Journal of Advances and Scholarly Researches in Allied Education
Vol. XIV, Issue No. 3, (Special Issue) February-2018, ISSN 2230-7540

A Study on Bioactive Components and Pharmaceutical Proprietors. Operculina Turpethum (Linn.)

Pramod Kumar Sharma*

Professor & PVC, Department of Pharmacy, Galgotias University, Greater Noida, Uttar Pradesh, India

Abstract – The genus Convolvulaceae (Linn.) refers to Silva Manso (OT). The study covers phytochemical and pharmaceutical profile literature from the OT herbs. A thorough literary analysis was carried out using all the available information on OT phytochemistry and pharmacology. The plant was found to be a powerful source of bioactive compounds, such as α- and β-turpethein, turpethinic acids (A, B, C, D and E), coumarins, cycloartenols, lanota-5-enes,24-methylen-to-lanosterol, alpha and rhamnose, β-sitosterol, lupeol, scopoletin, Betolin, acrylamide, stigma-5,22dien-3-o-β-D-glucoide (H-1). Four new dammaranes, operculinosides A–D (1–4), which had special hepatoprotective activity are extracted from the aerial sections of OT. It has been documented that all the compounds have pharmacological properties such as antibacterial, analgesic, anti-arthritis, anti-inflammatory, anti-inflammatory and biopsy.

Key Words – Convolvulaceae, Operculina Turpethum, Operculinosides, Turpethinic Acids

- ***X*** -

1. INTRODUCTION

Terpethyl Operculina (Linn). Linn (OT) Because of its triangular shape, often referred to as Tihudi/Trivrit. The names of Indian Jalap/Turpeth root in English, Nisoth-Turpeth-Panila-Pithori in Hindi, Sanskript Trivrit, Telugu Tegada, Malayalam Trikolpakkonna/Triputa-Sivata, Kannada Tigate and Tamil Kumbham/Sivatai are also identified. It is typically present on the roadsides in India and often grown into gardens as ornamental trees up to 1,000 square metres. Rands are also present in tropical regions such as India, the US, Pakistan, China, the Philippines, Bangladesh, Madagascar, Mauritania and Africa. Randomly available is the range of this herb.

The plant's root bark produces an insoluble glycoside turpethein resin. It includes also certain secondary metabolites, which include saponins, flavonoids, glycosides and phenolics as well as a certain volume of fat, glucose and fructose. Resins, turpetheins, glycosides, sopoletins, saponins, sperm, hydrocarbons and steroids are the OT chemical elements. Chemical compounds There are several plant-based substances, including gycosidic resin, cumarin, beta sitoterol, sugar removal and essential oils, which help to treat different diseases or disorders.

It's also used as a powerful therapeutic herb for many medical purposes. In the Ayurvedic method of medicine, The root and seed of this plant normally occurs in skin illness, such as cervical lymphadenitis, fistulas, constipation, lengthened gout, fever, bronchitis, bronchitis, ulcers, haemorrhoids and other disorders, such as tumours, obesity, jaundice, and herpes and tears. Rhumatism, blowing, paralysis, scorpion bite, and serpent assault were also demonstrated by root powder. It also has been found that root powder is effective to cure hematemasis, herpes

and tuberculosis, and fresh juice is used to treat corneal opacity and conjunctivitis. The churna is an essential Ayurvedic formula for Trivrit, used mainly in stomach and intestinal disorders (OT).

As in the "ten purging herbs" category, which endorse a medicinal enema, ten herbs antimicrobial have been included in the Ayurvedic scheme, in the toxin-excision herb group, and in the colon-cleansing, anticancer and antidiotic herb group. As a vegetable are the young leaves and stem of the herb. The stem's antimicrobial function was also investigated.

2. GROWTH AND DISTRIBUTION

There are two types of trivrites (the botanical word is OT-Silva-Manso) classified as Shweta or white turpet or Krishna or Black Turpet (the botanical name is Ipomoea petaloidea Chois). OT is growing in India at an altitude of 900 metres. It is native to the whole of Australia and is spread throughout (NWT, Queensland), India and Asia Trogyne (Chinas: Guangdo Guangdo-Napoleon) and Asia Temperate native or dispersed across Australia (North Territory and Queensland); Africa Tanzania, Mozambique and Southern China (Kenya, Tanzania). Spruce is also a herb that is native throughout Australia and scattered across Australia (NWT, Queensland); (West Indies).

3. PHYTOCHEMICAL PROFILE

OT (Trivrit) contained turpethinic acid (A, B, C, D, and E), which were isolated from plants' resins, in a large quantity and included several bioactives such as albumin, lignin salt, volatile oil, starch, ferric oxide, lupeol and α- and β-turpethein, fructose, β-sitosterol, scopoletin [Figure 1], Mhaskar et al. and Rastogi et al. reported that OT (Trivrit).

