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Phytochemical Constituents and Pharmacological Activities of *Betula alba* Linn.- A Review

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Abstract: In spite of many synthetic compounds the most efficient drugs have their origin directly or indirectly related with the plant kingdom. Many of the plant extracts have proven to possess important pharmacological actions depending upon the presence of chemical constituents. *Betula alba* is widely used in the traditional medicinal systems like Ayurveda and Unani. This plant has been reported to possess glycosides, flavonoids, tannins, essential oils, vitamins, sterols etc. in different parts and exhibit various pharmacological activities like anti-malarial, anti-cancer, anti-microbial, anti-inflammatory, etc. This review highlights some of the phytochemical and pharmacological aspects of *Betula alba*.
Keywords: *Betula alba*, white birch, black birch, silver birch.

Introduction

The use of local plants in folk medical practices has a long history. The resource base of the traditional medical practices prevalent in rural and tribal villages of Chhattisgarh is mainly the plants. Medicinal plants are used to maintain and promote healthy life, prevent disease and cure ailments. It has being estimated that even today 80% of the world populations rely on herbal traditional medicine for primary health care[1] . According to one study the tribal's of India use over 7500 plant species for medicinal purposes. Out of this the medicinal value of over 4000 species are not known to the mainstream population[2]. Unfortunately this rich and varied folk knowledge is fast disappearing. Keeping this fact in the mind we have planned to review traditional knowledge, phytochemical constituents and scientific validation of traditional claims of plant *Betulaalba.*

Betulaalba Linn. (family: Betulaceae), is a tree growing to about 30m height, mainly grown in and cultivated in Asian country. It is known as the "Lady of Woods" derived from the Sanskrit word Bhurga, 'a tree whose bark is used for writing upon'. It is remarkable for its lightness, grace and elegance and after rain it has a fragrant odor.

Plant Description:

It is known as *white birch*, *black birch* and *silver birch*. The silvery-white bark becomes black and fissured with age. Transverse section shows distinct growth ring boundaries marked by 2 or 4 rows of radial flattened cells. Pores are scattered in radial multiples of 2 or 4 pores and in clusters. Pore size varies highly from one growing site to the other. Radial section shows scalariform perforation plates with 10 to 15 bars. It shows homogenous rays occasionally square marginal cells. Ray vessels pits numerous and extremely small libriform fibers present. Fiber-tracheids absent.Tangential section shows uniserrate rays. Average ray height is 10 to 25 cells. The young twigs often droop.

Leaves are small and simple with a toothed margin. The flower are wind pollinated, grouped into catkins, the males long, loose and hanging down, the female shorter, stiff and erect. Female catkins disintegrate at fruiting stage to release plentiful, tiny winged seeds which dispersed by the wind. The leaves emerge shortly after, a bright emerald green at first turning golden in autumn. The leaves of silver birch are small and roughly diamond shaped. They are toothed on both sides and born on slender warty twigs that shiver in the slightest breeze[3].

Taxonomical Classification:

Domain: Eukaryota
Kingdom: Plantae
Subkingdom: Viridaeplantae
Phylum: Tracheophyta
Subphylum: Euphyllophytina
Infraphylum: Radiatopses
Class: Magnoliopsida
Subclass: Hamamelididae
Superorder: Faganae
Order: Corylales
Family: Betulaceae
Subfamily: Betuloideae
Tribe: Coronilleae
Genus: *Betula*
Species: *alba*
Botanical name: *Betulaalba*(zipcodezoo)

Traditional uses:

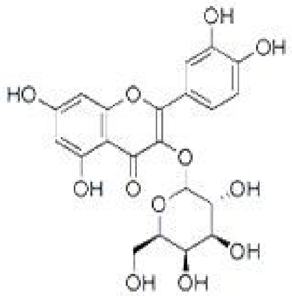
The medicinal properties of the plant is used in arthritis, boils, fever, gout, headache, kidney stones, rheumatism and worms, also used as anti-inflammatory, the leaves are antibacterial, diaphoretic, used in gonorrhea, diarrhea, dysentery, cholera. In Ayurveda the essential oil is used for eczema and psoriasis, hair loss[4] .

Phytochemical Constituents:

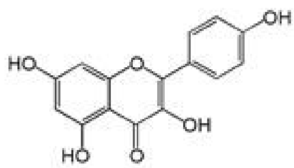
The plant has received great deal of attention from chemical as well as pharmacological point of view. As various parts of plant exhibit varied pharmacological action, we are reviewing the chemical constituent of different parts of *Betulaalba*is used for pharmacological actions.

It contains betulin and betules, empyreumatic oil, oleumbetulinum. It contains high percentage of methylsalicylate, betuloside with aglycone betuligenol and also cresol and guaiacol.

