How to Cite:
Bainsal, N., Bora, K. S., & Singh, J. (2022). Ethnic and scientific reports on medicinally potential rare explored genus - thalictrum of family ranunculaceae. *International Journal of Health Sciences*, *6*(S1), 9078–9095. https://doi.org/10.53730/ijhs.v6nS1.7054

Ethnic and scientific reports on medicinally potential rare explored genus - thalictrum of family ranunculaceae

Neeraj Bainsal
University Institute of Pharma Sciences, Chandigarh University, Mohali, Punjab, 140413, India

Kundan Singh Bora
University Institute of Pharma Sciences, Chandigarh University, Mohali, Punjab, 140413, India

Jitender Singh
Professor and Principal, Institute of Pharmaceutical Sciences, IET Bhaddal Technical Campus, Rupnagar, Punjab, 140108, India
Corresponding author email: jitender.kuk@gmail.com

***Abstract*---**Background: Plants remains a source of food as wells as medicine and healthcare needs since the dawn of civilization. Plants and plants derived products are available in crude form as well as in dosage forms which are widely prescribed by the medical practitioners and believed safe to consume as compared to the synthetic compounds based medicines. Many bioactive compounds derived from the plant sources are utilized in various health problems. A vast research on the medicinal plants has been conducted worldwide but there are many plants species which are still unexplored. Despite having ethnic reports as medicine, a very lesser number of plant species of the genus. Methods: We have been consulting various articles from scientific data available on internet specially, ScienceDirect, Scopus, PubMed, Web of Science. Thalictrum of family Ranunculaceae have been explored scientifically in terms of pharmacology, phytochemistry, bioactivity studies. Results: Thalictrum is the genus of plants bear flowers in the family Ranunculaceae containing about 200 species in the diverse region of the globe. Species of the genus have been used in the management of various healthcare problems like, clearing heat, stimulating diuresis, subdue swelling detoxification, hepatitis, jaundice, measles, swollen body, febrile convulsion, malnutrition of children, fever, etc. and have reported to have scientifically proven pharmacological activities like, antibacterial, antifungal, antimalarial, anti-inflammatory, antiparasitic, cytotoxicity, anticancer, immunomodulatory,

antioxidant, antipyretic, antiulcer, etc. The species of genus Thalictrum are reported to contains various medicinally significant class of phytoconstituents like, alkaloids, glycosides, flavonoids, terpenoids, etc. Conclusion: The review report on ethnopharmacological, phytochemical and pharmacological data on various species of the genus Thalictrum will be beneficial for the researchers and the scholars working or intent to work in plant based research and certainly generates scopes for the future scientific research studies specially, in the management of infectious and noninfectious diseases by plants based drugs

***Keywords*---**Thalictrum, Ethnic medicines, Ethnopharmacology, Phytochemistry, Pharmacology.

Introduction

Plant and plant products have been a reliable source for the treatment of health problems and used as ethnic medicine in a wide spectrum of ailments since the ancient times. Ethnic Herbal medicines have been an essential part of the culture and traditions worldwide and are used in the form of traditional formulations viz. poultices, decoctions, ointments, churnas, infusions, etc.[1] Plant based natural products can be obtained from various parts like, roots, leaves, fruits, flowers, seeds, bark, resins, etc. and the existence of bioactive molecules might be specific to the plant parts. A Phytocompound isolated from a plant source has been considered as bioactive, prototype, lead, and their later structural modifications can have generated potent bioactive compounds with good therapeutic potential[2]. The ethnopharmacological literature has been played a vital role for the scientific studies to isolate bioactive molecules from the traditional medicines.

The genus Thalictrum contains about 200 species of family Ranunculaceae, distributed throughout the globe specially in South America, Asia, Africa, North America, Europe etc.3 About 67 species of Thalictrum are reported to be a part of the medicinal flora of China. Most common medicinal plants species of the genus are, *Thalictrum cultratum, Thalictrum foiolosum, Thalictrum glandulosissimum, Thalictrum finetii, Thalictrum baicalense, Thalictrum minus, Thalictrum squarrosum.* Species of the genus Thalictrum are reported to contain alkaloids, specially berberine and benzylisoquinoline, flavonoids, glycosides and terpenoids at major extent[4,5,6,7]. Plants of this genus have been used as ethnic medicines for the treatment of gastrointestinal diseases, cooling, diaphoresis, dysentery, bloodshot, malnutrition, eyes inflammations, etc.[4,8,9,10,11] The review contents cover ethnic, phytoconstituents and Pharmacological reports of 10 species of Thalictrum, which are reported to have ethnic use and scientific reports. The information in the review article might be a key to generate new research ideas on the less explored plant species of the genus Thalictrum.

Thalictrum atriplex Finet et Gagnep

The common name for *T. atriplex* is Ma wei Lian and Shiu Huang Lian is a Tibetan and Folk medicine. The roots of *T. atriplex* was utilized to cure diarrhea

along with infectious hepatitis, dysenteric and some gastro enteric ailments[12]. Whole plant along with roots also consumed to cure swollen boils[4]. Cytotoxic activity of cycloatriosides A, B and thaliatrioside A against cancer cells (human lung cancer cells and human breast cancer cells) A549, MDA-MB-231 respectively were screened using MTT method.17Neothalfine inhibit aggregation of platelets which is induced by adenosine diphosphate and collegen in vitro[13]. Various Phytoconstituents isolated from *T. atriplex* mention in Table 1.

***Thalictrum cultratum* Wallich**

The roots and rhizomes of *T. cultratum* used as substitute of plant coptis, anti-inflammatory and antipyretic[4] also given in diarrhea, influenza, measles, carbuncles, viral hepatitis, swollen boils, dysentery,and red eyes.[18] From roots thalicultratine L (tetrahydroprotoberberine-aporphine alkaloid), thalicultratines A–K (thalifaberine-type aporphine-benzylisoquinoline alkaloids) and Thalifaronine, Thalifaberine, Thalifabatine Dehydrothalifaberine and Thalibealine isolated and all the alkaloids evaluated for antiproliferative activity against prostate cancer PC-3 and human leukemia HL-60 cells. Most of the alkaloids possesed effective cytotoxicity against cancer cells. The most active compound showed apoptosis and at S phase arrest the HL-60 cell cycle along with loosing mitochondrial membrane potential. The Phytoconstituents isolated from *T. cultratum* mention in Table 2.

***Thalictrum faberi* Ulbrich**

It is an everlasting herb which is native to china, utilized in stomach cancer and Chinese traditional medicine as antiphlogistic[23], swelling eye pain and as Substitute of coptis.[4] Out of all the isolated compounds Thalifaberine and Thalifasine reported as cytotoxic against various human cancer Cells like human epidermoid carcinoma, Human fibrosarcoma, Human colon cancer, Human breast cancer, murine lymphoid leukemia, hormone-dependent human prostatic cancer, human lung cancer, hormone –dependent human breast cancer, human glioblastoma, human oral epidermoid carcinoma (A431, HT-1080, Col-2, BCA-1, P-388, LNcaP, Lu- 1, ZR-751, U373, KB respectively). Thalifasine showed antimalarial activity against *Plasmodium falciparum*[23]. The phytoconstituents reported from this plant stated in Table 3.

