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BENEFICIAL EFFECTS OF AGNIHOTRA ON ENVIRONMENT AND AGRICULTURE

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ABSTRACT

Agnihotra is a type of sacrifice, which consists of making four offerings per day, two at sunrise and two at sunset of brown rice mixed with cow ghee to the fire, accompanied by chanting of mantras. Though Agnihotra is a Vedic ritual, it has scientific background and therefore we studied the effects of Agnihotra and its ash on the environment and plant growth. Experiments were performed to study the effects of Agnihotra fumes on microbial load, SOx and NOx levels in ambient air and plant growth. Experiments were also conducted to check the effects of Agnihotra ash on seed germination, plant growth, plant genotoxicity and water purification. From the study it was observed that Agnihotra resulted in reduction in microbial load and SOx levels but slight increase in NOx levels in surrounding air. There was significant increase in seed germination and plant growth as well as genotoxicity was neutralized due to Agnihotra ash. Our results suggest that Agnihotra ash can be used to purify waste water. It can be seen that Agnihotra is beneficial for environment and agriculture.

KEYWORDS: Agnihotra, Vedic Ritual, Sox Level, Nox Level, Plant Growth, Genotoxicity, Water Purification

INTRODUCTION

Agnihotra Yadnya is performed daily, at sunrise and sunset. Pieces of dried cow dung cakes are piled up in an inverted copper pyramid with specific dimensions and lighted; oblation of brown rice mixed with cow ghee is given while chanting specific mantra. Different mantras are chanted for sunrise and sunset. Although it is a simple vedic ritual, it emerges many questions about specific materials used in Yadnya and its uses. These questions can be resolved by studying overall process of Agnihotra, fumes generated during process which spread in ambient air and ash generated after Yadnya. Effects of Agnihotra on microbial content of air (Purandare V. R. and Prasad N. B, 2012; Mondkar A. G., 1982), germination of rice seeds (Heisnam J. Devi et al, 2004), growth of mushroom (V. Indira et al, 2010), scabies in rabbits (Mondkar A. G., 1982), skin wounds (Rao D V K, 1987) and radioactivity in air (Matela Leszek, 1988) have been reported.

Work done on Somyag Yadnya fumes (Abhang Pranay, 2015) showed reduction in sulfur oxides (SOx) and microbial load in the air. Somyag Yadnya differs from Agnihotra in terms of oblations used in it. *Somawali*, stalks of Ephedra (Wojciech Puchalski, 2009), twigs of Banyan, Pimpal, Mango and many more plants are used in Somyag Yadnya. Somyag Yadnya as well as Agnihotra is performed to regulate seasonal cycle and maintain equilibrium, but both Yadnyas differs in terms of time period, number of people chanting the mantra at a time and the cost of materials required for the Yadnya.

Air contains pollutants like oxides of nitrogen and sulfur, hydrocarbons and pathogenic microorganisms (Richa Rai et al., 2011). There is impact of these air pollutants on plant growth (Richa Rai et al., 2011 and S. Tiwari et. al., 2006). Sustainable agriculture and ambient environment are correlated with each other (L. Horrigan et al. 2001). In agriculture, there are problems like delay in seed germination, slow growth of plants and adverse effects due to toxicity of insecticides and fertilizers used. Study was done to check if Agnihotra can be implemented to overcome all these problems. The purpose of the study was to find out the effect of Agnihotra fumes and Agnihotra ash on the different aspects of environment and agriculture. The experiments were carried out in New English School, Ramanbaug, Pune and Biotechnology Department, Fergusson College, Pune.

MATERIALS AND METHODS

Agnihotra was performed as mentioned by V. Indira et al (2010), using known amount of materials. About 100 gm of dried cow dung was arranged in an inverted pyramidal copper pot of dimensions 14.5 x 14.5 cm at the top 5.25 x 5.25 cm at the bottom and 6.5 cm in height. Fire was lit using 18 ml purified cow ghee and offerings of 2 gm brown rice mixed with 2 ml of purified cow ghee was given by chanting following mantras,

At Sunrise -

Sooryaya swáahá, Sooryáya idam na mama|

Prajápataye swáahá, Prajápataye idam na mama||

At Sunset -

Agnaye swaáhá, Agnaye idam na mama|

Prajápataye swaáhá, Prajápataye idam na mama||

To study effect of Agnihotra fumes, experiment was performed during sunrise in a closed room and the ash was collected for experimentation to find out its effect.

