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Comparative Studies of *Yagya vs* Non-*Yagya* Microbial Environments

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Abstract

In this paper a study of the effect of *Yagya* (fumigation with rituals, herbs and mantras) and Non-*Yagya* (burning of plain wood) on the indoor air micro-flora has been reported. In two separate experiments, the colony counts of air microflora viz. bacteria, fungi and pathogens, were taken by exposing pretreated petri-dishes for a fixed time one day before, on the day and till 2 days after the experiments in both *Yagya* and Non-*Yagya*, and were compared with the background i.e. before the day of *Yagya* / Non-*Yagya*. The results showed that in both the experiments, the counts reduced after the day of *Yagya* and the reduction continued till two days after *Yagya*, while in the case of Non-*Yagya* the counts of all the microbes increased on the day of experiment and further increased the next day, and the day after, despite the fact that all care was taken for excluding interference from external sources.

Introduction

Airborne microorganisms (thermophilic actinomycetes, fungi, protozoa, bacteria and several pathogens) are harmful for animals, humans and plants [Finnegan et al, 1987], since they are responsible for infectious or allergic disorders such as asthma [Burge et al, 1985; Burrel,1991] and humidifier fever [Edwards,1980] in the exposed people as also for the destruction of plants [Irma Garcia, 1998]. It has also been found that airborne contaminants can cause symptoms of sick building syndrome such as dermatological, ocular and ear problems among the exposed office workers in mechanically ventilated buildings [Bholah and Subratty, 2001].

Yagya, a Vedic procedure of burning some herbs in fire along with some rituals, is stated to be known for the purification of atmospheric pollution through removal of foul odour, lowering of harmful gas levels and removal of harmful microbes [Joshi, 2001]. Theoretical analysis of *Yagya* (Agnihotra) has been done in the past [Prakash, 1937] but without any experimental backup. Some scientific studies have also been conducted by individual scientists [Mondkar, Ming Lai, Bhujbal, Mutalikdesai, Irma Garcia], but they also need to be supported and verified.

In the present paper, against the commonly prevailing conception that fumigation of any substance produces smoke which renders the atmosphere bacteriostatic i.e. the microbes present in the atmosphere get killed, the authors have conducted two separate experiments, at the ground floor apartments of M.S. Apartments, K.G. Marg, New Delhi, to study the effect on the air microflora by treating the atmosphere with *Yagya* as well as *Non-Yagya* performances. The *Yagya* was performed in one of the apartments of the building with proper rituals, mantras and burning of herbs-mixture known as '*Havan Samigri*' along with mango wood and ghee as described by Pt. Shri Ram Sharma Acharya,, while in the Non-*Yagya* experiment only wood was burnt for an equivalent time simultaneously under similar circumstances in another similar apartment about 50 m apart in the same building. Special care was taken to keep the variability factors like number of persons in the room, temperature, humidity, condition of the room, sampling time etc., the same at both the places.

Materials and Methodology

The ambient air was sampled by using the *'Gravity Settle Method.'* .In one sample a set of four petri-dishes, pre-treated with i) Nutrient Agar(NA), ii) Potato Dextrose Agar (PDA), iii) Total Count Agar (TCA), and iv) Mac Conkey Agar (MCA) were exposed at a time to capture and cultivate Bacteria, Fungi, Total Microflora and Pathogens respectively on them. Four samples were taken in a day after every four hours (starting at 08.00 A.M.) to have a picture of the variability during the day. Sampling was done on a day before the experiment, on the day of the experiment performed early in the morning, on a day after the experiment and continued till two days after the experiment to see the effect. In the first experiment, however, on account of

some unavoidable reasons, the data for the 2nd day after non-*yagya* could not be taken. Plots of the mean values of the micro-flora of the *Yagya* were made in the form of line and bar figures to see their variability as also their comparison with the results of non-*Yagya*. The first experiment was performed during April 2003, while the second experiment was performed during April 2004.

The petri-dishes, pre-treated with NA, PDA and TCA, were exposed in the center of the room in both the apartments at a height of 0.6 m from the ground for a period of one minute, while the dish pre-treated with MCA was exposed for 5 minutes. All the doors and windows were closed while taking the sample so as to let the microflora settle down freely without any disturbance from the air currents.