***Thalictrum foetidum* Linnaeuss**

The roots and rhizomes of *T. foetidum* used traditionally for detoxification of blood, conjunctivitis, infectious hepatitis, carbuncles, swelling eye pain, swollen boils[4]. Pharmacologically *T.foetidum* reported as antialziemer, it shown its activity by suppressing amyloid precursor protein, acetylcholinesterase along with glial fibrillary acidic protein (GFAP) and increased glucose and decreased acetylcholinesterase expressively in the serum of experimental animal.[31]various Phytoconstituents isolated from *T. foetidum* enlisted in table 4.

***Thalictrum foliolosum* DC**

Thalictrum foliolosum DC commonly known as Mamira, pilijari belongs to family Ranunculaceae. Traditionally *T.foilolosum* was used to clears the brain, have purgative action, used in opthalmia as collyrium, recovers eye-sight, good in toothache, in diarrhea, effective in piles, nail diseases, and spots on skin. The plant rootscombine tonic and aperient properties and has been documented as useful in convalescence after acute disease, in mild forms of intermittent fevers, and in atonic dyspepsis. In india and Afghanistan, root is largely used as an anjan, or application of opthalmia.[32]

Pharmacologically, the aqueous extract of rhizomes has shown antipyretic activity in albino rats, in which pyrexia induced by yeast. The water extract at doses 200 and 400 mg/kg showed remarkable antipyretic activity after 2 hrs. of insertion of doses whereas 500 mg/kg extract shown activity within one hour comparing to standard drug paracetamol.[39] The isolated compounds Thalfoliolosumines A and B isolated from entire part of *T .foliolosum* reported reasonable in-vitro antiprofilerative activity against HL-60, PC-3 and MCF-7 cells. IC50 values was found to be 7.50 and 6.97 μM for Thalfoliolosumines A and B respectively and shown good inhibitory effect against U937cells. 8-oxyberberine and jatrorrhizine also possessed strong antiproliferative activity against cell lines with IC50 0.93, 1.69 μM respectively.[33]Another isolquinoline alkaloids isolated from 70% ethanolic extract of roots evaluated in-vitro for cytotoxic activity against human lung cancer cell lines (A549, H23, H441, H460, H2170 and HTB-58. The two alkaloidal compound named 5,6,7,12-tetramethoxy-2-methyl-13-hydroxy-11-(4′-carbonylphenoxy) benzylisoquinoline and 5,6,7,12-tetramethoxy-2-methyl-13-hydroxy-11-(4′methoxycarbonylphenoxy) benzylisoquinoline showed maximum activity against tumor cell lines with reported IC50 values less than 20μM.[37] Bisbenzyltetrahydroisoquinoline alkaloids such as Thalrigosidine, thalrugosaminine, thalirugidine and thalirugine isolated from whole plant reported with strongest antioxidant activity in ABTS assay.[33]The root extract of *T. foliolosum* rich in phenolic and flavonoidal content reported well scavenging of DPPH free radicals.[40] The chloroform extract of *T.foliolosum* leaves shown maximum antioxidant activity against DPPPH and FRAP assay method. Along with that molecular docking study also indicated that alkaloid berberine strongly interacts with CYP51 and human peroxiredoxine 5 proteins, thus *T. foliolosum* consider as rich source of berberine and potent antioxidant.[41]*T. foliolosum* is reported as good antimicrobial plant. Antimicrobial activity of root extract evaluated against *Escherichia coli, Candida albicans, Staphylococcus aureus, Pseudomonas aeruginosa. T.foliolosum* rich in berberine showed maximum activity on *S. aureus* and *C. albicans.* For the determination of the MIC of various microbial strains, dilution method was utilized along with streptomycin and gentamycin as standard control.[40]In vitro antimicrobial activity of Pet ether, Chloroform, Methanol, Aqueous extract of *T. foliolosum* plant also evaluated.[42] *T. foliolosum* leaves extract evaluated against numerous fungal strains (*Candida albicans* (ATCC90028), *Saccharomyces cerevisiae* (H1068) and *Candida albicans* (MTCC277) for antifungal activity. Chloroform extract of leaves possessed maximum antifungal activity specified by the area of diameter of Zone of inhibition 16 ± 0.7 mm, 18 ± 0.5 mm, 16 ± 0.7 mm and MIC values 3.13 ± 0 μg/ ml, 1.56 ± 0 μg/ ml, 3.13 ± 0 μg/ ml against *C. albicans* (MTCC277), *S. cerevisiae*

(H1068) and *C. albicans* (ATCC90028) respectively.[41]Das et al evaluated the antimalarial activity of n-butanol, chloroform and ethyl acetate extract of *T. foilolosum*roots against resistant and sensitive strain of *Plasmodium falciparum.* Out of all extractsn-butanol and chloroform extract reported as more effective against both type of strains of *P. falciparum* i.e. chloroquine resistant (RS) and sensitive (SS). IC_{50} value of chloroform extract was 1.1± 0.0 and 0.5 ± 0.0 against RS and SS strains respectively.[43] Another study reported antimalarial activity of leaves of *T. foliolosum* evaluated against chloroquine resistant (RKL-9) and chloroquine sensitive (MRC-2) strain of *P. falciparum*. Out of all the extracts, the Ethanolic extract showed significant in-vitro antimalarial activity against both the strains. Ethanolic extract categorized as highly active and promising active against chloroquine resistant and chloroquine sensitive respectively.[44] Four alkaloids reported from stem of *T. foliolosum* evaluated for inhibitory activities against DNA topoisomerase IB of *Leishmania donovani*. 6, 5', 6', 7', 12-pentamethoxy-2, 2'-dimethyloxycanthan out of all four alkaloids inhibit the enzyme completely at 50 µM concentration. This alkaloid found to be most effective in destroy both types of parasites like wild type and SAG resistant promastigotes.[36]The hydro-ethanolic extract of *T. foliolosum* whole plant evaluated for antiepileptic activity in Wistar albino rats. Doses at 300mg/kg and 400 mg/kg injected intraperitoneal showed remarkable rise in GTCS (Generalized tonic-clonic seizures) latencies.[45] The Phytoconstituents isolated from *T. foliolosum* mention in Table 5.

***Thalictrum fortune* S. Moore**

It is a long lasting plant scattered in the southeastern places of country China. For thousands of years the parts of this plant has been utilized in Traditional medicines of China for the management of bacterial and tumor diseases along with its immune regulatory effects.[46] Traditionally it used in furunculosis, smallpox and as substitute of Coptis[4]. Aerial parts of *T. fortunei* used as cytotoxic, anticancer, Proapoptotic[4] and in opthalmia, dysentery and jaundice.[47] Pharmacologically, the two cycloartane isolated by Zhang et al. assessed for their cytotoxic activity against human heptoma cells (Bel-7402), human non-small cell lung cancer cells (NCIH-460), human colon carcinoma LoVo cells by MTT assay (dimethylthiazoyl 1-3,5-diphenyltetrazolium bromide). The IC_{50} value of two compounds was found to be 24.33, 6.83, 5.61 µg/ ml and 7.79, 3.32, 3.08 µg/ ml for humun colon carcinoma LoVo cells, human heptoma cells (Bel-7402), human non-small cell lung cancer cells (NCIH-460) respectively.[47] Ten Cycloartane triterpenoid saponins isolated from n-butanol fraction of ethanol extract evaluated for *in-vitro* cytotoxic activity against A549 (lung cancer cells) and HepG2 (liver cancer cells) by MTT assay method. These saponin compounds had no good cytotoxic effects[48]. Eight terpenoid compound isolated from aerial part evaluated on tumor cells by MTT assay. Out of all the compounds, 3-*O*-*β*-D-glucopyranosyl-(1→4)-*β*-D-fucopyranosyl(22*S*,24*Z*)-cycloart-24-en-3*β*,22,26-triol 26-*O*-*β*-D-glucopyranoside showed stronger inhibitory activity on Bel-7402 (human hepatoma Bel-7402 cell line), LoVo (human colon lovo cells), NCIH-460 (human non-small cells lung cancer), SGC-7901 (human gastric carcinoma SGC-7901) with IC_{50} 66.4, 84.8, 73.5, 89.6 µM respectively. The mechanism of antitumor activity of strongest antitumor compound on Bel-7402 explored through flow cytometry, nucleus dyeing, western blot and fluorescence assay. Apoptosis and

