TECHNICAL NOTE

LowInputBreeds

Egg quality

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About

This technical note discusses the influence of flock nutrition, housing and other aspects of bird management as well as egg storage on egg quality and how this has been investigated under the LowInputBreeds project.

Introduction

Egg quality can be considered as both internal egg quality, focusing on the egg content, and external egg quality, focusing on the egg shell. For producers egg size is also important since small eggs can't be sold as table eggs and large eggs have a higher risk to crack.

Internal egg quality

The internal quality of an egg is determined by the composition of egg white and yolk and possible enclosures (flesh, blood), but also by the freshness since egg starts to age directly after laying.

This aging impact can be measured using either destructive or non-destructive methods. The *non-destructive method* assesses the size of the air chamber in the egg and the *destructive method* measures the height of the thick albumen, with egg content on a flat surface, the so-called Haugh Units. During aging there is CO_2 and O_2 exchange and water evaporates through the shell increasing the air chamber and reducing albumen height. This process is influenced by the storage environement: in high temperatures and/or low relative humidity evaporation is higher, resulting in a faster aging of the egg. Oiling of the shells (which is common practice in the USA) prevents the exchange of O_2, CO_2 and water and thus reduces aging and weight loss. A loss of 0.1 g per day is considered acceptable. The Haugh Unit is used in legislation as the indicator for freshness of eggs and should be above specified levels for eggs to be sold.

Blood and meat spots in the eggs have a genetic background: some breeds have a higher incidence than others. The classical way for detection of blood spots is by candling, although modern techniques using spectrophotometers are more effective than candling, especially in brown eggs.

External egg quality

External egg quality is determined by shell colour, cleanliness, integrity (cracks, strength) and shape. Egg shells are covered with a cuticula, protecting the egg from penetration by microorganism, which is lost by washing.

Washed eggs in the USA always are oiled, which serves as an alternative protective layer. European legislation however does not allow egg washing for A-grade (table) eggs.

Van Niekerk (2014): Egg quality.
LowInputBreeds technical note. Download at www.lowinputbreeds.org

Dirt on eggs has various origins, including manure and urine and problems with large eggs or vent pecking can result in blood stains. Blood stains can also occur with high infestations with red mites within the housing. If these parasites are abundant especially on the egg belt, eggs roll over the mites resulting in typical little blood spots on the shells.

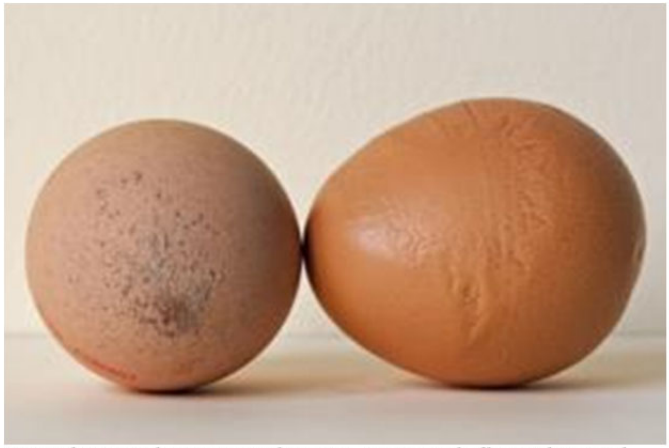
Cracks are not always easily visible and although hairline cracks can be detected by candling, sometimes they can only be detected after a few days storage. Shell integrity can also be measured automatically by sound detection sensors as the intact egg has a different resonance compared to one with a hair crack. Sophisticated egg packing machines are equipped with both candling and sound detection techniques. As shell integrity is closely related to shell strength and tests have also been developed to measure shell strength. Strength has a genetic background (e.g. brown eggs have stronger shells than white eggs), but is also related to the age of the birds (thinner shells and more cracks in older hens), egg size (larger eggs are easier damaged) and nutritional factors (e.g. calcium availability).

If shell formation is disrupted, **soft shelled or shell-less eggs** are laid. This is quite common in pullets coming into lay, especially if laying occurs too early although they can also be induced by stress, elevated temperatures, incorrect nutrition or disease outbreaks.

Influence of hen nutrition on egg size and shell quality

There is a direct relation between dietary protein supply and egg size. Lowering total protein, methionine or other essential amino acid supply can reduce egg weight. In organic diets, without synthetic amino acids, it is a real challenge to realize a balanced amino acid profile. Egg weight is also influenced by fat in hens' diet; both its levels and composition. Early egg weight gain can be stimulated by adding extra fat to the diet, especially vegetable oils rich in unsaturated fatty acids and linoleic acid have positive effects on egg weight. In older birds feeding more saturated fat (palm oil) and limiting the supply of unsaturated fatty acids like linoleic acid can control the increase of egg weight, normally occurring later in the period of lay.

IB or stress may cause rings around the egg.



Irregular egg laying resulting in eggs with flat sides and extra calcified eggs.

Some disease problems (IB: Infectious Bronchitis, EDS: Egg Drop Syndrome, TRT: Turkey Rhinotracheitis, NCD: Newcastle Disease) and stress can cause darker or lighter shell colours (Photos: Thea van Niekerk, Wageningen UR Livestock Research).

