International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 1 Jan-Feb 2021, pp: 85-95 www.ijprajournal.com ISSN: 2249-7781

A Review of Phyto-Chemical Constituent and Pharmacological Activity of Thuja Species

Mohit Gupta[1], Komal Sharma[2]
[1,2]*Department of Pharmacy, Shri Ram Murti Smarak College of Engineering and Technology, Bareilly, U.P. India*

Date of Submission: 25-12-2020 Date of Acceptance: 10-01-2021

ABSTRACT: Traditional healthcare systems play an important role in our healthcare system. The villagers use this plant mainly for the treatment of various diseases. Thuja belongs to the family of cupressacae. This is commonly used in Ayurvedic medicine. There are five species in the thuja genus, three local to eastern Asia and two local to North America. Phylogenomic investigations resolved two sister sets, T. standishii- T.koraiensis andT.ocidentalis- T.sutchuenensis, with T. Plicata sister to T. occidentalis-T. sutuenensis. This alternative system of medication is increasing expanding fame overall Thuja species are generally used as an antiviral, antibacterial, anti-cancer, anti-diabetic, anti HIV, anti fungal etc. Antiviral action and immunopharmacological action of Thuja,as stimulatory effects on cytokine and antibody production and also activate macrophages cells, have been tested in various in vivo and in vitro study. Thuja species have different chemical substances like thujone, Isothujone, fenchone, sabines and α-pinen. This review article provides comprehensive information on various useful and traditional medicinal properties of chemical composition and pharmacological activity of plants and their components.

KEYWORDS: Thuja, Antiviral, Antibacterial, Anti-cancer, Anti-diabetic.

I. INTRODUCTION

Ayurveda, an old Indian treatment, is perceived as one of the most significant frameworks of option and integral medication. Like other herbal systems, most medications are based on local herbs. In the recent years, the interest for therapeutic plants has expanded in a lot. Aside from this; western countries are preferred it and conducting various researches on plant based medicines.[1]

The thuja grows from 10 to 200 feet in height and is an evergreen tree with a reddish brown crust. Usually the leaves are 1-10 mm long, and the needles are scaly, like in the first year. Most places are grown as ornamental plants. The leaves are organized on the branches in four rows, substituting decoupage two by two. The flowers are monotonous (a few flowers are male or female, yet are found in both genders on a similar plant) and are pollinated by the wind. Male and female flowers usually grow from separate branches or twigs.[2]

Thuja are small, distal and tapered. The cones of the males are round, red or yellowish, while the females are very small, green or purple. It is a large humid place with dense greenery and a habit of growing shrubs.[3]

TAXONOMICAL CLASSIFICATION:

- **Domain**: Eukaryota
- **Kingdom**: Plantae
- **Subkingdom**: Viridaeplantae
- **Phylum**: Pinophyta
- **Subphylum**: Euphyllophytina
- **Infraphylum**: Radiatopses
- **Class**: Pinopsida
- **Order**: Pinales
- **Family**: Cupressaceae
- **Tribe**: Spiraeeae
- **Genus**: Thuja

The five species of Thuja are-

- Thuja koraiensis- Korean Thuja
- Thuja occidentalis- Eastern Arborvitae, Northern White cedar
- Thuja plicata- Western Red cedar
- Thuja standishii- Japanese Thuja
- Thuja sutchuenensis- Sichuan Thuja

Thuja koraiensis

The tree of life is the common name for one of the coniferous or evergreen shrubs of the

International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 1 Jan-Feb 2021, pp: 85-95 www.ijprajournal.com ISSN: 2249-7781

genus Thuja, belonging to the evergreen family (William and Jackson, 1967). Thuja leaves are plentiful in nutrient C and were utilized by Native Americans and early European specialists to treat scurvy. The leaves are utilized to treat rheumatism. Curiosities are often referred to as the herb commonly used to treat human papillomavirus (HPV), genitalia, or warts. Height up to 3-10 m. The leaves form a flat sprayer with large leaves 2 to 4 mm (up to 15 mm if the shoots are very strong), dark green on top and dark white waxy stripes on the bottom. Cones are oval, yellow-green, ripe, reddish-brown, 7-11 mm long, 4-5 mm wide (up to 6-9 mm), with 8 to 12 overlapping scales.[4]

Figure 1: Plant of Thuja koraiensis

Thuja occidentalis

The most commom name of Thuja occidentalis are Northern white-cedar, thuiercedre, cedre-thuya occidental, eastern whitecedar, American or eastern arborvitae.The Northern White Cedar is a monoecious conifer achieving a height of 15-38 m, having a tendency to be hindered or prostrate in cruel, cold conditions. Sporadically the trunk is partitioned into a few auxiliary stems, frequently imitating from fallen trunks. The skin is reddish brown or gray, 6-9 mm thick, fibrous and matted. Eggplant leaves are 1.5-3.5 mm long, and both surfaces are pointed in yellow-green. Pollen flowers 1-2 red, ellipsoidal, 9-14 mm long and brown.[3]

