



Ethnobotanical and Pharmacological Importance of Western Himalayan Fir *Abies pindrow* (Royle ex D. Don) Royle: A Review

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Aims: *Abies pindrow* (Royle ex D. Don) Royle., colloquially known as the Western Himalayan fir, is a conifer that grows along the Himalayan mountains from Afghanistan to Nepal. The plant is extensively used by locals for the treatments of various ailments. Thus based on the available reports about its importance in traditional system of medicine, an attempt has been made to review this species in context of its medicinal and pharmaceutical importance.

Study Design: The review article has been designed based on literature survey. The article is grossly divided into four broad phases consisting of compiled information of *Abies pindrow*: (1) Ethnobotanical information (2) Chemical Constituents (3) Pharmacological activities (4) Discussion mainly highlighting the mode of action of the bioactive compounds in relation to its pharmacological activity.

Methodology: Extensive literature search have been performed in the web using PubMed, PubMed Central, google scholar as search platform. Efforts have also been taken to compile information from research papers and review articles not more than 10 years old. Information from old literatures were preferably avoided unless found to be very relevant to the subject.

Results: The literature survey revealed that the plant has been used to treat cough and cold,

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diabetes, cataract and bladder diseases. The plant is also considered to be carminative, astringent, antispasmodic, diuretic, tonic and anti-inflammatory. The plant is also rich in terpenes and terpene alcohols. Testing for antidiabetic, neuroprotective, anticataract and antixiolytic activities have been promising and the bioactive constituents and efforts are made to interpret the possible mechanism of action of bioactive compounds in bringing about the pharmacological activities.

Conclusion: It is concluded that the plant can be explored and bioprospected for an affordable source of drug and nutraceutical for better management of health related issues of people of Indian subcontinent.

Keywords: *Abies pindrow* (Royle ex D. Don) Royle; anti-inflammatory; antixiolytic; terpenes; antioxidant.

1. INTRODUCTION

The Himalayan mountains are a major biodiversity region [1], containing nearly 10000 plant species of which 4000 are endemics [2]. The Himalayan region harbors 8 families of gymnosperms, representing 20 genera and 51 species [3]. Conifers forms a dominant proportion of the gymnosperm vegetation in this region. *Abies pindrow* (Royle ex D. Don) Royle, or the western Himalayan fir, is one such member of the conifers, and forms a distinctive vegetation at an altitude above 2000 m along the Western Himalayan region from Afghanistan to Nepal [4]. The plant finds use in Ayurvedic formulation 'Vigroll' [5]. The leaves of *A. pindrow* are referred to as Zarnab in the Unani system of medicine and are used as a remedy for fever, hypoglycemia, bronchitis, asthma, hemoptysis and inflammatory conditions [6]. A decoction of the plant is used to treat coughs, phthisis, asthma and other pulmonary infections, while fresh juice is given to infants for treatment of fever and respiratory infections [7]. The plant is also considered to be antiperiodic, antispasmodic, stomachic, carminative, expectorant and astringent [8]. The wood of the plant is also used for construction purposes in making doors, windows, houses, furniture and for fuel food [9]. The plant is reported to contain terpenoids, fatty acids, chalcones, flavonoids, cyclic polyol (pinitol) in their various parts, and most of them are reported to have biological and pharmacological activities [10]. The importance of this plant with respect to its pharmacological activities have been somewhat neglected and less projected to the scientific community. Thus this review have been framed with a notion of bringing in all the relevant information related to *Abies pindrow* in one common platform. This will provide an enriching inventory to the scientific community for further research on the plant and also would provide a thrust for bioprospecting the

plant as a source of medicine for overall benefit of the population of Indian subcontinent. Thus based on the available reports about its importance in traditional system of medicine an attempt have been made to review *A. pindrow* in context of its medicinal and pharmaceutical importance.

2. METHODS

A literature search was performed in the internet using PubMed, PubMed Central and Google Scholar as the search platform. Review articles and research papers were selected based on the study design and planning of the review article. The information on ethnobotanical uses of *Abies pindrow* was explored in the internet using phrases such as 'ethnobotanical uses of *Abies pindrow*'. This was also accompanied by region wise collection of information using the keywords 'Uttarakhand', 'Kashmir' etc. Data of chemical constituents of the plant was collected using the phrases such as 'chemical constituent of needle of *Abies pindrow*'. Information related to pharmacological activities of the plant was collected using the phrases 'antiinflammatory activity of *Abies pindrow*'. Research papers and review articles not more than 10 years old were incorporated for framing the article. Research papers older than 10 years were not included unless found to be extremely relevant.

3. RESULTS

3.1 Ethnobotanical Uses

Abies pindrow is used extensively by the inhabitants of Himalayan region for both non medicinal and medicinal purposes. The plant is used for construction purposes, and also as furniture and fuelwood. Medicinally, the plant is used for treatment of various ailments including cough and fevers, amongst other (Table 1).