Typically the shell on a single egg contains up to 3 grams of calcium, making adequate calcium supply in the feed necessary. The provision of larger particles high in calcium (e.g. shell grit) can be beneficial and about 50 to 70 percent of dietary calcium should be in the form of course particles (2 to 5 millimetres) with the remaining in powder form.. The uptake of calcium from the gut is closely related to the phosphorus; high phosphorus levels may impair the uptake of calcium and thus result in weaker shells. Vitamins such as Vitamin D are necessary for calcium metabolism and vitamin C may have an indirect influence on egg quality as it reduces the effects of stress and thus can have an effect on shell structure and strength.

Diets containing high levels of non-starch polysaccharides (NSP's) may result in watery, sticky droppings, which contaminate eggs. To overcome this in recent years NSP-degrading enzymes have been developed for feed application, however, these may cause lighter shell colours and a reduce Haugh Units.

Internal egg quality is also affected by nutrition. Albumen quality (Haugh Units) decreases with increasing dietary lysine concentration and increases with Vitamin C or E supplementation.

Influence of housing on egg quality

Housing systems influence bird behaviour, especially if hens in cages and non-cage systems are compared. Birds in non-cage systems will spend more energy on movement, which may result in either smaller eggs or reduced yolk content. Contamination of shells with microorganisms is higher in non-cage systems since more eggs tend to be laid outside nest boxes and the interactions between active hens and bedding material increases dust in the atmosphere which is a carrier of microbes and thus contamination.

Aviary system (Photo: Thea van Niekerk, WUR).

In cages eggs will roll onto the collection belt, but in non-cage systems if laid outside the nest boxes they remain on the slatted floor, in the litter or even in the outside run. Frequent collection of these eggs is necessary to prevent escalation of the problem. Most floor laid eggs will be dirty and thus not suitable as table egg. Depending on the size and management of the farm these eggs will be either sorted into first and second grade or all be send off as second grade. Housing system and nest design, genotype and age of the hens all influence the number of mislaid eggs. At start of lay the percentage of mislaid eggs is higher than later on into the production period, provided frequent collection occurs to reduce the incidence. A housing layout encouraging hens to move easily towards nest boxes will reduce the number of mislaid eggs.

Influence of free range on egg quality

Hens under free range circumstances experience a larger variation in climate, both inside and outside the house, compared with caged or barn-kept hens. Open pop-holes make it difficult to control the temperature in the henhouse and feed formulations for free range flocks should take these harsh circumstances into account.

To obtain good quality eggs under these [free range] conditions, layers should be fed balanced diets or farm feeds (cereals) enriched with at least high-protein (e.g. soybean meal, rapeseed meal or sunflower meal) and mineral components. Digestible lysine and methionine +cysteine content should be at least 6.1 and 5.7 g/kg, respectively. At the start of the laying period calcium and absorbable phosphorus content of 37 g/kg and 3.2 g/kg is recommended, whereas these values gradually move to 44 g/kg and 2.8 g/kg, respectively, for hens of 55 weeks of age onwards. In comparative studies often, but not always, positive effects of free range are found on egg shell thickness and fat composition of the yolk. Variation in feed formulation may partly explain differences but the extent that birds use the range and availability of vegetation, insects and other potential feeds may also influence egg quality. Consumption of green vegetation may result in darker yolk colour.

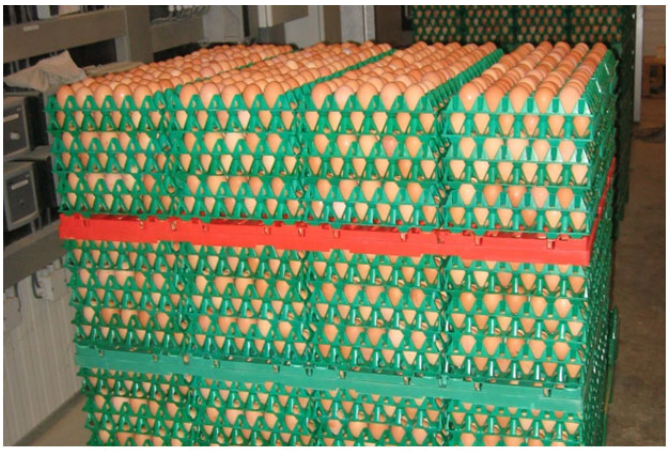
Free range hens will be more susceptible to worm infections compared to cage hens and heavy infestations with round worms or capillaria worms can result in pale shells and yolks. Deworming treatments may be necessary.

Studies in the Netherlands revealed higher dioxin contamination of free range eggs compared to cage or barn eggs. An important factor was the proximity to waste incineration, indicating the importance of keeping range areas clean and preferably not in the vicinity of industrial activities.
There are frequent reports about the influence of sunlight on the incidence of pale egg shells. This is said to be more marked in flocks with poor feather quality, although the problem can be resolved if birds are housed, when the number of pale eggs drops to normal level. No definite explanation for this phenomenon has been found.

Free ranging hens (Photo: Monique Bestman, LBI).

Influence of storage

Fresh eggs can easily be stored for 3 to 5 weeks, depending on the conditions. Prolonged storage can influence internal egg quality if the environment in the storage room is inadequate. One week at 25 °C will reduce the Haugh Units (HU) up to the limit of acceptable freshness (70 HU), whereas one week at 8 °C will result in eggs that are still very fresh (85 to 90 HU). Therefore, ideally a cooling chain should be set up to store and transport eggs. In Europe, this is not common, and storage rooms are often kept at 18 °C which needs to be maintained throughout the year. Small farms without fully controlled storage room may have a problem maintaining good egg quality during hot summer periods.



Storage of eggs (Photo: Thea van Niekerk).

Further reading

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