A case study of possible health hazards associated with poultry houses

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Abstract

This study on layer and broiler houses is expected to give basic information on the nature of microbes, their occurrence, health hazard they could constitute and the possibilities for disease control measures. Modern husbandry practices, state or local concentration of the industry, high stocking densities, uniform age distribution of birds and continuous feeding may promote the spread of poultry diseases. Illness due to contaminated food, poultry wastes, poultry and poultry by products are one of the most widespread problems of the contemporary world. From the poultry houses investigated, bacteria and fungi were isolated from swabs of window nets dust, feed stock, roof dust, faeces, floors, feeders, drinkers, feathers, cages and egg trays using standard microbiological media and biochemicals procedures. The isolates encountered include: Aspergillus fumigatus, Aspergillus niger, Aspergillus flavus, Aspergillus terreus, Streptococcus faecalis, Bacillus sp., Pasteurella gallinarum, Pasteurella multocida, Klebsiella sp., Eschericia coli, Salmonella sp., Pseudomonas aeruginosa, Yeast and Rhodotorula spp., which were not typed. Aspergillus fumigatus, Aspergillus niger, Aspergillus flavus, Aspergillus terreus, Bacillus sp., Pasteurella gallinarum, Klabsiella sp., Eschericia coli, Yeast and Rhodotorula Sp., were present in both layers and broilers houses structures and materials in varying proportions. However, Pasteurella Multocida, Salmonella sp., and Pseudomonas aeruginosa were isolated from egg trays, feathers, faeces, and feeders respectively from poultry house materials only and none from the structures of layers and broilers houses. The layer house structures and materials tend to yield more microbes mix than broiler house structures and materials. There were no acid-fast organisms observed from the sediments of washed swabs materials for culture using Ziehl-Neelsen stain.

Keywords: Poultry, house, health hazard, bacteria, fungi, microbes

Introduction

Technological breakthroughs in recent times has contributed to the improvement of modern commercial high density poultry houses resulting in confinement of broilers, hens and turkeys in high density housing to provide meat and eggs more efficiently, effectively and economically than at any other period in the past history of animal production. However, these novelties in management practice have created major pollution problems from dust,
odours, feathers, litters, cages and other waste products.

Dust originates from the birds themselves, their feathers, feed, bedding, excretion, expulsion of droplets of mucus and saliva from the respiratory tract (Koons et al., 1963; Honey and McQuitty, 1979; Melhorn, 1980). The capacity of the dust particle to remain airborne, or pass through filters or to be deposited in the respiratory tracts or removed from the air by sedimentation, diffusion or impaction depends on the size and density of the particle (Noble et al., 1963; Drett, 1967). Dust level in poultry housings air may vary much depending on type of birds, birds activity, birds interactions, the different work phases of the day by poultry staff, feed type, feeding methods and feeding troughs, weighing activity, cleaning and replacing of the saw dust bedding. Temperatures and relative humidity have been documented to have direct effect on birds activity and the amount of airborne particles generated (Koon et al., 1963; Grub et al., 1965; Anjum, 1990.; Baskerville et al., 1992). In laying hens, bird density was found to be the most important factor affecting the concentration of dust particles. Also dust in these hens emanates more from deep litter and from facilities for laying hens in cages (Rautit and Leesment, 1975).

Poor ventilation in poultry houses may lead to the accumulation of atmospheric pollutants such as ammonia and carbon dioxide (Koelkerbeck and Odom, 1994). Particulate matter has also been implicated as an odor transport agent in the poultry houses (Burnett, 1969a,b). Ammonia gas has been shown to cause kerato-conjunctivitis, reduce growth rate, reduce egg production, reduction in feeding, increased feed conversion ratio and tracheitis in chickens and turkeys. Tracheitis has been documented to predispose the birds to respiratory disease and secondary infection (Bullis et al., 1950, Charles and Payne, 1966a,b).

The accumulation of manure and feathers have not only led to pollution and an increased waste disposal problems, but also means that there are more opportunities for alternative methods of waste utilization (Bressami, 1986b).

