



PHYTOCHEMISTRY AND PHARMACOLOGICAL POTENTIAL OF *OPERCULINA TURPETHUM*

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Abstract

Operculina turpethum belongs to family Convolvulaceae found throughout India at an altitude of about 1000 m and commercially cultivated in Ceylon, tropical America, Mauritius, Philippines, Africa tropical region and Australia. The bark and root of the *Operculina turpethum* is wealthy in resins consisting of turpethin, turpethinic acids, albumin, volatile oil, salts of lignin, starch, betulin, scopoleptin, beta- sitosterol, lupiol, turpethosides A, B and also contain dammarane-type saponins *i.e.* operculinosides A, B, C, D etc. The plant posses numerous medicinal property such as anti-diabetic activity, anti-inflammatory activity, antisecretory and ulcer protective activity, hepatoprotective activity, hyperlipidemic activity, antimicrobial activity, anticancer activity, analgesic activity, Immuno-modulatory activity, anti-hemolytic activity, anti arthritic activity, antioxidant activity, antidiarrhoeal, antispasmodic, bronchodilator activity, laxative activity, larvacidal activity etc. The plant is an ingredient of various polyherbal formulations. The current review article is an effort to provide comprehensive information on chemical and pharmacological profile of the plant.

Key words : *Operculina turpethum*, Pytoconstituents, Pharmacological activity, Polyherbal formulations.

Introduction

The pytoconstituents extracted from medicinal plants plays vital role for curing the several disease (Choudhary and Bassi, 2015; Choudhary *et al.*, 2012; Saleem *et al.*, 2008). Moreover, the major challenge is lack of documented evidence and quality control parameters which affects the use of herbal formulations across the globe. However, there was need to record all the scientific findings available on herbal medicines in order to develop documented evidence (Wang *et al.*, 2016). The genus *Operculina* is one of the main genera of family Convolvulaceae which comprises of 15 species all over the world. The most common species of the genus *Operculina i.e.* *Operculina aequisejala*, *Operculina brownii*, *Operculina hamiltonii*, *Operculina pinnatifida*, *Operculina pteripes* and *Operculina*

turpethum. Out of 15 species only *Operculina turpethum* is available in India (Fischer, 2002).

Operculina turpethum (Convolvulaceae) is widely spread across the globe that contains various bioactive constituents helpful in treatment of various diseases (Sharma and Singh, 2012; Narayana, 1992). This review article is an attempt to categorize the different bioactive compounds and to explore the therapeutic activity of the plant.

Biological source

It is obtained from the root and stem of the plant of *Operculina turpethum* belonging to Family- Convolvulaceae (Ayurvedic Pharmacopeia of India).

Description

The plant commonly known as Nisoth, secretes a white juice on incision, roots are fleshy having long stems

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that are winged and angle in shape. The leaves were simple, both sides pubescent uneven shape, truncate or cordate having width 3.7 and 5-10 cm length. The flowers are white, campanulate, long sepals, sepals covers the globose capsules (Kohli *et al.*, 2010). The picture of the plant was mentioned in Fig. 1, 2 and 3.



Fig. 1: Leaves of the plant *Operculina turpethum*.

Fig. 2: Flower of the plant *Operculina turpethum*.



Fig. 3: Stems and roots of the plant *Operculina turpethum*.

Taxonomical Classification (Simoes *et al.*, 2019; Sharma and Singh, 2012)

Kingdom: Plantae

Subkingdom: Tracheobionata

Super division: Spermatophyta

Division: Angiosperm

Class: Dicotyledons

Order: Solanales

Family: Convolvulaceae

Genus: *Operculina*

Species: *Operculina turpethum* (Linn.)

Vernacular Names- (Ayurvedic Pharmacopeia of India.)

Sanskrit: Syama, Tribhandi

Bengali: Dhdhakalami, Tvuri, Teudi

English: Indian Jalap, Terpeth Root

Guajarati: Nasottara Kala

Hindi: Nisoth

Malayam: Trikolpokanna

Tamil: Karum Sivada

Kannad: Tigade Vili

Telgu: Tella, Tegada

Oriya : Dudholomo

Marathi: Nisottar

Punjabi: Nisoth

Urdu: Turbud, Nishoth

Phytochemistry

The plant aerial parts contain turpethosides A, B glycosidal resin and acid glycosides turpethic acids A-C, (Ding *et al.*, 2012). Four new dammarane-type saponins separated from plant roots are operculinosides A, B, C, D (Ding *et al.*, 2011).