Table 1. Ethnobotanical use of *Abies pindrow* across various Himalayan regions

S. no.	Region	Vernacular name	Ethnomedicinal uses	Other uses	Reference
1.	Poonch Valley, Pakistan occupied Kashmir	Kashmiri/ Hindko: Tung	Branches: Fuel Cones: Decorative purpose. Inner Bark: Powder of inner bark used for treatment asthma.	Wood: Timber for building bridges, beams and furniture	[11]
2.	Ayubia National Park, Abbottabad, Pakistan	English: Fir		Wood: Used for manufacture of furniture and beams of houses and as fuel wood.	[12]
3.	Pakistan occupied Kashmir	English:Fir	Bark and Leaves: Used as fodder	Wood: Used as fuel	[13]
4.	Neelam Valley, Muzaffarabad, Pakistan occupied Kashmir	Hindko:Rewar, English: Fir	Root: Decoction used for treatment of cough, phthisis and bronchitis. Leaf: Juice used for treatment of dentition aches in infants. Powder of leaf is used for treatment of cough, bronchitis and fever.	Wood: Used for construction of doors, windows, houses, furniture and as fuelwood.	[14]
5.	Lilownai Valley, Pakistan	Pashto:Achar	Trunk & Cones: Used for treatment of Kidney stone and antirheumatic.		[15]
6.	Kurram Agency, Pakistan	Pashto:Shandi beejur	Resin: Applied for treatment of tick bites.	Wood: Used as timber	[16]
7.	Shogran valley, Pakistan	English: Western Himalayan Fir	Plant: Used for the treatment of expectorant, respiratory disorders, fever, antioxidant, carminative, digestive disorders, astringent, antispasmodic, diuretic, tonic and anti-inflammatory.		[17]
8.	Koh-e-safaid range, Pakistan	Pashto:Bejoor	Seeds: Antidiabetic		[18]
9.	Kaghan Valley, Pakistan	Hindko:Paludar, Rewar	Leaves: Tincture or decoction of the dried leaves are used for treatment of cough, asthma, chronic bronchitis phthisis and cataract. They are also used for treating diseases of the bladder and other pulmonary diseases. Juice of fresh leaves used to treat dentition ache and fever of infants, and chest problems.		[19]
10.	Bangus Valley, Kashmir, India	Kashmiri: Budul	Bark: Red part of bark is chipped to pieces, boiled in water and added to sugar and milk and consumed to get relief from sickness.		[20]
11.	Jammu and Kashmir	Kashmiri: Badul, Drewar, Tung	Leaf: Grounded leaves mixed with honey is used to treat cough and cold. Leaves also used to cure asthma.	Wood: Used for packing cakes, construction of buildings and furniture. Branches: Used as fuel.	[21]
12.	Mornaula reserve forest, Kumaon, India	Kumaoni: Rago	Resin and Bark: Used for the treatment of rheumatism and fuel.		[22]
13.	Kedarnath wildlife sanctuary, Garhwal, India	English: Western Himalayan Fir	Bark: Extract is used for treatment of cough and bronchitis.		[23]
14.	Nanda devi biosphere reserve, India	Kumaoni: Ragu	Leaf: Paste is used to reduce swelling of injured parts. Wood: Used for construction purpose and making furniture.		[24]
15.	Theog forest division, Himachal Pradesh, India	Himachali: Thaneira, Hindi:Tosh	Leaf: Leaf paste is applied to udder of cow to treat clotting of milk and swelling of udder.		[25]
16.	Baitadi and Darchula district, Nepal	Byanshi/Rang: Himisin	Woods: Used as medicine, and agricultural implements.	Woods: Used as prayed flag, fuelwood, furniture, butter churners.	[26]

3.2 Chemical Composition

Abies pindrow has been extensively studied for its chemical constituents. Almost all parts of the plant is rich in bioactive compounds. The

various compounds present in different plant parts of *A. pindrow* is depicted in Table 2 and chemical structures of selected compounds are presented in Figs. 1, 2 and 3, respectively.

