2. Hatching egg sanitation: from the hen to the hatchery

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Good starts for broiler and broiler breeders rely on optimum chick quality, which can affect early uniformity in pullets and first week bodyweight of broilers.

Several factors can affect chick quality, including hatching egg condition. It is crucial to understand the structures of the egg protecting it and how to prevent contamination of the egg. Hatching egg sanitation starts after oviposition and also during development in the reproductive tract.

During egg formation

Hatching egg sanitation begins within the hen. There are multiple poultry pathogens that can be vertically transmitted from hens to their progeny, including salmonella, mycoplasma, fowl adenovirus, and chicken infectious anaemia virus. In the oviduct, select pathogens can contaminate the yolk and albumin. Pathogens may also infect the egg during passage through the cloaca. Contamination of eggs is not limited to females. Males can deliver pathogens through semen during mating. For these reasons, biosecurity and vaccination play key roles in preventing hatching egg contamination while they form.

The cuticle is an invisible structure consisting mainly of glycoproteins that protects eggs from bacterial penetration. It is the outermost layer of the eggshell deposited during the last 1-2 hours of eggshell formation in the shell gland. Cuticle deposition can be impacted by many factors, including egg retention and calcium surface deposits. Rodent and insect annoyances, improper feeding space, and other environmental stressors can also interfere with proper cuticle deposition.

After laying

The cuticle is a thick viscous liquid and does not fully mature until around six hours after oviposition. The dry cuticle is a physical barrier and has antimicrobial properties. The drying process begins due to temperature and humidity differences between the hen's body and the barn environment. If relative humidity in the environment is high or there is damp material in the nest, the drying process will be delayed, which will increase the contamination risk. Maintaining a hygienic nest environment, with routine cleaning of the nest mat or frequently replacing the bedding material, will reduce the risk of bacterial contamination.

Fumigation or disinfection of hatching eggs on the farm should be applied as soon as possible to prevent bacterial penetration before the cuticle matures. Eggs should be treated with chemical-based antimicrobials — scraping, rubbing, or washing the eggshell will damage the cuticle and remove the physical and antimicrobial barrier. Since the eggshell permeability increases after 24 hours and makes the eggs more susceptible to bacterial invasion, the eggs should be sanitised as soon as possible. Thus, if fumigation or disinfection on the farm is not possible, eggs should be sanitised at the hatchery as soon as they are received.

Negative pressure

After oviposition, the egg experiences two rapid drops in temperature:

- Before/after oviposition: 41˚C to 20-30˚C
- Nest box to egg room: 20-30˚C to 15-20˚C

These drops in temperature create an inward suction pressure on the cuticle, which can draw bacteria into the eggshell pores. The risk of bacterial contamination increases if the cuticle layer is insufficient; the hatching egg was laid in humid or unhygienic conditions; or improper fumigation, disinfection, or cleaning was applied to the eggs. Moisture on the hatching eggs or in the environment can facilitate bacteria penetration of the eggshell. Negative pressure is unavoidable as

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Table 1. Condensation (dew) point of hatching eggs exposed to increases in temperature.

Outside air temperature exposed (˚C)	Outside % relative humidity exposed							
	90	80	70	60	50	40	30	20
41	38	36	34	32	28	24	18	16
38	36	34	32	29	26	22	17	13
35	33	31	29	26	23	19	15	11
32	31	28	26	23	20	17	12	
29	27	26	23	21	18	14		
27	25	23	21	18	15			
24	22	20	18	16				
21	19	17	15					
18	17	15						
16	14							

Hatching egg temperature (˚C)

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hatching eggs must be cooled before incubation. Therefore, care must be taken after oviposition and during cuticle drying to reduce the risk of egg contamination through negative pressure.

Condensation

Condensation (also referred to as sweating) occurs when cold eggs are exposed to a warmer and more humid environment. Condensation on eggs commonly occurs during transportation in air-conditioned trucks when the doors are opened, and outside air fills the truck.

In cases where egg delivery trucks do not have air conditioning in the cargo hold, it is recommended to deliver eggs at night when ambient temperatures are lower.

Condensation of eggs is more common in hot and humid climates but can happen in other regions depending on humidity. Table 1 describes the dew point according to hatching egg temperature, outside temperature and relative humidity (RH). For example, if the hatching egg temperature is 20°C and it is exposed to 24°C with 80% RH, condensation will begin.

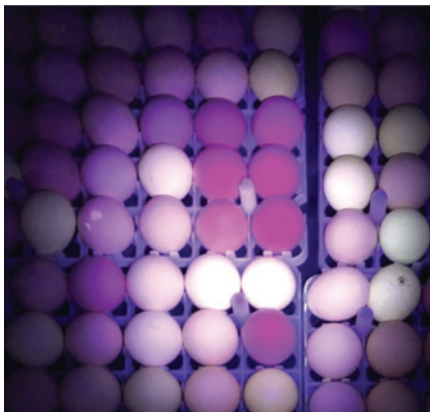
Condensation facilitates bacteria entering the eggshell, especially when the cuticle is damaged. To prevent condensation, the temperature must be strictly regulated when eggs are on the farm and transferred to the hatchery. If the temperature cannot be regulated, it is recommended to transport eggs from the farm to the hatchery cold room on the day eggs are laid. In general, the temperature should always decrease after oviposition along the way to the egg room of the hatchery. The temperature should never increase until it is time to prewarm or set the eggs for incubation.

Hatching egg disinfection

Formaldehyde fumigation is a traditional and effective method for hatching egg disinfection. However, it is not permitted in all countries as it is a human carcinogen. If allowed by law, single to triple doses can be considered based on contamination risk at each complex. Because of the restriction of formaldehyde use in some regions, spray or aerosol disinfection is preferred and works as well as fumigation. However, spraying or aerosolising can damage the cuticle, therefore eggs should not be handled after treatment.

Table 2. Formaldehyde fumigation guidelines/m³

	Formalin (ml)	+	Potassium permanganate (g)	Paraformaldehyde powder (g)
Single dose	14		7	3.5
Double dose	28		14	7
Triple dose	42		24	10



Incomplete cuticle by UV light. A paler colour indicates an inferior cuticle.

Contamination in hatchery

Humidifiers throughout the hatchery can create a common source of contamination. If the water system is contaminated with biofilms, hatching eggs can be continuously exposed to bacteria during incubation. Regular sanitising schedules of your humidification system and having a filtration unit in place can help reduce the risk.

Conclusion

A strong sanitation programme is key to producing and protecting high-quality hatching eggs. It is important to monitor, validate, and audit the sanitation programmes on the farm and at the hatchery. Through monitoring and auditing, areas with deficiencies can be identified and corrected to continue producing high-quality hatching eggs. ■

Fig. 1. Key areas to control bacterial penetration from hen to hatchery.