Some triterpenenes, such as cycloartenol [Fig. 4], lanosta-5-ene, 24-methylene-tre-5-lanosterol and Turpethosides, have also been extracted from the roots of OT. Other isolations were found in this region. Antiviral, antibacterial, antitumor, antiseptic, diuretic and analgesic actions have been confirmed to be therapeutically.

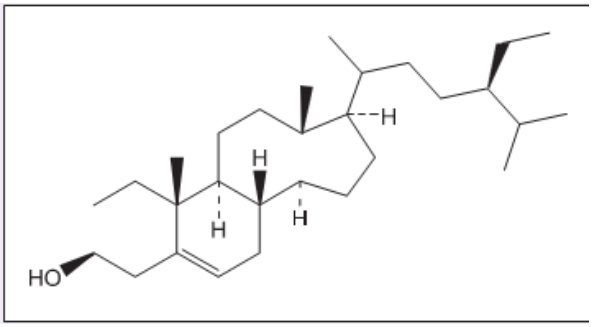

Figure 1: β-sitosterol

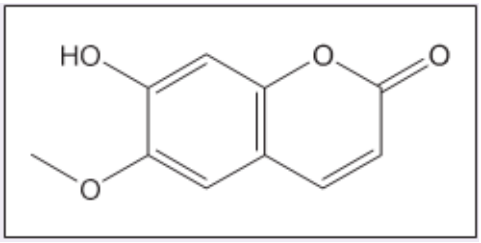

Figure 2: scopoletin

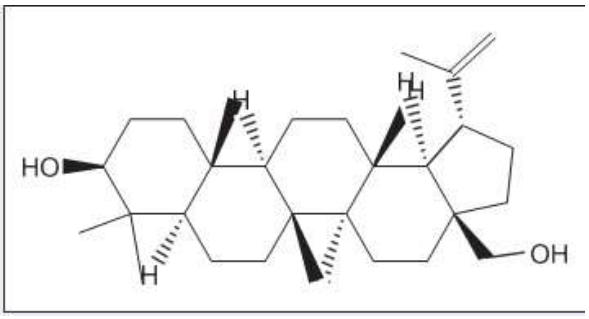

Figure 3: betulin

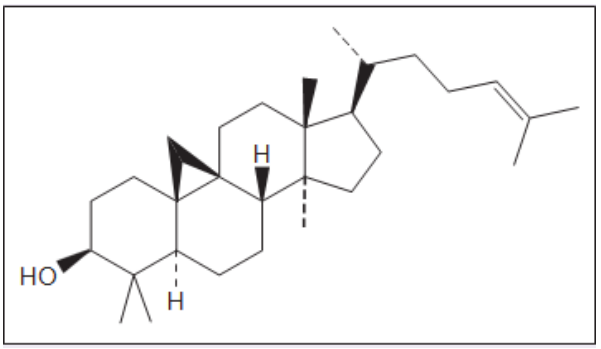

Figure 4: cycloarteno

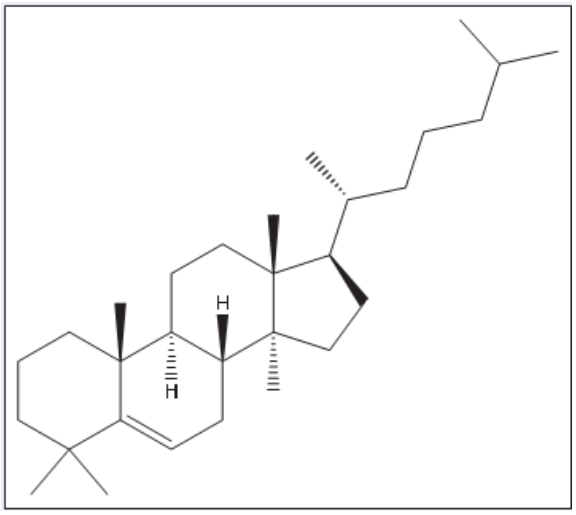

Figure 5: lanosta-5-ene

The root bark often includes about 10% turpethein, a compound similar to Jalapine and Convolvulin, of the overall plant constituents. Trivrit's laxative effect is attributed primarily to turpethein, which is insoluble in alcoholic and ether, benzene, essential oils and carbon sulphide. Turpethein is converted into turpetholic acid, glucose and fructose when used with hydrochloric acid and turned into turpetheic acid when processed with alkaline base. The leaf of the plant is abundantly flavonoid, heart glycoside and terpénoid secondary metabolites. Roots include bitter, acrylic, sweet, hydrogenic, analgesic, purgative, carminative, anti-pyretic, expectorant, hepatic, stimulant and hydragogogue.

In 2013a, Veena and Manu reported that certain phenolic compounds, such as tannins, are strong inhibitors of several hydrolytic enzymes, including proteolytic enzymes from plant pathology.

Some plants produce non-toxic glycosides that could be hydrolysis toxic to microbial pathogens to transform to phenolics.