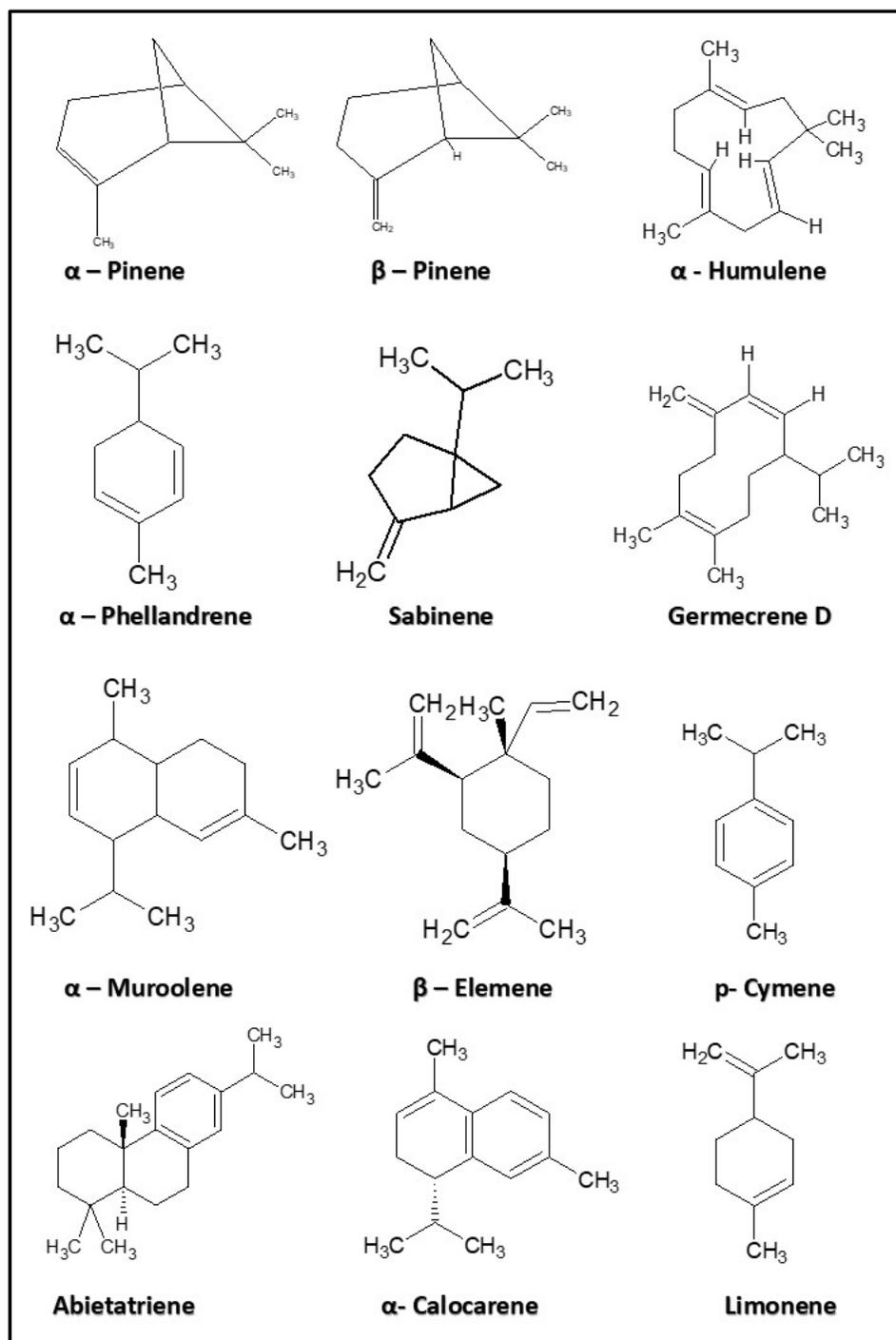


Fig. 1. Chemical structures of selected terpenes found in *Abies pindrow*

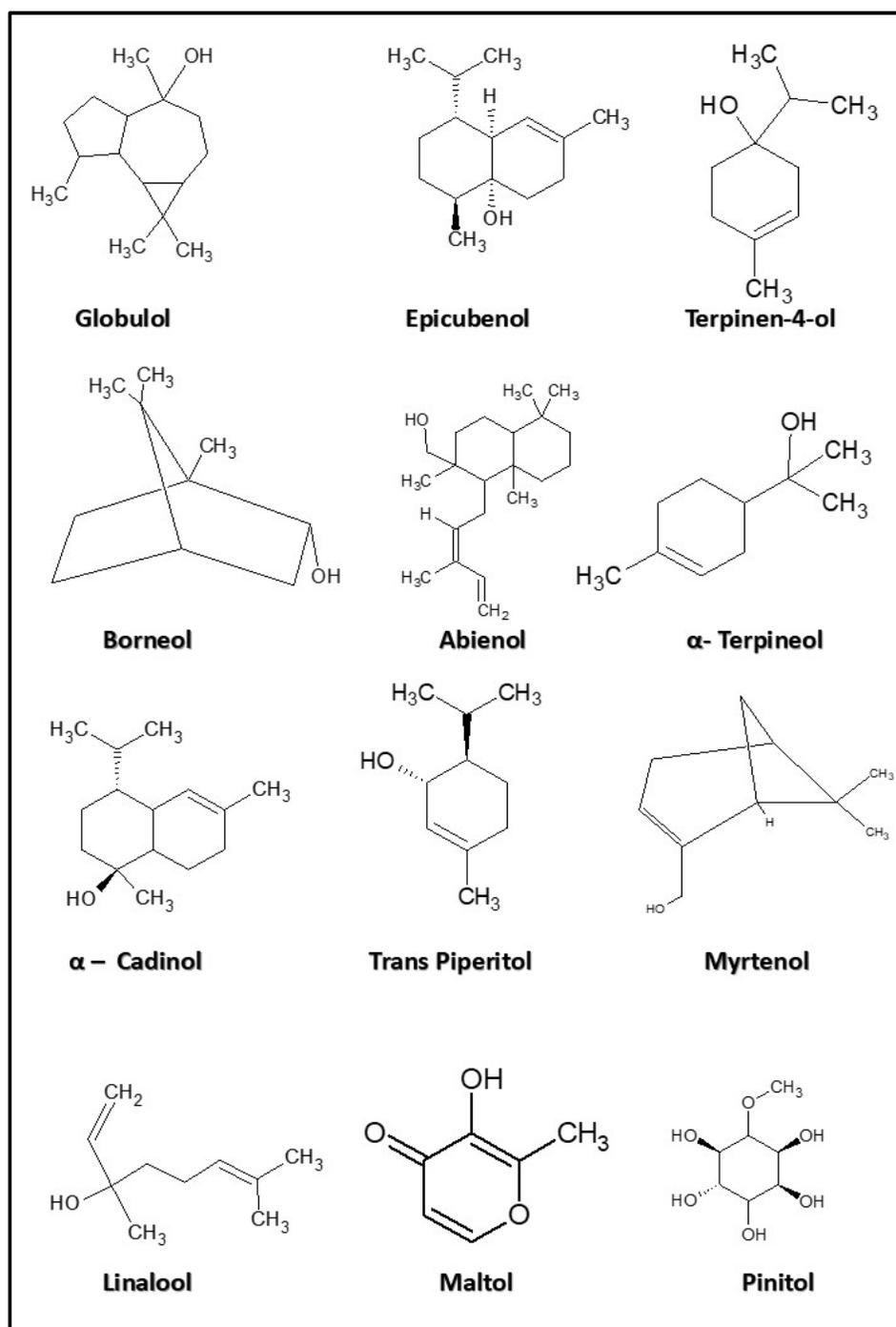


Fig. 2. Chemical structures of selected alcohols present in *Abies pindrow*

3.3 Pharmacological Potential

3.3.1 Anti-inflammatory activity

(+)- Pinitol isolated from leaves of *A. pindrow* is reported to possess anti-inflammatory activity. It is reported from a study [35] that (+) - Pinitol at a

dose of 2.5-10 mg/kg resulted in significant inhibition of oedema volume of carrageenan induced paw oedema in wistar rats. The percent inhibition of highest dose of (+) - Pinitol was comparable to inhibition by phenyl butazone (100 mg/kg).

