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Research Article

Microbial air contamination with air borne bacteria in the outdoor environment at Janakpurdham, Nepal

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ABSTRACT

Background and Objectives: Bacteria can cause allergic asthma and seasonal allergies, diseases which are increasingly prevalent in developing nations. Allergic asthma is currently affecting millions of people in Nepal. Therefore, the objective of this study was designed to measure the bacterial load in outdoor air.

Materials and Methods: Airborne outdoor bacteria were assessed during the spring season using conventional methods to investigate the enumeration of airborne microorganisms. This was determined by sampling air using the 'settle plate technique'. The air samples were collected during the spring season (February-March) from 10 different areas of Janakpur. Counts of airborne bacteria were measured as CFUs collected by gravity onto Nutrients Agar plates. Samples were taken periodically over a period of 2 months of February and March 2017.

Results: A total of 7,404 bacterial colonies were counted on 30 Petri plates that were exposed for 1 hour. The maximum number of colonies of bacteria was 412. Similarly, the least number of bacterial colonies was 32. Higher numbers of CFUs were found in the petri plates which were exposed for 1 hour in comparison to the petri plates which were exposed for 30 minutes. According to the measurement, 36.6% of total CFUs of bacteria were collected during morning hours, 28.4% during day time and 35% during evening hours. Also, the highest numbers of colonies of bacteria were found in the petri plates that were exposed in ward number 7 and the least number of bacterial colonies were obtained in ward number 9.

Conclusion: The bacteriological quality of air in janakpur was very poor. Very high microbial load was found in the outdoor air in Janakpur. The microbial count was found higher in morning than the noon and evening.

Key words: Airborne, Colony forming Unit, Microorganism, Settle plate

INTRODUCTION

Scientists have long known that bacteria are ubiquitous in the atmosphere. Bacterial concentrations typically range from 10^6 cells m^{-3}, through concentrations may be for higher proximity to point sources such as compost facilities, feedlots and waste water treatment facilities. Recent evidence suggests that even in source relatively unpolluted locations, bacteria or portions of bacteria may represent a major component of organic aerosols residing in the atmosphere. Airborne bacteria can have important effects on human health and the productivity of managed and natural ecosystems [1,3]. For example – Bacteria can cause allergic asthma and seasonal allergies, diseases which are increasingly prevalent in developing nations, with allergic asthma currently affecting millions of people in Nepal. Likewise, important plant and livestock pathogens are dispersed through the atmosphere and there is some evidence that bacteria are capable of influencing atmospheric processes by initiating cloud condensation plus ice nucleation events, potentially altering precipitation patterns.

Despite their abundance and likely importance, we have a limited understanding of the quantities and types of bacteria found in the atmosphere. With recent advances in high throughout sequencing, we can now describe the dynamics of airborne bacterial populations and determine likely sources of bacteria in the atmosphere, building a more comprehensive understanding of those bacteria found in the atmosphere and the control of their populations. Many processes generate bioaerosals of diverse forms ranging from sub-micron allergens to much larger fungi, pollens, droplets nuclei, and dust rafts. Humans and animals are disseminators, e.g., during sneezing while acting too as reservoirs and amplifiers. Residential environments may present more serious risk through infection and allergy than those of lower bioaerosol concentration as occur outdoors [2,3].

Outdoors many processes cause bioaerosol liberation including air turbulence, spray imgation, sewage treatment plants, breaking plants, breaking of waves, bursting of bubbles, and crop spraying. Bacteria constitute a large domain of prokaryotic microorganisms. Bacteria inhabit soil, water, acidic hot springs, radioactive waste, and the deep portion of Earth's crust. Bacteria also live in symbiotic and parasitic relationships with plants and animals. There are approximately $5x10^{30}$ bacteria on Earth, forming a biomass which exceeds that of all plants and animals. Bacteria are vital in recycling nutrients, with many of the stages in nutrients cycles dependent on these organisms, such as the fixation of nitrogen from the atmosphere and putrefaction. In the biological communities surrounding hydrothermal vents and old seeps, bacteria provide the nutrients needed to sustain life by converting dissolved compounds, such as hydrogen sulphide and methane, to energy [3,5]. Therefore, the objective of this study was designed to measure the bacterial load in outdoor air.

MATERIALS AND METHODS

Current study was carried out to examine the quality of air in Janakpur, Nepal. The samples of air were collected from different areas of Janakpur market. Sample collections were lasted from 2017 February to 2017 March. Sampling was performed according to standard protocol method for the examination of air.