In 2016, Jalai and Madhavan carried out an analysis of the identification & quantification by high-performance liquid chromatography (HPLC) of the phenolic compounds present on methane leaf extract, thus estimating total phenol (1,89 mg/mL) or flavonic leaven content (1,0 mg/mL) according to normal processes in methane leaf and stem extract. In 2010 Huang et al. identified antioxidant, anticarcinogenic and anti-inflammatory properties of natural phenolic compounds.

In 1999, Attele et al. and in 2013, Veena and Manu confirmed that the plant produces glycoside saponins & is responsible for a broad range of medicamental benefits, including antiallergic, analgesic, antiinflammatory, antidiabetic, bactericidal, antifungal and cytotoxic. The existence of antimicrobial activity of OT saponins against several micro-organisms was documented by Gopish and Kannabiran in 2008.

In 2013 Arif et alqualitative .'s phytochemical screening for various phytochemicals in the various OT extracts was carried out. They said that OT's ethanol root extracts are carbohydrates, steroids, flavonoids, and saponins; carbohydrates, steroids, gum, flavonoids, and saponins are contained in OT etheral, and in OT chloroninal extracts; and the ethanol, ether and chloroform leaf extracts contain carobhydrates, gums, flavonoids, tannins, alkalin, sugar reducing products and saponins.

Phytochemical elements, such as flavonoids, alkaloids, tannins and other aromatic compounds on this world are defence factors against various bacterial and fungal infections. Doss et al. investigated in 2009 and, in 2011a, and Doss et al. confirmed in 2011b that their capacity to complex with cell-walls of bacteria and complex with extracellular and soluble proteins is attributed to antibacterial action of flavonoids. The development of hot shock proteins in diverse malignant cell lines, including leukaemia and breast and colon cancer, is also well-known to be inhibited.

In 2013, Veena and Manu performed an experiment that showed the existence of watery extracts from OT in the herb of flavonoids that could be used to prevent inflammatory and analgesic effects. The alkaloid's existence in the plant indicates that plant extracts can be used for antiparasite and antifungal properties. In 1998, Verpoorte analysed approximately 300 alkaloids showing these properties. The antibacterial impacts of similar Mahonia genus organisms were analysed by Slobodniková et al. in 2004, Duraiswamy et al. in 2006 and Li et al. in 2007.

The presence of different phytochemical units, anthraquinones, saponins, flavonoids, alkaloids, ketones, carbs, amino acids and other types of tannins was tested for crude OT black species ethanol extract. This was investigated. In 2015, the coumarin content in Basak and Mohapatra was investigated and estimated by the wild root of OT in 0.212 – 0.271% dry weight and by 0.061 to 0.21% dry weight in uncultivated plants.

A comprehensive range of biochemical and pharmacopoietic functions, such as anticancer, antioxidant, anti-inflammation, anti-HIV, antibacterial, anticoagulant, anti-tumor, analgesic and immunomodulation are the chemical components of OT.

Operations. OT has been identified as antioxidant, hematopoietic, hepatoprotective, antiulcer, antimicrobial and antidiabetic.

The benzopyrone (2H-1-benzopyrane-2-one) coumarins [Figure 6], generally referred to in OT is made up of the rings of fused benzene and α-pyron. When plants are attacked or harmed by other

species, they are produced as defensive substances, so they are called phytoalexins. Coumarins are antimicrobial activators of the central nervous system, antitumor agents, anti-HIV drugs, and enzyme inhibitors. Table 1 shows the biological activity of coumarins.

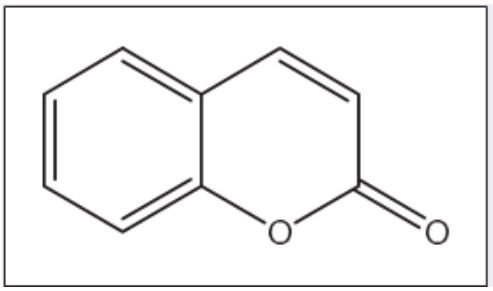

Figure 6: Coumarins [2H-1-benzopyran-2-one]

