

A COMPREHENSIVE REVIEW ON TRIVRIT [*OPERCULINA TURPETHUM* SYN. *IPOMOEA TURPETHUM*]**KOHLI K R¹, *NIPANIKAR S U² AND KADBHANE K P³**

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ABSTRACT

Trivrit (*Operculina turpethum* syn. *Ipomoea turpethum*) is commonly used since centuries in Ayurvedic system of Medicine to treat fevers, edema, ascites, anorexia, constipation, hepato-splenomegaly, intoxication, haemorrhoids, fistula, anemia, obesity, abdominal tumors, ulcers/wounds, worm infestation, pruritus and other skin disorders. It is the best amongst the herbs used for *Virechana* (i.e. therapeutic purgation), one of the procedures of Ayurvedic *Panchakarma* therapy. This review comprehensively incorporates the pharmacognosy, medicinal uses, and pharmacology of *O. turpethum*. Few preclinical studies done on *Operculina turpethum* have shown that it possesses anti-inflammatory, anticancer, cytotoxic, antisecretory, ulcer protective, hepatoprotective, & antibacterial activities. Some preliminary clinical studies have reported laxative, anti-inflammatory, analgesic, anti-helminthic and anti-arthritis effects of its crude root powder. The herb merits further research as it may be a source of potential anticancer and anti-rheumatic agent(s). As the plant *Operculina turpethum* is endangered, also prompt attention needs to be given to protect it from extinction.

KEY WORDS

Trivrit, *Operculina turpethum*, Purgative, Anticancer, Antirheumatic.

INTRODUCTION

Trivrit is an important herb, used in ayurvedic system of medicine since ages. Root bark, root, stem, and leaves of this herb have high medicinal value.^[1] Root of *Trivrit* is the vital ingredient of *Avipattikar Churna*, which is used in South East Asia on large scale for the treatment of skin

disorders, acid peptic disorders, & constipation. In Ayurveda, *Trivrit* has been included in the group of 'ten purgative herbs' (i.e. *Bhedaniya Mahakashaya*), group of 'ten antidote herbs' (i.e. *Vishaghna Mahakashaya*), group of 'ten herbs supportive for therapeutic enema' (i.e. *Ashthapanopag Mahakashaya*),^[2] group of 'colon cleanser, antitumor & antidote herbs'

(i.e. *Shyamadi Gana*), and in the group of 'herbs eliminating the toxins (i.e. vitiated *Doshas*) from lower half of the body' (i.e. *Adhobhagahar Gana*).^[3] Root bark of *Trivrit* is typically administered in powder form with number of vehicles such as fermented rice water (*Kanji*), milk, cereal water, *Triphala*, black paper, sugarcane juice, cow's urine, goat's urine, sheep's urine etc ^[4] as a therapeutic purgative agent for the treatment of GI disorders, skin disorders, ascites and various cancers.^[5]

Trivrit has two varieties as *Aruna* or *Shweta* (i.e. having whitish or reddish coloured root) & *Shyama* (i.e. having blackish root).^[1] The botanical name of *Aruna* or *Shweta Trivrit* is *Operculina turpethum* (L.) Silva Manso (syn. *Ipomoea turpethum*), while that of *Shyama* is *Ipomoea petaloides* chois.^[6] *Aruna* or *Shweta Trivrit* is the best amongst the herbs used for *Virechana* (therapeutic purgation).^[7] *Shyama*, with its drastic purgative action, can treat the conditions like intoxication & abdominal tumors.^[8] However, *Shyama* is inferior in properties and can cause fainting, burning sensation, giddiness, confusion, chest pain and roughness of throat and hence is rarely used in medicine.^[6]

In spite of consistent use of *Trivrit* in Ayurvedic medicine since centuries, the herb is little known to the research community. It may be due to lack of availability of adequate information on the plant on global level. Though few researches have been done, *Operculina turpethum* is under explored herb.