Study the Effects of Agnihotra Fumes

Estimation of Microbial Load in Ambient Air

To study the effect of Agnihotra fumes on microbial load in the surrounding air, passive monitoring of air samples was done by settle plate method which was used by Pathade G. and Abhang Pranay (2014) (Acquarella C., 2000). In this method, sterile nutrient agar plates were kept open 5 min. before and 5 min. after the Agnihotra, at the distance of 10 feet from the Yadnya. Plates were incubated at 37°C and colony count was taken after 30 hours.

Estimation of SOx and NOx

SOx and NOx in the ambient air was collected by using air handy sampler (Spectralab, HDS -8). Methods used by Abhang P. (2015) were employed to estimate oxides of sulfur and nitrogen. SOx was estimated by improved P. West - Gaeke method (1956) and NOx was estimated by modified Jacobs - Hochheiser method (J. Blacker and R. Brief, 1972). Samples of SOx and NOx were collected 30 min. before, during and 30 min after Agnihotra, at 10 feet away from Yadnya. Control samples were collected from the area where Yadnya was not performed.

Effect of Agnihotra Fumes on Plant Growth

Two pots of 20 germinated seeds of moong (*Vigna radiata*) were maintained for 5 days by providing same amount of water, light and other environmental conditions. 10 seedlings with same shoot and root length were selected and planted in two separate pots. One was kept in room where Agnihotra was performed and another was kept in normal room where Agnihotra was not performed. Plant growth was measured in terms of shoot and root length within 5 days by providing same amount of water, light and other environmental conditions.

Study the Effects of Agnihotra Ash

Analysis of materials used in Agnihotra

Analysis of Cow dung cakes, Brown rice, cow ghee, cow dung ash, brown rice ash and Agnihotra ash was done using atomic mass spectroscopy in Kulkarni Laboratory and Quality Management Services, Pune (Accredited by ISO & NABL).

Effect of Agnihotra Ash on Seed Germination and Plant Growth

To study the effects of Agnihotra ash on seed germination and plant growth, soaked seeds of chickpea (*Cicer arietinum*) were used. The seeds were allowed to germinate separately in A. distilled water; B. Agnihotra ash; C. cow dung ash and D. rice ash The number of germinated seeds was counted after 36 hours. To check the effect on plant growth, length of shoots and roots were measured (in cm) after 5 days.

Genotoxicity Neutralization Assay

To check neutralization effect of Agnihotra ash, onion root tip assay for genotoxicity was performed (Matsumoto et al. 2006). Seeds of onion were treated with A. Distilled water; B. Agnihotra ash; C. Cow dung ash and D. Rise ash. To check the effects of genotoxicity neutralization, 0.5 mg/ml colchicine was used and seeds were treated with E. Only Colchicine; F. Colchicine + Agnihotra ash; G. Colchicine + Cow dung ash and H. Colchicine + Rise ash. Mitotic index of all samples were calculated and compared.

Water Purification

To study the effect of ash on raw water, a column of about 100 gm of tightly packed Agnihotra ash with 20 cm of height and 2.7 cm of diameter was prepared. Before experimentation, the column was washed with distilled water and then 500 ml of raw water collected from Mula – Mutha River, Pune, MH, India (a source at which municipal waste water is mixed with river) was passed and collected for analysis. Following parameters were considered to check potability of water pH, Color, Odor, Conductivity, Total solids, Total dissolved solids, Total suspended solids, Total hardness, Biochemical oxygen demand, Chemical oxygen demand, Most probable number and Standard plate count (Table 2).

Water sampling, storage, analysis and estimation of parameters were done according to the guidelines given by Central Pollution Control Board (CPCB), Delhi (2007-2008).

RESULTS AND DISCUSSIONS

Effect of Agnihotra Fumes on Microbial Load in Surrounding Air

The average microbial colony count after Agnihotra was 52 CFU/m^3/min which were 70% less than the colony count before Agnihotra 171 CFU/m^3/min (Graph 1).