loss of mitochondrial membrane potential (MMP) found in Bel-7402 cells reported in flow cytometric analysis. In florescence assay, intracellular reactive oxygen species (ROS) distinctly provoked by strongest compound treatment equated to control cells. The significant increase in the expression levels of cleaved caspase-3, P53 and Bax protein and reduction in expression level of Bcl-2 protein found in immunoblot results of strongest compound. These all findings indicate *T.fortunei* inhibit the growth of tumor cells.[46] The Phytoconstituents isolated from *T. fortune* mention in Table 6.

***Thalictrum minus* Linn.**

This plant distributed in northern hemisphere and rarely found in southern hemisphere. Antibacterial activity of Dichloromethane: methanol extract of root and its isolated compounds evaluated against five mastitis bacterial strains (*Staphylococcus equorum, Staphylococcus xylosus, Enterococcus faecalis, Staphylococcus lentus and Pantoea agglomerans*). The Extract possessed broad spectrum antibacterial activity. Three compounds isolated from the root extract, thalrugosaminine and hydroxythalidasine these two compounds showed maximum activity with Minimum inhibitory concentration values 64-128 µg/ml. The Staphylococcus strain were observing to be most sensitive strain.[59]Antimicrobial activity of Thalicoside A1, Thalicoside A2, Thalicoside A3 isolated from aerial parts of *T. minus* evaluated against *Candida albicans, Staphylococcus aureus* and *Pseudomonas aeruginosa.* Out of all the Thalicosides, Thalicoside A2 at concertation 1 mg/ml possessed inhibitory activity against tested strain *C. albicans* and *S. aureus.*[52] The Phytoconstituents reported from *T. minus* mention in Table 7.

Thalictrum simplex

Thalictrum simplex is the plant utilized as Traditional Tibetan and Mongolian Medicineto treat acute and chronic infectious diseases.[60,61] and for blood purification and wound healing[60, 62]. Anti-influenza activity of (-)-thalimonine isolated from aerial parts was evaluated against A/Germany/34, A/Germany/27, str. Rostock (H7N1) and str. Weybridge (H7N7) influenza virus. The isolated alkaloid markedly reduced the virus-specific protein synthesis, haemagglutinin production, virus induced cytopathic effects, infectious virus yield. (-)-thalimonine inhibited viral reproduction in a specific and selective manner[63]. The isolated compound (-)-thalimonine also evaluated for antiviral activity, replication of HSV-1 was inhibited by isolated alkaloid in dose dependent manner. (-)-thalimonine also possessed immunological activity and at the concentration between 10 and 100 µM (-)-thalimonine inhibited the antibody response against SRBC. This effect was also dose dependent.[67] The Phytoconstituents reported from *T. simplex* mention in Table 8

***Thalictrum squarrosum* Stephan ex Willd**

It is widely spread from East Siberia to north China. The dried whole plant utilized as Heat-clearing and Detoxification, invigorate stomach and relieve hyperacidity, diaphoresis.[4] For biological activity *T. squarrosum* is still unexplored as no reported data was found on various search engines.

***Thalictrum wangii* B. Boivin**

It is a long lasting Chinese medicinal plant founf in areas of Lijiang Country and cold alpine of Southern Tibet. Tibetan people utilized this plant as anti-inflammatory and antidote drug.[76]

These entire isolated compounds investigated for cytotoxicity against (GSC-3) glioma stem cells and (293 T) human normal embryonic kidney cell lines. Aporphine, oxoaporphine alkaloids and 6,7,12-trimethoxy-2-methyl-13-hydroxy-11-(4′-formylphenoxy) affect the (293 T) cell lines at 20 µg/ml and inhibited the growth of GSC-3. The IC_{50} value for such bioactive isolated compounds was found 15-20 µg/ml calculated by MTS method which were nearly equals to recognized antitumor drug i.e. taxol (13.59 µg/ml) and also better than first class drug temozolomide) for human glioblastoma multiform (IC_{50}> 50 µg/mL) respectively.[78] Aporphine alkaloid isolated from whole plant of *T. wangii* were Thallactones A and Thallactones B, thaliglucine N-oxide along with their biosynthetically related precursor northalphenine. All isolated aporphine compounds except Thallactone B evaluated for immunosuppressive activity against mitogen-induced (Con-A) splenocyte proliferation. The result showed that these aporphine compounds inhibited T lymphocyte significantly in a dose dependent manner. It was noted that activities of these compounds were even better than the reference control dexamethasone at a concentration between 25-50 µM. This potent immunosuppressive activity makes it more attractive to scientist for further evaluation and research.[79] The Phytoconstituents reported from *T. wangii* mention in Table 10.

Discussion

Ethnopharmacological records indicate that plant species of the genus Thalictrum have lots of therapeutical potential for the treatment of communicable and non-communicable diseases. There is a strong need to carry out the research to find out the bioactive molecules that further can be developed as a drug candidate or their chemical derivatives for the treatment diseases. Majority species of Thalictrum have ethnic use for the treatment of inflammations, blood detoxification, bacterial and viral infections and for cooling effects, which further unlock the scopes of scientific studies related to immunomodulators, anti-inflammatory, antibacterial, antiviral, liver diseases, skin problems, anticancer, etc.

Acknowledgements

Acknowledged to Chandigarh University, Punjab, India and Institute of Pharmaceutical Sciences, IET Bhaddal Rupnagar, Punjab India for providing necessary facilities.

