International Journal for Multidisciplinary Research (IJFMR)
E-ISSN : 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Efficacy of Medicinal Woods/Trees vis-a-vis Environmental Pollution

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Abstract

Woods/trees a lovely, non-demanding, and most kind entity on our earth. All living beings on this planet depend on the wood/trees in some prospective. As they fight against not only against the diseases but tackles environmental pollution which is brought on by increased industrialization, excessive use of chemicals and plastics. Wood/trees play a crucial role in maintaining a healthy atmosphere and stabilize our climate. By limiting the passage of dangerous pollutants and dust particles, wood/trees also enhance the quality of the air. Few medicinal wood/trees, by virtue of their brilliant purifying abilities and therapeutic advantages, beyond treating diseases plays a significant role in the management of environmental pollution. Woods/trees by consuming carbon dioxide by the process of photosynthesis in potentially diminish environmental pollution by locking up the carbon which is caused by the burning of fossil fuels. Ancient System of Medicine, *Ayurveda* also has suggested to plant trees like *Emblica officinalis* Gaertn., *Cedrus deodara* Roxb.etc and herbs like *Ocimum sanctum* Linn. to encounter environmental pollution. The present study will discuss strategic methodology of selected woods/trees in context to traditional synonyms mentioned and their mode of action to tackle environmental pollution.

Keywords: Woods, environmental pollution, photosynthesis, carbon-di-oxide, *Ayurveda*,

INTRODUCTION

Forests are just similar to other vital elements on earth as they act on planet's purification system by absorbing airborne chemicals and helps in releasing more oxygen. Wood/trees do a lot in helping out to fight against environmental pollution, mainly air pollution. They help improve the quality of air by absorbing carbon dioxide and releasing oxygen, increasing humidity by transpiring water vapor and passively absorb pollutants on the surface of leaves and also help to minimize the effect of air- pollution in environment. Planting more trees for abatement of pollution and improvement of environment is an effective way and well recognized throughout the world. In *Ayurveda*, medicinal plants are not only used for curing various diseases using *yuktivyapashrya* (strategic usage) but also are praised for their *divyaja /prabhavaja guna* (inherent empirical qualities) which fight against various microbes and pollutants present in our environment.

AIMS & OBJECTIVES

- To enlist some medicinal wood/trees possessing potential to guard our environment from various air-pollutants with reference to their ancient database.

- To review general mechanism of action of carbon absorption of woods/trees.
- To co-relate medicinal woods in context to their traditional data-base and strategic methodology for reduction of net carbon percentage in the environment.
- To analyze APTI values of selected trees in context to pollution,

MATERIAL & METHODS

The present study is based on following selected woods/trees and their synonyms available in traditional database of *Ayurveda*. Commonly found six medicinal trees/woods are namely - *Nimb, Chirbilva, Sheesam, Peepal, Vata, Bilva* are being discussed.

Table no.1-Introduction of the enlisted plants-

Sr. No.	Name	Botanical name	Family
1	*Nimb*[1]	*Azadirachta indica* A.Juss	Meliaceae
2	*Chirvilva*[2]	*Holoptelea integrifolia* Planch.	Ulmaceae
3	*Sheesam*[3]	*Dalbergia sissoo* Roxb	Fabaceae
4	*Peepal*[4]	*Ficus religiosa* Linn.	Moraceae
5	*Bilva*[6]	*Aegle marmelos* Corr.	Rutaceae
6	*Vata*[5]	*Ficus benghalensis* Linn.	Moraceae

General Mechanism of Action of carbon absorption of woods/trees[7]

Trees drew carbon dioxide from the atmosphere through a process called Photosynthesis. Trees store carbon predominantly in the form of carbohydrates, for immediate and long-term growth. Carbohydrates are produced using photosynthesis, the process that occurs within all the plants to convert sunlight into chemical energy. Photosynthesis is the basis of almost all life on Earth as it converts inorganic compounds into fuel for living organisms. Trees absorb light in green-pigmented chloroplasts/stomatal cells of leaves and further root system drew up water and take in carbon dioxide. The Solar energy is used to power up the chemical reaction within the chloroplasts, which splits the water and carbon dioxide and recombines them into glucose, an organic compound that includes carbon. Thus, wood/trees are net absorbent of CO_2.

Following the process of photosynthesis, glucose and the constituent carbon that is not used is stored in the form of starch in the sapwood layer or xylem of a tree trunk. This stored carbon is in transitory phase and is available for respiration when tree needs it.