BOTANICAL DESCRIPTION

Taxonomical Classification-

Kingdom: Plantae
 Subkingdom: Tracheobionata, vascular plants
 Superdivision: Spermatophyta, seed plants
 Division: Angiosperma
 Class: Dicotyledons
 Order: Solanales
 Family: Convolvulaceae
 Genus: *Operculina*
 Species: *O. turpethum* (L.) Silva Manso

Binomial name: *Operculina turpethum* (L.) Silva Manso.^[9-10]

Synonyms -

Latin- *Ipomoea turpethum* (L.) R. Br., *Convolvulus turpethum* L. (basionym), *Convolvulus ventricosus* Bertero [= *Operculina turpethum* var. *ventricosa*], *Merremia turpethum* (L.) Rendle, *Operculina ventricosa* (Bertero) Peter;^[9] **Sanskrit-** *Shveta*, *Tribhandi*, *Trivruta*, *Triputa*, *Sarvanubhuti*, *Sarala*, *Nishotra*, *Kalaparni*, *Nandi*, *Kalameshi*, *Rechani*, *Kutarana*, *Bhandi*, *Palindi*, *Ardhachandra*, *Sushenika*, *Masurvidala*, *Kaulkaushiki*, *Kalameshika*, *Shyama*;^[1] **English-** Turpeth root, Indian jalap,^[8] Transparent wood-rose;^[9] **French-** Turbith vegetal;^[8] **German-** Turpeth Trichterwinde;^[8] **Hindi-** *Pithori*, *Nakpatra*, *Nishut*, *Nishoth*;^[8] **Arabic-** *Turband*, *Thurbud*;^[8] **Chinese-** *he guo teng*.^[10]

Geographical distribution:

O. turpethum is native to Asia (India, Nepal, Bangladesh, Pakistan, Sri Lanka, China, Taiwan, Myanmar, Thailand, Indonesia, Malaysia, Papua New Guinea, & Philippines), Africa (Kenya, Tanzania, Mozambique, Zimbabwe, Madagascar, Mauritius & Reunion) & Australia while is naturalised in West Indies.^[9, 11-12] Unfortunately, with the rapidly shrinking natural habitat, this important medicinal plant is dying out in many parts of the world.^[12-16]

Morphology:

O. turpethum is a stout perennial climber that exudes a milky juice when cut, with long fleshy roots and long twisting pubescent stems that are angled, winged which become very tough and brown when old. The leaves are simple, pubescent on both sides and variable in shape, cordate or truncate at base 5-10 cm long and 1.3- 7 cm wide. The flowers are white, campanulate, sepals long, borne in cymes of few flowers, giving way to globose capsules enclosed within overlapping brittle sepals. The capsules is rounded, being 1 to 1.5 centimeters

in diameter, and contains normally 4 black, smooth seeds. Roots of *Trivrit* occur in pieces, 1.5-15 cm long, 1-5 cm in diameter, usually unbranched, cylindrical, elongated, bearing thin rootlets; thicker pieces, occasionally split and show central wood portion; surface dull grey, reddish-grey to light brown, showing deep furrows or longitudinal wrinkles giving a rope-like or columnar appearance; transversely cut surface shows thick, whitish bark and light yellow centre; fracture in bark, short; in wood, fibrous.^[11]

STANDARDIZATION

Organoleptic properties –

Odour of roots is indistinct, taste is slightly pungent and nauseating when kept in mouth for some time. Mature roots of *O. turpethum* give grayish to light brown coloured powder.^[11]

Physical properties –

Fine powder of *Trivrit* root bark should give nil foreign matter, total ash not more than 10 %, acid-insoluble ash not more than 1.5 %, alcohol-soluble extractive not less than 10 % and water-soluble extractive not less than 8 %.^[11]

Thin Layer Chromatography (TLC)–

TLC of the alcoholic extract of *O. turpethum* on Silica gel 'G' plate using Toluene: Ethylacetate (9:1) shows under UV (366 nm) three fluorescent zones at Rf. 0.08, 0.21 (both light blue) and 0.58 (blue). On exposure to Iodine vapour seven spots appear at Rf. 0.21, 0.41, 0.49, 0.58, 0.71, 0.90 and 0.97 (all yellow). On spraying with Vanillin Sulphuric acid reagent and heating the plate for ten minutes at 110°C seven spots appear at Rf. 0.21, 0.41, 0.49 (all light violet), 0.58, 0.70, 0.90 and 0.97 (all violet).^[11]

