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Air Borne Microbial Contaminants in a Production Laboratory

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Abstract: A study was carried out to determine major bacterial and fungal contaminants in vaccine production laboratory of the Bacterial Vaccine Production, Department of the National Veterinary Research Institute, Vom. A total of 75 samples were collected between January 2006 and January 2007 from the environment of the 6 production sections of the laboratory. The isolates obtained were examined and identified using Colonial morphology, Gram stain and also by Physical and Chemical characteristics. The following 8 different organisms were isolated and identified: *Micrococcus roseurs*, *Bacillus cereus*, *Bacillus subtlest*, *Norcadia mudarea*, *Bacillus alvei*, *Staphylococcus aureus*, *Aspergillus niger* and *Aspergillus fumigatus*. The study, therefore incriminated these organisms as common agents of airborne contamination in the bacterial vaccine production department. The knowledge of common contaminants in a production laboratory should go a long way in devising measures that will minimize sources of contamination and therefore, save cost of production and improve the quality of products.

Key words: Airborne, contaminants, bacteria, fungi, vaccine laboratory

INTRODUCTION

Microorganisms abound in the atmosphere where they are suspended as dust particles of bacterial and fungal spores. When animals or plants die, they are invaded by these atmospheric microbes. When these microbes dry up, they are dispersed into the atmosphere. In addition, microbes are disseminated into the environment in masses of infected secretions, from the nose or mouth, on fingers, handkerchief, cups or spoons. They are also discharged by humans via sneezing, coughing and speaking.

Harvey *et al.* (1976) indicated that contamination with pathogenic microorganisms is important in the epidemiology of certain disease of animals and man. The contamination of the environment by both pathogenic and non-pathogenic bacteria is significant and may be relevant to safety of laboratory workers and the quality of technical performance.

The microbiology of the atmosphere is very challenging, particularly in the tropics where climate conditions are inclement, coupled with poor standard of hygiene which favour the survival and propagation of many microorganisms. Some studies however have shown that both atmosphere and the surrounding surfaces around research production and diagnostic laboratories constitute a major source of various microorganisms which may cause serious medical, ecological and economical problems. Though the extent of infections acquired in place like hospitals and related environments will depend on the type of organisms occurring in these places and the standard of hygiene in relation to both human and environmental surfaces (Kundsin, 1976).

The aim of this research is to microbiologically sample the air of Bacterial Vaccine Production Laboratories in Vom, Nigeria with a view to isolate and identify fungal and bacterial organism within the laboratory air-space.

MATERIALS AND METHODS

Sample collection: Samples were collected from the 6 sections of the Bacterial Vaccine Production Department, namely Media Production section and Anthrax Spore, Black Quarter, Fowl Typhoid/Fowl Cholera, Contagious Bovine Pleuropneumonia, Hemorrhagic Septicemia/ Brucella Vaccine Production Sections.

For sampling purposes, each section is divided into 3 areas i.e., black, gray and white areas. The black area is where non-aseptic work is carried out, while the gray area is where reagents and equipments are kept, while the white area is the sterile room where only aseptic work is conducted and is always beamed with ultraviolet light when not in use.

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Media: Settle plate sedimentation method was used Mackie and MacCartney (1987) to prepare Blood, MacConkey and Subouraud Dextrose agar plates. The plates were allowed to solidify at room temperature in the sterile room and then incubated at 37°C overnight to check for sterility. The following day, sterile Blood, MacConkey and Suboraud Dextrose plates were used for the experiments.

Sampling: In each of the 3 sampling areas 3 sets of Blood agar, MacConkey agar, Sabouraud Dextrose agar plates were exposed on tables for 30 min.

Incubation: Each set of plate was incubated at 37°C aerobically, anaerobically (Gas pak system) and in an increase 10% carbon-dioxide. All anaerobic plates were incubated for 2 days while the aerobic samples were for 1 day (Hambraeus and Benedickts, 1980).

Identification of isolates: A total count of the different types colonies formed on each plate was taken to determine the occurrence of each type of bacterium, in each sampling. This was made possible as the colonies on the plates appeared singly. However, a representative colony of each of the morphologically distinguishable colonies was subcultured on to the corresponding media; they were isolated and Incubated accordingly to obtain discrete colonies and to propagate the isolates. The methods employed for the differentiation of all isolates were as described by Elmer *et al.* (1989). The identification of the isolates were confirmed culturally, morphologically and by their biochemical characteristics as described in Cowan and Steel (1974) manual for the identification of medical bacteria.

