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Phytochemistry and Pharmacology of *Artemisia absinthium* Linn: A Multipurpose Medicinal Plant

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A B S T R A C T

Plants are nature's gift to humanity to acquire a healthy and prosperous life and used not only to treat several diseases but also as nutraceuticals to improve or modulate biological activities. About 500 species of *Artemisia* have been found in nature. Among them, Artemisia absinthium (A. absinthium) or wormwood is the most popular herb in the temperate zone of Northern Africa, Eurasia. It is widely distributed in the Northern United States and Canada and descriptions are found in almost all medicinal books of the Western World. It is grown as a decorative plant and is used in various alcoholic beverages as well as an ingredient in the spirit absinthe. The information regarding *A. absinthium* ethno pharmacological activities, phytochemistry, and its various medicinal uses wereexplored using different search engines in PubMed, Google Scholar, Research gate and Web of science. Different terms included "worm wood", "Artemisia absinthium", "and pharmacological", "therapeutic/medicinal uses" were used to find the scientific literatures. Studies have shown that *A. absinthium* possesses anti-bacterial, anti-depressant, anthelmintic, anti-malarial, antioxidant, antiprotozoal, antipyretic, anti-tumor, anti-ulcer, hepatoprotective and neuroprotective activities. These activities are attributed to various active metabolites present in *A. absinthium*, whereas for further research, these results are useful and valuable. Adverse properties of *A. absinthium* required severe efforts to identify, isolates, and validates the chemical constituents for their therapeutic potentials, which gives direction to develop a novel medicine for various diseases.

Keywords: *Artemisia absinthium*, Nutraceuticals, Medicinal uses, Chemical constituents, Pharmacological activity

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Introduction

Artemesia absinthium belongs to family Asteraceae. This plant is found in Asia, North America, and Europe. A. absinthium is native to Northern Asia, Northern Africa, and Europe. In the early years of the 19thcentury, this plant was explored for social and medicinal properties in North America. In 1841, A. absinthiumwas ommited from cultivated gardens, and it was found on waste grounds and along the roadsides. A. absinthium has initially originated in the northeastern areas of the United States and can occasionally observe in North as well as South Carolina. A. absinthium is also found in North Dakota, Minnesota, Wisconsin, Indiana, Ohio, Montana, and South Dakota. In 1973, A. absinthium was documented as a noxious weed in North Dakota. Now, this plant reported in many