Phytochemistry-

Root bark of *Trivrit* is rich in turpeth resin consisting of 10% 'turpethin' which is a glycoside analogue of Jalapine and Convolvulin and is insoluble in ether, benzene, carbon sulphide and essential oils. Under the action of alkaline bases, turpethin is transformed into turpethic acid, while it gets converted into turpetholic acid, Glucose

and fructose in presence of hydrochloric acid.^[8] *Trivrit* also contains Turpethinic acids- A, B, C, D, & E,^[17] some ether soluble resin, volatile oil, albumin, starch, lignin salts, ferric oxide, Scopoleptin, Betulin, lupiol & beta- sitosterol.^[8, 17-18] Turpethin is mainly responsible for purgative action of *Trivrit* and is an excellent & relatively safer substitute for jalap.^[8]

AYURVEDIC PHARMACOLOGY

In Ayurveda, *Charaka* have devoted a separate chapter on description of *Trivrit* including method of its collection, processing, contraindications, indications, dosage and therapeutic use of its 'one hundred & ten' purgative formulations.^[4]

Properties Described in Ayurvedic Texts:

As per Ayurvedic Pharmacopoeia of India, *Trivrit* has sweet (*Madhura*), pungent (*Katu*), bitter (*Tikta*), & astringent (*Kashay*) tastes (*Rasa*); is hot in potency (*Veerya*); gives pungent (*Katu*) effect after metabolism (*Vipaka*); and possesses properties (*Guna*) like lightness (*Laghu*), dryness (*Ruksha*), & warmth (*Ushna*). With these properties, it eliminates *Kapha* & *Pitta* and exaggerates the *Vata*. It also easily and safely eliminates the body wastes (*Sukhavirechan*), and pacifies fever (*Jvarahar*).^[1, 4, 11]

Medicinal Uses:

In Ayurveda, root of *Trivrit* is used internally to treat fevers, anorexia, edema, anemia, ascites, constipation, hepato-splenomegaly, hepatitis, intoxication, abdominal tumors, ulcers, wounds, worm infestation, pruritus and other skin disorders.^[11] Root is also administered to treat obesity, haemorrhoids, cough, asthma,^[5] dyspepsia, flatulence, paralysis, gout, rheumatism, melancholia, scorpion sting, and snake bites.^[8] The paste of root powder of *Trivrit* is used topically to treat vitiligo & other skin disorders, alopecia, cervical lymphadenitis, haemorrhoids, fistulas, ulcers, & chancres.^[20- 21] Oil extracted from the root bark of *Trivrit* is used in skin diseases of a scaly

nature.^[19] A processed ghee with *Trivrit* or fresh juice of *Trivrit* leaves is dropped into the eyes to treat diseases like corneal opacity or ulcer and conjunctivitis. Root powder of *Trivrit* mixed with ghee and honey is also used to treat hematemesis, tuberculosis & herpes.^[1]

Ayurvedic Formulations:

There are at least 135 herbal and herbomineral formulations used in Ayurvedic medicine, which contain *Trivrit* as their vital ingredient.^[4] The concise list of commonly used formulations and their indications^[22-27] is given in Table 1.