Air samplings were performed using settle plate methods. Settle plate method is also known as passive air sampling. The air sampling was performed during morning, daytime and evening hours. 10 petri dishes of 90mm diameter containing nutrient agar were transported to different sites of Janakpur in plastic bags.

The plates were labelled with sample number, time of collection. The plates were placed at the chosen places. The plate was exposed for 30 minutes and 1 hour respectively. After exposure, the plates were covered with their lids and taken to laboratory at Department of Microbiology, Model Medical Institute, Janakpurdham in sealed plastic bags and incubated at 35-37^{o}C for 24 hours. The microorganism concentrations were expressed as colony forming unit, "CFU" per plate [6,7]. The settle plate technique was performed and the numbers of microorganisms were expressed in CFU.

RESULTS

This study estimated the numbers of airborne microorganism i.e. bacteria present in the outdoor air of Janakpur. The bacteria were present in all studies sites of Janakpur. In this experiment, the plates were exposed to air for 30 minutes and one hour in different site at different time during a day. The bacterial count is illustrated in Table 1 & 2.

The study showed that a total of 7,404 colonies were counted on 30 petri plates that were exposed for 1 hour. It was found that the number of bacteria in the plates which were exposed for 1 hour was higher than that in the plates which were exposed to air for 30 minutes. 36.6% of the total colonies bacteria were collected during morning, 28.4% during day time and 35% during evening hour. It was also found that the highest number of bacteria count were obtained in ward number 7 and the least number of bacteria count were obtained in ward number 9.

DISCUSSION

Microbiological quality assessment for outdoor air study is one of the most vital investigations to determine the microbial outdoor air pollution. The information on the outdoor microbial concentrations of airborne bacteria is necessary both to estimate the health hazard and to create standards for outdoor air quality control [7,9]. The concentrations of bacterial aerosols in outdoor environment of Janakpur, estimated with the use of settle plate method, ranged between 32 - 412 CFU. The concentrations of bacteria measured in different areas of Janakpur were significantly different to each other. These can be mainly explained by the variation of time periods of a day and also the population and pollution caused by them.

Bacteria occur in most environments; particularly in dusty, dirty places inhabited by human or other animals. According to measurements, the highest CFU of bacteria was observed in ward number 7 and the lowest CFU of bacteria was recorded from ward number 9. The CFUs of bacteria collected in the petri plates exposed were higher in morning and evening than during day time. With regard to the effects of our environmental factors - temperature, relative humidity, light intensity and wind speed, the relative humidity had the most pronounced influence on the outdoor bacterial concentration, with the number of bacteria increasing sharply on a day of high relative humidity.

Table 1: The number of colony forming units of bacteria resulting from different areas of Janakpur

Places	Exposure Time	CFUs
Ward No. 1	8:00 AM - 8:30 AM	128
	8:00 AM - 9:00 AM	316
	12:00 AM - 12:30 PM	112
	12:00 AM - 1:00 PM	200
	5:00 PM - 5:30 PM	180
	5:00 PM - 6:00 PM	324
Ward No. 2	8:00 AM - 8:30 AM	132
	8:00 AM - 9:00 AM	300
	12:00 AM - 12:30 PM	112
	12:00 AM - 1:00 PM	278
	5:00 PM - 5:30 PM	152
	5:00 PM - 6:00 PM	288
Ward No. 3	8:00 AM - 8:30 AM	111
	8:00 AM - 9:00 AM	278
	12:00 AM - 12:30 PM	87
	12:00 AM - 1:00 PM	198
	5:00 PM - 5:30 PM	142
	5:00 PM - 6:00 PM	268
Ward No. 4	8:00 AM - 8:30 AM	144
	8:00 AM - 9:00 AM	324
	12:00 AM - 12:30 PM	128
	12:00 AM - 1:00 PM	212
	5:00 PM - 5:30 PM	76
	5:00 PM - 6:00 PM	120
Ward No. 5	8:00 AM - 8:30 AM	156
	8:00 AM - 9:00 AM	288
	12:00 AM - 12:30 PM	104
	12:00 AM - 1:00 PM	272
	5:00 PM - 5:30 PM	184
	5:00 PM - 6:00 PM	284

Table 2: The number of colony forming units of bacteria resulting from different areas of Janakpur

