IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 10, Issue 11 Ver. I (Nov. 2016), PP 112-115
www.iosrjournals.org

Microbiological Analysis of the Outdoor Air Quality of the Poultry and Hatchery House in Ebonyi State University Abakaliki, Nigeria

Udu-ibiam O. E [1*]., Orji Jerry O[1]., Agah V. M[1]. Ede P. A[1]., Nwachi A.C[1]. Omotosun O[3]. and Okoro V[2].

[1]*Department of Applied Microbiology, Ebonyi State University, Abakaliki, Nigeria.*
[2]*Ministry of Health, Abakaliki, Ebonyi State, Nigeria.*
[3]*Department of Applied Microbiology, Federal University Ndufu-Alike Ikwo, Ebonyi State, Nigeria.*

Abstract: *This was designed to determine the microbiological analysis of the outdoor air quality of the poultry and hatchery houses of Ebonyi State University, Abakaliki. Sedimentation method was used for the study. The air sample was collected in the morning and afternoon from different locations around the poultry and hatchery houses in Ebonyi State University, Abakaliki, Nigeria. The airborne microorganisms were characterized after incubation through, microscopic and biochemical test methods and their identification confirmed using standard manuals. The identification and characterization revealed the presence of bacterias such as Staphylococcus spp, Enterobacteria, Pseudomonas, streptococcus, Micrococcus, Corynebacterium and Aeromonas. It also revealed the presence of moulds such as Aspergillus spp, Penicillium, Rhizopus, and Fusarium spp. in the regions monitored. The colony forming unit (CFU) was determined per meter cube with Corynebcterium sp being the predominant organism, followed by Staphylococcus aureus then Streptococcus sp. The dominant fungal isolated in both the poultry and hatchery unit in the morning examination was Penicillum sp. This study indicates that the outdoor air contains enough microbial loads.*

Keywords: *Outdoor air, Poultry, Hatchery, Bacteria and Moulds*

I. Introduction

Pollution is the contamination of earth's environment with materials that interfere with human health, the quality of life, or the natural functioning of ecosystem-living organisms and their physical surroundings [1]. Although some environmental pollution is as a result of natural causes such as volcanic eruptions, most is caused by human and animal activities.

Air pollution is therefore, the addition of harmful substances to the atmosphere resulting in damage to the environment, human and animal health and quality of life [2]. Air pollution affects the air quality of the surroundings and thus comes with a wide range of effects as it causes breathing problems, promotes cancer, and it harms plants, animals and the ecosystem in which they live [2]. The sources of air pollution can range from chemical or particulate droplets to biological contamination of the air by airborne microorganisms called Bio-aerosols. Poultry farming is the commercial raising of birds such as chickens, ducks, turkeys and geese for their meat and eggs. For decades now, the poultry business has become one of the, most efficient producer of protein for human consumption. The practice expanded during the World War 2 due to the shortage of beef, pork, and other protein sources, which require a much longer time to develop [3]. Unlike these other animals, only seven weeks is required to produce broilers and five months to produce a laying hen. Hatcheries collect hatchling eggs from the breeder's farms, incubate them and finally sell the newly hatched chicks to the commercial poultry farms. Good hygiene practices are very important to reduce the contamination with microorganisms in broilers; this is to help control the amount of dangerous effluents and bio-aerosols arising from the poultry and hatchery house. Poultry farming has recently become a popular substitute for beef and pork and in response to the public concern over dietary fats; its need has been on the rise and this rise in the need for protein supplements in human and animal diets has brought about a drastic rise in poultry and hatchery production in order to meet with the need and this has necessitated the need for an effective all round management ranging from adequate housing and waste management to efficient supply of ventilation to the poultry houses and hatcheries. Intensive poultry production, implying large densities of animals in small areas, is a significant source of air pollution which may constitute a considerable health hazard to the birds, farmers and those living in the proximity of the farm [4]. On the other hand, the spread of bioaerosol on the outside of animal housing may result in local or even more extensive environmental pollution [5]. Modern poultry production is usually polluted with large quantities of different microbial components, mainly aggregation of bacterial and fungal cells, their spores and fragments of mycelium as well as metabolites like endotoxins of Gram negative bacteria and 1,3-beta-glucan of fungi [6]. These components are suspended as the indoor and outdoor bioaerosol that may be generated either as

liquid droplets or as dry particles and transit in air individually or as cluster [7], which may be pathogenic or non pathogenic, viable or dead [8].

The increased need for poultry products and the exposure of poultry and hatchery workers and passerby's to bioaerosol of poultry origin for an extended period of time during management constitute the need for this study to ascertain the air quality of these areas. The interest in bioaerosol exposure has increased over the last few decades, both due to the emerging understanding of its association with a wide range of adverse health effects and due to the fear of bioterrorism. It is established that long term exposure to high concentration of airborne microorganisms can cause a number of respiratory damage, allergenic and immunotoxic effects [9].