The various new triterpenoids and steroidal esters were separated from root methanolic extract of plant are $3\alpha,7\alpha$ -epoxy lanost-5,25-dien- 3β -ol, lanost-5,25-dien- 3α -ol, 4β -hydroxy- $3\alpha,7\alpha$ -epoxy stigmast-(Z)-5,22-dien- 3β -tetradecanoate, $3\alpha,7\alpha$ -epoxy stigmast-5,20-dien- 3β -hexadecanoate, 12β -hydroxy- $3\alpha,7\alpha$ -epoxy lanost-(Z)-5,20,22-trien-26-oic acid- 3β -tetradecanoate and $3\alpha,7\alpha$ -epoxy stigmast-(Z)-5,20,22-trien-28-oic acid- 3β -hexadecanoate (Shuaib, M *et al.*, 2013). The Stigma 5,22 dien 3 O- β -D-Glucopyranoside obtained from alcoholic extract from the roots of the plant (Sharma and Singh, 2014).

The roots of the plant contains various bioactive compounds such as β -sitosterol, Scopoletin, Betulin, Cycloartenol, Lanosta-5-ene, Coumarin, acrylamide 3-(4-hydroxy-phenyl)-N-[2-(4-hydroxy-phenyl)-ethyl] and salicylic acid (Gupta and Ved, 2017; Gomes *et al.*, 2011). The various structure of the plant was mentioned in figure 4 and classification of secondary metabolites in Fig. 5.

Pharmacological activity

Antidiabetic activity

The stem and root methanolic extract of plant was analyzed using Streptozotocin induced type- II diabetic models at a dose 100 mg/kg for 21 days. The plant extract significantly reduce the fasting blood sugar levels (Pulipaka *et al.*, 2012).

The chronic treatment of the aqueous plant extract of at 500 mg/kg *concentration* showed positive effect in diabetic animals with significant reduces blood sugar level, serum nitrite; brain homogenate nitrite & nerve homogenate nitrite levels when analyzed by STZ induced diabetic neuropathy (Solanki Nilay D, 2016; Raut *et al.*, 2014).

Anti-inflammatory activity

The oral administration of herbal formulation Avipattikar churna at 100 mg/kg concentration significantly decrease rat paw edema induced by formalin by 36.45% (Bhande *et al.*, 2006).