Places	Exposure Time	CFUs
Ward No. 6	8:00 AM - 8:30 AM	158
	8:00 AM - 9:00 AM	290
	12:00 AM - 12:30 PM	110
	12:00 AM - 1:00 PM	232
	5:00 PM - 5:30 PM	160
	5:00 PM - 6:00 PM	298
Ward No. 7	8:00 AM - 8:30 AM	215
	8:00 AM - 9:00 AM	398
	12:00 AM - 12:30 PM	190
	12:00 AM - 1:00 PM	375
	5:00 PM - 5:30 PM	240
	5:00 PM - 6:00 PM	412
Ward No. 8	8:00 AM - 8:30 AM	98
	8:00 AM - 9:00 AM	142
	12:00 AM - 12:30 PM	56
	12:00 AM - 1:00 PM	132
	5:00 PM - 5:30 PM	101
	5:00 PM - 6:00 PM	210
Ward No. 9	8:00 AM - 8:30 AM	58
	8:00 AM - 9:00 AM	96
	12:00 AM - 12:30 PM	32
	12:00 AM - 1:00 PM	70
	5:00 PM - 5:30 PM	62
	5:00 PM - 6:00 PM	112
Ward No. 10	8:00 AM - 8:30 AM	148
	8:00 AM - 9:00 AM	276
	12:00 AM - 12:30 PM	78
	12:00 AM - 1:00 PM	129
	5:00 PM - 5:30 PM	152
	5:00 PM - 6:00 PM	272

Low humidity, scarce nutrients, variable temperature, and UV exposure, in the atmosphere create harsh environment and challenging for the survival as well as growth of microorganism. Despite, these bacteria are ubiquitously present in the ambient air.

They cause air pollution and the airborne bacteria also result in respiratory disorders and other adverse health effects such as infection, hypersensitivity, pneumonitis and toxic reactions. The control of microbial load of the surrounding air is thus important. Hence, an obvious practice to improve a more healthy quality of air is to control air pollution using different techniques [6,7].

An assessment of the airborne bacteria in the outdoor environment was experimentally investigated. Experiments of the numbers of airborne micro-organisms were carried out at varying types of areas during spring season [4,5]. The current study clearly indicates that there is significant assessment of the outdoor airborne bacteria.

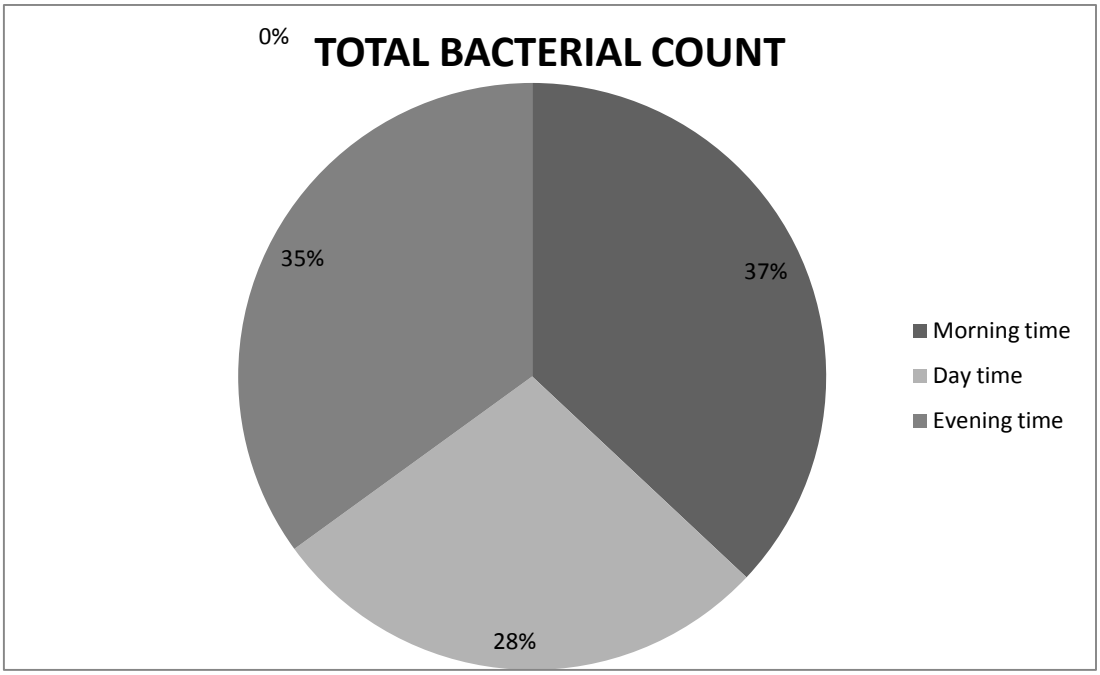

Figure 4-1: Percentage of microbial air contamination in different areas of Janakpur during morning, day and evening time.

