

To wash, dip, rinse, spray, or leave alone...

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Should hatching eggs be washed, dipped, rinsed, sprayed, or simple left alone? A common and often hotly debated topic among hobbyists. The best answer? Unfortunately, there is no single correct answer and the best answer rests in a complex web of details. In developing this article, I examined a large number of evidence-based papers, considered a backyard hobbyist's limitations, and then formulated a feasible and effective approach for the majority of hobbyists. If a person has a method that works well for them, they should not alter that method.

VERTICAL TRANSMISSION: Vertical transmission is where a hatching egg becomes contaminated with microbes during the egg forming process – the microbes come from inside the hen. This article does not address vertical transmission and deals only with horizontal transmission – contamination from outside the hen.

MOTHER NATURE'S DESIGN

Mother Nature created a near perfect self-contained chamber for developing chicks. It contains sufficient water, nourishment, and vascular networking to support the developing chick. It contains a porous shell that permits the escape of excess water and the exchange carbon dioxide for fresh supplies of oxygen. It also contains five layers of protection against invasive microbes:

1. **CUTICLE (Bloom):** a liquid protein layering applied to the outside of the shell. Once dried, the cuticle it the most effective barrier in preventing movement of microbes from the outside the shell to inside. The cuticle, however, is not perfect and its integrity can be compromised:
 - a. **Dirty Nests:** Eggs are most vulnerable to bacterial penetration in the first 30 to 60 seconds after lay before the cuticle hardens and caps the pores.
 - b. **Hen Age:** Eggs from hens older than 70 weeks have poorer quality cuticles than young hens.
 - c. **Wetting:** Any process that wets the exterior of the egg partially dissolves the cuticle decreasing its effectiveness. Moisture also promotes microbial growth on the shell and acts as a media to aid microbe movement through the shell.
2. **THE SHELL:** Although egg shells appear solid, they have thousands of pores that permit moisture and gases to escape and oxygen and contaminants to enter. Thick shells help reduce contamination, but microscopic cracks, thin shells, and overly porous eggs compromise its effectiveness. Several factors affect shell quality including nutrition, stress, weather, health, and disease. Weather and hen age may be of particular importance:
 - a. **Weather:** During the warmer summer months, a hen responds to excess heat by panting changing the blood pH and reducing the available blood calcium. Additionally, hens naturally decrease their feed intake further reducing available calcium.

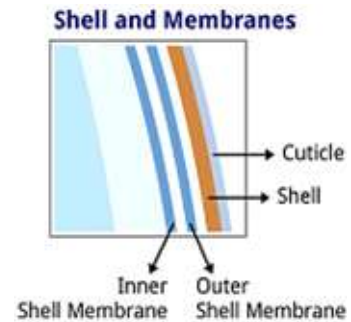
Bacteria inside the egg may use the nutrients found in the egg to multiply, robbing the embryo of a crucial food source or perhaps producing a toxin harmful to the embryo. During incubation, bacteria can actually prevent embryonic development, ultimately causing the embryo to die. Even if the embryo of a contaminated egg survives hatching, the chick will either die in the broiler house or simply not grow as it should.¹



¹ "Contamination of Hatching Eggs," North Carolina Cooperative Extension, North Carolina State University, 2007

b. **Hen Age:** The older the hen, the larger the eggs and the more calcium is required; however, as the hen ages she is less able to absorb and mobilize the available calcium... more than a 50% decrease of normal after 40 weeks of age.²

3. **INNER & OUTER MEMBRANE:** The egg contains two permeable (penetrable) membranes – the inner membrane attached to the inside shell surface and the outer membrane surrounding the egg contents. These membranes act as filters to discourage microbe penetration into the egg interior.
4. **ALBUMEN:** Finally, the chemical composition of the albumen (egg whites) discourages bacterial growth.



Unfortunately, Mother Nature's design is imperfect. Bacteria and mold are endemic – everywhere: in the soil, the nest, the manure, even floating dust particles. **Contamination remains a leading cause in hatch failure.** While gross infections are easily detected by their pungent smell and oozing exudate, milder forms can be more difficult to identify:

1. Eggs candle clear (appear infertile),
2. Deaths occurring at various stages of development,
3. Fully developed chicks failing to pip, zip, or hatch,
4. Unhealed or wet navels or mushy, soft chicks, and
5. Abnormally small, weak, or fragile chicks.

When an egg is laid, it is warmer than the environment, since the body temperature of the hen is 42°C. The warm egg cools to environmental temperature, and this cooling causes the contents of the egg to contract. Such contraction tends to form a negative pressure within the egg. Bacteria present in the environment or on the egg surface can then be pulled into and through the eggshell and its membranes.³

FACTORS INFLUENCING EGG CONTAMINATION

- **THE NEST:** The egg is most vulnerable to contaminants when it is first laid. The egg is warm and the cuticle is in its liquid form. As the egg cools and dries, contaminants from the surrounding area are drawn into the interior of the egg. Once inside, no amount of washing and sanitizing will have an effect. Action: keep the nest perfectly clean and dry.

Avoid using nesting material, such as hay, that promotes the growth of mold. During wet weather, be sure the coop floor has sufficient bedding to discourage the tracking of mud and muck into the nests.

Remember, mold and bacteria are microscopic and may not be visible... change nesting frequently during warm, wet weather even if it looks clean and dry.

