

Broiler Breeder Egg Quality Influences Hatching Results

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Key Points:

- Better egg shell quality and interior quality translates into higher fertility and hatchability
- Proper moisture loss of eggs during incubation should be a top priority to achieve good hatchability and top quality chicks.
- Supplementing breeder hen diets with BacPack™ ABF may increase albumen height and Haugh units as well as shell thickness and breaking strength.

What role does egg shell quality have in hatchability? Studies indicate that there is a direct correlation between hatching success and egg shell quality.

Proper Moisture Loss is Critical

Jim Arthur, Arbor Acres Farm, Inc., Blairsville, GA stated at the 2000 Arkansas Nutrition Conference that proper moisture loss of eggs during incubation should be a top priority to achieve good hatchability and top quality chicks. Relative humidity during holding eggs should be 75%. Relative humidity of 50% minimum (wet bulb temperature ~80–85°F) in the incubators, with the use of nozzle sprayers and sufficient water pressure, helps obtain the desired 11–14% loss in original egg weight from set time until transfer to hatchers at 18–18½ days. Control the infertile egg temperatures at 98.8–99.2°F for Jamesway incubators or 99.4–99.8°F for Chick Master incubators.

Shell Quality and Fertility

An interesting connection between fertility of eggs and shell quality, as measured by specific gravity of 1.080 or higher (“high”) or below 1.080 (“low”), was discovered by McDaniel, Brake, and Eckman at Auburn University (Anim. Nutr. & Health, May 1982, v. 37, n. 4, p. 34). In a field trial, flocks of broiler breeder hens 6–15 months of age were characterized according to shell quality as “high” or “low”. The % fertility of eggs averaged 3% better, and was in some cases 8–10% better, for “high” shell quality flocks. In a university trial, breeder hens were grouped according to egg

specific gravity and inseminated with pooled semen to eliminate any male effect on fertility. Hens with good shell quality had 100% fertility of eggs up to 7 days after insemination and then declined gradually; those producing eggs with poor shell quality started declining in fertility 3 days after insemination. Having adequate amounts of vitamin D3, Ca, and/or P absorption may be important for egg quality and fertility.



Calcium Levels and Direct-Fed Microbials (DFMs)

Egg shell is primarily composed of calcium carbonate (similar to limestone or oyster shell). Direct-fed microbials can improve hatching egg performance via proper oxygen and moisture exchange (conductance). The mode of action is thought to enhance calcium absorption due to greater limestone digestibility as native lactobacilli proliferate and produce more lactic acid. A test by Calpis Co. Ltd in Japan with laying hens fed diets supplemented with CALSPORIN® demonstrated that osteoclast cells in femur bone were more active and dynamic showing a greater flow of calcium through the deposition and resorption cycle, putting more calcium into the bloodstream for shell formation. CALSPORIN® contains *Bacillus subtilis* C-3102 spores, which is patented for strengthening egg shells (U.S. 6,660,294; December 9, 2003.)

With improved egg shell quality, the DFM's effect of greater shell thickness and better structure reduces pathogens entering the pores. Examples of shell-transmitted diseases are: *Salmonellas*, Arizona paracolon, *E. coli*, coliforms, *Pseudomonas*, *Proteus*, and fungus (aspergillosis).

Shell Quality and Hatchability

England et al. (2012; Int. J. Poult. Sci. 11(5):316–325) separated 400 eggs from Cobb broiler breeder hens (Cobb-Vantress Fayetteville Hatchery) into 23 categories based on shell weight as % of egg weight, incubated them at University of Arkansas, and evaluated % fertile eggs and embryonic mortality. Results are shown in Table 1. Eggs with 8.85 to 9.85% shell weight (relative to egg weight)

and 1.077 to 1.082 specific gravity and 0% infertiles had 0–6% embryonic mortality which was less than lower shell weight % and specific gravity groups. These are the approximate desired ranges for commercial flocks to achieve best hatching results.