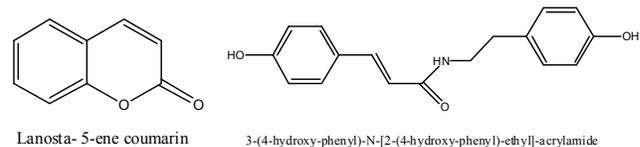
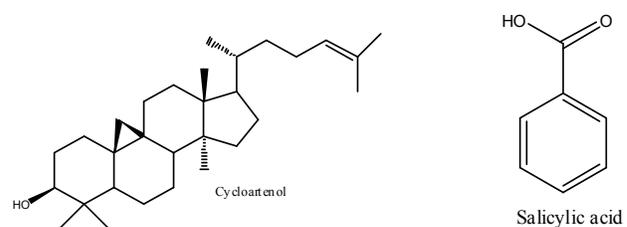
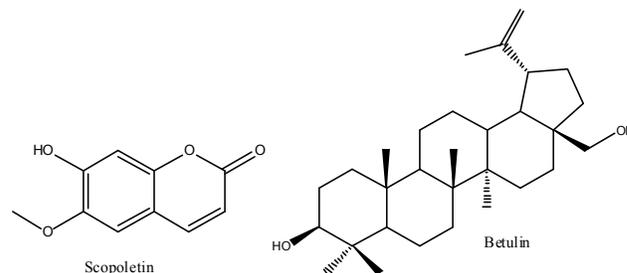
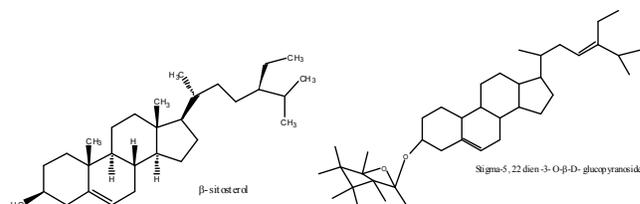
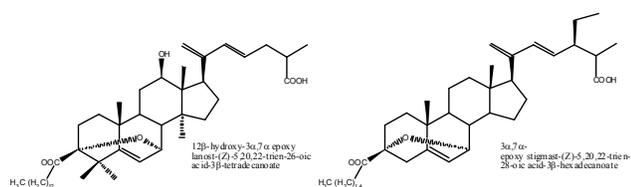
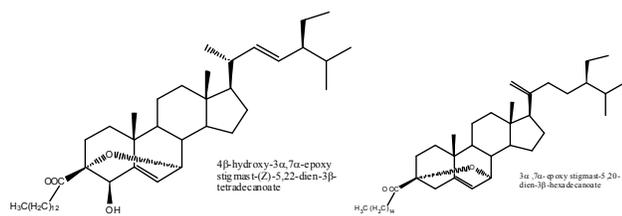
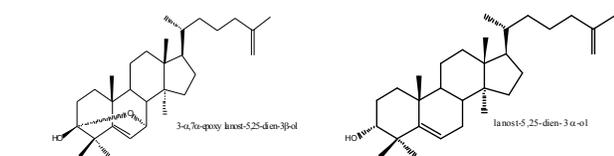
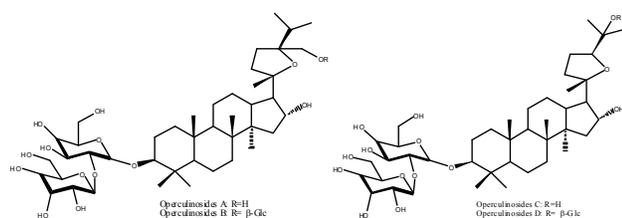
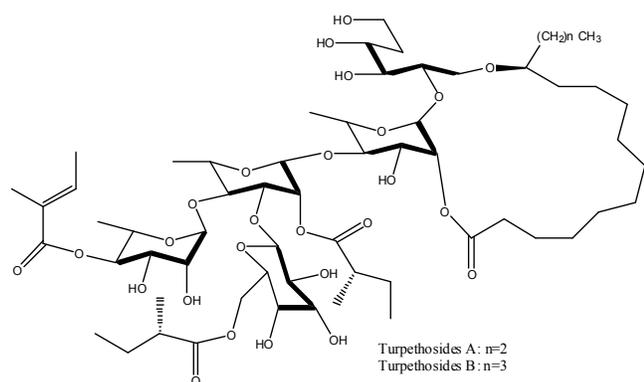
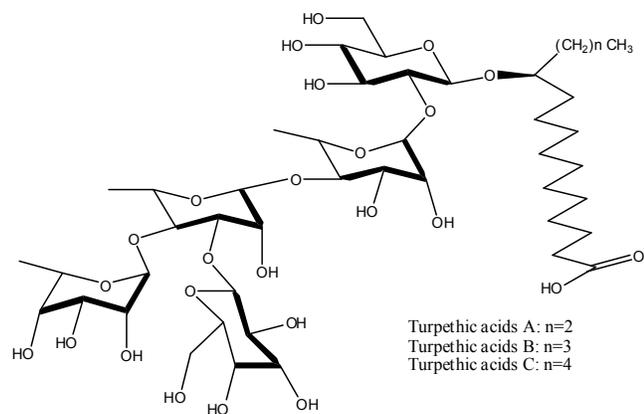


Fig. 4: Represents the various structures obtained from the plant.

