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Controlling the Microflora in Outdoor Environment: Effect of Yagya

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Abstract

Air micro-flora bacteria, fungi, pathogen and Total Micro Flora (TMF) counts (CFU/m^3) are reported to be associated to a number of illnesses. Cleaning products and chemical treatments have their limitations and ill effects. In order to study the ecofriendly bioremediation of microflora in outdoors, we propose to adopt the activity of performance of *Yagya* (a Vedic way) to manage the health and environmental problems. A five days experiment with 108 *Kund Yagya* was conducted in the outdoor environment which was participated by thousands of persons. The variables to influence the air microflora considered were the duration of *yagya*, persons participated and the wind intensity. The correlation and multiple regression analysis helped to establish the relationship between microflora and its correlates. The reduction in the CFU/m^3 after 24 hours of the end of experiment ranged from 53.5% to 87.9%. It was concluded that *yagya* is an effective means to reduce the air microflora in the outdoor environment. In other words, the air microflora stress in the atmosphere can be managed via *yagya*.

Key Words: Air microflora; Yagya; ecofriendly environment management, Vedic

Introduction

Extensive industrialization and urbanization has led to massive mobilization of natural resources, inadvertently resulting in environmental pollution. The presence of fine and coarse fractions of airborne particulate matter and harmful airborne microflora in various indoor and outdoor environments has been associated with a variety of illnesses. The sources are fossil fuel, re-suspension of dust, fragments from living organisms and secondary organic compounds (Womiloju et al, 2003). The microbes are transported from one place to another by air. When their proportion in the atmosphere increases, it starts affecting adversely the health of humans, flora and fauna. The increased airborne microorganisms may be responsible for infectious or allergic disorders such as asthma, humidifier fever (Burge et al. 1985, Burrel et al. 1991; Edwards, 1980) etc. Such disorders can be due to agents such as thermophilic actinomycetes, fungi, protozoa, amoebae, bacteria and several pathogens (Finnigan et al., 1987). Thus it is important to control the population of these microbes and annihilate them to the possible extent, especially the disease causing microbes.

Often for healthy living and to check unwanted microflora people use cleaning products and sprays which have substantial risks particularly with the products containing volatile organic compounds (Nazaroff and Weschler, 2004). The significance of air pollutant exposures resulting from the volatile constituents of cleaning products and air fresheners has limiting role in the spread of diseases (Rusin et al, 1998). However, they do cause irritation and hazards owing to inhalation exposure to cleaning product constituents, exposure to dust and the pollutants, owing to the reaction of unsaturated organic compounds with oxidants (Wolkoff et al, 1998). The indiscriminate use of nitro-aromatics has resulted in inexorable environmental pollution (Kulkarni et al, 2007). Epidemiological studies by Nishino et al (2000) have indicated that several nitro-compounds are powerful carcinogens. Remedial measures taken by governmental agency to control microflora have harmful effects on both human beings as-well-as animals. Any external measure that is taken to kill these micro-flora, kills all microbes indiscriminately which results in ecological imbalance. It is also harmful for human and animal population.

Not all microbes are harmful. Increased public awareness about hazardous risks of pollution controlling materials have led to new researches (Kanekar et al, 2003) that they are inefficient, expensive and non-sustainable (Chauhan et al, 2001). There are certain micro-floras that are friendly to life and are important for maintaining ecological balance. Use of bioremediation techniques are eco-friendly (Alexander 1999). We can look back to our Vedic era where the performance of yagya has been mentioned to control several hazardous situations, which include health and environment (www.angihotraindia.com).

A survey of Vedic literature shows, that yagya has been given immense importance in life management. By performing the ritual of yagya, one can conserve the environment, purify the atmosphere (Chhand Upanishad, 4.16.1), kill and destroy many disease-causing microbes (Shatapatha Brahamana, 9.4.1.11, Yajur Veda, 31.14) generate physical and mental development of mankind and attain a long life through a disease free environment (GoPath Brahamana Upanishada, 1.19). Hence, all the Vedas lay a lot of emphasis on performing yagya on day to day basis by all the individuals. The main reason for this is that yagya is the mechanism (procedure) through which one can maintain the natural equilibrium in the various components of the environment (Rig Veda 10.90.6, Yajur Veda 31.14).

The Vedic literature (Pt. Sharma, 1995) claims to reduce both indoor and outdoor pollution through Vedic means. Few researchers have worked on agnihotra and its ash (Mondkar, 2003; Denver, 2003). More literature pertaining to agnihotra and yagya is available at www.agnihotraindia.com. The results of the indoor experiments on the air microflora have been reported (Saxena. et al 2007, 2007a), where the authors have demonstrated how the yagya was effective in controlling the indoor microbial growth, even after several days of its performance.