Figure 2: Plant of Thuja occidentalis

Thuja plicata

Thuja plicata,is a species of Thuja normally called western red cedar or Pacific red cedar, giant arborvitae or western arborvitae, giant cedar, or shinglewood. It's anything but a genuine cedar of the class Cedrus. Thuja plicata is among the most expansive trees in the Pacific Northwest. It is related with Douglas-fir and western hemlock in many place where it develops. It is achieve at the height scope of ocean level to a limit of 2,290 m (7,510 ft) above ocean level at Crater Lake in Oregon. Notwithstanding developing in rich woodlands and mountainsides, western red cedar is likewise a riparian tree, developing in many forested marshes and stream banks in its range. The tree is conceal open minded and ready to recreate under thick shade. It has been familiar with other gentle zones, including western Europe, Australia (at any rate as far north as Sydney), New Zealand, the eastern United States (in any occasion as far north as Central New York),[citation needed] and higher ascents of Hawaii. Thuja plicata is a tremendous to immense tree, going up to 65 to 70 m (213 to 230 ft) tall and 3 to 7 m (9.8 to 23.0 ft) in trunk expansiveness. Trees developing in the open may have a crown that arrives at the ground, though trees thickly dispersed together will display a crown just at the top, where light can arrive at the leaves.[5]

International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 1 Jan-Feb 2021, pp: 85-95 www.ijprajournal.com ISSN: 2249-7781

Figure 3: Plant of Thuja plicata

Thuja sutchuenensis

Thuja sutchuenensis, the Sichuan thuja, is a species of Thuja, an evergreen coniferous tree in the cypress family Cupressaceae. It is local to China, where it is an risked close by endemic in Chengkou County, on the southern grade of the Daba Mountains. It is a little or medium-sized tree, showing up at possibly 20 m tall, anyway no trees of this size are starting at now known. The foliage structures in level sprinkles with scale-like leaves 1.5–4 mm long, green above, and with tight white stomatal gatherings underneath. The cones are oval, green developing natural shaded, 5–8 mm long and 3-4.2 mm wide (opening to 7 mm wide), with 8-10 covering scales.[6]

Figure 4: Plant of Thuja sutchuenensis

Thuja standishii

Thuja standishii (Japanese thuja; nezuko, kurobe) is a species of thuja. It is nearby to southern Japan, where it occurs on the islands of Honshū and Shikoku. It is a medium-sized tree, showing up at 20–35 m tall and with a trunk up to 1 m estimation. The foliage structures in level showers with scale-like leaves 2–4 mm long, matte green above, and with tight white stomatal gatherings underneath. The cones are oval, yellow-green maturing red-hearty hued, 6–12 mm long and 4–5 mm wide (opening to 8 mm wide), with 6–10 covering scales. It is a significant lumber tree in Japan, developed in ranger service manors for its solid, waterproof, alluringly scented wood. There is some proof that concentrates of. T standishii have biological action. It is having a compound called standishinal which has demonstrated generally intense impacts on the enzyme aromatase. It goes about as an inhbitor, along these lines diminishing the production of Estradiol in the human body. This compound shown even powerful inhibition of Aromatase.[7]

Figure 5: Plant of Thuja standishii

PHYTOCHEMISTRY

The new plant of Thuja (identified with the dry substance) contains 0.6% basic oil, 2.07% diminishing sugar, 4.9% water-dissolvable polysaccharides, 2.11% water-solvent minerals, 1.67% free corrosive and 1.31% tannic operators. The basic oil of the new leaves (identified with the monoterpene division) contains 65% thujone, 8% isothujone, 8% fenchone, 2% α-pinen and 5% sabines (figure 6, 7, 8, 9 & 10) as the fundamental monoterpenes. Different monoterpenes, in particular carvotanacetone, origanol, origanes, myrcen and camphen, have been portrayed

International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 1 Jan-Feb 2021, pp: 85-95 www.ijprajournal.com ISSN: 2249-7781

Recently, further bioactive constituents have been found. High sub-atomic weight glycoproteins/ polysaccharides are exceptionally pertinent for the movement of the plant.[1]

The most noteworthy substance of fundamental oil was found in removes acquired by refining, whils permeation with sanitized water diminished the thujone contentin the concentrate to the least level.Using purged water as a dissolvable, a normal of 0.6mg of thujone was extricated from 1gof medication during permeation. In contrast, when 30% (v/v) ethanol was utilized, 2.8mg of thujone was extricated from 1g of Thuja occidentalis spice a, and>2.5-overlap higher measures of thujone (7.9mg) were accomplished with high ethanol concentration(90%v/v).[3]

