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REVIEW ARTICLE

Review on *Vishajanya Janapadodwamsa Vyadhi* w.s.r. to Environmental Toxicity

Bhavani pujar[1] **,Shivakumar Budihal**[2]

1- Associate Professor Department of Agadatantra SJG Ayurvedic Medical College Koppal
2-Associate Professor Department of Koumarabhritya SGV Ayurvedic Medical College Bailhongal

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ABSTRACT

Environmental toxicology is a multidisciplinary domain of science, which occupies an important niche, overlapping the field of toxicology. It focuses on humans and other living beings and therefore plays an important role in addressing public health challenges. With increasing numbers of environmental problems, there is a need for immediate health solutions. Environmental toxicity and its health hazards are not a new global issue; it has been in practice for 5,000 years. In olden days, kings, when they entered enemy kingdoms along with the military, faced the threat of being poisoned by entities like air, water, land, grass, and cattle feed. In present days, because of human activities, industries, pesticides, chemicals, and other unhealthy behaviors, the environment is getting poisoned and affecting the health of not only human beings but also the other living creatures of the earth and aquatic ecosystems. The present COVID-19 crisis is also a kind of environmental toxicity affecting the whole world. This paper is an attempt to review the health problems and methods of purification of such environmental particulates explained in classical texts and discuss the adaptation of these methods for challenging problems related to environmental toxicity in the present era.

1.INTRODUCTION

Environmental toxicity is a multidisciplinary field of science concerned with the study of the harmful effects of various chemical, biological, and physical agents on living [1]organisms. There are many sources of environmental toxicity that can lead to the presence of toxicants in our food, water, and air. These sources include pesticides, insecticides, heavy metals, radiation, and all biological agents, which can have harmful effects on living organisms and their communities through shifts in species diversity and abundance. Even 5,000 years back, the practice of environmental poisoning was present. In ancient times, kings used to be the prime targets. Enemies defeated in wars awaited a chance to kill the king due to their anger and desire for revenge. Kings and their military used to travel far and wide in pursuit of conquering various kingdoms, and they faced the threat of being poisoned. So, kings, before entering the enemy's kingdom, should examine the grass, water, path, food, smoke, air, and so on, which may be poisoned by enemies.[2] *Acharyas* have described the *dooshita laxanas* and various methods of purification of these entities.

Corresponding author
Bhavani pujar
Associate Professor Department of Agadatantra SJG Ayurvedic Medical College Koppal
Email - bhavani.pujar@gmail.com

2.REVIEW OF LITERATURE

The environment is the most necessary factor for a healthy life, as well as for the socio-economic growth of society and the nation.

2.1 According *Acharya sushrutha*

Janpada means by which mass people get afflicted with disease and destroy the whole region; the disease that spreads in the form of epidemics is called "*Janpadodhvansa Rogas*." A disease produced due to a specific infectious agent or its toxic products, capable of being directly or indirectly spread from man to man, animal to animal, or from the environment to man or animal. [3]Sometimes these diseases are developed as a result of *visha*. They are called *visha janya janpadodwamsa rogas*. *Acharya Sushrutha* has given a detailed description of these conditions in *Kalpa Sthana*, 3rd chapter. Enemies defeated in wars await a chance to kill the king due to their anger and revenge. Kings and their military used to travel far and wide in pursuit of conquering various kingdoms, and they face the threat of being poisoned. So the king, before entering the enemy's kingdom, should examine the grass, water, path, food, smoke, air, and so on, which may be poisoned by enemies. *Acharyas* have described the *dooshita laxanas* and the method of purification of these entities.

2.2 According *Acharya Charaka*

This has been described by *Acharya Charak in Vimana Sthan* chapter 3, in which *Vayu* (Air), *Desha* (Land), *Kala* (Season), and *Jala* (Water) are all affected (Fig. 1). *Charaka* has also described symptoms of *Samanya vayu* (Normal Air), *Vikrutvayu* (Polluted air), and *Vishdushit vayu* (Poisoned air). *Poorvarupa* (Early Signs) of *Janpadopdhvansa* are abnormal conditions of stars, planets, the moon, the sun, air, fire, and the environment, which derange the seasons.[4]

Though the *prakriti* of each person differs, *Vayu, udaka, desha*, and *kala* are the same in all individuals. So, any vitiation in these entities will bring diseases to a mass of people at a time with similar *laxanas* and intensity.