In “The Virtual Chicken” (2005; Auburn University), a Powerpoint slide set funded by USDA and Poultry Products Safety and Quality Program, “higher Haugh unit = better hatchability”. “Haugh units should be 80 or better for good hatch”. In our experience, Haugh units of 75-80 have been found in flocks with good egg interior quality. In Table 2, sampled eggs from Cobb 700 breeder hens receiving BacPack™ ABF for about 3 weeks had Haugh units of about 77-79 (November and January) compared to about 67-68 during the

Table 1. Shell weight % of egg weight % of egg weight, egg weight, specific gravity, infertile eggs %, total embryonic mortality % of 400 incubated eggs from Cobb broiler breeder hens.

Shell weight, % of egg weight	Shell weight, g	Egg weight, g	Specific gravity	Infertile eggs, %	Embryonic mortality
6.31	3.89	61.9	1.061	40	20
7.42	4.81	64.8	1.065	18	27
7.84	5.02	64.0	1.069	4	25
8.04	4.95	61.6	1.073	0	16
8.15	5.08	62.4	1.072	8	33
8.24	5.05	61.2	1.075	0	40
8.35	5.30	63.5	1.072	0	35
8.45	5.24	61.9	1.074	9	15
8.56	5.26	61.5	1.076	3	9
8.64	5.44	62.9	1.076	5	20
8.75	5.41	61.8	1.077	10	10
8.85	5.47	61.8	1.077	0	6
8.95	5.39	60.3	1.078	0	4
9.06	5.63	62.1	1.078	0	4
9.15	5.54	60.6	1.078	3	10
9.24	5.79	62.6	1.081	10	0
9.36	5.66	60.5	1.081	0	6
9.45	5.79	61.2	1.080	9	9
9.54	5.69	59.6	1.082	6	12
9.65	5.74	59.5	1.081	0	0
9.75	5.82	59.7	1.082	0	9
9.85	5.74	58.3	1.082	0	0
10.17	6.04	59.4	1.085	7	14

pre-supplementation period (June and September). Shell thickness and breaking strength were greater when BacPack™ ABF was fed (November and January) versus the pre-supplementation period (June and September).

Conclusion

Broiler breeder egg interior and shell quality affect hatchability. Better shell quality has been linked to higher percent of fertile eggs too, although the mode of action is not known (possibly adequate amounts of Ca, P, and/or vitamin D3 absorption). Supplementing breeder hen diets with BacPack™ ABF, containing CALSPORIN® and IMW50™, may increase albumen height and Haugh units as well as shell thickness and breaking strength which are generally associated with better hatching results.

Table 2. Quality of eggs from Cobb 700 hens before or during BacPack™ ABF feeding.

Flock Codes	Pre-Supplementation				BacPack™ ABF			
	F	C	M	RJ	DR	WR	DR	WR
	June 24, 2014		Sept 5, 2014		Nov 25, 2014 (fed 3 wks)		Jan 26, 2015 (fed 12 wks)	
Age, Wks	50.0		48.5		48.0		57.0	
Egg weight, g P value = 0.0000	66.9b		65.7b		66.0b		68.2a	
Breaking strength, k(f) P value = 0.0005	3.43b		3.77a		3.89a		3.83a	
Shell thickness, mm P value = 0.0090	0.313a		0.314ab		0.322b		0.321b	
Albumen height, mm P value = 0.0005	5.35c		5.20c		6.67b		7.19a	
Haugh units P value = 0.0000	67.9b		67.4b		78.6a		76.7a	

Note: BacPack™ ABF contains CALSPORIN® and IMW50™. Seasonal and additive effects likely. This field research was a cooperative effort of a broiler integrator, QTI, and Calpis America, Inc.



About the Author:

Danny Hooge has provided poultry technical services to QTI since June 11, 2003. He has BS, MS, and PhD degrees related to poultry science, and is a consulting poultry nutritionist and managing member of Hooge Consulting Service, LLC of Eagle Mountain, Utah.

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