Avian Botulism: A Growing Threat to Wetland Birds in Rajasthan

Balram Yadav[1]*, Balwant Kumar[2] and Mamta Meel[3]

[1]Assistant Professor, Department of Veterinary Pathology, Shekhawati Veterinary College, Kochhor, Sikar, Raj. (332001)
[2]Assistant Professor, Department of Veterinary Physiology, Shekhawati Veterinary College, Kochhor, Sikar, Raj. (332001)
[3]PhD Scholar, College of Veterinary and Animal Science, Vallabhnagar, Navania, Udaipur, Raj. (313601)

Corresponding Author
Balram Yadav
Email: rbryadav95@gmail.com

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ABSTRACT

Avian botulism is a toxin-mediated paralytic disease caused by *Clostridium botulinum*, posing a serious threat to wild and domestic bird populations worldwide. In Rajasthan, India—particularly in wetlands such as Sambhar Lake—recurrent outbreaks have resulted in significant mortality among migratory and resident birds. Environmental factors such as high temperature, low water levels, and organic matter accumulation promote toxin production. Transmission occurs primarily through ingestion of toxin-contaminated food, especially via the carcass–maggot cycle. Clinically, affected birds exhibit progressive flaccid paralysis, including the characteristic "limberneck." Although treatment options exist, they are impractical during large outbreaks. Prevention depends on environmental management, carcass disposal, and early disease surveillance. This article presents a comprehensive overview of avian botulism with special reference to Rajasthan, integrating epidemiology, transmission, clinical signs, treatment, prevention, and case studies.

INTRODUCTION

Wetlands are among the most productive ecosystems on Earth, supporting a vast diversity of flora and fauna. Rajasthan, despite its arid climate, hosts important wetlands that serve as critical stopover sites for migratory birds. However, these ecosystems are increasingly under threat from environmental degradation and disease outbreaks.

One of the most alarming diseases affecting wetland birds is avian botulism, a paralytic condition caused by toxins produced by *Clostridium botulinum*. Type C toxin is most commonly associated with birds (Merck & Co., 2023).

Unlike contagious diseases, avian botulism spreads through environmental exposure, making it particularly dangerous in wetland ecosystems. Outbreaks in Rajasthan have been frequently reported from Sambhar Lake, highlighting the need for urgent attention (Agriculture Victoria, 2023).

1. Understanding Avian Botulism

1.1 Etiology

Avian botulism is caused by *Clostridium botulinum*, an anaerobic, spore-forming bacterium. The organism produces potent neurotoxins that block nerve impulses, leading to paralysis (USGS, 2023).

1.2 Types of Toxin

- Type C – Most common in birds.
- Type E – Occasionally reported in aquatic birds (Merck & Co., 2023).

2. Epidemiology and Risk Factors

Outbreaks are strongly influenced by environmental conditions:

- High temperature.
- Low water levels.
- Organic matter accumulation.
- Anaerobic (low oxygen) conditions.

These factors promote bacterial growth and toxin production (USGS, 2023).

Seasonally, outbreaks are most common during late summer and post-monsoon periods, when water stagnation and decomposition increase (Cornell Wildlife Health Lab, 2022).

3. Mode of Transmission

Avian botulism is not contagious; it spreads through ingestion of toxin.

3.1 Carcass–Maggot Cycle (Primary Route)

C. botulinum spores in environment
↓
Favorable conditions (heat, low oxygen)
↓
Toxin production
↓
Bird dies → carcass
↓
Maggots feed on carcass
↓
Maggots accumulate toxin
↓
Healthy birds eat maggots
↓
New infections → cycle continues

(USGS, 2023)

3.2 Other Routes

- Contaminated water ingestion (Massachusetts Division of Fisheries and Wildlife, 2022).
- Food chain transmission via fish/invertebrates (Cornell Wildlife Health Lab, 2022).

4. Pathogenesis (Disease Mechanism)

Toxin ingestion
↓
Absorption into bloodstream
↓
Blocks acetylcholine release
↓
Flaccid muscle paralysis
↓
Respiratory failure
↓
Death

(Pennsylvania Game Commission, 2022)

5. Clinical Signs

Affected birds show characteristic neurological symptoms:

- Weakness and lethargy.
- Inability to fly or walk.
- Neck paralysis ("limberneck").
- Drooping wings.
- Eyelid paralysis.
- Respiratory distress.

Death often occurs due to respiratory failure or drowning (Pennsylvania Game Commission, 2022).

6. Diagnosis

Diagnosis is based on:

- Sudden mass mortality.
- Typical clinical signs.
- Absence of gross lesions.
- Laboratory toxin detection.

Early field diagnosis is essential for outbreak control (USGS, 2023).

7. Treatment

Treatment is rarely practical in wild outbreaks:

- Supportive care (clean water, shelter).
- Antitoxin therapy (early stages only).

Most severely affected birds die despite intervention (Merck & Co., 2023).

8. Prevention and Control

8.1 Prevention Flowchart

Early detection
↓
Carcass removal
↓
Break maggot cycle
↓
Improve water management
↓
Reduce organic pollution
↓
Prevent outbreaks

8.2 Key Strategies

- Rapid carcass removal (USGS, 2023).
- Maintain water levels (Agriculture Victoria, 2023).
- Reduce pollution and eutrophication.
- Continuous surveillance (Cornell Wildlife Health Lab, 2022).

9. Rajasthan Case Study: Sambhar Lake Outbreak (2019)

The 2019 outbreak at Sambhar Lake was one of the largest avian mortality events in India.

Key Facts:

- 18,000–22,000 bird deaths (Kumar *et al.*, 2020).

- Affected species: flamingos, pelicans, ducks.
- Cause: botulinum toxin (Merck & Co., 2023).

Contributing Factors:

- High temperature and low water levels.
- Salinity imbalance.
- Organic matter accumulation.
- Carcass–maggot cycle (Kumar *et al*., 2020; USGS, 2023).

10. Recent Outbreaks (2024–2025)

Sambhar Lake continues to experience outbreaks, with hundreds of bird deaths reported (Down To Earth, 2024).

These recurring events indicate:

- Environmental persistence of the pathogen.
- Climate sensitivity of outbreaks.
- Need for long-term ecological management (Ontario Ministry of Agriculture, 2023).

11. Why Rajasthan is Highly Vulnerable

- Extreme temperature fluctuations.
- Seasonal wetlands.
- High migratory bird density.
- Increasing pollution.

These factors create ideal conditions for botulism outbreaks (Cornell Wildlife Health Lab, 2022).

12. Ecological and Economic Impact

Avian botulism outbreaks result in:

- Loss of biodiversity.
- Disruption of migratory patterns.
- Economic impact on tourism.
- Ecological imbalance.

13. Future Directions and Recommendations

- Strengthen wetland conservation policies.
- Improve disease surveillance systems.
- Promote research on avian diseases.
- Increase public awareness.
- Develop rapid response teams.

CONCLUSION:

Avian botulism is a serious ecological and veterinary concern in Rajasthan. The repeated outbreaks at Sambhar Lake highlight the urgent need for integrated management strategies. Effective prevention requires a combination of environmental management, scientific monitoring, and policy intervention.

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