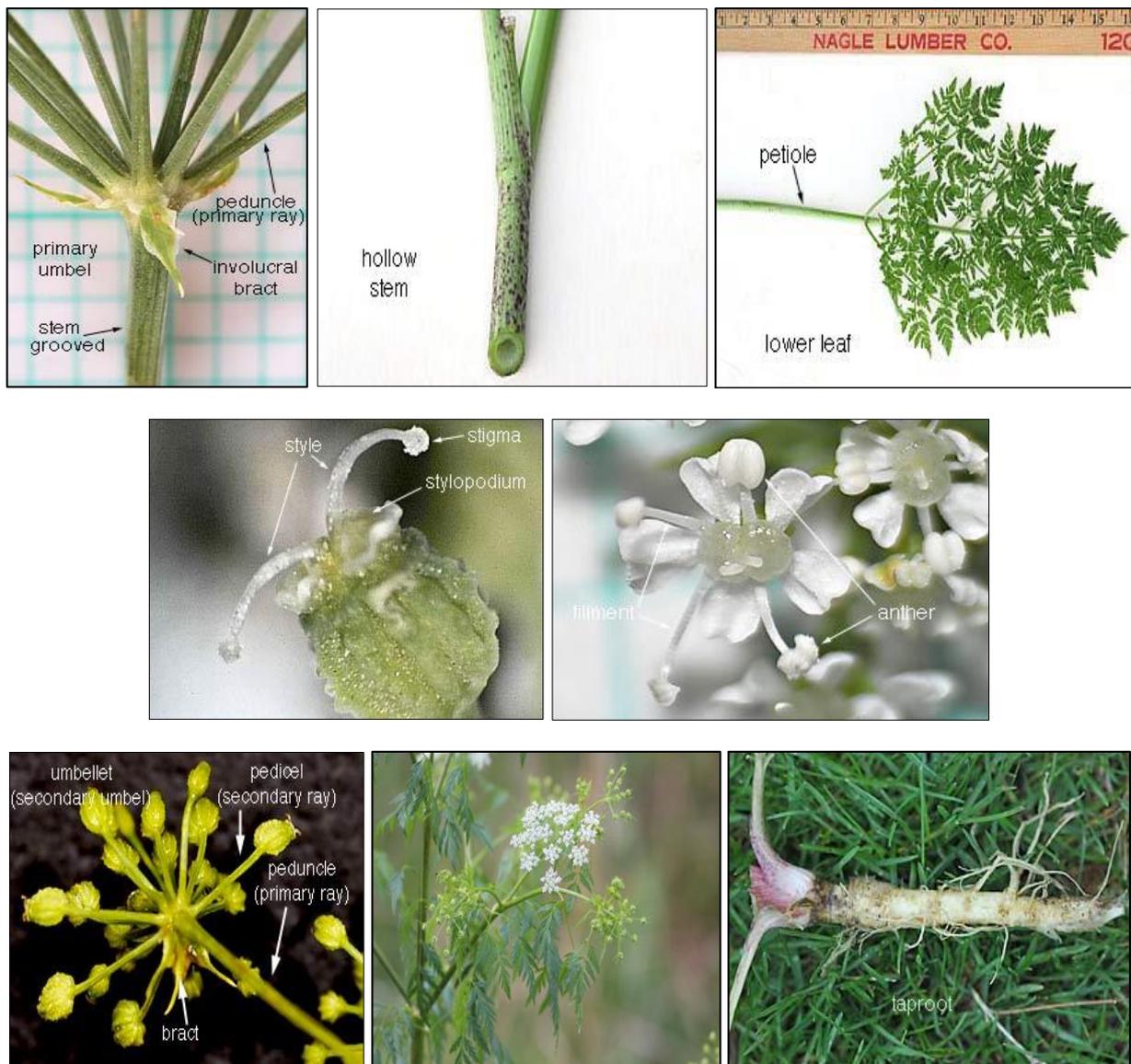
*Conium maculatum* (poison hemlock) belongs to family Apiaceae. It is native to Europe, North Africa and western Asia (López *et al.* 1999) [3].

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The plant's name was derived from the Greek word "Konas", meaning "to whirl about) due to the reason that its intake causes ataxia, tremor and convulsions. While "maculatum" is a Latin word, meaning "spotted" and refers to the very characteristic brownish-reddish spots of stem (Mitich, 1998; Vetter, 2004) [4-5]. *Conium maculatum* is a tall plant, with many branches. The flowers are small, white and in compound

umbels. Leaves are fern-like, bipinnate, and lower leaves are long petioled. Stems are smooth or grooved, hollow, purple or green or green with purple blotches. Plant usually is 1-3 m tall. The seeds are 2-2.5 cm long, grey or brown, short-lived (probably not more than 6 years), broadly ovoid, flattened laterally, glabrous, obtuse, and undulate with 5 prominent ribs when dry. The tap root is long, forked and pale yellow.