- **CONDENSATION:** (Sweating) Place a glass of ice water on a cabinet and you will notice condensation (water droplets) form on the exterior of the glass. Under similar



circumstances, condensation accumulates on egg shells when moved from a cool to a warm environment – such as from the nest during winter months. Action: When moving eggs from a cool to warm climate, avoid exposing cool eggs to warmer air... keep them inside their cartons or tightly cover the eggs with a clean towel until they reach room temperature.

Moisture provides a needed nutrient for microbial growth and might also provide a medium to aid the movement of microbes through the shell... Minimize the number of cracked or broken eggs. Egg contents can provide nutrients for the bacteria to multiply and spread.⁴

² Lokesh Gupta, PhD, "Factors Influencing Shell Quality," Regional Technical Manager, Avitech, March 1, 2008.

³ M. E. Berring, USDA, et. al. "Bacterial Penetration of The Egg Shell and Shell Membranes of The Chicken Hatching Egg: A Review," Applied Poultry Science, 1999.

⁴ "Contamination of Hatching Eggs," North Carolina Cooperative Extension, North Carolina State University, 2007

- **CROSS-CONTAMINATION:** Cross contamination involves accidentally transferring microbes from one surface to another and can occur several points in the incubation process:
 - ✓ **Hands:** Failure to wash hands before touching eggs or inadvertently touching a dirty surface and then touching an egg. This can occur anywhere in the process: collection, storage, setting, candling, and transfer. *Action:* Wash hands before touching eggs and remain aware of what your hands touch.
 - ✓ **Collection Basket:** Using the same basket to collect incubation, dirty, or eating eggs and not sanitizing the basket between collections. *Action:* The simplest solution may be to use a new, clean paper towel to line the collection basket and to use two baskets – one for incubation eggs and one for eating eggs.

Dirty, broken, cracked, leaking and dented eggs should be collected in a separate container and should not be used for hatching purposes. Eggs coated in egg yolk are especially dangerous.

- ✓ **Countertops:** Placing incubation eggs on a countertop, especially a kitchen countertop. *Action:* Transfer eggs directly from the collection basket to their storage carton or sanitize the countertop using an antimicrobial cleanser.
- ✓ **Used Egg Cartons:** Using egg cartons from eating eggs and/or reusing incubation egg cartons. *Action:* Use only new cartons to store hatching eggs or use other suitable containers that can be sanitized.
- ✓ **Candling:** Candling usually involves picking up an egg, shining a light into it, looking at the contents, and placing the egg back into the setting tray, and then picking up the next egg. This is an ideal situation for transferring contaminants from one egg to another. *Action:* Candle eggs as infrequently as necessary. Wash and **dry** hands thoroughly before candling and at any time you suspect that a touched egg might be contaminated. Use your nose (smell) instead of candling to locate and identify any “bad” eggs.

REASONS NOT TO WASH

The breeder part of the poultry industry does not want hatchery eggs to even get wet as it is believed that may aid bacteria to enter the pores and may actually increase the number of rotten...

Dr. Craig Coufal, Texas A&M AgriLife Extension Service poultry specialist in College Station.

- **Cosmetic Only:** Washing eggs may be more visually appealing but this only cosmetic... it only looks better. Mold, viruses, and bacteria are microscopic—cannot be seen with the eye – and remain on the egg surface after washing.
- **Wetting Increases Microbial Growth & Movement:** Mold and bacteria need moisture to multiply. Dry dirt and droppings remain relative inert (inactive). Adding moisture not only provides microbes access to the nutrition necessary to reproduce, the liquid also compromises the cuticle and provides the medium that allows the microbes to move into the inner shell. Before wetting an egg, the harms should be carefully considered.
- **The Wrong Focus:** Entry of microbes into the inner shell primarily occurs in the nest before the cuticle fully dries. Egg washing is not capable of addressing microbes already inside the egg but can damage the cuticle allowing microbes to enter other, uncontaminated eggs... ones that have not yet been affected. The primary focus should be on maintaining a clean, dry nest before the problem occurs.

Wetting hatching eggs with or without disinfectants can result in contamination. Any concentration of moisture on warm eggshells evaporates, thus cooling the eggs. This lowers the internal pressure, driving contaminants through the pores into the eggs. Many bacteria use moisture as a vehicle to literally swim into eggs.⁵

⁵ Sue Ann Hubbard, D.V.M. Poultry Specialist, College of Veterinary Medicine, “Keys to Successful Handling of Hatching Eggs,” Issue 1638, Mississippi State University, 2002.

- **Washing Damages the Cuticle:** Simply wetting the cuticle can damage it. Rubbing the egg and using cleansers are likely to severely damage, if not completely remove, the cuticle. Remember, the cuticle is the first and best defense in limiting microbes to the outside of the egg.
- **An Inexact Process:** Unlike commercial hatcheries that primarily rely upon fumigation rather than traditional washing, most hobbyists do not have the chemicals or the equipment to thoroughly sanitize the egg surface. An inexact cleansing can cause greater harm than good:
 - ✓ Too cool of water will cause the air in the egg to contract drawing microbes and cleanser inside the egg.
 - ✓ Too hot of water for too long can damage the internal egg composition by changing the characteristics of the albumen and possibly harming the fragile blastoderm.
 - ✓ Using the wrong or too weak of a sanitizing agent can leave microbes on the outer surface while leaving a wet surface better enabling the microbes to move to the inside of the shell.
 - ✓ Using the wrong or too strong of a sanitizer agent can change shell characteristics and damage the internal composition.
 - ✓ Washing multiple eggs in one setting increases the chances of cross-contamination... transferring harmful microbes from dirty eggs to those that are not contaminated.
- **False Security:** Many people wash eggs to keep contaminants out of their incubator. Unfortunately, incubator contamination is more likely to originate from microbe growth starting inside the egg and then seeping out. Although the eggs appear clean, washing does not sterile the shell and many harmful microbes remain. We develop a false sense of security and may lose focus on the primary means of avoiding problems with harmful microbes – a clean nest and an intact cuticle.