2.3 Visha dushita jala

Water pollution is the release of substances into bodies of water that make water unsafe for human use and disrupt aquatic ecosystems.

Vikrita jala lakshana; water should be known as non-acceptable when it is excessively deranged in the six categories namely as *Sparsha* (touch), *Roopa* (sight/color), *Rasa* (taste), *Gandha* (odor), *Veerya* (potency), *Vipaka* (chemical transformation). Lakshanas of visha dushita jala; a sheet of poisoned water becomes slimy, strong-smelling, frothy, and marked with (black-colored) lines on the surface.[5]

Effects of *dooshita jala*; frogs and fish living in the water die without any apparent cause. In birds and beasts that live in the water and on its shores, roaming about wildly in confusion can be seen as the effects of poison, and if a man, a horse, or an elephant bathes in this poisoned water, they may suffer from vomiting, fainting, fever, a burning sensation, and swelling of the limbs.[6]

Diseases due to ingestion of contaminated water – excessive thirst (*Trishna*), flatulence (*Adhmana*), abdominal disease (*Udarvyadhi*), fever (*Jwara*), cough (*Kasa*), loss of appetite (*Kshudhamandhya*), goiter (*Granthi*), heaviness (*Angagaurav*), abdominal pain (*Udarshool*), constipation (*Kosthabaddhata*), edema (*Shotha*), anemia (*Pandu*), indigestion (*Ajeerna*), asthma (*Shwasa*) & rhinitis (*Pratishaya*); and diseases due to contact with contaminated water – contact with contaminated water using a bath or any other means causes skin disorders (*Kustha*), itching (*Kandu*), & conjunctivitis (*Netrabhishyanda*).[7]

2.4 Various ayurvedic methods of Purification of *dooshita jala*

a)Davashwakarnadi yoga [8](Table 1)

To purify the poisoned water, drugs mentioned in the table should be collected and burnt. The cold ashes should then be cast into the poisoned water; it will make the water pure (non-poisonous), or a handful (1 *Anjali* = 160 gm) of this ash should be put into the pot containing drinking water to be used when needed.

b)Mechanical purification

This method of purification is clean and neat. Cotton clothes are applied for filtration to remove the mechanical contaminations like mud, crystals of chemicals, and so on.

c) Impregnation of Kataka (Strychnos Potatorum L.), Gomeda (Hessonite), Bisagranthi (Root of Lotus), Shaivala moola (Root of Algae), *Vastra* (Cloth), *Mukta* (Pearl), and *Mani* (Potash alum).[9]

d) It should be made clear by putting *Parnimula* (a kind of grass that has the property of diluting the water) and knots (tubers) of lotus plants into the water.

e) Chandrakanta mani (moonstone) – When exudates in water, it removes harmful bacteria, insects, worms, and poison.[10]

f) Thermal purification

This method of purification is done by heating on fire, sunlight, or by dropping heated solid metals in water. The most effective method is boiling the water for 2-3 minutes. It helps to remove the biological contaminants of water.

Visha dooshita vayu/dhooma

Air pollution is a mixture of solid particles and gases in the air. Car emissions, chemicals from factories, dust, pollen, and mold spores may be suspended as particles.

In ancient times, atmosphere poisoning was conducted as a military operation to harm the enemy by fumigation of toxic substances.

✓ Vikrita Vayu Lakshana – Air of this type should be known as causing illness such as – not following the season, excessively

moist, speedy, harsh, cold, hot, rough, blocking, terrible sounds; excessively clashing with each other and affected with an unsuitable smell,
vapor, gravels, dust, and smoke. [11] ✓
Characteristics & Effects of polluted air – When bird droppings fall from the sky in a tired condition, it indicates that the wind and the smoke (of the atmosphere) are poisoned. It is further attended by an attack of cough, nasal discharge, headache, and severe eye diseases among persons inhaling the same wind and smoke.[12]

Treatment of vishadooshita dhooma
In the case of poisoned air, the atmosphere should be purified by burning herbal drugs mentioned in Table 2 in the open ground. The fumes of these drugs would purify the poisonous air. [13]
a)Shigruvadi agada; fine powder of devadaru, arjuna, lodhra, and shigru are to be sprinkled over the trees, flagpoles, etc. Poisoned air, when it comes in contact with the agada, gets detoxified.