Anti-ulcer activity

The herbal formulation Avipattikar churna oral administration in rats decreases the hyperacidity, gastric ulcer, gastric acid content, GIT disturbances (Bhande *et al.*, 2006). The stem bark methanolic and hydroalcoholic extract at 100 mg/kg concentration in rats exhibits antiulcer property using pylorus ligation. Moreover, the hydroalcoholic extract was found to be more potent than methanolic extract (Ignatius *et al.*, 2013). The plant poses anti-ulcer activity at 100 mg/kg concentration in rats using pylorus ligated model (Nitin *et al.*, 2012).

Hepatoprotective activity

The plant ethanolic extract at 100 and 200 mg/kg concentration in rats exhibits hepatoprotective effect when analyzed by paracetamol induced hepatotoxicity model (Suresh Kumar *et al.*, 2006) and toxicity in liver induce by carbon tetrachloride (Kohli *et al.*, 2010; V.A. *et al.*, 2011). The plant hydro alcoholic extract at 200mg/kg and 400 mg/concentration showed potent hepatoprotective property thereby decreasing the injury of liver by D-galactosamine induced hepatotoxicity in rats

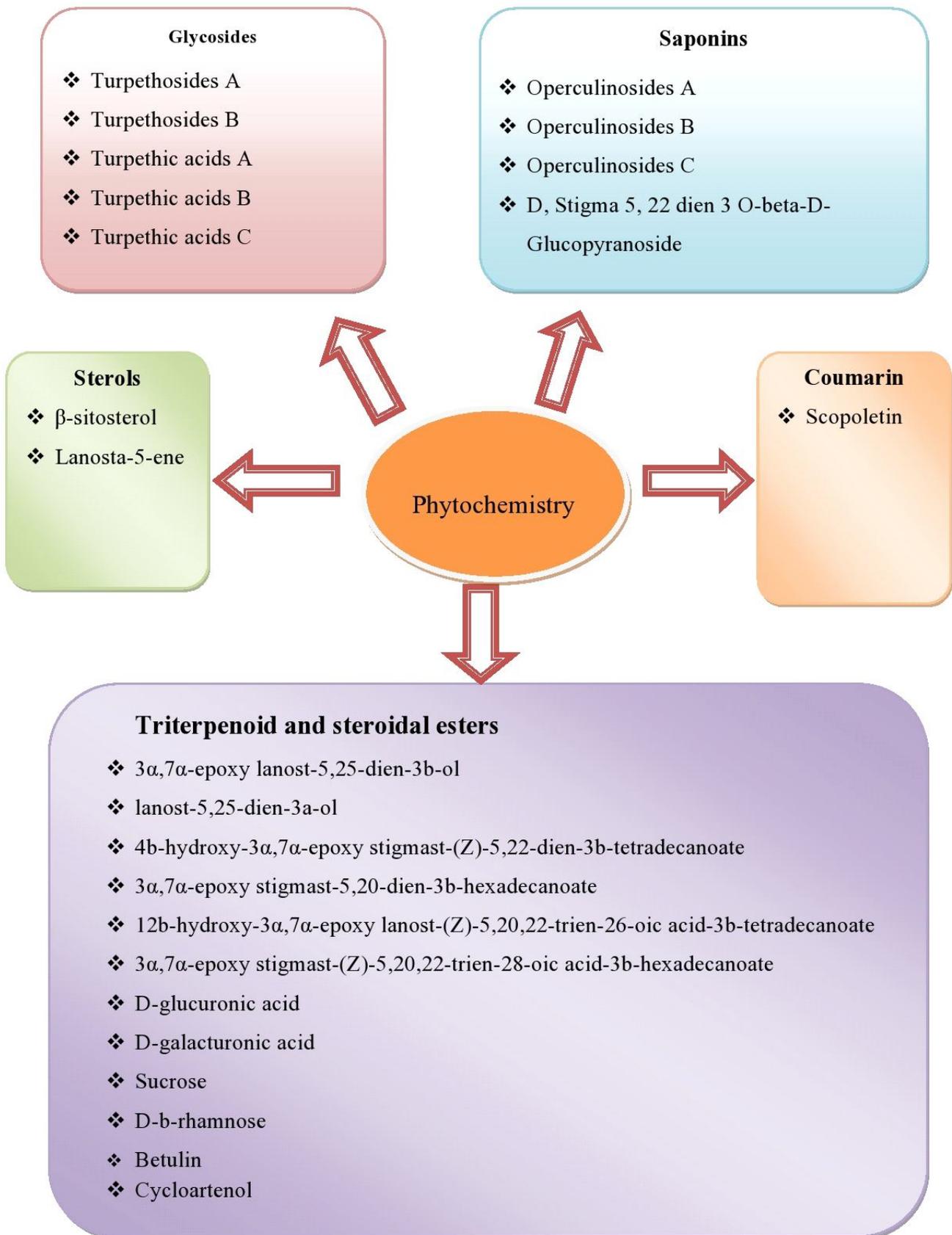


Fig. 5: Represents the classification of various secondary metabolites.

(Arka *et al.*, 2015; Vunta Prabhakaran and Diviti Ranganayakulu, 2014). The ethanolic plant extract at 400 mg/kg concentration in mice exhibits significant recovery in N-Nitrosodimethylamine anticlastogenic property and hepatoprotective property against NDMA-induced liver fibrosis in wistar rats (Sharma and Singh, 2012; Ahmad *et al.*, 2009).

Hyperlipidemic activity

Aqueous plant extracts showed significant inhibitory effects against lipase enzyme which suggests that these herbs could be candidate for anti-obesity drug (Chethana, G. and K.R. Hari Venkatesh 2013). The n-hexane, ethyl acetate and aqueous extract at 25, 50, 75, 100 μ g/ml concentration represents 44.26%, 53.27% and 63.11% lipase inhibition respectively whereas ethanol extract showed potent inhibition of 85.24% (Jayshree, 2014; Tamizh, M. and D. Nagavall 2016). The clinical reports represents that plant decreases the serum triglycerides and cholesterol level (Talekar *et al.*, 2018; Verma and Paraidathathu, 2014).