Conflict of interest: NIL

References

1. Hoareau L, DaSilva EJ. Medicinal plants: a re-emerging health aid. Electronic Journal of biotechnology. 1999 Aug;2(2):3-4.
2. Cragg GM, Newman DJ. Natural product drug discovery in the next millennium. Pharmaceutical biology. 2001 Jan 1;39(sup1):8-17.
3. Hen L. Flora reipublicae popularis sinicae. Inst Bot Kummingense Acad Sin. 1979; 13:1-2.
4. Hao DC. Ranunculales medicinal plants: biodiversity, chemodiversity and pharmacotherapy. Academic Press; 2018 Apr 23.
5. Nuralieva ZS, Litvinenko VI, Alimbaeva PK. Flavonoids of Thalictrum foetidum. Chemistry of Natural Compounds. 1969 Sep;5(5):307-8.
6. Ganenko TV., Isaev MI, Gorovits TT et al. Triterpene glycosides and their genins from Thalictrum foetidum. I. The structure of foetoside C. Chem. Nat. Compd. 1984; 20. 433–438.
7. Trofimova NN, Gromova AS, Lutsky VI, Semenov AA, Avilov SA, Kalinovsky AI, Li D, Owen NL. New triterpenoid glycosides from Thalictrum minus L. Russian chemical bulletin. 1998 Jul;47(7):1395-8.
8. Telyat'ev VV. Useful Plants of Central Siberia. Vostochno-Sibirskoe Knizhnoe Izdatel'stvo, Irkutsk. 1985.
9. Shreter AJ, Miravieva P, DA EF. Medicinal flora of the Caucasus.1979.
10. Fedorov AA, Sokolov PD. Plant Resources of the USSR.1988
11. Waller GR, Yamasaki K, editors. Saponins used in traditional and modern medicine. Springer Science & Business Media; 2013 Jun 29.
12. Zhengyi W, Taiyuan C, Peigen X, editors. New compendium of Chinese medicinal herbs, vol. 1. Shanghai Scientific and Technical Publishers, 1988:184.
13. Gao GY, Chen SB, Chen SL, Wang LW, Xiao PG. Novel dimeric alkaloids from the roots of Thalictrum atriplex. Journal of Asian natural products research. 2005 Dec 1;7(6):805-9.
14. CHEN SB, GAO GY, CHEN SL, WANG LW, XIAO PG. Bisbenzylisoquinoline alkaloids from roots of Thalictrum atriplex [J]. Chinese Traditional and Herbal Drugs. 2005;4.
15. Guangyao G, Sibao C, Junshan Y, Peigen X. A new flavonoid from the aerial part of Thalictrum atriplex. Fitoterapia. 2000 Dec 1;71(6):627-9.
16. Gao G, Chen S, Wang L, Liao M, Yu S, Xiao P. Studies on chemical constituents of Thalictrum atriplex Finet et Gagnep. Zhongguo Zhong yao za zhi= Zhongguo zhongyao zazhi= China journal of Chinese materia medica. 1999 Mar 1;24(3):160-1.
17. Meng F, Wei X, Sun Y, Zeng Q, Wang G, Lan X, Liao Z, Chen M. Cytotoxic triterpenoid saponins from Thalictrum atriplex. Natural Product Research. 2020 Oct 13:1-8.
18. Chen SB, Chen SL, Xiao PG. Ethnopharmacological investigations on Thalictrum plants in China. Journal of Asian natural products research. 2003 Dec 1;5(4):263-71.
19. Hussain SF, Guinaudeau H, Freyer AJ, Shamma M. Bisbenzylisoquinoline alkaloids from Thalictrum cultratum. The structures of thalrugosinone and thalpindione. Journal of Natural Products. 1985 Nov;48(6):962-6.

20. Hussain SF, Freyer AJ, Guinaudeau H, Shamma M, Siddiqui MT. Seven new aporphine-benzylisoquinoline alkaloids from Thalictrum cultratum. Journal of Natural Products. 1986 May;49(3):494-9.
21. Li DH, Li JY, Xue CM, Han T, Sai CM, Wang KB, Lu JC, Jing YK, Hua HM, Li ZL. Antiproliferative dimeric aporphinoid alkaloids from the roots of thalictrum cultratum. Journal of natural products. 2017 Nov 22;80(11):2893-904.
22. Kang W, Li J, Li D, Li Z, Chen S, Hua H, Bai J. New benzyl-aporphine alkaloids from Thalictrum cultratum. Natural product research. 2019 Nov 2;33(21):3176-9.
23. Lin LZ, Hu SF, Zaw K, Angerhofer CK, Chai H, Pezzuto JM, Cordell GA, Lin J, Zheng DM. Thalifaberidine, a cytotoxic aporphine-benzylisoquinoline alkaloid from Thalictrum faberi. Journal of natural products. 1994 Oct;57(10):1430-6.
24. Lin LZ, Hu SF, Chu M, Chan TM, Chai H, Angerhofer CK, Pezzuto JM, Cordell GA. Phenolic aporphine-benzylisoquinoline alkaloids from Thalictrum faberi. Phytochemistry. 1999 Mar 10;50(5):829-34.
25. Wagner H, Lin LZ, Seligmann O. Alkaloids from Thalictrum faberi. Planta medica. 1984 Feb;50(01):14-6.
26. Lin LZ, Li SF, Wagner H. Thalifaboramine, a dimeric aporphinoid alkaloid from Thalictrum faberi. Phytochemistry. 1987 Jan 28;26(2):583-4.
27. Ganenko TV, Isaev MI, Lutskii VI, Semenov AA, Abdullaev ND, Gorovits MB, Abubakirov NK. Triterpene glycosides and their genins from Thalictrum foetidum. III. The structure of cyclofoetoside A. Chemistry of Natural Compounds. 1986 Jan;22(1):61-5.
28. Ding CF, Zhang RP, Yu HF, Yang J, Qin XJ, Dai Z, Liu YP, Lu QM, Lai R, Luo XD. Hybrid isoquinolines from Thalictrum foetidum: a new type of aporphine inhibiting Staphylococcus aureus by combined mechanisms. Organic Chemistry Frontiers. 2019 a;6(19):3428-34.
29. Cai-Feng DI, Zhi DA, Hao-Fei YU, Xu-Dong ZH, Xiao-Dong LU. New aporphine alkaloids with selective cytotoxicity against glioma stem cells from Thalictrum foetidum. Chinese journal of natural medicines. 2019 Sep 1;17(9):698-706.
30. Ding CF, Qin XJ, Yu HF, Liu YP, Wang XH, Luo XD. Thalicfoetine, a novel isoquinoline alkaloid with antibacterial activity from Thalictrum foetidum. Tetrahedron Letters. 2019 b Oct 10;60(41):151135.
31. Bae JY, Lee SR, Jung IC. The Effects of Thalictrum foetidum (TFD) on the Alzheimer's Disease Model. Journal of Oriental Neuropsychiatry. 2007;18(1):63-78.
32. KR K. Basu BD. Indian medicinal plants. Vol. II. Dehradun: International Book Distributors. 1987:1429.
33. Li DH, Guo J, Bin W, Zhao N, Wang KB, Li JY, Li ZL, Hua HM. Two new benzylisoquinoline alkaloids from Thalictrum foliolosum and their antioxidant and in vitro antiproliferative properties. Archives of pharmacal research. 2016 Jul;39(7):871-7.
34. Chattopadhyay SK, Ray AB, Slatkin DJ, Knapp JE, Schiff Jr PL. The alkaloids of Thalictrum foliolosum. Journal of Natural Products. 1981 Jan;44(1):45-9.
35. Bhakuni DS, Singh RS. The alkaloids of Thalictrum foliolosum. Journal of Natural Products. 1982 May;45(3):252-5.