All sanitizing procedures will remove the outer cuticle from the egg as well as the dirt and may leave the egg at greater risk from bacterial contamination. Any cleaning procedure incorrectly followed can contaminate the egg rather than sanitize it.⁶

DOES WETTING DAMAGE THE CUTICLE?

Opinions vary among the “experts” as to how much damage occurs by simply wetting the outer shell. Brinsea asserts that simply wetting the shell damages the cuticle and the broiler industry tends to agree:

All sanitizing procedures will remove the outer cuticle from the egg as well as the dirt and may leave the egg at greater risk from bacterial contamination. Brinsea Website

Other sources assert that the cuticle is not dissolved by water, and simply wetting the shell for less than three minutes does minimal harm:

*The cuticle is the outermost layer, deposited on the palisade layer of the eggshell during the last 1.5-2 hr of eggshell formation in utero. It is a non-calcified, thin, **water-insoluble** layer composed mainly of glycoproteins with some carbohydrate and fat constituents.⁷*

The vast majority of the material related to sanitizing indicates that simply wetting the egg shell with an approved sanitizer does no physical damage the cuticle, in the absence of surfactants (soaps) or chemical or mechanical abrasion (rubbing). However, we should not forget that microbes thrive in a moist environment and simply wetting the egg shell increases microbial activity and growth.

DOES A BROODY HEN WASH HER EGGS? Well, yes, she does, in a way... Oils, feathers, and movement act as a wash cloth to gently cleanse the eggs from dirt and feces. She doesn't use water but the eggs under my broody hens are always clean and shiny.

⁶ “Should hatching eggs be cleaned before setting in an incubator?” Brinsea, <<http://www.brinsea.com/Articles/Advice/EggCleaning.aspx>>.

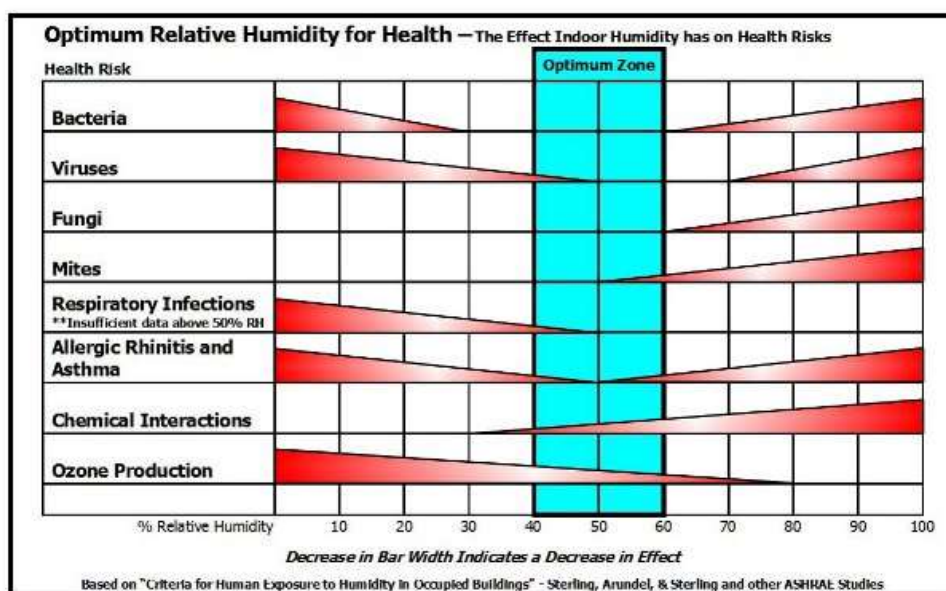
⁷ S. Samiullah and J.R. Roberts, “The eggshell cuticle of the laying hen,” *World's Poultry Science Journal*, Volume 70, Issue 4 December 2014.

IS THE INCUBATOR AN IDEAL ENVIRONMENT FOR MICROBIAL GROWTH?

It is commonly assumed that a poultry egg incubator is the ideal environment for microbial growth; however, this assumption is not necessarily accurate. Microbes, in general, require three key elements for reproduction: warmth, moisture, and nutrients. Incubators certainly provide the ideal temperature, but they generally lack the other two ingredients: moisture and nutrients.

HUMIDITY: Normal incubator humidity is less than ideal for bacterial, virus, or fungal replication.

Bacteria cells are weakened the most during the 40-60% humidity range. Numerous studies have shown that outside of this range, it's more plausible that bacteria will survive and multiply.⁸



Since most hobbyist incubate Days 1-18 in the 40% to 60% range, then the poultry incubator provides the least ideal humidity range for bacterial, viral, and fungal reproduction.

Moisture on the egg shell, either by condensation or intentional wetting, does promote microbial growth. It is important to avoid condensation and allow sanitized eggs to dry completely prior to storing or setting.

Hatching in a multi-stage incubator can be problematic... where eggs at different stages of development are incubated and hatched in the same machine. When humidity levels rise above 60%, microbes begin to reproduce. Unless the unit is emptied and sanitized on a frequent, regular basis, the incubator can indeed provide an ideal environment for microbial growth. However, using a separate hatcher eliminates this potential problem. Dedicated hatchers can be cleaned, sanitized, and dried between batches.

