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Research paper

Antiviral Drug Strategies to Control Poultry and Livestock Diseases

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Abstract: Livestock and poultry are vital components of the agricultural industry, providing essential food products such as meat, milk, and eggs, as well as raw materials like leather and wool. However, viral diseases affecting these animals can spread rapidly, leading to significant economic losses and posing a challenge to disease control. Developing effective antiviral strategies is therefore essential for mitigating the impact of such infections, safeguarding animal health, and ensuring sustainability in the livestock and poultry sectors.

Keywords: Livestock, Poultry, Viral Diseases, Antiviral Drugs

Introduction:

Livestock and poultry are highly susceptible to various viral infections that adversely impact global food security and animal welfare. These diseases reduce productivity, disrupt markets, increase production costs, and may cause trade restrictions. Rapid transmission, high morbidity, and frequent co-infections complicate disease management. Vaccines are not always effective, and indiscriminate drug use contributes to antimicrobial resistance.

This review examines major respiratory infections in poultry, including those caused by infectious bronchitis virus, avian influenza virus, Newcastle disease virus, and others. It also addresses environmental and management factors, detection technologies, and vaccine development. The article highlights current challenges and emerging antiviral strategies, offering insights into prevention and control measures.

Common Poultry Diseases:

Poultry diseases are caused by a combination of viral, bacterial, mycoplasma, and chlamydial pathogens, often exacerbated by poor hygiene, overcrowding, and inadequate management (Fig. 1). Major viral diseases include:

Avian Influenza (AI): Highly pathogenic strains like H5N1 and H7N9 cause severe respiratory illness and high mortality. Certain strains can infect humans (Yehia et al., 2023).

Newcastle Disease (ND): A contagious viral disease affecting chickens, causing

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respiratory and neurological symptoms with significant economic losses.

Infectious Bursal Disease (IBD): Affects young chickens, causing immunosuppression, poor growth, and increased susceptibility to secondary infections (Roussan et. al., 2008).

Other notable respiratory infections include those caused by infectious bronchitis virus, infectious laryngotracheitis virus, and avian metapneumovirus (Nagimudeen et al., 2021; Wu et. al., 2022; Nakamura et. al., 1996).

Challenges in Treating Viral Diseases

Several challenges hinder effective treatment of viral infections in livestock and poultry:

Viral Mutation: Rapid genetic mutations lead to new variants, reducing drug efficacy.

Limited Broad-Spectrum Antivirals: Most antivirals are virus-specific.

Intracellular Replication: Viruses replicate inside host cells, making targeted drug delivery difficult.

Host Immune Response: Modulating the immune system is complex and requires precision.

Drug Resistance: Overuse of antivirals may result in resistance, diminishing treatment effectiveness.

Addressing these challenges requires interdisciplinary research and innovative therapeutic approaches (Kelly et. al., 1994).

Antiviral Drug Development Process

The development of antiviral drugs involves several key steps:

Target Identification: Pinpointing viral components essential for replication or entry.

Drug Design: Designing compounds to disrupt viral processes using computational modeling.

Compound Synthesis: Creating and optimizing candidate molecules in the lab.

1. **In Vitro Testing:** Evaluating antiviral efficacy and safety using cell cultures.
2. **Animal Models:** Testing in relevant animal species to assess pharmacokinetics and safety.
3. **Preclinical Trials:** Determining optimal dosage and delivery routes.
4. **Regulatory Approval:** Submitting data to obtain authorization from regulatory bodies.
5. **Clinical Trials:** Testing in target populations under field conditions.
6. **Post-Marketing Surveillance:** Ongoing monitoring for adverse effects and long-term efficacy.

Disease Surveillance

Surveillance is critical for early detection and containment of viral outbreaks:

Passive Surveillance: Relies on stakeholders to report disease symptoms.

Active Surveillance: Proactive sampling of animals regardless of clinical signs.

Laboratory Testing: PCR, serology, and viral isolation techniques are used.

Epidemiological Investigations: Analyze patterns and risk factors.

Reporting Systems: Centralized databases enable coordinated responses.

Vaccination:

Vaccination is a key preventive strategy that reduces disease prevalence and severity (Kelly et. al., 1994; Hassan et. al., 2016). Vaccines are available against various diseases such as:

Newcastle Disease: Live or inactivated vaccines via eye drops.

Infectious Bronchitis: Serotype-specific vaccines.

Avian Influenza: Subtype-specific vaccines (H5, H7).

Other vaccines include Fowlpox, Marek's, Gumboro, and Vector-based vaccines (Fig.

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2). Vaccination schedules and administration routes vary (Figs. 3 & 4).

Treatment Protocols and Monitoring

Treatment protocols should be developed in consultation with veterinary experts, detailing:

- Drug selection and combinations.
- Dosage and administration.
- Duration and frequency.