Inspired by the philosophy of yagya, we decided to study the effect of yagya activity on the growth of microflora through an outdoor experiment. An attempt has been made in this study to capture some of the physical effects on the air micro-flora that occurred in the outdoor open atmosphere on account of a large scale yagya. To the best of our knowledge this is the first report on the relationship of the consequences of yagya on the external microbial environment.

There are several factors that are known to affect the growth of the air microflora like outside contamination (Spendlove, 1975), seasonal and daily variations (Flanigan et al, 1991), climatic factors such as temperature, humidity, wind etc. (Bovallius et al, 1978). In the outdoor experiment, these factors cannot be controlled. The three most common factors which influence the performance of yagya are number of persons attending the yagya, duration of yagya and the intensity of wind. Hence, the objective of the study was to see the effect of the duration of yagya, number of persons attending yagya and the wind intensity on the air microflora i.e. bacteria, fungi, pathogen and TMF and to develop the microflora prediction models.

Materials and Methods

An experiment was conducted in the month of May 2003 to see the influence of yagya activity on the air microflora. The 108 kund experiment was performed in the fields of Karawal Nagar, New Delhi during 12-16 May, 2003. May month is the season with hot winds in the northern part of India. The winds bring a lot of dust with them and thus increase micro-flora density. The observations were recorded according to the following scheme;

Date of Observation	May 11	12	13	14	15	16	17	18
	↑	↑	↑	↑	↑	↑	↑	↑
D_{-1}	D_0	D_{+1}	D_{+2}	D_{+3}	D_{+4}	D_{+5}	D_{+6}	

The steps followed for performing of yagya were as discussed by Pt. Shri Ram Sharma (www.awgp.org/gamma/LiteratureHindi. 2/2007). Herbs of different kinds along with Havan Samigri and pure desi ghee were used in combination for offering obligations into the fire. To study the air microflora, the sampling was done at a height of 1 meter above the ground in the center of the hall of yagya. Every time a set of four petri-dishes was exposed to air to capture bacteria, fungi, pathogens and total microflora (TMF). The first three dishes were exposed to the atmosphere for one minute each to capture the spores of the bacteria, fungi and total microflora and the fourth one was exposed for 5 minutes to get the samples of pathogenic spectra. The plates were removed from the sampler after the prespecified duration of exposure and placed them in the individual sterile bags in a cooler with ice pack at 4°C. The plates were then sent to CPCB for microscopic examinations. Samples were collected thrice daily (9:00, 13:00 and 17:00 hours). The exposed petri-dishes were then kept in the incubator at an average temperature of 30°C for 5 days to grow the culture. The petri-dishes were coated with specific culture media Nutrient Agar (NA), Potato Dextrose Agar (PDA), Total count Agar (TCA) and Mac Conkey Agar (MCA) respectively. To observe the post yagya effect, the sampling was also done on D+5 and D+6. The background load of microflora at

Karawal Nagar was sampled on D-1, i.e. a day before the yagya begins. An average of three observations, i.e. the Mean Colony Count (MCC) formed the basic data of all four types of microflora which were used for further statistical analysis.

In the statistical analysis, the significance of differences between yagya intervention and background samples was compared by one-way analysis of variance followed by Newman-keul's test. Step-wise regression analysis was used to find the relationship of bacteria, fungi, pathogens and TMF on the size of the people participated in yagya, days since yagya started and the wind intensity. The significance of model was tested by F-Test and the significance of individual variable was tested by t-test.

Results

The daily average bacteria, fungi, pathogens and TMF levels during and after the yagya have been shown in Fig. 1. An increase in the pathogens micro-flora was observed initially. However, the counts decreased on the post yagya days (i.e. D+5 and D+6).

Fig 1.: Profile of microflora during and after experiment.