II. Materials and Methods

This study was carried out around the poultry farm and hatchery of the Ebonyi State University, Abakaliki, Nigeria, located at the college of Agricultural science (CAS).

Sample Collection

This study was carried out at the Ebonyi State University, Abakaliki, Nigeria, college of Agricultural science (CAS) poultry farm and hatchery, by carefully placing the sterile media on a stool and opening carefully. The Sedimentation method was adopted for trapping the air borne microflora. The exposed plates containing the growth medium were allowed to stay for 10 and 20 minutes of exposure. The time of sampling was kept uniform at all the stands between 10 am to 12 am (morning section) and 3 pm to 5 pm (evening section). After exposure, the plates were transported in a clean container to the microbiology laboratory of Ebonyi State University, Abakaliki for microbiological examination.

Identification and Characterization of Isolates

The bacterial cultures were identified on the basis of macroscopic and microscopic examinations. Biochemical tests were done for proper organism identification as described by [10]. Further characterization of recovered isolates was performed according to Bergey's Manual of Determinative Bacteriology. The fungal cultures were identified using appropriate microbiological standards.

III. Results

Table 1: Showing the Average Colony Forming Units (CFU/M^3) Of Bacterial and Fungal Isolates around the Poultry House of Ebsu, Abakaliki

		Bacteria isolates			Fungal isolates		
Investigated site	Period	Suspected Organism	CFU/M^3 in10mins of exposure (%)	CFU/M^3 in 20min of Exposure (%)	Suspected organism	CFU/M^3 in 10mins of exposure (%)	CFU/M^3 in 20mins of exposure (%)
Poultry	Morning	*Corynebacterium*	72 (64.9)	64 (59.8)	*Aspergillus spp*	14 (26.9)	21 (35.6)
		Streptococcus spp	12 (10.8)	07 (6.5)	*Penicillium spp*	22 (42.3)	12 (20.3)
		Staphyloccus spp	14 (12.6)	16 (15.0)	*Rhizopus spp*	04 (7.7)	18 (30.5)
		Enterobacteria	07 (6.3)	02 (1.9)			
		Pseudomonas spp	04 (3.6)	18 (16.8)			
		Micrococcus spp	02 (1.8)	-(0)			
		Total	111 (100)	107 (100)	Total	52 (100)	59 (100)
	Afternoon	*Enterobacteria*	14 (29.2)	06 (9.8)	*Penicillium spp*	12 (40.0)	19 (32.8)
		Streptococcus spp	12 (25.0)	29 (47.5)	*Aspergillus spp*	07 (23.3)	18 (31.0)
		Micrococcus spp	06 (12.5)	08 (13.1)	*Rhizopus spp*	11 (36.7)	21 (36.2)
		Aeromonas	02 (4.2)	03 (4.9)			
		Staphyloccus spp	07 (14.6)	04 (6.6)			
		Corynebacterium Spp	03 (6.3)	05 (8.2)			
		Total	48	61		30	58

Table 2: Showing the Average Colony Forming Units (CFU/M^3) of Bacterial and Fungal Isolates around the Hatchery House of Ebsu, Abakaliki

		Bacteria isolates				Fungal isolates			
Investigated site	Period		Suspected Organism	CFU/M^3 in10mins of exposure (%)	CFU/M^3 in 20min of Exposure (%)		Suspected organism	CFU in 10mins of exposure (%)	CFU in 20mins of exposure (%)
Hatchery	Morning		*Rhizopus* sp	12 (20.0)	14 (27.5)		*Rhizopus spp*	11 (24.4)	07 (15.6)
			Aspergillusp	20 (33.3)	17 (33.3)		*Aspergillus spp*	16 (35.6)	09 (20.0)
			Penicillium sp	28 (46.7)	11 (21.6)		*Penicillium*	18 (40.0)	29 (64.4)
			Total	60 (100)	51 (100)		Total	45 (100)	45 (100)
	Afternoon		*Rhizopus* sp	10 (35.7)	15 (36.6)		*Rhizopus spp*	10 (30.3)	23 (38.3)
			Penicillium sp	15 (53.6)	04 (9.8)		*Penicillium spp*	12 (36.4)	18 (30.0)
			Aspergillus sp	03 (10.7)	08 (19.5)		*Aspergillus spp*	07 (21.2)	12 (20.0)
			Fusarium sp	_	09 (22.0)		*Fusarium spp*	01 (3.0)	04 (6.7)
			Total	28 (100)	41 (100)		Total	33 (100)	60 (100)

IV. Discussion

The microbiological examination of the hatchery and poultry unit of Ebonyi State University was determined and it was observed that *Staphylococcus spp, Enterobacteria, Pseudomonas spp, Corynebacterium spp, Micrococcus spp, Streptococcus spp,* and *Aeromonas spp* was isolated at varying percentage of frequency of occurrence which occurred at different time of exposure. Four fungal species belonging to different genera were also isolated which include *Aspergillus spp, Rhizopus spp, Fusarium spp,* and *Penicillium spp* all from the assessed unit.

