

Egg Shell, The Most Important Component of Egg Quality

Written By: Mert Yalcinalp, Senior Technical Manager – Cobb Turkey



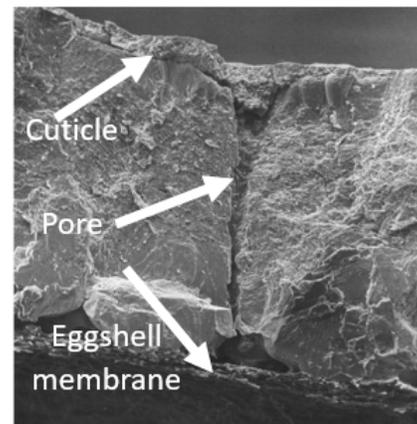
Introduction

Shell quality affects egg quality which ultimately affects chick quality. Poor shell quality can lead to problems in the incubator associated with microbial contamination (rots and bangers) and late embryonic mortality. Post-hatch issues may be in the form of increased incidence of yolk sack infections. Shell integrity is important for protection of the embryo from physical damage. The shell provides a calcium source to the embryo while pores in the shell assist in the regulation of gas exchange and minimizes moisture loss. The cuticle layer serves as the first line of defence in resisting the entry of pathogens



Poor shell means lack of hatchability & chick quality therefore economic losses

Structure and composition: Egg shell is made almost entirely of CaCO_3 crystals deposited over 20 hours while the egg is in the uterus of the hen. These inorganic crystals tightly attach to each other like a fabric material and are held together by proteins found in the uterine fluid. It has been suggested that the importance of these specific proteins to the shell matrix is proof that chicken came first, not the egg. Average egg shell thickness is 0.30 mm. The surface of the shell has approximately 10,000 pores with each pore having a diameter of 0.0017 mm. This is equivalent to a 1.8 mm^2 opening to aid in gas exchange. It has been found that eggs with a shell thickness of below 0.28 mm rarely hatch viable chicks due to excessive moisture loss.



Layers of egg shell

*Egg weight increases with the flock age but not the % of egg shell**

Breeder age and egg size:

As the hen ages, egg weight and percentage yolk increases whilst the percentage albumen decreases. The shell, however, does not respond the same thus resulting in shell thinning as the breeder ages. This leads to the reduction in shell integrity making eggs more vulnerable to breakage. In addition, pore length is reduced making them more susceptible to the entry of microorganisms. Therefore, it can be helpful to support the older breeder flocks by giving them some trace minerals (Zn, Mn), vitamin D3 and oyster shell, particularly in hot seasons.

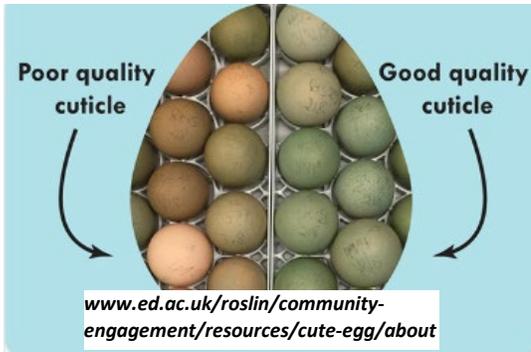
Age (week)	Egg Weight (g)	% Yolk	% Albumen	% Shell
31	58,7	25,8	65,2	9,1
38	66,1	28,0	62,7	9,3
43	66,5	29,0	61,8	9,3

**Adapted from Julia Sampaio, 2006*

Cuticle and shell color: Shell pigmentation is typically a breed characteristic that once served as protection from predation. Today a uniform, brown shell color is often a sign of good shell quality. Shell pigment is secreted from epithelial cells located on the surface of the uterus. Although pigment is deposited throughout the duration of the shell formation it is most concentrated at the very end when the cuticle is secreted.

A cuticle is a non-calcified, thin, water-insoluble layer composed mainly of glycoproteins with some carbohydrate and fat constituents (S. Samullah, 2012). The cuticle is formed just prior to oviposition and mixes with shell color pigments. It dries and hardens within 20 to 30 seconds after the egg is laid and acts as the first line of defense against microorganisms and controls moisture diffusion from the egg.

Shell color after staining
which points out cuticle quality



Cuticle thickness has been reported to decrease significantly as the hen ages (Sparks & Board, 1984). Any kind of physical removal of cuticles by cleaning and washing can lead to damage and ultimately conductance of egg shell, increased penetrations of pathogens and poor hatchability and chick quality. Although there is no correlation between degree of pigmentation and cuticle deposition there appears to be an advantage to improved cuticle coverage. Significant variation in cuticle deposition has been observed between broiler breeder strains. Vertical and horizontal transmission of disease in the hatchery could potentially be reduced and the health of poultry improved by selecting for improved cuticle deposition. Evaluation of cuticle quality is relatively easy to do.

Egg cuticle cover may be assessed by a simple qualitative staining technique developed by Board & Halls (M.Bain, 2016).

Shell quality and egg recovery: Shell thickness and strength are extremely important for commercial broiler breeders. There are a variety of destructive tests (breaking strength, shell weight and thickness) to evaluate shell quality. The average egg recovery rate is nearly 3% for broiler breeders. Almost 50% of unselected eggs are due to shell problems. As previously mentioned, the first sign of poor egg shell quality for broiler breeders is that they are pale brown or white in color. It is likely that the deposition of cuticle and Ca accumulation is getting weaker which could be a result of factors such as breeder age, nutrition and disease. It is important to monitor shell quality characteristics for the life of your flock and respond to fluctuations in quality. You will never hatch good quality chicks by setting eggs with poor shell quality.

References:

Samiullah (2012) The eggshell quality of table eggs and how this affects food safety. Master of Rural Science Degree Thesis, University of New England Armidale NSW Australia.

Sparks, N.H.C. and Board, R.G. (1984) Cuticle, shell porosity and water intake through hen eggshells.

Bain, M.(2016), Egg Shel Integrity & quality. Zinpro European Poultry seminar, Amsterdam.

Julia Sampaio, 2006 <http://hdl.handle.net/1843/31998>