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countries of the World [1]. Artemisia is a medicinal plant and used in herbal drugs for treatment purpose distributed in Asia. Artemisia is one from 45 genera in India. In Pakistan itis found in Himalaya across Jammu and Kashmir. It is a perennial shrub with multiple branches having leaves with soft hairs. It has yellow-green flowers. It grows at the height of 60-120cm with high branching stem. It yields dark green or yellow oil with acrid taste [2]. The stem is very long with branches and has white trichomes. The leaves are 2 inches in length. It has leaves of greenish-white color. Itis mostly used in medicines because of its therapeutic benefits. It is the best tonic and has effects on the digestive organs of the body. It has great importance in traditional medicine and is a potential herb. It has more than 500 species found mainly in India. It is mostly used drug in folk medicine because it has properties like antioxidant, antiseptic, hepatoprotective, neuroprotective and antipyretic activity. It has bioactivities and used for animal nutrition. Its methanol extract has polyphenols and flavonoids. It also has monoterpene and condensed tannins in it. It surveys from the world health organization that 75-80% of people use herbal medicines as non-conventional medicines. It has attracted physicians that it is needed to search plants as crude extracts because of its potential. Many types of research are going to perform on these views. Plants scope has been emphasizing to isolate its bioactive compounds. Screening of A. absinthium showed that it has bioactive compounds that lower cholesterol level. It has been using in Pakistan for cardiac stimulations, improving the memory function and mental functions. It has a protective effect on the brain because it reduces cerebral oxidative stress and also reduces ischemic injury and behavioral disturbance. It had been used in traditional medicines from centuries. It has bioactive compounds to treat the diseases, and it is more need to found better therapeutic effects with not well reported side-effects. The leaves of Artemisia are used in medicine and beverage as absinthe. It is an aromatic plant and has the best potential to treat digestive organs and regarding known as anthelmintic. It is used in fomentation because of its antiseptic activity (2). Coccidiosis is a sporozoal infection of the intestine; it can also affect the liver [3]. It is caused by Eimeria species having an economic loss in rabbits with a mortality rate of 20%. Upto 50% within 4-8weeks [4], it is responsible for the fattening, inferior skin pigments and high mortality [5]. It is mostly treated by using antibiotics such as sulfonamides, salinomycin and robenidine, which are used in rabbits diet for the purpose to treat. Protozoa were resistant to antibiotics, and there was a need to found suitable alternative treatment [6]. Antibiotics ban in 2006 because of protozoal resistance, and it leads to motivate the researchers for new research [7]. Medicinal plants have been used for treatment as an alternative, and they have better effects against parasites [8].Artemisia belongs to family Asteraceae is one of 300 species. Its oil composed of two bitter substances (absinthin and anabsinthine), tannins, resins, malic acid and succinic acid [9]. The oil has anti-bacterial, antifeedant, antipyretic, fertility enhancing and anti-malarial properties [10]. Herbs used as nutrition has the potential for growth and health benefits without adverse reactions [11]. Cellular metabolism, which results in the production of reactive oxygen species increase in level [12]. It causes cellular damage, known as oxidative stress [13]. As a result of oxidative stress, pathological changes occur, and membrane function impairs, cellular damage raise, arthritis, neurological disorders, protein denaturation occurs [14]. Aerobic microorganisms have protection against free radicals and block the effects of ROS [12]. The liver is a significant organ which helps in detoxification [15]. There are many mechanisms that provide protection. Antioxidants provide protection against damage by reactive oxygen species. Glutathione is important because it provide protection by decreasing effects of xenobiotics and lipid peroxidation.

A. absinthium herb used in folk medicine and has pharmaceutical importance [16]. Its oil has neuroprotective activity, anti-fungal action, antimicrobial action [17], acaricidal action [18], anthelmintic action [19], anti-malarial action [20], hepatoprotective, anti-

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depressant activity. Herb provides beneficial effects in reducing the pain of labor and treat leukaemia and sclerosis [21]. It is toxic and antifeedant for L.decemlineata [22]. It is antioxidant and protects against cellular damage by free radicals such as neurological and cardiac diseases [23]. A. absinthium life cycle has been observed [24]. When the plant fully blooms, he flowering ops and leaves are collected and dried naturally or by unnatural heat [25, 26]. The efficacy of A. absinthium has been reported against weakly reactive early-stage IgA nephropathy [27]. It is used in inflammatory diseases, cachexia, cancer, HIV, anorexia, hepatitis, diabetes, hyperlipidemia, insomnia, pain, inflammation, parasitic infection and epilepsy [27]. It is used in pyrexia, liver disorders, and gastric ulcer. It is used in skin infection. It is used as a sedative agent. It has been prescribed in intestinal worm infections. It is used in muscular pain due to its analgesic properties. Due to the antiseptic activity, it helps to treat bruises and wounds. It has been used in the treatment of breast cancer [28]. It has antispasmodic activity and helps relieve in muscular spasm. Due to its carminative action, it is useful in flatulence. It has an antipyretic effect and helps relieve in fevers, particularly typhoid fever. It is also used for the removal of intestinal worms. It is used to relieve gastric pain and stomach disorders. Tea of A. absinthiumis used in labor pain [29]. It is reported that A. absinthium speeds up the healing process in patients with Crohn's disease and represses the tumor necrosis factor alpha. In powder form, it is used as a tincture. To improve the blood circulation this plant oil can be used as a cardiac tonic. Keeping in view all the therapeutic activities of this medicinal herb this review article was compiled tocomprehensively described the the medicinal applications and pharmacological activities of *A. absinthium.*

Materials and methods

A. absinthiumactivities regarding its ethnopharmacology, phytochemistry, and its various medicinal uses were searchedusing reference search engines like PubMed, Google Scholar, Research gate and Web of science. The search terms were "worm wood", "*Artemisia absinthium*", “and its pharmacological”, “therapeutic/medicinal uses of A. absinthium”.

