

A review study on the concept of disinfection in *Ayurveda*

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Abstract: The key to man's health lies largely in the environment. Air, water and soil are important physical components of environment which is essential for living being. The environment always has billions of microorganisms in its ecosystem and most of them are not harmful to mankind. Certain kinds of microbial load of the air, water, and land cause various diseases. As per *Ayurveda*, vitiation of air, water, land, and time lead to *Janpadodhvansa* (epidemic). Disinfection of air, water, and land is a serious concern of the present time. In *Ayurveda* various methods of disinfection are described in different contexts. Disinfection is a method of thermal or chemical destruction of pathogens and other types of microorganisms. In *Ayurveda* various herbs, minerals and animal origin products are used for the disinfection of air, water, land etc. The researches show that drugs used for disinfection like neem, *guggulu*, turmeric etc. have antimicrobial effect. Hence, disinfection by traditional method is cost effective and devoid of harmful effects. Further, there is great scope for research to validate the traditional methods on modern scientific grounds to bring about global acceptance.

Key Words: *Dhoopana*, environment, fumigation, *Janapadodhvamsa*, *Prasadana*

Introduction

There are two etiology for diseases, one is related with individual's lifestyle, diet pattern and any infection¹. Other cause is related with vitiation of air, water, land, and time. These environmental components are responsible for epidemic like situation.² The term environment implies all the external factors- living and non-living, material and non-material surrounding man. In *Ayurveda* there is a concept of *Janapadodhvamsa* (epidemic) because of vitiation and pollution of air, water, land, and time³, which are physical components of environment. According to *Ayurveda* the main reason behind this type of epidemic is *Adharma* (unethical practices by human being).⁴ In the present scenario, the unethical practices in the form of not obeying rules laid down by the government for protection of environment in the greed of gaining more profit is very common. In developing country like India, population explosion, rapidly expanding industries, automobile, deforestation due to needs of agricultural, industrial and housing sector result in pollution of air, land and water. Improper hygiene in the catering, food processing and meat processing sector, results in spread of many infectious diseases from biological agents like viruses, bacteria and other pathogens. Nosocomial infections or health care-associated infections (HCAIs) are currently one among the major problems of health care system. HCAIs result in increased antibiotic resistance, financial burden, morbidity and mortality.

Disinfection of environment is one among the interventions for counteracting the problem of pollution. Usually, disinfection is achieved by thermal or chemical destruction of pathogen and other type of microorganism. Disinfection is less harmful compared to sterilization, because it destroys most recognized pathogenic microorganism but not necessarily all microbial forms (e.g. bacterial spores).⁵ Disinfectants are chemical agents (but sometimes physical agent) which destroy disease causing pathogens or other harmful microorganisms, but might not kill bacterial spores. They are used to disinfect non-living objects. Even though various disinfection methods as per modern science is generally followed in most of the domestic and professional setups, they have their own disadvantages like adverse effects on humans, animals and plants on long term use.

So, this is the right time to look into the ancient time holistic techniques of disinfection. In *Ayurveda*, the description of disinfection of air, water, land is found. Disinfection of *Aturalaya* (hospital), *Sutikagara* (Puerperal room), *Kumaragara* (pediatric ward), *Shastragara* (operation theaters), *Vranitagara* (wound management ward), *Bhesajagara* (pharmacy) mentioned in text of *Ayurveda*. These are preventive and curative measures aimed at control and elimination of harmful macro & microorganisms along with purification of environment.

Materials and method: Classical text books of *Ayurveda* like *Charak Samhita*, *Sushruta Samhita*, *Ashtang Samgrah*, *Ashtang Hridayam*, *Kashyam Samhita*, *Bhaisajya Ratnavali* etc. online publications cited through Google scholar, science direct, research gate, MEDLINE database etc. modern science books like park's text book of preventive and social medicine are also the source of content for this review article.