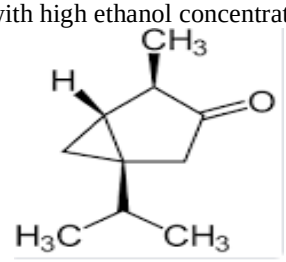

Figure 6: Thujone

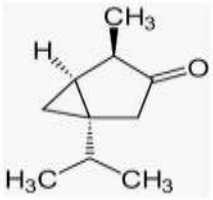

Figure 7: Isothujone

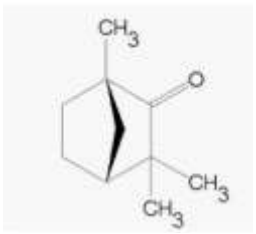

Figure 8: Fenchone

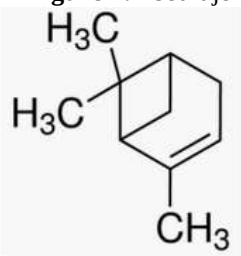

Figure 9: α-Pinene

Figure 10: Sabine

The Five new components including two stilbenes to be specific thujasutchinsA and B, two phenolic mixes assigned thujasutchins C and D, as well as one sesquiterpene thujasutchin E (figure 11),were detached from the 95% ethanolic remove from the trunks and foundations of Thuja sutchuenensis. Their structures were assessed by methods for widely spectroscopic examination including UV, IR, HRESIMS, 1H and 13C NMR (Cozy, HSQC, HMBC). What's more, mixes 1, 3–5 were surveyed for in vitro cytotoxic exercises against SF-268, MCF-7, HepG-2, and A549 tumor cell lines.[6]

Figure 11: Structure of thujasutchins A(1), B(2), C(3), D(4) and E(5)

The constituents of the dried natural substance Thuja occidentalis spice are recorded in Table 1. As per Hänseletal, the medication contains 1.4–4% basic oil, 60% of which is thujone, which relates to 2.4% thujone in the entire medication. Thujone happens in nature as a combination of α- and β-isomers. As per the European Agency for the Evaluation of Medicinal Products (EMEA), the substance of thujonein dried twigs was resolved as 7.6mg/g, comprising of 85% α-thujone and 15% β-thujone. The balance blend comprises of 33% α-thujone and 67% β-thujone.[3]

The dried Thujae occidentlis herba having following constitution-

Group	Constituents
Essential oil (1.4–4% of drug)	Borneol
	Camphene
	Fenchone
	Limonene

International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 1 Jan-Feb 2021, pp: 85-95 www.ijprajournal.com ISSN: 2249-7781

Group	Constituents
	Myricene
	α-Terpine
	Terpinolene
	Thujone (0.76–2.4% of essential oil, 85% α-thujone, 15% β-thujone)
	Thujylalcohol
Coumarins	p-Coumaric acid
	Umbelliferone
Flavonoids	(+/−)-Catechine
	(−)-Gallocatechine
	Kaempherol
	Kaempherol-3-O-α-rhamnoside
	Mearnsitrin
	Myricetine
	Myricitrin
	Procyanidin B-3
	Prodelphinidin
	Quercetin
	Quercitrin
Other	Tannic acid (~1.3% of drug)
	Thuja polysaccharides and proteins (~4% of drug)

Table 1: Constituents of the dried herbal substance Thuja occidentalisherba.

PHARMACOLOGICAL ACTIVITIES

ANTI MICROBIALACTIVITY

The antimicrobial movement of the T. koraiensis separate by paper circle scattering look at against the test living beings. The concentrate stifled Gram-positive minuscule creatures S. aureus and B. subtilis, with breadths across of restriction zone 17 and 13 mm, Gram-negative microorganisms E. coli and S. typhimurium, with measurements of prevention zone 15 and 12 mm. Particularly, the antimicrobial effect of concentrate at the B. subtilis strain was higher than in the control. The MIC esteems went from 0.6 to 12.5% of the concentrate. The concentrate displayed the most elevated action against B. subtilis,with MIC of 0.6%.The outcomes demonstrated that T. koraiensis remove has antimicrobial action both at gram-positive and gram-negative microscopic organisms. At different investigations, the development of gram-positive microorganisms was restrained successfully than gram-negative microscopic organisms in an examination utilizing quercetin and naringenin which are single mixes in a phenolic compound, while it had comparable examination results for the T. koraiensis remove single compound. Yet, likewise, the consequences of the T. koraiensis remove had a superior antimicrobial impact at gram-positive microorganisms in this investigation which may contain phenolic compound in the T. koraiensis separate. Further examination was finished breaking down T. koraiensis antimicrobial viable single compound using superior fluid chromatography (HPLC) profiling.[4]

Leaf oil (CLO), separated from the Westernred cedar, Thuja plicata, was utilized as asafeand satisfactory wide range antimicrobial specialist, with a view to its likely applications in structures, including the all eviation of debilitated structure disorder.Different Gram-positive and Gram-negative human microbes, and two parasitic life forms, all known to be normal atmo circle wellsprings of possible sicknesses, were shown and tried quantitatively, and every one of them were discovered to be defenseless to CLO fluid and vapor.[8]

