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SOURCES OF EGGSHELL STRENGTH

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The avian egg is a notably well-designed structure. Sources of eggshell strength include overall shape, shell membrane quality, and composition and design of the calcified shell.

At ovulation, a spherical yolk is literally engulfed by the funnel-shaped end of the oviduct (I've seen movies of this). During passage through the first 12-inch section of oviduct, called the magnum, the yolk is encapsulated in a thick mass of egg white. During passage down the loose, stretchable oviduct, the egg takes on its characteristic oblong shape.

Shape is a very important factor in eggshell strength. Since an egg is rounded in all directions, high stress points, where fractures would easily occur, are avoided.

Obviously, the strongest shape would be a perfect sphere. In fact, some birds, such as ostriches, humming birds and Japanese quail, lay more nearly spherical eggs. The spherical shape allows these birds to make thinner shelled eggs relative to egg size, conserving body materials.

Approximately two hours after ovulation, the egg has traversed the magnum and the white has completely formed. The egg then enters the isthmus region of the oviduct. In this region the shell membranes (there are two) are formed over the egg white, a process that takes about an hour and a half.

Shell membranes are well known to all who have peeled hard boiled eggs — I find it quite discouraging when trying to whip up a platter of grand-looking deviled eggs, to have the membranes so firmly attached to the white that whites get torn. (I would like to hear from readers who know of tricks to prevent this problem. Please call me at 814-865-6722.)

Shell membranes consist of a crisscrossed network of protein fibers that look like a multilayered filter when magnified 1,000X by a scanning electron microscope. These fibers are linked to each other by chemical bonds to form a very tough sheet. The shell membranes are thinner in older birds.

Upon entry into the shell gland, fluid is added through the shell membranes. This causes the egg white to swell and push the shell membranes into a fully distended position. Next, calcium carbonate is secreted by the shell gland. Clusters of calcium carbonate crystals form at fairly precise distances from each other on the outer surface of the shell membrane. From these clusters, columns of calcium carbonate grow outward and parallel to each other to form a calcified layer. Only microscopic spaces exist among the tightly packed columns of crystals. It is not known what controls the spacing of the first crystals formed from which the columns grow.

Finally, a layer of pigment followed by an impervious material, the cuticle, is laid down on the eggshell surface. The cuticle is microscopically thin and contributes very little to overall eggshell strength, but it is important for preventing dehydration.

The total time spent in the shell gland is 20 hours. The combination of shape and the integration of the several different layers of which the eggshell is comprised contribute to its strength.

It is interesting that reptiles such as turtles and snakes form eggs by a similar process. However, their eggs are not calcified. Instead, the shell membranes are thicker and have a leather-like composition.

It might be possible to select, by genetic manipulation, hens that make substantially thicker shell membranes so that the thickness of the calcified portion would be a less critical factor in overall eggshell strength.

Tough Growing Year Requires Harvest Management

COLUMBUS, Ohio—An early killing frost in late September slammed the last nail in the coffin of what was a very tough growing season for Ohio's corn growers, said an Ohio State University agronomist.

In some cases, the Sept. 23 freeze in northwest Ohio was irrelevant given that much of the corn had prematurely died under the combined stresses of late-season drought and leaf diseases, namely gray leaf spot, said Peter Thomison.

"The plants just shut down and died with kernels prematurely forming the black layer stage," he said.

Producers will see the combined effects of the season's stresses as they begin to combine their fields, requiring extra management to handle the damaged and high-moisture corn.

Yield losses from freeze damage depend on how much stalk tissue was killed as related to the stage of kernel development. Stalks that are green after a frost can mobilize sugars from the stalk to the ear for continued kernel development. However, some fields didn't have that chance because stresses damaged stalks, which depleted the green color.

Thomison said in the worst cases of freeze damage, fields in the fully dented stage could have had up to 31 percent yield loss, although those cases were probably rare. The likelihood was greater that corn was in the late dent stage, which would result in a 4 percent to 8 percent yield loss because of the freeze.