

NC STATE UNIVERSITY

Understanding and Managing Microbial Challenges



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Zoetis

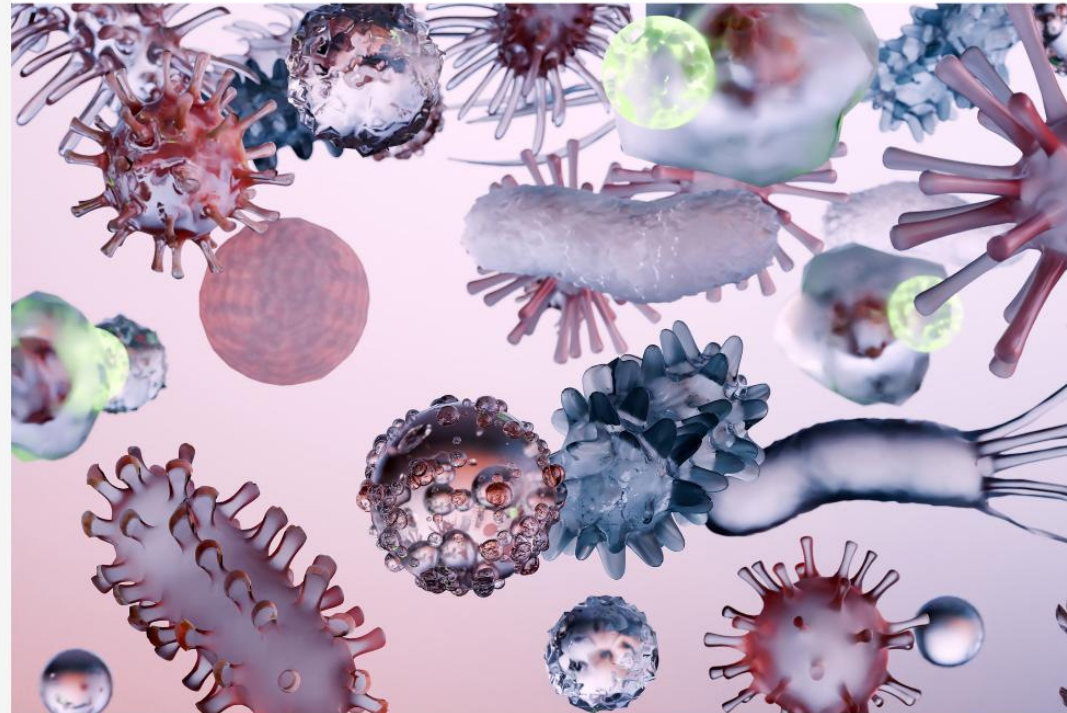
Introduction

Managing microbial challenges in a hatchery requires multiple control points and interventions.

A good monitoring program is essential to identify high-risk areas for microbial contamination in the hatchery, to evaluate the effectiveness of chosen interventions and to take further actions if necessary.



'Microbes' can refer to many organisms: this module focuses on bacterial and fungal control.



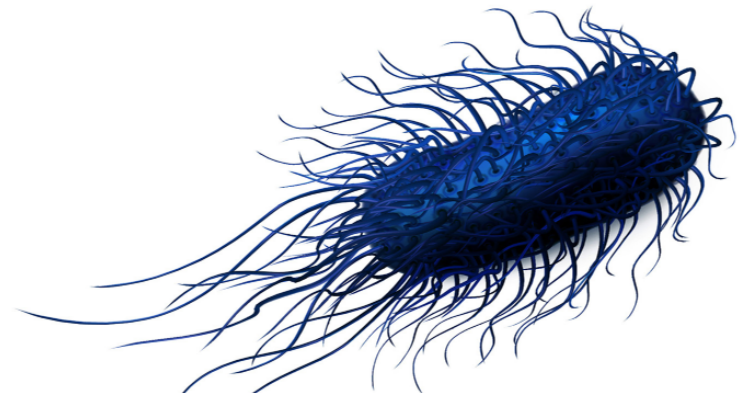
Why is microbial control important?

Starting with good quality chicks is essential to the success of a production cycle and becomes especially relevant with shorter grow out cycles, and to support more responsible antibiotic usage.