Result: Naturally, vitiation of season (*kala* or time) is most difficult to rectify. Similarly vitiated air, water and land are progressively difficult to purify. Season is impossible to rectify as vitiation is due to the influence of inevitable factors like stars, planets, moon, sun, air etc.⁶ In the ancient time, the disinfection of environment and instruments was done through *Agni* (fire), *Kwath* (decoction), sunlight and various *Dhoopana* (fumigation with polyherbal, mineral and animal product formulations), to protect *Atura* (patient) from different pathogens and microorganisms. The results of the various studies strongly suggested that the *Ayurvedic* disinfection with plants, minerals and animal products is effective in reducing air-borne bacteria and in disinfecting inanimate surfaces. The fumigation through herbo-mineral methods has large potential to solve the problem of hospital acquired infections (nosocomial infections).⁷ The cost of formaldehyde fumigation, which is toxic, and hydrogen peroxide fogging or spraying is too much as compared to traditional methods. Fumigation by traditional method could be done with less expenditure without any harmful effect because they are natural and most of them are easily available at home and in surroundings or cheaply available in market. Chlorine is an effective disinfectant for killing microorganisms of water. However, it produces toxicity and destroys healthy gut bacteria⁸. About 10 case-control studies before 2001 suggest an associations between bladder cancer and disinfection by chlorination⁹. *Ayurveda* indicates methods to identify impure water and suggests several techniques like use of herbs and metals like copper to enhance the quality of drinking water.

Discussion

Air: Sun, moon and air together are responsible for different seasons in the universe.¹⁰ According to *Ayurveda* *Vayu* (air) is *Ayu* (life)¹¹. In *Charak Samhita* there is a complete chapter is described to dedicate the role of *Vayu* in body and environment. This is an evidence of a seminar on discussion of importance and function of *Vayu*¹². There is detail description of normal state and an abnormal state of *Sharira Gata Vayu* (air which is functioning in inside the body) and *Lokgata Vayu* (air which is functioning in external environment). In this seminar *Rajarshi Vayorvid* explains that due to *Vikrut Lokgata Vayu* (abnormal state of environmental air) there is environmental contamination happened (*Bhootanam Ch Upsargah*).¹³

As per contemporary science air is an admixture of invisible, odorless, tasteless gases like nitrogen, oxygen, carbon dioxide and inert gases like helium, neon, krypton, and xenon that surrounds the earth¹⁴. The normal composition of air by volume is approximately as follows: nitrogen- 78.1%; oxygen- 20.93%; carbon dioxide-0.03%. The balance is made up of other gases which occur in traces, e.g. argon, neon, krypton, xenon and helium. In addition to these gases, air also contains water vapour, traces of ammonia and suspended matter such as dust, bacteria, spores and vegetable debris.¹⁵ Pathogens are organisms that spread from an infected person to another. They can spread through respiratory tract through coughing, talking and sneezing, breathing and laughing. Trillions of microbes are present in human body and millions of microbes around us in air, cloths etc.¹⁶ the dead cells fallen from the surface of the body carries thousands of such organisms and to our surprise, it contributes almost 37% of our house hold dusts.¹⁷ Generally pathogenic organisms like gram positive, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli* etc. are present at the site of infection. Gram positive *Staphylococcus aureus* lives in nostrils of 30 % of population.¹⁸ More than 100 substances are known to cause air pollution, among them carbon monoxide, Sulphur dioxide, hydrogen sulphide etc. are important¹⁹

According to *Acharya Charak* vitiated air is unhealthy, absence of characteristic features of particular season, blowing of violent and cyclonic wind. Air becomes excessively dry, cold, hot, humid and fierce.²⁰ Disturbance in natural flow of air responsible for disturbing rain pattern.²¹ Influenza like viral disease, tuberculosis is some example of communicable diseases which are spread through the medium of air. When air is vitiated various ill health effects are seen in effected persons are like coughing, dyspnoea,

vomiting, rhinitis, headache, fever.²² *Acharya Sushruta* also describes the symptoms of poisonous air like rhinitis, headache, acute eye disease etc.²³

Water: Water is the Basic component of life, 2/3rd of earth is covered with water and human being cannot survive without water. Different types of water based on place of origin and availability are described in *Ayurveda*.²⁴ Quality of water flowing in different rivers vary in properties.²⁵ Different sources and types of contamination of water are described in detail in classical Ayurvedic texts. Impurity of water was known as '*Kalusha*'. Consumption of impure water results in *Dosha* aggravation. The polluted water has abnormal in smell, color, taste and touch, excessive stickiness. The water source devoid of aquatic animals and birds or from a drying up water reservoir without pleasantness and is basically devoid of normal features is also polluted.²⁶ Poisoned water becomes slimy, strong-smelling, frothy and marked with (black-colored) lines on the surface. Death of frogs and fish in the water without any apparent reason denote vitiation of water. According to *Ayurvedic* principles, contaminated water causes eruptions on the skin. The birds and animals living in or consumption of poisonous water roam wildly due to confusion. The internal or external use of poisonous water by man and higher animals like horse, elephant suffer from vomiting, fainting, fever, a burning sensation and swelling of the limbs. These animals and human need an immediate intervention. Proper purification of poisoned water is highly essential.²⁷ Contamination of water is one among the etiologies of waterborne diseases like diarrhea.²⁸ Water during rainy season and natural calamities (floods, famines etc) causes various diseases or epidemic leading to death of people.