RESULTS AND DISCUSSION

Eight different bacteria and fungi species were identified, these are: *Micrococcus resource, Staphylococcus aureus*, *Norcadia mudarea*, *Bacillus cereus, Bacillus subtilis, Bacillus alvei*, *Aspergilosis niger* and *Aspergillus fumigatus.*

From the Haemorrhagic Septiceamia, Vaccine production section 3 different organisms were identified, they are *Bacillus cereus*, *Aspergillus formigation*, *Micrococcus reseurs*, while the Contagious Bovine Pleuropneumonia Vaccine production section four different organisms were identified, they are *Norcadia mudarea*, *Bacillus alvei*, *Bacillus cereus*, *Aspergillus niger*. Sampling from the Black Quarter Vaccine production section yielded 3 different organisms, which we identified as *Bacillus cereus, Bacillus subtilis*, *Aspergillus fumigatus*. Sampling from the Fowl Cholera/Fowl Typhoid Vaccine production section yielded 2 different organisms identified as *Bacillus subtilis*, *Aspergillus fumigatus*. From the Anthrax Spore Vaccine production section 3 different organisms were identified, they are *Staphylococcus aureus*, *Aspergillus fumigatus, Bacilus subtilis*, while Media Production section yielded 2 different organisms identified as *Bacillus cereus* and *Staphylococcus aureus* (Table 1).

Samples obtained from the 6 sections of Bacterial Vaccine Production Department were examined over 12 months. Two hundred microbial counts of organism were isolated. The microbes were identified as either *Micrococcus resource, Staphylococcus aureus*, *Norcadia mudarea*, *Bacillus cereus, Bacillus subtilis, Bacillus alvei, Aspergilosis niger, Aspergillus funmigatus.*

The mainstay of Bacterial Vaccine Production, Department of the National Veterinary Research Institute Vom, Nigeria is to produce safe and potent animal bacterial vaccines at affordable cost to combat diseases of economic importance in Nigeria. This can only be achieved if the laboratory facilities are suitable to achieve this goal. Bacterial contaminants are a major source of problems in obtaining safe and pure products, as the vaccines may be contaminated by unwanted bacteria, fungi, parasites and even chemicals, during production processes of inoculation, dispensing and storage.

This study was conducted in all the various section's where vaccines are produced and a total of 200 microbial counts were detected and identified to belong to 6 different species of bacteria and 2 fungal species.

Table 1: Airborne Bacteria and Fungi isolated from various sections of Bacterial Vaccine Production Laboratories

Section/Laboratory	No. of sample collected	Bacterial isolates (total colony counts)	Fungi isolates (total colony counts)
Anthrax Spore Vaccine	12	6 samples contain *Bacillus subtilis,*(13) *Staphylococcus aureus* (30)	*Aspergillus fumigatus* (10)
Black Quarter Vaccine	13	9 samples contain *Bacillus cereus,* (15) *Bacillus subtilis* (5)	*Aspergillus fumigatus* (9)
Contagious Bovine Pleuropneumonia Vaccine	13	13 sample contain *Norcadia mudarea,* (2) *Bacillus alvei,* (7) *Bacillus cereus* (10)	*Aspergillus niger* (13)
Fowl Typhoid/Fowl Cholera	12	12 samples contain *Bacillus subtilis* (10)	*Aspergillus fumigatus(11)*
Hemorrhagic Septicemia and Brucella Vaccine	13	9 samples contain *Bacillus cereus* (15) *Micrococcus roseurs* (6)	*Aspergillus fumigatus* (7)
Media production	12	12 samples contain *Bacillus cereus* (10) *Staphylococcus aureus* (18)	Nil

This result, therefore indicates that microbes do reside in the laboratory including rooms where aseptic production activities are carried out. Contagious Bovine Pleuropneumonia, Vaccine section yielded more organisms than any of the other sections with 4 organisms, while Haemorrhagic Septiceamia and Black Quarter Vaccine production sections followed with 3 organisms each. Fowl Cholera/Fowl Typhoid and Anthrax Spore Vaccine production sections and Media Production section yielded 2 organisms each.

This result may be explained from the location of the sections. Haemorrhagic Septiceamia Vaccine, Contagious Bovine Pleuropneumonia vaccine and Black Quarter Vaccine sections are directly facing the main street of the institute, therefore being perpetually exposed to external dust particles. The others i.e., Fowl Cholera/Fowl Typhoid Vaccine production sections, are located further away from the road, which gives it more protection from the dust particles.

This investigation is agreement with Mackie and MacCartney (1987), which stated that microbes may be dust-borne and take place by inhalation of air-borne infected dust particle.

The study also indicates that the ultraviolet radiation used as the major source of decontamination in the sterile room of the laboratories, may not be enough to get rid of all the microbes. This is in agreement with the work of Baker (1980) which stated that the application of ultra violet radiation of bacteria in air, water and on contaminated surfaces is not a very satisfactory sterilizing agent.

CONCLUSION

From this research it can be concluded that unwanted microbes are found in the production laboratories, which may affect the quality of vaccines being produced. To tackle this problem it is recommended that standard laboratory procedures be adopted and applied by ensuring that all bench surfaces, floors are disinfected at the beginning and end of each day.

There is need also to install exhaust filters to reduce outside air getting into production areas.

In the long run however, it is suggested for a complete relocation of production laboratories to an isolated location within the institute.

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