Table 1
Common Ayurvedic Formulations of *Trivrit* with their Indications

Sr No.	Formulations	Indications / Uses
1	<i>Trivrit Avaleha</i>	GI disorders, hepato-splenomegaly, abdominal tumors
2	<i>Panchasama Churna</i>	Flatulence, constipation, anorexia, dysentery
3	<i>Alambushadi Yoga</i>	Ascites, edema, arthritis
4	<i>Malashodhak Churna</i>	Constipation, flatulence
5	<i>Avipattikar Churna</i>	Acid peptic disorder, constipation
6	<i>Abhayadi Modak</i>	Constipation, therapeutic purgative
7	<i>Agnimukh loha</i>	Anaemia, edema, haemorrhoids, & GI disorders
8	<i>Kalyanak Gud</i>	GI disorders, tumors, ascites, edema, & skin diseases
9	<i>Vyoshadi Gutika</i>	GI disorders, debility, vertigo, urinary disorders
10	<i>Narach Churna</i>	Ascites
11	<i>Sukhavirechak Churna</i>	Habitual constipation
12	<i>Tryushanadi Churna</i>	Abdominal tumor, chest pain
13	<i>Haridra Khanda</i>	Urticaria & other skin disorders
14	<i>Punarnavadi Mandoor</i>	Anaemia, ascites, edema, hepatosplenomegaly
15	<i>Mahamanjishthadi Kwath</i>	Skin disorders, Paralysis, Elephantiasis, wounds
16	<i>Trivritadi Kalka</i>	Worm infestation
17	<i>Kaishore Guggulu</i>	Musculoskeletal disorders, skin ailments, diabetes, wound, ascites
18	<i>Aragwadhadi Kwath</i>	Anticarcinative, laxative & colon cleanser
19	<i>Chandraprabha Vati</i>	Urinary & musculoskeletal disorders
20	<i>Ashwagandharishta</i>	Anxiety, stress, sexual or general debility
21	<i>Bharangyadi Kwath</i>	Flu, asthma, pneumonia
22	<i>Trivritadi Modak</i>	Respiratory disorders, backache
23	<i>Trivrit Arishta</i>	Abdominal tumor, edema, anaemia, & sprue
24	<i>Vachadi Lepa</i>	Topically for skin disorders, alopecia, lymphadenitis, & fistula
25	<i>Jambvadi Taila</i>	Topically for wounds and Gonorrhoea (genital ulcers)

Dosage as per Ayurveda:

For therapeutic purgation (viz. *Virechana*), maximum 10-12 gm paste of root bark of *Trivrit* is administered in the morning on empty stomach, along with fermented rice water or milk.^[28] This dose generally produces 10 to 30 loose motions

as a part of body cleansing.^[29] As a palliative therapy, 1-3 gm of drug is used in powder form.^[1] However, the dose needs to be individually tailored as severity of purgative action can vary from person to person and

overdosing may lead to serious complications.^[28]

Safety aspects, contraindications & precautions–

Trivrit should not be used in pregnancy, in children below 12 years of age, in elderly, in physically or mentally weaker persons, and in persons suffering from diarrhea, bleeding per rectum, rectal prolapse, or fecal incontinence.^[30] *Trivrit* may act as an abortifacient when used in pregnant ladies. Use in children or in physically or mentally weaker persons or overdose of *Trivrit* may lead to complications like excessive purgative activity, bleeding per rectum, vomiting, abdominal pain, chest pain, dehydration, hypotension, vertigo, confusion, shock, & unconsciousness.^[31]

TOXICITY STUDIES

In an acute toxicity study (Rajashekar M et al; 2006), healthy albino mice of either sex were divided into eight different groups of six animals each. Animals of the group 1 received acacia suspension (0.5 ml orally) while the animals of group 2 to 8 received suspension of root of *O. turpethum* at 10, 30, 100, 200, 400, 600, 800 mg/kg dose levels respectively. The animals were observed at 0, ½, 1, 2 and 4 hours after the administration for acute effect and mortality. The observation was continued for one week for the delayed effects and mortality. Results revealed that there were no treatment related deaths or any toxic effects in any of the groups.^[32]

In another acute toxicity study (S. V. Suresh Kumar et al; 2006), an ethanolic extract of *O. turpethum*, when administered in different groups of Wistar rats of either sex in doses ranging from 100-2000 mg/kg, produced no lethality in any of the groups. Also the extract did not produce any alterations in liver function markers like SGOT, SGPT, serum alkaline phosphatase and serum bilirubin.^[33]

PHARMACOLOGICAL ACTIVITIES

Antisecretory and Ulcer protective activity-

Rajashekar M., et.al. (2006) found that oral administration of *O. turpethum* and its polyherbal formulation *Avipattikar churna* is effective in reducing gastric acid content, gastric ulcer, hyperacidity & related GIT disturbances in albino rats.^[32]

Anti-inflammatory activity-

An experimental study was carried out (Rajashekar M et al; 2006) to evaluate the effect of oral administration of root powder of *O. turpethum* and its polyherbal formulation *Avipattikar churna* on rat paw edema in albino rats. Results indicated that pretreatment with the root powder of *O. turpethum* and *Avipattikara churna* (100 mg/kg body weight) reduced the formalin induced edema volume to the extent of 36.45% and 27.11% respectively.^[32]

