Bacillus subtilis spores improve brown egg colour

A brown egg has to be brown. The colour of shells is often dependent on the layer breed and nutrition, as well as several other factors. Various trials conducted in different parts of the world have shown that Bacillus subtilis spores can give a hand in improving the shell colour.

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In the past 2 or 3 years, scientists have discovered that Bacillus subtilis C-3102 (Bs) spores supplemented to laying hen diets improve brown egg colour within approximately 1-14 days, depending mainly on the inclusion rate (e.g., 3.33x to 1x level; 1 million to 300,000 CFU/g feed). Typically, the initial darker brown colour of eggs produced by pullets gradually fades so that egg colours become a lighter brown as hens age. However, brown egg colour may also drop due to stressors such as high stocking density, handling or loud noise (i.e., epinephrine release), to chemotherapeutic agents such as sulfonamides or nicarbazin, or to certain diseases such as Newcastle and infectious bronchitis. Therefore, a simple and economical intervention strategy involving dietary aerobic Bs C-3102 spores (which vegetate, consume oxygen, and induce more favourable anaerobic conditions in digesta) to increase native lactobacillus proliferation, decrease pathogens, and enhance egg shell quality and colour would be welcome.

Importance of brown egg colour

Uniformity and intensity of brown egg colour are important marketing considerations. This is because excellent brown egg colour may allow egg production to be extended, bring a premium price (e.g. in Japan and South Korea), and/or enhance marketing of “natural” and “organic” eggs (e.g. in the US). The brown eggs sales as a proportion of total egg sales varies from country to country with highest numbers in China and South Korea (approximately 80%) and in Puerto Rico (nearly 100%). Consumers prefer brown eggs over white eggs in several countries of the world, including the United Kingdom, Italy, Portugal, Ireland, Southeast Asia, Australia and New Zealand.

Colour and shell quality

There has been contradictory evidence in the scientific literature about whether or not darker brown egg colour is related to improved shell quality. It has been reported that the darker brown the egg shell is in four strains of broiler breeders, the higher the egg specific gravity (an indicator of shell quality). There was a small but highly significant positive correlation between brown colour and egg specific gravity (they move in the same direction, or as colour got darker, egg specific gravity increased). On the other hand, it is found that using eggs from dwarf caged layers, genetic correlations of brown egg colour with external and internal quality traits were low, ranging from -0.23 to 0.13 (-1.00 or 1.00 would be perfect negative or positive correlations).

In the case of Bs C-3102, however, the manufacturer received a US patent (6,660,294) in December 2003.
for its egg shell thickness improving effect in laying hens. Therefore, with dietary Bs C-3102 spores, both egg shell quality and colour may likely be beneficially affected. The mode of action for improving egg shell thickness appears to be better calcium utilisation, but the mechanism for improving brown egg shell colour is not yet known.

Brown colour pigments
The brown pigment in the egg shell is protoporphyrin, whereas the blue pigment (e.g. in Araucana egg shells) or green pigment is ocyanin. During the last 3 or 4 hours of shell formation, epithelial cells lining the surface of the shell gland (uterus) synthesise and accumulate pigments for brown egg colour, mainly protoporphyrin-IX from the breakdown of hemoglobin in blood, together with biliverdin-IX and its zinc chelate. During the last 90 minutes of shell formation, the pigments are transferred to the protein-rich viscous fluid secretion that becomes the cuticle. Cuticles with brown pigments can be removed with vinegar or sandpaper.

Whitening of brown eggs
It is well known that Nicarbazin (a broiler chemical coccidiostat) can cause whitening of brown eggs in broiler breeders due to cross-contamination of breeder feeds. Nicarbazin affects porphyrin metabolism in erythrocytes and the uterus, and markedly lowers uterine and egg shell porphyrin content. Whitening malfunction appeared to be due to impaired kinetics of porphyrin deposition in brown egg-laying strains with a high or low incidence of shell whitening because the amount of porphyrin deposited was normal. Some hens stressed by means of cages with open nest sites (nest hollows), as compared to enclosed nest sites, retained their eggs in the shell gland beyond the normal time of laying, resulting in deposition of extra-cuticular calcium making brown eggs appear paler.

A field survey of 2,206 eggs from Kadaknath breed hens in India show 67.9% dark brown and 32.1% light brown eggs, indicating possible stresses and room for improvement.

Chinese field trial in 2006
A preliminary field trial conducted at an egg farm in Asia in 2005 (unpublished data) showed that Bs C-3102 spores at the regular recommended dose (300,000 CFU/g feed) improved brown egg shell colour within two weeks, as judged by Ghen Corporation brown colour fan scores (1=light to 10=dark brown).

Next, a field trial was carried out with 63-week old caged Kadaknath breed hens in India show 67.9% dark brown and 32.1% light brown eggs, indicating possible stresses and room for improvement. It is well known that Nicarbazin (a broiler chemical coccidiostat) can cause whitening of brown eggs in broiler breeders due to cross-contamination of breeder feeds. Nicarbazin affects porphyrin metabolism in erythrocytes and the uterus, and markedly lowers uterine and egg shell porphyrin content. Whitening malfunction appeared to be due to impaired kinetics of porphyrin deposition in brown egg-laying strains with a high or low