ANTI VIRALACTIVITY

The antiviral activity of 1% T. koraiensis separate against BVD infection. The result exhibited that the MNCC of T. koraiensis separate on MDBK cells was 0.031% and the MNTD of concentrate was 0.0195% on BVD infection replication in MDBK cells. Especially, the concentrate at low fixations had a solid antiviral impact at BVD infection; BVD infection is a RNA infection. T. koraiensis separate had antiviral impact at RNA infection. T. koraiensis separate, which hostile to infection influences, will show up at DNA infection and ought to be more trial test in the future.In rundown, T. koraiensis separate would be advised to antiviral impact. Also, we had first recognized that Korean Arbor vitae

International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 1 Jan-Feb 2021, pp: 85-95 www.ijprajournal.com ISSN: 2249-7781

(Thujakoraiensis) remove has sway about antiviral.[4]

ANTI BACTERIAL ACTIVITY

The alcoholic concentrate of twigs of Thuja occidentalis was set up for Antibacterial activity against both gram negative and gram positive life forms i.e., Pseudomonas aeruginosa, Yersinia aldovae, Citrobacter, Shigella flexneri, E. coli and Staphylococcus aureu, Vernonia anthelmintica, Dryopteris chrysocoma and Trachyspermum ammi were tried In vitro for their antibacterial and antifungal exercises. Antibacterial assessment performed against six microscopic organisms viz., Escherichia coli, Citrobacter, Shigella flexenari, Yersinia aldovae, Staphylococcus aureus and Pseudomonas aeruginosa indicated that had powerful movement against all microorganisms. The antifungal activity of these concentrates was performed against six growths, viz., Saccharomyces cereviciae, Aspergillus parasiticus, Trichophyton rubrum, Macrophomina, Fusarium solani and Candida albicans. The concentrates showed critical results against different parasitic strains.[9]

ANTI- CANCER

Thujone rich segment of Thuja occidentalis showed noteworthy enemy of malignant growth possibilities confirmations from in vitro examinations on A375 cells. Unrefined ethanolic concentrate of Thuja occidentalis was used as homeopathic mother color (TOΦ) to treat various diseases, particularly moles and tumors, and besides used in various different frameworks of conventional medication. Hostile to proliferative and apoptosis-initiating properties of TOΦ and the thujone-rich portion (TRF) separated from it have been evaluated for their conceivable enemy of disease possibilities in the threatening melanoma cell line A375. On starting preliminary by S-diphenyltetrazolium bromide measure, both TOΦ and TRF demonstrated greatest cytotoxic effect on A375 cell line while the other three chief parts disengaged by chromatography had irrelevant or no such effect, as a result of which just TRF was moreover depicted and presented to certain different analyzes for deciding its exact enemy of proliferative and apoptotic possibilities. TRF was accounted for to have an atomic equation of C10H16O with a sub-atomic load of 152. Introduction of TRF of Thuja occidentalis to A375 cells in vitro demonstrated more cytotoxic, antiproliferative and apoptotic impacts as contrasted and TOΦ, anyway had immaterial advancement inhibitory reactions when introduced to typical cells (fringe blood mononuclear cell). Additionally, both TOΦ and TRF similarly caused a critical lessening in cell reasonability, actuated between nucleosomal DNA fracture, mitochondrial transmembrane likely breakdown, improve in ROS age, and arrival of cytochrome c and caspase-3 enactment, which are all firmly identified with the enlistment of apoptosis in A375 cells. Thusly, TRF showed up and composed all the counter malignancy reactions of TOΦ and could be the primary bio-dynamic portion. The usage of TOΦ in customary meds against tumors has, subsequently, an intelligent basis.[10]

ANTI-HIV ACTIVITY

Thuja polysaccharides (TPS) repressed human immunonodeficiency infection (HIV)- subordinate cell passing at a last convergence of 625 µg/ml. At this fixation, TPSg was shown to be totally non-harmful for MT-4 cells, which had not been tainted with HIV-1. TPS were seemed to hinder HIV-1-explicit antigen articulation on newly contaminated MT-2 cells in a portion subordinate manner.[10]

ANTIBODY PRODUCTION

The retentate division conveyed a focus subordinate increment in the amount of immune response creating lymphocytes in the hemolytic plaque examine in vitro. The amount of against SRBC-(sheep red platelet)- IgM-delivering plasma cells rose, as did all Ig-emitting plasma cells, as enlisted by the 'opposite' method utilizing protein A-marked SRBCs. Hatching with lipopolysaccharide (LPS) as certain control likewise prompted a fixation subordinate addition in the amount of plaque-framing cells.[10]

ANTISPASMODIC ACTIVITY

Antispasmodic action of Thuja occidentalis twigs was evaluated by Noorjahn and mansoor Ahemad and found to have noteworthy effect on detached tissues.[10]

ANTIOXIDANTS ACTIVITY

Lipid peroxidation action was finished to survey the cell reinforcement potential on took care of rodents. The cancer prevention agent movement of ethanol part was upgraded in a focus subordinate way. Around 100, 150, 200, 250 and 300 µg EFTO (ethanol portion of concentrate of ethereal piece of

International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 1 Jan-Feb 2021, pp: 85-95 www.ijprajournal.com ISSN: 2249-7781