2.5Visha dooshita bhumi

Land pollution means undesirable physical, biological, and chemical factors introduced by human activities inland.
Sources – Increased mechanization & urbanization, pesticides, increased leisure and available wealth, increased waste disposal, and increased military presence.

Vikrita Bhumi/Desha lakshana – The *desha (bhumi)* of the following description is to be known as unwholesome; having color, odor, taste, and touch that are unnatural; excessively damp; abounding in serpents, beasts of prey, mosquitoes, locusts, flies, mice, owls, birds, and animals such as the jackal; and abounding in woods of weeds and *Ulupa* grass; abounding in creepers where crops have either fallen, withered, or been destroyed in an unprecedented manner; where the winds are smoky; where the sound of birds is unceasing; where the baying of dogs always assails the ears; where herds of animals and flocks of birds of various kinds are always in a state of alarm and pain. [14]
Effects of *vikrita bhumi*; ground surfaces of rocks, banks of rivers, and sand which have been poisoned and which come in contact with the body parts of cows, horses, elephants, camels, donkeys, and human beings produce swelling, burning sensation, and cause the falling of hairs and nails.[15]

2.6 Treatment of *visha dooshita bhumi*[16]

Decoction agents for the treatment of the affected surface of the body
Ananta (*Hemidesmus indicus*) along with *sarvagandha* (*Eladigana dravyas*) and *madhu*, *guda* made into a paste should be dissolved in *sura* or *jala* and sprinkled on the poisoned road.
Cow milk mixed with soft mud can be sprinkled over the road.
Vidanga (*Embelia ribes*).
Pathaa (*Cissampelos pareira*)
Katabhi (*Albizzia procera*).
Decoction made from such drugs can be sprinkled over such roads in order to purify them.

Vishadooshita Truna
Grass poisoning – This is the poisoning of the crops in order to cause casualties.
Sources – Cattle poisons, insecticides, fertilizers, chemicals, etc.

Health impacts
If the *truna* (grass), *bhakta* (cattle feed, corn, etc.) are poisoned, then the animals that feed on them will become weak, faint, some will vomit, some will purge, and some animals will die. Hence, they should be treated quickly and suitably.

Treatment of truna poisoning

The poisoned items should be smeared with *visha hara agadas*. The intoxicated animals should be made to hear the melodious sound of musical instruments such as drums, kettledrums, etc., which are beaten hard while being smeared with the paste of *taara* (silver), *sutara* (mercury), *surendra*, *gopa* (sariva), and *kuruvinda* (musta). All drugs in equal quantity should be macerated in the bile of a brown-colored cow. By the sound of such musical instruments, poison, though strong, gets destroyed. [18]

2.7 Dooshta kala

Vitiation is nothing but, in terms of *ritu*, there will be *ritu vipareeta laxanas*, *ati* or *heena laxanas*.

2.8 General Management of *Janpadodhwansha* according to *Acharya Charaka*[19]

Panchkarma therapy (*Vamana* - Emesis, *Virechana* - Purgation, *Niruha*, *Anuvasanam*, *Nasya* - Errhines) is the best treatment. Thereafter, the proper use of *Rasayan* (Rejuvenative therapy/Immuno-modulator) measures and management with the drugs collected in a normal environment is recommended. *Sadvritta & Aachar Rasayan* (Good behavioral activity and personal hygiene) is also helpful for reducing the effect of *Adharma* (i.e., not following the rules & regulations set by ancestors), which is the main reason for *Janpadodhvansa* (Imbalance of ecosystem).