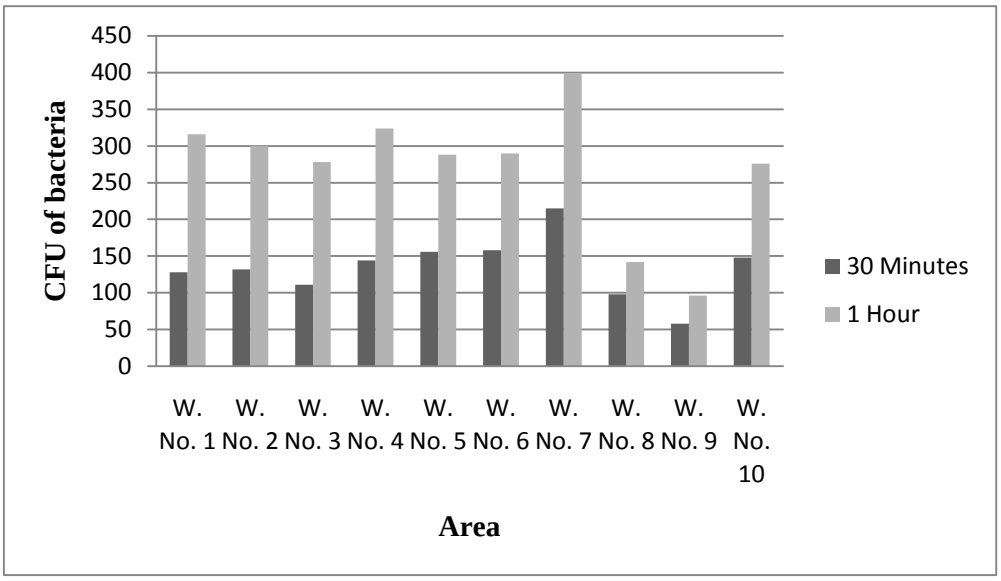

Figure 4-2: Comparison of bacteria count following periodic sampling in 10 different areas of Janakpur during morning time

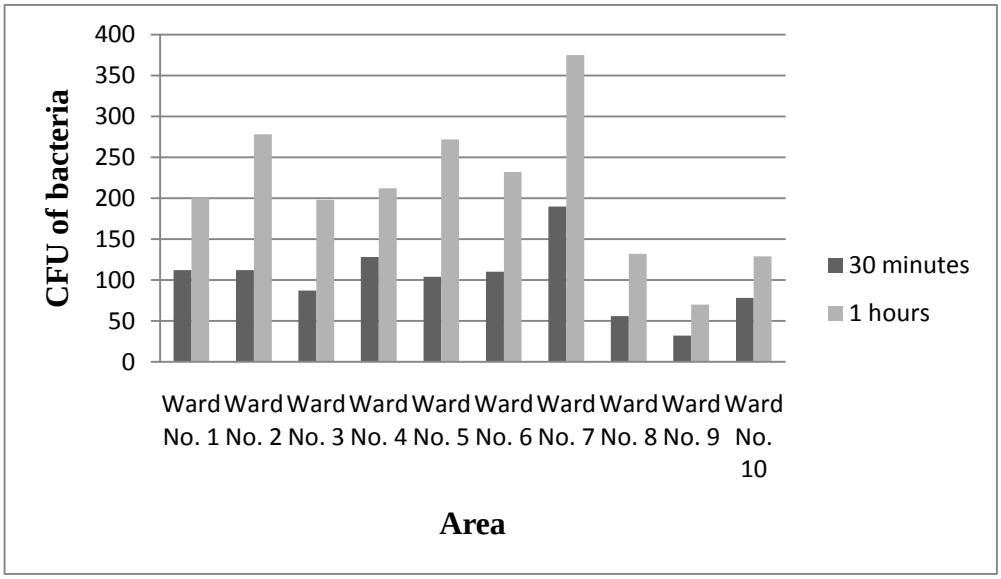

Figure 4-3: Comparison of bacteria count following periodic sampling in 10 different areas of Janakpur during day time.