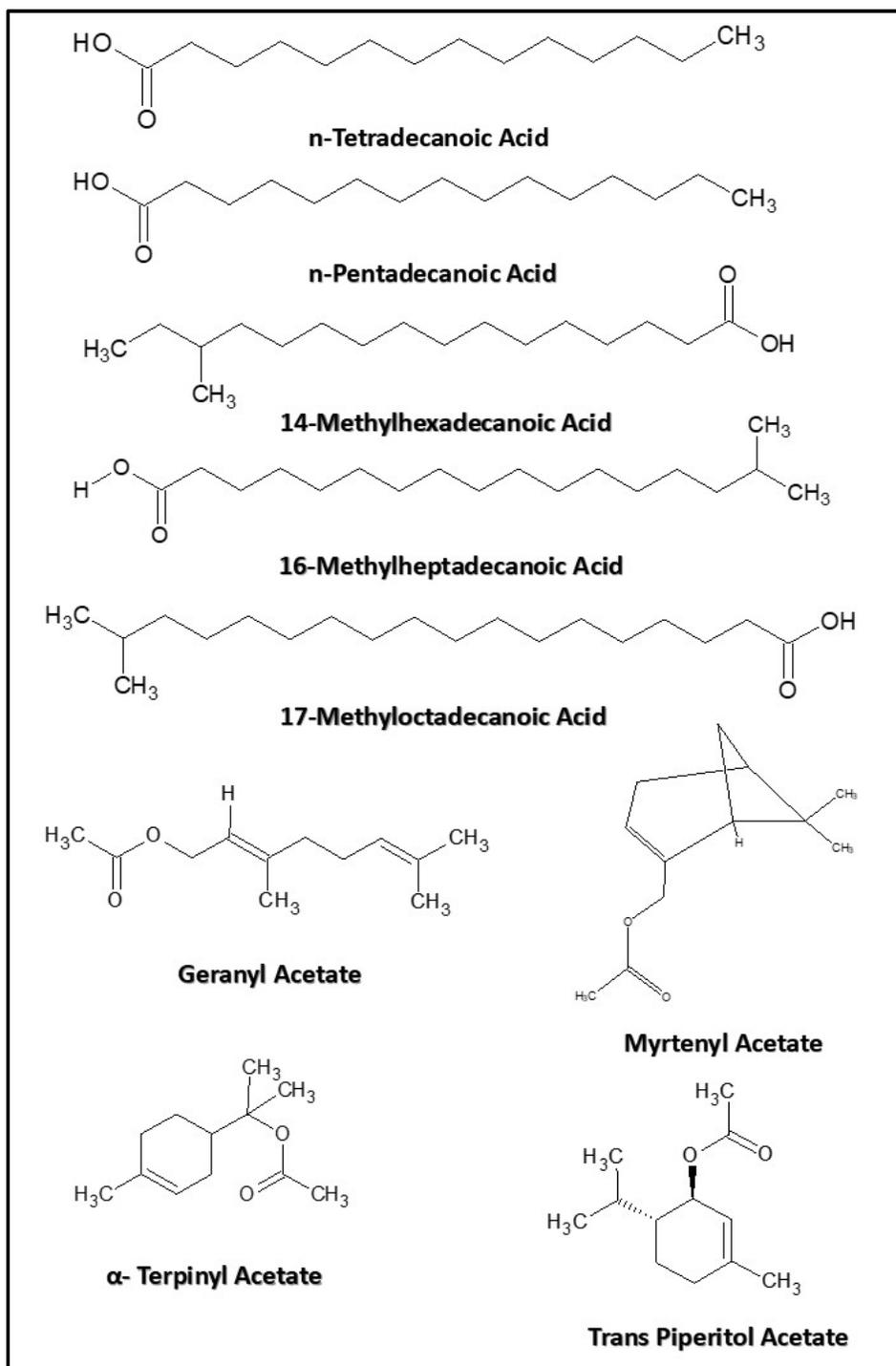


Fig 3. Chemical structures of selected long chain fatty acids and esters present in *Abies pindrow*

3.3.2 Anticataract activity

Cataract is the leading reason of blindness worldwide, and is largely caused due to oxidative

stress in the lens [36]. It is reported from a study that aqueous leaf extract of *A. pindrow* at concentrations of 5-20 mg/ml confers protection against hydrogen peroxide induced cataract in

Table 2. Major constituents of different plant parts of *Abies pindrow*

Plant parts	Nature of compounds	Name of compound	Reference
Stem	Chalcones	Okanin; Okanin-4'-O- β -glucopyranoside; Butein-4'-O- β -D-glucopyranoside; 2',3'4':3,4-pentahydroxychalcone-4'-(L-arabinofuranosyl- α -1 \rightarrow 4-D-glucopyranoside- β)	[27]
	Flavonone	8,3'4'-trihydroxyflavonone-7-O- β -D-glucopyranoside	[27]
Leaf	Hydrocarbons	Tricosane; Eicosane; Heneicoasane; Docosane; Tetracosane; Nonadecane; Octadecane; 1-Docosene; Heptadecane; 1-Octadecane; 2,6,10,14-Tetramethylhexadecane	[28]
	Heterocyclic ketone lanostane derivative	3-Hydroxy-2-methyl-4H-pyran-4-one (Maltol) Pindarolactone	[29] [30]
Leaf	Fatty acid	n-Tetradecanoic acid; n-Pentadecanoic acid; 14-methyl-Pentadecanoic acid; Cyclopentaneundecenoic acid; 14-Methyl-hexadecanoic acid; 16-Methyl-heptadecanoic acid; cis-9-Octadecenoic acid; 5,9-Octadecadienoic acid; 17-Methyl-octadecanoic acid; Docosanoic acid; Tetracosanoic acid.	[31]