Moreover, heartwood of tree provides structural strength and defence against disease and decay. Heartwood stores carbon in the form of lignin (a structural component), resins and phenols and is present in higher concentration than sapwood. Carbon in the form of starch is not only stored in the trunk, but also in root system of trees. The proportion of carbon stored by a tree in the below-ground root system is estimated to be around 24%. By storing carbon temporarily and permanently in their biomass, trees act as a sink for carbon, sequestering more than they return into the atmosphere. Also, about 48% of carbon is stored in the leaf litter and soil of the forest, by which it is learnt that a healthy forest ecosystem stores far more carbon than trees individually. This all contributes in making forests as the largest component of

atmospheric carbon absorber. Essentially, forests have great potential to absorb up to 25% of the current atmospheric carbon pool and are one of the most cost-effective tools to reduce CO_2 surplus.

Table no.2- Synonyms and their meanings of selected trees-

Sr. No.	Name of Tree	Synonym	Description/Meaning
1	*Nimb*[8]	*Arishta*	Relieves sickness
		Sarvatobhadra	Over-all auspicious
		Krimivishpranut	Effective against worms and poisonous infections
2	*Chirbilva*[9]	*Udkeerya*	Grows near water bodies
		Indian elm tree	Leaves have rough surface
		Krimikaphapaha	Useful in worm infestations and mucus disorders
3	*Peepal*[10]	*Bodhidru/ Bodhivriksha*	Over-all fortunate
		Chalpatra	Leaves always flutter in air
		Gajashana	Fruits are eaten by elephants
4	*Sheesham*[11]	*Picchila*	Leaves possess sticky material
		Bhasmagarbha	Heartwood is ashy-black in colour
5	*Bilva*[12]	*Maloor*	Alleviate all type of disorders
		Triparna	Trifoliate leaves
		Gandhapatra	Leaves are aromatic
6	*Vata*[13]	*Ksheeri*	Tree exudes milky latex
		Yakshatru	Divine evergreen tree

Table no.3 Correlation of medicinal woods in reference to their traditional data-base available and their strategic methodology for reduction of net carbon percentage in the environment.

S.No.	Name of Tree	Description of Synonym	Strategic co-relation
1	*Nimb*	Relieves sickness	bestows good fortune in the vicinity by eradicating pollutants
		Effective against worms and poisonous infections	kill microbes present in the environment
2	*Chirbilva*	Leaves have rough surface	rough surface traps insects and pollutants
		Useful in worm infestations	kill microbes present in the environment
3	*Peepal*	Over-all fortunate	cleans up the vicinity from air pollution
		Leaves always flutter in air	fluttering leaves help to clean nearby environment

		Fruits are eaten by elephants	elephant exhales comparatively more CO2 which is further needed by its leaves for photosynthesis which results in more expulsion of O2 in the environment
4	*Sheesham*	Leaves possess sticky material	pollutants and insects get trapped on the leaves due to presence of mucilaginous substance
		Heartwood is ashy-black in colour	more pollutants get adhered to black/ashy coloured heartwood
5	*Bilva*	Alleviate all type of disorders	removes pollutants and microbes and improves the quality of air
		Trifoliate leaves	Trifoliate leaves are able to capture more carbon present in atmosphere
		Aromatic leaves	Aromatic leaves attract more insects and microbes
6	*Vata*	Tree exudes milky latex	Latex enables insects and microbes to get trap within it
		Divine evergreen tree	Its long-lived and evergreen nature captures more carbon from the environment.

Selection Markers of Woods/trees for pollution control[14]

While selecting the species of woods for pollution control the following important characteristics are taken into consideration-

- ❖ Wood/trees should be evergreen and possess more and bigger leaves. e.g., Pines, Abies.
- ❖ Their bark should be rough and dark colored. E.g., Oak, Chir
- ❖ Woods must be indigenous, ecologically compatible and their requirement of water should be minimal. E.g., Neem, Alianthus, Figs
- ❖ Minimum care and pollution tolerance and dust scavenging capacity of trees should be high. E.g. Ashoka
- ❖ Canopy architecture of trees provide protection from strong winds and storms and serves as net carbon sinks. E.g., Rosewood, Ebony.
- ❖ Their growth rate, habit like straight undivided trunk and aesthetic effect (foliage, conspicuous and attractive flower color) are also important factors e.g., Polyalthia, Bauhinia.