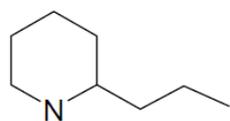


The dried leaf and juice of the plant were listed in pharmacopoeias of London and Edinburgh from 1864 to 1898 and the last official medicinal recognition appeared in the British Pharmaceutical Codex of 1934 in Great Britain (Bowman & Sanghvi 1963) [6]. The *Conium maculatum* mother tincture is prepared with ethanol (65 per cent V/V), using fresh, flowering, aerial parts of *Conium maculatum* L. harvested at the end of the blooming season as mentioned in Homoeopathic Preparations (1038) and French Pharmacopoeia Authority Supplement (Berenbaum & Harrison 1994; Corsi & Biasci 1998, Cromwell, 1956;

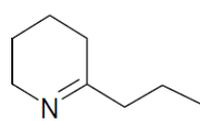
Fairbairn & Challen 1959; Fairbairn & Suwal, 1961; Kielland & Anders 1998; Le Stragne, 1977; Leete & Olson 1972). [7-14]

**Constituents of *Conium maculatum***

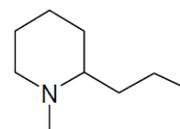
It contains piperidine alkaloids, flavonoids, coumarins, vitamins, polyacetylenes and volatile oils. There are eight known piperidine alkaloids include coniine, N-methylconiine, conhydrine, pseudoconhydrine, and gamma coniceine, that is precursor of other hemlock alkaloids. Coniine is testified to be eight times more toxic than  $\gamma$ -coniceine (López *et al.* 1999). [15].



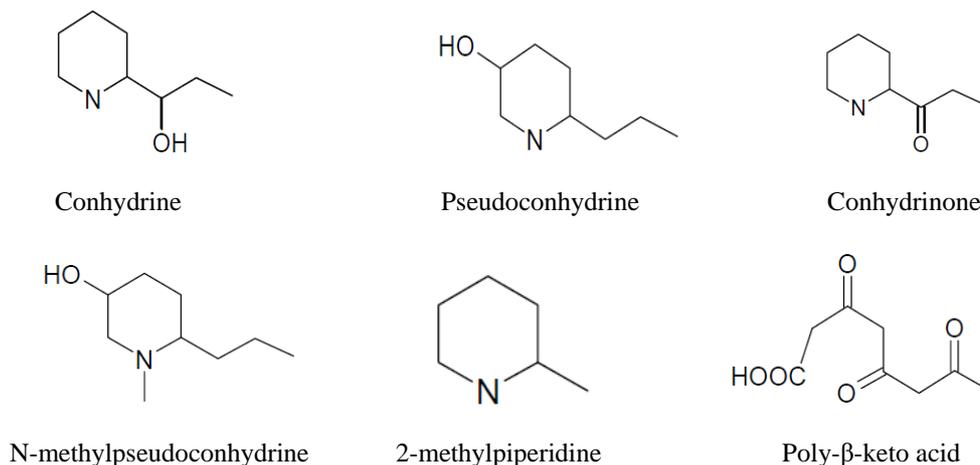
Coniine



Coniceine



N-methylconiine



**Fig 1:** Piperidine alkaloids present in *Conium maculatum* (Larson 2004) <sup>[16]</sup>

### Pharmacological effects and Indications

*Conium maculatum* was employed externally to treat herpes and erysipelas. The tincture or extract of plant may be used as anti-spasmodic, sedative, analgesic, whooping cough, angina, chorea, to relieve nervous excitation, rheumatic pains, pain in stomach; pain of gastric ulcer, nervousness and restlessness. It is of special use in old age when the vital powers of the body are collapsing. It has been used against severe type of malignant tumors. Conium is the main remedy for prostate gland and swelling of the testis. In homeopathy, it is used as a remedy for breast cancer and cancer of cervix uterus Bowman & Snaghi, 1963. <sup>[6]</sup>