NUTRIENTS: Hatching only clean eggs deprives bacteria of the nutrient necessary for ideal reproduction.

Egg yolk is the perfect nutritional medium for rapid microbe growth. In fact, egg yolk has long been used in the production of many vaccines. A wise person, therefore, will not set eggs exposed to egg yolk, even if that egg has been washed.

There are other potential nutrient sources: eggs contaminated with mud, dirt, or feces, dander and gunk from hatching chicks, and cracked, leaking eggs. Establishing sound nest, collection, cleaning, and storage practices helps reduce contamination from mud, dirt, and feces. Hatching in a dedicated hatcher eliminates the gunk and dander from hatching eggs. And, quickly identifying and removing defective and infected eggs decreases instances cracked and leaking eggs.

⁸ Seaira Global, "How Does Relative Humidity Affect Your Health?" Seaira Global, NDA, <<https://www.seairaglobal.com/blog/humidity-and-dehumidifiers/health-effects-of-humidity.php>>

CAN MICROBES BE TRANSMITTED THROUGH THE AIR INSIDE AN INCUBATOR?

The most common means of transmitted microbes inside the incubator is through physical contact with a contaminated source such as the surface of a bad egg, a spill, or dirty hands. Microbes can travel through the air on small dust and danger; therefore, the incubator should not reside in dusty locations or where birds are maintained. Hatching chicks produce a great deal of airborne fluff, liquids, and gunk... hatching eggs inside an incubator is discouraged. Microbes can also be spread through the air on small water droplets... not a normal occurrence where the humidity is maintained below 60%.

SHOULD WE MAINTAIN A STERILE INCUBATION ENVIRONMENT?

There is absolutely no point in cleaning and sterilizing your eggs if you are then going to put them in an incubator that hasn't also been sterilized.⁹

If we scrub our eggs and remove or severely damage the cuticle, then microbes can easily cross the cuticle, shell, and membrane barriers. In such cases, it is extremely important that we focus on providing the cleanest environment possible; however, sterilizing (completely free of microbes) is not within our means. Even if we follow the sanitization steps perfectly, some living microbes remain behind. Those with cabinet incubators rarely shutdown and sanitize those incubators except for a few times each year.

There are steps that we can take to minimize cross-contamination of eggs while they are inside the incubator:

- ✓ Using an antiseptic soap, lathering the hands for a minimum of 30 seconds prior to handling eggs or equipment that will come into contact with clean eggs.
- ✓ Rewash hands whenever you suspect that they might have touched a contaminated egg or unclean surface.
- ✓ Store eggs in new, paper cartons. If using setting trays, sanitize the trays before each use.
- ✓ For single-stage incubation (one batch), clean and sanitize the incubator after each batch.
- ✓ For multi-stage incubation (multiple batches), hatch in a separate, dedicated hatcher and clean and sanitize the hatcher after each batch.
- ✓ Sanitize setting trays (turner rails) with each new batch and whenever they become soiled.
- ✓ When bad egg is suspected, place your nose near but not touching each egg. Sniff each egg until the culprit is identified. Once identified, deal only with the suspected eggs and wash your hands before touching any other egg.
- ✓ When encountering a leaking or bad egg, remove the bad egg and any eggs contaminated from the leakage, wash your hands, sanitize a fresh setting tray, and transfer the non-affected eggs to the new tray. For desktop turners, remove the eggs from the affected rail, remove the rail, clean and sanitize, replace the rail, and then move the unaffected eggs back to the original rail.
- ✓ Spills, fluids, shell fragments, and other muck that drop onto the metals shelves or incubator bottom should be cleaned and sanitized as soon as discovered. Use dish detergent and water to remove any muck and then sanitize using the same solution and dilution used to clean the hatching eggs. Do not rinse.
- ✓ The cause of any condensation or water pooling within the incubator should be immediately identified and corrected. The affected area should be sanitized using the same solution and dilution used to clean the hatching eggs. Do not rinse.
- ✓ When rotating eggs to even out temperature variations, do not move the individual eggs from one spot to another. Instead pull the entire setting tray, rotate the tray 180°, and place the tray on a different level. For foam desktop incubator, rotate the lid rather than the eggs.
- ✓ **MOST IMPORTANTLY:** Take steps to preserve each egg's cuticle by using the *least aggressive* sanitization method that results in a satisfactory level of egg cleanliness.

⁹ Tim Daniels, "How To Clean Eggs For Incubation," *poultrykeeper.com*, September 2018

WHEN TO RINSE, WASH, DIP, OR SPRAY...

INTRODUCTION: Individual beliefs regarding cleaning and sanitizing eggs vary greatly:

- Some feel that wetting an egg should be avoided and it is best to simply discard a dirty egg – Why risk contaminating the entire batch for a single egg?
- Some feel that sanitizing an egg poses a minimum risk and that all eggs are essentially dirty – It makes no sense to place a dirty egg in an environment that promotes bacterial growth.
- Some feel that if you sanitize some, you must sanitize them all – It makes no sense to mix dirty and clean eggs... the clean eggs quickly become contaminated by the dirty ones.
- Some people simply dislike seeing a soiled egg placed in their clean incubator – Incubating an egg with poop on it is absolutely nasty.
- Some take a minimalist approach wiping away soiled portions of the egg with a Clorox wipe – Addressing the biggest problems helps reduce the largest risks.