Observation and Results-

1. Nimb (Azadirachta indica* A.Juss*)

Nimb, commonly known as *Neem* tree is one of the most widely used herb in *Ayurveda*. The word *nimb* mean that the plant is very useful and maintains health and prosperity.In Sanskrit *neem* is called *'arista'* which points out its imperishable nature. *Neem* has been referred as an "air purifier" because it absorbs environmental pollutants including SO2, and act as an "air freshener" by releasing oxygen and odorous substances[15]. *Neem* trees act as very efficient, natural air filters trapping dust particles, absorbing gaseous

pollutants. The planting of *Neem* trees helps reduce greenhouse gases through photosynthesis absorbing large quantities of CO2 and producing oxygen.

2. Chirbilva (Holoptelea integrifolia* Planch.*)

Chirbilva trees tolerate well various pollutants present in the air, so can be used for minimizing of concentration pollutants to a safer level into the environment. It is a fast-growing tree with a good canopy. It is resistant to gaseous pollutants. Due to the rough leaf surface, it traps dust and particulate pollutants. It is good for plantation on roadside as well as in the greenbelt around thermal power plants[16].

3. *Peepal (Ficus religiosa* Linn.*)*

Peepal is large evergreen tree and is considered to be sacred in India. It is a common indigenous tree of roadside with a good canopy architecture.The leaves of this tree are known to emit a lot of oxygen into the environment.It can be used as biomarkers and mitigators of pollutant coming out of automobile exhaust[17]. It is good for plantation on roadside especially highways and expressways.

4. Sheesham (Dalbergia sissoo* Roxb*)

Dalbergia sissoo Roxb. can successfully be grown in an area where it is mild and droughts are common for monitoring air pollution. It is an ideal tree species to control pollution effectively beside acting as a shade tree and being a source of food for birds and animals. By plantation of Dalbergia sissoo Roxb., mitigative measure at the polluted sites to control generation of particulate matter and the air quality required can be ensured[18]. It is commonly used for erosion control and soil stabilization along stream and river banks. It is widely planted in several countries for reforestation programs. It is also valued for its ability to increase soil fertility through nitrogen fixation.[19]

5. *Vata (Ficus benghalensis* Linn.)

Plant is lactiferous tree, up to 30m in height with widely spreading branches bearing many aerial roots. The life span of the *Vata* tree is more than 100 years. Banyan tree is used as a potent agent for pollution control because of wide un-divided trunk, aerial roots and bigger leaves. Leaves with their vast area in a tree crown, absorbs pollutants on their surface, thus effectively reduce their concentrations in the ambient air.[20] Often, the absorbed pollutants are incorporated in metabolic stream and thus settle air is purified.

6. ***Bilva (Aegle marmelos Corr.)***-

Bilva plant acts as a 'sink' for chemical and air pollutants as it absorbs poisonous gases from atmosphere and make them inert or neutral because of its trifoliate leaves. It is also a member of plant species group known as 'climate purifier' which emits greater percentage of oxygen in sunlight as compared to other plants [21]**.**

DISCUSSION-

Vegetation naturally cleanses the atmosphere by absorbing gases and some pollutant matter through leaves. Plants have a very large surface area and their leaves, roots, sapwood and heartwood functions as an efficient pollutant trapping device. Some plants have been classified according to their degree of sensitivity and tolerance towards various air pollutants. Sensitive plant species like lichens are suggested to act as bio-indicators to monitor the health of the Environment. Levels of air pollution tolerance varies from species to species, depending on the capacity of plants to withstand the effect of pollutants without showing any external damage. This study is useful for better understanding and management of air quality index (AQI) as well as in selection of suitable plant species for plantation in industrial area as well as roadside.

Scientists suggested a method of determining Air Pollution Tolerance Index (APTI) which describes the inherent quality of plants to tolerate air pollution.by synthesizing the values of four different biochemical parameters i.e., leaf extract, pH, ascorbic acid, total chlorophyll and relative water contents[22.] The APTI is calculated as follows-

APTI= [A (T+P) + R] /10

{where, A= Ascorbic acid (mg/g dry wt.), T= Total Chlorophyll (mg/g dry wt.), P= pH of leaf extract, R= Relative water content of leaf tissue (%)}

Table no. 4- Categorization of trees with their sensitivity in accordance to APTI values of plants[23]