Regular monitoring of treated animals helps evaluate outcomes and adjust strategies.

Compliance and Education

Ensuring adherence to protocols and educating stakeholders on biosecurity, proper drug use, and early disease detection is essential. Training programs enhance awareness and capacity for effective disease control.

Research and Development

Ongoing R&D is vital for:

- Discovering new antivirals.
- Understanding host-virus interactions.
- Incorporating novel technologies into disease control programs.

Efforts should be tailored to regional needs and disease prevalence (Kelly et al., 1994).

Advancements in Antiviral Drug Development

Recent advances include:

Broad-Spectrum Antivirals: Target multiple viruses or viral families.

RNA-targeting Therapies: RNA interference and antisense oligonucleotides.

Host-Targeted Therapies: Modulate host cellular functions to prevent viral replication.

Nanotechnology: Targeted drug delivery via nanoparticles.

Immunomodulators: Boost host immune defences.

Artificial Intelligence: Speeds up drug discovery and design.

These innovations promise enhanced efficacy and preparedness against viral threats.

Conclusion:

An integrated approach combining antiviral drugs, surveillance, vaccination, and biosecurity can effectively control viral diseases in livestock and poultry. This not only ensures animal health and economic stability but also contributes to global food security and public health resilience.

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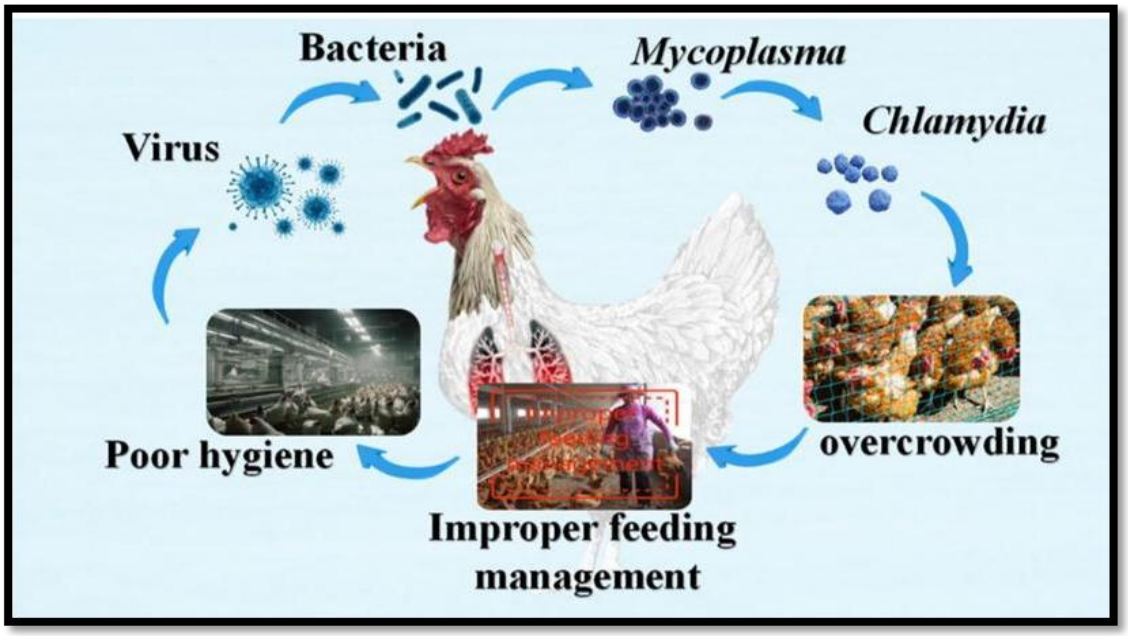

Figure: 1. Most common cause of poultry industry.