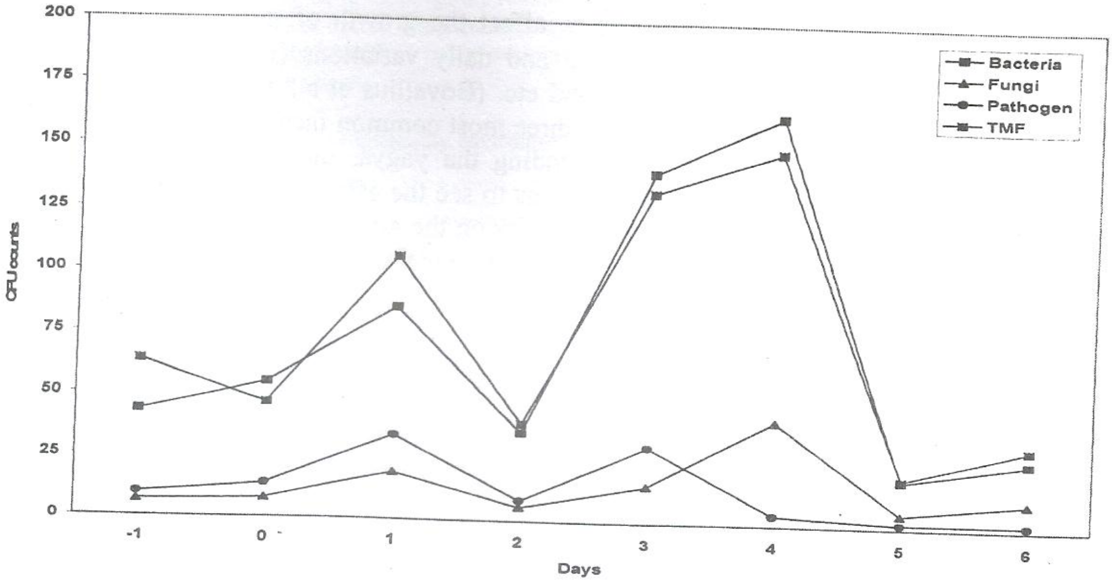

Figure 1: Profile of Micro-flora During and After Exposure

The comparative growth of various micro-flora show that combined effect of wind intensity, yagya and the persons participated was almost similar in all the micro-flora and exhibited the peak and decline almost simultaneously. One day post yagya, i.e. on D+5 the load of bacteria reduced to 37.6% ($p<0.05$) from the background and the level of pathogens and TMF counts also declined by 79.4% ($p<0.01$) and 69.4% (0.01) respectively. However, the fungi colony count decreased by 14.9% on D+5 from background.

The correlation between the duration of the yagya, the number of persons participated in yagya, the wind intensity, and microflora colony counts has been shown in Table 1. The correlation matrix shows the extent of relationship between microflora and its influencing variables. The duration of yagya is negatively correlated with pathogen. It suggests that as days of yagya increase, the micro-flora counts decrease. The influence on microflora counts of the wind intensity and persons attending yagya, can be seen from the positive correlation with all the four types of microflora.

Table 1: Correlation of Micro-flora with Duration of *Yagya*, Number of Persons Attended the *Yagya* and Wind Intensity

	Bacteria	Fungi	Pathogen	TMF
Duration of *yagya* (X_1)	0.025	0.229	-0.413	-0.080
Persons attended *yagya* (X_2)	0.743	0.589	0.256	0.646
Wind Intensity (X_3)	0.485	0.226	0.794	0.547

Table 2: Relationship of Micro-flora Counts with its Influencing Variables

Dependent Variable	*Regression Equation*	R^2	*St. Dev.* (σ)	$F_{3,4;(0.05)}$
Bacteria	$=-3.120 + 1.243X_1 + 0.006X_2 + 11.745X_3$	0.704	38.83	3.18 NS
Fungi	$= -2.178 + 1.381X_1 + 0.001X_2 + 0.846X_3$	0.442	12.212	1.055 NS
Pathogen	$= 8.801 - 2.442X_1 + 0.002X_2 + 5.881X_3$	0.870	6.061	8.91*
TMF	$= 17.937 - 1.328X_1 + 0.004X_2 + 13.133X_3$	0.635	39.207	2.324 NS

* Significant at $p<.05$; ** Significant at $p<.01$; NS Not-Significant.

The relationship showing simultaneous effect of days (X1), number of persons (X2) and wind intensity (X3) on each of bacteria, fungi, pathogen and TMF was studied using the multiple regression analysis. The results of regression relationship have been shown in Table 2. Results of the multiple regression suggest that the growth of pathogens can be significantly ($p<0.05$) predicted using the three predictor variables. The coefficient of multiple regression equation (Table 2) suggests that the outdoor environment can be better managed through Yagya when the wind intensity is low or there is no wind.

Discussion

Microbes are the only entities with an exceptional ability to exploit various inorganic or organic compounds for their growth. They have the power to inhibit various ecological niches and pursue unusual metabolic and physiological activities (Timmis et al 1994). Extensive research is going on in isolation with their toxic behaviour and means to control them. Each such measure has limitations and severe side effects harming human health and the eco system at large. But the Vedic literature suggests that where ever the yagya is performed, it purifies the atmosphere of the location as-well-as its surroundings (Pt. Sharma, 1995).

