

***Agnihotra* technology in the perspectives of modern science – A review**

^{1,3}Pranay Abhang* & ^{2,3}Girish Pathade

*Corresponding author

¹Institute of Bioinformatics and Biotechnology, Savitribai Phule Pune University, Pune 411007, Maharashtra, India;

²HV Desai College, Pune 411002, Maharashtra, India;

³Department of Environmental Science, Fergusson College, Pune 411004, Maharashtra, India

E-mails: pranayabhang@yahoo.co.in ; girishpathade@yahoo.co.in

Received 15 June 2016, revised 18 July 2016

Abstract

Agnihotra, the simplest form of ‘*Yajnya/Homa*’ performed in many countries all over the world. Although it’s an ancient fire ritual, it is based on the scientific aspects. It invokes sunrise and sunset timings, when far infrared radiations are produced from the sun, the burning of cow ghee, dried cow dung, unpolished rice in the typical inverted pyramidal shaped copper pot with the chanting of mantras about Sun (*Surya*) and fire (*Agni*). It is found that far infrared radiations of sun and that of *Agnihotra* resonate to generate a huge amount of vital energy useful for life processes. The fumes and ash of *Agnihotra* are useful to purify water and air, ameliorate agriculture, reduces the pathogenicity of microorganisms and help to improve the health of living beings. Performing *Agnihotra* with right timings and ingredients will create conducive atmosphere in the surrounding for the well-being of life.

Keywords: *Agnihotra* technology, Modern science, Medical applications, Agricultural applications, Environmental applications

IPC Int. Cl.⁸: C02F, F24, F23, F16L 55/02, F16H 33/00

Agnihotra is a traditional domestic solemnity, performed to maintain harmony between living beings and nature, without harming and by giving respect. *Agnihotra*, the simplest forms of ‘*Yajnya*’ performed at sunset/sunrise in which cow dung is burned in the copper pot by using cow ghee and brown rice as oblations along with chanting of mantras of sun and fire. *Agnihotra* is mentioned and explained by traditional Vedic literature, i.e., The *Grihya-Sutra* (Rules of Vedic domestic ceremonies), (1) 1.2, 1.9 and 1.10 of *Asvalayana Grihya-Sutra*, (2) 1.1 and 1.3 of *Gobhila Grihya-Sutra*, (3) 1.5 of *Khadira Grihya-Sutra*, (4) some part of *Sankhayana Grihya-Sutra*¹. Different forms of *Agnihotra*, in perspectives of ingredients used, can be seen in the society. In some forms of *Agnihotra* about 26 dried plants or its parts

get used, which was mentioned by Kumar, *et al.* (2015) along with their elemental analysis². In around 1944, Shree Gajanan Maharaj (1918 – 1987) from Akkalkot (India), following the command of Lord Parshuram standardized the methodology for *Agnihotra* and started propagating its use and benefits all over. From 1970 onwards, Mr M Potdar³ started spreading knowledge of *Agnihotra* in India and Mr Vasant Paranjpe⁴ started expanding this *Agnihotra* technology into many countries. At the same time, many scientists started revealing the scientific basis for the beneficial effects of *Agnihotra*. Although it's an ancient fire ritual, it is based on the scientific aspects. About more than 50 Colleges/ Institutions/ Universities are working on the *Agnihotra* technologies⁵. Current review compiles the work done about *Agnihotra* technology in the perspectives of modern sciences by various scientists and institutions.

Physiochemical properties of *Agnihotra*

It is important to study necessary dynamics of physiological processes to understand biotic processes affected by *Agnihotra*. Life energy, may be absorbed or emitted by specific substances and living organisms, is important to measure to understand the change in the energy during *Agnihotra*. Life energy levels increase during the process *Agnihotra*. Chanting of mantras has a great impact on the increase in life energy, which may require for the growth and normal physiological functioning of plants. *Ephedra* or *Somavalli* particularly used in Somyag stores most of the cosmic energies during *Yajnya*, which along with other oblation materials is responsible for the increase in life energy. Burning material used in *Agnihotra* has very low calorific value. Also burning temperature of base fire is low; hence, there is controlled production of oxides of nitrogen. For complete combustion sufficient amount of oxygen is required, which is ensured by the pyramidal shape of a copper pot. Carbon dioxide and other volatile organic compounds are produced during combustion of *Agnihotra* fire, which are nontoxic to the environment. But carbon dioxide acts as one of the greenhouse gas. As *Agnihotra* is performed at sunrise/sunset timings, produced carbon dioxide will be utilized by surrounding plants and converted into molecular oxygen. Base fire breaks down molecular bonding in substances, due to which they get vaporized and does not cause their independent combustion process⁶.