2.9 Environmental toxicity

Environmental toxicology is defined as the science that deals with the effects of pollutants on the environment and wildlife. The environment particularly includes air, soil, and water. A pollutant is a substance that occurs in the environment, at least in part as a result of human activity, and which has a deleterious effect on living organisms.
Types of pollution

Air pollution
Water pollution
Soil pollution
Water pollution: water pollution is the contamination of bodies of water by different human activities, industrial wastes, etc.
Sources of water pollution: [20]
A) Organic – Detergents, insecticides, herbicides, lubricants, petroleum hydrocarbons, fuel (gasoline, diesel, fuel oil), volatile organic compounds, chlorinated solvents.
B) Inorganic – SO2, NH3, nitrates, phosphate fertilizers, heavy metals.
C) Macroscopic – Garbage (paper, plastic, food waste).
D) Thermal pollutants – Includes wastes from atomic, nuclear, and thermal power plants.

2.10 Effects of water pollution on living beings

Pollution of water bodies by mercury causes Minamata disease in humans and dropsy in fish.
A high amount of lead in water causes dyslexia.
Increased levels of cadmium cause Itai-itai disease.
Oil pollution of the sea kills marine birds and adversely affects other aquatic life and beaches.
Pollution due to pesticides and inorganic chemicals may enter the food chain.
Heavy metals like lead, zinc, arsenic, and cadmium have serious effects on living beings, causing skin lesions, rough dry and itchy skin, which may lead to skin carcinoma.
Anemia, vomiting, loss of appetite, damage to the liver and kidneys, hepatitis A & E, diarrhea, GIT diseases, fever (typhoid), diseases of the CNS, carcinogenicity, skin problems,

2.11 Method of controlling water pollution

A) Storage – Water is drawn out from the source and impounded in natural or artificial reservoirs. When water is stored, it helps provide a reserve of water from which further pollution can be avoided.
B) Filtration – Filtration is a second stage in the purification of water and quite an important stage because 98-99% of the bacteria are removed by filtration, apart from other impurities, e.g., 'biological or slow sand' filters and 'rapid sand or mechanical' filters.
C) Disinfection – For a chemical or an agent to be potentially useful as a disinfectant in water supplies.
Proper treatment of sewage water by sedimentation, coagulation, filtration, disinfection, softening, and aeration.
Water recycling after treatment should be practiced to the maximum extent possible.
The quantity of wastewater discharge should be minimized.

2.12 Air pollution

Air pollution is the result of industrial gases, vehicles, deforestation, chemical warfare, and certain domestic activities, and so on. Air pollution can be defined as any solid, liquid, or gaseous substances, including noise and radioactive substances, in the atmosphere in such a concentration that may be directly or indirectly injurious to humans and other organisms, and plants, which interfere with the normal environmental process.

2.13 Sources of Air pollution[21]

A) Automobiles: One of the major sources of air pollution is motor vehicles. These vehicles emit hydrocarbons, carbon monoxide, lead, nitrogen oxides, and particulate matter.
B) Industries: Industries emit large amounts of pollutants into the atmosphere. The combustion of fuel to generate heat and power produces smoke, sulfur dioxide, nitrogen oxides, and fly ash.
C) Domestic Sources: In the domestic usage of coal, wood, or oil, smoke, dust, sulfur dioxide, and nitrogen oxide are produced.
D) Miscellaneous: These comprise burning refuse, incinerators, pesticide spraying, natural sources (e.g., windborne dust, fungi, bacteria), and nuclear energy programs.
E) Indoor air pollution: Tobacco smoke, stoves, aerosol sprays, solvents, resin products, building materials, etc.
Table 3 - Shows the health impacts of pollutants
Prevention and control of air pollution [22]
The following procedures for the prevention and control of air pollution were recommended by WHO:
A) Containment – Prevention of the escape of toxic substances into the ambient air.
B) Replacement – Replace a technological process that causes air pollution with a new process that does not affect the air.
C) Dilution – Establishment of 'green belts' between the industrial and residential areas for diluting the condensed air.
D) Legislation – Air pollution is controlled in many countries by suitable legislation, e.g., Clean Air Acts.
E) International action – To deal with air pollution on a worldwide scale, the WHO has established an international network of laboratories for the monitoring and study of air pollution.