Land: Any land having abnormal colour, odour, taste and touch etc. is known to be vitiated land.²⁹ A poisoned ground or stone-slab, landing stage or desert country gives rise to swellings in those parts of the bodies of men, bullocks, horses, asses, camels and elephants that may chance to come in contact with them. In such cases a burning sensation is felt in the affected parts and the hair and nails (of these parts) fall off.³⁰

Season (Kala or Time): Erroneous habits of humans lead to unpredictable seasonal changes.³¹ The vitiation of *kala* or time result in seasonal variation including early rain or delayed rain or no rain during rainy season, excessive rain during winter and summer, extreme hot and cold during winter and summer respectively.³²

Ayurvedic methods of disinfection

Disinfection of air: In Vedic literature, there are references of *Homa-Havana* and *Yajna*, sterilization of air by *Agnihotra*, sterilization of house and place around it by *Dhoopana*(Fumigation with medicated smoke).³³ Fumigation with smoke of *laksha* (*Ficus laccur*), *Haridra* (*Turmeric*), *Ativisha* (*Aconitum heterophyllum*), *Haritaki*(*Terminalia chibula*), *Kustha* (*Sassuria lappa*), *Valaka* (*Cinnamom tamala*), *Ela*(*Cardamom*), *Mustak* (*Cyprus rotundus*), *Priyangu* are used to purify the air. Some other drugs like³⁴ *Guggula*(*Commiforamukul Engl.*), *Somraji*(*Psoralia corlifolia*), *Agaru*(*Aquilaria malaccensis*), *Nimba* (*Azadirachta indica*) etc are also used to purify air. Some studies show the efficiency of fumigation with various herbs to reduce airborne bacteria. Nautiyal et al. demonstrated that 500 g *Havan Samagri* (mixture of more than 50 odiferous and medicinal plants) reduced the airborne bacteria by 94% within 1 h of fumigation.³⁵ A study by Sushma Bagde Bhatwalkar et al Shows that use of only 3gm of four herbal materials (Garlic peel, Turmeric powder, Carom seeds, Loban) resulted in nearly 60-70% reduction in airborne bacteria in more than 300 times bigger space.³⁶ *Nimb* (*Azadirachta indica*), *Guggulu*, *Sarshapa*(mustered), *Ela*(*Cardamom*), *Haridra*(*Turmeric*), *Bhallatak*(*Semecarpus anacardium*), *Jatamansi* (*Nardostachys jatamansi*), *Nirgundi*(*Vitex nigundo*) and *Tulsi* (*holly basil*) these nine drugs are mentioned in *dhoopkalpa* chapter in *kashaypa samhita* for fumigation.³⁷ Fumigation by these drugs creates an aseptic environment, kills microbes and thus, prevents infection.³⁸

Disinfection of water: There are many methods of water treatment in *Ayurveda*. These are generally non-specific as in the present-day. The effects of different drugs advocated for purification of water against specific pathogenic microorganisms or harmful chemicals need to be researched. *Hamsodaka* is naturally purified water by rays of sun and moon along with the rise of *Agastya* star during *Sharad Ritu* (autumn). It is *Rasayana* (rejuvenating), *Balya*(strength promoting), *Medhya* (intellect promoting), alleviates three *Doshas*, *Anabhishyandi* (which does not obstruct channels of circulation).³⁹

According to *Acharya Sushruta* water is purified by two ways *Marjana* and *prasadana*. The highly polluted water should be disinfected through boiling, moderately polluted water by quenching red hot iron ball or sand and less polluted water by exposure to sun light.⁴⁰ Many references in the texts on boiling water (*Shrutashita jala*) indicate the ancient people understood the relevance and importance of boiling water.⁴¹ Boiled water is known to be 'Wholesome' water and pacifies *Tridosha*. The *Ayurvedic* recommendation for reducing the number of pathogens entering body is to boil water and allow it to cool. Some drugs are used to purify water like *Kataka* (*Strichnus potatorum*), *Bisa Granthi* (lotus/ water lily), *Gaibal Moola* (rhizomes of algae), *Mukta* (pearl), *Chandrakanta Mani* (moon stone), *Gomedaka* (cat's eye) etc.⁴² Protection from micro-organisms, can be obtained by filtering water through thick cloth.⁴³