Heat energy generated during *Yajnyas* fire and sound energy by chanting of mantras both combines to achieve desired physiochemical, biological and spiritual benefits. Transformation of energies may be due to materials used during *Agnihotra*, which is responsible for chemical changes in the atmosphere. Materials (*samidha*) (Table 1) used during *Yajnya* process are dried twigs of Mango, Pipal, etc., odoriferous substances like *Chandan*, Saffron, etc., medicinal plants like *Brahmi*, *Guggul*, etc., and other materials such as sugar, honey, milk, etc. After complete combustion of cellulose of wood, it gets vaporized, some volatile organic compounds get released during combustion, e.g. eugenol, terpinol, etc., which get diffused in the surrounding air and after that they undergo photochemical reactions of decomposition, reduction or oxidation. Fatty substances (mainly ghee) help in the rapid combustion of cellulose matter and releases acetone bodies, aldehyde, etc. Fumes of *Yajnya* purify the surrounding environment by removing foul odors replaced with various volatile organic compounds⁶. Hydrogen sulphide (H₂S) and nitric oxide (NO) are released due to cows dung and ghee (hump-backed Indian cow) during *Yajnya* process, both H₂S and NO act as bio-signaller and involved in growing of new blood

vessels, control of Alzheimers disease, etc., Cow ghee provides all fat soluble vitamins like A, D, E and K. It works as antiaging, antioxidant agents who improve the immunity, secretes biliary lipids and control the levels of cholesterol. Pyramidal shaped copper pot is important to create, store and transform energies during *Yajnya* process. Copper acts as good energy conductor and it have antimicrobial properties (oligodynamic action). *Yajnyas* are indirectly responsible for the continuation of seasonal cycles on the earth. Due to *Yajnya* clouds are produced due to the creation of solidity, humidity, heaviness, fluidity, etc., in the surrounding atmosphere. CO₂ produced during combustion of *Yajnya* is important for carbon and oxygen cycles of the environment. *Yajnya* purify the environment by reducing or controlling the pollutants in the soil, air and water⁷. Use of cow dung, cow ghee, brown rice, copper pot, activity timings and chanting of mantras during *Agnihotra* altogether has a significant effect on *Agnihotra* ash. Ash of *Agnihotra* performed at sunrise/sunset timings, by chanting of *mantras* and by using proper *Yajnya* materials shows the presence of organic carbon, sulphur, phosphorus, potassium, iron, calcium, magnesium, manganese, aluminium, copper and zinc. The variations made in materials of *Agnihotra* changes the chemical composition of *Agnihotra* ash. *Agnihotra* ash is alkaline in nature. During homa farming all these agrochemicals present in ash act as a source of micronutrient and macronutrient for crop, hence there is an increase in plant growth in terms of shoot and root length ultimately increases the productivity of crops^{8,9}.

Table1 – List of plants with local names:

Name of Plant	Scientific Name	Common Name
Somavalli	<i>Sarcostemma brevistigma</i>	Soma, Somalata, Somamum, Akujemudu
Mango	<i>Mangifera indica</i>	Amba, Maangai, Amramu
Pipal	<i>Ficus religiosa</i>	Aswatha, Pipli, Pipar
sandalwood	<i>Santalum album</i>	Chandan, Anukkam, Bhadrasri, Anindita
Saffron	<i>Crocus sativus</i>	Kesar, Kashmiram
Brahmi	<i>Bacopa monnieri</i>	Jalnaveri , Jalamimba , Sambranichettu
Guggul	<i>Commiphora wightii</i>	Indian Bedellum, Devadhupa
Rice	<i>Oryza sp.</i>	Chaval, Tandul, Dhan, Akki, Bhatta
Lemon grass	<i>Cymbopogon sp.</i>	Olecha, Gandhatrina, Nimmagaddi, Lilicha
Green gram	<i>Vigna radiate</i>	Moong, Kattuuluntu, Masaparni
Grape	<i>Vitis vinifera</i>	Angur, Draksha
Corn	<i>Zea mays</i>	Maize, Makkai
Bell pepper	<i>Capsicum annum</i>	Pepper, Chilli, Mirchi

Medicinal applications of *Agnihotra*

Skin is the largest organ of the body which forms an outer covering and protects the internal organs from surrounding environment, microbes, physical damages, radiations, chemicals, etc. To achieve this, skin needs to face wear and tear, which leads to damage to the skin. To recover these damages body utilizes wound healing process. Wound healing is a normal biological process achieved through four highly integrated and overlapping stages: hemostasis, inflammation, proliferation, and remodeling or resolution¹⁰. To smoothen and faster these stages one needs to apply external ointments having appropriate metals and trace elements to increase the activity of process involved enzymes. Application of *Agnihotra* ash as an ointment is a novel therapeutic approach for wound healing process. *Agnihotra* ash is used as an external