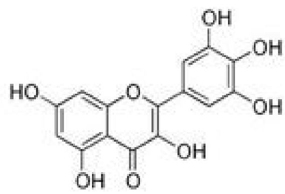
Bark:



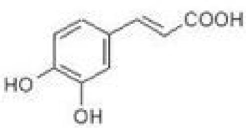
Hyperoside



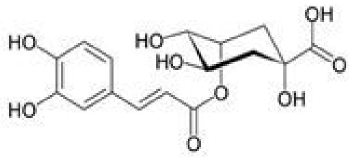
Kaempferol



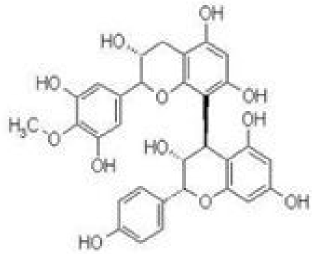
Myricetin



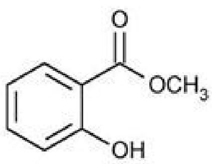
Caffeic acid



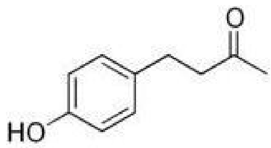
Chlorogenic acid



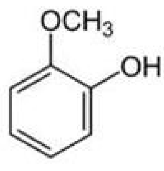
Polymeric anthocyanidins



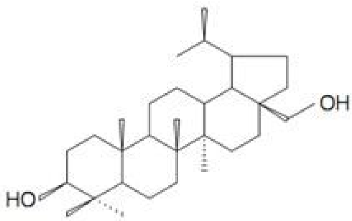
Methyl salicylate



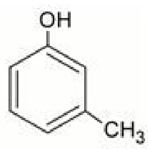
Betuligenol



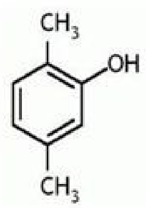
Guaiacol



Betulin



Cresol



Xylenol

Leaves:
The leaves contains 1-3% of flavones glycosides, basically hyperoside and other quercetin glycosides together with glycoside of kaempferol and myricetin.Leaves contain phenolic compounds 3,4-dihydroxypropiophenone 3-glucoside, caffeic acid and chlorogenic acid. Leaves also containstriterpene alcohol and malonyl esters of the dimarene type and saponins. Leaves contain mainly polymeric proanthocyanidins,their total content is 39mg/g.

Buds:
Bud contain 4-6% of essential oil. The dry distillation of birch bud yield about 6% phenol, cresol, quajacole, xylenol, coesole.

Roots:
High potassium, sodium ratio were determined in dry birch roots and in a 1% decoction. There are also essential oil (0.04-0.05%), vitamins(upto 2-8%) of ascorbic acid, coumarins(0.44%), saponins(upto 3.2%), tannins(5-9%), and sterol[5].

Pharmacological Activities:

Anticancer Activity:
Chemical synthesis and modification of betulinic acid are being explored. 3-oxo-23-hydroxybetulinic acid was the most cytotoxic and murine melanoma B_{16} cells(IC_{50}=22.5µg/ml). It caused a rapid increase in reactive oxidative species product and a concomitant dissipation of mitochondrial membrane potential in a dose and time-dependent manners which resulted in cell apoptosis, as demonstrated by fluorescence microscopy, gel electrophoresis, and flow-cytometric analysis[6] .

Antibacterial Activity:
Betulinic acid and 3-hydroxylpentacyclictriterpenoic acid(HPTAs) have been investigated for antibacterial activity against *Staphylococcusaureus* and *E coli*[7].

Antimalarial Activity:
Both in vitro and in vivo studies were carried out. The invitro antiplasmodial IC_{50} values of betulinic acid against chloroquine resistant and sensitive *Plasmodium falciparum* were found to be 19.6µg/ml and 25.9µg/ml respectively. The invivo activity in a murine malaria model, the top dose employed of 250mg/kg/day was ineffective and exhibited some toxicity[8].

Antiviral Activity:
New nitrogen containing derivatives of betulinic and betulonic acid were synthesized and their invitro antiviral activities were studied. All the derivatives of betulinic acid under study displayed antiviral activity towards influenza A virus, herpex simplex type I virus and HIV I virus by preventing the formation of cellular aggregates[9].

Antileishmanial Activity:
Disuccinylbetulin, diglutaryldihydrobetulin, and disuccinyldihydrobetulin derived from *Betulaalba* inhibit the growth of the parasite*Leishmaniadonovani* as well as relaxation activity of the enzyme type IB topoisomerase of the parasite.These compounds reduce the intracellular parasite burden in macrophages infected with wild-type *L. donovani* as well as with sodium antimony gluconate resistant parasite (GE1)[10] .

Conclusion:

Although the efficacy of many traditional remedies are well known, the risk of using certain plants in various traditional medicines still continues as well as there are myths about the toxic property of some medicinal plants. Scientific validation in terms of efficacy, safety, shelf life, pharmacological properties, mode of action and standardization should be carried out. Phytomedicines with modern strands of safety and efficacy or allopathic type of drugs can be developed from traditional clues. Development of Ayurvedic type of medicine/phytomedicine is inexpensive, less time consuming and more relevent to our economic conditions. This can be achieved, based on ethnomedical clues, by developing standardized herbal drugs in light of modern science for various aspects of healthy life[11].
With this back ground we have selected *Betulaalba*for this review because this plant has been reported to possesssaponins, essential oil, betulinic acid, tannins, flavanoids, bitters, glycosides, etc. in different parts and exhibited various pharmacological activities like anticancer, antiviral, antibacterial, antimalarial etc. This review also highlighted traditional uses of *Betulaalba*.
Hence,*Betulaalba*may be considered as a valuable plant in both traditional and modern drugs development areas for its versatile medicinal uses. Standardization of *Betulaalba* extract can be carried out for direct use against various above mentioned problems or further research can be undertaken for isolation, purification and pharmacological validation of active constituents responsible for particular pharmacological activity.

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