The problems associated with elevated airborne fungi have become an increasing concern in recent years of their being associated with various adverse health effects (Shelton et al 2002). Air quality is an important determinant of human health and comfort. There are innumerable evidences on the hazardous nature of indoor pollutants on their exposure to human beings. These can be controlled through yagya. Decrease in the levels of pathogens may be the result of cumulative effect of yagya procedure and the quantum of its continuous intervention for 5 days with the air.

In general, the days of May 2003 were windy and there were severe dust-storm on three days during experimentation. The intensity of winds, for the purpose of analysis, has been taken on a scale 1 to 5 with 5 being "most severe", three being moderate and 1 being "no wind". The normal Vedic yagya was performed on all the days with the general havan samagri (herbs). The mango wood was used as samidha (fuel wood) for performing yagya.

The performance of the outdoor experiment depends much upon the seasonal, climatic and local factors. In our experiment, factors like summer season, scorching sun, day temperature ranging 42-44°C, dusty hot winds and the open fields where yagya took place were some factors which were beyond the control of the experiment. In the absence of any scientific literature support and data base we performed it as a 5 day activity and recorded the observations. Air temperature and moisture in micro-environment in summer could be adaptable for the germination, growth and propagation of air micro-flora (Fang et al, 2005). The wide range of MCC could be attributed to micro-environmental and meteorological conditions (Adhikari et al, 2004)

The fall in the MCC after the yagya was over and general downward trend in bacteria, fungi, pathogen and TMF shows the impact of the gaseous changes on colony counts. The dusty winds may be held responsible for the variation in the daily counts. But the high decrease 24 hours after the closing of yagya shows the cleansing effect. Impressive count reduction 54.5% in bacteria and around 79.4% in pathogen counts after 24 hours of the closing day of Yagya, supports what has been said in the Vedas. Even 48 hours after the closing of yagya the relative decrease in microflora counts on D+6 from D+4 ranged from 37.6% to 79.4%. This indicates that the buffer of chemical changes in the atmosphere due to Yagya resists the growth of micro-flora.

The high value of R2 (Table 2) shows the potential of relationship of micro-flora with its predictors. The results show that the growth of bacteria, fungi, pathogen and TMF are related to the size of participants in the yagya, the length of conducting the yagya and the wind intensity. The performance of the yagya experiment for 5 days has clearly shown the significant multivariate relationship of predictors in the growth of pathogens (R2=87%). An increase in the number of samples and the selection of non-dusty season could have improved the performance of gaseous changes in the air following the yagya. The high value of R2 for prediction of bacteria, and TMF hints for its relationship with the predictors. The greater effect of yagya in reducing the microflora can be expected if it is performed on a large scale and for a larger duration possibly when the wind intensity is low.

6. Conclusion

The results of present study help us to conclude that yagya renders the atmosphere bacteriostatic to the extent, that it not only reduces the microbial load from the atmosphere but also makes it non-conducive for its growth. This was reflected in all the four kinds of air microflora samples. It was seen that the effectiveness of yagya, was maintained atleast upto 48 hours after its closing and with almost same potential as after 24 hours. Thus, in view of all above, we see that the Vedic ritual of 'yagya' is one of the effective measures to control microbial population and their growth in the atmosphere. In order to see the efficacious results of yagya, it should be performed strictly as per the procedure laid down in the book 'Saral Aur Sarvopyogi Gayatri Havan Vidhi', by Pt. Sharma. Finally, it can be said that the atmospheric stress can be managed successfully via yagya.

Annexure I

Explanation of the terms used

'Yagya' a Vedic procedure of burning some herbs in fire along with some rituals is known for purification of atmospheric pollution through removal of foul odour, lowering of harmful gas levels and removal of harmful microbes. The detailed procedure has been laid down in the book 'Form and Spirit of Vedic Ritual Worship: Procedure of Yagya', by Pt. Sriram Sharma Acharya

'*Kund*' is the inverted pyramid shaped vessel used for the fire and oblations in the Yagya.

'*Havan Samigri*': the herbal preparation that is used for offering oblations into the fire.

'*Samidha*' is the wood that is used to prepare fire for Yagya.

'*Mandap*': The enclosure covered from the top where the main activity of Yagya takes place.

'*Desi- Ghee*': the clarified butter obtained from cow's pure milk.

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