Eggshell Quality:
Prioritizing Ultrastructure Over Thickness

Author:
Alba Fireman
Zinpro Poultry Nutritionist

The eggshell quality is largely determined by the quality of the inner and outer membranes. Defects in these structures can only be detected by translucency scoring, not by the traditional specific gravity method. How is this new concept turned into practice? Here is how.

Did you know that modern, fast-growing lines of broiler chickens spend a third of their lives inside the egg? So, it makes sense to optimise this environment as best as we can, including all the components of the eggshell, that have important roles in embryo protection, respiration and nourishment. Eggshell quality is therefore considered among the most important factors affecting hatchability in broiler breeders.

A Solid Ultrastructure

When we talk about eggshell quality in our industry, it is too often linked with solely looking at the eggshell thickness. However, other quality parameters need to be checked, such as translucent spots. These spots are flaws in the ultrastructural formation of the inner and outer shell membranes which make the shell more fragile, with less elasticity and resistance. A stronger ultrastructural formation of the membranes, and consequently the eggshell will provide better embryonic development and greater protection of the egg's internal contents against contamination. This means that we should concentrate more on this important quality parameter. Strong eggs can have a relatively thin eggshell with well-designed shell ultrastructure, and conversely, weak eggs can have a thick eggshell, with a poorly designed shell ultrastructure due to a high translucency of the membranes. Images 1 and 2 show how an eggshell is divided in different layers.

Image 1 – Eggshell layers.

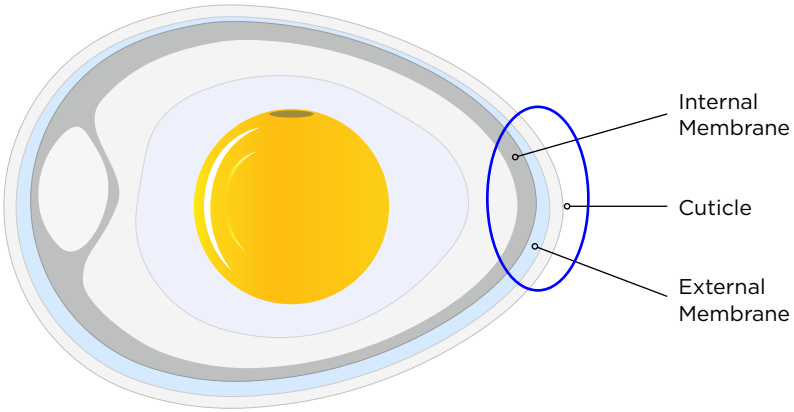
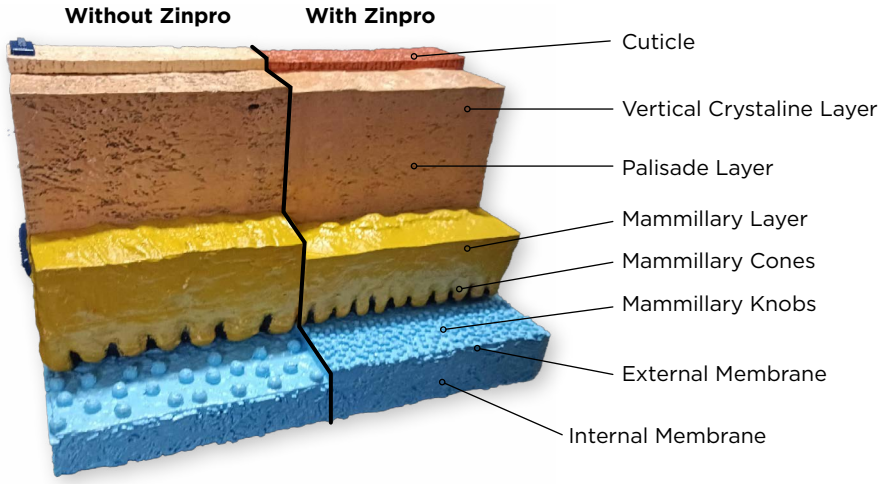


Image 2 – The structure of the eggshell 3D model shows a zoomed in view of the eggshell layers.
See the difference between a well-designed membrane ultrastructure supported by Zinpro® Performance Minerals® and a poorly designed ultrastructure.



Well-designed membrane ultrastructure leads to nicely opal eggs (with low translucency). On the left, you can see that the membrane ultrastructure has been formed in a messier way, leading to wider pore canals between the palisades in the shell, more flaws and more translucent spots.