The samples were taken on the same day to the laboratory of Central Pollution Control Board (CPCB) where they were kept in an incubator for 5 days at a uniform temperature of 30° C. Thereafter, the dishes were taken out and colonies of the microflora which had developed were counted. In the absence of identification system, it was not possible to identify the microbes individually hence the total counts were used as the data for analysis. The parameters measured were Bacteria, Fungi, Total Microflora (TMF) and Pathogens. Since the indoor environment was almost the same, the temperature and humidity were treated to be the same in both the cases i.e. in *Yagya* and Non-*Yagya* experiments.

Results and Analysis

1. All the sets of data collected for the four types of microflora were subjected to the following statistical analysis:
2. Pair-wise Descriptive Statistics to see the variability within various groups of microflora for both the experiments.
3. Trend Figures to study the growth / decrease in microbial counts in *Yagya* and Non-*Yagya* atmosphere.
4. Bar Figure Plots of the mean data of the various types of microflora counts comparing *Yagya* with Non-*Yagya* in both the experiments. This shall also show the variability in the counts before and after *Yagya* and Non-*Yagya*.
5. Percentage Change in the microflora counts as compared to the background, both in the *Yagya* and Non- *Yagya* cases, to see the effect of *Yagya* and Non-*Yagya* on the various microflora.
6. Chi–Square Statistics for testing the hypothesis that there is year wise significant association between the various micro-flora in *Yagya* and Non-*Yagya* atmosphere.

Pair–wise Descriptive Statistics

The grouped descriptive statistics for the years 2003 and 2004 is shown in Table 1. It may be seen from this Table that there is a significant difference in the average counts of the various types of microbes in both the years, and further that the counts and their variability for 2003 are much higher as compared to the counts for 2004.

Trend Figures

To study the overall trend of the microbes in the *Yagya* and Non-*Yagya* environment, the data for the two experiments, which were performed at an interval of one year, were compiled together and lines were plotted for each type of microbe for *Yagya* and Non-*Yagya* separately for both the experiments (Figures 1 to 4). It is seen from these figures that while the *Yagya* bacteria have gone down after *Yagya*, the non-*Yagya* bacteria have increased after Non- *Yagya*. This difference is more pronounced for the experiment performed during April, 2004 as compared to the experiment performed during April, 2003. In April, 2003, the *Yagya* fungi and *Yagya* TMF have decreased with respect to the background, while the Non-*Yagya* fungi and TMF have increased. The *Yagya* pathogens, on the other hand, are negligible and have remained almost constant.

In April, 2004 a uniform pattern is seen in all the cases. In the *Yagya* case, Bacteria, Fungi, TMF and Pathogens have all decreased after the *Yagya*, on the other hand, in the Non-*Yagya* case all the microbes have increased during and after the Non-*Yagya* experiment.

Table 1: Group Statistics

	Experiment No	N	Mean	Std. Deviation
Yagya Bacteria	Apr '03	12	41	24.773
	Apr '04	16	9	6.861
Yagya Fungi	Apr '03	12	14	8.241
	Apr '04	16	4	3.582
Yagya TMF	Apr '03	12	29	12.435
	Apr '04	16	7	4.464
Yagya Pathogen	Apr '03	12	4	3.279
	Apr '04	16	3	1.482
Non-*Yagya* Bacteria	Apr '03	12	44	20.427
	Apr '04	16	19	5.648
Non-*Yagya* Fungi	Apr '03	12	14	11.572
	Apr '04	16	7	4.396
Non-*Yagya* TMF	Apr '03	12	44	20.608
	Apr '04	16	21	8.420
Non-*Yagya* Pathogen	Apr '03	12	6	6.653
	Apr '04	16	8	4.106

