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Review Article

# PHARMACOGNOSTIC AND PHARMACOLOGICAL PROFILE OF TRADITIONAL MEDICINAL PLANT: *MYRICA NAGI*

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**ABSTRACT**

*Myrica nagi* belongs to myricaceae family. It is commonly known as Bay berry (English) and Kathphal (Hindi). *Myrica nagi* has a long history of usage in traditional medicine against various ailments. In Ayurvedic and other traditional medicinal practices the plant has been used against diseases like, fever, Cardiac debility, typhoid, diarrhoea, dysentery. Phytochemicals like glycosides, saponins tannins, flavonoids, triterpenes and sterols have been isolated. Important pharmacological activities such as hepatoprotective, antioxidant, antibacterial, antifungal, antihelmintic, antiinflammatory and antiasthmatic properties were shown by researchers. This review presents a detailed survey of the literature on various traditional uses, phytochemical and pharmacological properties of *Myrica nagi.*

**Keywords:** *Myrica nagi*, traditional uses, phytochemicals, pharmacological activities.

## INTRODUCTION

From the earliest times, herbs have been used for their pain-relieving and healing abilities and in the third world millions of the people still use the herbal drugs. It has been estimated by WHO that 80% of the people living in the developing countries rely upon the traditional health practices for their primary health care needs. However, the potential of higher plants as sources for new drugs is still largely unexplored. Many higher plants are known to be the main source of the drug therapy in traditional system of medicines[1, 2]. In India, around 20,000 medicinal plants have been recorded. *Myrica nagi* is also one of the most common plants currently used in ayurvedic formulations for human health management. *Myrica nagi* is a medium to large woody, evergreen, dioecious, subtropical tree belonging to the family myricaceae. In India *Myrica nagi* is commonly known as kaifal in Hindi, Kathphala in Sanskrit and *Kaiphal* in Urdu[3]. In other languages plant is known as, in English: Wax myrtle/Bay berry, Arab: Azuri[9]. Synonyms of Myrica nagi are *M. spida* and *M. cerifera*. However three genera and 50 species are related to family *Myricaceae* found throughout the world[4]. Some of the species related to genus Myrica are *M. adenophora*[4], *M. caroliniesis, M. cordifolia, M. dentulata, M. esculenata*[4], *M. faya, M. gale*[5], *M. hartwegi*[5], *M, heterophilla, M. inodora, M. integra, M. nana, M. quercifolia*[4], *M. rubra*[6], *M. pensylvanica*[7].

Tree attains height of 12 to 15 meters. Leaves are lanceolate, 9 cm long, 3 cm broad, lower surface-pale green, upper surface-dark green. Generally leaves are crowded towards the end of branches[8]. Flowers are minute, unisexual and glandular. The peak flowering season was observed to occur during the first fortnight of March. However flowering season starts from the first fortnight of February and continues till the second fortnight of April [8, 9]. Fruits are A drupe, ellipsoid or ovoid shaped, in length 0.7-1.0 cm, 0.5-0.7 cm wide, dark brown coloured, surface is tubercled and sourish sweet in taste (Figure :1). Shape of seed is ovoid, in length seeds are 0.6 cm long, 0.3 cm wide. Surface of seed is very smooth, light brown coloured and oily in taste[12]. The bark is quills or thick pieces, about 1to 2 inches long and from ¼ to ½ inches in thickness; fissured transversely and longitudinally; outer surface rough and it's colour is grey to brownish-grey, inner surface dark brown in colour and smooth, fracture hard, taste bitter[12]. Epidermis of brownish color and scaly, soft, and easy separable from the true bark by scratching; true bark soft is of reddish color and brittle, cut surface here and there studded with a red or dark red gummy resin like substance, smell like that of camphor; odour fruity and somewhat less acrid and aromatic[10].