Microbial contamination of the egg and the day-old chick can occur during egg formation (vertical transmission), through contact with dirty materials or through horizontal transmission.


Microbial contamination in the hatchery leads to decreased hatchability, a higher amount of poor-quality day-old chicks and subsequent poor on farm performance¹.

Age-related susceptibility to infection with microbes like *Salmonella enteritidis*² makes preventing early challenge in the hatchery very important.



Microbial monitoring in the hatchery


Data obtained from microbial analysis can be used in troubleshooting, to evaluate risk and to assess the impact of control measures.

- ▶  Sampling aims to detect, enumerate, and identify microbes. Common sample types are contact plates or swabs (to sample surfaces), and air plates (to sample air). Adenosine triphosphate (ATP)-linked bioluminescence can be used to detect contamination with organic materials.



Areas expected to have a high microbial load, and (or) will directly or indirectly contact the eggs and chicks are '**high-risk areas**'. These areas must be sampled. **High-risk areas include the ventilation system, water used in the hatchery, egg storage room, hatcher, vaccine preparation room and anything that touches the eggs or chicks** (such as trays, hatcher baskets, and vaccination and processing equipment).



- ▶  Although there can be good correlation between microbial loads in the air with loads on surfaces, it is not always the case³: take samples of both.

A sampling standard operating procedure (SOP) should be specific to the hatchery and use a combination of sample areas and types. This SOP should be easy to access, with the team well trained on both the SOP and the required sampling methods.

Trending data can be useful as an early warning tool and to determine the impact of interventions. To facilitate trending, standardise the sample methods and use sample materials that are readily available.

Bringing in a third party to audit the sampling procedures and SOP helps to confirm that the monitoring program is still working and relevant.



The egg is not defenceless⁴

A key part of microbial control is supporting the innate defences of the egg.

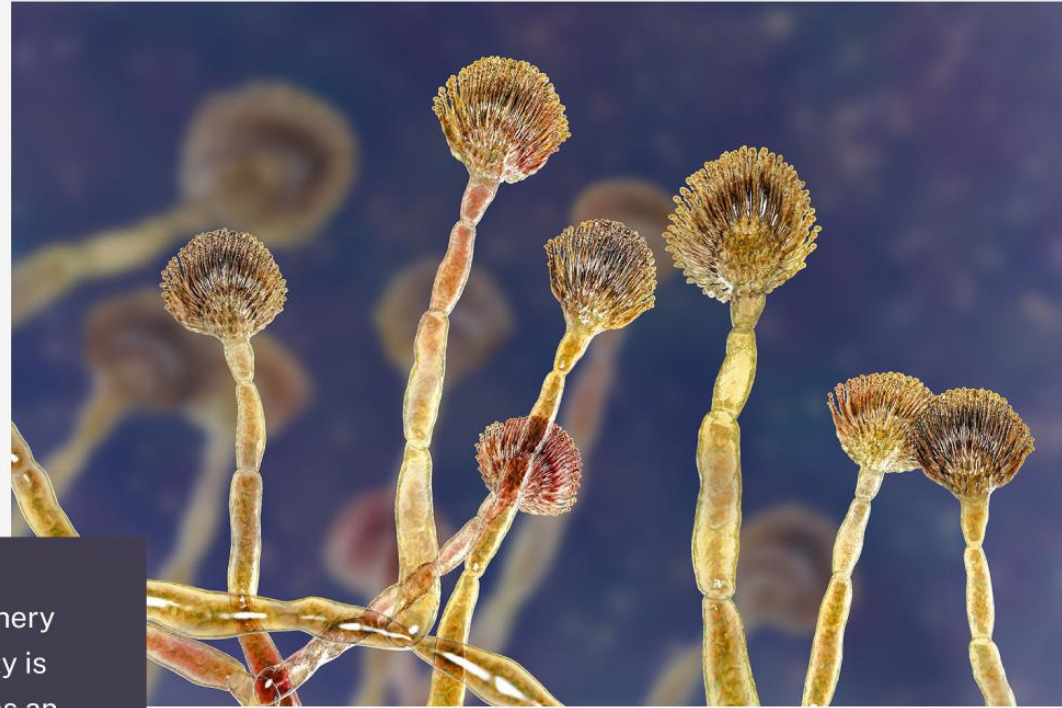
- ▶ The **cuticle** (the first barrier against microbial contamination) reduces permeability for bacteria, providing protection in the first 96 hours post-lay.
- ▶ The second barrier is the **porous eggshell**. Outer and inner shell membranes made of glycoprotein fibres containing antibacterial substances form the third barrier.