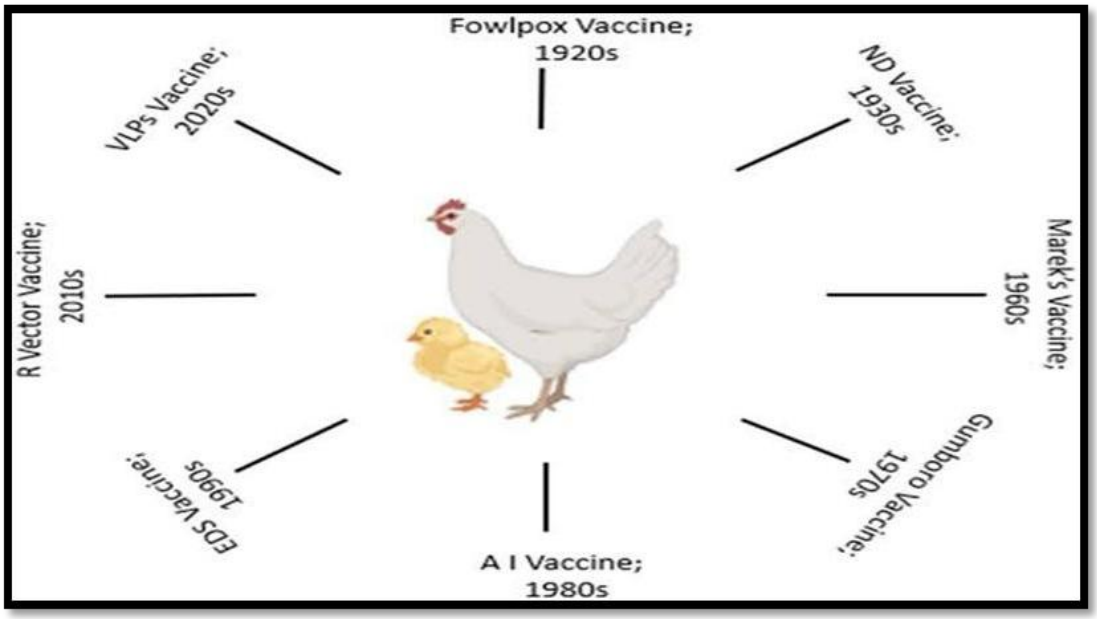

Figure: 2. Common Vaccines used in poultry industry.

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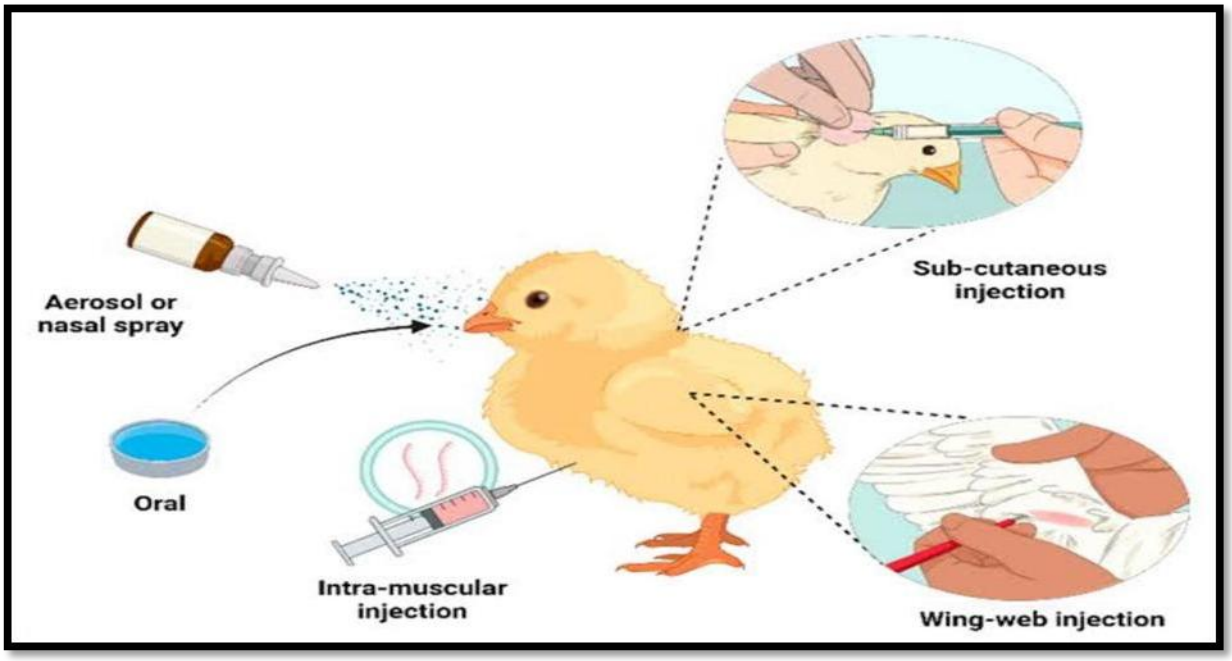

Figure: 3. Common route of administration of drugs in poultry industry.

DAY	VACCINE / DRUGS	ROUTE
1	Multivitamins	Oral
2-6	Antibiotics	Oral
8	1st Gumboro vaccine	Oral
10	1st Lasota Vaccine	Oral
12- 14	Coccidiostat	Oral
16	2nd Gumboro Vaccine	Oral
18	2nd Lasota vaccine	Oral
27	3rd Gumboro Vaccine	Oral
29	Coccidiostat	Oral
31	3rd lasota Vaccine	Oral
33 – 37	Antibiotics	Oral
42	Dewormer	Oral
44	Coccidiostat	Oral

Figure: 4. Common vaccination schedule used to be followed in the poultry industry.