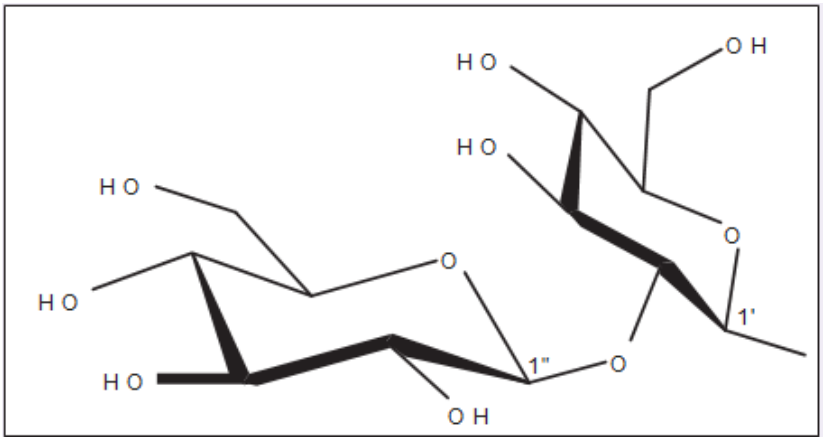

Figure 7: operculinosides A(1) R=H

Table 1: Biological/medicinal importance of coumarin showed in literature

Biological activity	References
Anti-inflammatory activity	García-Argáez et al., 2000
Antifungal activity	Sardari et al., 1999
Hepatotoxicity activity	Kumar et al., 2006
Antioxidant activity	Kostova et al., 2011; Kumari et al., 2010
Antimicrobial activity	Kwon et al., 1997; Alam et al., 2010
Analgesic activity	Prabhavathi et al., 2012; Sharma and Singh, 2013b
Antitumor-promoting Activity	Fujioka et al., 1999; Mirunalini and Krishnaveni, 2011
Immunomodulatory Activity	Venugopala et al., 2013

On literature, Xiaoyi et al. observed in 2011, that four modern dammarane saponins, which are A–D (1-4) operculinosids, were extracted from the aerial portions of OT [Figures 7-10]. In C-24 [Figure 8], β-glucopyramanides are present in the two first dammarane triterpenoids, while in C-25 the β-glucopyramanside is C(3) and D (4). The first two dammarane triterpenoids comprising oxymethyl at C-24 are compounds. Relevant hepatoprotective actions against D-galactosamine-induced (liver-toxicity) hepatopathy in human hepatic cells is shown by the compounds A(1) and C(3). The structures of these were established by means of Acid hydrolysis and spectroscopic

testing. x-ray crystallography verified the absolute structure of operculinoside A(1) [Figure11]. Four new saponins, the operculinoids A–D (1–4), are seen in Table 2 in the chemical parameters.

In the laboratory sample it was isoled from the ethyl acetate section of the I. turpethum stem extracts (Synonym – OT) of Rashid etal, i.e. 3-(4-hydroxy phenyl)-N-[2-(4-hydroxy phenyl)-ethyl]-acrylamide [Figure 14] in 2002. With spectral analysis, they demonstrated the chemistry.

In another 2013 experimental sample, Sharma and Singh extracted a steroid glycoside, e.g. a stigma-5,22dien-3-O-β-D-glucopyranoside, [Figure 15] from ethanol root bark extracts of OT by means of thin layer chromatography, column chromatography and HPLC.

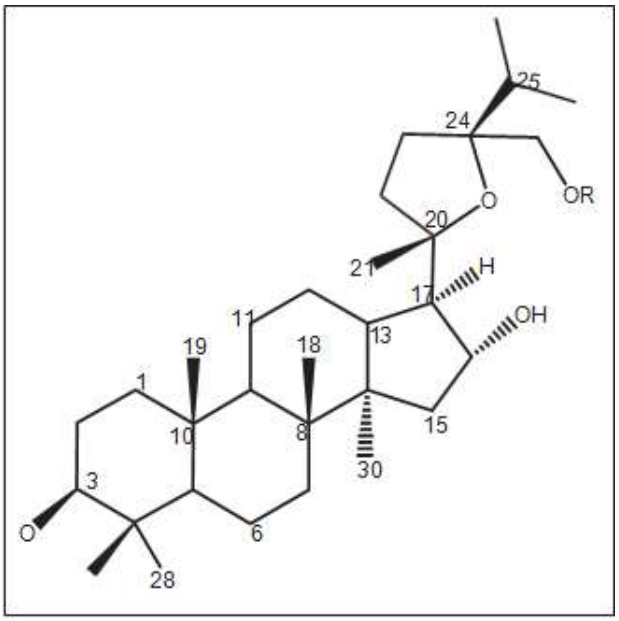

Figure 8: operculinosides A(2) R=β-glucopyranose

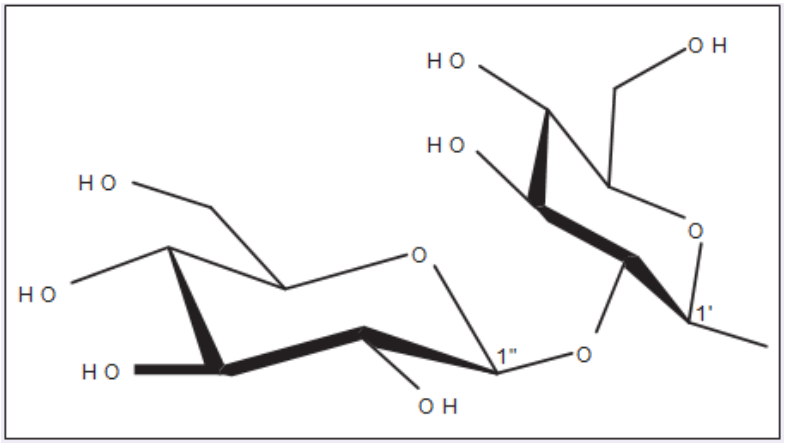

Figure 9: operculinosides C(3) R=H

4. PHARMACOLOGICAL PROFILE

4.1 Antimicrobial activity (antibacterial activity)

The antimicrobial agents obtained from herbal extracts lead to cell leakage by impairing of membranes' activity or hindering DNA/RNA synthesis/function, thereby preventing the bacterial cell walls or synthesis of protein.