2.14 Soil pollution

Addition of certain substances that adversely affect the environment by polluting the soil and its fertility is called soil pollution.
Plastics, cloths, glass, metals, organic matter, sewage wastes, building debris, pesticides, chemical fertilizers, and other biodegradable materials cause soil pollution.

Sources –
Increased mechanization and urbanization,

Pesticides, increased leisure, and available wealth,
Increased waste disposal and increased military presence.

Health impact –

Cancers, skin diseases, respiratory disorders, birth defects, Liver, kidney, and lung disease; landfills become breeding grounds for mice, rodents, flies, and birds that can transmit diseases.

Control of soil pollution
Indiscriminate disposal of solid wastes should be avoided.
Ban on plastic bags. Sewage should be treated properly.
Organic matter from domestic, agricultural, and other wastes should be segregated and vermicomposted.
Industrial waste should be properly treated to remove hazardous materials.
Biochemical wastes should be separately collected, incinerated, and disposed of deep in the ground.

3. DISCUSSION

Environmental toxicity being a global issue, it has been proven to be hazardous to public health and safety. When we consider the same condition about 5000 years back, the environment was intentionally poisoned in the hunger of conquering kingdoms. In the present scenario, the environment is also being poisoned by the toxicants produced from pesticides, industrial waste, and even biological weapons that are being used for the same purpose. Some say that the present global pandemic, the Covid-19 virus, was also developed as a biological weapon. The whole world has been severely affected by this disease. Purification of the environment and management of such conditions can be attempted by the methods mentioned in the classics.
Visha dooshita vayu – Air becoming toxic is nothing but an increased percentage of irrespirable gases in the environment. The presence of particulate matter suspended in the air will lead to different diseases in people who are respiring that air. The *shigruvadi agada* mentioned by *acharya sushruta* contains *vishagna dravyas* that help in detoxifying the air. *Agada* will be applied to things like flags, posters, etc.; it releases its active principles constantly into the air and purifies the environment. Burning of *vishagna drugs* like *devadaru*, *haridra*, *shigru*, *eladala*, and *ativisha* produces smoke that purifies the environment immediately.

3.1 Recent studies

Medicinal smoke reduces airborne bacteria [23]
➢ This study shows the impact and ethnopharmacological aspects of medicinal smoke on aerial bacteria in an indoor environment. Smoke was originated by burning wood and a complex mixture of odoriferous and medicinal herbs (*havan* material) like *Aegle marmelos* (L.), *Cedrus deodara* (Roxb. Ex D. Don), etc. The obtained results show a 94% reduction in bacterial counts by 60 min, and the effective time was up to 24h in the closed room.
Agnihotra – A non-conventional solution to air pollution. [24]
➢ Under the natural lab conditions and local artificial indoor pollution, the obtained results show a noticeable reduction in SO2 and NO2 concentration by almost 51% and 60%, respectively, more by *Yagya* when compared without *Yagya*. In this study, materials used for *Yagya* (fire rituals) include cow's ghee (clarified butter), Pipal wood (*Ficus religiosa* L.), Guggula (*Commiphora mukul* Hook. ex Stocks), etc.
Experimental study of *Shushrutokta Jalaprasadana vidhi* wsr to *Gomeda* [25]
➢ The objective of this study was to discover the possibility of *Jala prasadana vidhi* with the help of *Gomeda* (Hessonite). Containers used for water in this study were made of glass and earthen vessels. Values were observed by applying the ANOVA test and unpaired 't' test, and the obtained results show a very significant effect of *Gomeda* on water impurities. In this experiment, 1 carat of *Gomeda* was used against 1 liter of water. One carat is approximately equal to 200 mg.
An experimental study on the efficacy of *Vangbhatokta Jala Nirvishikarana Yoga* on polluted water. [26]
➢ *Jala Nirvishikarana Yoga* was prepared according to the classical method. The optimum dose and period were found to be three drops per 100 ml for 30 min of contact time. The sample was analyzed for various physical, chemical, and microbiological parameters before and after treatment. *Jala Nirvishikarana Yoga* shows efficient antimicrobial activity and effectiveness for at least 1 year at room temperature.
Extraction of cadmium and the tolerance of three annual cut flowers on Cd-contaminated soils. [27]
➢ The main objective of this study was to find out the production potential and Cd removal by three flower crops, namely marigold (*Tagetes erecta* L.), chrysanthemum (*Chrysanthemum indicum* L.), and gladiolus (*Gladiolus grandiflorus* L.). An experiment was conducted on differentially contaminated soils. The obtained results show that Cd removal was maximum with chrysanthemum and gladiolus, with the highest tolerance, and Cd content in the saleable part holds the potential to clean up moderately contaminated soils.