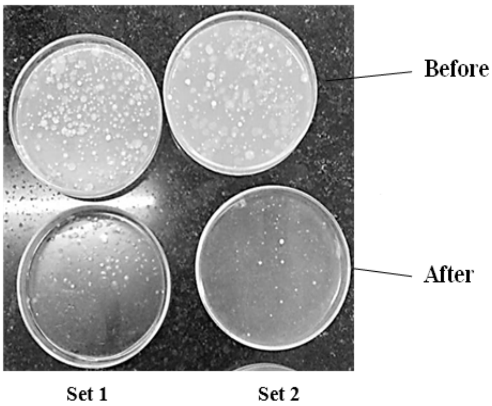
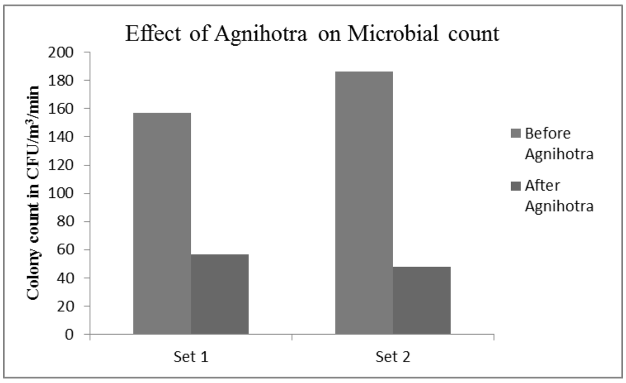


Figure 1: Nutrient Agar Plates Opened Before and After Agnihotra



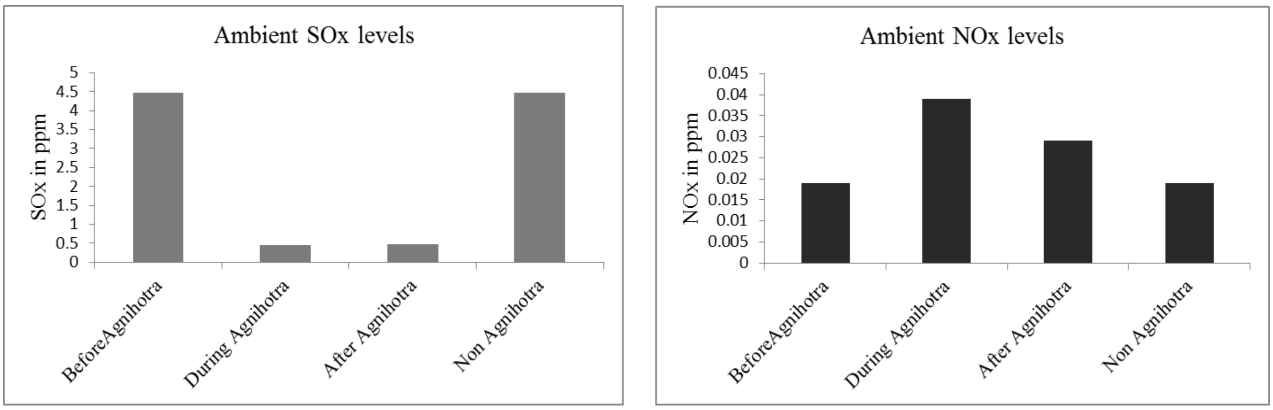
Graph 1: Effect of Agnihotra Fumes on Microbial Count in Surrounding Air

From the result (Figure 1) it was seen that microbial count after Agnihotra was significantly reduced that the microbial count before Agnihotra. This suggests that Agnihotra fumes may have anti-microbial properties.

Effect on SOx Level and NOx Levels

SOx level reduces by 89.37% during Agnihotra as compared to initial levels (from 4.4729 ppm to 0.4758 ppm), and remains lower than initial levels after Agnihotra (Graph 2, SOx levels).

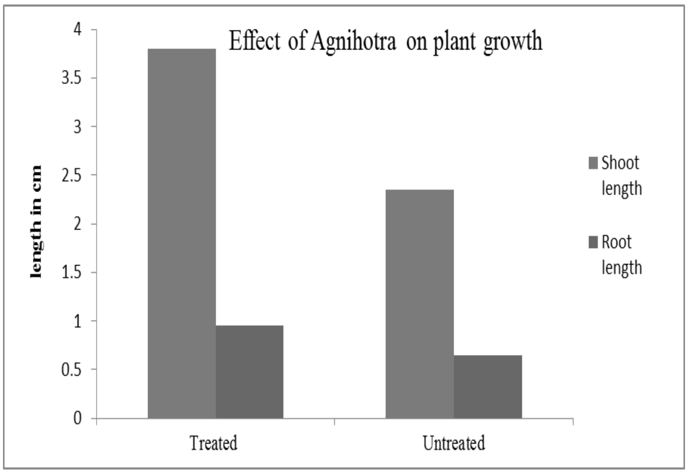
NOx level increases up to 50% (from 0.019 ppm to 0.039 ppm) that of initial levels during Agnihotra. After Agnihotra, NOx level decreases up to 25% i.e. from 0.039 ppm to 0.029 ppm (Graph 2, NOx levels).