ointment to recover skin wounds, *in vivo* experiments conducted on white skin disease of *Gold fish*¹¹, cat ear infections and physical damage to human finger¹². In *Gold fish* (*Carassius auratus*) white spots on the skin (disease is known as Ich) caused by the protozoan *Ichthyophthirius multifiliis*. In cat, many viral, bacterial and fungal pathogens cause ear infections (known as Otitis). All these infections cause the formation of lesions (edema and erythema) and to overcome on these infections body utilizes wound healing process. Application of *Agnihotra* ash to the infected area shows up to 20 % faster healing as compared to control (not treated with ash). *Agnihotra* ash shows good antimicrobial and antifungal activity, apart from this ash provides necessary trace elements and metals required in different stages of wound healing process. The performance of *Agnihotra* shows a reduction in suspended particulate matter near *Yajnya*. The suspended particulate matter may get precipitated with fumes of *Yajnya*. Analysis of suspended particulate matter shows an increase in the amount of zinc content; this may come from materials used during *Agnihotra* in the form of zinc oxide. Emitted zinc has a curative effect on skin infections and also protects from ultraviolet radiations¹³. The ash analysis shows the presence of high amounts of lead and manganese within threshold levels. The presence of manganese is important for normal functioning of nervous system and bone metabolism¹⁴. *Agnihotra* ash with cow ghee acts as an ointment. When applied to infected part on the skin (scabies), it shows rapid cure as compared to other medicines. Irritation due to the application of chemicals can be reduced by replacing them with *Agnihotra* ash¹⁵. Golechha *et al.* reported the use of *Agnihotra* as a treatment for smack addiction¹⁶ (1987) and alcoholism¹⁷ (1991). State of tranquillity of mind is enhanced in smack addict demos due to the performance of *Agnihotra*. Fumes generated during *Agnihotra* might be responsible for enhanced tranquillity of mind. Apart from this, vibrations, i.e., electromagnetic waves and radiations, generated from pyramidal shaped copper pot during *Agnihotra*, by chanting of mantras at sunrise/sunset might be accountable for beneficial effects of *Agnihotra*. People addicted to various types of intoxicants can be recovered in *Agnihotra* atmosphere may be due to conversion of cosmic rays during sunrise/sunset into other forms which are responsible for positive effects of *Agnihotra*. *Agnihotra* can be used to control alcoholism. Reported case study suggests that continuous performance of *Agnihotra* can control addiction of alcohol within two weeks. Although *Agnihotra* does not totally cure alcoholism it may use as subsidiary treatment during de-addiction. Electromagnetic waves generated during *Agnihotra* may effect on rhythms of body and brain, they may stimulate neurotransmitters or neuromodulators required to enhance the tranquillity of mind and hence may be responsible for control of alcoholism. *Agnihotra* renews the cells, tissues, organs and having wholesome effects on circulatory, pulmonary as well as nervous systems¹⁴.

Ethnobotanical inhalation therapy (known as *Yajnya* therapy) can be used to treat pulmonary tuberculosis caused by *Mycobacterium avium tubercular*. Sublimation, volatilization and other chemical transformations in the slow combustion and slow heating process of *Agnihotra Yajnya*, are responsible for treating tuberculosis disease by controlling pathogen number and their pathogenicity¹⁸. Curative effects of *Agnihotra* are not only limited to animal or human health but also effective in plant health. Use of plant-based smoke (fumigation) in combination with other practices (such as *Yajnyas*) has been practiced since ancient time to protect the environment and improve the health of human, animals and plants. *Vrikshayurveda* mentioned about plant-based fumigation for various purposes in more than 53 verses from

various treaties. Treatment of about 32 different plant materials (i.e. inhaling their fumes) is mentioned in *Vrikshayurveda* for various illnesses of body parts of human and other animals. Apart from disease control, fumigation has been used for a good yield of crops along with their healthiness. This may be achieved due to improvement in plant growth, hasten fruiting or flowering and also, may be due to insect and pathogen growth control, etc. Smoking treatment is given to control microorganisms and hence it purifies surrounding environment. Use of all these plant materials with *Agnihotra* can be used as a supplement in modern farming techniques to overcome its disadvantages¹⁹.

Agnihotra creates positive environment due to which human behaviour get modified. It provides specific direction to energize the surrounding environment and due to this brain get activated to perform miracle activities²⁰. A tremendous amount of energy is resonated along with the production of a magnetic field which will activate positive energies due to which *Agnihotra* reduces stress, clarity of mind and improves the health. Cosmic energy gathered during *Yajnya* has a positive effect on nature or the environment²¹. Ash of *Agnihotra* is not radioactive although materials used during *Yajnya* may be radioactive. It is evident from Chernobyl nuclear accident (in 1986), that *Agnihotra* and *Tryambakam Yajnya* can control the levels of radiation. Also, the people living in houses covered with cow dung were not affected by radioactive contaminants. Analysis of *Agnihotra* ash shows the presence of all 92 natural elements²².

Agricultural applications of *Agnihotra*

Use of ash (burned dried-twigs of plants; cow dung; vegetable waste, etc.) in fields to increase crop production is a common practice in India since ancient time. *Agnihotra* ash when applied to seeds, it enhances germination process with the increase in plant growth. In vitro experiments were conducted by Abhang *et al.* (2015) on *Moong* seeds⁹ while that of actual field experiments were done by Devi *et al.* (2004) on rice seeds²³ and Punam *et al.* (2012) on lemon grass²⁴. Seeds of *Moong* (*Vigna radiata*) when treated with *Agnihotra* ash show faster germination as compared to control ashes (cow dung ash, rice ash, normal ash).

Treatment with *Agnihotra* ash influences rice seed germination from primary stage, i.e., radical emergence from seed coat due to its higher rate of increase in respiration, which was measured in terms of shoot and root length with fresh and dry weight. Efficacy of *Agnihotra* in accelerating rice seed germination is not dependent on seasonal variations; it is effective in summer, winter and autumn as well as in adverse conditions also²³.

