Breeding chickens to meet egg quality needs

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Worldwide, egg customers have much in common, generally preferring eggs which have a sound shell, uniform shell colour, freedom from obvious blood and meat spots and a reasonably upright egg white.

However, there are also regional preferences that can strongly influence the choice of genetic type for particular markets.

Differences in market needs

● **Shell colour.**
The most obvious trait affecting breed choice is eggshell colour, with the brown egg type dominating the markets of most of Europe, Southeast Asia, Australia, New Zealand, much of Africa and some countries in South America.

However, there are differences in shell colour preference from country to country within Europe.

In the UK, Italy, Portugal and Ireland consumers buy only brown shelled eggs. However, in markets such as Germany, Holland and Spain brown shelled and white shelled eggs are sold in similar numbers.

The Hy-Line variety Brown and other white tailed Red varieties provide most of the world's supply of brown eggs.

In Japan, many brown eggs are sold into the premium market, and exacting standards are set for a uniform dark brown shell.

There is also a market for eggs with a light brown tint shell colour and this is met with special crosses between white egg and brown egg lines.

Eggs enriched with various nutrients such as omega-3 fatty acids and iodine are also sold at a premium in many markets.

● **Albumen height.**
Although all consumers prefer that the albumen in a broken-out egg be reasonably thick, the relative importance of this trait varies from one market to another.

In the USA, standards are set for the minimum acceptable Haugh unit level.

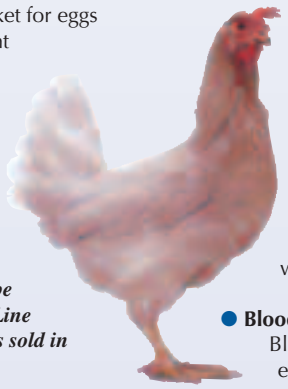
Haugh units are a measure of the height of the thick white in a freshly broken egg.

The Haugh unit calculation takes into account egg size, since it is correlated with the thickness of the egg white.

The US Department of Agriculture specifies that AA quality eggs have a firm white with a Haugh unit value of 72 or more.

The consumer's perception of the freshness of an egg is linked to albumen height.

Haugh unit values are not specified for most other countries, but in Japan strong emphasis is placed on the thickness of the egg white. Many Japanese eggs are consumed uncooked, as with Sukiyaki, where a raw egg may be served as a side dish. Eggs may be held in Japanese markets for several days without refrigeration. Since the egg white quality can decline by as much as 15 to 20 Haugh units when held for seven days at room temperature, it is important for the Japanese market that the egg has thick albumen when first laid.



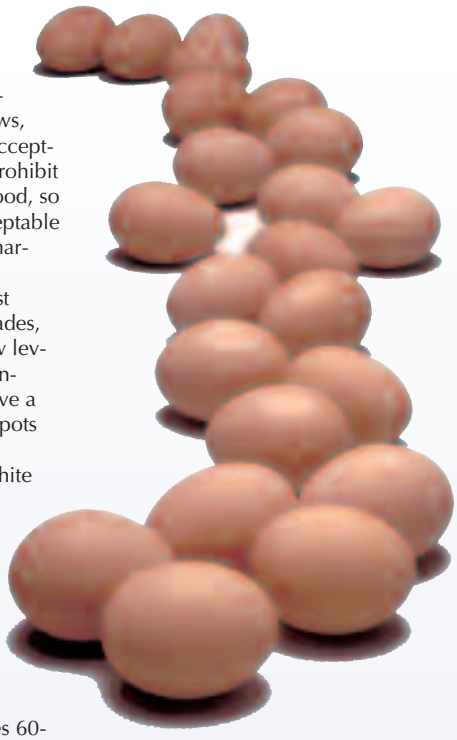
Some markets call for an egg with a light brown colour. This is filled with crosses of white egg and brown egg type birds such as the Hy-Line variety Sonia, which is sold in Japan.

● **Blood spots.**
Blood spots in the egg are generally unacceptable, but very small spots will pass unnoticed in most markets.

However, for those adhering to the Kosher dietary laws, any blood in the egg is unacceptable. Islamic dietary laws prohibit the eating or drinking of blood, so blood spots are also unacceptable in predominantly Muslim markets.

Breeders have bred against blood spots in eggs for decades, and have achieved very low levels, but the there is still a tendency for brown eggs to have a higher incidence of blood spots than white eggs.

While predominantly a white egg market, brown eggs are also popular in Israel, and those genetic brown strains that have a lower incidence of blood spots are at a premium in this market.

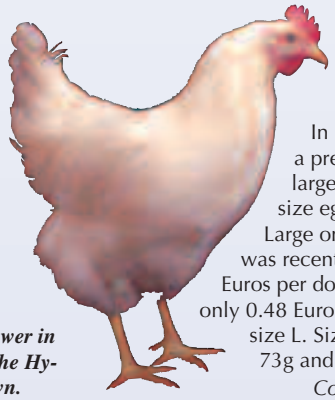


In all brown egg markets consumers prefer a uniform shell colour.

● **Egg size.**
In general, egg size averages 60-61g across the world; however, there are regional preferences for egg sizes that can influence the choice of genetic strain toward varieties that produce eggs that are larger or smaller than this average.