Stem & Leaf	Terpenes	α -Pinene; α -Thujene; α -Terpinene; α -Humulene; α -Selinene; α -Muurolene; α -Longipinene; α -Calacorene; β -Pinene; β -Caryophyllene; β -Elemene; γ -Terpinene; γ -Elemene; γ -Muurolene; δ -2-Carene; δ -Elemene; δ -Cadinene; (E)- β -Farnesene; (E)-Calamenene; (Z)-Calmenene; p-Cymenene; p-Cymene; Linalool; Camphene; Sabinene; Myrcene; Limonene; Terpinolene; Kaurene; Abietadiene; Abietatriene; Germacrene D; Camphene hydrate; trans-Sabinene Hydrate; Humulene oxide II.	[32]
	Terpene Alcohol	Borneol; Isoborneol; Myrtenol; Abienol; Terpinen-4-ol; 6-Camphenol; Selin-11-en-4- α -ol; 13-epi-Manool; cis-p-Menth-2-en-1-ol; trans-p-Menth-2-en-1-ol; α -Cadinol; epi- α -Cadinol; α -Terpineol; β -Eudesmol; γ -Eudesmol; (E)-Nerolidol; 1-epi-Cubenol; 10-epi- γ -Eudesmol;	[32]
	Terpene esters	Linalyl acetate; Bornyl acetate;	[32]
	Cyclic polyol	Pinitol	[33]
	Carboxylic acid	Shikimic Acid	[33]
Essential oil from leaf	Terpenes	Santene; Tricyclene; Myrcene; Sabinene; Camphene; Abietadiene; α -Pinene; α -Phellandrene; α -Humulene; (E)- α -Bisabolene; (+)-(R)-Limonene; (+)-3-Carene; β -Pinene; β -Bisabolene; β -Alaskene; γ -Bisabolene; γ -Terpinene; Germacrene D; Camphene hydrate.	[34]
	Terpene alcohol	α -Terpineol; Terpinen-4-ol; cis-Piperitol; trans-Piperitol; Citronellol; Isoborneol; Abienol; Epicubenol; (E)-Nerolidol; Cadin-4-en-10-ol; epi- α -Bisabolol; T-Muurolol; Fenchyl alcohol; (E)-p-2-Menthen-1-ol; β -Linalool	[33]
	Terpene esters	Bornyl acetate; Menthyl acetate; Citronellyl acetate; Geranyl acetate; Trans-Piperitol acetate; Myrtenyl acetate; α -Terpinyl acetate.	[34]
	Terpene-ketone	Piperitone	[34]
	Dialkyl ketone	Undecan-2-one	[34]
	Hydrocarbons	Tetracosane	[34]
	Aldehyde	Dodecanal	[34]
	Alcohol	n-Dodecan-1-ol	[34]
Ether	Carvacryl methyl ether	[34]	