If all of my hens were consciousness, wiped their feet before they entered the coop, and laid all of their eggs in a nice, clean, dry nest, then I wouldn't have a dilemma... I'd collect my eggs in nice, clean baskets, store them in nice, new cartons, and set them in nice, newly sanitized setting trays. But, not all of my hens are thoughtful. I have some hens that think a pile of leaves under a fir tree makes a better nest than the one in the coop. I have mallard ducks that like to hide their eggs, turkeys that prefer the floor under the poop board, and peahens that think a pile of poop makes the softest of cushions. I could discard the dirty eggs, but many of those eggs are quite valuable. I could clean and sanitize all eggs, but I believe that even the mildest form of cleansing compromises the cuticle to some extent. Instead, I have chosen a balanced approach addressing each egg individually and striving to the least harm to the cuticle as possible. If I can preserve the cuticle, I believe, then I can maximize the number of eggs incubated while presenting a minimal risk for all eggs.

WARNINGS: There are several warnings that I think are of maximum importance:



WARNING: GREAT CARE IS REQUIRED WHEN WETTING HATCHING EGG SHELLS: The hobbyist can easily do greater harm than good. It is especially important to carefully follow the directions of the chosen sanitizer. Overdosing should be avoided, as this may either cover the pores, which could hamper weight loss and gas exchange during incubation, or damage the protective cuticle.¹⁰ Using a strength that is too weak can compromise the cuticle while leaving lethal bacteria behind.



WARNING: SANITIZING EGGS DOES NOT STERILIZE THE SHELL: Sanitizers do not kill all bacteria, molds, or viruses; they merely significantly reduce the colony count. Some contaminants remain on the egg shells, are capable of reproducing, and can cause harm given the proper environment. Protecting the cuticle (bloom) remains an important element in preventing contaminants from entering the egg.



WARNING: USE ONLY SOLUTIONS LABELED SAFE FOR HATCHING EGGS: Trials also showed that some products can be very good disinfectants but may have a negative effect on hatchability. Especially those containing a surfactant which creates a nice layer around the egg but prevent the egg from breathing. The pores are closed and the egg may suffocate causing poor hatching results.¹¹ If the label doesn't mention "hatching eggs," do not use it.

¹⁰ Gerd de Lange, "Formalin-free hatching egg disinfection: an achievable goal!" White Paper, PAS Reform, 12 January 2012.

¹¹ Luc Ledoux, CID Lines, Ieper, Belgium, "Hatching egg sanitation beyond the myths!" Poultry World, Elsevier Volume 18, No 10. '02



WARNING: DO NOT SAND OR BUFF: Sanding and buffing will remove at least part of the cuticle resulting in eggs that are more susceptible to penetration. The sanding process itself may actually grind the bacteria further into the shell. The general rules for sanding, buffing or wiping is that to: never exceed one wipe to remove material on the shell; and don't do it.¹²



WARNING: IMMERSION IS NOT RECOMMENDED: The recommended time of immersion was five minutes and there were many instances when the eggs were left in the tank too long resulting in elevated yolk temperatures and lower hatchability. Leaving them in the disinfectant solution too short a time causes inadequate sanitation. The lack of proper temperature control was another major drawback... In short, immersion dipping proved to be a very ineffective and even harmful procedure for hatching egg sanitation.¹³



WARNING: LIMIT DIPPING TIME LENGTH: The cuticle is not impenetrable and water on the surface of the egg shell can undermine these defenses because water helps bacteria pass through the shell pores into the egg. If the period of contact between egg and water is short, there will be little microbial penetration into the egg. Therefore, it is important to limit the amount of time that the shell is wet. Soaking eggs in water for as little as one to three minutes can allow microbes to penetrate the shell.¹⁴



WARNING: APPLY THE SANITIZER AS SOON AS POSSIBLE: Failure to apply the sanitizer in a timely manner will give the opportunity to the bacteria to penetrate into the hatching eggs through the pores of the eggshell and thus reaching the shell membrane. Inside the eggs, the microorganisms will not be exposed to the sanitizer anymore and, during the incubation process, they will find the ideal condition to multiply in the egg's interior.¹⁵

SANITIZING SOLUTIONS: There are numerous sanitizing products on the market labeled for use with hatching eggs... far too many to examine individually. In deciding which to use, examine the product description and label for the following:

1. Is it labeled safe for hatching eggs?
2. Does it effectively sanitize the eggs?
3. Does it leave residual protection on eggs?
4. Is safe for equipment and personnel?
5. Is reasonable in cost?

Hatching egg sanitizing solutions must effectively reduce surface microbes without being toxic to the developing embryo or blocking pores that will prevent transfer of moisture and gases through the shell. Solutions must be gentle on the shell cuticle and should not contain surfactants (soap) which tend to dissolve the cuticle. Product descriptions and labels must clearly outline proper usage and dilution rates. Solutions that have not been adequately researched, specifically labeled for hatching eggs, or possess adequate dosage should be rejected.

¹² Joseph M. Mauldin, Poultry Science, University of Georgia, "Reducing Contamination of Hatching Eggs," Poultry Industry, June 3, 2008.

¹³ Joseph M. Mauldin, Poultry Science, University of Georgia, "Reducing Contamination of Hatching Eggs," Poultry Industry, June 3, 2008.

¹⁴ "Small-Scale Egg Handling – 1," The Poultry Site, 01 November 2009, <<http://www.thepoultrysite.com/articles/1548/smallscale-egg-handling-1/>>

¹⁵ Dr Vincent TURBLIN, Deputy Regional Market Manager, Poultry CEVA Animal Health Asia, "Disinfection of Hatching Eggs Importance and Practical Aspects," CVE, November 2008.