N: No. of samples

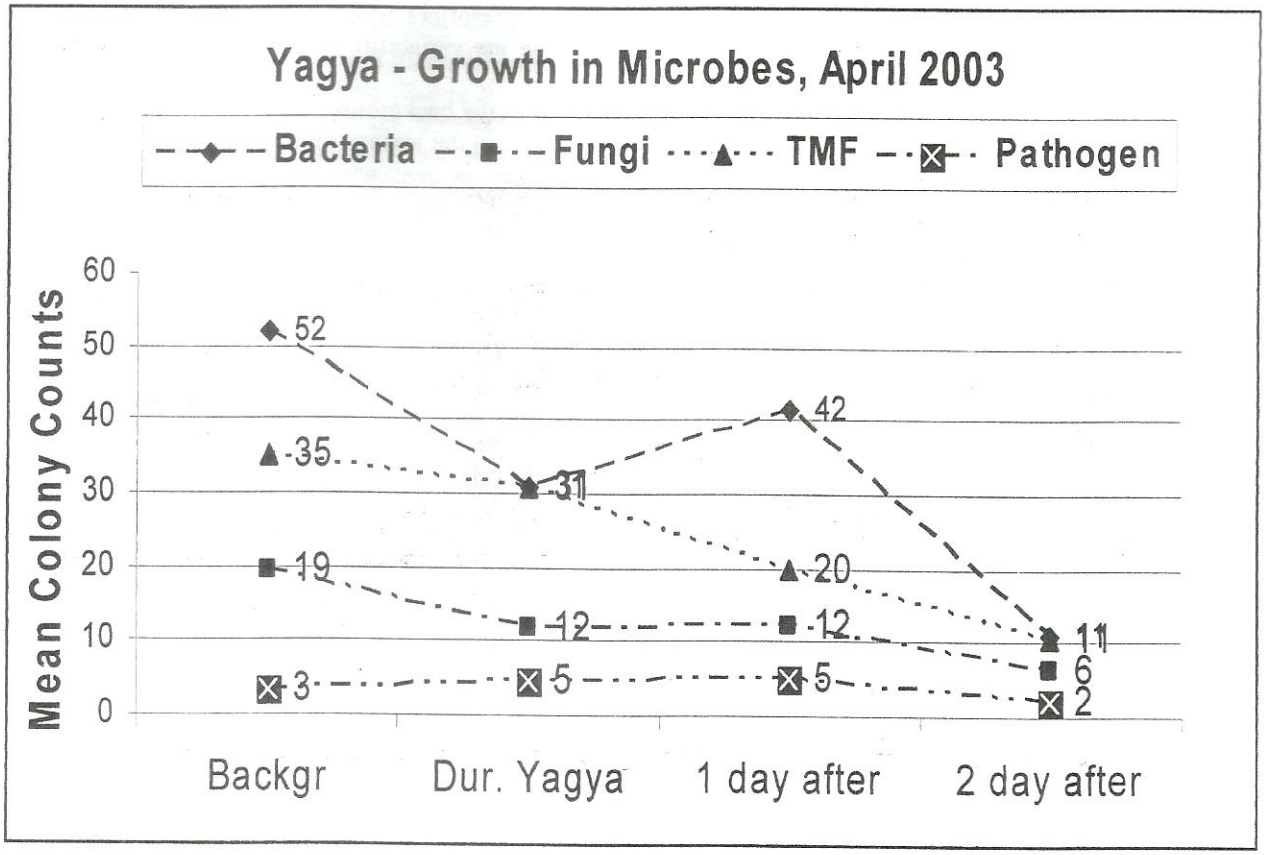

Fig. 1: A Plot of Growth in Microbes in the *Yagya* Experiment of April 2003

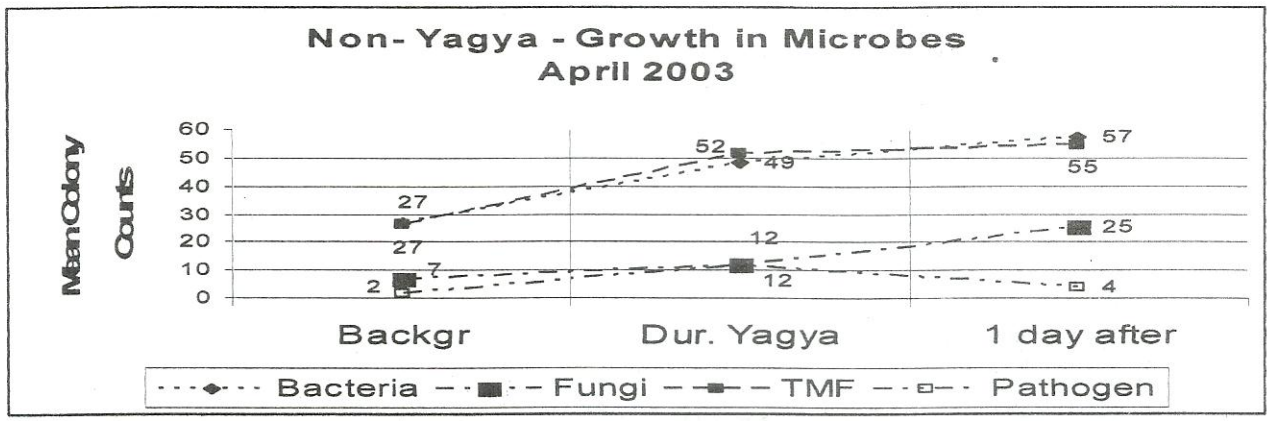

Fig. 2: A Plot of Growth in Microbes in the Non- *Yagya* Experiment of April 2003