In view of documented evidence that environmental factors such as dust, odour, feather and poultry litter can influence the survival or infectivity of certain microbes or the pathogenesis of certain diseases in temperate regions; this study therefore attempts to investigate types of microbial flora from dust, egg trays, floors, roofs, feeders, faeces, cages and feathers from and intensive high density poultry houses under tropical condition.

Materials and methods
Materials for culture were obtained from institutional poultry layers and broilers houses in Zaria, Kaduna State, Nigeria. Samples collected include: swabs of dust and particulate from window nets, stock of feeds, feathers (on the ground), faecal droppings, swabs from floor at different location in each of the poultry houses, swabs of poles and roofs, swabs of egg trays, drinkers, feeders and cages. All samples were collected before feeding the birds in the morning.

Wet preparation
Two smears were made from the sediment of the material being cultured plus one wet preparation. One of the smears was stained with modified Ziehl-Neelsen for quick detection of acid-fast bacteria and the second smear stained with Gram stain to have a quick view of the general bacteria flora before culture, the wet preparation was also examined for fungal mycelia.
**Preparation of specimen for culture**

Four replicates each of the different samples were collected as indicated above and immediately transferred separately into sterile physiological saline and rinsed thoroughly. The swabs were then removed and transferred into a sterile test tube without saline. The mixtures obtained from the rinsed swabs were then centrifuged at 1000 × G for 10 minutes. The supernatants were discarded and the sediments, and the wet swabs were separately inoculated into specialized and standard agar media to eject various microbes present in the samples. The agar media used include: blood agar (2 plates per samples), salmonella-shigella agar, maeconkey agar, sabourand dextrose agar and reinforced clostridial agar plate the plates. The plates were incubated anaerobically at 37°C to detect strict anaerobes in the samples) or longer depending on the type(s) of microbe(s) and their growth pattern. Sabouraud's dextrose agar plates (for fungi) were incubated at room temperature for 5-10 days. All isolates were subjected to biochemical tests in accordance to standard bacteriological procedure (Cowan, 1981; McFaddin, 1981).

**Microscopic examination of material for fungi**

This was performed as follows: A needle mount preparation was obtained by removing a piece of sporing mycelium from a culture on sabourand agar; the material was placed on a sterile, clean slide and was then teased out in a drop of 95% ethanol using two pins. Just before the ethanol has completely evaporated a drop of lactophenol blue stain was added and a coverslip was applied the preparation was then left at room temperature for a few minutes to allow the stain to penetrate. Excess stain was then removed by gentle pressure on the preparation through a sheet of blotting paper before viewing with low-power and high-power dry objectives for the different fungi morphological features.

**Results**

Isolates obtained from the layer and broiler poultry house structures and materials were shown in Table 1. From the layer house structures *Aspergillus fumigatus, Aspergillus flavus, Streptococcus faecalis* and *Yeast* were predominant followed by *Aspergillus niger*, *Bacillus sp.*, *Klebsiella sp.*, *Escherichia coli* and *Rhodotorula sp*. Scanty isolate of *Aspergillus terreus* was obtained in both layer and broiler houses. Similar trend was observed for *Aspergillus fumigatus, Aspergillus flavus*, and *Escherichia coli* in broiler house structures. *Streptococcus faecalis*, *Bacillus sp.*, *Pasteurella gallinarum* and *Klebsiella sp.* were isolated in the layer house structures only. *Pasteurella multocida, Salmonella sp.*, and *Pseudomonas aeruginosa* were not isolated from both layer and broiler houses structures. Microbes mix from the layer house structures exhibited the following patterns: cages > windows > floors > drinkers. The broiler house structures pattern was roofs > floors > drinkers > windows. More microbes mix was obtained from layer house structures when compared with that of broiler house structures.