### Poisoning Effects of *Conium maculatum*

The general symptoms of hemlock poisoning are effects on nervous system (stimulation followed by paralysis of motor nerve endings and CNS stimulation and later depression), vomiting, trembling, problems in movement, slow and weak later rapid pulse, rapid respiration, salivation, urination, nausea, convulsions, coma and death (Vetter 2004; Lopez, 1999; Madaan & Kumar 2012; Biberica *et al.* 2002; The Wealth of India, 1948; Felter & Lloyd 1898; Chopra *et al.* 1956; Holm 1948; Bakin & Baskin 1990; Biberica *et al.* 2002; Cooper and Johnson; Copithorne 1937; Drummer *et al.* 1995; Forsyth & Frank 1993; Frank & Reed 1987; Frank & Reed 1990; Frank *et al.* 1995; Galey *et al.* 1992; Howell & Mink, 1981; James *et al.* 1992; Jessup *et al.* 1986; Keeler 1977; Keeler & Balls 1978; Mekkonen, 1994; Nielsen & James, 1985; Nitao, 1987; Panter & Keeler, 1989; Penny, 1953; Rizzi *et al.* 1989; Rizzi *et al.* 1991) <sup>[5, 15, 17-44]</sup>.

### Macroscopic examination of *Conium maculatum*

It is a biennial plant, usually growing from 2 to 4 feet high, but sometimes attains nearly double that height. The root is long, forked, pale yellow and 1/2 to 3/4 inch in diameter. The erect, smooth stem, stout below, much branched above and hollow, is bright green.

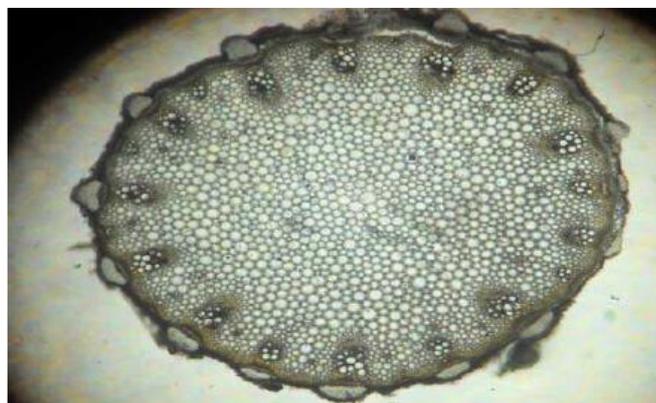
The leaves are numerous; those of the first year and the lower ones very large, even reaching 2 feet in length, alternate, long-stalked, tripinnate. The upper leaves are much smaller, nearly stalkless, with the short footstalk dilated and stem-clasping, often opposite or three together, more oblong in outline, dipinnate or pinnate, quite smooth, uniform dull green, segments toothed, each tooth being tipped with a minute, sharp white point.

Umbels composed of white flowers. Three short, lanceolate, acuminate, and membranous on the edges and deflexed bracts form the involucre. Involucel composed of short acuminate

bracts, linked at the base and attached on the same side. Flower peduncles with red spots. Flowers with 5 very short, green sepals, 5 white, obovate petals with a curved tip and 5 stamens. Inferior, concrete ovary with 2 loculi, each one presenting a single anatropous, pendant ovum tipped by 2 divergent styles expanded at the base in a stylopodium. Ovoid fruit, 3 mm long, 2 mm in diameter, with compressed commissure surfaces and bulging abaxial surfaces, always topped by the persistent remaining of the calyx and by 2 compressed conic stylopodia. The greenish mericarp is crossed by 5 yellowish-white, prominent, crenate, wavy, midribs

### Microscopic Evaluation of *Conium maculatum* aerial parts

Madaan Reecha *et al.* 2010 carried out transverse section technique on stem of *C. maculatum* and observed vessels and pericycle fibres <sup>[45]</sup>.



**Fig 2:** Photomicrograph of transverse section of stem.



**Fig 3:** Photomicrograph of surface view of lower epidermis.



**Fig 4:** Photomicrograph of trichome in powdered aerial parts of *C. maculatum*.



**Fig 5:** Photomicrograph of pericyclic fibre in powdered aerial parts of *C. maculatum*.



**Fig 6:** Photomicrograph of vessel in powdered aerial parts of *C. maculatum*.

#### Physio-chemical evaluation of *C. maculatum*

Madaan Reecha *et al.* 2010 carried out study of physio-chemical parameters of aerial parts of *C. maculatum*.<sup>[45]</sup> See the table below.