Advocation of dispersion of cold ashes of plants like *Dhava* (*Anogessuslatifolia*), *Ashvakarna* (*Diptereocapusturbinatus*), *Asana* (*Pterocarpus marsupium*), *Paribhadra* (*Erythrina variegata*), *Patala* (*Ster eospermum suaveolens*), *Siddhaka* (*Vitex negundo*), *Mokshaka* (*Schrebera swietenoides*), *Rajadruma* (*Casi a fistula*) and *Somavalka* (*Acacia catachu*) into the lake, pool or tank for nullifying the poisonous substance in water is mentioned. As an alternative, an *Anjali*-measure (half a seer) of the said ashes cast in a *Ghata*-measure (sixty-four seers) of the required water would lead to its purification.⁴⁴ Water treatment in Local Health Traditions Herbs such as *Tulsi* (*Ocimum sanctum*), *Jeera* (*Cuminum cyminum*), *Pattanga* (*Cesalpinia sapan*), *Vetiver* (*Vetiveria zizanioides*) are routinely added to drinking water to enhance their physiological property as a local health tradition.⁴⁵ Water boiled with *Ayurvedic* herbs are advocated for drinking in dehydration and found to be effective.⁴⁶ The purified water should be stored in vessel made of Gold, Silver, Copper, Bronze or Devine Stone as per convenience.⁴⁷ Water kept in copper vessel overnight should be consumed next morning to get health benefits. In the copper vessel prevents the growth of microbes, bacteria and fungi. Additionally, minute amounts of copper dissolved in water has beneficial effect on consumption. Copper enriches water with negative ions, and restores the chemical and physical balance that might have shifted due to the negative effects of pollutants, hormones and other contaminators.⁴⁸ The water of *Chandrakanta Mani* (moon stone) have antitoxic, wormicidal properties.⁴⁹ The researches show that metal like Gold, Silver etc. also have satisfactory antimicrobial property.⁵⁰

Disinfection of Land: Traditionally disinfection of land is performed by cleaning (sweeping), burning, by standing, grazing of cows, sprinkling of water (disinfectants), scraping and covering land. House can be purified by wiping, washing and white washing.⁵¹ The poisoned surface should be purified by sprinkling it over with a solution of *Ananta* (*hemidesmus indicus*) and *Sarvagandha* (the scented drugs) dissolved in wine (*Sura*), or with required amount of black clay dissolved in water or with the decoction of *Vidanga* (*Emblia ribes*), *Patha* (*Cissampelos paieta*), and *Katabhi* (balloon vine).⁵²

Management of vitiated Kala (time): The management of *Kala* is very difficult. It should be done with cultivation of positive attitude among population or any individual. *Satvavjaya Chikitsa* (counseling) for mental strength is essential to face the problem. Ethical practices must be followed by the population. The right behavior in the form of *Sadvritta* is the key for improving mental attitudes.⁵³

Disinfection of environment by sound wave:

Poisoned hay or fodder or any other poisoned foodstuff produces lassitude, fainting, vomiting, diarrhea or even death of the animal in severe condition. Such cases should be treated with proper anti poisonous medicines according to the indications of each case. As an alternative, drums and other musical instruments smeared with plasters of anti-poisonous compounds (*Agadas*) should be beaten and sounded (round them). One part each of silver, mercury and *Indra-Gopa* insects or red velvet mites with three parts of *Kuru-Vinda* or *Corundum* made into paste with the bile of brown cow. This paste should be applied over the musical instruments. The sounds from such drums, etc. are known to destroy the effects of lethal poisons.⁵⁴ *Dundhubhis* (drums), banners and the gate ways of houses should be smeared with medicated alkaline preparation⁵⁵, hearing the sound as well as the sight and touch result in complete expulsion of the poison from the system of the patient.⁵⁶

Disinfection of hospital under Raksha Vidhan (prophylaxis): *Acharya Sushruta* includes *raksha karma* under the umbrella of *Shasthi upakramas* to protect patient from '*Nishachara*' (invisible creatures).⁵⁷ Fumigation of room with mustard (*Sarshapa*), Neem (*Nimba*), ghee (*Ghrta*), and salt (*Lavana*) twice daily for 10 days is advocated for disinfection⁵⁸. The measure can be adopted for routine disinfection of indoor, outdoor and patients ward (*Vranitagara*).