36. Kumar A, Chowdhury SR, Sarkar T, Chakrabarti T, Majumder HK, Jha T, Mukhopadhyay S. A new bisbenzylisoquinoline alkaloid isolated from Thalictrum foliolosum, as a potent inhibitor of DNA topoisomerase IB of Leishmania donovani. Fitoterapia. 2016 Mar 1; 109:25-30.
37. Chattopadhyay SK, Ray AB, Slatkin DJ, Schiff Jr PL. Quaternary alkaloids of Thalictrum foliolosum. Phytochemistry. 1983 Jan 1;22(11):2607-10.
38. Sun N, Han Y. Cytotoxic isoquinoline alkaloids from the roots of Thalictrum foliolosum. Journal of Asian natural products research. 2021 Jan 2;23(1):1-8.
39. Ringmichon CL, Bindu G. Antipyretic activity of aqueous extracts of Thalictrum Foliolosum rhizome on yeast induced pyrexia in albino Rats. World Journal of Pharmacy and Pharmaceutical Sciences. 2014 Aug 11; 10:820-5.
40. Pandey G, Khatoon S, Pandey MM, Rawat AK. Altitudinal variation of berberine, total phenolics and flavonoid content in Thalictrum foliolosum and their correlation with antimicrobial and antioxidant activities. Journal of Ayurveda and integrative medicine. 2018 Jul 1;9(3):169-76.
41. Kumar R, Sharma N, Rolta R, Lal UR, Sourirajan A, Dev K, Kumar V. Thalictrum foliolosum DC: An unexplored medicinal herb from north western Himalayas with potential against fungal pathogens and scavenger of reactive oxygen species. Biocatalysis and Agricultural Biotechnology. 2020 Jul 1; 26:101621.
42. Khera N, Thakur Y, Bhatia A. Diversity in antimicrobial activity of some medicinal plants of high altitude area: Achyranthes aspera, Thalictrum foliolosum, Valeriana wallichii, Hedychium spicatum, Woodfordia fruticosa, Acorus calamu, Eupatorium cannabium. Asian J Plant Sci Res. 2012;2(5):638-42.
43. Das NG, Rabha B, Talukdar PK, Goswami D, Dhiman S. Preliminary in vitro antiplasmodial activity of Aristolochia griffithii and Thalictrum foliolosum DC extracts against malaria parasite Plasmodium falciparum. BMC research notes. 2016 Dec;9(1):1-5.
44. Walter NS, Bagai U. Antimalarial efficacy of Thalictrum foliolosum (Meadow rue) against chloroquine–resistant P. falciparum. J Trop Dis Pub Heal. 2015; 3:1000163.
45. Akhilesh NK, Bisht M. Antiepileptic activity of hydroethanolic extract of Thalictrum foliolosum on maximal electroshock (MES) and pentylenetetrazole (PTZ) induced seizure in rats. International journal of pharmacology & toxicology. 2017:71-6.
46. Zhang X, Zhao M, Chen L, Jiao H, Liu H, Wang L, Ma S. A triterpenoid from Thalictrum fortunei induces apoptosis in BEL-7402 cells through the P53-induced apoptosis pathway. Molecules. 2011 Nov;16(11):9505-19.
47. Zhang XT, Ma SW, Jiao HY, Zhang QW. Two new saponins from Thalictrum fortunei. Journal of Asian natural products research. 2012 Apr 1;14(4):327-32.
48. Jiang SQ, Zhang YB, Xiao M, Jiang L, Luo D, Niu QW, Li YL, Zhang XT, Wang GC. Cycloartane triterpenoid saponins from the herbs of Thalictrum fortunei. Carbohydrate research. 2017 Jun 5; 445:1-6.
49. Sun H, Zhang XT, Wang L, Zhang XQ, Wang Y, Chen SB, Xiao PG, Ye WC. Four New Cycloartane (= 9, 19-Cyclolanostane) Saponins from the Aerial

Parts of Thalictrum fortunei. Helvetica Chimica Acta. 2008 Oct;91(10):1961-6.
50. Zhang XT, Wang L, Ma SW, Zhang QW, Liu Y, Zhang LH, Ye WC. New cycloartane glycosides from the aerial part of Thalictrum fortunei. Journal of natural medicines. 2013 Apr;67(2):375-80.
51. Zhi-xing W, Guo-ping D, Tong-bin W, Zhi-da M. Studies on the alkaloids from Thalictrum fortunei. Journal of Integrative Plant Biology. 1990 Mar 20;32(3).
52. Gromova AS, Lutsky VI, Li D, Wood SG, Owen NL, Semenov AA, Grant DM. Thalicosides A1− A3, Minor Cycloartane Bisdesmosides from Thalictrum minus. Journal of natural products. 2000 Jul 28;63(7):911-4.
53. Gromova AS, Lutskii VI, Zinchenko SV, Ganenko TV, Semenov AA. Triterpene saponins from Thalictrum minus. VII. Structure of thalicoside E. Chemistry of Natural Compounds. 1993 Jul;29(4):498-501.
54. Gromova AS, Lutskii VI, Zinchenko SV, Ganenko TV, Semenov AA. Triterpene saponins from Thalictrum minus. VII. Structure of thalicoside E. Chemistry of Natural Compounds. 1993 a Jul;29(4):498-501.
55. Gromova AS, Lutsky VI, Semenov AA, Li D, Owen NL. The elucidation of the structure of thalicoside F, a minor oleanane glycoside from Thalictrum minus L. Phytochemistry. 1998 Feb 1;47(3):437-40.
56. Trofimova NN, Gromova AS, Lutsky VI, Semenov AA, Avilov SA, Kalinovsky AI, Li D, Owen NL. New triterpenoid glycosides from Thalictrum minus L. Russian chemical bulletin. 1998 Jul;47(7):1395-8.
57. Trofimova NN, Gromova AS, Lutsky VI, Semenov AA, Avilov SA, Li D, Owen NL. New Triterpenoid Glycosides from Thalictrum minus L. Part 11. Structure of Thalicosides H1. ChemInform. 1999; 30(44).
58. Popović M, Djurković R, Gašić O, Pal B, Dutschewska H, Kuzmanov B. Chemical and cytological investigation of Thalictrum minus from Vojvodina Region. Biochemical systematics and ecology. 1992 Apr 1;20(3):255-8.
59. Mushtaq S, Rather MA, Qazi PH, Aga MA, Shah AM, Shah A, Ali MN. Isolation and characterization of three benzylisoquinoline alkaloids from Thalictrum minus L. and their antibacterial activity against bovine mastitis. Journal of ethnopharmacology. 2016 Dec 4; 193:221-6.
60. Khaidav TS, Menshikova TA. In Lekarstvenie rastenia v Mongolskoi medizine. Akad. Nauk. MNR, Ulan Bator. 1978; 168:169.
61. Gusseva AP. Primenenie v Tibetskoi medicine zabaikalskih rastenii. Tridj Leningradskogopharma-cephticheskogo instituta. 1960:12-363.
62. Bazaron EG. Rani i ich lechenie v Tibetskoi medizine.1990.
63. Serkedjieva J, Velcheva M. In vitro anti-influenza virus activity of the pavine alkaloid (-)-thalimonine isolated from Thalictrum simplex L. Antiviral Chemistry and Chemotherapy. 2003 Apr;14(2):75-80.
64. Velcheva MP, Danghaaghiin S, Samdanghiin Z, Yansanghiin Z, Hesse M. Epimeric pavine N-oxides from Thalictrum simplex. Phytochemistry. 1995 Jun 1;39(3):683-7.
65. Velcheva MP, Petrova RR, Samdanghiin Z, Danghaaghiin S, Yansanghiin Z, Budzikiewicz H, Hesse M. Isoquinoline alkaloid N-oxides from Thalictrum simplex. Phytochemistry. 1996 May 1;42(2):535-7.
66. Umarov KS, Telezhenetskaya MV, Ismailov ZF, Yunusov SY. Alkaloids of Thalictrum simplex. Chemistry of Natural Compounds. 1970 Mar;6(2):219-20.