**Table 1:** Physio-chemical parameters of aerial parts of *Conium maculatum*.

S. No.	Parameters	Observations <sup>n</sup> (% W/W)
1	Foreign organic matter	0.28
2	Moisture content	10.50
3	Total ash	8.90
4	Acid insoluble ash	0.72
5	Water insoluble ash	4.50
6	Petroleum-ether extractive value	2.00
7	Alcohol-soluble extractive value	13.60
8	Water-soluble extractive value	25.60

n = 3; \* dry weight basis

#### Phytochemical Screening of *Conium maculatum* extract

Phyto-chemical analysis was done by Salma & Mustan, 2015 according to standard methods of qualitative analysis of *C. maculatum*.<sup>[46]</sup> See the table below.

**Table 2:** Phyto-chemical Screening of *Conium maculatum*

S. No.	Name of Phytochemicals	Test Name	Results
1	Sterols	Liebermann-Burchard test	+ve
2	Terpenoids	Salkowski test	+ve
3	Flavonoids	Ferric chloride Shinoda's Lead acetate	-ve
4	Alkaloids	Mayers Wagners Dragendorfs	-ve
5	Iridoids	Wieffering test	-ve
6	Tannins	Ferric Chloride	-ve
7	Phenols	Elagic acid test	-ve

#### Thin-layer Chromatography of aerial parts of *Conium maculatum*.

Madaan Reecha *et al.* 2010 carried out thin-layer chromatography of petroleum ether and chloroform extracts of *C. maculatum*. Spots were visualized by spraying with 0.5% anisaldehyde followed by heating at 110°C for 2 minutes in hot air oven.<sup>[45]</sup> See the table below.

**Table 3:** Thin-layer Chromatography of *Conium maculatum* aerial parts

Extract	Mobile Phase	Number of spots
Petroleum ether	Hexane: Ethyl acetate (8:2)	Five spots (0.20, 0.32, 0.45, 0.47, 0.65)
Chloroform	Toluene: Ethyl acetate: Glacial acetic acid (8.5: 1.5: 0.1)	Nine spots (0.18, 0.29, 0.33, 0.41, 0.49, 0.55, 0.67, 0.71, 0.92)

#### Aflatoxins, heavy metals, arsenic, and pesticides content estimation in *Conium maculatum* aerial parts.

Quantitative determinations of aflatoxins, heavy metals, arsenic and pesticides content in *Conium maculatum* aerial parts were carried out according to standard pharmacopeial methods by Madaan Reecha *et al.* 2010.<sup>[45]</sup>

**Table 4:** Aflatoxins, heavy metals, arsenic, and pesticides content estimation in *Conium maculatum* aerial parts.

Parameters	Observations (As Prescribed By Who)
Aflatoxin B1	Not detected
Aflatoxin B2	Not detected
Aflatoxin G1	Not detected
Aflatoxin G2	Not detected
Heavy metals	Complies
Arsenic	Complies
Pesticides (Heptane, Lindane, Heptachlor, Dieldrin, HCH Isomer, Endrin, DDT).	Not detected

#### Anti-microbial activities of *Conium maculatum*

Microbial limits were evaluated as per WHO specifications by Madaan Reecha *et al.* 2010<sup>[45]</sup>.

**Table 5:** Antimicrobial activity of *Conium maculatum*

Microbial Count	Observation	Limit (As prescribed by WHO)
Total bacterial count	176 cfu/10 gm	NMT 1000 cfu/gm
Total fungal count	Nil cfu/ 10 gm	NMT 100 cfu/gm
Pathogens		
<i>Salmonella</i>	Absent	Should be absent
<i>E.coli</i>	Absent	Should be absent
<i>Pseudomonas auroginosa</i>	Absent	Should be absent
<i>Staphylococcus aureus</i>	Absent	Should be absent

**Analgesic activity of *Conium maculatum***

Madaan & Kumar, 2012 evaluated the analgesic activity of alkaloidal fraction of *C. maculatum* using tail flick test, at the

doses of 100 or 200 mg/kg, p.o. See the table below. Alkaloidal fraction of *C. maculatum* exhibited significant analgesic activity at a dose of 200 mg/kg. [47]

**Table 6:** Analgesic activity of *Conium maculatum* alkaloidal fraction

Treatment	Dose (mg/kg)	Prereaction time (s)	Reaction time (s) Mean <sup>a</sup> ±SD			Mean % MPE		
			30 min	1 h	2 h	30 min	1 h	2 h
Control	Vehicle	2.6±0.45	3.6±0.55 <sup>a</sup>	3.4±0.55 <sup>a</sup>	2.8±0.45 <sup>a</sup>	13.22	10.36	2.50
Morphine (standard drug)	5.0	2.4±0.45	8.4±0.55 <sup>*</sup>	5.8±0.84 <sup>*</sup>	4.4±0.55 <sup>*</sup>	78.93	44.64	26.07
<i>C. maculatum</i> alkaloidal fraction	100	2.6±0.45	4.8±0.84 <sup>ab</sup>	3.0±0.55 <sup>a</sup>	2.8±0.45 <sup>a</sup>	31.79	13.22	2.50
	200	2.8±0.71	8.0±0.71 <sup>*</sup>	4.8±0.84 <sup>ab</sup>	3.8±0.84 <sup>*</sup>	74.29	33.21	20.36

n=5, <sup>a</sup>P<0.05 versus control, <sup>\*</sup>P<0.05 versus standard, Two way ANOVA followed by Student Newman Keul's test. MPE=Maximum possible effect, SD=Standard deviation