Hepatoprotective activity -

In an experimental study (S. V. Suresh Kumar et al; 2006), effect of ethanolic extract of *O. turpethum* was assessed in paracetamol (PCM) induced hepatotoxicity in Wistar rats. PCM intoxication in normal rats elevated the serum levels of SGOT, SGPT, Alkaline phosphatase and bilirubin significantly, indicating acute centrilobular necrosis. The rats treated with ethanolic extract of *O. turpethum* showed a significant reduction in all four biochemical parameters which was comparable with that of silymarin. The histopathological profile of the rat treated with ethanolic extract showed no visible deteriorations confirming the safety of the extract at 200 mg /kg body weight.^[33]

In other three experimental studies (Vaidya Balendu Prakash et al; 2010), an Ayurvedic herbomineral formulation (i.e. *Prak-20*) containing *O. turpethum* root powder as one of its ingredients showed significant hepatoprotective activity against CCl₄ induced liver toxicity in Rats.^[34]

Antimicrobial activity -

Three compounds H-1 (β -sitosterol- β -D glucoside), H-2 (22, 23-dihydro- β -spinosteryl glucoside) & CH-2 (salicylic acid) isolated from the chloroform extract of stem of *Ipomoea turpethum* (Synonym- *O. turpethum*) and the crude extracts of the same plant prepared in petroleum ether, chloroform and ethyl acetate were screened (Md. Harun-or-Rashid et al; 2002) against thirteen pathogenic bacteria for their antibacterial activities. The minimum inhibitory concentration (MIC) of the isolated compound CH-2 was also measured against *Bacillus subtilis*, *Shigella dysenteriae*, *Sarcina lutea* and *Escherichia coli*. The values were found to be between 128 and 256 μ g/ml. In this investigation, crude extracts and isolated compound CH-2 of *O. turpethum* showed significant antibacterial activity but were less potent than that of standard kanamycin whereas compound H-1 & H-2 showed little activities. The results of this study justify the traditional use of this plant in the management of microbial infection.^[35]

Another study (M. Jahangir Alam et al; 2010) was done to evaluate the antibacterial activities of ethanol extract and petroleum ether extracts of *O. turpethum* leaves on two Gram positive (viz. *Bacillus subtilis*, *Streptococcus haemolytica*), and three Gram negative bacteria (viz. *Pseudomonas aeruginosa*, *Shigella sonnei* & *Shigella dysenteriae*). Antibacterial activity was tested by disc-diffusion method. Activity was compared with those of ampicillin, neomycin as positive control and with ethanol & petroleum ether as negative control. Findings revealed that ethanol extracts showed a significant inhibition against pathogenic bacteria while petroleum ether extract did not show significant zone of inhibition. The MIC value of extracts ranged from 0.13 to 0.75 mg / ml; ethanol extracts had lower MIC values than petroleum ether extract.^[19]

Anticancer and Antioxidant activities:

Antioxidant activity of methanolic extract of *O. turpethum* stems (100 mg/kg for 45 days) on 7,12 dimethylbenz(a)anthracene (DMBA) induced breast cancer was investigated in female

Sprague-Dawley rats (C. Anbuselvam et al; 2007). A significant increase in lipid peroxidation levels were observed in tested samples of cancer induced rats while the activities of enzymatic antioxidants such as Superoxide dismutase, catalase, glutathione peroxidase and nonenzymatic antioxidants like glutathione, ascorbic acid and alpha tocopherol were decreased in cancer bearing animals when compared to controlled animals. A significant (P- 0.05) increase in breast tumor weight was observed in DMBA group while breast tumor weight decreased significantly in combination of DMBA and *O. turpethum* extract group. Investigators of this experiment recommended the use of the bioactive compounds from *O. turpethum* as a supplementary to anticancer medicines.^[36]

Cytotoxic activity -

Alluri V. Krishnarajua et al (2005) carried out Brine shrimp (*Artemia salina*) lethality bioassay to investigate the cytotoxicity of aqueous extract of *O. turpethum*. The extract showed moderate brine shrimp lethality and the LC 50 value was found to be 81 (lower than 100). This significant lethality is an indicative of the presence of potent cytotoxic components in the herb which merit further investigation for its antitumor activity.^[37]