A traditional farming system utilizes organic homa farming or *Agnihotra* technology to maintain disease free local crops. Farmers utilize their indigenous knowledge about *Agnihotra* or homa farming to predict harvesting conditions, seasons, crops behaviour, soil conditions and other factors. It shows complex interactions between the environment and farmers. *Agnihotra* technology is nature-friendly and is about the agricultural, environment, animal and other plant welfare, farming communities, use of sensible energy, conservation of soil and water, etc.²⁵ Grape seeds show increase germination rate in the environment of *Agnihotra*. The time required for germination can be reduced, i.e., dormancy will break faster due to *Agnihotra* treatment. Fumes of *Agnihotra* may contain signal molecules required to break dormancy and for seed germination. Plants became disease free, and hence, there is an increase in plant

growth and ultimately there is an increase in yield and productivity. There is no any loss during grape harvesting process due to *Agnihotra* treatment. *Agnihotra* is also helpful in the production of raisins from grapes. It ensures reduced microbial count in area hence raisins remains disease free. The process of drying of grapes is faster in *Agnihotra* atmosphere. During cultivation of mushroom, the straw substrate when supplemented with *Agnihotra* ash, show increase in the nutritive values and yield of mushroom. Carbohydrate, amino acid and protein content of fruiting bodies increased along with size and fresh weight of mushroom due to the addition of *Agnihotra* ash. Biological efficiency and biological profile of mushrooms increase due to the addition of ash in the substrate during its cultivation. The time required for harvesting spawns significantly reduced due to the addition of *Agnihotra* ash²⁶.

Homa farming with *Agnihotra* and *Tryambakam Yajnya* shows an increase in growth and yield of soybean plants. Biosol, a special organic fertilizer prepared by using ash of *Agnihotra* when applied as foliar application shows an increase in organic carbon, phosphorus, copper, manganese, iron, zinc, total protein and oil content. There is a drastic increase in soil dehydrogenase activity as well as the decrease in insect attack and incidence of rust in the plant due to the application of *Tryambakam Yajnya* ash and foliar application of *Agnihotra* ash. Due to the use of *Agnihotra* ash as a Biosol, there is an accumulation of dry matter in stem and increase in plant growth in terms of shoot and root lengths. Root nodules formation enhances due to the application of *Agnihotra* ash in the soybean plant. *Tryambakam Yajnya* ash treated seeds along with the foliar application of *Agnihotra* ash as Biosol, increases yield and productivity of soybean by providing necessary trace metals and other elements due to which there is an increase in metabolism. Increased metabolic rate is responsible for expression of proteins and increase in production of enzymes due to which plant become resistant against pathogenic attack²⁷.

Agnihotra fumes accelerated the germination of rice seeds. There is an increase in root length, shoot length, dry weight and fresh weight of rice plant after treatment with *Agnihotra*. Statistical records suggest that there is a predominant increase in the shoot length as compared to other parameters due to the treatment of *Agnihotra*. A comparative study between seeds treated with *Agnihotra* and non-treated (i.e. (a) without fire and *mantra*, (b) with only fire and (c) with the only *mantra*) revealed that chanting of *mantra* as well as the ignition of fire both contribute to *Agnihotra* for the increase in germination rate and plant growth. Major operational parts of *Agnihotra* are chanting of *mantra* at sunrise or sunset timings and ignition of fire, both shows interactive effects and not merely additive effects. Emission of fumes after combustion of *Agnihotra* materials alters the composition of surrounding environment. This change in environment influences the emergence of radical from the seed coat, the first stage of seed germination. This may be due to the increase in respiration rate of seeds after imbibition. Noticeable results of growth which is not relying on seasonal variation; they are similar in winter, summer as well as autumn. Treatment with *Agnihotra* to the seeds neutralizes adverse environmental conditions, resulted in normal germination of seeds and plant growth as compared to control (seeds germinated in an adverse environment).

Homa organic farming which is done by performing *Agnihotra* increases yield and productivity of horticultural crops like rose, *gerbera*, carnation, etc. Flower diameter, height and fresh weight increases with a higher shelf life of rose, carnation and *gerbera* plants due to fumes *Agnihotra*. The productivity of

cabbage and potato increases due to the performance of *Agnihotra* and use of homa farming practices. Horticultural crops become disease free due to the reduction of insect attack and microbial control by the performance of *Agnihotra* in a field. *Agnihotra* ash increases soil nutritive value which might be responsible for the increase in nutritive value, yield, and productivity along with the quality of crops²⁸. *Agnihotra* ash mixed with yellow soil enhances the yield of *Zea mays* (Maize) by regulating the growth of crops²⁹. Homa atmosphere shows a drastic increase in productivity of guava fruits with high quality as compare to other organic and normal farming systems³⁰.

Agnihotra ash treatment shows better productivity and quality of lemon grass as compared to other organic inputs (viz. vermicompost, neem powder and farm-yard manure). Comparative Homa and Biodynamic farming, i.e., addition of *Agnihotra* ash during sowing with respect to moon positions resulted in higher yield and oil content in the lemon grass as compared to control (sowing without moon positions). Both *Agnihotra* ash and moon positions may contribute to plant growth by higher germination rate, higher water absorption, and increase in plant metabolism²⁴.