Antimicrobial activity

The ethanolic leaves extract found to be effective against *Streptococcus haemolytica*, *Bacillus subtilis*, *Shigella sonnei*, *Pseudomonas aeruginosa* and *Shigella dysenteria* by disc-diffusion method when estimated for antibacterial activity (Alam *et al.*, 2010; Haque *et al.*, 2000).

Aqueous extract of *Operculina turpethum* root at a dose of 50 μ l/ml was evaluated against *Enterobacter aerogenes*, *E. coli*, *S. aureus*, *Klebsiella oxytoca*, *Bacillus cereus* and *Proteus vulgaris* by agar cup diffusion method (Kiran B., 2017). The ethanol, ether and chloroform of root was evaluated against *Shigella flese*, *Shigella boydii*, *Shigella dysenteriae*, *Proteus vulgaris*, *Escherichia coli*, *Enterococcus faecalis*, *Hafnia alvei*, *Staphylococcus epidermidis*, *Salmonella typhi*, *Staphylococcus aureus* and *Streptococcus pyogenes* by macro-dilution assay and disc diffusion method (Ahmed and Howlader, 2013; Rathnan *et al.*, 2012). The plant posses antimicrobial property against *Staphylococcus aureus*, *Shigella dysenteriae*, *Bacillus subtilis*, *Micrococcus pyogenes*, *Streptococcus haemolytica*, *Enterococcus faecalis*, *Micrococcus luteus*, *Shigella sonnei*, *Salmonella typhi*, *E. coli*, and *Pseudomonas aeruginosa* (Shuaib *et al.*, 2013; Ahmad *et al.*, 2013). The isolated phytoconstituents salicylic acid and 22, 23-dihydro- α -spinosteryl glucoside, β -sitosteryl- β -D glucoside from chloroform stem extract have shown antibacterial property (Md. Harun *et al.*, 2002). The methanolic and ethanolic extract of the plant at different

concentrations of 500, 1000, 1500 and 2000 ppm posse's antibacterial activity against *Klebsiella oxytoca*, *Proteus vulgaris*, *E.coli*, *Staphylococcus aureus*, *Enterobacter aerogenes* and *Bacillus cereus* (Kiran B. and N and Padmini, 2018).