### Distribution

*Myrica nagi* tree is distributed in India, Nepal[11], China[4], Pakistan and Malaya Islands. The plant is commonly found in outer Himalayan region at an attitude starting from about 900 meters and going up to about 2,100 meters. In India *Myrica nagi* is found from Punjab to Assam, including Arunachala Pradesh, Meghalaya, Nagaland, Manipur, Mizoram, in Khasia, Sylnet, Himachal Pradesh, Jaintia, Shimla, Bengal, Naga and Lushai hills.

### Pharmacognosy

### Microscopy[12]

**Fruit:** Shows epicarp cells isodiametric in surface view, mass of reddish-brown, thin-walled, parenchymatous cells, a few elongated tubercled cells with smooth walls; endocarp hard and stony consisting of sclerenchymatous cells.

**Seed:** Seed coat shows single layered, thick, brown coloured cells; cotyledons composed of single layered, thin-walled epidermal cells containing oil globules and aleuronic grains; mesophyll cells thin-walled, isodiametric and fully packed with oil globules and aleuronic grams.

**Seed Powder:** Yellowish-brown; shows rectangular to hexagonal, thin-walled seed coat and polygonal epidermal cells in surface view; tubercled parenchymatous cells, oil globules and aleuronic grains.

**Stem Bark:** Mature stem bark shows multilayered cork, composed of rectangular, tangentially elongated, thin-walled cells, some filled with red content; secondary cortex a wide zone, composed of thin-walled, rectangular to polygonal, parenchymatous cells, a number of cells filled with red colouring matter and simple, round to oval starch grains measuring 6-11mm in diagram.; a number of stone cells, in singles or groups, circular, polygonal or oval, thick walled, lignified with simple pits and radiating canals, found scattered throughout secondary cortex; secondary phloem consists of sieve elements, phloem fibers, crystal fibers, stone cells and phloem parenchyma traversed by phloem rays; numerous prismatic crystals of calcium oxalate present in

secondary phloem; phloem fibers with blunt or pointed end and highly thick walled, with very narrow lumen present in groups; stone cells similar to those found in secondary cortex, mostly in singles or in groups of 2-3, sometimes associated with fiber groups in phloem parenchyma; in isolated preparation and tangential sections, crystal fibers show more than twenty chambers having single prismatic crystals of calcium oxalate in each chamber; a number of phloem parenchyma cells containing red colouring matter; phloem rays 1-4 seriate containing red colouring matter.

**Bark Powder:** Rusty red; shows a number of stone cells, phloem fibers, crystal fibers and prismatic crystals of calcium oxalate and simple, round to oval, starch grains measuring 6-11 μ in dia.

**Physical constants**

*Myrica nagi* stem bark contains ash value not more than 4%, acid insoluble ash not more than 1%, Alcohol soluble extract not more than 13%, and water soluble extractive not more than 12%. Fruits of *Myrica nagi* found to have ash value not more than 5%, acid insoluble ash not more than 2.5%, alcohol soluble extract not more than 15%, and water soluble extractive not more than 17% (Table 1)[12].

**Thin Layer Chromatography**

**Stem-bark**

TLC of the alcoholic extract on Silica gel "G" plate using Toluene: Ethylacetate (7:3) in visible light shows four spots at Rf. 0.08 (grey), 0.32 (yellow), 0.51 (grey) and 0.58 (yellow). Under UV (366 nm) three fluorescent zones appear at Rf. 0.49, 0.67 (both light blue) and 0.86 (blue). On spraying with 5% Methanolic-Sulphuric acid reagent and heating the plate at $110^0$C for ten minutes six spots appear at Rf. 0.08, 0.21 (both grey), 0.35 (Pink), 0.52, 0.67, and 0.80 (all grey)