- ▶ The **albumen** is the next substantial defence mechanism. It holds the yolk away from the shell, impedes movement of microbes (highly viscous), increases in pH as carbon dioxide is lost, contains proteins with antimicrobial properties, and lacks readily available water and suitable nutrients to support microbial growth.
- ▶ The final barrier to the yolk is the **vitelline membrane** which acts as a physical barrier while also containing lysozyme.

What microbes are we worried about?

While predominantly Gram-positive bacteria are found on the shell post-hatch, more Gram-negative bacteria and fungi can be found on the inside of the egg⁵. Co-infections can result in higher neonatal mortality⁶.




An important microbe associated with hatchery contamination and first week chick mortality is *Aspergillus fumigatus*. The hatchery provides an ideal environment for this fungus to thrive.


Managing microbial challenges — overall rules

1. **Proper hatchery design** (good biosecurity, unidirectional process flow, easy cleaning, layout for easy expansion) supports microbial control.
2. Start with **good quality eggs** and support that quality as best as possible.
 - a. Visibly dirty eggs and floor eggs can carry larger amounts of bacteria on their surface^{7,8}. These eggs are a risk to set. A small percentage of dirty eggs can dramatically increase the number of bacteria carried into the hatcher.
 - b. The integrity of both the cuticle and the shell is important to prevent microbial penetration into the egg. Damage to the cuticle can be caused by physical factors, chemical factors, and by egg storage conditions. The integrity of the shell can be compromised by stress, improper nutrition, disease, and poor handling. Cracks can significantly impact on both hatchability and total embryo mortality⁹.
 - c. Increased storage and poor handling can compromise the structure and function of albumen.


3. An ideal ventilation system removes waste air, brings in clean air, aids in supporting an optimum environment, while preventing cross contamination between rooms.

 Clean (including changing filters) and sample the ventilation system frequently.

4. All water sources in the hatchery require frequent microbial and chemical testing.

 Microbial tests detect microorganism challenge and help assess the efficacy of water treatment and chemical tests assess parameters like pH or hardness which impact disinfectant efficacy and damage equipment.

5. Cleaning often and thoroughly throughout the hatchery prevents the level of dirt becoming impossible to deal with. Disinfection does not replace cleaning. In the presence of organic materials, disinfectants can lose effectiveness or may be unable to reach microbes.

 A thorough clean with water and detergent before applying disinfectant remains important. If there is a build-up of mineral scale and (or) biofilm, it may be beneficial to add a monthly acid wash.



Managing microbial challenges — added guidance for specific areas

1. The **egg storage room** should be a separate area dedicated only to egg storage.



Control temperature and humidity to suspend development of the embryo while hindering further microbial growth.

2. **Chicks hatching in setters introduce microbial contaminants** and extra debris into the machine: therefore, chicks hatching in setters need to be avoided.

Cleaning needs to be adapted according to setter type. Single-stage machines allow for complete cleaning after transfer. Multistage machines require planning to prevent spreading microbes to remaining eggs. Regardless of setter type, any broken eggs should be cleaned up immediately.



3. With substantial amounts of organic material from hatching chicks, **hatchers, hatcher bays and associated plenums are one of the most contaminated areas in the hatchery.** Exposure to microbial challenge in the hatcher can impact production¹.