**Anti-inflammatory activity of *Conium maculatum***

Madaan & Kumar, 2012 assessed anti-inflammatory activity by using carrageenan-induced paw oedema test of *C.*

*maculatum* (alkaloidal fraction). The results of the study revealed significant anti-inflammatory activity at a dose of 200 mg/kg. See the table below [47].

**Table 7:** Anti-inflammatory activity of *Conium maculatum* alkaloidal fraction

Treatment	Dose (mg/kg)	Increase in paw volume (ml) Mean <sup>a</sup> ±SD			Mean % inhibition of paw oedema		
		1 h	2 h	3 h	1 h	2 h	3 h
Control	Vehicle	0.46±0.055 <sup>a</sup>	0.80±0.071 <sup>a</sup>	1.02±0.045 <sup>a</sup>	-	-	-
Indomethacin (standard drug)	5.0	0.12±0.045 <sup>*</sup>	0.34±0.055 <sup>*</sup>	0.64±0.089 <sup>*</sup>	74.00	57.54	36.67
<i>C. maculatum</i> alkaloidal fraction	100	0.32±0.045 <sup>ab</sup>	0.64±0.055 <sup>a</sup>	0.90±0.071 <sup>a</sup>	30.00	19.52	11.80
	200	0.14±0.055 <sup>*</sup>	0.46±0.055 <sup>*</sup>	0.70±0.071 <sup>*</sup>	71.00	42.46	27.27

n=5, <sup>a</sup>P<0.05 versus control; <sup>\*</sup>P<0.05 versus standard. Two way ANOVA followed by Student Newman Keul's test. SD=Standard deviation

**Smooth muscle activity of *Conium maculatum***

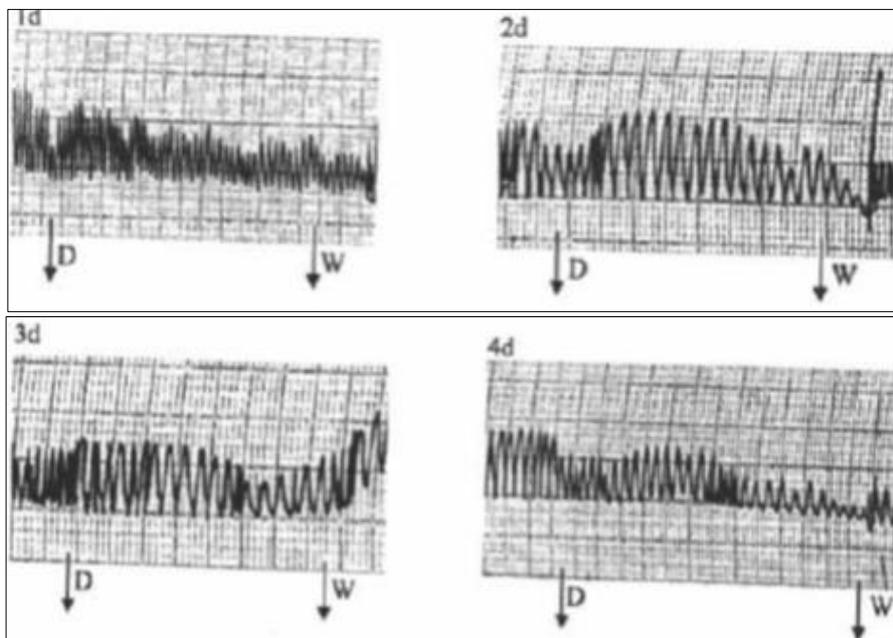
*C. maculatum* crude extract's (mother tincture) smooth muscle activity was performed by Alam, 2010, *invivo* on isolated rabbit's intestine. The effects of *C. maculatum* were observed through the contraction and relaxation of smooth

muscle tissue of rabbit's intestine. The effects of extract were observed at the doses 1-6 drops. The extract exhibited spasmolytic activity. The maximum response (66%) was observed at 4 drops [48].