isolated goat lenses. It was observed that application of leaf extract resulted in a decrease in malondialdehyde levels in lens cultured in hydrogen peroxide. Furthermore, there was a restoration in levels of superoxide dismutase and reduced glutathione (GSH) upon treatment with the leaf extract. On a morphological level there was a decrease in lens opacity upon treatment with the extracts, suggesting an anti-cataract activity [37].

3.3.3 Antixiolytic activity

Insomnia, agitation, anxiety are important neuropsychological problems that are frequently dealt by clinicians and are treated by anti-convulsant drugs [38]. The methanolic extract of *A. pindrow* leaves were used to assess its effect on various behavioural models of anxiety in rats. It was reported that treatment of rats with extracts at 50 mg/kg and 100 mg/kg resulted in open field ambulation, rearings, self-grooming and activity in centre as compared to rats treated with only vehicles. This was accompanied by elevated plus maze behaviours characterized by significant increase in time spent and entries made in open arms and decrease in time spent/entries in enclosed arms in comparison to control. There was also an elevated zero maze behaviour characterized by significant increase in time spent in open arms, entries in open arms and number of head dips in elevated zero maze. Treatment with *A. pindrow* leaf extracts resulted in overall improvement in behavioural pattern, thus indicating anti-convulsant activity [39].

In another study [42], the anti-anxiety activity of n-hexane, chloroform, methanol and water extracts of aerial parts at doses of 100, 200 or 400 mg/kg were studied on laca mice. It was reported from the study that the chloroform and methanolic extract exhibited significant anti-anxiety activity as evident from increase in number of entries in open arms and time spent in open arms in elevated plus maze model. Furthermore, the ethyl acetate fractions also exhibited significant anti-anxiety activity as reported from the parameters of elevated plus maze test [40].

3.3.4 Neuropharmacological activity

The methanolic extract at concentration 200 mg/kg and 400 mg/kg and ethyl acetate fraction at concentration 25 mg/kg or 50 mg/kg of aerial parts of *A. pindrow* was evaluated for anti-convulsant, antidepressant, locomotor and

anti-stress activities using laca mice as experimental system. It was reported [43] that both the extracts reduced the duration of tonic extension in mice thus showing anti-convulsant activity. Furthermore, both the extracts also exhibited antidepressant activity as evident by reduction of duration of immobility. The anti-stress activity of the extract on mice was determined by the cold swim test. It was observed that both the extracts resulted in significant reduction in immobile state as compared to control [41].

3.3.5 Antidiabetic activity

Insulin is the hormone that drives glucose uptake from blood into the tissues. It is secreted by the β cells of the pancreas and is stimulated by exogenous elevated glucose levels specially those occurring after consumption of meal [42]. The effect of ethanolic extract of *A. pindrow* on insulin secretion of INS-1 cells in presence of glucose was explored in a study. The results indicated that an *A. pindrow* extract of 10 μ g/ml significantly exhibited insulin secretagogue activity, suggesting its antidiabetic nature [43].

3.3.6 Calcium channel blockage

A 70% aqueous – methanolic leaf extract of *A. pindrow* resulted in blockage of calcium channels in isolated rabbit jejunum and trachea [46]. It was furthermore observed [46] that treatment with 0.01 mg/ml to 10 mg/ml of crude extract of *A. pindrow* resulted in concentration dependent relaxation of high K⁺ induced contractions in both the experimental tissues. High potassium concentration is known to induce contractions of smooth muscles by opening of L-type calcium channels resulting in influx of extracellular calcium. The results indicate that *A. pindrow* can be used in treatment of diarrhoea and bronchitis due to its calcium channel blocking ability [44].

4. DISCUSSION

Abies pindrow all along the shady slopes of Western Himalayan mountains. The plant finds extensive use among the local people dwelling in the Himalayan regions. It is widely used as timber for various construction purpose as it has high durability and less prone to attacks by microbes or insects. This is largely due to high content of terpenes and other allied compound in the wood which acts as a natural deterrent of microbes and insects [45,46]. It is reported from a study that terpenes penetrate into the cuticle

and interacts with the target site to bring toxicity response [47]. In addition to it, terpenoids are antagonistic to acetylcholine esterase and gamma amino butyrate in insects both of which are involved in neurotransmission [48]. It is also reported from a study that terpenoids cause growth inhibition and disrupts ion homeostasis in fungal system thereby causing inhibitory and toxicity response [49]. Furthermore, the terpenoids from essential oil also results in disruption of cell membrane. Alteration and inhibition of cell wall formation in fungi ultimately resulting in their death. The essential oils also disturb citric acid cycle, inhibit ATP synthesis and H⁺ ATP ase in fungi resulting in their death [50].