**Fruit:** TLC of the alcoholic extract on silica gel "G" plate using n-Butanol: Acetic acid: Water (4:1:5) shows in visible light five spots at Rf. 0.25, 0.43, 212 0.57, 0.75 (all grey.) and 0.88 (yellowish – green). Under U.V. (366 nm) seven fluorescent zones are visible at Rf. 0.09, 0.18 and 0.30 (all light blue), 0.43 (green), 0.49 (blue), 0.65 (blue) and 0.71 (pink). On exposure to Iodine vapour eleven spots appear at Rf. 0.07, 0.09, 0.12, 0.25, 0.30, 0.35, 0.43, 0.52, 0.57, 0.75 and 0.88 (all yellow). On spraying with 5% Methanolic-Sulphuric acid reagent and heating the plate for ten minutes at 110

0.57 (light brown), 0.71 (light pink), 0.82 (light pink) and 0.88 (yellowish-green) [12].

**Nutritional Value of *Myrica nagi***

Fruits of *Myrica nagi* plant are eaten raw and also used as pickels.[14] Research by Tapan seal et al., (2011) and Chandra S.et al., (2012) shows that *Myrica nagi* fruits have a good nutritional value. Nutritional parameters for Myrica nagi were found for percentage ash value, moisture, crude fat, crude protein, crude fiber, carbohydrate, nutritive value (Table: 2) and many minerals like Sodium, Potassium, Calcium, Manganese, Copper, Iron, Zink were evaluated(Table: 3). Studies showed that *Myrica nagi* has a good Nutritional value so it can be used in specific quantity for the nutrition purpose of human being and adequate protection can be obtained against diseases arising from malnutrition[15].

**Phytochemicals**

***Myrica nagi* Fruits**

Phytochemical studies by Chandra S. et al., (2012) show that Molish test, Fehling test, Benedict test are positive and proves the presence of carbohydrates/ glycosides. Also tests for flavanoids, saponins, tannins (Pyrogoll & catechol, Gallic acid), unsaturated sterol/triterpenes (Liebermann Burchard test, Salkowiskis test), were found positive showing their presence in *Myrica nagi* Fruits. In fruit Pulp Mayer's test, dragondroff test were found negative and hence shows absence of alkaloids. Studies also show the absence of resins in fruit pulp[16].

***Myrica nagi* Stem Bark:**

Phytochemical studies by Chandra S. et al., (2012) show the presence of alkaloids, flavanoids, tannins, unsaturated sterol/ triterpenes and resins. However testes for carbohydrates and saponins were found to be negative[16].

**Chemical Constituents:**

Large numbers of studies have been carried out to indentify various chemical constituents of *Myrica nagi.* Begley M. J. et al., (1971) studied the phenolic extract of *Myrica nagi* and found presence of myricanol, myricanone and diarylheptanoids. 16-bromomyricanol was found during chemical and spectroscopic studies[17].

Malterud K. E. et al., (1980), worked on Diarylheptanoids obtained from root bark of *Myrica nagi* and leads to the isolation of new [7.0]-metacyclophane and this new compound was proposed to be 13-oxomyricanol (Figure 2) [18].

Krishnamoorthy V. et al., (1966) discovered new proanthocyanidin from the stem bark of Myrica *nagi* Thumb. The molecular formula, $C_{30}H_{26}O_{13}$ was deduced from an analytical study of its derivatives (Figure 3). The homogeneity of the proanthocyanidin was confirmed by paper chromatography. Further this extracted proanthocyanidin was treated with different reagents to form proanthocyanidin acetate ($C_{52}H_{48}O_{24}$) and Proanthocyanidin methyl ether ($C_{39}H_{44}O_{13}$) [19].

Sun D. et al., (1988) made an investigation of the bark of *Myrica esculenta* that led to the isolation and identification of gallic acid, myricanol, myricanone, epigallocatechin 3-O-gallate, two prodelphinidin dimers epigallocatechin-(4β→8) - epigallocatechin 3-O-gallate and 3-O - galloylepigallocatechin-(4β→8)-epigallocatechin 3-O-gallate and the hydrolysable tannin castalagin (Figure 4 ) [20].