Results and Discussion

Scientific based literature review explored that *A. absinthium* has various medicinal and pharmacological activities such as anthelmintic, digestive, general tonic, anti-bacterial, neuroprotective, antioxidant, hepatoprotective, antileishmanial, anti-diabetic, antinociceptive, antipyretic, anti-malarial, anti-inflammatory, analgesic, antihyperlipidemic, anti-fungal and antinociceptive.

Chemical constituents

Pinene, thujone, fragrance oils, menthol, essential oil, phellandrene, 5,6-dihydrochamazulene, glucosides absinthin, absinthic acid, thujyl alcohol, acetate, geranyl isovalerate, 1,8 cineol, gamma terpinen, beta-caryophyllene, allo-ocimene, beta myrcene, 4-terpineol, beta linalool, alpha cymene, alpha phellandrene, thujone, sabinyl acetate, sabinene, absinthol, tanacetone, salviol, monoterpene, isoprenoid units, isopentylpyrophosphate [30]. *A. absinthium* is a bitter herb having active constituents, and bitter constituents are 0.15-0.4%, which are sesquiterpene lactones a natural compound and has medicinal property and include guanolide dimmers as absinthin 0.2-0.28% and its isomers anabsinthine, anabsin, artabsin 0.04-0.16% and absintholide, artabin a germacrene type [31], matricin, beta-santonin and ketopepenolid [32]. Essential oils have volatile constituents which vary by quality and quantity according to location and environment [33]. The essential oil has 0.2-1.5% of drug raise from arid to humidity [34]. There are four main constituents’ alpha-thujone, z-epoxy-ocimene, trans-sabinylacetat and chrysanthenyl-acetate [35]. Alpha-thujone grows in areas which are below

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1000m high mean level of the sea and has 40-70% of oil [36]. There are many of trans-sabinyl-acetate and chrysanthenyl components, and in Europe are mixed up [37]. It also contain myrcene 35%, alpha pinene 6%, nerol 3% Russian oil [38], P-cymene 16.5%, beta pinene 7.3% and 7-ethyl-5,6-dihydro-1,4-dimethylazulene 5.5% in Iranian oil [39]. It contains cis-chrysanthenyl acetate 7.7-17.9%, dihydrochamazoline isomer 5.5-11.6%, alpha-phellandrene 1-5.35 and linalool 5.3-7% in Tajikistan oil [40]. Thujanol, thujyi acetate 60-70%, myrcene 35%, camphor and 1,8-cineole also found [41]. It has phenolic acid 2.6% including chlorogenic, caffeic, syringic, coumaric, salicylic acid, vanilic acid, flavonoid 1.3%, rutin, quercitin, glycoside, carotenoids, coumarins, homo-diterpen peroxides and thiophene [21].

Ethnopharmacology of A. absinthium

In Herzegovina and Bosnia, Infusion of A. absinthium is used for stomachache and other gastrointestinal disorders. A decoction is used for gastric pain [17]. In China (Urumqi), *A. absinthium* is used to treat liver ailments [42]. In Croatia (northern Istria), Infusion of A. absinthium is used as a digestive agent [43]. In Croatia (Žejane), aerial parts of *A. absinthium* are used as a digestive [44]. In Cuba, *A. absinthium* is used to treat malaria [45]. In France, *A. absinthium* is used as emmenagogue, antipyretic, anti-bacterial, anthelmintic, and appetite stimulant [46]. In Iran (Elburz Mountains), A. absinthium is used as a diuretic, digestive, choleretic, antimicrobial, anti-fungal and anthelmintic [40]. In Italy (Marche, Abruzzo, Latium), infusion and decoction of leaves of *A. absinthium* are used to helminthiasis, anorexia, nausea and tendonitis [47]. In Italy (Piedmont Alps), infusion of *A. absinthium* is used to treat parasitic infections, hypertension and intestinal worms [43]. In Italy (Tuscany), *A. absinthium* is used to treat hypertension (48). In Pakistan (Gilgit District), A. absinthium is used to treat pyrexia, especially malaria and intestinal worms in children [49]. For the treatment of malaria, *A. absinthium* is used in Tunisia [50]. In Turkey (Kirklareli Province), aerial parts of A. absinthium is used as a gastroprotective, abortive, appetizer, wound healer, anti-hyperglycemic, anti-malarial and antihypertensive [51]. In Turkey (K. Maras), *A. absinthium* is used to treat pyrexia, wounds and gastric problems [52].