Graph 2: Effect of Agnihotra on SOx and NOx Level in Ambient Air

Effect Agnihotra on Plant Growth

The average shoot and root length of the seedlings treated with Agnihotra fumes was 3.8 cm and 0.95 cm respectively whereas the shoot and root length without Agnihotra treatment was 2.35 cm and 0.65cm respectively. The result shows 38% and 31% more growth in shoot length and root length in the seedling treated with Agnihotra fumes (Graph 3).



Graph 3: Effect of Agnihotra on Plant Growth, Graph Shows Shoot and Root Length of Seedlings Treated with Agnihotra and Control as Untreated I. E. without Agnihotra

Analysis of Materials Used in Agnihotra

Analysis of Agnihotra material and ash is recorded in following Table 1.

Table 1: Analysis of Brown Rice, Brown Rice Ash, Cow Dung, Cow Dung Ash, Cow Ghee and Agnihotra Ash

Sr. No.	Test Parameter in Percent	Sample					
		Brown Rice	Brown Rice Ash	Cow Dung	Cow Dung Ash	Cow Ghee	Agnihotra Ash
1	Volatile matter	0.1	0.02	0.2	0.05	-	0.04
2	Ash content	0.34	86.3	14.7	1.4	0.003	84.7
3	Iron (as Fe)	0.02	0.12	0.05	0.09	-	0.13
4	Aluminum (as Al)	-	1.5	-	-	-	1.2
5	Copper (as Cu)	-	-	-	-	-	-
6	Zinc (as Zn)	-	-	0.01	-	-	-
7	Calcium (as Ca)	0.1	1.4	1.1	0.35	0.0025	0.6
8	Magnesium (as Mg)	0.05	0.12	1.2	0.22	-	0.2
9	Potassium (as K)	0.053	2.5	0.19	0.28	5.1×10^{-4}	2.7
10	Manganese (as Mn)	8.9×10^{-4}	0.03	33×10^{-4}	0.0045	-	0.023
11	Silica	0.07	-	-	-	-	-

Iron, Potassium and Manganese content was increased after burning of brown rice and cow dung, which contributes as iron (Fe), Potassium (K) and Manganese (Mn) in Agnihotra ash. Presence of aluminum in Agnihotra ash is due to burning of brown rice.

Calcium and Magnesium content increases in brown rice and decreases in cow dung after burning. Cow ghee contributes as calcium and potassium source to Agnihotra ash.

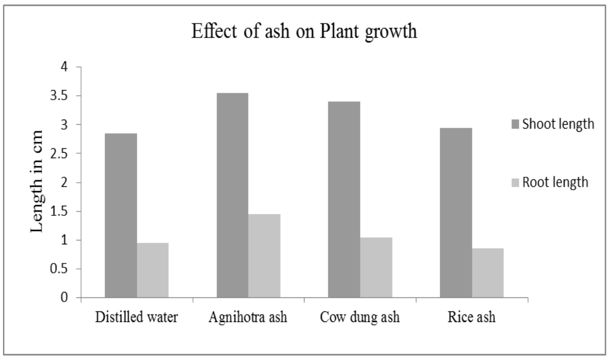
Our result shows that copper, zinc, and silica are absent in Agnihotra ash though there is presence of zinc and silica in cow dung and brown rice respectively.

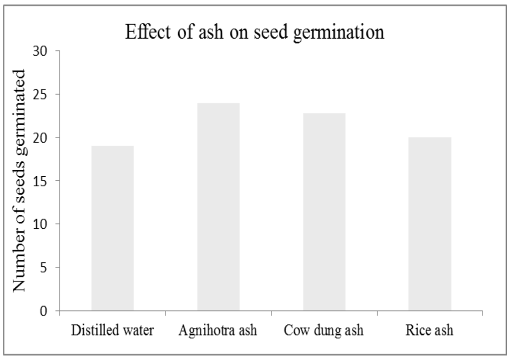
Iron and potassium content of Agnihotra ash was higher as compared to ash from brown rice and cow dung. On the other hand, Calcium, magnesium, manganese content of Agnihotra ash was lower that of brown rice ash and cow dung ash.

Effect of Agnihotra Ash on Plant Growth and Seed Germination

Seedlings treated with Agnihotra ash showed more growth as compared to others i.e. treated with cow dung ash, rice ash and control (water). There is 24% increase in plant growth when treated with Agnihotra ash as compare to control (distilled water). (Graph 4, plant growth).