67. Varadinova TL, Shishkov SA, Ivanovska ND, Velcheva MP, Danghaaghin S, Samadanghiin Z, Yansanghiin Z. Antiviral and immunological activity of a new pavine alkaloid (-)-Thalimonine isolated from Thalictrum simplex. Phytotherapy Research. 1996 Aug;10(5):414-7.
68. Yoshimitsu H, Nishida M, Qian ZZ, Lei ZH, Nohara T. Four new triterpene glycosides from Thalictrum squarrosum. Chemical and pharmaceutical bulletin. 2000 Jun 1;48(6):828-31.
69. Khamidullina EA, Gromova AS, Lutsky VI, Li D, Owen NL. Squarroside C, a new cycloartene bisdesmoside from Thalictrum squarrosum. Journal of natural products. 1999 Nov 29;62(11):1586-8.
70. Yoshimitsu H, Miyashita H, Nishida M, Mineno T, Nohara T. Dolabellane Diterpene and Three Cycloartane Glycosides from Thalictrum squarrosum. Chemical and Pharmaceutical Bulletin. 2010 Aug 1;58(8):1043-6.
71. Lutskii VI, Khamidullina EA, Gromova AS, Semenov AA. Triterpene glycosides of Thalictrum squarrosum. III. Structures of squarrogenins 1 and 2. Chemistry of Natural Compounds. 1989 Jul;25(4):436-41.
72. Khamidullina EA, Gromova AS, Lutsky VI, Semenov AA, Li D, Owen NL. Flavonoid glycosides fromThalictrum squarrosum St. ex Willd. andThalictrum minus L. Russian chemical bulletin. 1999 Feb 1;48(2):390-2.
73. Gatilov YV, Bagryanskaya IY, Lutskii VI, Gromova AS, Semenov AA. Triterpene glycosides of Thalictrum squarrosum. II. Molecular and crystal structure of squarrofuric acid. Chemistry of Natural Compounds. 1987 Jul;23(4):444-7
74. Khamidullina EA, Gromova AS, Litskii VI, Vereshchagin AL, Semenov AA, Larin MF. Triterpene glycosides of Thalictrum squarrosum. IV. Structures of squarrosides A1, A2, B1, and B2. Chemistry of Natural Compounds. 1989 Jul;25(4):441-7.
75. Khamidullina EA, Gromova AS, Lutsky VI, Zinchenko SB, Semenov AA. New triterpene glycosides from Thalictrum squarrosum St. ex Willd. The structure of squarrosides B3 and B4. Russian chemical bulletin. 1996 Jun;45(6):1476-80.
76. Yan-jie ZO. A Survey on Medicinal Plants of Thalictrum Used by 15 Nationalities [J]. Chinese Journal of Ethnomedicine and Ethnopharmacy. 2003;1.
77. Al-Howiriny TA, Zemaitis MA, Gao CY, Hadden CE, Martin GE, Lin FT, Schiff PL. Thalibealine, a Novel Tetrahydroprotoberberine− Aporphine Dimeric Alkaloid from Thalictrum wangii. Journal of natural products. 2001 Jun 22;64(6):819-22.
78. Jin Q, Yang D, Dai Z, Khan A, Wang B, Wei X, Sun Y, Zhao YL, Wang YF, Liu YP, Zhao XD. Antitumor aporphine alkaloids from Thalictrum wangii. Fitoterapia. 2018 Jul 1; 128:204-12.
79. Jin Q, Wei X, Qin XJ, Gao F, Zhu PF, Yuan HL, Njateng GS, Dai Z, Liu YP, Luo XD. Racemic immunosuppressive seco-aporphine derivatives from Thalictrum wangii. Fitoterapia. 2020 Jan 1; 140:104445.

Table 1
Phytoconstituents isolated from *Thalictrum atriplex* Finet et Gagnep

Plant Part	Phytoconstituents	Reference
Roots and aerial part	Neothalfine and thaliatrine, thalifaberine, thalirecebine and thalistine	13,14
Aerial parts	kaempferol 3-O- [3‘‘-acetyl-α-L-arabinopyranosyl(1’ ‘ -6”)]-β-D-glucopyranoside	15
	Protocatechuic acid, para coumaric acid, Kaempferol,Caffeic acid along with β sitosterol	16
Whole plant	Cycloatriosides A (3-O- β-D-galactopyranosyl (20S, 24R)-3β, 16β,25,29-tetrahydroxy-20,24-epoxycycloartane-29-O- β-D-glucopyranoside) cycloatriosides B (3-O- β-D-galactopyranosyl-(1→2)- α –arabinopyranosyl-(1→6)- β-D-glucopyranoside) thaliatroside A	17

Table 2
Phytoconstituents isolated from *Thalictrum cultratum* Wallich

Plant Part	Phytoconstituents	Reference
Whole plant	(-) – 2-northalmine, (-)-O-methylthalmine, (-)-thiamine, (-)-2-northalidasine, (-)- thalrugosinone, (-)-thalidasine, (-)-N desmethylthalidasine,	19
	Thalifaramine, Thalifaberine, Thalifaretine, Thalifarazine, Thalifaroline, Thalifaricine, Thalifaronine	20
	(+)-2’-noroxyacanthine, (+)-neothalibrine-2’-α-N-oxide, (+)-thalidasine-2-α-N-oxide, (-)-5-hydroxythalidasine-2-α-N-oxide, (-)-thalrugosaminine-2- α-N-oxide, (+)-cultithalminine, (-)-thaligosine-2- α-N-oxide, (+)-2’-northaliphylline, (+)-thaliphylline-2’-β-N-oxide	21
Roots	thalicultratine L (tetrahydroprotoberberine-aporphine alkaloid), thalicultratines A–K (thalifaberine-type aporphine-benzylisoquinoline alkaloids) and Thalifaronine, Thalifaberine, Thalifabatine Dehydrothalifaberine and Thalibealine	21
	new benzyl-aporphine alkaloids 6a,7-dehydrothaliculine and Thaliculine	22

Table 3
Phytoconstituents isolated from *Thalictrum faberi* Ulbrich

Plant Part	Phytoconstituents	Reference
Roots	Thalifaberidine (6'8-desmethylthalifabrine), Thalifaramine, Thalifaricine, Thalifarazine, Thalifaronine	23
	3-hydroxy-6′-desmethyl-9-O methylthalifaboramine, 3-hydroxythalifaboramine, 3,5′-dihydroxythalifaboramine, 3-hydroxy-6′ desmethylthalifaboramine, 6′-desmethylthalifaboramine, 5′-hydroxythalifaboramine	24
	Thalifasine, Dehydrothalifaberine, Thalifaberine, Thalifabine, Thalifarapine, Thalifabatine are Aporphine-benzylisoquinoline dimers and Faberidine, Dehydrohuangshanine, Huangshanine, Faberonine are Fetidine-type alkaloids	25
	Thalifabromine, a new dimeric aporphinoid alkaloid	26