The antimicrobial effectiveness of oil ether and ethanol extracts of OT leaves for their antimicrobial function was calculated by Alam et al. in 2010. Normal disc diffusion methods for gram-positive bacteria, such as Streptococcus haEmolytica, Bacillus subtilis, and Pseudomonasaeruginosa, Shigella sonnei and Shigella dysenteriae, have been used to test the antimicrobial function. In different human pathogenic species, ethanol extract shows a substantial zone of inhibition and therefore a minimum inhibitory concentration (MIC) of 0.13-0.75 mg/mL has been identified, although petroleum ether minerals have not shown a significant zone.

The antibacterial capacity in I. turpethum is observing using the normal disc diffusion technique in another research in 1984 and in 1951 Srivastava, and Bauer et al.. This plant's crude extracts are made of petroleum ether, chloroform and ethyl acetate as well as three H-1 compounds (Figure 16), H-2 [Figure 17] and CH-2 [Figure 18], eg.22,23-dioxy-α-spinosterol-β-D-gl; B-sitosterol-β-D-glucoside; Over 13 pathogenic bacteria, six of these were Gram negative and seve Gram positive, were insulated from the chloroform stem extract of the plant, i.e. salicylic acid (2-Hydroxy-Benzoic acid). These were brought together from the Nutrition and Food Institute, Dhaka University and the Bangladesh International Center for Diarrhoeal Research. Both extracts and extracted substances have been solubilized at 200 and 100 μg/10 μL respectively in methanol. Bacteriological media is nutrient broth and nutrient agar. As common drug, kanamycin was used. The bacteriotoxic effects of such samples were tested against all pathogenic bacteria, and it was recommended that the bioactive compounds of this plant can be used as antibacterial agents when compared with the permitted kanamycin disc (K-30 μg/disc).

In 1982, Reiners tests CH-2 MIC of pure compound with two gram-positive bacteria and two gram-negative bacteria by serial dilution procedure (107 cell / mL), i.e. Bacillus subtilis, Sarcinalutea and Escherichia Coli with Shigella dysenteriae.

In a further experimental analysis in 2002 Rashid et al. investigated the major bacterio-toxicity potentials with less extracted CH-2 (salicylic acid or 2-hydroxy benzoic acid) [Figure 18] of OT than kanamycin in combination with H-1 and H-2 ingredients [Figure 16]..

Table 2: Four new dammarane-type saponins, A–D (1-4) operculinoids are chemical parameters (Xiaoyi et. al., 2011)

Saponin name	Molecular formula	Configuration	Molecular weight (g/mol)	Fragment ions pattern	Chemical structure
Operculinoside A (1)	C43H74O14	S	815.051	853[M+K]+, 837[M+Na]+, 813[M−H]−, 873.5217[M+AcOH−H]−	Figure 7
Operculinoside B (2)	C49H84O19	S	977.18	1015[M+K]+, 999[M+Na]+, 975[M−H]−, 1021.5601[M+AcOH−H]−	Figure 8
Operculinoside C (3)	C42H72O14	S	801.01	839[M+K]+, 823[M+Na]+, 799[M−H]−, 835[M+Cl]−,	Figure 9
				845.4860[M+AcOH−H]−	
Operculinoside D (4)	C48H82O19	S	963.16	1001[M+K]+, 985[M+Na]+, 961[M−H]−, 997[M+Cl]−, 997.5063[M+Cl]−	Figure 10
Operculinoside 1a	C31H54O4	S	490.76	491[M+H]+, 513[M+Na]+, 489[M−H]−, 525[M+Cl]−	Figure 12
Operculinoside 3a	C30H52O4	S	476.73	499[M+Na]+, 475[M−H]−, 511[M+Cl]−	Figure 13

S=Sinister Absolute configuration

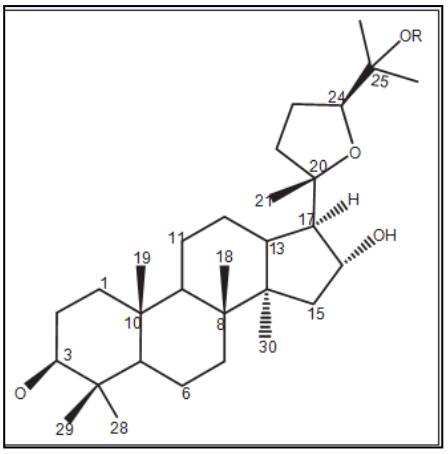

Figure 10: Operculinoside C (4) R=□-Glc

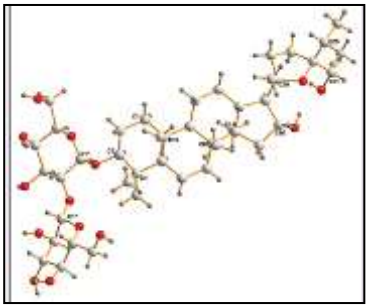

Figure 11: Operculinoside X-ray crystallographic structure A (1) in line with Xiaoyi et al., 2011