The number of germinated chickpea seeds treated with Agnihotra ash was more than that of seeds treated with rice ash and cow dung ash. Seed germination increased by 24 %, 5% and 20% due to Agnihotra ash as compare to control (distilled water), cow dung ash and rice ash respectively (Graph 4. seed germination).



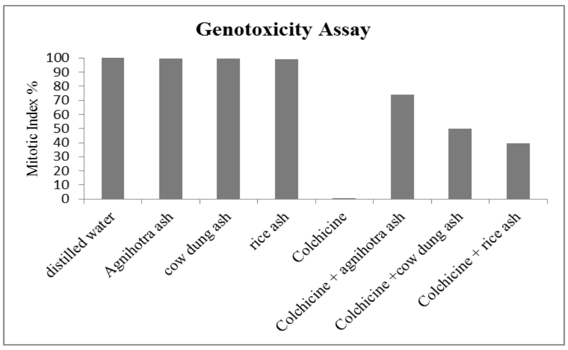


Graph 4: Effect of Agnihotra Ash on Seed Germination and Plant Growth, Graph Shows Comparison between Agnihotra Ash with Distilled Water, Cow Dung Ash and Rice Ash

Analysis of Agnihotra ash has shown presence of potassium, calcium and magnesium, Iron. These nutrients are essential for plant growth. Therefore the study suggests that Agnihotra ash must have supplied these essential nutrients and resulted in increased growth of the seedlings.

Neutralization of Genotoxicity

Agnihotra ash neutralizes genotoxicity due to harmful chemicals. Results (Graph 5) show that, 74%, 50% and 40% mitotic index due to Agnihotra ash, Cow dung ash and Rise ash respectively.



Graph 5: Genotoxicity Assay to Study Neutralization Effect

Water Purification

Polluted water when passed through a column of Agnihotra ash, there is significant reduction in conductivity (reduces 48.28%), total solid content (reduces about 90%), hardness (reduces 83.75%), Biological oxygen demand (reduces up to 48.4%) and chemical oxygen demand (reduces up to 7.15%) which is mentioned in Table 2.

Agnihotra ash shows antimicrobial properties, as microbial (especially pathogenic bacteria) count reduces up to 95% (Sr. No. 11 and 12 in Table 2). pH of treated water become neutral, color and odor was acceptable after the treatment of Agnihotra ash.

Raw water (non-potable) becomes potable (results matches with standards given by WHO Guidelines for Drinking-water Quality) after the treatment with Agnihotra ash, hence our study suggests that Agnihotra ash can be used in the process of water purification.

Table 2: Purification of Polluted Water by Using Agnihotra Ash, Table Showing Estimation of Polluted Water Parameters Before and After Treatment of Agnihotra Ash

Sr. No.	Parameters	Sample	Sample Treated with Agnihotra Ash
1.	pH	6.1	7.1
2.	Color	whitish	colorless
3.	Odor	Unacceptable	Acceptable
4.	Conductivity	406 μs/cm	210 μs/cm
5.	Total solids	1432.05 mg/l	165 mg/l
6.	Total dissolved solids	1426.5 mg/l	161 mg/l
7.	Total suspended solids	5.55 mg/l	0 mg/l
8.	Total hardness	160 mg/l	26 mg/l
9.	Biochemical oxygen demand	9.3 mg/l	4.8 mg/l
10.	Chemical oxygen demand	11.2 mg/l	10.4 mg/l
11.	Most probable number	75 CFU/ml	1 CFU/ml
12.	Standard plate count	45 CFU/ml	3 CFU/ml

CONCLUSIONS

From the study, it was seen that the microbial load, SOx levels in the air were reduced by performance of Agnihotra. NOx levels though increased after Agnihotra, but were still below the threshold limit of 0.053 ppm as per the guidelines of National ambient air quality standards (NAAQS) and Maharashtra pollution control board. The plant growth with treatment of Agnihotra fumes and the number of seeds germinated when treated with Agnihotra ash was higher as compared to seedlings not treated with Agnihotra ash and Agnihotra fumes. As per our results, it can be seen that raw water when treated with Agnihotra ash, there is notable decrease in biological oxygen demand and microbial load along with solid content in water and hardness. This suggests that waste water becomes potable and can be reused in fields. From the above results, it can be seen that if Agnihotra is performed and its ash is used in agriculture, it may result in reduction of pollution and increase the growth of the crops.

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