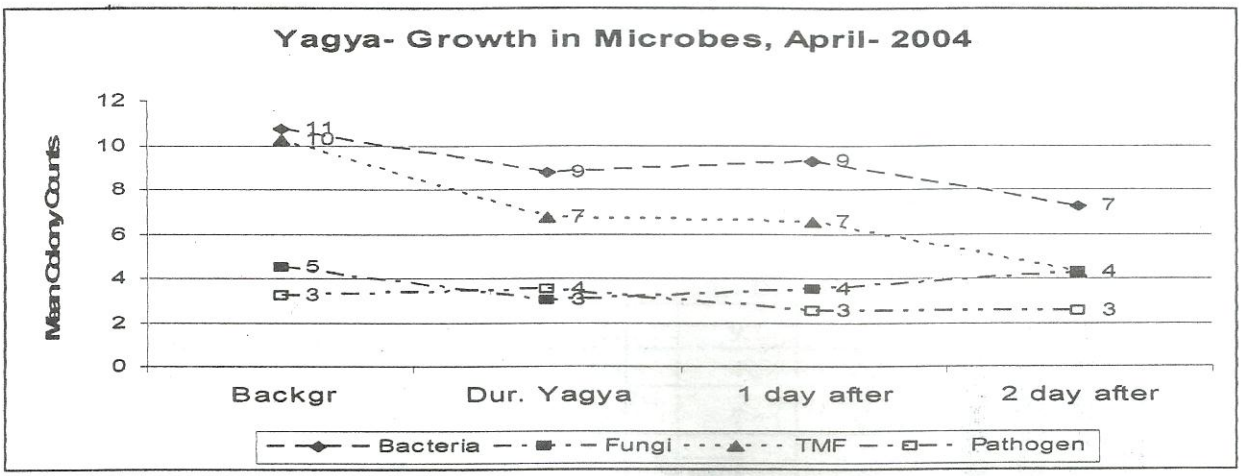

Fig.3: A Plot of Growth in Microbes in the *Yagya* Experiment of April 2004

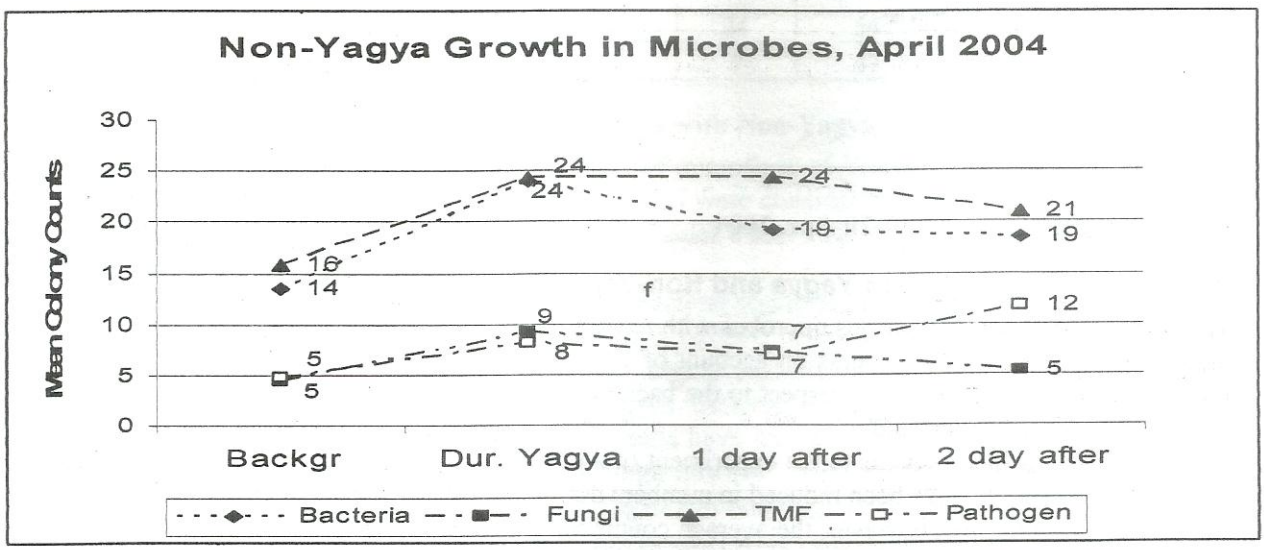

Fig.4: A Plot of Growth in Microbes in the Non-*Yagya* Experiment of April 2004

Bar Charts (2003 and 2004)

separately for both the experiments for the *Yagya* and Non-*Yagya* cases. The contrast between *Yagya* and non-*Yagya* results is more clearly seen in all these Figures.