The plant is also traditionally used for the treatment of asthma and other pulmonary disorders. Asthma is basically a chronic inflammatory disorder of lungs, characterized by

airway inflammation and hyper-responsiveness [51]. Asthma is closely associated with eosinophilic inflammation and IgE mediated mast cell activation [52]. Anti-inflammatory and bronchodilator treatments are thus the main approaches of asthma therapy [53]. It is reported that (+) - pinitol isolated from *A. pindrow* possess anti-inflammatory activity. Pinitol exerts its anti-inflammatory action by inhibiting activation of I κ B α kinase, resulting in sequential suppression of I κ B α phosphorylation, I κ B α degradation, p65 phosphorylation, p65 nuclear translocation and NF-kappaB-dependent reporter gene expression (Fig. 4). In addition to it, Pinitol also attenuated tumour necrosis factor receptor (TNFR)-1, TNFR-associated factor-2, transforming growth factor-beta-activated kinase-1 (TAK-1)/TAK1-binding protein-1, TNFR-associated death domain and I κ B α kinase induced Nuclear Factor κ B (NF-kB) reporter activity [54].

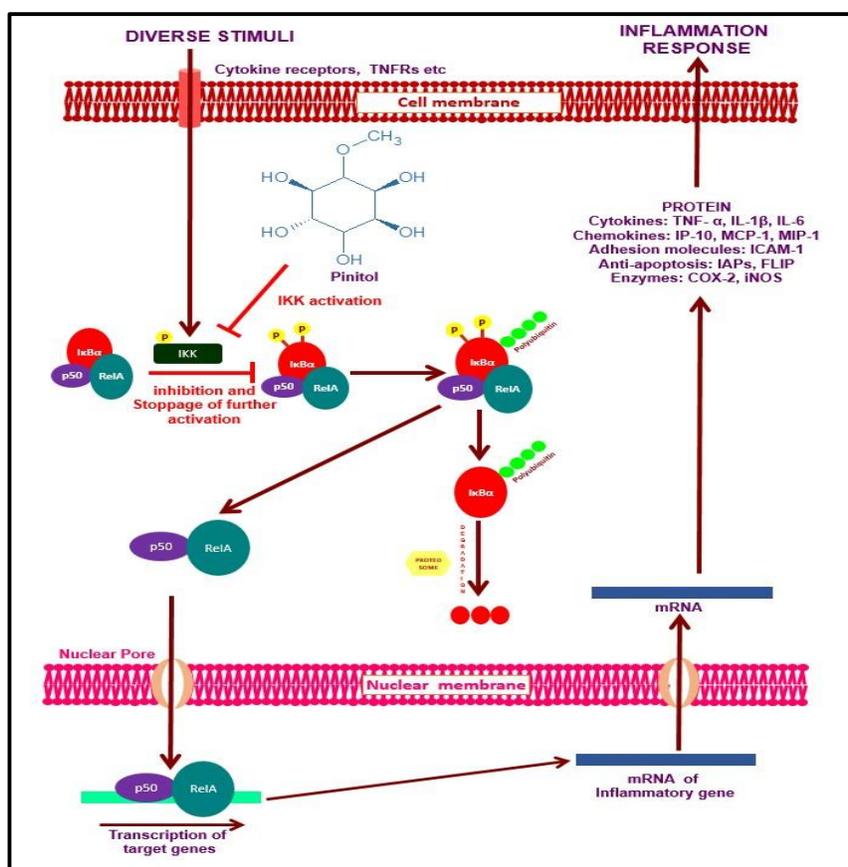


Fig. 4. Representation of NF- κ B induced inflammatory pathway and inhibitory action of pinitol
 IKK: I κ B kinase; TNF α : Tumour necrosis factor- α ; MCP-1: Monocyte chemoattractant protein-1; MIP-1: Macrophage inflammatory protein; ICAM-1: Intercellular adhesion molecule 1; FLIP: FLICE-inhibitory protein; IAP: Inhibitor of apoptosis

Terpenes also reported to possess antiinflammatory properties. Alpha Pinene, one of the terpenes present in *A. pindrow* exerts its inhibitory effects on inflammatory responses by reduction of interleukin-6 (IL-6), tumour necrosis factor- α (TNF- α), and nitric oxide (NO) levels. Additionally, alpha pinene also inhibited inducible nitric oxide synthase (iNOS) and cyclooxygenase-2 (COX-2) all of which are associated with inflammatory responses [55]. Similarly, myrcene and limonene are also reported to inhibit inflammatory responses by decreasing IL-1 β -induced NF- κ B, JNK and p38 activation, They also attenuate the gene expression of iNOS, catabolic matrix metalloproteinase (MMP-1 and MMP-13) genes [56]. In addition to terpenes, the antiinflammatory activity of the extract of *A. pindrow* is also due to the presence of chalcones. It has been reported from a recent study, it has been reported that chalcones exhibit antiinflammatory action through inhibition of cyclooxygenase, prostaglandin E2, inducible NO synthase and nuclear factor kb activities. Molecular docking analysis revealed that chalcones interacts with mediators of inflammatory processes through hydrogen bonding [57].