In the poultry unit, the highest occurring bacteria is the *Corynebacterium* spp 148cfu/m^3 (45.7%), followed by *Streptococcus* spp 60cfu/m^3 (18.5%), *Staphylococcus* spp 41cfu/m3 (12.7%), *Enterobacteria* 29cfu/m^3 (8.9%), *Pseudomonas* spp 22cfu/m^3 (6.8%), *Micrococcus* spp 16cfu/m^3 (4.9%). The *Aeromonas* 8cfu/m^3 (2.5%) had the lowest count. The fungal isolates has *Penicillium* spp 65cfu/m^3 (36.3%) as the most abundant, followed by *Aspergillus* spp 60cfu/m^3 (33.5%5) and *Rhizopus* spp 54cfu/m^3 (30.2%) with the lowest count. The result also showed higher prevalence of *Corynebacterium* spp 136cfu/m^3, *Staphylococcus* spp 30cfu/m^3, *pseudomonas* spp 22cfu/m^3, *Aspergillus* spp 35cfu/m^3 and *Penicillium* spp *4cfu*/m^3 in the morning compared to the 8cfu/m^3, 11cfu/m^3, 0cfu/m^3, 25cfu/m^3 and 31cfu/m^3 of the same isolates respectively that was isolated in the afternoon. This result is in agreement with [11], whose study revealed the prevalence of *S. aureus, E.coli, S. pyogenes and Bacillus spp*. In the hatchery unit, the highest bacterial count is the *Staphylococcus* spp 46cfu/m^3 (25.5%), followed by the *Micrococcus* spp 45cfu/m^3 (25.0%), *Enterobacteria* 39cfu/m^3 (21.7%), *Aeromonas* 30cfu/m^3 (16.7%), *Streptococcus* spp 15cfu/m^3 (8.3%) and *Corynebacterium* spp 5cfu/m^3 (2.8%) with the lowest frequency bacterial count. The fungal isolates frequency showed highest occurrence of *PenicIillium spp* 77cfu/m^3 (43.5%), followed by *Rhizopus* spp 51cfu/m^3 (28.8%), *Aspergillus* spp 44cfu/m^3 (24.9%) and *Fusarium* spp 5cfu/m^3 (2.8%) with the lowest fungal count. The result also revealed a higher prevalence of *Enterobacteria* 39cfu/m^3, *Staphylococcus* spp 37cfu/$m^{3,}$ *Micrococcus* spp 26cfu/m^3, *Penicillium* spp 47cfu/m^3, and *Aspergillus* spp 25cfu/m^3 in the morning compared to the 0cfu/m^3, 9cfu/m^3, 19cfu/m^3, 30cfu/m^3, and 19cfu/m^3 respectively of the same isolates during the afternoon. Although *Rhizopus* spp 33cfu/m^3 and *Fusarium* spp 5cfu/m^3 were higher in the afternoon, their presence was found to be low in the morning. These organisms isolated were found to be in line with the work of [11 and 12], who also isolated the said organisms in their various study of air quality. They noted that bioaerosol may contain representatives of Gram-positive bacterium: *Corynebacterium, Staphylococcus, Streptococcus, Micrococcus, Pantoea and Sarcina,* and some Gram-negative pathogens such as *E.coli, Pseudomonas, Shigella, Neisseria and Haemophillus influenza. Aspergillus* spp, *Rhizopus* spp, *Fusarium spp, and Penicillium spp* isolated in this study also conform with the findings of [13] in which he reported the presence of the organisms in outdoor air. In another study by [13], on the microbial air contamination in poultry house in summer and winter, the organisms were isolated which conforms to that [14[, and this study as well.

Studies have shown that a large number of people around the world are exposed to biological agents [15 and 16]. Though there is no official reference limit for the microbiological quality of air in human environment, the lack of quantitative health- based guidelines, values or thresholds for the acceptable level of microbial contamination in the air may be due to lack of dose-response relationship for most of the air microbiological agents [17]. Due to limited information or limit for the microbiological quality of air in human environment, qualitative and quantitative information on the composition and concentrations of microorganisms in the air environment of human habitations at any point in time would help a great deal in alerting the public of possible risk that may be encountered by vulnerable individuals.