Table 1 also shows the pattern of isolates from the poultry house materials. From the layer house materials *Aspergillus fumigatus, Aspergillus niger* and *Yeast* were predominant followed by *Streptococcus faecalis, Escherichia coli* and *Pseudomonas aeruginosa multocida, Klebsiella sp.*, *Salmonella sp.*, and *Rhodotorula sp.*, were obtained from the layer house materials. From the broiler house materials *Aspergillus fumigatus* and *Yeast* were predominant followed by *Aspergillus niger, Aspergillus terreus, Escherichia coli* and *Rhodotorula sp*. Scanty isolates of *Aspergillus flavus, Streptococcus faecalis, Pasteurella gallinarum*, *Klebsiella sp.*, *Salmonella sp.* and *Pseudomonas aeruginosa* were obtained. *Bacillus sp.*, and *Pasteurella multocida* were
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*Key:*

W = Window nets
R = Roots
F = Floor
D = Drinkers (Concrete slabs outside the house)
C = Cages
Fe = Feeds stock
Fa = Feaces
Fd = Feeders
Et = Egg trays
Ft = Feathers

**Broilers are raised in deep litters on the floor. No cages are used.**

The microbes mix pattern in layer house materials were feathers>egg trays and feeds stock>faeces>feeders>drinkers. The common microbes mix pattern for the two houses was cages and feathers>windows>roofs, floors, stock of feeds, egg trays>faeces, feeders>drinkers. There were no acid fast organisms observed from any of the layers and broilers structures and materials sediment samples using Ziehl-Neelsen stain.

**Discussion**

The study showed that both structure and materials in the poultry houses investigated harbour bacteria and fungi and could be important sources for the dissemination of these microbes. The broiler house structures showed less microbes mix. This might be due to broiler's house frequent restocking, cleaning and resting of the house before restocking with new batch of broiler chickens. However, there are more microbes spread in the broiler and layer house materials. This may be due to
poultry staff activities and frequent interaction with the chickens (feeding, watering, cleaning, weighing etc). During such activities microbes could be transferred from one house to another through fomites. Continuance of similar organism(s) to particular poultry houses within the unit could be due to persistence, cross-infection or reintroduction into new generations of poultry stock. Presence of rats on the farm from adjacent fields could be associated with an additional increased disease risk for the poultry houses and other sources of microbes transfer. In a study by Anjum (1990), disease outbreaks in 133 broiler and 93 layer flocks of various ages were recorded in farms around Faisalabad during 1988. The commonest disease on the farms were; Newcastle disease, feed poisoning, coccidiosis, coli-septicaemia, salmonellosis, infectious bronchitis, fowl cholera, mycoplasmosis. Newcastle disease was more common in broiler than in layers. Diseases such as Newcastle disease, salmonellosis, coccidiosis and avipoxvirus infection were more prevalent in spring than in other seasons; and feed intoxication was commonest in summer.

Feathers in poultry houses can also become a problem although not as much as that of litters. However, at the time of a forced moulting, feathers are shed from most of the birds in a poultry house can become a unique disposal problem. Feathers from such poultry houses can float and form adorous mats on the surface of liquid manure ponds, and these fibrous particles can block drains and pumps and dry feather in particular can be blown by air to other nearby farms serving as a source for spreading diseases. In addition desquamated epithelial cells from feather follicles was found to be permissive for replication of Marek's disease virus. Thus feather sheath cell which are present in large quantities in the poultry house environment could possibly be responsible for air transmission of the virus (Witter, 1970).

Four species of Aspergillus were isolated in this study. These fungi are ubiquitous and as a result likelihood of their contaminating feedstuffs and poultry feeds is high. Mohawed et al. (1995) in a mycological analysis of cow
hair, layer-strains and broiler feathers and flooring materials in Egypt isolated several species of *Aspergillus, Mucor, Penicillium* and *Rhizopus*. The Aspergillus showed a wide range of pathogenic activity in humans, animals and poultry. Almost every body organ has been reported to be affected. The effect on human body includes: Pulmonary aspergiloma, pulmonary allergy (asthma and rhinitis, broncho-pulmonary allergy and farmer's lung); nasal and orbital infections (*Aspergillus terreus* invade nails) causing onychohorumycosis and toxicosis. Aflatoxicosis represents one of the serious disease of poultry, livestock and human caused by ingestion of various feeds contaminated with *Aspergillus flavus, Aspergillus fumigatus*, and *Aspergillus parasiticus*.