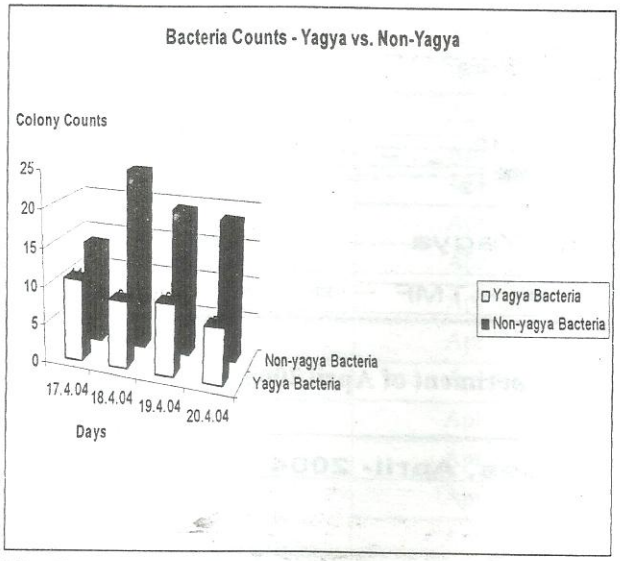

Fig. 5: Bacteria Counts during 17-20 Apr.04

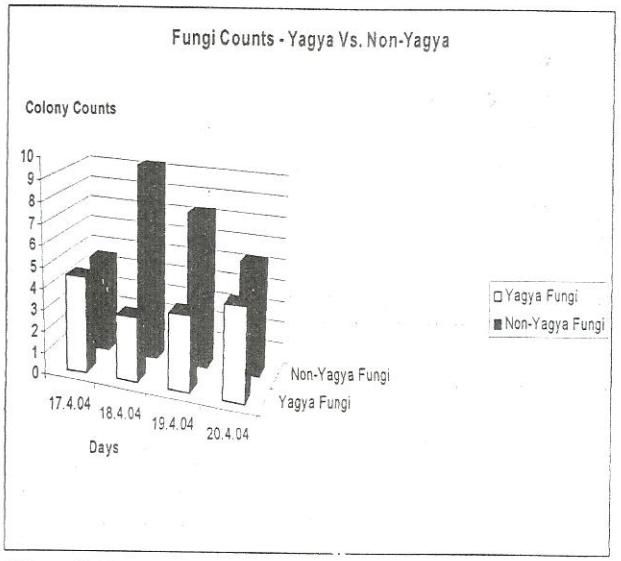

Fig. 6: Fungi Counts during 17-20 Apr. 04

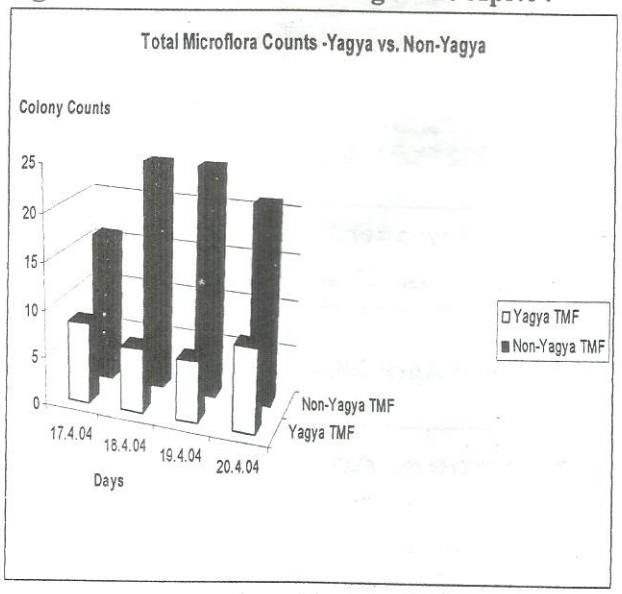

Fig 7: TM Counts during 17-20 Apr. 2004

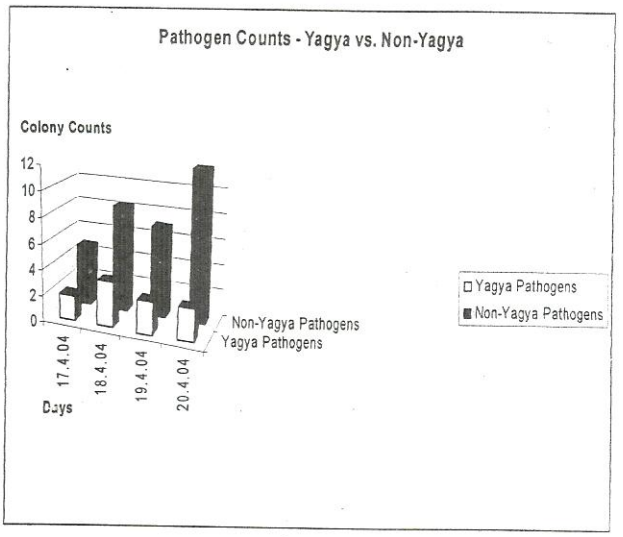

Fig. 8: Pathogen Counts during 17-20 Apr.04

Percentage Change due to *Yagya* and Non-*Yagya*

The percentage change of various microbes with respect to the background (Tables 2 and 3) gives an idea of the change in the microbial counts on account of *Yagya* and Non-*Yagya*. In these Tables, negative change implies reduction in counts with respect to the background and positive figures imply increase in the counts with respect to the background.

Table 2, which pertains to the experiment of April 2003, shows that the Bacteria, Fungi and TMF in the *Yagya* atmosphere have been reduced in numbers during the day of *Yagya*, the next day and the day after. In the case of Pathogens, however, the average counts have increased on the day of *Yagya* and the next day, but two days after the pathogens have also come down. In contrast the picture of non-*Yagya* is just the opposite. All the microbes have increased on the day of experiment and have further increased the next day, despite the fact that all care was taken for excluding interference from external sources.

Table 2: Percentage Change due to *Yagya* and Non-*Yagya*, during the Experiment of April 2003

		Background	Dur. *Yagya Do*	% change	1 day after D1	% Change	2 days after D2	% Change
Yagya	Bacteria	52	31	-41	41	-20	11	-79
	Fungi	19	12	-38	16	-19	6	-68
	TMF	35	31	-11	33	-6	11	-70
	Pathogen	3	5	38	4	19	2	-38
Non-Yagya	Bacteria	27	49	80	57	111	*	*
	Fungi	7	12	70	25	270	*	*
	TMF	27	52	94	55	106	*	*
	Pathogen	2	12	586	4	129	*	*

*** Data not available for the columns 2 days after Non-*Yagya***

In Table 3 which pertains to the second experiment conducted during April, 2004, almost a similar picture can be seen. There is reduction in microbes in the *Yagya* atmosphere whereas there is increase in the non-*Yagya* atmosphere. The reduction, however, is not significant. It is for the reason that the background itself had reduced considerably, probably, on account of repetitive *Yagya* experiments being conducted at the same venue.