Agnihotra may contribute towards plant growth by adding healthier chemical, physical and biological condition to the soil and in the ambient environment. Dormancy of plants is broken in *Agnihotra* atmosphere and there is an appearance of new leaves. Fumes and ash of *Agnihotra* may alter metabolic activities of plant cells; they provide necessary signal molecules as well as trace metals required for expression of different enzymes which may alter metabolism, hence break dormancy and affect plant growth. Materials used in *Agnihotra* are responsible for the production of medicinal fumes, which are responsible for the healthy growth of a plant. Comparative study between *Agnihotra* performed by using polished and unpolished (brown) rice revealed that there is no breaking of dormancy, rapid cell division, new leaves arise and cause yellowing of leaves is also faster in plants due to fumes of polished rice, while there is breaking of dormancy, no insect attack, increase in plant metabolism and hence increase in growth, generation of new green healthy leaves and increase in distance between internodal regions. *Agnihotra* fumes, as well as ash, maintained shoot-root balance in plants according to surrounding environment and seasonal variations³¹.

Agnihotra ash contains ions of potassium, calcium, aluminium, iron and magnesium in readily soluble forms, which acts as macronutrients or micronutrients and is essential for plant growth⁹. Although more amount of phosphorus is available in the soil, most of it is not in soluble form; hence, it will not be utilized by plants. Application of *Agnihotra* ash increases soluble phosphate content in the soil. There is a great impact of *Agnihotra* mantra and sunrise/sunset timings on *Agnihotra* ash. Use of *Agnihotra* ash prepared by chanting of *mantras* at proper timings show an increase in phosphate content as compared to control (i.e. Ash prepared without mantra and not at proper timings), hence, it directly affects the plant growth³². *Agnihotra* enhances soil nutritive value or fertility by controlling a microbial load. Nitrogen fixing and phosphate solubilizing bacteria get increased due to the addition of *Agnihotra* ash into the soil. At the same time ash also kills the fungal pathogens. This will directly affect on yield and productivity of crops growing in the field.

Applications of *Agnihotra* in the reduction of microbial pathogenicity

The performance of *Agnihotra* shows the reduction in Microbial load in surrounding environment. Reduction of microbes is by direct killing or by inhibiting their growth, this may be due to the production of antimicrobial compounds from burning material or diffusion of microbes with fumes in upper strata in such a way that residual population is maintained within the tolerable limit in nature. *In vitro* experiments on bioenergetics system of *S. aureus* shows of *Agnihotra* will not kill pathogenic bacteria but it reduces its pathogenicity by inhibiting production of coagulase. *In vivo* experiments conducted on albino mouse revealed that although pathogen treated with *Agnihotra* is introduced in the mouse it will not produce any lesion or abscess; hence, diseases will not be produced. The pathogenic strain of *S. pyogenes* become nonpathogenic when kept in the atmosphere of *Agnihotra*^{15, 33}. Ash of *Agnihotra* shows antimicrobial properties by controlling the growth of many pathogenic bacteria. Pathogenicity of bacteria is reduced due to the application of *Agnihotra* ash; it reduces or stops the production of disease causing factors (e.g. capsule, pigments, hemolytic ability, etc.) in bacteria and not by killing them. Antimicrobial properties of *Agnihotra* ash also showed in water by killing or inhibiting water pathogens³⁴.

Ash of *Agnihotra* acts as a good organic antifungal compound. Major fungal pathogens of bell pepper (*Capsicum annuum*) are killed or suppressed by spreading *Agnihotra* ash on crops in the fields. Cow urine accelerates antifungal properties of *Agnihotra* ash. *In vitro* experiments on bell pepper suggest that this mixture of cow urine and *Agnihotra* ash inhibits the growth of fungal hyphae and soil borne pathogens. While *in vivo* experiments conducted in the field of bell pepper by spraying *Agnihotra* ash in cow urine resulted in inhibition of mycelial growth of major fungal pathogens. Comparative study of *Agnihotra* ash with *panchagavya*, fermented cow urine, fermented buttermilk and vermin-wash, showed that mixture of cow urine and *Agnihotra* ash acts as good antifungal agent. This may be achieved due to the production of antimicrobial compounds by microbes present in raw materials used during *Agnihotra*. Apart from this *Agnihotra* ash increases immune response of plants against fungal pathogens by providing necessary elements required in preparation of enzymes. Organic inputs (e.g. *Agnihotra* ash and related products) have a potential to act as an alternative for artificial or chemically synthesized antifungal agents³⁴. Benefits of use of ash in fields are (a) they are nontoxic to human, plants as well as to pet animals, (b) can safely and easily handled, (c) although amount required is high, they can be made easily available, (d) eco-friendly, (e) dispose in environment is nontoxic and easily degradable, (f) cost effective.