Cataract is a condition in which there is a complete or partial opacification on or in the human lens or in the capsule leading to impairment in vision [58]. The opacity of the lens is a direct consequence of oxidative stress induced by reactive oxygen species along with higher levels of superoxide dismutase, catalase, Glutathione peroxidase, malondialdehyde and reduced (GSH levels) [59]. It has already been discussed that aqueous leaf extract of *A. pindrow* confers protection against cataract formation. This anticataract activity was brought about by overall reduction in oxidative stress in the lens accompanied by reduction in lens opacity. It is reported that some terpenoids such as α -Pinene, limonene, Terpeneol, geraniol, linalool, myrcene acts as antioxidants by scavenging free radicals [60]. Structure –activity relationship reveals that among monoterpene hydrocarbons, those with strongly activated methylene groups in their molecular structure such as terpinolene, α -terpinene, γ -terpinene, Sabinene are most active in scavenging free radicals. Among oxygenated monoterpenes, the order of activity are monoterpene phenols (thymol, carvacrol) >allylic alcohols (geraniol, cis-verbenol)> monoterpene aldehyde and ketones. In addition to it, terpenoids also have the potential to enhance

both enzymatic and non-enzymatic antioxidant status [61].

The antixiolytic activity of *A. pindrow* have also been reported as evident from betterment in overall behavioural pattern of experimental animals upon treatment with the extract of the plant. It has been reported that terpenes exert their antixiolytic activity through modulation of Gama Amino butyric Acid (GABA_A) receptor function [62]. A study reported that myrtenol and Verbenol act on the δ -subunit -containing GABAA receptors and enhance tonic inhibition process in dentate gyrus granule cells [63]. It is also reported [66] that α -Pinene exhibits antixiolytic and hypnotic effects by binding with aromatic residues of α 1- and - γ 2 subunits of GABAA-BZD receptors there acting as a modulator molecule [64].

The extract of *A. pindrow* also possess antidiabetic properties. It was observed from the cited study that the extract of the plant resulted in increase in insulin secretion by the pancreas. It is known that hyperglycemia is accompanied by an increase in oxidative stress in pancreas. During hyperglycemia β -cells are exposed to high concentrations of glucose for a prolonged period of time resulting in saturation of normal route of normal route of glycolysis and diversion of excess glucose to ROS forming pathway including glycosylation [65]. This results in disruption of normal function of pancreatic beta cells. It is reported that oxidative stress results in reduced DNA binding activity of duodenal homeobox factor 1 (PDX1), an important factor responsible for maintaining proper function of beta cells, resulting in lowering of insulin gene expression [66]. The increased secretion of insulin upon treatment with plant extracts is largely due to presence of terpenoids which restores the activity of both enzymatic and non-enzymatic antioxidants [67]. Some studies [68] also reported that monoterpene exert their antidiabetic activity by stimulating glucose uptake, promoting GLUT4 translocation and activating insulin receptor IRS1.

5. CONCLUSION AND FUTURE PROSPECTS

Abies pindrow finds extensive ethnomedicinal uses among people residing in Himalayan region. In most cases it has been observed that the traditional use of the plant has been documented by a number of researchers but scientific validation of the information through

pharmacological investigation is yet to be performed. This traditional knowledge thus can provide ample opportunity for further exploration of pharmacological activities. However, the activities of *A. pindrow* that were explored till date were performed on animals. Thus research needs to be undertaken to further explore the pharmacological activities using humans through introduction of clinical trials. Since *A. pindrow* exhibits antiinflammatory activity, it has the potential of modulating a large number of disease associated with inflammatory response and can thus be very well utilized to explore the efficacy against inflammation related diseases. Moreover mechanisms of action of bioactive compounds isolated from *A. pindrow* also needs to be further explored for clarity of pharmacological actions. There has been reports from various studies that chalcones behave as strong antioxidants [69,70] and antiproliferative activities [71,72]. Since chalcones have been isolated from the barks of *A. pindrow*, investigations on anticancer and antiproliferative activity also needs to be undertaken for development of anticancer drug. Several other species of *Abies* also reported to possess various pharmacological actions that are yet to be explored for *A. pindrow*. As for example Abigenol, a nutraceutical, extracted from the bark of silver fir (*Abies alba*) is rich in polyphenols and have shown pharmacological efficacy [73,74]. Efforts can be undertaken for development of similar nutraceutical from *A. pindrow* for better management of diseases of people of Himalayan region. Since the plant is widely available throughout the Western Himalayas, it can be a useful raw material for development of affordable drugs and nutraceutical for overall benefit of population of Indian subcontinent.

CONSENT AND ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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