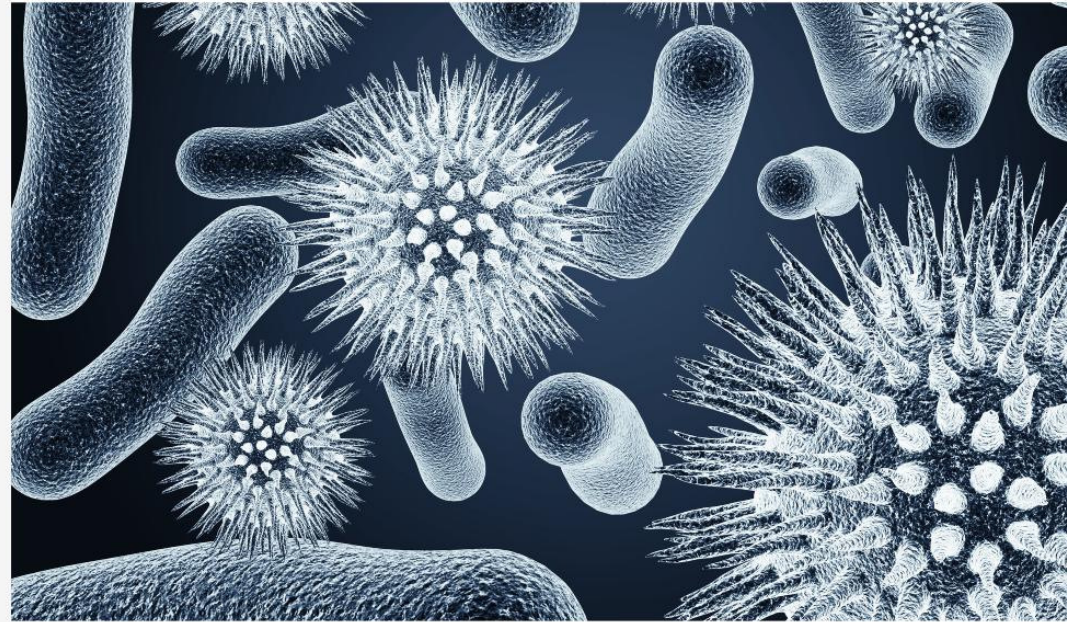
a. Going into the hatcher, keep the potential microbial load low. Remove clears and early embryo deaths at transfer to help decrease the potential microbial load. Handle eggs gently to reduce the chance of cracking. Avoid unnecessarily touching eggs as this can promote cross contamination. (An automated egg removal and transfer system can help with these points.)


b. Transfer eggs into clean, dry and warm hatcher baskets to limit potential contamination of chicks at hatch.

- c.** Incorrect environmental conditions and pulling time can cause increased stress and affect the quality of the chick, affecting its robustness.
- d.** After each hatch, thoroughly clean and disinfect the hatcher and plenum and allow them to dry.



4. To help prevent vaccination from spreading contamination, control access to the vaccination preparation room and ensure correct storage of the vaccine and all associated materials. Follow proper vaccine application procedures. Clean, disinfect, and store application equipment as per the manufacturer's recommendations.
5. Automatic washers are included in the microbial monitoring program as they can spread contamination. Confirm that water used for washing trays and baskets is at the correct temperature with chemicals added at the right concentration.



- ▶  As microbes can survive in moist environments, trays and baskets should be moved to a clean room to properly dry after washing. Trays and baskets need to be checked to confirm that they have been properly cleaned. Cleaning will need to be repeated if there is residual dirt. Even if a tray or basket appears clean, always follow up with samplings there may still be microbial contamination.

Practical guidelines for maximising the efficacy of disinfectants



Ideally, disinfectants should be suitable for the targeted area, safe to work with, easily applied on a large scale, non-corrosive, reliably supplied and cost effective.



To get the best effect from a product, follow the advice from the manufacturer. Using a product off-label can impact efficacy and introduce unexpected risks.

Improper storage of disinfectants can affect their potency. Expired disinfectants should not be used.

Availability of different active ingredients depends on the market. Even if active ingredients between products are the same, formulations can differ between suppliers, therefore it is important to follow the manufacturer's advice.

Conclusion

The aim of a hatchery is to **provide the maximum amount of good quality chicks to support successful production.** Microbial control at the hatchery is critical to support the quality and number of chicks produced.



A robust microbial control program requires multiple control points and interventions, especially around 'high-risk' areas.



As it is impossible to manage what is not measured, a good monitoring program is essential to ensure that microbial control in the hatchery is effective.





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