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## A Review on Various Water purification techniques with Neem and Tulsi Extracts

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### Abstract

Water being the universal solvent and one of the first essential requirements of any life, demands an utmost care and attention for maintaining its quality and quantity on earth. Due to a high increase in the pollution rate and use of non bio-degradable substances the water resources are being contaminated day by day. It becomes a key aspect to purify the water not only from its physical impurities but also to clear it from its biological impurities retaining its nutritional quality. In spite of the availability of several traditional methods of water purification techniques, the busy corporate life demands an alternative, easy and economic method for practical ease. Being known that India is gifted with an archive of medicinal herbs possessing answers for all kinds of health issues, the review aims to select and study some useful, magical medicinal plants that can exhibit their efficacy in purification of water with its bactericidal and fungicidal activities and enhancing its quality. The current review focuses on the importance of various water purification techniques and the use of herbal extracts in the purification and quality enhancement of potable water. The review also highlights various herbs and Plants with medicinal values that can be used in water purification techniques.

**Keywords:** *Water purification, Medicinal Herbs, Bactericidal, Fungicidal, Neem, Tulsi*

### Introduction

#### Importance of maintaining quality of water

Maintaining the quality of water is not an optional concept but a must to be followed step before using it for various household and life purposes. Use of contaminated or polluted water could lead to several water borne diseases and infections like Cholera, Typhoid, diarrhea, dysentery etc.,. It is not only important to remove pathogenic agents from water but maintaining the nutritional and mineral quality of water is also a prerequisite. Lack of water minerals may lead to nutrition deficiencies and dental problems. Thus it is important to take utmost care in the purification and mineralization of water before being supplied for household consumption.

Several techniques for the water purification are known since long like chlorination, filtration, sedimentation, distillation etc.,. Though these techniques are capable of removing particulate impurities and microbial contaminants, it would not satisfy the need for retaining mineral content and nutritional quality of water. Thus a new technique of water purification and mineralization proposed is the use of herbs and their extracts. Several medicinal plants like Tulasi, Amla, Neem, Moringa etc., are known since generations for their extra efficacy in antimicrobial property in addition to their nutritional quality.

#### Proposal for the use of Neem and Tulsi in water Purification

This technique was proposed especially for those people in rural areas who lack access for pure and safe drinking water because of open water channels. The lack of purification units demands the development of such new

techniques. One of the study conducted by Mr Parthiban L *et.al.*, from the VIT Tamil Nadu, March 2017 exposed the antimicrobial effect and purifying efficiency of Neem and Tulsi seed extracts [9]. Their work involved the use of these extracts for the treatment of water so as to impart potability to the water and disinfect it. The organisms that were found in the untreated water were *Staphylococcus aureus*; *Bacillus*; *Janthano*; *Chromobacteria*; *Duganella* and *Streptococcus*. According to the study these organisms showed susceptibility to the slurry of neem and tulsi seed paste making water free from these pathogens. Thus the study proves the efficiency of these extracts in water purification.

According to an article by Pradeep Mutttagadur *et.al.*, both Tulsi and neem extracts can act against *Enterococcus faecalis* in Endodontics. This study showed that the leaf extracts were more effective against *E. faecalis* compared to 2% chlorhexidine gluconate [6]. This depicts the importance of these herbs in preventing dental infections and plaque. The study can be a path laying standard for the proper selection and application of herbal plants in the purification of water.

Another research conducted by Tanushree Bhattacharjee *et.al.*, (Jan 2013) [5] was related to the role of natural herbs in the disinfection of drinking water in rural areas. In their study the water from various sources was collected and treated with herbal extracts and the efficiency was tested by MPN indexing. The results showed that extract of Neem reduced the MPN of water from various sources. The reduction of water MPN obtained from various sources like well, lake and river was in the range of 313, 175 and 125 to 0, 4 and 2 CFU respectively. While the use of alcoholic extracts from Tulsi was capable in reducing the bioburden to 2.0 CFU. Thus the results conclude that both the herbs are efficient water purifying agents. Furthermore it can be a potential economic method to render the portability and retain the nutritional quality of contaminated water.

### **Therapeutic compounds in Azadirachta**

Mohammad A. Alzohairy from College of Applied Medical Sciences, Quassim University in 2016 [3] conducted a research on the chemical components of Azadirachta (neem) that are responsible for its therapeutic role. In the study it was stated that this plant was used in Unani, Ayurveda, and Chinese medicine also in the treatment of several diseases and ailments. The article also suggests about the anticancer activity of the herbal plant. Some of the important chemical components present in neem imparting its therapeutic potential include: azadirachtin, nimbolinin, nimbin, nimbidin, nimbidol, sodium nimbinate, gedunin, salannin, and quercetin. The leaves of this tree contain nimbin, nimbanene, 6-desacetylnimbinene, nimbandiol, nimbolide, ascorbic acid, n-hexacosanol and amino acid, 7-desacetyl-7-benzoylazadiradione, 7-desacetyl-7-benzoylgedunin, 17-hydroxyazadiradione, and nimbiol. Some of the other important therapeutic components in neem include Quercetin, polyphenolic flavonoids.