*Aspergillus fumigatus* has been documented to cause tracheitis in poultry resulting in difficult respiration and high mortality (Singh et al., 1993). Aflatoxicosis of animals is usually manifested by pathologic changes in the liver, but they have been found to be carcinogenic and teratogenic as well as causing impaired protein formation, unthriftness, coagulation, reductions in weight gains, feed efficiency, feed production and immunity. Animals are variably susceptible to aflatoxins, depending on such factors as age, species, breed, sex, nutrition and certain stresses. Swine, cattle and poultry are the domestic species of greatest economic concern in terms of aflatoxicosis. The poultry industry probably suffers greater economic loss than any of the livestock industries because of the greater susceptibility of their species to aflatoxins than other species (Robens and Richard, 1992). The occurrence of aflatoxins in agricultural commodities depends on factors such as region, season and post-harvest storage conditions (Dada and Bale, 1986).

*Streptococcus faecalis* (*Enterococcus*) can give rise to endogenous urinary tract infections in man. It plays an important role in initiating dental caries and periodontal disease and highly resistant to that and many antimicrobial drugs making treatment difficult. It is also an indicator of high environmental pollution.

Moderate to serious respiratory problems with necrotic pneumonia, growth depression and fast increasing mortality are seen in commercial turkeys and broilers as a result of *Pasteurella* organism. It causes arthritis and economic losses in poultry industry (Confer, 1994; Van-Beck et al., 1994).

The chief cause of bovine mastitis has been documented to be *Escherichia coli*, *Staphylococcus aureus* and *Streptococcus* species. These organisms are significant since cattle graze around the poultry house investigated. *Escherichia coli* can cause diarrhoea in man (Sussanan, 1985). It is also capable of producing exotoxin and endotoxin. Colibacillosis is a major cause of mortality and morbidity in chicken and turkeys and significant economic losses to the poultry industry (Gross, 1991). In poultry, *Escherichia coli* causes acute coli-septicemia, sub acute fibronopulent serositis, yolk sac infection, cellulitis, suroleen head syndrome and coligranuloma. Dead-in-shell embryos or embryonic mortality accounting for high number of lowered hatchability has been associated with *Escherichia coli* and other bacterial infections due to contamination (faeces and dusts) of the surface of eggs from dirty nests (Gross, 1994; Kabilika and Sharma, 1997).

The survival of *salmonella* spp. in feed stocks and feathers in the study is not surprising since salmonella has been documented to be able to survive in many ecological niche causing severe loss to the poultry industry and of public health significance to man. Davis and Wray (1966) have also isolated *salmonellae* from
samples of feed, drinking water, drinking troughs, cloacal swabs, faeces, feed trays, litter from broiler and layer flocks, feed trays, litter from broiler and layer flocks, feed left over in feed trays, water in the main tanks, stock feed, and fan dust. They observed that *Salmonella* contamination appeared to persist preferentially in association with dust particles swept from the floor and in the food troughs. Poultry house and hatchery infections play an important role in transmission of *Salmonella*. *Salmonella* species is a common pathogen of all species of mammals and fowls. *Salmonella* had been incriminated as the cause of outbreaks of foodborne infection in Europe from consumption of poultry meat, milk and eggs (Obuegbu et al., 1993). Transmission of *Salmonella* apparently occurred vertically through the egg and horizontally by contact in the hatcheries and by placement of chicks on contaminated litter (Johnson et al., 1992). Choice of salmonellae strain, phage type, age of bird and inoculum size may affect the outcome of an infection, organism may cause systemic infection in chicks and laying hens accompanied by prolonged faecal shedding (Suzuki, 1994).

The adverse effect of *Pseudomonas aeruginosa* needs no emphasis. It is pathogenic to man and cause severe mortality in poultry (Lin et al., 1993). It has an ability to persist and multiply in wet places and on wet equipment resulting in corrosion of the lining of water tanks and reservoirs. It is an indicator of environmental pollution. It can cause severe diarrhea in infants; and in association with other bacteria make wounds, burns and abscesses difficult to heal. Incase of eye infection could cause perforation and eventual loss of the eye. It is highly resistant to most antibiotics and few drugs of choice are toxic to man.