**Table 8:** Dose related response of mother tincture of *Conium maculatum* on isolated rabbit's intestine

Dose (drops)	Control (cm)	Response (cm)	Response in percentage	t-value	p-value
1	0.76 0.033	0.46 0.0333	39	6.428	0.0015**
2	0.86 0.033	1.05 0.033	22	-3.942	0.007**
3	0.60 0.0577	0.80 0.057	33	-2.481	0.035*
4	0.90 0.0577	0.30 0.057	66	7.443	0.0009**
5	0.90 0.1154	0.40 0.115	55	3.063	0.018*
6	0.70 0.0577	0.40 0.057	43	3.722	0.01*

The results are expressed in ±SEM, at P≤ 0.05 and P≥0.05; \*significant, \*\*highly significant



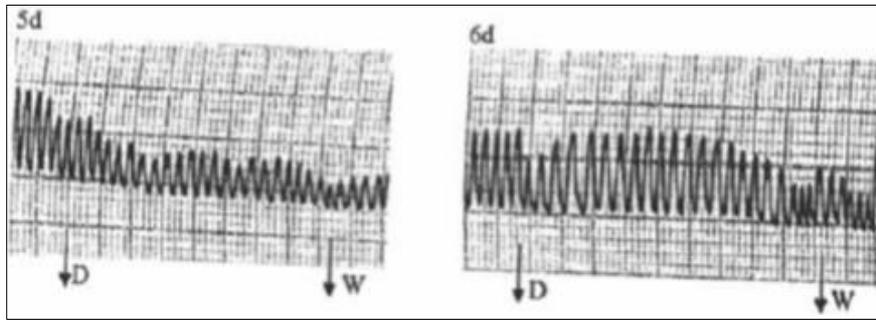


Fig 7: Tracings showing effects of *Conium maculatum* on isolated rabbit's intestine

**Insecticidal activity of *Conium maculatum***

Alam, 2010 evaluated insecticidal activity of *C. maculatum* on *Tribolium castaneum* and *Sitophilus oryzae*. It was observed that *C. maculatum* extract had 30% mortality against *Tribolium castaneum* and 30% against *Sitophilus oryzae* [48].

Table 9: Insecticidal activity of *Conium maculatum*

Dose	<i>Sitophilus oryzae</i>		
	No of survivor	Time of onset of drug action (Immobility time)	% Mortality
1	10	7 hrs	0
2	10	7 hrs	0
3	10	6 hrs	0
4	08	6 hrs	20
5	07	6 hrs	30
6	07	6 hrs	30
7	07	6 hrs	30

Name of insects	% Mortality	
	Positive Control	Negative Control
<i>Sitophilus oryzae</i>	100	0

Concentration of standard drug = 235.9 µg/cm<sup>2</sup>; Positive control – Permethrin (Copex) standard drug; Negative Control – solvent

**Anthelmintic activity**

Alam, 2010 carried out anthelmintic activity of *C. maculatum* extract. The extract caused 1 death at 4 drops of *C. maculatum* mother tincture after 24 hours. No mortality was observed at 1, 2, 3, 5 and 6 drops doses at the end of 24 hours [48].

Table 10: Assessment of anthelmintic activity

Treatment Doses of Conium (drops)	Time								
	Within 1 min	5 min	10 min	15 min	30 min	1 hr	2 hr	4 hr	24 hr
Control	N	N	N	N	N	N	N	N	N
1	1	2	2	2	2	1	2	2	A
2	1	2	2	2	2	2	2	2	A
3	2	1	2	2	1	1	2	1	A
4	2+	1	2+	1	2	1	3+	2	1D
5	2	1	2	2	1	2	3	2	A
6	2	1	2	2	1	2	3	2	A
7	2	1	2	2	1	2	3	2	A

Number of replicates = three worms

Alive = A

Grade 0 = Spontaneous motility

Grade 1 = moderate motility

Grade 2 = less motility

Grade 3 = reduce touch evoke response

Grade 4 = total paralysis

Grade N = Normal

Grade D = Death

Secretions = S

Edema = E

Size reduction = ↓

Bleeding = B

Intensity – high =+, moderate high =++, very high =+++ , low = -, moderate low = --, very low = ---

Increase contraction and secretion for few seconds than desensitized, there is bleeding and secretion.