Fumigation by using chemicals like formaldehyde has hazardous effects on the body, but by using *Agnihotra* fumes for fumigation it not only control microbial load but also heals the atmosphere and purifies the air. Aeromicroflora containing bacteria and fungi can be controlled by using *Agnihotra* fumes. The reduction in microbial load might be due to volatile organic compounds released during the burning of *Yajnyas* material. Apart from these medicinal volatiles, there might be antimicrobial nanoparticles which are released during burning of *Agnihotra* materials which acts as fumigants³⁵. Medicinal smoke produced by the burning natural substances has been used from immemorial time to purify the environment. The addition of complex mixture of odoriferous and medicinal herbs during *Agnihotra* significantly reduces microbial load in the surrounding environment. This complex mixture contains dried twigs, seeds, fruits of many medicinal plants also sugars, honey, milk and its derived products, which together contributes to *Yajnya* for control of microbial load in the surrounding air. Medicinal smoke control aerial bacterial

population by killing or inhibiting the growth of mainly pathogenic human as well as plant bacteria within less time. Also, it is a simple inexpensive way of extraction of certain volatile organic compounds to control microbial load in the surrounding air. This method of diagnosis of bacterial infections is highly effective and shows rapid pharmacological reactions. Dynamic biological reactions in the atmosphere are highly correlated with dynamic chemical reactions within provided space in the atmosphere. Use of medicinal smoke (i.e., use of different plant derived materials during *Agnihotra*) can balance individual dynamic biological as well as chemical reactions and also their interactive reaction within the atmosphere. Fumes show antimicrobial activities and remove microbes and insects nearby *Yajnya*; this may be due to vaporize secondary metabolites of *samidha* used during *Yajnya* which contain mainly volatile organic compounds. *Agnihotra* cleans the pollutants and helps in the better growth and productivity of plants^{36, 37}.

Applications of *Agnihotra* in water purification

Agnihotra ash when treated with raw water, there is a noticeable decrease in conductivity, total solid content, hardness, biological and chemical oxygen demand as well as microbial count of water. *Agnihotra* ash may be used in water purification process as it alters chemical as well as biological properties of raw or non-potable water and converts it into potable water. Other parameters such as pH, color, odor of raw water changes due to treatment with ash and becomes acceptable as potable water⁹.

Use of *Agnihotra* for water purification is one of the major advantages of performing *Yajnya*. Purification of water is achieved only by performing *Agnihotra* in an enclosed room, and not by any physical contact between water and ash or fumes of *Agnihotra*. Experiments conducted by keeping water samples in Faraday cages (steel, aluminium and copper) in *Agnihotra* atmosphere shows less improvement in water purification as compared to that of samples not kept in Faraday cages. This is due to the amount of dissolved oxygen which may differ due to absorption of infrared rays from *Agnihotra* and increase of temperature within Faraday cages. These Faraday cages shielded electromagnetic waves of wide ranges, which suggest that there is the unknown field of energy created during *Agnihotra* which ultimately purifies water³⁸.

Applications of *Agnihotra*—control air pollution

Fumes of *Agnihotra* are of medicinal use, they control pollution of an ambient air. An *Agnihotra* fume shows antimicrobial properties by killing or decreasing the growth of microbes which resulted in the reduction of microbial load in the surrounding environment⁹. Fumes of *Agnihotra Yajnyas* control basic levels of SO_x and NO_x in the surrounding environment, which are required for the healthy and happy environment for human, plants and other animals. SO_x in an ambient air can be reduced during *Yajnya* and its effects are long lasting. NO_x in an ambient air increase below threshold levels, this may be due use of cow dung during *Yajnya* which acts as a nitrogen source³⁹⁻⁴².

Use of specific shape of a copper pot, chanting of mantras, offerings used and activity timings all have a great impact on *Agnihotra*. Materials used during *Agnihotra* for burning are oxidized to CO, CO₂ and other volatile organic compounds. By the process of photoelectric effects, there might be the generation of electrons due to infrared or solar rays, which may fall on pot used, at sunrise/sunset timings. Due to these

electrons, CO and CO₂ may deoxidize and there is a formation of ozone, which may get mixed with ozone layer in the atmosphere. Electrons generated by solar rays and protons generated by the moisture content of organic matter during burning process, may be deoxidized oxides of sulphur and nitrogen, into its nontoxic molecular compounds. Another possibility of these generated protons and electrons may involve in the process of atmospheric nitrogen fixation in soluble forms like NH₃ into the soil. Volatile organic compounds generated during *Yajnya* may further subject to the photochemical reactions like decomposition, oxidation or reduction due to UV and solar rays. Hence, generated protons or electrons during *Agnihotra* heals and purify surrounding environment by preventing air pollution⁴³.

Agnihotra is a bio-energy science mentioned in the Vedic literature which can be described as a process of fumigation. Ingredients used during *Agnihotra* burned during combustion and evolves many gaseous compounds in an ambient environment. Cow dung contains menthol, indols, ammonia, phenols, formalin, etc. Brown rice contains ethylene and propylene oxides, formaldehyde, acetylene, pro pyolactone, etc. All these compounds get volatilized during burning and help to control air pollution⁴⁴.