Sakurai N. et al., (1991) worked on stem bark of *Myrica rubra* and two new diarylheptanoid glycosides were isolated and their structures were established as myricanol 5-0-β-D-glucopyranosyl-( 1-3)-β-D-glucopyranoside and myricanol 5-0-α-L-arabinofuranosyl-(1→6)-β-D-glucopyranoside (Figure 5) [21].

Sakurai N. et al., (1987) isolated a new triterpene together with tarxerone, taraxerol, myricadiol, and sitosterol from stem bark of *Myrica rubra.*

**Traditional Uses:**

**Bark Powder [3, 10, 15]**

- Cardiac debility
- Cardiac edema
- Carminative mixtures
- Chronic gonorrhea
- Cough, Bronchitis
- Dental ach
- Diarrhea
- Diuresis
- Dysentery
- Earache
- Epilepsy
- Gargle
- Heamoptysis
- Hypothermia and cold Sweating (Bark Powder + Ginger)

- Inhaled as a Snuff in catarrh and headache
- Menorrhagia
- Pesserise made of it are used to promote secretion of menses
- Putrid sores
- Typhoid
- Useful to strengthen teeth and gums
- Vata Diseases like: Facial Palsy and paralysis (Bark + Sesame oil)
- Wound Healing

**Fruit Wax/Oil** [3, 10, 15]

- Bleeding Piles,
- Body ach
- Bar discharge
- To regulate menstrual cycle
- Toothache
- Ulcer Healing

*Myrica nagi* is an important constituent of Ayurvedic formulations like Chwayanprash and Brahmarasayan. Chwayanprash leads to free health, strength of the senses, enhanced digestive capacity, complexion and longevity even to the aged. According to Ayurveda, the famous Rishies of Vaikhanas and Balkhilya group used this Brahmarasayan and attained immeasurable life span, acquired youth replacing aged physique, endowed with great memory, intellect, concentration and physical strength[24]. *Myrica nagi* is also used as traditional veterinary medicine in India; it is used as an ingredient of an ointment against sprains and sores[23].

**Pharmacological Uses:**

Myrica nagi is used traditionally to treat large number of disorders and diseases, buy yet very few pharmacological activities have been found significant. Studies those found to be significant are following:

**Anti Inflammatory Activity:**

Tejaa Patel et al., (2011) carried out antiinflammatory activity of *Myrica nagi* stem bark using two animal models i.e. Carrageenan induced rat paw edema and Histamine induced rat paw edema. Ethyl acetate extract of dried bark of Myrica nagi powder was carried out by using Soxhlet extraction process; and aqueous extract was obtained by decoction extraction (boiling bark powder in water) process. Acute toxicity studies were preformed and acute toxicity studies showed that $LD_{50}$ of ethyl-acetate and aqueous extract in mice was 1000mg/kg/i.p. route.

Studies shows that in carrageean induced rat paw edema model inflammation in animals were induced by using carrageenan (0.1ml of 1.0% of carrageenan solution in normal saline) before 1 hour of treatment animals were treated with ethyl-acetate and aqueous extracts of *Myrica nagi*(100 and 200mg/kg/p.o.) and Aspirin(100mg/kg) as standard drug. Results tell that the Myrica nagi (200mg/kg/p.o.) shows percent inhibition ($P<0.01$) to those of standard drug treated group.

Histamine induced rat paw edema was induced by injecting Histamine to the paw of rats. These rats were then treated with standard drug Aspirin (100mg/kg) and ethyl-acetate and aqueous extracts of *Myrica nagi* (100 and 200mg/kg/p.o.). Effects were observed after 3 hours of drug treatment. Ethyl-acetate and aqueous extracts of *Myrica nagi* (100 and 200mg/kg/p.o.) showed significant percent inhibition ($P<0.01$) against the Histamine induced rat paw edema. So the study provides evidence of anti-inflammatory activity of ethyl-acetate and aqueous extracts of *Myrica nagi*[25].