**Neuro-pharmacological activity of *Conium maculatum***

**Gross behavioral studies**

Alam, 2010, tested *C. maculatum* crude extract 300mg/kg dose orally. Diazepam (2mg/kg) and Imipramine (15 mg/kg) were used as reference drugs and 0.5 ml saline orally as control group. The results of behavioral studies are shown in table below. [48]

Table 11: Assessment of Gross Behavioral activity

Parameters	<i>Conium maculatum</i> 300 mg/kg										
	Control	0 min	5 min	10 min	15 min	30 min	60 min	2 hrs	4 hrs	24 hrs	
Lacrimation	-	-	-	-	-	-	-	-	-	-	
Pupil size	-	-	-	-	-	-	-	-	-	-	
Nystagmus	-	-	-	-	-	-	-	-	-	-	
Salivation	-	-	+	+	+	+	-	-	-	-	
Vocalization	-	-	-	-	-	-	-	-	-	-	
Pilo erection	-	-	-	-	-	-	-	-	-	-	
Micturation/Diarrhea	-	-	+	+	+	+	+	-	-	-	
Irritability	-	-	-	-	+	+	+	+	-	-	
Disorientation	-	-	-	-	-	-	-	-	-	-	
Head tap (aggressive)	-	-	-	-	-	-	-	-	-	-	
Passivity	-	-	-	-	+	-	+	-	-	-	
Spontaneous activity	-	-	+	+	+	+	+	-	-	-	
Decrease Motor activity	-	-	-	-	-	-	-	-	-	-	

Decrease Respiratory rate	-	-	-	-	-	-	-	-	-	-
Decrease respiratory depth	-	-	-	-	-	-	-	-	-	-
Increase Respiratory Rate	-	-	-	-	-	-	-	-	-	-
Increase Respiratory depth	-	-	-	-	-	-	-	-	-	-
Dyspnea	-	-	-	-	-	-	-	-	-	-
Pain response	-	-	-	-	-	-	-	-	-	-
Anesthesia	-	-	-	-	-	-	-	-	-	-
Corneal reflex		+	+	+	+	+	+	+	+	
Light reflex		+	+	+	+	+	+	+	+	+
Ataxia	-	-	-	-	-	-	-	-	-	-
Limb tone decrease	-	-	-	-	-	-	-	-	-	-
Body tone	+	+	+	+	+	+	+	+	+	+
Tail erection	-	-	-	-	-	+	+	-	-	-
Tail lashing	-	-	-	-	-	-	-	-	-	-
Enophthalmoses	-	-	+	-	-	-	-	-	-	-
Exophthalmoses	-	-	-	-	-	-	-	-	-	-
Touch response	+	+	+	+	+	+	+	+	+	+
Tremor	-	-	-	-	-	-	-	-	-	-
Straub reflex	-	-	-	-	-	-	-	-	-	-
Rightning reflex	+	+	+	+	+	+	+	+	+	+

Neuro-pharmacological activity were assessed by open field test, head dip test, cage cross test, rearing test, traction test and forced swimming test. See the tables below.

**Table 12:** Assessment of neuro-pharmacological activity of *C. maculatum* using open field and cage cross activities

Treatment	Dose mg/kg (orally)	Open field activity (Mean $\pm$ SEM)	Cage crossing activity (Mean $\pm$ SEM)
<i>Conium maculatum</i>	300 mg/kg	159 $\pm$ 2.157	66 $\pm$ 1.06
	500 mg/kg	178 $\pm$ 3.157	71 $\pm$ 1.09
Diazepam	2mg/kg	28 $\pm$ 1.157	30 $\pm$ 2.81
Imipramine	15 mg/kg	198 $\pm$ 2.983	65 $\pm$ 2.41

Mean $\pm$ SEM; n = 5; Significant with respect to control (\* = significant; \*\* = Highly Significant)

**Table 13:** Assessment of neuro-pharmacological activity of *C. maculatum* using head dip and rearing activities

Treatment	Dose mg/kg orally	Head dip activity (Mean $\pm$ SEM)	Rearing activity (Mean $\pm$ SEM)
Control	0.5 ml saline	55 $\pm$ 3.569	41 $\pm$ 2.905
<i>Conium maculatum</i>	300 mg/kg	51 $\pm$ 0.09	39 $\pm$ 1.45
	500 mg/kg	57 $\pm$ 0.89	45 $\pm$ 0.65
Diazepam	2 mg/kg	12 $\pm$ 0.86**	06 $\pm$ 0.58**
Imipramine	15 mg/kg	89 $\pm$ 3.42*	54 $\pm$ 2.39*

Mean $\pm$ SEM; n = 5; Significant with respect to control (\* = significant; \*\* = Highly Significant)