Table 4
Phytoconstituents isolated from *Thalictrum foetidum* Linnaeuss

Plant Part	Phytoconstituents	Reference
Epigeal part	Cyclofoetoside A (24S-cycloartane-3β, 16β, 24, 25, 29-pentaol 3-O-α-L-arabinopyranoside 16-O-[O-α-L-rhamnopyranoside-(1 → 6)-β-D-glucopyranoside])	27
Whole part	Aporphine alkaloids, Thalfoetines A–D	28
Roots	9-(2′-formyl-5′, 6′-dimethoxyphenoxy)-1, 2, 3, 10-tetramethoxy dehydroaporphine; (−)-9-(2′-methoxycarbonyl-5′, 6′-dimethoxyphenoxy)-1, 2, 3, 10-tetramethoxy aporphine; (−)-2′-methoxycarbonyl thaliadin; 3-methoxy-2′-formyl oxohernandalin; (−)-9-(2′-methoxyethyl-5′, 6′-dimethoxyphenoxy)-1, 2, 3, 10-tetramethoxy aporphine; (−)-3-methoxy hydroxyhernandalinol; 3-methoxydehydrohernandaline; 6-(1, 3-dioxolo [4, 5-g] isoquinolin-5-ylcarbonyl)-2; 3-dimethoxy-benzoicacidmethyl ester; 8-oxyberberine; Thaliadine; Berberine; 9-(2′-formyl-5′,6′-dimethoxyphenoxy)-1, 2, 3, 10-tetramethoxy oxoaporphine; *O*-methylflavinantine	29
	O-bridged spirobenzylisoquinoline alkaloid named Thalicfoetine have a spirotetrahydropyridine-furanone core	30

Table 5
Phytoconstituents isolated from *Thalictrum foliolosum* DC

Plant Part	Phytoconstituents	Reference
Entire plant	Thalfoliolosumines A and Thalfoliolosumines B, chloro-containing benzylisoqinoline alkaloids along with eight isoquinoline alkaloids named as thalrigosidine, thalirugine, 8-oxyberberine, palmatine,thalirugidine, berberine,thalrugosaminine, jatrorrhizine Thalfoliolosumines A (9'R-hydroxy-3',4'-methylenedioxol-6'-vinylbenzyl-3-chloro-5,6-dimethoxyisoquinoline)	33
Roots	Thalrugosidine, Thaligosine,Thalirugidine, Oxyberberine (berlambine), Thalrugosaminine	34
Rhizomes	N, O, O-Trimethylsparsiflorine, Magnoflorine, Thalidasine, Reticuline, Thalrugosidine,Berberine, Palmatine, Thalicarpine	35
Stem	6, 6', 7', 12-tetramethoxy-5'-hydroxy-2, 2'dimethyloxycanthan, Thalifendine, 6, 5', 6', 7', 12- pentamethoxy-2, 2'-dimethyloxycanthan and Berberine	36
Roots	Thalifendine, Columbamine, Palmatine, Jatrorrhizine, Berberine, Rugosinone, Thalidastine, Xanthoplanine, Dehydrodiscretamine, Magnoflorine, Tembetarine	37
	3-methoxy-10-O-acetylprodensiflorin B, 5,6,7,12-tetramethoxy-2-methyl-13-hydroxy-11-(4′-carbonylphenoxy) benzylisoquinoline, 5,6,7,12-tetramethoxy-2-methyl-13-hydroxy-11-(4′methoxycarbonylphenoxy) benzylisoquinoline	38

Table 6
Phytoconstituents isolated from *Thalictrum fortune* S. Moore

Plant Part	Phytoconstituents	Reference
Aerial part	3-O-β-d-glucopyranosyl (1 → 4)-β-d-fucopyranosyl-(22S,24Z)-cycloart-24-en-3β,22,26,30-tetraol 26-O-β-d-glucopyranoside; 3-O-β-d-glucopyranosyl (1 → 4)-β-d-fucopyranosyl-(22S,24Z)-cycloart-24-en-3β,22,26,29-tetraol 26-O-β-d-glucopyranoside	47
Whole plant	Thaliside A (3-O-β-D-glucopyranosyl-(1→4)-β-D-xylopyranosyl (22S,24Z)-cycloart-24-en-3β,22,26,30-tetraol 26-O-β-D-glucopyranoside); Thaliside B (3-O-β-D-glucopyranosyl-(1→4)-β-D-xylopyranosyl-(1→4)-α-L-arabinopyranosyl-(1→6)-β-D-glucopyranosyl-(1→4)-β-D-fucopyranosyl (22S,24Z)-cycloart-24-en-3β,22,26-triol 26-O-(6-O-acetyl-β-D-glucopyranoside); Thaliside C (3-O-β-D-glucopyranosyl-(1→4)-β-D-xylopyranosyl- (1→6)-β-D-glucopyranosyl-(1→4)-β-D-fucopyranosyl (22S,24Z)-cycloart-24-en-3β, 22,26-triol 26-O-(6-O-acetyl-β-D-glucopyranoside); Thaliside D (3-O-β-D-xylopyranosyl-(1→4)-α-Larabinopyranosyl-(1→6)-β-D-glucopyranosyl-(1→4)-β-D-fucopyranosyl (22S,24Z)- cycloart-24-en-3β,22,26-triol 26-O-β-D-glucopyranoside); Thaliside	48

	E (3-O-β-D-glucopyranosyl-(1→4)-β-Dfucopyranosyl (22S,24Z)-cycloart-24-en-3β,22,26,30-tetraol 26-O-(6-O-acetyl-β-Dglucopyranoside); Thaliside F (3-O-β-D-quinovopyranosyl-(1→6)-β-D-glucopyranosyl-(1→4)-β-D-fucopyranosyl (22S,24Z)-cycloart-24-en-3β,22,26,30-tetraol 26-O-β-D-glucopyranoside); 3-O-β-D-glucopyranosyl (1→4)-β-D-fucopyranosyl (22S,24Z)-cycloart-24-en-3β,22,26,30-tetraol 26-O-β-Dglucopyranoside; 3-O-β-D-glucopyranosyl-(1→4)-β-D-fucopyranosyl (22S,24Z)- cycloart-24-en-3β,22,26-triol 26-O-β-D-quinovopyranosyl-(1→6)-β-D-glucopyranoside; 3-O-β-D-glucopyranosyl-(1→4)-β-D-fucopyranosyl (22S,24Z)- cycloart-24-en-3β,22,26-triol 26-O-β-D-glucopyranoside; 3-O-β-Dglucopyranosyl (24S)-cycloartane-3β,16β,24,25,30-pentaol 25-O-β-D-glucopyranosyl- (1→6)-β-D-glucopyranoside	
	3β,16β,24S)-cycloartane-3,16,24,25,30-pentol 3,25-di-β-D-glucopyranoside, 3β,16β,24S)-24-(acetyloxy)cycloartane-3,16,25,30-tetrol 3,25-di-β-D-glucopyranoside, 3β,16β,24S)-24-(acetyloxy)-3-(β-D-glucopyranosyloxy)cycloartane-16,25,30-triol 25-[β-D-glucopyranosyl-(1→6)-β-D-glucopyranoside, 3β,16β,24S)-24-(acetyloxy)-3-(β-D-glucopyranosyloxy)cycloartane-16,25,30-triol 25-[β-D-glucopyranosyl-(1→4)-β-D-glucopyranoside	49
	3-O-β-D-xylopyranosyl-(1 → 6)-β-D-glucopyranosyl-(1 → 4)-β-D-fucopyranosyl (22S,24Z)-cycloart-24-en-3β,22,26-triol 26-O-(6-O-acetyl)-β-D-glucopyranoside, 3-O-α-L-arabinopyranosyl-(1 → 6)-β-D-glucopyranosyl-(1 → 4)-β-D-fucopyranosyl (22S,24Z)-cycloart-24-en-3β,22,26-triol 26-O-(6-O-acetyl)-β-D-glucopyranoside, 3-O-β-D-glucopyranosyl (24S)-cycloartane-3β,16β,24,25,30-pentaol 25-O-β-D-glucopyranosyl-(1 → 6)-β-D-glucopyranoside, 3-O-β-D-glucopyranosyl (24S)-cycloartane-3β,16β,24,25,30-pentaol 25-O-β-D-glucopyranosyl-(1 → 4)-β-D-glucopyranoside.	50
	Thalifortine, N-phenyl-2-haphthylamine and another compound similar with aromolirie	51