Parts used and their curative properties

The useful parts are stem, roots, flowering parts, leaves and mostly whole plant. They are used in menstrual disorders, inflammation of the liver, swelling, and chronic fever. It is a remedy for debility and digestive problems. Tincture of the plant is anthelmintic, febrifuge, digestive, tonic, and brain concussion. Flowers are tonic, vermifuge in intermittent pyrexia. Rheumatism is treated by using the Essential oil of *A. absinthium* externally [53].

Mechanisms of action

A. absinthium contains thujone constituent, which has vermicidal, insecticidal and bactericidal effects [54]. Thujonemodulates gamma-aminobutyric acid (GABA) type a receptor and stimulates central nervous system stimulant. *A. absinthium* is useful in diseases influenced by pro-inflammatory cytokines by reducing the level of tumor necrosis factor (TNF-). The study reported that *A. absinthiumon* human breast cancer cells have an anti-proliferative activity which could probably produce apoptosis [55].

Mode of administration

Capsules, tinctures, extracts, powdered herb, decoction, etc. are prescribed orally for the therapeutic purpose (Table 1). The recommended doses are usually prescribed in routine practices. But in some cases, physicians can

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recommend the higher or lower doses depending on the severity of the disease [53].

Pharmacological aspects

A. absinthium is used in Unani system of medicine for the management of different disorders and is one of the indispensable therapeutic plants (Figure 1).

Palatability enhancement

A. absinthium contains constituents that induced the intense flavors, which increase palatability in diet intake of animals. Its dryness attracts the ruminants. Kim et al., (2002) reported that 18% palatability increase in dry matter and sheep intake of diet increase. If absinthine containing diet is used, it contains higher protein concentration and enhances digestibility. If we replace rice straw in ruminants, it increases digestion, nutrients and promotes compounds in beef [56].

Experimental studies

Several studies have been reported on the anthelmintic, anti-bacterial, neuroprotective, antioxidant, hepatoprotective, antileishmanial, anti-diabetic and antinociceptive property [57, 58].

A. absinthium in bacterial infections

A. absinthium is used as an antimicrobial agent. In earlier studies, its anti-bacterial efficacy against various bacteria has been reported. In one study, caffeoylquinic acids antimicrobial action against gram-positive bacteria has been reported [19]. In another study, *A. absinthium* exhibited anti-bacterial activity against surgical wounds in the rat model. A. absinthium exhibited significant anti-bacterial activity against Staphylococcus aureus [59]. It has bactericidal activity against *S. aureus*, *Enterobacter aerogenes*, *Klebsiellaoxytoca*, *K. pneumonia*, *Proteus mirabilis*, *Escherichia coli*, *Clostridium perfringens*, *Pseudomonas aeruginosa*, *Listeria monocytogenes* and, *Shigellasonnei.*

Cell stability activity

De Freitas et al. flavonoids in extract provide protection of erythrocytes against hypnotic shock [60].

Antipyretic activity

In one study, ethanolic extract of *A. absinthium*, which contains 24-Beta-ethyl p-cholesta-7, 22-dien-3Bat, exhibited antipyretic effect in rats with least adverse effects. In another study, chloroform, hexane, and water-soluble extract of *A. absinthium* exhibited antipyretic activity in rabbits comparable with antipyretic activity of aspirin. In acute toxicity study, no toxic effects were reported at a dose of 1.6 mg/Kg [61].