Genetic level study was also conducted on the anti cancer role of neem extract. It was found that the ethanolic extract of neem leaf upregulates the pro apoptotic genes and proteins which include P53, Bax (Bcl-2-associated X protein), (Bcl-2-associated death promoter protein) Bad etc., One of the study revealed that ethanolic neem leaf extract enhanced the expression of certain proapoptotic genes like caspase-8 and caspase-3, and also suppresses the expression of Bcl-2 and mutant p53. All these cellular activities indicate that Neem extracts [7] can be best used for the prevention of infections and also for the therapy of various diseases.

### **Mechanism of action**

The therapeutic effect is provided by several mechanisms like:

Free radical activation, Cell signaling pathway regulation, Enzyme Activity regulation are the several means through which the herb functions.

The herb being a rich source of **antioxidants** it possesses the property of free radical scavenging thereby causing the lysis or death of pathogenic agents and cells. Neem exhibits a peculiar activity on Oncogenes, Tumor suppressor gene, it has a role in angiogenesis, Apoptosis etc.,

Paola Del Serrone (2015) *et al.*, from Agricultural Research Council, Italy in their research published in Biomed International detailed about the efficiency of neem extracts against enteropathogens causing intestinal diseases. They explained the pathogenic activity of neem extracts specifically against *E. coli* involved in various intestinal infections and also a major pollutant in water. 48 different isolates of *E. coli* were tested against the Neem extract. This study revealed that the treatment of Neem oil causes a decline in the cell count of *E. coli* due to cell death.

### Important components in Tulsi with therapeutic role

One of the articles in “India water portal” by Aditi sharma (May 2014) focused on the therapeutic role of tulsi where tulsi is referred as the purifier and reverse osmosis filter. The article states that a handful of tulsi leaves has the capacity to detoxify 20 liters of water. This information can serve the foundation for using these leaves for water purification purpose.

**Table 1: Important Chemical components in Tulsi and Neem**

	<b>Tulsi (<i>Ocimum sanctum</i>)</b>	<b>Neem (<i>Azadiracta indica</i>)</b>
<b>Chemical Components</b>	<p><b>Phenolic compounds</b> (antioxidants) like cirsilineol, circimaritin, isothymusin, apigenin and rosameric acid, and appreciable quantities of eugeno.</p> <p>The oil also contains carvacrol and sesquiterpine hydrocarbon caryophyllene</p> <p>Two <b>flavonoids</b> Orientin and Andvicenin</p>	<p><b>leaf extract:</b> isomeldenin, nimbin, nimbinene, 6-desacetyl nimbinene, nimbandiol, immobile, nimocinol, quercetin, and beta-sitosterol. 7,8 Two additional tetracyclic triterpenoids zafaral [24,25,26,27-tetranorapotirucalla-(apoeupha)-6alpha-methoxy-7alpha-acetoxy-1,14-dien-3,16-dione-21-al] (1) and meliacin anhydride [24,25,26,27-tetranorapotirucalla-(apoeupha)-6alpha-hydroxy,11alpha-methoxy-7alpha,12alpha-diacetoxy,1,14,20(22)-trien-3-one]</p> <p><b>Seed:</b> Azadirachtin H and</p>

		Azadirachtin I  <b>Tree Bark:</b> Tannin, Oil
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**Pavithra Sivaraja (Jan 2012)** from Bannari Amman Institute of Technology in one of her articles [11] “Effect of Tulsi (*Ocimum sanctum*) as a Disinfectant for Water Treatment”, highlighted the importance of Tulsi in water purification [6]. The article reports that Tulsi is not only antimicrobial but also plays a major role as anticancer, anti-diabetic and anti-ulcer activity. A research was conducted to assay the water purification efficacy of tulsi on tap water and river water. The 500 mg/litre of extract treated water showed 95 to 98% antibacterial activity in 14 to 16 hrs.

Another study by Hanaa A. Yamani *et.al* (May 2016) from Royal Melbourne Institute of Technology University, Australia, reported the antimicrobial efficacy of the essential oils obtained from *Ocimum tenuiflorum* (Tulsi). At a concentration of 4.5 and 2.25% these oils inhibited the growth of *E. coli* and *S aureus* including Methicillin resistant *S aureus*. A total of 54 compounds have been extracted from Tulsi possessing therapeutic effect. Of these compounds 3 major components include **camphor, eucalyptol** and eugenol. Some of the volatile compounds that are extracted from Tulsi using HS-SPME/GC-MS include Methyl isovalerate, Ethyl isovalerate, Tricyclene, Thujene, Alpha pinene, Camphene, Sabinene, Beta pinene, Octen 3 ol, Myrcene, Phellandrene, Terpinene Etc., Due to the presence of such cytoactive compounds tulsi exhibits bacteriostatic activity.