Thuja occidentalis) quelled the FeSO4 initiated lipid peroxidation in a portion subordinate way and exhibited IC50 esteem 195.60µg/ml. The results acquired in this examination show that EFTO can be a likely wellspring of regular cancer prevention agent and exercises identified with this. The drunkard and fluid concentrate of Thuja occidentalis twigs set up for calming and cancer prevention agents activity.[10]

ANTI DIABETIC ACTIVITY

The investigation was to determine the anti diabetic action ofethanolic fraction of Thuja occidentalis (EFTO) and to probe into its mechanism of action. Fasting blood sugar, blood glutathione levels and serum biochemical determination in alloxan induced diabetes were studied. EFTO released a significant anti diabetic action at dose level of 200 mg/kg. EFTO also having significant about increase in blood glutathione level due to its antioxidant activity.[10]

HEPATOPROTECTIVE ACTIVITY

The hepatoprotective possible effect of ethanolic part of Thuja occidentalis has been against CCL4 impelled liver harm in rodents. A portion of EFTO 400 mg/kg p.o.exhibited basic affirmation from liver harm in intense and ongoing CCL4 actuated liver harm model. Histopathological appraisal was finished after the treatment to assess hepato assurance. The division was found to have extraordinary hepatoprotective property in ethanolic remove, Hepatoprotective activity was evaluated.[10]

INSECTICIDAL ACTIVITY

Insecticidal movement of two known bug sprays (deltamethrin and imidacloprid), thujone and fundamental oil of rosemary against the hatchlings and grown-ups of sycamore ribbon bug (Corythucha ciliata) was assessed. The investigation was coordinated in an exploration office, under room conditions. We tried the activity of each item in three unique focuses. The most appealing insecticidal movement had deltamethrin, which caused directly around 100 % mortality of both formative periods of the vermin at all three fixations. Succeeding items were imidacloprid, which caused 89.6 % larval mortality at suggested focus, and basic oil of rosemary, which caused 81.7 % grown-up mortality at 1 % fixation. Hatchlings of sycamore trim bug were altogether more defenseless to tried items than grown-ups. Fundamentally the most reduced mortality was resolved one day after treatment (41.7 %), while the most elevated mortality was expressed three days after treatment (71.3 %). For future decline of the harm brought about by the examined bug on plane trees, we suggest the utilization of thujone and fundamental oil of rosemary, which had all the earmarks of being earth more adequate substances. In our assessment the two operators demonstrated a center fulfilling activity in controlling hatchlings and grown-ups, however they have additionally clear anti-agents movement, which prompts their great suitability in the open. Thujone goes about as repellent specialists to bugs affirmed high mortality of the western corn rootworm hatchlings in light of intense harming with thujone.[10]

RADIOPROTECTIVE ACTIVITY

The effect of Thuja occidentalis against hurt provoked by gamma radiation was thought of. Whole body introduction of Swiss pale skinned person mice to gamma-beams (6 Gy) diminished the all out white platelet check to 1900 cells/mm(3) on the third day, which was raised to 2050 cells/mm(3) by the organization of alcoholic concentrate of Thuja occidentalis (5 mg/portion/creature, intraperitoneally). Six creatures from each gathering were killed following 2, 7, and 11 days of light to perceive the bone marrow cellularity and radiation-initiated harmfulness. The quantity of bone marrow cells and alpha-esterase positive cells in control creatures following 11 days was diminished to 12.2 x 10(6) cells/femur and 693.5/4000 cells, individually. In Thuja occidentalis - treated creatures, bone marrow cellularity was upgraded to 16.9 x 10(6) cells/femur and alpha-esterase positive cells were 940/4000 cells, an almost typical level. Alcoholic concentrate of Thuja occidentalis diminished the raised degrees of GPT and soluble phosphatase in liver and serum after illumination. The lipid peroxidation levels were likewise lit in the lighted creatures treated with the Thuja remove. Defensive effect against radiation actuated harmfulness in mice evaluated.[10]

ANTI ATHEROSCELOROSIS ACTIVITY

To survey the hypolipidaemic activity of an (EFTO) ethanol division of concentrate of aerialpart of Thuja occidentalis Linn. (Cupressaceae) in hypolipidaemic action EFTO at the portion of 200 mg and 400mg/kg body weight altogether diminished serum cholesterol (77 and

International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 1 Jan-Feb 2021, pp: 85-95 www.ijprajournal.com ISSN: 2249-7781

92%), LDL (53 and 84%), fatty oils (27 and 46%). The upgrade in HDL to add up to cholesterol proportion and lessening in atherogenic list in EFTO treated gatherings firmly bolsters hostile to atherosclerotic property of Thuja occidentalis.[10]

.**NEUROPHARMACOLOGICAL ACTIVITY**

Watery concentrate of airborne part was investigated for evaluation of neuropharmacological activity by using raised in addition to labyrinth test, open field test in which they were noted ambulation, raising self prepping, movement in focus, rota pole test and tail suspension test.[10]