Anticancer activity

The aqueous plant extract was evaluated for lethality bioassay in Brine shrimp to explore anticancer potential. The extract exhibits LC 50 value 81. (Pourfraidon and Sharma, 2009; Krishnaraju *et al.*, 2005; Meyer B.N. *et al.*, 1982). The hydro-methanolic extract of plant inhibits the COX-2, NF- κ B, D1 Cyclin and upregulation expression of p53 in OSCC cells (Arora *et al.*, 2017).

The Methanolic extract of plant evaluated in SD Rats using dimethylbenz anthracene induced breast cancer model. The result indicates that the extract retrieved levels of Catalase, Glutathione Peroxidase, Superoxide Dismutase, Ascorbic acid, alpha-tocopherol, Glutathione decrease the peroxidation of lipids and weight of tumor (Anbuselvam *et al.*, 2007). The isolated compound Stigma-5-22 dien-3-O- β -D-glucopyranoside showed anticancer potential in albino mice (Sharma and Singh, 2014).

Analgesic activity

The chloroform extracts of *Operculina turpethum* showed the analgesic activity in mice using tail immersion and writhing induced by acetic acid model (Prabhavathi *et al.*, 2012). The alcoholic plant root extract at 250, 300 and 350 mg/kg concentration exhibits analgesic activity using hot plate, writhing induce by acetic acid, tail flick and formalin method alongside antipyretic activity in Swiss albino mice (Nazrul Islam, 2016; Ezeja *et al.*, 2015; Veena S. and M. Singh, 2013).

Immunomodulatory activity

The isolated compound Formonoetin-7-O- β -Dglucopyranoside at the doses of 10, 20, 40, 50 mg/kg, p. o. evaluated for immunomodulatory potential by the Neutrophil adhesion test, phagocytic activity, delayed type hypersensitivity response and antibody titre. The compound amplifies the adhesion of neutrophil to fibers of nylon in concentration dependent manner and exhibits phagocytic activity (Tamizhmozhi and Nagavalli, 2017).

Anti-hemolytic activity

The plant ethanolic extract prevents erythrocytes haemolysis due to its stabilization of membrane potential evaluated against *in-vitro* hypotonic and heat lysis of erythrocytes (Sharma and Singh, 2013).

Anti arthritic activity

The plant extract capable of managing the auto

antigen production and also prevents the protein denaturation in comparison to standard Diclofenac at concentration of 1000 $\mu\text{g/ml}$ (Sharma and Singh, 2013). The isolated compound Formonoetin-7-O- β -D-glucopyranoside from plant methanolic extract was analyzed for anti-arthritic potential by foot pat thickness, body weight measurement, rheumatoid factor, spleen index score assessment and hematological estimation for arthritis in rats using a model Freund's Adjuvant model. The compound holds anti arthritic property by modulating bone erosion (Tamizmozhi and Nagavalli, 2017). The decoction of polyherbal formulation exhibit significant recovery in rheumatoid arthritis symptoms (Islam *et al.*, 2015).

Antioxidant activity

The whole plant methanolic extracts at 100 $\mu\text{g/ml}$ concentration analyzed by DPPH assay, ferric reducing power assay, nitric oxide free radical scavenging, photometric assay and scavenging effect on the OH radical (Santhosh, 2017; Pulipaka, 2013).

The ethanolic root extract at 1 mg/ml concentration posses antioxidant activities when evaluated by as determined by scavenging effect on the OH radical, reducing power, FRAP and superoxide assay (Singh, 2015).

Antidiarrhoeal, antispasmodic and bronchodilator activity

The ethanolic plant extract exhibits bronchodilator, antispasmodic and antidiarrhoeal activity (Shareef *et al.*, 2014; Sujatha *et al.*, 2010). The plant at different concentrations of 300 to 1000 mg/kg posses antidiarrhoeal activity against diarrhea cause by castor oil model (Shareef *et al.*, 2014)

Laxative Activity

The plant exhibits significant *in-vivo* laxative activity against enter pooling, intestinal motility and fiscal consistency model (Onoja *et al.*, 2015).

Larvacidal activity

The pet ether, acetone plant extracts showed mosquito larvicidal potential against *Anopheles stephensi* malarial vector (Bhattacharya and Chandra, 2015).

