FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
POULTRY DEVELOPMENT REVIEW

Poultry health and disease control in developing countries

Emerging pathogens of poultry diseases

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WHAT IS AN EMERGING PATHOGEN AND HOW IS IT RECOGNIZED?

Emerge = "to come forth into view from concealment or obscurity in background". (Macquarie Dictionary, Macmillan publishers)

As opposed to a specific pathogen that is known to be present as the cause of a recognizable poultry disease, an emerging pathogen is a specific microbe that can be shown to be the causative agent of a disease that:

i. has been recognized previously, but the cause has remained unclear; or
ii. is a new disease syndrome that has not appeared previously.

The usual sequence of events in the emergence of a disease generally starts with a novel disease becoming apparent to industry veterinarians and supporting diagnostic laboratories in a country, or sometimes simultaneously in several countries. Serological and virological investigations will often exclude the obvious involvement of currently known poultry pathogens. If the disease losses caused by this new pathogen are likely to be significant, further investigations will be undertaken in the research laboratory to clarify the pathogenesis of infection, means of transmission, immunity mechanism, and potential for vaccine development or eradication, depending on which is the most appropriate approach.

Cultivation of the microbial agent outside the host will usually permit serological screening to establish the prevalence of infection in flocks. Diagnostic investigations may include retrospective studies of previously unresolvable field disease problems, such as avian leukosis (subgroup-J) (Example 1).

The nature and intensification of the poultry industry make it seem likely that high numbers of specific pathogens will have to be excluded or prevented by vaccination at production sites, and that many pathogens will have arisen or been recognized as emerging in recent decades.

The industry is not unique in this regard among the intensive animal industries (pigs, poultry and fish), but pathogen-host dynamic interactions occur on a huge scale and are frequent within the poultry industry globally. Among production animal species, poultry have a uniquely short generation interval and must be reproduced continually, with probably about 100 million individual animals a day across the world's poultry industries. Vaccination is an essential measure for protecting poultry stocks against a range of dangerous pathogens, and during this protection process, the host's immunity continually exerts selection pressure on these poultry pathogens.

Viral pathogens, particularly those with ribonucleic acid (RNA) genomes (e.g., infectious bronchitis, Newcastle disease, infectious bursal disease viruses, and avian retroviruses such as avian leukosis virus), are all susceptible to the development of point mutations during replication of the genome. These viruses appear to lack effective proof-reading mechanisms for control of viral translation and repair of mutations during replication. Payne (2001) estimates that the rate of point mutations in avian retroviruses is as high as one per million virions, occurring within just one twelve-hour cycle of replication.

As viruses are continually mutating, so it must be accepted that new virus strains and disease problems will emerge in the future.

Several examples of poultry pathogens that have emerged in the last decade or so are given in the following, along with a brief explanation of the mechanism(s) involved in their emergence.

Example 1: Avian leukosis (subgroup-J) virus

This pathogen developed by genetic recombination in the field between two avian retroviruses. Between 1995 and 1998, neoplasms were observed in young breeders, leading to major losses of broiler breeders worldwide. This was due to primary breeding companies having genetic stock contaminated with ALV-J, the progeny from which were then exported to more than 50 countries. Retrospective virological and serological examinations by Payne (2001) and his laboratory group showed that this virus was circulating in the United Kingdom as early as 1989, with infections in some flocks sporadically producing tumours then in broiler breeding stocks.

Example 2: Newcastle disease.

The emergence of virulent NDV from lentogenic strains of Newcastle disease in Australia from 1999 to 2001 has been closely investigated and scientifically proven using molecular epidemiology.

Example 3: Highly pathogenic avian influenza.

Because of its zoonotic potential, the emerging poultry disease of greatest concern worldwide has been avian influenza, whether HPAI H5N2 (China, Hong Kong Special Administrative Region in 1999 and 2001) or HPAI H5N1 (in Asia from 2003 onwards, spreading to some 60 countries worldwide). This pathogen has subsequently been eradicated from all developed poultry industries, but is persisting as an endemic infection of poultry in several continents.

THE MECHANISMS FOR A POULTRY PATHOGEN'S EMERGENCE

Genetic changes

These can occur in a pathogen through accumulation of point mutations in the genome or even recombination and reassortment of gene sequences. These changes sometimes result in an altered pathogen with the ability to multiply more effectively in the host. Initially these changes may not be recognized, but as the mutant strain of the pathogen multiplies, becomes better adapted to the host, and spreads within flocks and among production sites, disease problems can become apparent – emerge – against the background of normal expected levels of losses during production activities.

The co-evolution of viral pathogens with their vaccines and medications

As do any other organisms, poultry pathogens tend to change and evolve. Antigenic change results from genetic control, and can be accelerated under immune pressure. Immune responses are geared to controlling pathogens, and include antibody production and T-cell activation against pathogen-specific protein structures, which are those most likely to change over time. Medication with antibacterial or anticoccidial drugs exerts similar effects over time. Continued treatment against coccidiosis or bacteria with the same unchanging drugs, especially with subtherapeutic doses, tends to promote the emergence of resistance to those antimicrobial or anticoccidial drugs.

REFERENCES

Payne, L.N. 2001. Avian leukosis virus – new mutations: A threat for the upcoming century. *World's Poultry Science Journal*, 57: 265–274.