A. absinthium in helminthiasis

In comparison to albendazole the *A. absinthium* extracts have high anthelmintic activity against ovine nematodes has been reported [62]. This study showed that the aerial part of A. absinthium's ethanolic and aqueous extract have anthelmintic action. In another study, ascaricidal properties of A. absinthium have been reported [36]. In 1994 Singh et al., investigated that on an empty stomach the fresh aqueous extract of A. absinthium is given with sugar for 8-10 days it removed roundworms [63].

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Neuroprotective activity

Artemisia is used in improving and treatment of decline cognitive functions by acting on its nicotinic and muscarinic activity and by homogenate human cerebral cortical membrane by Wake et al., [64]. It also helps in the growth of neuron by nerve growth factors [65]. It also acts as neuroprotective and reduces ischemic injury in rats of cerebral [66]. It reduces brain infarct and oxidative stress and improves behavior. It inhibits lipid peroxidation and restores endogenous antioxidant enzymes and help to treat stroke. Zeng et al., [67] reported that it contains sesquiterpene dimer caruifolin D that suppress intracellular reactive oxygen species. Hallal et al reported that it contains antioxidants that protect brain dysfunction induce by HgCl2 and protect the brain [68]. The study reported that *A. absinthium* has a neuroprotective effect on reperfusion-induced cerebral injury and focal ischemia. The middle cerebral artery was occluded for induction of focal ischemia for 90 minutes, followed by 24 hr reperfusion. Middle cerebral artery occlusion led to a reduction in glutathione concentration, catalase and superoxide dismutase activity in brain and significant rise in lipid peroxidation and infarct size, and depletion of catalase, superoxide dismutase activity and glutathione content, activity in the brain. Others behavioral defects like short-term memory impairment and motor incoordination were also affected by MCAO. There was significant reduction in behavioral defects in mice pretreated with *A. absinthium* extract at dose of 100 mg/kg and 200 mg/kg. This study indicated that A. absinthium is useful in the management of stroke and has neuroprotective action [57].

Anti-ulcer activity

A. absinthium is used to treat dyspepsia, including gastritis and gall bladder diseases. Shafi et al. reported that it contains extracts of methanol or ethanol, which treat acetylsalicylic induce ulcer in rats. It increases the level of mucine and reduces gastric juice [69].

Anti-malarial action

The incidence of malaria in the World with the lack of vaccine and development of resistance against anti-malarial drugs makes it compulsory to search for naturally occurring and new synthetic anti-malarial drugs. *A. absinthium* is widely used as an anti-malarial drug. A. absinthium is reported as an anti-malarial drug in 1970. The ethanolic extract of A. absinthium is given orally to Plasmodium berghei infected mice and observed that it has the maximum suppression (96%) against P. berghei. In Cuba, a research group in collaboration withUniversity of Antwerp observed that the A. absinthiumhave an anti-plasmodial effect [70]. The study proves that A. absinthium showed the best action in decreasing the parasitemia in vitro and is 64 times stronger than Artemisia annua, which is most likely due to the essential oils that are present in *A. absinthium* [71].

Anti-inflammatory action

The studies on the anti-inflammatory property of *A. absinthium* have reported that flavones isolated from this plant exhibit anti-inflammatory activity in vitro because it inhibits the cyclooxygenase-2, nitric oxide and E-2 and PGE-2 prostaglandins in lipopolysaccharide-stimulated RAW cells [72]. *A. absinthium* is administered in the viral hepatitis patients in a dose of 6 gm in the form of fine powder for four weeks in two divided doses. The results showed 80-90% symptomatic relief in patients of viral hepatitis [73]. The results of another study showed that in acute viral hepatitis patient, it reduces the serum bilirubin level.

[DOI: 10.61186/pbp.6.1.76]

Analgesic effect

All the synthetic drugs that are used as analgesics have the side effects also, so due to the lack of adequate and safe analgesics *A. absinthium* had been chosen to study its analgesic effect and establish new medicinal plants to make cheap, safer and effective drugs. Ethnopharmacological literature proves that A. absinthium is used for muscle pain, decreasing pain during labor, insect bites, improve skin lesions, heal bruises and used in joint rigidity or pain [74].