**Antihelmintic Activity**

Vibhor K. Jain et al., (2010) carried out antihelmintic activity of bark of *Myrica esculenta* using 50% aqueous ethanolic extract prepared by Soxhlet extraction method. Activity was evaluated on adult Indian earthworm *Pheritima posthuma*. It resembles anatomically and physiologically with the intestinal round worm parasite of human being. Earthworms were divided into five groups and each group was treated with one of the following: Vehicle (1% gum acacia in normal saline). Piperazine (15 mg/ml) and extract (50 mg/ml, 25mg/ml, 12.5mg/ml).And paralysis time and subsequently for death time were observed. Data revels that the aqueous ethanolic extract at the concentration of 12.5 mg/ml showed both paralysis and death. The effect increases with the concentration. It was observed that aqueous ethanolic extract of *Myrica esculenta* is more potent than reference control piperazine citrate. The results show the antihelmintic properties of aqueous ethanolic extract of *Myrica esculenta* bark[26].

**Antimicrobial Activity:**

Bin Shan et al., (2007) carried out antibacterial activity for Myrica nagi bark. Ethanolic extract (80% ethanol in 20% water) was prepared for study. Antimicrobial activity was performed on five different species of Bacteria that includes three gram positive bacteria (*Bacillus cereus, Listeria monocytogenes, Staphylococcus aureus*) and two Gram negative bacteria (*Escherichia coli, and Salmonella anatum*). The strains were cultured using agar-well diffusion method at 37 °C on plate count agar (PCA) medium. During studies diameter of inhibition zone (DIZ) of negative control for each bacterium was found to be 4.6 mm. Ethanolic extract of Myrica nagi was found to have 17.9mm (mean) DIZ values for all five bacterial strains that are greater than negative control. Maximum DIZ value was recorded for *Staphylococcus aureus*[27].

A recent study by Chandra S. et al., (2012) has been carried out to evaluate the anti-bacterial and anti-fungal activity of *Myrica nagi* fruit pulp. Ten bacterial strains (*Escherichia coli, Klebsiella pneumoniae, Enterobacter gergoviae, salmonella entericatyphim, shigella flexneri, Staphyloccus aureus, staphyloccus epidermidis, streptococcus pyogenes* and *Bacillus cereus.)* and three fungal (*Candida albicans, Aspergillus flavus* and *Aspergillus parasiticus)* were investigated by using disc diffusion method. And five different extracts (Petroleum ether extract, chloroform extract, ethyl acetate extract, acetone extract, ethanol extract and water extract) and two different doses (10mg/ml and 50mg/ml) of each extract were used for study. Ethanolic extract at all doses (10mg/ml and 50mg/ml) showed significant antimicrobial activity[16].

**Antioxidant Activity:**

Tapan Seal (2011) carried out an antioxidant activity of the acetone and aqueous methanol extracts of four wild edible fruits including *Myrica nagi* collected from Meghalaya state in India.

Study was based on evaluation of total phenolic content, determination of total flavonoids, determination of total flavonols, measurement of reducing power and determination of free radical scavenging activity. Result shows that Myrica nagi has good quantity phenolic, flavonoids, and flavonols. Also the reducing power of Myrica nagi was found best out of four wild fruit extracts. Aqueous methanol extract also showed enough DPPH radical scavenging activity. The results indicate that the *Myrica nagi* wild edible fruits can be utilized as natural antioxidant[28].