SEDATIVE ACTIVITY

The methanolic leaf concentrate of Thuja occidentalis was surveyed for conceivable opiate activities in mice. Narcotic activity was surveyed by utilizing gap cross, open field, thiopental sodium-prompted resting time and raised in addition to labyrinth (EPM) tests at 200mg/kg and 400 mg/kg. The concentrate lessened the locomotor development of mice in gap cross, open field and EPM test and exhibited the surprising results when contrasted with the norm at both referenced portions. Also, the extractsignificantly limited beginning of rest and amplified the term of dozing time when taken with thiopental sodium and measurably it was noteworthy ($p < 0.05$).[11]

ANTI FUNGAL ACTIVITY

The basic oils from leaves, twigs and stems of enormous trees and bush like trees of Thuja sutchuenensis were extricated by hydrodistillation and supercritical liquid extraction, and broke down by GC and GC–MS. The fundamental oil sythesis contrasted essentially among the three organs, just as between huge trees and bush like trees. Moreover, predictable with the eastern Asia–North American disjunct dispersion of the sort, numerous distinctions in the fundamental oil creation between T. sutchuenensis and other Thuja species were evident. The fundamental oils showed a particular degree of antifungal activity against six strains of human pathogenic fungi.[12]

II. CONCLUSION

Our pharmacy industry consistently search new lead atoms having better therapeutic activity and less adverse effect, in previous years lead compounds from natural origin had increasing greater prevalence because of less adverse effects and better therapeutic activity. Specially in antimicrobial area because of suddenly developing resistance to synthetic compounds. Present review indicates that different extracts shows good pharmacological action. Its immunopharmacological potential has been shows in various in vivo and in vitro test perform on test models showing its immunostimulating and antiviral action.It can be concluded thatextraction of Thuja having various compound which is safe and effective herbal medicinal product for treatment many kinds of disease.Thuja species hasbroadscope to saperatemany phytochemical compounds and estimate their pharmacological results to get better therapeutic action.

III. ACKNOWLEDGEMENT

The authors are grateful to Prof. Rajat Yadav and Dr. Nita Yadav, Department of Pharmacy, SRMS CET (Pharmacy), Bareilly, U.P. for their support during review work.

REFERENCES

[1]. Prabuseenivasan S, Jayakumar M, Ignacimuthu S. In vitro antibacterial activity of some plant essential oils. BMC Complement Altern Med 2006;6:39. 21:1199-12

[2]. Devprakash, Rohan Tembare, Suhas Gurav, Senthil Kumar G.P, T. Tamizh Mani. An Review of Phytochemical Constituents & Phamacological Activity of Plumeria Species. Int J Curr Pharm Res2012;4:1-6.

[3]. Joseph A Antos, Cosmin N Filipescu, Roderick W Negrave. Ecology of western redcedar (Thuja plicata): Implications for management of a high-value multiple-use resource. Forest Ecology and Management2016;375:211-22.

[4]. Meenu Bhan "Pharmacognosy and phytochemistry of Thuja occidentalis Linn. Int. J. Adv. Sci 2016;1:6-7.

[5]. Xiao-Wan Zhang, Yeong-Ho Choe, Youn-Jin Park, Byeong-Soo Kim "Effect of Korean arbor vitae (Thuja koraiensis) extract on antimicrobial and antiviral activity" Afr. J. Pharm. Pharmacol2014;8:274-77.

[6]. Benjamin A Harlow, Remko Duursma and John D Marshall "Leaf longevity of western red cedar (Thuja plicata) increases with depth in the canopy" Heron Publishing—Victoria, Canada2005;25:557-62.