Antinephrotoxic activity

The isolated compound stigma 5,22 dien 3 O β D glucopyranoside separated from alcoholic root fraction when administrated at 50 and 400 mg/kg concentration in mice cause potent reduction of hepatopathy and nephrotoxicity (Sharma, V. and M. Singh 2014).

Acute toxicity

The ethanolic extract of the plant exhibits safer effects at 2000 mg/kg concentration in rats and no alterations was found in liver function markers such as serum glutamic pyruvic transaminase, bilirubin, transaminase, glutamic oxaloacetic and alkaline phosphates (Carpejane *et al.*, 2016; Suresh Kumar *et al.*, 2006).

The suspension of the root did not produce any toxicity when administered for one week at different doses of 10, 30, 100, 200, 400, 600, and 800 mg/kg (Bhande *et al.*, 2006). The LD50 of plant methanolic extract in mice was reported as 1917.66 mg/kg (Gupta and Ved, 2017). The LD 50 of root ethanolic extract was safe at 5 gm/kg concentration in mice (Mohammad Abu Bin Nyeem *et al.*, 2016).

Poly Herbal formulations

The various marketed formulations contain *Operculina turpethum* as ingredients and are used in treatment of various ailments. The various formulations include Arthcure Capsule effective in arthritis (Choudhary *et al.*, 2015), Saraswata ghrita in anti-dementing activity (O.A. and J.S., 2013), Deedan (Unani) in worm infestation (Dar *et al.*, 2015), Vranashodana Taila in wound healing (Vijaya Kumari and Nishteswar, 2011), Tekshan Virechana churna, Avipattikar Churna, Panchsam churna, and Sukha Virechana churna in treatment of constipation (Borhade *et al.*, 2013). However they are various formulations which are evaluated using various animal models so these formulations are mentioned in table 1.

Conclusion and Future Perspectives

There is an effort to provide comprehensive information as per the available literature on several pytoconstituents such as saponin, glycosides, sterols, coumarins, triterpenoidal and steroidal esters which are responsible for the therapeutic activity of the plant that are responsible to produce desired pharmacological action against anti-diabetic activity, anti-inflammatory activity, antisecretory and ulcer protective activity, hepatoprotective activity, hyperlipidemic activity, antimicrobial activity, anticancer activity, analgesic activity, Immuno-modulatory activity, anti-hemolytic activity, anti arthritic activity, antioxidant activity, antidiarrhoeal, antispasmodic, bronchodilator activity, laxative activity and larvacidal activity. However, there is a scope in the plant that can be further explored regarding the separation of various fractions of secondary metabolites and evaluation of their acute toxicity profile and pharmacological activity.

Table 1: Represents various formulation of *Operculina turpethum* evaluated using various animal models.

S.No	Brand Name	Dose	Model	Indications	References
1.	Sivathai Chooranam	3.024mg/kg, p.o,	Carrageenan- induced localized inflammation in wistar rats	Anti-inflammatory activity	(Janakiram A, 2019)
2.	Brahmi Ghrita	12 gm/kg, p.o	Evaluating changes in TNF and IL10 inflammatory markers	Alzheimer's disease	(Tripathi , R, Tripathi, 2019)
3.	Dashmularishta	500, 1000 and 2000 mg/kg, p.o	ABTS free radical scavenging assay (antioxidant), Swim endurance and DNA super coiling assay (antifatigue), Mouse Splenocytes and YAC-1 based assay (Immunostimulatory)	Antioxidant, Immunostimulatory and Anti-fatigue property	(Gupta <i>et al.</i> , 2018)
4	Majoon Najah	260 mg/kg, p.o	Increased Current Electroshock Seizure in mice	anticonvulsant activity anticonvulsant activity	(Afrin <i>et al.</i> , 2019)
5.	Chandraprabha Batika	40 mg/kg body, p.o	Thyroid Hormone Profile in SD rats	Increase in Thyroid Hormone	(Md. Hasif Sinha <i>et al.</i> , 2019)

Conflicts of interest

All authors declare no conflicts of interest.

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