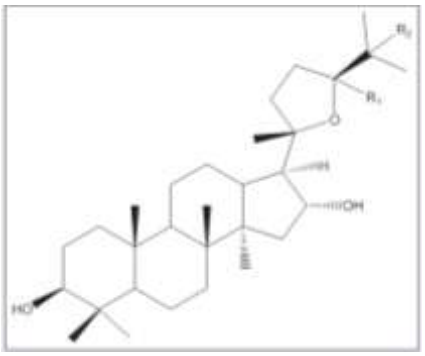

Figure 12: Operculinoside 1a R1 = CH2OH, R2 = H

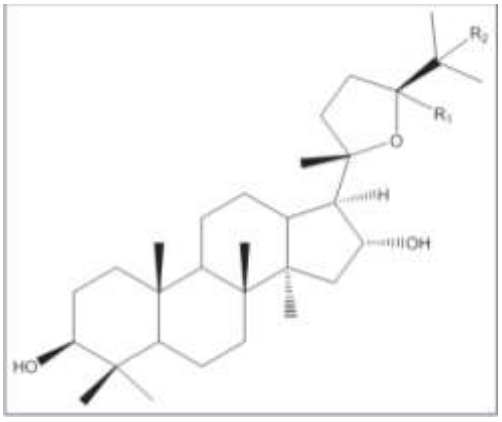

Figure 13: Operculinoside 3a R1 = H, R2 = OH

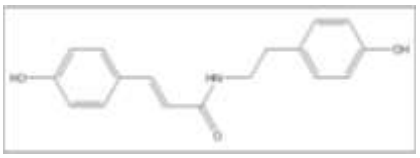

Figure 14: 3-(4-hydroxy-phenyl)-N-[2-(4-hydroxy-phenyl)-ethyl]-acrylamide

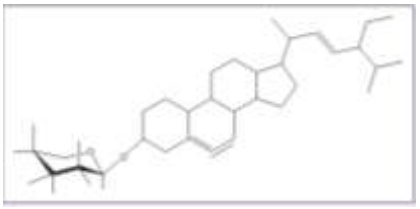

Figure 15: Stigma-5,22dien-3-O-β-D-glucopyranoside

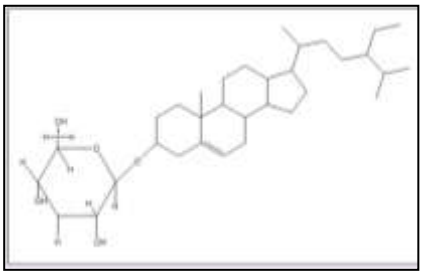

Figure 16: H-1 (β-sitosterol-β-D-glucoside)

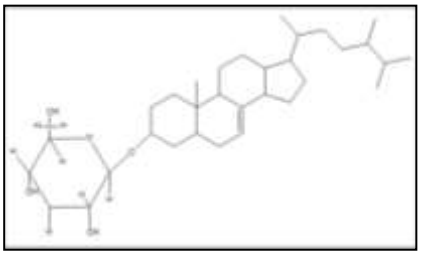

Figure 17: H-2 (22,23-dihydro-α-spinosterol-β-D-glucoside)

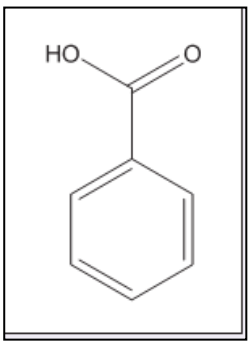

Figure 18: CH-2 (salicylic acid or 2-hydroxy benzoic acid)

4.2 Antihepatotoxic activity

Most hepatotoxic chemicals destroy liver cells mainly because they trigger lipid peroxidation or other oxidative damage to liver or through the formation of the reactive, free oxygen radicals which directly cause hepatotoxicity or increase apoptosis or reduce glutathione.

In 2006, Kumar et alestimated .'s OT hepatoprotective function for acute centralilobular necrosis in paracetamol-induced hepatopathy (Liver toxicity) in rats. The ethanol extract of OT was intraperitoneally administered at a dosage of 100 to 2000 mg/kg in body weight and showed considerable dose-dependent liver protection function. Silymarin was used as a routine medicine here and demonstrated a substantial increase in hepatoprotective effectiveness.

Vaidya et al. conducted three laboratory analyses in 2010 and evaluated the hepatoprotection of herbomineral formulae of OT root powder in rats for hepatotoxicity caused by carbon tetrachloride.