[7]. XueyingGuo et.al "Chemical constituents of the trunks and roots of Thuja sutchuenensis" Fitoterapia 2019;134:264-269.
[8]. Jeff B. Million, Thomas H. Yeager. Production of Thuja (T. standishii xT. plicata) Using an Automated Micro-Irrigation System and Routine Leaching FractionTesting in a Container Nursery2018;36:140-5.
[9]. James Hudson, Michael Kuo, Selvarani Vimalanathan. The Antimicrobial Properties of Cedar Leaf (Thuja plicata) Oil; A Safe and Efficient Decontamination Agent for Buildings. Int. J. Environ. Res. Public Health2011;8:4478-87.
[10]. Kumar Brijesh, Rani Ruchi, Das Sanjita, Das Saumya. Phytoconstituents and Therapeutic potential of Thuja occidentalis. RJPBCS2012;3:354-62.
[11]. Belal Naser, Cornelia Bodinet, Martin Tegtmeier, Ulrike Lindequist. Thuja occidentalis (Arbor vitae): A Review of its Pharmaceutical, Pharmacological and Clinical Properties. Evid Based Complement Alternat Med2005;2:69–78.
[12]. A. Abdul, A. K. Imran, H. Musaddique, A. R. Muhammad. Pharmacological Evaluation of Sedative activity of methanolic extract of Thuja occidentalis in mice. Int J Adv Biol Biom Res2014;2:202-10.
[13]. Huaping Lei, Yonggang Wang, Chang Sua, Fengyin Liang, Weiwei Su, Mamie Hui,Pangchui Shaw, Yulong Luo. Chemical Composition and Antifungal Activity of EssentialOils of Thuja sutchuenensis, a Critically Endangered Species Endemic to China. Natural Product Communications2010;5:1674-76.
[14]. S. K. DUBEY, A. BATRA. ANTIOXIDANT ACTIVITIES OF THUJA OCCIDENTALIS LINN. AJPCR2009; 2:73-6.
[15]. D. Anju, B. Meenu, L. Ratan, D. Bindu, S. Chhavi. AN APPRAISAL ON PHARMACOGNOSY, PHYTOCHEMISTRY AND BIOACTIVITY OF THUJA OCCIDENTALIS LINN.CUPREESSACEAE. JPSI2012;1:1-5.
[16]. Neetu Jain, Meenakshi Sharma. Ethanobotany, Phytochemical and Pharmacological Aspects of Thuja orientalis: A Review. Int. J. Pure App. Biosci2017;5:73-83.
[17]. Warren K Coleman, Trevor A Thorpe. In vitro culture of western redcedar (Thuja plicata Donn). I. Plantlet formation. Botanical Gazette1977;138:298-304.
[18]. Aili Qin, Bo Liu, Quanshui Guo, Rainer W Bussmann, Fanqiang Ma, Zunji Jian, Gexi Xu, Shunxiang Pei. Maxent modeling for predicting impacts of climate change on the potential distribution of Thuja sutchuenensis Franch., an extremely endangered conifer from southwestern China. Global Ecology and Conservation2017;10:139-46.
[19]. Adam M Taylor, Barbara L Gartner, Jeffrey J Morrell, K Tsunoda. Effects of heartwood extractive fractions of Thuja plicata and Chamaecyparis nootkatensis on wood degradation by termites or fungi. Journal of Wood Science2006;52:147-53.
[20]. JAF Gardner, GM Barton, Harold Maclean. The polyoxyphenols of western red cedar (Thuja plicata Donn.): I. Isolation and preliminary characterization of plicatic acid. Can. J. Chem1959;37:1703-9.
[21]. Nan-nan Zhang, Dong Ki Park, Hye-Jin Park. Hair growth-promoting activity of hot water extract of Thuja orientalis. BMC complementary and alternative medicine2013;13:1-12.
[22]. Shiv Nandan Sah, Sunil Regmi, Man Kumar Tamang. Antibacterial effects of Thuja leaves extract. IJASBT2017;5:256-60.
[23]. DW Larson, J Doubt, U Matthes-Sears. Radially sectored hydraulic pathways in the xylem of Thuja occidentalis as revealed by the use of dyes. Int. J. Plant Sci1994;155:569-82.
[24]. U Matthes-Sears, DW Larson. Limitations to Seedling Growth and Survival by the Quantity and Quality of Rooting Space: Implications for the Establishment of Thuja occidentalis on Cliff Faces. Int. J. Plant Sci1999;160:122-8.
[25]. Shohini Chakraborty, Nashra Afaq, Neelam Singh, Sukanta Majumdar. Antimicrobial activity of Cannabis sativa, Thuja orientalis and Psidium guajava leaf extracts against methicillin-resistant Staphylococcus aureus. J. Integr. Med 2018;16:350-7.
[26]. K Yogesh, Jamshed Ali. Antioxidant potential of thuja (Thuja occidentalis) cones and peach (Prunus persia) seeds in raw