COMMONLY USED HOBBYISTS SOLUTIONS:

- **BLEACH:** (5.25% Sodium Hypochlorite) I love bleach and buy it 5 gallons at a time. I use it to sanitize feeders, waters, brooders, stock tanks, etc. I have read that bleach interacts negatively with the shell calcium. However, I found no such comments in the research dealing with hatching eggs. Sodium hypochlorite was used in numerous studies and those studies indicated that bleach was safe and effective when used in the proper dilution. If you decide to use bleach, be sure that it contains no added ingredients such as fragrances or surfactants (soap).
- **BRINSEA EGG SOLUTION:** (Halogen Tertiary Amines) Brinsea's eggs solution seems to have moderate support among hobbyists, is moderately priced, and is labeled for use with hatching eggs. However, I found no research verifying its effectiveness. Those who do not like bleach and do not want to buy a full gallon of a different type of disinfectant, might find it useful.
- **PEROXIDE:** (Hydrogen Peroxide) Consumer peroxide usually comes in a 3% solution but the best peroxide study used a 5% solution; however, some studies also found that a 1.5% solution was safe and effective. Peroxide may interact with the cuticle resulting in an increase loss of moisture during incubation. Personally, I don't care for the way peroxide smells and interacts with small cuts on my hands; however, research indicates that it is very effective with hatching eggs. Effectiveness reduced by feces exposure. Peroxide does have the tendency to lose potency once opened and when stored in direct sunlight. Do not use bottles that have been opened more than 30-45 days and do not let a bottle sit out uncapped.
- **LISTERINE GOLD:** (Essential Oils: mint, thyme, wintergreen, and eucalyptol) There are studies that indicate Cumin and Oregano are effective hatching egg sanitizers, but no research was found using Listerine's active ingredients. Listerine Gold contains 29.6% alcohol; however, this level is far below concentrations necessary to kill bacteria (40%). While Listerine Gold may be beneficial as an oral product, it is not labeled for use with hatching eggs, has not proven effective against a wide range of microbes, and **is not recommended** for use as a hatching egg sanitizer.
- **OXINE AH:** (Chlorine Dioxide) Activated Oxine has proven effective against a wide range of microbes and, unlike bleach, does not require rinsing after applications. Unfortunately, the manufacturer, Bio-Cide, makes no such claims concerning Oxine in a non-activated form. Activated Oxine is approved for "SHELL EGGS INTENDED FOR FOOD OR FOOD PRODUCTS" but hatching eggs are not mentioned. Research indicates that Chlorine Dioxide foam may be safe and effective for hatching eggs; however, since the ppm of available Chlorine Dioxide in unactivated Oxine AH is not known, **this product is not recommended**.
- **TEK-TROL:** (Orthophenol) TEK-Trol, a phenol compound, is not widely used within the hobbyist community perhaps because it can only be purchased in gallon form and costs about \$50.00 after shipping. Phenol compounds are mentioned in several studies and Tek-Trol specifically in at least two. Comparatively it is less effective than peroxide but more so than bleach. It is labeled specifically for use with hatching eggs and studies indicate that it is both effective and safe. Personally, I plan to conduct experiments using Tek-Trol both as a hatching egg and incubator sanitizer.

Sanitizer	Ingredients	Maker	Research	Label	Efficacy	Rate
Bleach 5.25%	Sodium Hypochlorite	Generic	Yes	--	Yes	½ oz per gallon
Brinsea Egg Sol.	Hal. Tertiary Amines	Brinsea	NO	Yes	Unknown	1 ¼ oz per gallon
Peroxide*	Hydrogen Peroxide	Generic	Yes	--	Yes	1.5% solution
Listerine Gold	Essential Oils	Pfizer	NO	NO	Unknown	50:50 solution
Mannah Pro	Natural Enzymes	Mannah	NO	Yes	Unknown	2 caps per gallon
Oxine AH	Chlorine Dioxide**	Bio-Cide	NO	NO	Unknown	6 ½ oz per gallon
Tek-Trol	Orthophenol	Bio-Tek	Yes	Yes	Yes	½ oz per gallon

* Can cause an increased loss of moisture from the eggs during incubation.

**Chlorine dioxide reacts with the protein of the egg shell cuticle which neutralizes it before it can effectively attack the microorganism.¹⁶

¹⁶ Henry R. Wilson, professor, Dairy and Poultry Sciences Department, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, "Hatching Egg Sanitation," Engormix, July 15, 2009.

METHOD FOR SANITIZING EGGS IN THE HOME:

- **WASHING:** Washing eggs involves using a detergent (generally dish soap) and a scrubbing action to remove dirt, mud, and feces. While commercial hatcheries have the professional equipment to safely and effectively wash hatching eggs, washing is not a good idea in the home environment. The soap will largely dissolve the cuticle leaving the egg vulnerable to bacteria and it does NOT kill all of the microbes on the shell. The interior egg is the perfect growth medium for microbes and, without a cuticle, microbes can move out of the egg and contaminate nearby eggs. Washing, in my opinion, poses greater risks than potential benefits.
- **IMMERSION:** Immersion eggs involves placing them in a tub of warm sanitizing solution and allowing the solution to seep partially into the shell. If done perfectly, immersion can be more effective than dipping or spraying. However, immersion requires great precision in timing and temperature... something most hobbyists don't achieve on a daily basis. Because lack of precision ultimately causes greater harm than potential benefits, immersion at home is not recommended.
- **DIPPING:** Dipping eggs involves dipping them into a warm sanitizing solution just long enough to coat the entire shell. Dipping is usually more effective than spraying because spraying may leave a portion uncoated. Unfortunately, it also involved placing all eggs in the same container and possibly spreading contamination from a bad egg to the others – remember a sanitizing solution is not 100% effective. If all eggs are free from dirt and feces, then cross-contamination is minimal; it's more of a problem with dirty eggs. Because of this potential risk, I prefer spraying over dipping.
- **SANDING:** Using sandpaper to sand away dried dirt and feces is a common practice. Unfortunately, a person can accidentally damage the cuticle in the process and give microbes a window to enter the egg. Sanding is not something that I would consider... my hands are not that precise.
- **SCRAPING:** Scraping involves using a finger nail to dislodge chunks of feces from an egg. Scraping usually leaves a layer of feces next to the shell so is imperfect; however, there is less risk of damaging the cuticle than sanding. Scraping, in conjunction with rinsing, can remove the vast majority of the feces, provide less nutrients for microbes, and allow better penetration of the sanitizing solution.
- **RINSING:** Rinsing involves placing the egg under a stream of warm water and gently using the thumb to dislodge dirt and feces. The motion should attempt to move the impurity away from the shell and not press it into the shell. As a rule, no single area of the egg should be rubbed more than once else there is an increased likelihood that the cuticle will be damaged. The water should be at least 10°F warmer than the egg, ideally between 105-110°F. No soap or detergent should be used. Once the egg has been rinsed, use a patting motion (no rubbing) and clean paper towels to dry the egg and then set it in a basket to air dry. Never store a wet egg in a sealed container.
- **SPRAYING:** Spraying is my current preferred method for sanitizing eggs. It involves placing eggs in a setting tray small end up, misting with a warm sanitizing solution, flipping the eggs so the large end is up, misting again, and permitting the eggs to dry. No attempt is made to remove any debris on the shell surface. The flipping of the egg ensures that all surfaces are covered. This method is similar to dipping except the eggs are not placed into a common container.

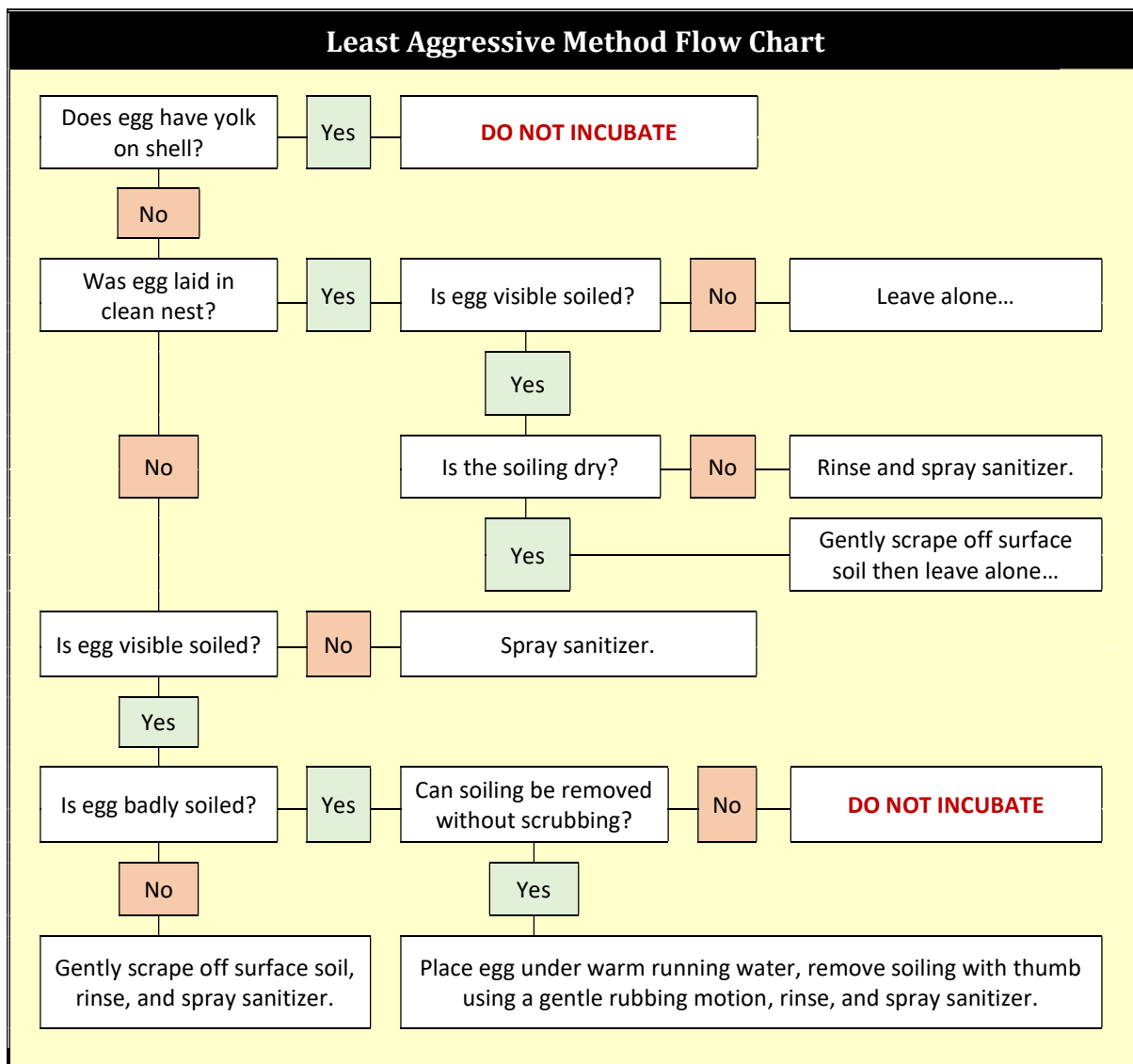


REMINDER: EVEN WARM WATER RESULTS IN EGG COOLING: Any concentration of moisture on warm eggshells evaporates, thus cooling the eggs. This lowers the internal pressure, driving contaminants through the pores into the eggs. Many bacteria use moisture as a vehicle to literally swim into eggs.¹⁷

¹⁷ Sue Ann Hubbard, D.V.M. Poultry Specialist, College of Veterinary Medicine, "Keys to Successful Handling of Hatching Eggs," Issue 1638, Mississippi State University, 2002.