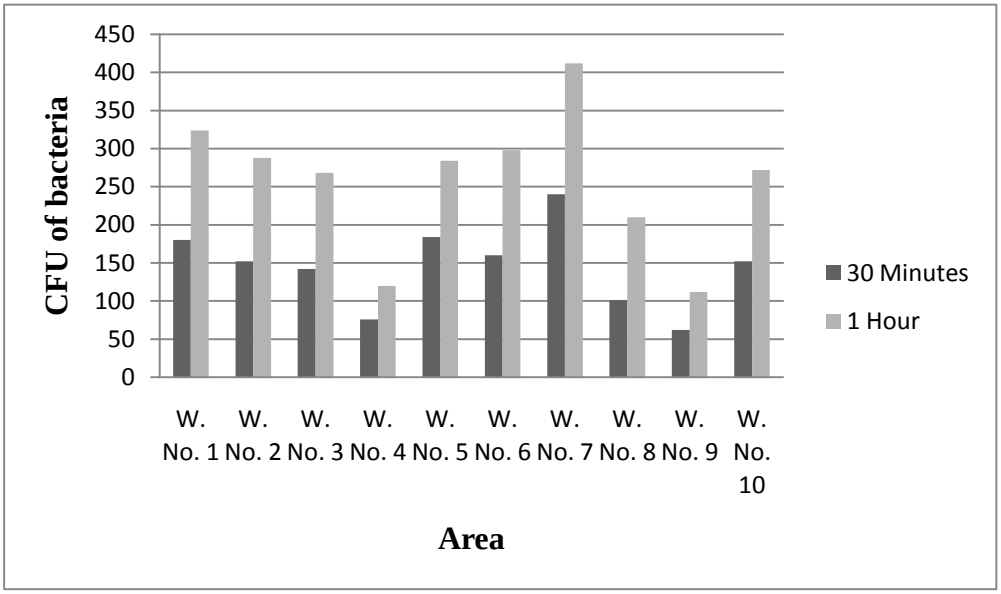

Figure 4-4: Comparison of bacteria count following periodic sampling in 10 different areas of Janakpur during evening time.

CONCLUSION

This study concluded that there was a significance difference in air microbial loads in different places of Janakpur with higher counts in places which are more crowded. Bacteria were determined to be most frequently detected in the air of all places. Generally, the bacterial concentration was found to be higher on increment of the exposure time of the petri plates. Also, the bacterial load of air was found to be higher during morning and evening hours in comparison to the day time. The places which were highly polluted were also showed significant growth of bacteria.

Increase in population can increase the level of bacteria and make health problems. Efforts are need to improve outdoor environment. It is recommended to raise the awareness and educational status of people to reduce the hazards of airborne transmission of such potentially pathogenic microorganisms. Provision of clean and safe air should be regarded as not only essential to health but also a legal right. Further studies are needed to reducing the contamination of air in the environment. Various techniques for controlling air pollution should be applied.

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AUTHOR'S CONTRIBUTION

NPY-supervised the whole research, scripted first draft and final revision of manuscript **RKY-** involved in collecting and reading review literature, writing first draft of manuscript; **AT-**involved in data collection, writing and revision of manuscript.

SOURCE OF SUPPORT

Nil

CONFLICT OF INTEREST

None

REFERENCES

1. Hameed A, Khoder MI, Yuosra S, Osman AM, Ghanem S. Diurnal distribution of airborne bacteria and fungi in the atmosphere of Helwan area, Egypt. Sci Total Environ 2009; 407(24): 6217-6222.
2. Bauer H, Kasper-Giebl A, Loflund M, Giebl HH, Zibuschka F, Puxbam H. The contribution of bacterial and fungal spores to the organic carbon content of cloud water, precipitation and aerosols. Atmospheric Research 2002; 64: 109-119.
3. Bowers RM, Mcletchie S, Knight R, Fierer N. Seasonal variability in airborne bacterial communities at a high - elevation site. Atmospheric Environment 2012; 50: 41-49.
4. Cappelletty DP. Microbiology of bacterial respiratory infections. Pediatric Infectious Disease Journal; 1998; 17: 555-561.
5. Cox CS, Wathes, CM. Bioaerosols handbook 1995; NY: Lewis Publishers.
6. Fang Z, Ouyang Z, Zheng H, Wang X, Hu L. Culturable airborne bacteria in outdoor environment in Beiging, China. Microbial Ecology 2007 54: 487-496.
7. Fracchia L, Pietronare S, Rinaldi M, Martinotti MG. The assessment of airborne bacterial contamination in three composting plants revealed site related biological hazard and seasonal variations. J. Appl. Microbial 2006; 100(5): 973-984.
8. Kuske, C. Current and emerging technologies of the study of bacteria in the outdoor air. Current opinion in Biotechnology 2006; 17: 291-296.
9. Maier RM, Pepper JL, Gebra PC. Environmental microbiology. Canada, Academic Press. 2007. P: 236-240.
10. Rajash B, Rattan LI. Essential of medical microbiology. 4th ed. New Delhi: Jayppe Brothers Medical Publishers; 2008, p: 415-439.

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