In another study (Md. Harun-or-Rashid et al; 2002), the cytotoxic activity of the crude, chloroform and ethyl acetate extracts of *Ipomoea turpethum* and its isolated compound CH-2 was determined by the Brine shrimp lethality bioassay. The LC50 values of these substances were found to be 56.23, 199.53 and 31.62 μ g/ml, respectively. Ethyl acetate extract was found to be much more cytotoxic than chloroform extract. The cytotoxic action of a drug was exhibited by disturbing the fundamental mechanisms concerned with cell growth, mitotic activity, differentiation and function. Although the exact mechanism of cytotoxic action of these extracts could not be explained by the study, the results indicate that

the *Ipomoea turpethum* extract may be a potential chemotherapeutic agent.^[35]

CLINICAL TRIALS

Some open label clinical studies have reported laxative, anti-inflammatory, analgesic, anti-arthritic and anti-helminthic effects of root powder of *O. turpethum*.^[38-40] However, authors of this review could not trace electronically published randomized comparative clinical trial on the herb.

In an open, uncontrolled clinical study (Shailej Gupta; 2009), powder of *Trivrit* roots administered as a single dose of 30 gm with fermented rice water (*Kanji*) for *Virechana* procedure produced strong purgation in 30 patients of *Amavata* i.e. Rheumatoid Arthritis. This purificatory procedure produced statistically significant improvement in the subjective parameters like joint pain, stiffness, swelling, tenderness, and in global assessment for overall improvement. Also there was a statistically significant reduction in the ESR values in the study patients.^[38] However it should be noted that *Virechana* with *Trivrit* powder can't be recommended for each and every patient of Rheumatoid arthritis as there are number of contraindications for the procedure. Many patients may not tolerate one time dose of 30 Gms *Trivrit* powder. Shyju Ollakkod (2004) evaluated the effect of '*Alambushadi Yoga*' (polyherbal formulation having *Trivrit* as its main ingredient) in 27 subjects of Rheumatoid arthritis (RA). Subjects were equally divided in three groups. Subjects from group A received oral *Alambushadi yoga*, subjects from group B received *Dhanyamla Kayaseka* (fomentation with fermented cereal water) while subjects from group C received combination of oral *Alambushadi yoga* & *Dhanyamla Kayaseka* for 21 days. The complete remission in the symptoms of RA was registered in 3 patients from group C, in 2 patients from group B and in 1 patient from group A. Good response in symptoms of RA was noted in seven patients from group A, in five patients from group B and in four patients from group C. Moderate response in the symptoms of RA was noted in one patient in group A, two patients each in group B

and group C. No major side effects were reported in any subjects during the period of this study.^[39]

In a clinical study (Nusrat Parveen et al; 2004), administration of Unani Remedy- '*Qurs Deedan*' (having *Ipomoea turpethum* as its main ingredient) in a dose of two tablets daily at bedtime for 30 days in patients of ascariasis caused clearance of *A. lumbricoides* ova from the stool samples and relief from clinical signs & symptoms of worm infestation in most of the patients.^[40]

CONCLUSION

Trivrit (*O. turpethum*) is an important medicinal plant, which is safely & effectively used to treat various disorders in Ayurvedic system of Medicine since centuries. Few toxicity studies done in rodents have confirmed the safety of both crude powder and extract of *O. turpethum*. There are preliminary reports of antisecretory, ulcer protective, anti-inflammatory, hepatoprotective, antibacterial, anticancer, & cytotoxic activities of the herb. Though few clinical studies have reported efficacy and safety of *Trivrit* in some patients of rheumatoid arthritis and ascariasis, there is a need of randomised, controlled clinical studies to confirm its efficacy and safety. Such evidence is needed to provide scientific credence to the folklore use of traditional Ayurvedic medicines like *Trivrit* and even be helpful in the development of future drugs or treatment modalities for diseases like rheumatoid arthritis and cancer. As the *O. turpethum* is endangered, a prompt attention needs to be given to protect the plant from extinction.

ACKNOWLEDGEMENTS

The Authors sincerely thank Dr. Gajanan Pawar (Lecturer, Dept. of *Dravyaguna*, Dr. D. Y. Patil Ayurvedic Medical College, Navi Mumbai) for his kind help in providing few references.

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