Antihyperlipidemic activity

Hyperlipidemia is a risk for cardiovascular diseases such as atherosclerosis, MI, heart attacks and cerebrovascular diseases [75]. It reduces serum cholesterol and triglycerides in rabbits by 8 and 3.5 times [76]. It is antihyperlipidemic by a dose of 500-1000mg/kg in cholesterol-induced rabbits and enhances catabolism of proteins [77], it inhibits the lysosomal lipid hydrolytic enzymes in the liver [78]. Hyperlipidemia is a major cause of cerebrovascular diseases, heart attacks, myocardial infarction and atherosclerosis, which can be managed with A. absinthium that has been documented to decrease serum triglycerides and cholesterol by 3.5 and 8 times, respectively. Antihyperlipidemic activity of ethanolic extract of *A. absinthium* (500, 1000 mg/kg) has been reported in hyperlipidemia models [76].

A. absinthium as anti-oxidant

It is used as an antioxidant and cardio-protective agent. It is reported that the extracts of *A. absinthium* have free-radical scavenging and antioxidant activity [21]. Another study showed the antioxidant and cytoprotective activities of ethanolic extracts of *A. absinthium.* The role of A. absinthium extract on oxidative stress in ameliorating lead-induced haemato-toxicity has been reported [79]. Reactive species are dangerous because it causes oxidative damages to biomolecules such as protein, lipids, lipoproteins and is the leading cause of chronic diseases such as atherosclerosis, cancer and cardiovascular diseases [80]. There are many side effects that are toxic to normal cells, and it requires the use of antioxidants and leads to prevention of oxidation, which reduce the risk of diseases. It prevents the prevention of tissue damage from free radicals. Herbs have antioxidant potential because of bioactive constituents. Polyphenols are major as antioxidants [81]. The essential oil has antioxidant activity, and its extract has rutin, quercitin, thymol, carvacrol and phenolic compounds, flavonoids reduce peroxide radical [82]. Highest antioxidant activity is 63.3% and has phenol accumulation1.48mg, flavonoids 0.48mg in 35day and proved antioxidant activity [83].

Anti-depressant activity

Herbs are most useful in the treatment of depression. It is the leading cause of disability and prematurity. Absinthium shows anti-depressant activity by tail suspension test, and in the flowering stage, it reduces immobility period in testes [84].

Anti-diabetic activity

The ethanol extract of A. absinthium was investigated in alloxan-induced diabetic rats, which showed anti-diabetic activity. Ethanol extract of *A. absinthium* was administered to rats (250, 500, and 1,000 mg/kg body weight) in comparison with glibenclamide (10 mg/kg body weight/ daily). A. absinthium ethanolic extract decreased the blood glucose level at a dose of 500, and 1,000 mg/kg body weight after 7 and 10 days of therapy [85].

[DOI: 10.61186/pbp.6.1.76]

A. absinthium in liver disorders

Hepatic diseases are primary diseases that cause serious illness. The reduction in inflammation of liver and oxidation is a therapeutic effect in treating liver injuries. In vivo rodents were used induced hepatic disease by the CCl4 cause cellular damage by free radicals (Jung EH 2015). Phytochemicals present in absinthium has antioxidant potential and protect the liver from damaging, caffeoyl and dicaffeoylquinic acids are hepatoprotective. The methanolic extract is protective against acetaminophen and CCl4 and treats various liver biliary diseases. It inhibits the microsomal drug metabolism enzymes, antioxidant and Ca channel blockers. Mohammadaian et al., reported that hydro-alcoholic extract improves the function of the liver and oxidative stress [86]. It lowers the levels of ALT and AST.

A. absinthium is used in jaundice, and liver disorders, particularly hepatitis B. The hepatoprotective action of A. absinthium aqueous extract against immunologically and chemically influenced liver injuries in mice has been reported [42]. In another study, the protective and therapeutic effects of A. absinthium on CCl4 and acetaminophen-induced hepatotoxicity have been reported. The presence of channel blockers and anti-oxidants contributes to its hepatoprotective action and by inhibiting Microsomal Drug Metabolizing Enzyme [87].