**Table 14:** Assessment of neuro-pharmacological activity of *C. maculatum* using Light and Dark activity

Treatment	Dose mg/kg (orally)	Time spent in dark area (Mean $\pm$ SEM)	Time spent in light area (Mean $\pm$ SEM)
Control	0.5 ml saline	5.25 $\pm$ 0.255	4.48 $\pm$ 0.181
<i>C. maculatum</i>	300 mg/kg	3.89 $\pm$ 0.07	6.11 $\pm$ 0.121
	500 mg/kg	5.57 $\pm$ 0.143	4.43 $\pm$ 1.13
Diazepam	2mg/kg	9.4 $\pm$ 0.184	0.6 $\pm$ 0.07
Imipramine	15mg/kg	2.99 $\pm$ 0.099	7.01 $\pm$ 0.078

Mean $\pm$ SEM; n = 5; Significant with respect to control (\* = significant; \*\* = Highly Significant)

**Table 15:** Assessment of neuro-pharmacological activity of *C. maculatum* using Forced swimming activity

Treatment	Dose mg/kg orally	Mobility time (Mean $\pm$ SEM)	immobility time (Mean $\pm$ SEM)
Control	0.5 ml saline	3.54 $\pm$ 0.187	2.46 $\pm$ 0.120
<i>Conium maculatum</i>	300 mg/kg	3.05 $\pm$ 0.13	2.95 $\pm$ 0.041
	500 mg/kg	3.88 $\pm$ 0.179*	2.12 $\pm$ 0.127*
Diazepam	2 mg/kg	0.53 $\pm$ 0.019**	5.47 $\pm$ 0.211**
Imipramine	15 mg/kg	4.05 $\pm$ 0.086**	1.95 $\pm$ 0.122**

Mean $\pm$ SEM; n = 5; Significant with respect to control (\* = significant; \*\* = Highly Significant)

**Table 16:** Assessment of neuro-pharmacological activity of *C. maculatum* (Traction time)

Group	Traction time $\pm$ SEM (Time in minutes)							
	0 min	30 min	60 min	90 min	120 min	150 min	210 min	270 min
Control	14.48 $\pm$ 1.15	13.98 $\pm$ 1.05	14.05 $\pm$ 2.05	12.95 $\pm$ 1.95	13.1 $\pm$ 1.08	14.02 $\pm$ 1.25	13.50 $\pm$ 2.05	12.09 $\pm$ 1.85
<i>C. maculatum</i> (300 mg/kg)	14.44 $\pm$ 1.15	13.87 $\pm$ 1.05	14.07 $\pm$ 2.05	12.59 $\pm$ 1.95	13.09 $\pm$ 1.08	14.05 $\pm$ 1.25	13.61 $\pm$ 2.05	12.07 $\pm$ 1.85
<i>C. maculatum</i> (500 mg/kg)	14.43 $\pm$ 0.25	15.31 $\pm$ 1.02	16.20 $\pm$ 1.08	14.08 $\pm$ 2.11	14.53 $\pm$ 1.24	14.04 $\pm$ 1.15	14.19 $\pm$ 2.25	14.12 $\pm$ 1.05
Diazepam 2 mg/kg	15 $\pm$ 0.0143	16 $\pm$ 0.0036	16 $\pm$ 0.0082	17 $\pm$ 0.0012	19* $\pm$ 0.0051	20* $\pm$ 0.0086	21 $\pm$ 0.0081	19 $\pm$ 0.0091
Imipramine 15 mg/kg	14.58 $\pm$ 1.25	9 $\pm$ 2.02	8 $\pm$ 0.08	9.02 $\pm$ 0.11	10.46** $\pm$ 0.14	10.11* $\pm$ 0.15	12 $\pm$ 0.25	12 $\pm$ 0.05

Mean $\pm$ SEM; n = 5; Significant with respect to control (\* = significant; \*\* = Highly Significant)

### Anti-cancer activity of *Conium maculatum*

Anti-cancer potential of *Conium maculatum* extract against cancer cells *in vitro* was explored by Mondal *et al.* 2014. [49] *Conium* has the potential to interact with the DNA and thus hinders in the process of cell proliferation and cell cycle. *Conium* treatment reduced cell viability and colony formation ability of HeLa cells, reduced cell proliferation and caused cell cycle arrest, initiated ROS accumulation in HeLa cells, depolarized mitochondrial membrane potentials, induced morphological changes in HeLa cells, with nucleosomal fragmentation, modulates expression of different proteins related to cell proliferation and apoptosis in HeLa cells. The actual mechanism of apoptosis lies in the up- and down-regulations of some proteins.

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