Disinfection of wound: *Dhoopana* is indicated to purify wound (*Vrana*) by *Rakshoghna Dhoopa* made from drugs like *Guggula* (*Commiforamukul* Engl.), *Aguru* (*Aquilaria malaccensis*), *Raal* (exudate of *Shorea robusta*), *Vacha* (*Acorus calamus* Linn.), *Shweta Sarsap* (variety of mustard seeds), *Saindhav Lavana* (rock salt), neem leaves (*Nimba Patra*), and ghee (*Ghrita*).⁵⁹ These eight dhoopana drugs are *krimighna*, *kaphagna* and *laghu gunatmaka* excellently work as antibacterial and antifungal as per researches.⁶⁰ Various concoctions (*Kashayas*) are used to purify *Vrana* Viz *Panchavalkala Kashaya*, *Tripala Kashaya*, *Surasadi Gana Kashaya*, *Araghvadi Kashaya*. Application of old cow's ghee etc. helps in healing of wound. Holly spell is also suggested by *Acharya* to protect the wound from invisible or microorganisms.⁶¹

***Krimighna Vidhan* (deworm infestation):** In *Ayurveda* the term *krimi* is used in a broader sense. It includes microscopic and macroscopic organisms covering wide range of infections and infestation. Prevention of *Krimi* is done through *Rakshoghna Vidhi* which can be correlated to disinfection.⁶² This is done by *Kashaya Prakshalana* (cleaning with antiseptic concoctions), *Parisheka* (irrigation), fumigation, sunlight etc.⁶³

Disinfection of surgical instruments: Disinfection of surgical instruments prior to surgery is mentioned by *Acharya Sushruta*. Incision is taken after proper heating of instruments; otherwise *Paka* (pus formation) takes place.⁶⁴ Disinfection of surgical instruments is done by *Payana* technique.⁶⁵ Su. Su. 8/12

Disinfection rooms: *Sutikagara* (room for parturient lady), *Kumaragara* (paediatric ward), *Vranitagara* (In patient ward) should be free from direct light, fierce wind, contaminated air, dust, smoke and with proper ventilation.⁶⁶ The branches of *Adani*, *Khadira* (*Acacia catechu* Willd.), *Karkandhu* (*Zyzyphus nummularia*), *Pilu* (*Salvadora persica* Linn.), and *Parushaka* (*Grewia asiatica* Linn.) should be tied in the *Sutikagara* (Post-partal room).⁶⁷ The plants of *Nimba* (*Azadirachta indica*), *Tulasi* (*Ocimum sanctum*), *Vanatulasi* (*Ocimum basilicum*) should be present in and around houses for prevention of disease and protection against unwanted harmful animals and insects. The fumigation by putting *Nimbapatra* (leaves of *Azadirachta indica*), *Sarsapa* (seeds of *Brassica campestris*), *Sarjarasa* (exudates of *Shorea robusta* Gaertn), *Hingu* (exudates of *Ferula foetida* Regel) etc. on charcoal or cow dung fire, repels insects, and disinfects houses, *Vranagara* (In patient ward), *Kumaragara* (paediatric ward) and *Sutikagara* (Room for parturient lady). The vaginal fumigation reduced infection rate in normal delivery with episiotomy.⁶⁸

Disinfection of *Kumaragara* (pediatric ward): The protection neonate with various compound formulations, comprising of natural biocides and fumigants is advocated in classics. Fumigation of the garments, bed, and furnishings barley, mustard, *Atasi* (*Linum usitaissimum* Linn.- flax seed), *Hingu* (*Ferula narthex* Boiss.-asfoetida), *Guggulu* (*Commifora mukul* Engl.), *Vacha* (*Acorus calamus* Linn.), *Choraka* (*Angelica glauca* Edgw), *Vayahstha* (*Bacopa monnieri* Pennel.), *Golomi* (type of *Vacha*), *Jatila* (*Nardostachys jatamansi* D. C.), *Palankasha* (type of *Guggulu*), *Ashoka* (*Saraca indica* Linn.), *Rohini* (*Picrorhiza kurroa royle* ex Benth.) and *Sarpa Nirmoka* (sloughs of snakes) with ghee.⁶⁹

Conclusion: Disinfection by traditional method is cost effective and devoid of harmful effects. Many research findings show that the many natural plant, mineral and animal-based products used in traditional *Ayurvedic* disinfection have anti-microbial effect. Further researches are needed to revalidate the ancient knowledge of disinfection for global recognition and acceptance.

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