chicken ground meat during refrigerated (4 ± 1 ℃) storage. J. Food Sci. Technol2014; 51:1547-53.
[27]. Avinaba Mukherjee, Naoual Boujedaini, Anisur Rahman Khuda-Bukhsh. Homeopathic Thuja 30C ameliorates benzo (a) pyrene-induced DNA damage, stress and viability of perfused lung cells of mice in vitro. J Integr Med 2013;11:397-404.
[28]. Madhav Pandey, Om P Rajora. Genetic diversity and differentiation of core vs. peripheral populations of eastern white cedar, Thuja occidentalis (Cupressaceae). Am. J. Bot2012;99:690-9.
[29]. JH Russell, DC Ferguson. Preliminary results from five generations of a western redcedar (Thuja plicata) selection study with self-mating. Tree Genetics & Genomes2008;4:509-18.
[30]. Nakuleshwar Dut Jasuja, Suresh K Sharma, Richa Saxena, Jyoti Choudhary, Ramavtar Sharma, Suresh C Joshi. Antibacterial, antioxidant and phytochemical investigation of Thuja orientalis leaves. J. Med. Plant Res2013;7:1886-93.
[31]. Gábor Bozsik, A Tröger, W Francke and Gábor Szőcs. Thuja occidentalis: identification of volatiles and electroantennographic response by the invasive cedar bark beetle, Phloeosinus aubei. J Appl Entomol2016;140:434-43.
[32]. L.D.S. Alves, C.B.M. Figueirêdo, C.C.A.R. Silva ,G.S. Marques , P.A. Ferreira , M.F.R. Soares , R.M.F. Silva, P J. Rolim-Neto. THUJA OCCIDENTALIS L. (CUPRESSACEAE): REVIEW OF BOTANICAL, PHYTO-CHEMICAL, PHARMACOLOGICAL AND TOXICOLOGICAL ASPECT. IJPSR2020; 11:1163-77.
[33]. Suman Shrivastava, S. J. Daharwal. Extensive review on the analytical methods for the estimation of Thuja occidentalis homeopathic mother tincture. Research J. Pharm. and Tech2019;12:4523-30.
[34]. Mohammed abdul aziz ismail, Farkad Hawas Musa, Abdullah .H.Alkhater. Effect of Lawsonia and Thuja Extract on Hemolysin from Staphylococcus aurous which Isolate from Tonsillitis. SRP2020;11:468-70.
[35]. S. Kshirsagar, S. Malode, S. Bansode. PHARMCOLOGICAL ACTIVITY OF THUJA ORIENTALIS LINN. IJP2018;5:331-6
[36]. Pooja Tiwari, Deepak Rathore. ANTIBACTERIAL ACTIVITY OF TWIGS OF THUJA OCCIDENTALIS. World J Pharm Pharm Sci2019;8:535-46
[37]. MW Bannan. THE VASCULAR CAMBIUM AND RADIAL GROWTH IN THUJA OCCIDENTALIS L"Can J Bot1955;33:113-38.
[38]. Meredith W Cornett, Peter B Reich, Klaus J Puettmann and Lee E Frelich. Seedbed and moisture availability determine safe sites for early Thuja occidentalis (Cupressaceae) regeneration. Am. J. Bot 2000;87:1807-14.
[39]. Gwenaël Vourc'h, Bruno Vila, Dominique Gillon, José Escarré, Frédéric Guibal, Hervé Fritz, Thomas P Clausen. Jean Louis Martin. Disentangling the causes of damage variation by deer browsing on young Thuja plicata. Oikos2002;98:271-83.
[40]. Harold MacLean, Koji Murakami. Lignans of western red cedar (Thuja plicata Donn): IV. Thujaplicatin and thujaplicatin methyl ether. Can. J. Chem1966;44:1541-5.
[41]. Zicheng Yu. Late Quaternary paleoecology of Thuja and juniperus (Cupressaceae) at Crawford Lake, Ontario, Canada: pollen, stomata and macrofossils. Review of Palaeobotany and Palynology1997;96:241-54.
[42]. ZS Ololade, OA Fakankun, FO Alao, OU Udi. Phytochemical and Therapeutic Studies of the Fruit essential oil of Thuja orientalis from Nigeria. Glob. J. Sci. Front. Res. B Chem2014;1:14.
[43]. Eun Ha Lee, Dae-Geun Song, Joo Young Lee, Cheol-Ho Pan, Byung Hun Um, Sang Hoon Jung. Flavonoids from the leaves of Thuja orientalis inhibit the aldose reductase and the formation of advanced glycation endproducts. Journal of the Korean Society for Applied Biological Chemistry 2019; 52:448-55.
[44]. Peter Weyerstahl, Helga Marschall, Guy Collin. Two New Guaiadiene Derivatives Isolated from Thuja occidentalis L. Wood Oil. EurJOC1996;1:99-101.
[45]. Sushil Kumar Dubey, Amla Batra. Hepatoprotective Activity from Ethanol Fraction of Thuja occidentalis Linn. Asian J. Chem2008;1:32-35.

[46]. Lori D Daniels, J Dobry, Karel Klinka, Michael C Feller. Determining year of death of logs and snags of Thuja plicata in southwestern coastal British Columbia. Can. J. For. Res1997;27:1132-41.
[47]. Meredith W Cornett, Klaus J Puettmann, Lee E Frelich, Peter B Reich. Comparing the Importance of Seedbed and Canopy Type in the Restoration of Upland Thuja occidentalis Forests of Northeastern Minnesota. Restoration Ecology2001;9:386-96.
[48]. Jeffrey Keating, C Ingemar Johansson, John N Saddler, Rodger P Beatson. The nature of chromophores in high-extractives mechanical pulps: Western red cedar (Thuja plicata Donn) chemithermomechanical pulp (CTMP). Holzforschung2006;60:365-71.
[49]. Eman Ramadan Elsharkawy, Haya Aljohar, M Donia Abd El Raheim. Comparative study of antioxidant and anticancer activity of Thuja orientalis growing in Egypt and Saudi Arabia. J. Pharm. Res. Int2017;15:1-9.
[50]. Ben A LePage. A new species of Thuja (Cupressaceae) from the Late Cretaceous of Alaska: implications of being evergreen in a polar environment. Am. J. Bot2003;90:167-74.
[51]. Johann M Housset, Martin P Girardin, Mathieu Baconnet, Christopher Carcaillet. Yves Bergeron. Unexpected warming induced growth decline in Thuja occidentalis at its northern limits in North America. J. Biogeogr2015;42:1233-45.