Table 3: Percentage Change due to Yagya and Non-Yagya during the experiment of April 2004

		Background	Dur. Yagya Do	% Change	1 day after D1	% Change	2 day after D2	% Change
Yagya	Bacteria	11	9	-19	9	-14	7	-33
	Fungi	5	3	-33	4	-22	4	-6
	TMF	9	7	-21	7	-24	9	3
	Pathogen	2	4	75	3	25	3	25
Non-Yagya	Bacteria	14	24	78	19	43	19	37
	Fungi	5	9	106	7	61	5	17
	TMF	16	24	54	24	54	21	33
	Pathogen	5	8	74	7	47	12	147

Chi Square Analysis to Study the Association of Yagya with Non-Yagya

In order to study the association of the colony counts of microflora of Yagya and non-Yagya atmosphere, Chi square test was performed. The average colony counts were considered for each micro-flora separately for the purpose of calculations. The results are given in Tables 4 and 5 for the experiments conducted during April 2003 and April 2004 respectively.

From Table 4 it is seen that the impact of *Yagya* on the bacteria counts is highly significant ($p<0.01$) since on the day of *Yagya* and even one day after, the reduction in bacteria counts as compared to the background is highly significant. The Chi Square statistics is also **highly significant** which implies that there is no significant Association between *Yagya* and Non-*Yagya* bacteria. However, since *Yagya* bacteria have decreased on the two subsequent days, non-*Yagya* bacteria have increased, which also shows the efficacy of *Yagya* in the reduction of bacteria. In the case of fungi, however, it is seen that Chi Sq. statistics is non-significant on the day of *Yagya* which implies that *Yagya* and non-*Yagya* were Associated. On the day after *Yagya*, however, Chi Sq. statistics becomes significant ($p<.05$) which shows **non- Association** of *Yagya* and Non-*Yagya*. Again in the case of TMF, Chi Sq. statistics is significant which thereby implies **significant non- Association**. The null hypothesis is rejected in the above 3 cases. In the case of pathogen, Chi Sq. statistics is not significant which implies that both the populations have some Association. However, since

case of Non-*Yagya* it can be inferred that the reduction in counts was due to the *Yagya*.

In the experiment conducted in 2004, the microflora counts in the *Yagya* and Non *Yagya* group respectively have followed the same trend as in the year 2003 i.e. the counts of microflora have decreased in the *Yagya* group and have increased in the Non-*Yagya* group. The increase of microflora colonies in the non-Yagya atmosphere could be either on account of increase in the microflora in the outer atmosphere or may be due to heat. In both the cases the effect should have been in the Yagya atmosphere too, which is not the case. From Table 5, it is further seen that Chi Square values for all the four microbe counts are non-significant (NS) i.e. p>.05, implying that the null hypothesis is accepted. This means that there is significant Association between the microbe counts of Yagya and non-Yagya atmosphere.

Table 4: Chi Square Statistics for the Yagya and Non-Yagya Air Microflora during April 2003 (Average colony counts)

Bacteria	Background – BG	During Do	Chi Sq. Statistic1 D.. F	Background – BG	One Day After D1	Chi Sq. Statistic1 D.. F
Yagya Observed	52	31	11.68**	52	41	10.09**
Yagya Expected	41.24	41.76		41.51	51.49	
Non-*Yagya* Observed.	27	49		27	57	
Non-*Yagya* Expected	37.76	38.24		37.49	46.51	
Fungi						
Yagya Observed	19	12	2.82 NS	19	16	7.39 **
Yagya Expected	16.12	14.88		13.58	21.42	
Non-*Yagya* Observed	7	12		7	25	
Non-*Yagya* Expected	9.88	9.12		12.42	19.58	
TMF						
Yagya Observed	35	31	5.22 *	35	33	5.27 *
Yagya Expected	28.22	37.78		28.11	39.89	
Non-*Yagya* Observed	27	52		27	55	
Non-*Yagya* Expected	33.78	45.22		33.89	48.11	
Pathogen						
Yagya Observed	3	5	1.34 NS	3	5	0.03 NS
Yagya Expected	1.90	6.10		2.86	5.14	
Non-*Yagya* Obs.	2	11		2	4	
Non-*Yagya*Exp.	3.10	9.90		2.14	3.86	

**** implies p<.01 i.e. highly significant and * implies p< .05, i.e. significant and NS implies Non- Significant at all levels.**

Table 5: Chi Square Statistics for the Yagya and Non-Yagya Microflora Counts in the Experiment of April 2004