Table 7
Phytoconstituents isolated from *Thalictrum minus* Linn

Aerial part	Thalicoside A1 (3-O-β-d-galactopyranosyl-29-O-β-d-glucopyranosyl-3β,16β,29-trihydroxy-22(S),25-epoxycycloartane) Thalicoside A2 (3-O-α-l-arabinopyranosyl-29-O-β-d-glucopyranosyl-3β,16β,29,22(S)-tetrahydroxycycloart-24-ene) Thalicoside A3 (3-O-α-l-arabinopyranosyl-29-O-β-d-glucopyranosyl-3β,16β,29-trihydroxy-22(S),25-epoxycycloartane)	52
Epigeal part	Thalicoside C (3β,16β,22(S),29-tetrahydroxy-9,19-cyclo-20(S)-lanost-24-ene 3-O-β-galactopyranoside 22,29-di-O-β-D-glucopyranoside)	53
	Thalicoside E (9,19-cyclo-20(S)-lanost-23-ene-3β,16β,22ζ,25,29-pentaol 3-O-β-D-galactoside 29-O-β-D-glucopyranoside)	53
	Thalicoside E (9,19-cyclo-20(S)-lanost-23-ene-3β,16β,22ζ,25,29-pentaol 3-O-β-D-galactoside 29-O-β-D-glucopyranoside)	54

Above-ground part	Thalicoside F (3-β-*O*-[α-L-rhamnopyranosyl-(1→ 2) -β-D-glucopyranosyl-(1 → 4)-α-L-arabinopyranosyl]-11α, 12α-epoxyoleanane-28,13β-olide)	55
Terrestrial part	Thalicoside G_1 (3-O-β-D-galactopyranosyl-29-O-β-D-glucopyranosyl-9β, 19-cyclo-20(S)-lanost-24(Z)-ene-3β, 16β, 22(S), 26, 29-pentaol) thalicosides G_2 (3-O-β-D-galactopyranosyl-29-O-β-D-glucopyranosyl-9β, 19-cyclo-20(S)-lanost-25-ene-3β, 16β,22(S), 24ζ, 29-pentaol)	56
	Thalicoside H_1, (22S,25-epoxy-3-O-β-D-galactopyranosyl-29-O-β-D-glucopyranosyl-9β, 19-cyclo-20S-lanostane-3β,16β,24S,29-tetrol)	57
Aerial part	Thalmethine, O-methylthalmethine, Thalicberine and O-methylthalicberine and Thaliglucine, Thaliporphine, Berberine, Thalactamine, Thalflavine	58
Roots	bisbenzylisoquinoline alkaloids, 5′-Hydroxythalidasine, O-Methylthalicberine Thalrugosaminine	59

Table 8
Phytoconstituents isolated from *Thalictrum simplex*

Plant Part	Phytoconstituents	Reference
Aerial parts	(-)-thalimonine, (3,4-methylene-deoxy-2,8,9-trimethoxypavinan)	63
	epimeric N-oxides, (-)-thalimonine N-oxide, (-)-thalimonine N-oxide B and (+)-leucoxylonine	64
	Aporphine alkaloids, (+)-thalicsimdine N-oxide, (+)-thalicsimidine, (+)-preocoteine, (+)-ocoteine and (+)-preocoteine N-oxide	65
	Thalicmine, magnoflorine, β-allocryptopine, thalicminine and thalicristine	66

Table 9
Phytoconstituents isolated from *Thalictrum squarrosum* Stephan ex Willd

Plant Part	Phytoconstituents	Reference
Aerial parts	Squarroside I designated as cycloartane type glycosides whereas Squarroside II, III and IV as oleanene glycosides. Squarroside II (3-O-β-D-glucopyranosyl-(1→4)-[α-L-rhamnopyranosyl-(1→2)]-β-D-xylopyranosyl oleanolic acid 28-*β-D-glucopyranosyl ester*	68
	cycloartane 3,21-bisdesmoside, Squarroside C (3-O-[O-α-l-rhamnopyranosyl-(1→6)-β-d-glucopyranosyl]-21-O-β-d-glucopyranosyl-21(S),22(S),23(R),3β,21α,22β,30-tetrahydroxy-21,23-epoxycycloart-24-ene)	69
	Squoside A (dolabellane diterpene glycoside), Squarrosides V, VI, VII (Cycloartane glycosides)	70

	Squarrogenin 1 and squarrogenin 2, squarrosides A1 and A2. Squarrogenin 1 (21R, 22S, 23R)-21-methoxy-21,23-epoxycycloart-24-ene-3β,22β-30-triol Squarrogenin 2 as (21S, 22S, 23R)-21-methoxy-21,23-epoxycycloart-24-ene-3β,22β,30-triol	71
	7-O-(6-O-acetyl-β-allopyranosyl)-4′-O-(β-allopyranosyl)apigenin	72
	artifactual genin, squarrofuric acid (3β,30-dihydroxy-20(S),22(S)-22,25-epoxylanost-9(11)-en-21-oic acid)	73
	Squarroside A1 (21R, 22S, 23R)-3β-(β-D-glucopyranosyloxy)-21α-methoxy-21,23-epoxycycloart-24-ene-22β,30-diol), Squarroside A2 (the (21S)-epimer of compound A1 Squarroside B1 (21R, 22S, 23R)-3gb-[O-α-L-rhamnopyranosyl-(1 → 6)-β-D-glucopyranosyloxy]-21α-methoxy-21,23-epoxycycloart-24-ene-22β,30-diol Squarroside B2 (the (21S)-epimer of compound (B1)	74
	Squarroside B3 – (3-O-[O-(α-L-rhamno-pyranosyl)-(1←6)-β-D-glucopyranosyl]-21 (S),22(ε),23(R)-3β,21,22,30-tetralmydroxy-21, 23-cpoxycycloartlt-24-ene, Squarroside B4 - 21(R) epimer of B3.	75

Table 10
Phytoconstituents isolated from *Thalictrum wangii* B. Boivin

Plant Part	Phytoconstituents	Reference
Roots	(-)-thalibealine, berberine, (+)-magnoflorine and (+)-thalmelatidine	77
	(−)-10-O-acetyl prodensiflorin A (−)-10-O-acetyl prodensiflorin B], (+)-8-(4′-formylphenoxy) glaucine, (+)-8-(4′-hydroxymethylphenoxy) glaucine, (+)-3-methoxy-8-(4′-formylphenoxy) glaucine 1,2,3,9,10-pentamethoxy-11-(4′-formylphenoxy)-7-oxoaporphine, 1,2,9,10-tetramethoxy-11-(4′-formylphenoxy)-7-oxoaporphine 6,7,12-trimethoxy-2-methyl-13-hydroxy-11-(4′-formylphenoxy) 5,6-(methylenedioxy)-7,12-dimethoxy-2-methyl-10-(4′-formylphenoxy). Prodensiflorin B, Thalidine, 4-methoxyoxohernandaline.	78