Video - The difference between a poorly designed and well-designed ultrastructure.

https://www.youtube.com/watch?v=rnrQkaoEa5s

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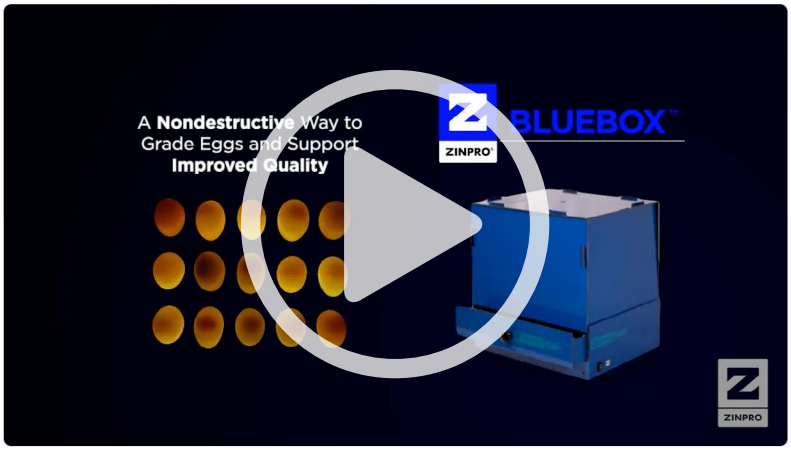

New Published Results

Several methods for the assessment of eggshell quality are available in the poultry industry. Egg specific gravity (SG) is probably the most employed approach for measuring eggshell quality in the industry, due to its low cost and strong correlation with shell thickness. But SG cannot detect translucency spots. Only an eggshell translucency method can. But how are these two methods related? Or are they not? This is a question that was asked by many in the poultry industry when Zinpro® started to use the methodology of translucency scoring with our customers. This was one of the important topics we delved into in a recent scientific paper, published in Poultry Science*.

I was involved in the development of this paper where we specifically looked at the relationship between eggshell translucency with SG and eggshell color and its influence on broiler egg weight loss, hatchability and embryonic mortalities. We didn't compare different diets.

The 3 main findings from this study were:

1. There were no interactions between eggshell translucency and SG, or between eggshell translucency and color.

2. An interaction was observed between SG and eggshell color for the variable egg weight loss, where light-shelled eggs, in most SG categories lost more weight throughout incubation than dark-shelled eggs.

3. Eggshell translucency affected egg weight loss, hatchability and embryonic mortality from 11 to 18 d of incubation, with highly translucent eggs showing the worst results.

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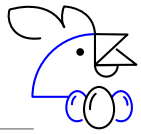
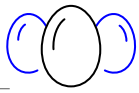
Turning Science Into Practice



I was not surprised by the fact that translucency scoring and SG are not related. This is because – what I mentioned before – eggs can have a thin shell, but a well-designed shell ultrastructure, and vice-versa. Essentially, we are measuring different things with the two different methods. And we know that shell ultrastructure is very important for the embryo to form its skeleton, which has a direct hatchability result and an effect on the quality of the chick. The results found from the publication in Poultry Science will therefore spark a new way of thinking about how we define eggshell quality and what and how we measure it. It was also no surprise to me that there was no link between translucency and eggshell color. This is because the deposition of the brown pigment in eggs (a protoporphyrin IX) does not depend on the ultrastructural formation of the eggshell membrane, but on factors that affect the availability of iron in the bloodstream and the health of the bird, among others.

Although there were no major surprises in the study, these insights are very important to educate the industry about the benefits of translucency methodology and how this helps to design the best nutritional and management interventions to reduce the eggs with a high translucency score (consequence of a poor membrane formation) and pale eggs (which can have 10 percentual points reduced hatchability over pigmented eggs). For example, by adding highly available iron in the diet of the birds, we can reduce the number of pale eggs. By using other performance trace minerals, we can positively influence the formation of the membrane ultrastructure. These are effective nutritional interventions we can implement to take eggshell quality and hatchability to the next level.

The Puzzle Around Eggshell Quality



There is still a lot to learn about the ingenious world of membrane ultrastructure and eggshell formation and its effects on the short, medium and longer term. At Zinpro we are highly dedicated to solve the puzzle around eggshell quality and getting better insights in all the processes and factors that influence this. We believe in the methodology of translucency scoring measurement as the right way to go, which led to the launch of the Zinpro® BlueBox™. Backed by data from over 300,000 eggs from more than 30 countries so far, this non-invasive system allows operations to closely monitor the quality of the eggs and even detect early on subclinical health challenges. And we continue to test more eggs from our customers by using the translucency score and follow these eggs from their formation to hatch and even after that. I am excited to be part of this journey!

*Neto, Felipe, *et al.* "Eggshell translucency: its relationship with specific gravity and eggshell color and its influence on broiler egg weight loss, hatchability, and embryonic mortalities". Poultry Science, Volume 103, Issue 5, May 2024, 103528 pp. 1-9.

Did the Zinpro BlueBox spark your curiosity? Click here to learn more. Or send me a direct message.

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