Aftab Alam, et al., (2000) carried out study for ethanolic extract of Myrica nagi for reduction of Cumene Hydroperoxide-Induced Cutaneous Oxidative Stress. Thirty swiss albino female mice, 20–25 g, were divided into five groups of six mice each. The animals of group I received topical application of acetone only (0.2 ml/mice). The animals of group II received topical application of only *Myrica nagi* at a dose level of 4.0 mg/kg body weight in acetone. The animals of group III received topical application of only Cumene Hydroperoxide. The animals of group IV and V received single topical application of *Myrica nagi* at dose levels of 2.0 mg and 4.0 mg/ kg body weight in acetone respectively. After one hour of Myrica nagi treatment Cumene Hydroperoxide was applied topically on mice of group IV and V. Twelve hour after cumene hydroperoxide treatment, the animals were killed by cervical dislocation, their skin quickly removed and processed for preparation of post-mitochondrial supernatant, cytosol and microsome. Biological estimations like total glutathione level, glutathione peroxidase activity, glutathione reductase activity, catalase activity, glutathione S-transferase activity, quinone reductase activity, glucose 6-phosphate dehydrogenase activity, lipid peroxidation, xanthine oxidase estimations were performed by using post-mitochondrial supernatant, cytosol and microsome. Results shows that decreased level of glutathione level, glutathione peroxidase activity, glutathione reductase activity, catalase activity, glutathione S-transferase activity, quinone reductase activity due to cumene hydroperoxide found to be increased in Myrica nagi treated animals. *Myrica nagi* studied, higher doses of *Myrica nagi* (4 mg/kg body weight) reduced lipid peroxidation to 63% as compared to the cumene hydroperoxide- treated control group. Also a dose-dependent protection in the activities of xanthine oxidase was observed[29].

**Antiasthmatic Activity:**

Tejas Patel et al., (2011) evaluated the mast cell stabilizing activity of ethyl acetate and aqueous extracts of bark of *Myrica nagi* using compound 48/80 and egg albumin induced allergy tests. Adult Wistar albino rats were subjected to compound 48/80 and egg albumin induced allergy tests.

Ethyl acetate and aqueous extract of *Myrica nagi* at (100 and 200 mg/kg, p.o.) showed significant better protections as compare to the control group against the compound 48/80 induced degranulation of mast cells. Activity of Myrica nagi was found to increase with increase in dose. *Myrica nagi* at 200 mg/kg showed protection similar to those of the standard group.

In egg albumin induced allergy test the ethyl acetate and aqueous extract of *Myrica nagi* bark showed (100 and 200 mg/kg, p.o.) a dose-dependent significantly better mast cells protection ($p < 0.01$), as compared to the control group[30].

**Table 1: Physical contents of *Myrica nagi***

| Value | Stem Bark | Fruit |
|---|---|---|
| Ash value | Not more than 4% | Not more than 5% |
| Acid insoluble ash | Not more than 1% | Not more than 2.5% |
| Alcohol soluble extractive | Not less than 13% | Not less than 15% |
| Water soluble extractive | Not less than 12% | Not less than 17% |

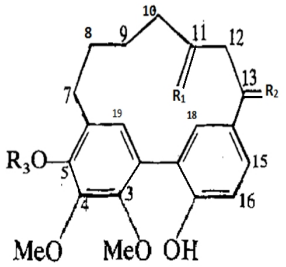
**Table 2: Nutritional Parameters for *Myrica nagi* Fruits[15]**

| Nutritional Parameters | Percentage (Approximate) |
|---|---|
| Ash Value | 1.90% |
| Total Moisture | 71.40% |
| Crude Fats | 4.93% |
| Proteins | 9.28% |
| Crude Fiber | 7.53% |
| Carbohydrate | 76.33% |
| Nutritive Value | 386.88 (Kcal/100g) |

**Table 3: Nutritive Mineral Value for *Myrica Nagi* Fruits[15]**

| Minerals Present | Percentage (Approximate) (mg/g) |
|---|---|
| Sodium | 0.75% |
| Potassium | 7.63% |
| Calcium | 4.23% |
| Manganese | 0.04% |
| Copper | 0.005% |
| Iron | 0.41% |
| Zink | 0.31% |