The yeast and fungi are heterotrophs and scavengers. Unlike most microorganisms, yeast has been of service to man in the bakery, confectioneries. In addition, yeast has been used in the formulation of vegetable protein mixtures for human feeding (Sure, 1946; Bressani and Elias, 1968). However, attempts to use yeast for human consumption have not been encouraging due to economic factors, problems of palatability, intolerance and high nucleic acid content, all of which limit the amounts that can be used in human diets. Yeast has also assumed a significant pathogenic role with increased use of broad-spectrum antibiotics, corticosteroids and antitumor agents. Yeast fungaemia occurs frequently inpatients with indwelling catheters and other prosthetic devices. Yeast endocarditis is also frequent in drug addicts *Candida albicans* and other species of *Candida* are frequently present on the normal mucous membranes of mouth, vagina and intestinal tract. It is responsible for infections in these sites and elsewhere when there is a disturbance of local conditions or impairment of the defense mechanisms. The opportunistic *Candida* infections may occur in pregnancy, minor trauma, and continued expose of the skin to moisture or when diabetes or alcoholism debilitates the individual. Bronchial and pulmonary candidiasis and keratomycosis have also been documented.

**Conclusion and recommendations**

In conclusion, it is advocated that dust should be effectively controlled or reduced in poultry houses. Therefore the possibility of fogging and vacuum cleaning should be exploited in addition to the use of facemask while operating in poultry houses. Also feathers should be gathered together and preferably buried or recycled. Cleanliness of the operators, the poultry house, equipment and surrounding environment should be stressed. It is also recommended that avoidance of all raw or lightly cooked egg dishes should be stressed. In those for whom any risk is unacceptable, this is the only solution. In formulating guidance it is
important to consider the consumer, and the fact that eggs are a nourishing, cheap and convenient food. In infants and children the no-risk policy is advisable. However careful the consumer is, control of the epidemic of *Salmonella* in babies, children and adults requires the eradication of the organism from layer and broiler chicken flocks. Outbreaks of foodborne diseases in humans were associated with the consumption of raw or undercooked hens', eggs. As long as antibiotics are used in poultry feeds one can expect the incidence of antibiotic-resistant foodborne pathogens to rise resulting in foodborne illnesses. This will require rapid identification of causative microbes, tracing the outbreaks where occurred as well as an improved understanding of the pathogenesis of the foodborne diseases. Management can influence the incidence of leg and foot problems via effects on rate of gain, flooring systems and litter moisture. Slippery surfaces should be avoided to prevent spraddled legs. Broilers reared in cages have more leg deformities than floor-reared birds. Dry litter conditions can help prevent footpad dermatitis caused by *Staphylococcus aureus* and other bacteria (Hester, 1994). Data recorded in different country show that the incidence of some of the diseases mentioned above has increased dramatically over the past years, but because of under-reporting the data are of limited value and cannot be compared between countries. In most countries (including Nigeria), individual cases of illness are usually not reported. New developments in policy production and changing trends in feed preparation could lead to the emergence of new hazards. Additionally, because the population is aging and there has been an increase in the number of individuals with underlying disease, the state of public health is deteriorating. Organisms such as *Campylobacter*, *Salmonella* and *entero-hemorrhagic Escherichia coli* are examples of micro organisms that have the opportunity to increase as a consequence of intensive husbandry. *Listeria* and *Aspergillus* are examples of organism that can cause disease in immunosuppressed individuals.

**Areas for further research work**

The principal future research needs include: (i) prospective surveillance of incidence, morbidity, mortality and cost of infection in both layer and broiler houses, (ii) surveillance of targeted complications as a result of poultry diseases and impact of this infections, (iii) case-control and other studies to define more precisely the risk factors for the acquisition of sporadic infection and to measure the proportion of infections attributable to each and (iv) studies to determine how chicken flocks become colonized in these poultry houses and how this can be prevented or reduced.

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