CHOOSING THE LEAST AGGRESSIVE METHOD FOR INDIVIDUAL EGGS:

Many people strongly believe in uniformity and that the same method used on one egg should be used on all eggs. There are solid, important reasons for believing this way; however, I take a different path. Instead, I believe in examining the needs of the individual egg and utilizing the least aggressive but effective method for addressing those needs. Some eggs will be left alone. Some will be scraped, rinsed, and sprayed. And some, hopefully only a few, will be discarded. This approach, I believe, minimizes damage to the cuticle while significantly minimizing instances of damage due to internal contamination.



EXAMPLE 1: Weather conditions are dry and Rhode Island White Betty lays her pretty brown eggs in a clean dry nest. Her eggs are free from soilage and fecal matter. Her eggs are collected and stored without intervention.

EXAMPLE 2: Weather conditions are damp and Cream Legbar Lady lays her pretty blue eggs in a clean nesting box but she also poops at the same time she lays. Her eggs are generally clean but have a small amount of wet feces on the shell. Her eggs are collected in a separate basket, rinsed briefly, sprayed, dried, and then stored.

EXAMPLE 3: Weather conditions are wet and Brown Chinese Gertrude lays her extra-extra-large white eggs in a nest filled with muddy water. Her eggs are coated in mud. Her eggs are placed under warm running water, a gentle rubbing motion is used to remove the mud, it is rinsed, sprayed with sanitizer, dried, and then stored.

THINGS TO REMEMBER WHEN SANITIZING EGGS:

1. **WASH HANDS FREQUENTLY:** Using an antiseptic soap, lathering the hands for a minimum of 30 seconds prior to handling eggs or equipment that will come into contact with clean eggs. Rewash hands whenever you suspect that they might have touched an unclean surface.
2. **SANITIZE AS SOON AS POSSIBLE:** Under ideal conditions, microbes begin reproducing as soon as the encounter the egg. The sooner the sanitizing solution can be applied, the lower the microbe population both before and after sanitizing.
3. **PRODUCT LABEL:** Carefully read and follow the instructions on the product label. Using too strong a concentration can block the pores and damage the fragile embryo. Using too weak of a solution allows dangerous microbes to remain.
4. **SOLUTION TEMPERATURE:** The sanitizing solution should be at least 10°F warmer than the egg, ideally 105-110°F. This will reduce the effects of negative pressure and lessen the number of microbes moving into the interior of the shell.
5. **DISTILLED WATER:** For best results, use distilled or filtered water in areas where dissolved solids exceed label recommendations or creates a layer of film on the egg shell.
6. **ALLOW COLD EGGS TO WARM:** During cold weather, allow eggs to reach room temperature prior to sanitizing to prevent condensation forming. Condensation dilutes the sanitizer strength and slows drying time.
7. **DOUBLE-CHECK COVERAGE:** When spraying sanitizer, be sure all surfaces are covered paying particular attention to the bottom of the eggs.
8. **DO NOT RINSE:** Sanitizers labeled for use with hatching eggs provide additional protection once the solution dries; rinsing eliminates this additional protection. Products labeled for use with hatching eggs have been tested and the dried film does not harm the embryo.
9. **ALLOW EGGS TO DRY COMPLETELY BEFORE STORING OR SETTING:** Remember, sanitizers only reduce the microbe population, they do not eliminate them. Microbes will continue to grow as long as there is warmth, moisture, and nutrients. Allowing the eggs to dry completely before storing or setting, robs the microbes of the necessary moisture for reproduction.

WARMING SANITIZERS: For solutions that do not require dilution, pour the amount needed into a separate, clean bottle and place in the incubator 4-6 hours prior to use. Discard any solution that remains after treatment.



When the egg is laid its temperature is slightly less than the hen's body temperature, approximately 40°C (104.0°F). It will take the egg 4-6 hours (depending on the external temperature) to attain ambient temperature. It is during this period that the air cell is created and that eggs should be disinfected.¹⁸

EFFECT OF EGG STORAGE UPON SHELL SURFACE CONTAMINATION¹⁹

	Day 1 of Storage	Day 7 of Storage	Day 14 of Storage
Number of Bacteria/Egg	154,446	254,228	310,444

TOTAL BACTERIA COLONIES ON SHELL SURFACE²⁰

Non-Sanitized Controls	Inadequate Misting	Thorough Coverage with Sanitizer
121,263 colonies/egg	43,830 colonies/egg	331 colonies/egg

¹⁸ "Incubation Guide," Hubbard Breeders, NDA, pg. 12.

¹⁹ Michael Wineland, Extension Poultry Specialist, "Spray Sanitizing Hatching Eggs," North Carolina State University. 6/96, PS Facts #23.

²⁰ Michael Wineland, Extension Poultry Specialist, "Spray Sanitizing Hatching Eggs," North Carolina State University. 6/96, PS Facts #23.