The result of this study show some level of microbiological contamination which varies in frequency with time/duration of exposure. The isolated organisms have been shown to be among the common bacterial and fungal species isolated from the air. Poultry and hatchery practices introduce a considerable amount of bioaerosol into the atmosphere which affects the microbiological air quality of the outdoor environment. The recent advances in the scale of production has demonstrated that Poultry and Hatchery workers as well as those around the surrounding environment are exposed to large quantity(ies) of bioaerosol which possess a potential risk for disease, especially among immune compromised individuals. The essence of assessing the outdoor air quality of the investigated site is due to the human activities which takes place around the area. The concentration and composition can be used to determine the healthiness of the air around the said environment, the source of human discomfort and certain airborne microbial infections. This study has shown that microorganisms of medical importance are actually present in the outdoor air of poultry and hatcheries and this has a potential of rising to levels of public health importance. Because of the risk associated with exposure to unwholesome air arising from the poultry and hatchery houses, it is therefore important that protective clothing's and nose masks be worn when in and around the poultry and hatchery to reduce the concentration of bioaerosol inhaled which may constitute health hazards. It is also worthy of note that extended exposure to this bioaerosol be avoided.

References

[1]. Fabian, M.P., Miller, S.L, Reponen, T and Hernandez, M.T (2005). Ambient Bioaerosol Indices for Indoor air Quality Assessments of Flood Reclamation. *Aerosol Science* 36:763-783.

[2]. Hart, John (2008). Air Pollution. Microsoft Encarta 2009. Redmond, WA: Microsoft Corporation.

[3]. Womack, A. M., Bohannan, B.J.M and Green, J.L (2010). Biodiversity and Biogeography of the Atmosphere. *Philosophical Transaction of the Royal Society B*, 365:3645–3653.

[4]. Lonc, E and Plewa, K (2010).Microbiological Air Contamination in Poultry Houses, *Polish Journal of Environmental Studies,*19(1):15-19.

[5]. Burge, H.A and Hoyer, M.E (1990). Indoor air quality. *Applied Occupational and Environmental Hygiene* 5:84-93

[6]. Karwowska, E (2005). Microbiological air Contamination in Farming Environment. *Polish Journal of Environmental Studies*, 19(1):15-19.

[7]. Millner, P.D (2009), Bioaerosols associated with animal Production Operations. *Bioresource Technology*, 100:5379-5385.

[8]. Douwes, J., Thorne, P., Pearce, N and Heederik, D (2003). Bioaerosol health effects and exposure assessment: Progress and Prospects. *Annals of Occupational Hygiene* 47(3): 187-200.

[9]. Rintala, H., Pitkaranta, M., Toivola, M., Paulin, L and Newalainen, A (2008). Diversity and Seasonal Dynamics of Bacterial Community in Indoor Environment. *BMC Microbiology.* 8(56):1471-2180

[10]. Cheesbrough, M (2006). *District laboratory practice in tropical countries*. Cambridge university press. 62-71

[11]. Makut, M.D., Nyam, M.A., Shehu, L and Anzaku, S.J (2014). A survey of the Microflora of the Outdoor air Environment of Keffi Metropolis, Nassarawa State, Nigeria. *African Journal of Microbiology Research* 8(27):2650-2655.

[12]. Gorny, R. L (2004).Filamentous Microorganisms and their Fragments in Indoor air: A Review. *Annals of Agricultural and Environmental Medicine*, 11:185-197

[13]. Karwowska, E (2004). Microbiological air contamination in farming environment. *Polish Journal of Environmental Studies*, 14(4):445.

[14]. Wójcik, A., Łukasz C., Tomasz, M., Dorota, W., Krystyna, I and Janina, S (2010). Microbial Air Contamination in Poultry Houses in the Summer and Winter. *Polish Journal of Environmental Studies.19 (5):1045-1050*.

[15]. Daisey, J. M., Angell, W.J and Apte, M.G (2003). Indoor air Quality, Ventilation and Health Symptoms in Schools: an Analysis of Existing Information. *Indoor Air* 13:53.

[16]. Dales, R., Cakmak, S., Judek, S., Dann, T., Coates, F., Brook, J and Burnett, R (2004). Influence of outdoor Aeroallergens on Hospitalization for Asthma in Canada. *Journal of Allergy and Clinical Immunology.* 113:303-306.

[17]. Golofit-Szymczak, M., Gorny, R.L, (2010). Bacterial and Fungal Aerosol in air Conditioned Office Building in Warsaw, Poland. The Winter Season. *International Journal of Occupational. Safety and Ergonomics.* 16(4): 465-476.