An article in Times of India (June 2017) published by Shivangani Dhavan emphasized [10] the medical benefits of Tulsi. The articles states that Tulsi has been used since generations in ayurvedic medications in view of its healing properties. Respiratory diseases can be treated using the leaf extracts f Basil. Several health issues like kidney stones, stress, digestive disorders, head ache etc., can be treated by this magical plant. One of the best effects required for the current generation is its antidiabetic effect by means of activation of insulin releasing cells. Use of Basil root powder in water would control the sugar concentrations in the blood. It acts as a very good appetizer by acting upon the digestive enzymes and enhancing their secretions.

In recent times an article published by the Patanjali’s Acharya Balkrishan (Nov 2017) in the online News “The Asian Age” [2] described Basil to be a “Queen of Herbs” with a natural efficacy to treat several diseases. It is referred as a virtual tonic for our body and health. Acharya Balakrishan states that the magical herb also has a potential to increase the expectancy of the life. Some of the metabolic effects of Tulsi is its Antibacterial, Antifungal, Anti-inflammatory and Antioxidant properties. It is known to be a natural remedy for several viral infections and acts in strengthening immunity, reproductive system, and cardiovascular system. It also has a healing effect on Skin and hair.

Surprisingly the leaf extract is also useful in the treatment of snake bites as shown by Abhijit Dey et.al., in their research published in African Journal of Traditional, Complementary and Alternative Medicines (2012) [8].

### Use of Neem and Tulsi in the water treatment

Based on the above mentioned potential of neem and tulsi, several water purification techniques were designed which can yield good quality of portable water in a cost effective method. Some of the water purification practices followed including these extracts are mentioned below:

Mr. Chandy Abraham, Kottayam, Kerala has published his practice on the use of these magical herbs in water purification [14]. He has used the most simple method of just adding a fistful of both the leaves in the sample water to be purified and mixed. The container was kept aside without disturbing for 4 to 5 hrs. The extract was purified and water collected. The results showed pure and contamination free water but with a lite aroma and bitter taste. However the protocol can be employed in those situations where in the sterilized water supply is difficult.

Another Article by Ashwini Yevate *et.al.*, dealt with development of a simple water purification unit based on the Tulsi and Neem leaf extract [1] especially used for the removal of fluorine from water containing high fluoride content. The setup included the clay made pot into which a candle and a disc made of the neem and tulsi extracts was inserted. The water to be purified is allowed to pass through the container. To analyze the quality of water the fluoride concentration was estimated before and after the treatment. The results conclude that the average % removal of fluoride from water was around 51.35% & 47.77% using tulsi & neem powder [4]. Thus it can be a basis for the development of further sophisticated mechanisms.

In one of the Book authored by Aniruddha Bhalchandra Pandit (March 2019), it was proved that the treatment of water for drinking using the Tulsi and Neem leaf extracts showed very satisfactory results. 500mg/litre of Tulsi extract treated water showed 95 to 98% antibacterial activity (Drinking Water Treatment for Developing Countries: **Physical, Chemical and Biological Pollutants**, Aniruddha Bhalchandra Pandit, Jyoti Kishen Kumar, Royal Society of Chemistry, 06-Mar-2019) in 14 to 16hrs as proved by plate count assay [13]. In this experiment the water from River Kaveri of Trichy, Tamil Nadu was used. The study also showed that the alcoholic extracts of Neem and Tulsi exhibited a high reduction in the MPN number and specifically exhibited an inhibitory effect against Salmonella typhi, involved in the onset of Thphoid.

This concludes that the use of these herbs treated water can protect against several coliform infections and also prevent typhoid simultaneous retaining the nutritional quality of water. .

## Conclusion

In view of the importance of water treatment in preventing the water borne diseases, the current review focuses on the use of Tulsi ad Neem extracts in the water treatment and purification. Several research articles, books and papers were screened and reviewed to analyze the importance of these two herbs in preventing the growth and development of these pathogenic organisms. The medicinal activity of these herbs was also studied and the results of several studies were included. The chemical components within these herbs were investigated and the details are included and their importance is explained. Several techniques involving the use of these herbs is mentioned in the article. The medicinal, therapeutic and purifying efficacy of these two leaf extracts was emphasized. The study concludes that both the plants are magical herbs possessing antibacterial, antifungal, anti-inflammatory activities. They have the potential to prevent the growth of pathogens like *Salmonella*, *Staphylococcus*, *E coli* etc. Use of these extracts as the source of water purification will not only eliminate the pathogenic bacteria and other organisms but also enhances the biological quality of water by imparting it some herbal properties. Thus, this technique has to be emphasised to build up economic and simple water purification units. This can be of high importance in villages where in the supply of pure and unpolluted water is a challenging task.

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