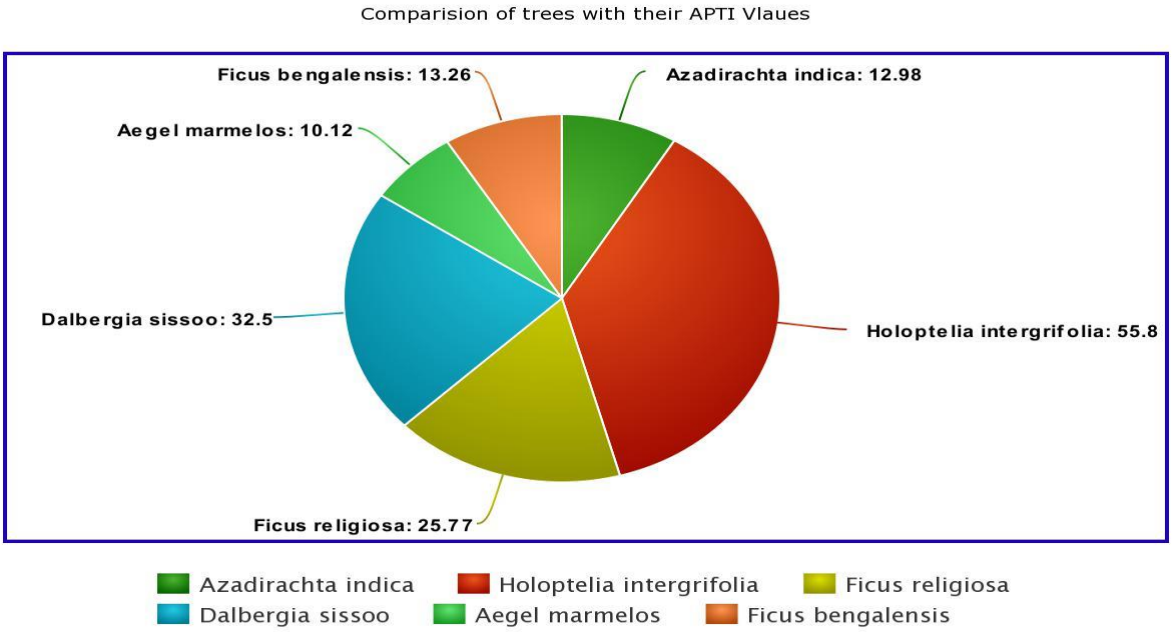
Very sensitive	Sensitive	Intermediate	Tolerant
<1	16-1	29-17	30-100

Conclusion-

It is widely acknowledged that plants are important in today's world because they help to clean our environment. Following are APTI values of selected trees.

Table No. 5- Woods/Trees with their APTI values: -[24]

Sr. No.	**Name of Woods/trees**	**Botanical Name**	**APTI**
1	*Nimb*	*Azadirachta indica* A. Juss.	12.98
2	*Chirbilva*	*Holoptelea integrifolia* Planch.	55.8
3	*Peepal*	*Ficus religiosa* Linn.	25.77
4	*Sheesham*	*Dalbergia sissoo* Roxb.	32.5
5	*Bilva*	*Aegle marmelos* Corr.	10.12
6	*Vata*	*Ficus bengalensis* Linn.	13.26



Nimb (Azadirachta indica A. Juss.) with APTI is 15.51 APTI and Banyan tree with an APTI value of more than 13, suggests good control agents for air pollution. They take in gases like certain sulphur oxides and nitrous oxide available in atmosphere as air pollutants. *Bilva (Aegle marmelos Corr.)* plant acts as a

'climate purifier', as it's APTI is 10.12. Tri-foliate leaves emits large amount of oxygen in the presence of Sunlight. Moreover, due to presence of long petiole and continuously fluttering leaves of *Peepal* (Ficus religiosa Linn.) helps wind to move from one place another which helps in clearing the atmosphere of the vicinity. Its APTI is 25.77. *Sheesam* (Dalbergia sissoo Roxb.) with APTI of 32.5 suggest their capability to capture more atmospheric pollutants through chloroplasts present on their leaves. Due to rough surface of leaves, *Chirbilva* (Holoptelea intergrifolia Planch.) is able to trap air pollutants more easily present in atmosphere. It has an APTI value of 55.8 which suggest it's best pollution scavenging capacity among others trees included.Growing these medicinal plants in fields or along roadsides not only provide shadow to prevent from scorching sunlight but also helps in purifying air and improves air quality index (AQI).

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