**Figure 1: *Myrica nagi* leaves and fruits[13].**




**Myricanone:**
R1 = O
R2 = H, H
R3 = H

**Myricanol:**
R1 = H, OH
R2 = H, H
R3 = H

**13-oxomyricanol:**
R1 = H, OH
R2 = O
R3 = H

**Figure 2: Chemical Structure of Myricanol, Myricanone and 13-oxomyricanol[18].**

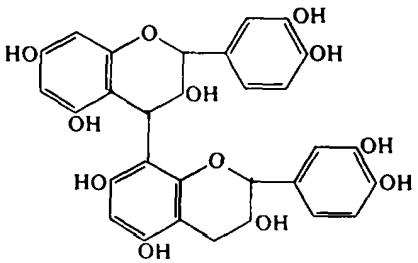
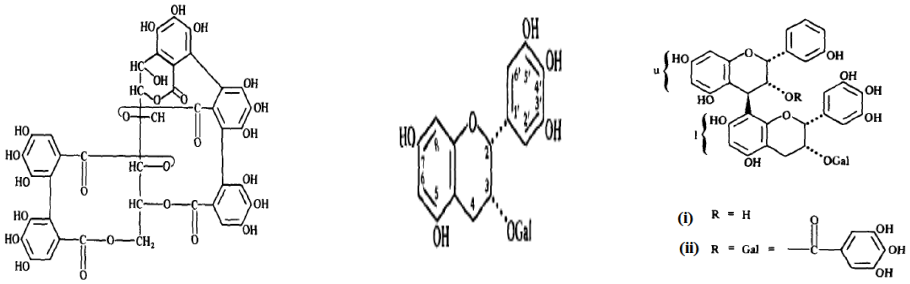


**Figure 3: A Proanthocyanidine from Stem Bark of *Myrica Nagi*[19].**



**(a) (b) (c)**

**Figure 4: (a) Structure of *Castalagin*- a hydrolysable tannin (b) Structure of 3-O-galloylepigallocatechin. (c) Structure of two prodelphinidin dimmers (i) Epigallocatechin-(4β→8)-epigallocatechin 3-O-gallate (ii) 3-O -galloylepigallocatechin-(4β→8)-epigallocatechin 3-O-gallate[20].**

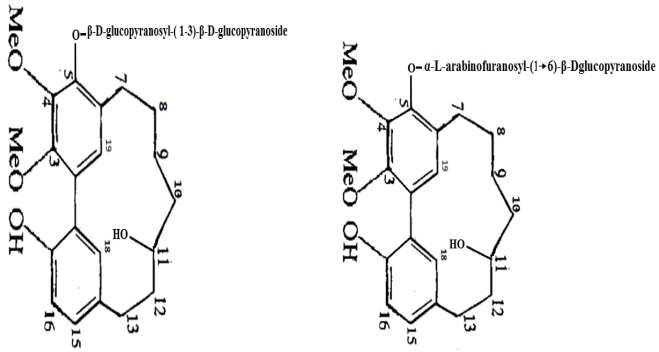


**Figure 5: (a) Structure of myricanol 5-0-β-D-glucopyranosyl-(1-3)-β-D-glucopyranoside. (b) Structure of myricanol 5-0-α-L-arbinofuranosyl- (1→6)-β-D-glucopyranoside[21].**

## CONCLUSION

The medicinal properties of *Myrica nagi* are available both in the written and non-written format as traditional knowledge since time immemorial. In traditional medicines the plant has been used as treatment option against diarrhea, dysentery, typhoid, strengthen teeth and gums wound healing etc. Traditional knowledge regarding the usage of this plant is many but the scientific research available today to support this knowledge is limited. Here we have tried to compile all the available information from both traditional and published scientific literatures regarding the medicinal uses of *Myrica nagi*. It will helpful for the future researchers to get the information in a nut shell. This will provide tremendous opportunities for planning and conduct research related to various aspects of this medicinal plant.

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