A. absinthium in leishmaniasis

A. absinthium is a possible source for the treatment of leishmaniasis. In another study, antileishmanial activity, as well as toxicity of essential oils of A. absinthium, has been reported [58]. *A. absinthium* is a supporting candidate for the activation of compounds against Leishmania [88].

A. absinthiumas antinociceptive

Antinociceptive effect of *A. absinthium* was investigated in mice. Tail flick test was used for investigation of analgesic effects of plant extract. Naloxone, ondansetron, metoclopramide and atropine were injected intraperitoneally before the tail immersion in normal saline containing different concentration (1, 2.5, 4, 6 % w/v) of plant extract. Maximum analgesic effect was observed at a dose of 4 and 6% w/v of plant extract in the tail-flick model. Furthermore, the anti-nociceptive effect of plant extract at 4 w/v concentration was attenuated by pretreatment with naloxone, ondansetron, metoclopramide, and atropine. This study indicated that plant extract exhibits antinociceptive effect in tail-flick model probably through the opioidergic, dopaminergic, serotoninergic and cholinergic system [30].

Anti-cancerous activity

Absinthium is much beneficial for the intercellular signals because it inhibits cell proliferation, promote apoptosis in carcinoma in an estrogenic-responsive cell line, MCF-7. Chlorogenic acid inhibits carcinoma in large gut, liver and tongue and is antioxidant. It has anti-tumour potential against melanoma B16 and retard growth of Pliss lymphosarcoma. Shafi et al., reported that it has anti-proliferative effects in a breast cancer cell by modulating the Bcl-2 proteins and MEK pathway [69].

Immuno-modulatory activity

Herbal drugs are beneficial in treating immune disorders and have immunomodulatory activity [89]. It provides effects by induction of Th1 receptors and nitric oxide production. It also suppresses the tumor necrosis factors and heals chon's disease. Its concentration of 100 ug/ml modulate immune response towards Th1 cells and induce CD40 on dendritic T cell stimulation [90].

[DOI: 10.61186/pbp.6.1.76]

Crohn's Disease

Clinical studies indicate that for the management of Crohn's disease, A. absinthium is active [91]. It is also used in many digestive disorders. The study showed that 18 patients who were using wormwood in spite of steroids, steady improvement were shown but after 8 weeks of treatment, almost whole symptoms were remitted.

Adverse effects

A. absinthium has been reported to cause muscle pain, nausea, and vomiting. A syndrome known as absinthium occurs after chronic ingestion of absinthe, an alcoholic extract possessing A. absinthium. This is said to consist of hallucinations, insomnia, and gastrointestinal symptoms. Some adverse effects including suicide, psychiatric disorders, epilepsy, paralysis and addition have been reported [92]. It is safe if it is not used in excessive amount, but the excessive doses of A. absinthium are toxic, and its poisoning leads to hallucinations, delirium, seizures, hepatotoxicity and even death [93].

Contraindication

It is contraindicated in liver disorders, cholangitis, obstruction of the bile duct and pregnancy [94].

Conclusion

A. absinthium has anti-bacterial, anthelmintic, neuroprotective, antioxidant, hepato-protective, anti-leishmanial, and anti-nociceptive activities etc. In vitro and in vivo study on biological activities of *A. absinthium* indicates that *A. absinthium* has multiple functions and it can be used as a therapeutic agent. Herbs have great potential to treat diseases and have great pharmaceutical importance because of its therapeutic effects and are beneficial with least side effects. Chemicals and phytochemicals are screened to investigate the effects on the body, and it has attracted physicians to found alternative treatments. Absinthin has therapeutic potential in treating disorders and is anti-bacterial, anti-malarial, anti-depressant, antipyretic, antioxidant, hypolipidemic, anti-ulcer and immune modulator etc. It has intense flavors and has powerful actions, and it should be used carefully because its overdose has adverse reactions. It is highly nutrition and bioactive medicinal plant. It is essential to evaluate its potential by clinical and nutritional trials

Ethics approval and consent to participate

Not applicable.

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Competing interests

Authors declare no conflict of interest.

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