4.3 Antinephrotoxic activity

In 2010a Sharma and Singh tested the antininephrotoxic ability of N-nitrosodimethylamine mediated renal carcinogenicity in male mice as well as hepatotoxicity in the liver of mice as a therapeuit for steroidal glycosides, a stigma-5,22dien-3-O-β-D-glucopyranos ide [Figure 15]. The ethanol fraction of OT root-bark extracts is isolated from steroid glycosides. When an ethanol extract from the roots and the separated compound were applied to mice at doses of 400 mg/kg and 50 mg/kg, the nephrotoxicity and hepatopathy were significantly decreased.

4.4 Antiulcer activity

In an experimental sample, In men's albino rats, the effectiveness of aspirin and pyloric ulcers induced by a combination of OT (MEOTS) and hydroalcoholic stem extracts OT (HEOT) is assessed... Ignatius et al. reviewed it. MEOTS and hydroalcoholic stem extracts from OT were provided at 100 mg/kg body weight, showing high antigripal activity. As a standard treatment, ranitidine has been used. Finally, it was noted that stronger findings were seen in the hydroalcoholic stem extracts than in methanol extracts.

The ulcer protection effects of OT and its polyherbal formulation were assessed by Rajashekar et al. in 2006 by experimenting on the model of rats which reduced hyperacidity, the gastric ulcers, and gastrointestinal tract problems.

4.5 Antidiarrheal activity

Shareef etc. also conducted an experimental analysis to explore the anti-diarrheal efficacy of ethanol root extract in OT by means of the diarrhoea model in mice caused by beaver oil. The normal dosage of 10 mg/kg was loperamide. The root extract was provided orally in three separate doses and antidiarrheal results were seen in ethanol root extracts depending on the dosage.

4.6 Antidiabetic activity

In diabetes patients it is essential to continuously track blood glucose since the synergistic impact is generated with oral hypoglycemic agents. OT can modify glibenclamide pharmacokinetics. It may result in an increased release of insulin as a result of potential mechanisms by which MEOTS and methanol extracts from OT roots (MEOTR) have a hypoglycemic impact on diabetic rats.

Pulipakan et al. conducted a comparative analysis to determine MEOTS and MEOTR antidiabetic efficacy in Streptozotocin-induced diabetes at 100 mg/kg of body weight on laboratory rat models. The standard medication was glibenclamide. Compared with the norm the received values. Results found that the amount of fasting glucose at the end of 21 days was significantly reduced by methanol extracts.

4.7 Cytotoxic activity

Person researched and conducted brine shrimp bioassays (Artemia salina) in 1982, For the analysis of chloroform and ethilacetate extracts and OT, Meyer et al. in 1982 and Mclaughlin and Anderson 1988 areolating compounds of salicyl acid (CH-2). Other experiments include: The 5 mg/ml dissolved per sample in vipes of 5, 10, 20, 40, 80 µL and 5 mL of seawater per vial, i.e. crud chloroform, and ethyl acetate, CH-2, including 5 mL of sea water composed of 10 larvae (nauplia). A set of testing solutions were given for each dimethyl acetate and CH-2. After 1 day the amount of larvae surviving was tested for each vial.

4.8 Analgesic activity

The symptoms obstruct the biosynthesis of prostaglandin by the inhibition of cyclooxygenase injections. Centers of inhibition of this enzyme are the analgesic antipyretic effect and peripherally their anti-inflammatory effect is generated by inhibition of this enzyme.

In 2012, the experiment Prabhavathi et al. conducted using tail flick and acetic acid caused the reaction of writhing. As a normal analgesic prescription, diclofenac sodium was used. As extract was taken orally dose-dependent, a stronger dose-dependent reaction was found for the chloroform extract of OT than petroleum ether.

4.9 Anti-arthritic activity

An study was conducted in 2013 by Sharma and Singh to detect the anti-arthritis activity of the ethanolic radiculine extracts used by OT in vitro denaturation models. Ethanol extract power in the various bovine serum albumin levels was evaluated. Acetylsalicylic acid was typical and in the case of acetylsalicylic acid, meaning 70 percent, a major inhibition was found, while ethanol extract accounted for 67.22,0 percent.

4.10 Anti-inflammatory activity

The anti-inflammatory ability of OT-root powder in formalin-induced edoema in rats is explored in 2006 by Rajashekar et al. The tests involved oral root powder administration in rats with its ayurvedic polyherbal formulation in a dose of 100 mg/kg body weight (Avipattikar Churna). The findings revealed that the formalin edoema volume was significantly reduced, i.e. 36.45% and 27.11%.

4.11 Toxicity studies

In 2006, Kumar et al. conducted an experiment with ethanol extract OT toxicity tests. When extract was provided in various dose-dependent groups of rats, mortality was observed at the time and liver feature markers, including serum glutamic oxaloacetic transaminase, serum glutamic pyruvic transaminase, serum bilirubin, and serum alkaline phosphatase, were not altered.