Use of cow ghee and *Pipal* wood along with different 324 combinations of *ahuties* (offerings of plant and plant derived materials) during *Yajnya* reduces major air pollutants after burning or fumigation process. *Agnihotra* (performed along with the use of dried plant materials) fumes reduces the concentration of oxides of sulphur and nitrogen in the artificially polluted area. Suspended particulate matter (SPM and RSPM) can significantly reduce due to *Yajnya* performance in an ambient air. Although concentration of air pollutants not completely reduced its concentrations are within threshold values and they are not to the extent of unhygienic conditions. Also odor or smell of *Yajnyas* fumes are acceptable, hence it can be used to purify ambient air⁴⁵. Materials used in *Agnihotra* are responsible for control of air pollutant in an ambient air. Plant materials burned during *Agnihotra* produces medicinal fumes which varies chemical composition of surrounding environment. SO_x, NO_x, SPM and RSPM all reduces and their levels are maintained during *Yajnya* timings. Combustion gases are responsible for raining during *Yajnya* and have positive response on atmospheric conditions. CO₂ levels increases during *Yajnya* process and then they reduced but O₂ levels significantly increases due to *Yajnya*. CO, CO₂ and O₂ concentrations maintained up to the threshold levels. The total aerosol number and ozone concentrations have no any significant effect during *Yajnya*⁴⁶.

Conclusion

Although *Agnihotra* is an ancient ritual nowadays it has being used as a therapy in many countries; to treat various plant or animal diseases, to control pollution procreated due to human interferences, to improve agricultural efficiency in perspectives of increase in productivity of crops, etc. *Agnihotra* technology has many applications in the different divisions' viz. medicine, agriculture, pollution control, technology and industry. As *Agnihotra* technology is a nature-friendly, it maintains harmony in between living beings and nature. To overcome present day problem one needs to expurgate proper use of *Agnihotra*, its fumes, and ash. One needs to understand *Agnihotra* technology by considering its positive as well as negative, if any, prospective and required to implement as a solution for day to day problems. Further research on *Agnihotra* should be encouraged as mentioned by Berk (2016)⁴⁷.

Acknowledgement

Authors are grateful to Dr Pramod Moghe (Retired scientist NCL, Pune), Mr Satish Kulkarni, Prof Prashant Holay and Dr Ulrich Berk for their encouragement and valuable guidance for the literature review of this extensive task.

References

- 1 Muller FM, *The grihya-sutras part I: The sacred books of the east part twenty-nine*, (Kessinger Publishing, USA), 2004, 15-172.
- 2 Kumar S, Navneet, Tiwari MM & Kumar V, Assessment of mineral elements composition of medicinal plants used in yagya (Agnihotra), *Advan Biol Res*, 9 (3) (2015) 189-195.
- 3 Potdar M, *Agnihotra for equilibrium of nature and enhancement of human life*, 2nd edn, (Institute for Studies in Vedic Sciences, Akkalkot), 1993.
- 4 Paranjpe VV, *Homa therapy: Our last chance*, (Fivefold Path, Parama Dham, India), 1989.
- 5 Abhang P, Moghe P & Holay P. Edited by Kulkarni Satish, *Rediscovering Indian Knowledge System*, 1st edn, (Pradnya Vikas Shikshan Sanstha, Pune), 2015.
- 6 Chandra Harish, *Agnihotra - Brief remarks from combustion sciences*, *Vedic Soc Tech Rep*, New Jersey (2004) 1.
- 7 Sharma H, Scientific principles in Vedas, the massive scientific principles, *Ved-Pradip* (2010) 1.
- 8 Richa K, *Evaluation of environment healing-homa farming "Agnihotra" activity in organic farm* (MSc Thesis, CSK HP Agricultural University, Palampur), 2009.
- 9 Abhang P, Patil M & Moghe P, Beneficial effects of Agnihotra on Environment and Agriculture, *Int J Agr Sci Res*, 5 (2) (2015) 111-20.
- 10 Gosain A & Luisa A DiPietro, Aging and wound healing, *World J Surgery*, 28 (3) (2004) 32-36.
- 11 Kale M, *Application of Agnihotra ash as innovative therapy in skin wound healing in gold fish* (MSc Thesis, Holkar Science College, Indore, Madhya Pradesh), 2012.
- 12 Pathade G & Abhang P, Scientific study of Vedic knowledge Agnihotra, *Bhartiya Bouddhik Samada, Quarterly Sci Res J Vijnana Bharati*, 43-44 (2014) 18-27.
- 13 Rao M, Duvvuri S, Naik HR, Kiran M & Srivatsav G, Environmental Impacts of Homam - a Case Study (at Sridevi Veda Vidyalayamu, Srisailam), *International Proceedings of Chemical, Biol Env Eng*, 30 (2012) 83-86.
- 14 Golechha GR, Deshpande M, Sethi IC & Singh RA, Agnihotra-A useful adjunct in recovery of a resistant demotivated smack addict, *Indian J Psychiatry*, 29 (3) (1987) 247-252.
- 15 Golechha GR, Sethi IG & Deshpande UR, Agnihotra in the treatment of alcoholism, *Indian J Psychiatry*, 33 (1) (1991) 20-26.
- 16 Basarkar PW, Agnihotra A Vedic wonder tool – I, *Bharatiya Bouddhik Sampada*, 19 (2004) 3-9.
- 17 Kumari R, Punam, Panda AK & Atul, Agnihotra effect on microbial contamination of air, *The Bioscan*, 10 (2) (2015) 667-669.