4. CONCLUSION

Environmental toxicology is a multidisciplinary field of science concerned with the study of harmful effects of various chemicals and physical agents on living organisms. Eco-toxicology is a sub-discipline of environmental toxicology concerned with studying the harmful effects of toxicants at the population and ecosystem levels. When we go through the history of environmental toxicity, earlier it was with less intensity and in a restricted area, but in the present situation, the hazardous effects of environmental toxicity are bothering the globe. Harmful effects of chemical and biological agents as toxicants from pollutants, insecticides, pesticides, and fertilizers can affect an organism and its community by reducing its species diversity and abundance. Such changes in population dynamics affect the ecosystem by reducing its productivity and stability. Though a lot of acts and regulations have been enforced by the government

in this regard, the control of environmental toxicity is not effective. The purification methods practiced in the present day are expensive in nature and require a lot of manpower. Hence, adapting Ayurvedic methods of purification for detoxifying natural sources will help in preventing the harmful effects on living beings. These methods are simple and can be implemented at the level of each household. Although "prevention is always better than cure," avoiding the sources of pollution and toxicants from reaching the environment should be followed to preserve the sanctity of the environment for future generations.

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8.ETHICAL APPROVALS

Ethical approval was not required for this study, as it was a review article with data obtained through a literature search.

9.CONFLICTS OF INTEREST

Nil

10.DATA AVAILABILITY

This is an original manuscript, and all data are available for review purposes only from principal investigators.

11.PUBLISHERS NOTE

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Table 1- Davashwakarnadi yoga

S.N	Drug	Botanical name
1	*Dhava*	*Anogeissus latifolia*
2	*Ashwakarna*	*Dipterocarpus alatus*
3	*Asana*	*Pterocarpus marsupium*
4	*Paribhadra*	*Erythrina variegate*
5	*Patala*	*Stereospermum suaveolens*
6	*Siddhaka*	*Vitex negundo*
7	*Mokshaka*	*Schrebera swietenioides*
8	*Amalatasa*	*Casia fistula*
9	*Somavalka*	*Acacia leucorrhoea*

Table 2-Poisoned air purification drugs

S.N	Drug	Botanical name
1	*Laksha*	Shellac
2	*Haridra*	*Curcuma longa*
3	*Ativisha*	*Aconitum heterophyllum*
4	*Abhaya*	*Terminalia chebula*
5	*Abdha (musta)*	*Cyperus rotundus*
6	*Harenuka*	*Vitex negundo*
7	*Eladala*	*Elettaria cardamomum*
8	*Vakra(tagara)*	*Valeriana officinalis*
9	*Kushta*	*Saussurea lappa*
10	*Priyangu*	*Callicarpus macrophylla*

Table 3- Health impacts of Pollutants

Pollutant	Adverse effect
Oxides of nitrogen	Respiratory tract irritation, bronchialhyperactivity, impaired lung defences
Hydrocarbons	Lung cancer
Ozone discomfort	Cough, substernal broncho-constriction, decreased exercise performance, respiratory tract irritation
Sulphur dioxide	Exacerbation of asthma and COPD, respiratory tract irritation, death may occur in severe exposure
Lead	Impaired neuropsychological development in children
CO	CO poisoning cause cherry lips, unconsciousness, death by asphyxiation
Suspended particles	reduces sunlight visibility, and causes diseases like pneumoconiosis, allergic bronchitis, asthma, cancer and other lung diseases.