In 2006, Bhande et al. have conducted another acute toxicity trial in safe mice for the analysis of toxicity. In this research, eight separate classes of safe men/women albino rats were divided into six mice per community.

5. CONCLUSION

In this study, the analysis literature provided a number of bioactive compounds and their pharmacological activities for OT plants. The phytochemical inquiry confirmed the existence of

glycosides, terpenoids (lupeol), alkaloids, saponin, tannin, flavonoids, A–D coumarins and operculinoids in separate OT extracts (skopoletin, turpethinic acids [A–E]), and sugar reduction (skupoleine, betulin) in various OT extracts. Antimicrobial, anti-hepatic, anti-inflammatory, anti-ulcer, antidiarrheal, cytotoxin, antiphalogenic and anti-arthritis-free activity has been shown to be promoting. The presence of turpethin, turpethinic acid (A–E), in high quantities, can be the pharmacological behaviour of the plant. The latest literature review found that the OT plant has important medicinal values and is healthy for care.

REFERENCES

1. Kohli KR, Nipanikar SU, Kadbhane KP (2010). A comprehensive review on Trivrit [Operculina turpethum syn. Ipomoea turpethum]. Int J Pharma Bio Sci.;1: pp. 443‑52.

2. Rastogi R, Mehrotra BN, Sinha S, Shrivastava M, Bhushan B (2002). Compendium of Indian Medicinal Plants. Vol. 4. New Delhi, India: CDRI Lucknow & National Institute of Science Communication; p. 513.

3. Yoganarasimhan SN (2005). Medicinal Plants of India. Bangalore: Self Publication; p. 41.

4. Shah CS, Qadry JS, Krishnamurthy TN (1972). Sugars and coumarins in black‑turpeth (Ipomea turpethum). Indian J Pharm.; 34: pp. 126.

5. Ding W, Zeng F, Xu L, Chen Y, Wang Y, Wei X (2011). Bioactive dammarane‑type saponins from Operculina turpethum. J. Nat. Prod.; 74: pp. 1868‑74.

6. Shareef H, Mahmood S, Farrukh U, Ahmed A, Rizwani GH (2010). In vitro antimicrobial and phytochemical activity of Operculina turpethum L. inventi impact. Ethnopharmacol.; 1: pp. 50‑3.

7. Ramkumar KM, Manjula C, Sankar L, Suriyanarayanan S, Rajaguru P (2009). Potential in vitro antioxidant and protective effects of Gymnema montanum H on alloxan induced oxidative damage in pancreatic □‑ cells, HIT‑T15. Food Chem Toxicol.; 47: pp. 2246‑56.

9. Jalaj AV, Madhavan RP (2014). Pharmacognostic studies on leaf of Operculina turpethum (L.) Silva Manso. Int J Adv Res.; 2: pp. 585‑90.

10. Veena S, Manu S (2013a). Comparative analysis of the phytochemicals present in different extracts of Operculina turpethum. Int J Drug Dev Res.; 5: pp. 244‑50.

11. Aboaba OO, Efuwape BM (2001). Antibacterial properties of some Nigerian species. Biol Res Comm.; 13: pp. 183‑8.

12. Jalaj AV, Madhavan RP (2016). Identification and quantification of phenolic compounds from O. turpethum (L.) Silva Manso leaf by HPLC method. IJPSR; 7: pp. 1656‑61.

14. Malik CP, Singh MB (1980). Plant Enzymology and Histo‑Enzymology. New Delhi: Kalyani Publishers; p. 286.

15. El‑Far MM, Taie AA (2009). Antioxidant activities: Total anthocyanins, phenolics and flavonoids contents of some sweet potato genotypes under stress of different concentrations of sucrose and sorbitol. Australian J Basic Appl Sci.;3: pp. 3609‑16.

16. Huang WY, Cai YZ, Zhang Y (2010). Natural phenolic compounds from medicinal herbs and dietary plants: Potential use for cancer prevention. Nutr Cancer.; 62: pp. 1‑20.

17. Attele AS, Wu JA, Yuan C (1999). Analgesic effects of different auc point stimulation frequencies in humans. Biochem Pharmacol.; 58: pp. 1685‑93.

18. Finar IL (1989). Chemistry. Stereochemistry and the Chemistry of Natural Products. 5th ed., Vol. 2. UK: Longman Group; pp. 517‑605.

19. Trease GE, Evans MD (1989). A Text Book of Pharmacognosy. 13th ed. London: Baillier, Tindal and Caussel; pp. 144‑8.

20. Gopish KV, Kannabiran K (2008). Antimicrobial activity of saponin fractions of the leaves Gymnema sylvestre and Eclipta prostrata. World J Microbiol Biotechnol.; 24: pp. 2737‑40.

Corresponding Author

Pramod Kumar Sharma*

Professor & PVC, Department of Pharmacy, Galgotias University, Greater Noida, Uttar Pradesh, India