Bacteria	Back-ground – BG	During Do	Chi Sq. Statistic 1 D.. F	Backgro und – BG	One Day After D1	Chi Sq. Statistic 1 D.. F	Back-ground BG	Two Day After D2	Chi Sq. Statistic 1 D.. F
Yagya Obs.	11	9	1.76 NS	11	9	0.79 NS	11	7	1.63 NS
Yagya Exp.	8.62	11.38		9.43	10.57		8.82	9.18	
Non-*Yagya* Observed.	14	24		14	19		14	19	
Non-*Yagya* Expected	16.38	21.62		15.57	17.43		16.18	16.18	
Fungi									
Yagya Obs.	5	3	1.47 NS	5	4	0.40 NS	5	4	0.06 NS

***Yagya* Exp.**	3.64	4.36		4.29	4.71		4.74	4.26	
Non-*Yagya* Observed	5	9		5	7		5	5	
Non-*Yagya* Expected	6.36	7.64		5.71	6.29		5.26	4.74	
TMF									
***Yagya* Obs.**	9	7	1.22	9	7	1.22 NS	9	9	0.22 NS
***Yagya* Exp.**	7.14	8.86		7.14	8.86		8.18	9.82	
Non-*Yagya* Observed	16	24		16	24		16	21	
Non-*Yagya* Expected	17.86	22.14		17.86	22.14		16.82	20.18	
Pathogen									
***Yagya* Obs.**	2	4	p=0.62 NS	2	3	p = 0.69 NS	2	3	p= 0.84 NS
***Yagya* Exp.**	5	8		5	7		5	12	

NS implies Non-Significant at 95% level

The findings of the above study can be summarized as follows:

- The general trend of microbes is to decrease over the period of two days after *Yagya* and increase over the period of two days after non-*Yagya*.
- The atmospheric microbes of the *Yagya* environment decrease significantly even over a period of one year.
- In the year 2003, the Bacteria, Fungi and TMF counts (mean) had decreased by 79%, 68% and 70% respectively as compared to the background and the pathogens decreased by 38 % till two days after the *Yagya*.
- In the case of Non-*Yagya*, in 2003, the Bacteria, Fungi, TMF and Pathogen mean counts one day after the Non-*Yagya* experiment had increased by 111%, 270%, 106% and 129% respectively as compared to the background.
- In the year 2004, in the *Yagya* environment, the reduction after two days in Bacteria and Fungi counts, was 33% and 6% respectively. However there was nominal increase in TMF & Pathogen counts by 3% and 25% respectively as compared to the background. In contrast in the Non-*Yagya* experiment of the same year i.e. 2004, there was an increase of 37%, 17%, 33% and 147% respectively in the counts of Bacteria, Fungi, TMF and Pathogens.
- In the year 2003 (Table 4), in view of decreasing counts of Bacteria, Fungi and TMF in *Yagya* and the increasing counts of the same microflora in the non-*Yagya* group, and the probability that χ^2 was significant for Bacteria, Fungi and TMF, it means that there was significant non-Association in these three cases. Thus Yagya has had a significant effect in the reduction of bacteria, fungi and TMF. In Case of pathogens the number of colony counts being very low, the Association became significant. Since the impact of Yagya is different from that of Non-Yagya, it can, therefore, be inferred that the reduction in microbe counts was due to the *Yagya*.
- In the 2004 experiment, the χ^2 statistic was not significant (Table 5) for all the four types of Microflora which implies that *Yagya* and Non-*Yagya* were 'Associated'. They followed separate patterns as the counts of microbes decreased in case of Yagya and increased in case of Non-Yagya. The decreasing trend in the *Yagya* group and the increasing trend in the non-*Yagya* group confirm the pattern of influence of *Yagya* in controlling the growth of *air microflora.*

Conclusion

From the above studies a general picture that emerges is that in the *Yagya* atmosphere the effect of *Yagya* remains till two days after *Yagya* and that the reduction in microbes was there even on the 2nd day after *Yagya*. On the other hand, by just burning plain wood and producing smoke did not result in the destruction of micro-flora, which in fact increased after the experiment. It can be thus concluded that any type of smoke/ fumigation does not reduce the air microbes in the environment. In fact the fumigation of simple wood leads

to an increase in the counts in most of the cases, whereas the smoke/ gases produced as a result of *Yagya* lead to an overall decrease in the *Air microflora* in the atmosphere.

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