- 18 Raghuvanshi M, Pandya P & Joshi RR, Examen in vitro d'une thérapie inhalatrice ethnobotanique (yagya-thérapie) contre la tuberculose pulmonaire, *Phytothérapie*, 7 (5) (2009) 243-249.
- 19 Nene YL, Fumigation of plant in Vrikshayurveda, *Asian Agri-History*, 18 (1) (2014) 23-41.
- 20 Kar S, Agnihotra: The vedic practice for the purification of environment and modification of human behavior, *Int J Rel Spirituality Soc*, 2 (3) (2013) 69-74.
- 21 Bissa S, *Agnihotra: a boon to humanity*, *Int Educ Res J*, 1 (5) (2015) 93-94.
- 22 Anonymous, *Purification of atmosphere, including neutralization of harmful radiation, using Vedic science*, (A project by Biodynamic Association), 2009, 1.
- 23 Devi HJ, Swamy NVC & Nagendra HR, Effect of Agnihotra on the germination of rice seeds *Indian J Tradit Knowle*, 3 (3) (2004) 231-239.
- 24 Punam P, Kumar R, Sharma S & Atul D, The effect of organic management treatments on the productivity and quality of lemon grass (*Cymbopogon citratus*), *J Org Sys*, 7 (2) (2012) 36-48.
- 25 Sofia PK, Prasad R & Vijay VK, Organic farming ¾ Tradition reinvented, *Indian J Tradit Knowle*, 5 (1) (2006) 139-42.
- 26 Indira V, Dhasarathan P & Anandadevi M, Impact of agnihotra in mushroom cultivation technology, *Biosci Res*, 1(4) (2010) 245-250.
- 27 Kumari N, Basarkar PW, Babalad HB & Sreenivasa MN, Yield, yield attributes and economics of soybean as influenced by homa organic farming practices, *Karnataka J Agric Sci*, 25 (2) (2012) 270-272.
- 28 Berk U & Johnson B, *Bringing homa organic farming into the mainstream of Indian agricultural system*, (Fivefold Path Publications, Maharashtra), 2009.
- 29 Sharma S, Sengupta T, Sunar K, Berk U, Dave V, *et al*, Agnihotra ash amended with yellow soil as The growth regulator for Zea Mays, *J Am Sci*, 8 (1s) (2012) 43-45.
- 30 Ram RA & Pathak RK, Integration of organic farming practices for sustainable production of guava: a case study, *Int Guava Sym*, (2005) 357-363.
- 31 Limaye V, Agnihotra: A holistic energy system affecting plant growth, *Asian J Multidis Stu*, 1 (1) (2013) 6-15.
- 32 Kratz S & Schnug E, Homa farming - a vedic fire for agriculture: Influence of agnihotra ash on water solubility of soil P, *Landbauforschung Volkenrode*, 57 (3) (2007) 207-211.
- 33 Purandare VR & Prasad NB, Effect of Agnihotra (sacred fire) on microbial growth, *Int J Ayur Herbal Med*, 2 (5) (2012) 799-802.
- 34 Berde C, Kulkarni A, Potphode A, Gaikwad A & Gaikwad S, Application of agnihotra ash for enhancing soil fertility, *Int J Sci Eng Technol Res*, 4 (7) (2015) 2546-2551.
- 35 Ashlesha & Paul YS, Antifungal bioefficacy of organic inputs against fungal pathogens of bell peeper, *Paripex – Indian J Res*, 3 (6) (2014) 4-9.
- 36 Pachori RR, Kulkarni N, Sadar P & Mahajan N, Effect of agnihotra fumes on aeromicroflora, *The Bioscan*, 8 (1) (2013) 127-129.
- 37 Nautiyal C, Chauhan P & Nene YL, Medicinal smoke reduces airborne bacteria, *J Ethnopharmacol*, 114 (2007) 446-451.

- 38 Berk U & Sharma S, Effect of Agnihotra energy field on water purification, *Indian J Tradit Knowle*, 1 (1) (2015) 63-68.
- 39 Abhang P, Scientific study of somyag yajnya, *Int J Sci Res*, 4 (1) (2015) 2080-2083.
- 40 Anonymous, *Scientific evaluation of Yajnya*, (A project by Swadeshi Vidnyan Sanshodhan Sanstha, Nagpur), *Bharatiya Bouddhik Sampada* 1 (1999) 3-8.
- 41 Abhang P & Pathade G, Study the effects of Yajnya fumes on SO_x and NO_x levels in the surrounding environment, *Tattvadipah, Res J Acad Sanskrit Res*, Proceedings of ASTRA-2015 (2015) 57-62.
- 42 Abhang P & Pathade G, Purification of ambient air by performing Somyag Yajnya, *Int J Env Sci*, 6 (5) (2016) 707-717.
- 43 Singh R, Yagya - vedic way to prevent air pollution, *Dev Sanskriti: Interdiscipl Int J*, 01 (2012) 28-34.
- 44 Patil CS, Role of 'Agnihotra' in prevention of air pollution, *Asian J Chem*, 15 (1) (2003) 567-569.
- 45 Sharma PK, Ayub S, Tripathi CN, AjnaviS & Dubey SK, Agnihotra - A non conventional solution to air pollution, *Int J Innov Res Sci Eng*, 2 (4) (2014) 177-189.
- 46 Anonymous, *Vedic methodology on environment protection*, (Vedic and Scientific Research Foundation, India), 2009, 1.
- 47 Berk U, *Suggested experiments with agnihotra and homa therapy: what has been done and what can be done*, (German Association of Homa Therapy, Germany), 2016.