For example, in South Africa, the market preference averages around 58.5g, but even within that, there is a 'formal' market using a somewhat larger egg and an 'informal' market with only two categories – 'juniors' weighing 48g and less and 'seniors', weighing 49g and up.

The South African market prefers a brown egg, but there are two types of bird supplying these eggs, the conventional white-tailed red sold in Europe and much of the rest of the world and a special white plumaged, brown egg type which lays a smaller egg (for example the Hy-Line variety Silver Brown and the Lohmann variety Silver).



The Hy-Line variety Silver Brown has predominantly white plumage but lays a dark brown egg averaging 2-3g lower in egg weight than the Hy-Line variety Brown.

The informal market is supplied by the white plumaged type and the conventional market by a blend of eggs from both types.

In Israel a very large egg is preferred. There are seven size categories, the largest, size 1, being over 70g.

Recently, size 1 eggs were being sold at a premium of 0.45 NIS per dozen (about 0.08 Euros) over the next smaller size.

In Spain, there is also a preference for a very large egg. The largest size egg, size XL or Very Large on the EU scale, was recently priced at 0.65 Euros per dozen, compared to only 0.48 Euros per dozen for size L. Size XL eggs weigh 73g and above.

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In both Israel and Spain, those genetic varieties with a larger size have an edge over strains with smaller sizes. In addition, birds are managed in a way to get more eggs of the larger grades.

● **Percent solids.**
Historically, most eggs have been sold in the shell, but the proportion being marketed as liquid, dried or further processed product is increasing.

In the USA, approximately 30% of all eggs produced are now broken out for further processing. A similar market split, between the shell egg and broken out eggs, also occurs in Italy.

The US Department of Agriculture has set minimum standards for percentage solids in egg product. For liquid egg mix resulting from the combination of yolk and white, the minimum is 24.2% solids.

For whole egg resulting from the direct breakout of the egg, with no separation of white and yolk, buyers are commonly asking for at least 23.6% solids. Egg product that falls below these standards is commonly 'docked' in price, with the producer receiving less than the market rate.

Percent solids in the egg vary with age, but it is also influenced by strain of bird, so there is pressure on breeding organisations to develop hens that produce higher proportions of solids.

Since the yolk is much higher in solids content than the white, varieties with a lower proportion of albumen are favoured for this market.

In Italy much of the egg product is used for the manufacture of pasta and the emphasis is on percentage lipids. The Italian industry has set a standard of 10.5% lipids in liquid yolk.

Breeding to meet market needs

Breeders of egg type chickens are improving all of the key egg quality traits. This improvement takes the form of selection within the pure lines making up each commercial cross. This within line improvement is translated into a slow but steady improvement of the commercial product.

The proportion of the total observed variation for each trait that is genetically determined influences the amount of genetic change that a breeder can make. This proportion is referred to as 'heritability'.

The heritability for some key traits is listed in Table 1.

From Table 1, it is clear that it is much easier to modify some traits than others. Egg weight has a relatively high heritability and responds rapidly to selection.

Blood spots on the other hand have been bred to very low levels, particularly in white egg stocks. Further reduction in blood spots is very difficult, but selection is continued each generation to make sure that the incidence stays low.

Trait	White egg lines	Brown egg lines
Egg weight	0.53	0.55
Shell strength	0.27	0.40
Albumen height	0.37	0.44
Shell colour	0.43	0.55
Blood spots	0.03	0.10

Table 1. The heritability for some key traits.

At Hy-Line, eggs from each hen in the pureline populations are sampled at multiple ages with five eggs from each hen individually evaluated at every age. Each egg is labelled with a bar code indicating her line and wing band number.

This bar code is scanned into the computer and we then measure shell colour, egg weight and shell strength, after which the egg is broken onto a mirrored glass, allowing observation of the egg from all angles.

Blood and meat spots are recorded, as are any other abnormalities in the egg. Albumen height is measured.

Finally, the yolk is separated and weighed.

In addition to the eggs brought in from the pure lines, we also bring in samples from our field trials, where each family is on test. These eggs are sent in at three ages before the moult, and once post moult.

As an illustration of the process of evaluation, the procedures for evaluation of two traits will be described in more detail.

Over one million eggs per year are evaluated at the Hy-Line egg quality laboratory in Dallas Center, Iowa.

Albumen height measurement

As each egg is broken out, a tripod is placed over the egg, with a probe centred midway between the edge of the thick white and the yolk.

This probe is lowered on down into the white, and at the instant at which it comes into contact with the white, a signal indicating the height off the glass plate is transmitted to the computer.

This is the albumen height, which is measured in millimetres. Since the egg weight has already been measured, we can calculate the Haugh units.

The eggs that are brought in from our field tests are held for two days at room temperature before breakout. This allows us to take into account differences among genetic types in the decline in albumen quality as the egg ages.

Because of consistent selection for albumen height, Haugh units in Hy-Line stocks have increased steadily over time. At the present time, we are adding about 0.5 Haugh unit per generation.

Shell colour measurement

Shell colour for each egg is evaluated using a device manufactured by the Minolta Corporation.

The aperture of the device is centred on the top of the shell, and when the trigger is depressed, a flash of light is projected onto the egg's surface.

From the reflected light is determined its lightness (L) and its hue, expressed on a red-green scale (a) and a yellow-blue (b) scale. We convert L, a, and b into an index, calculated so that a high value indicates a dark brown shell and a low value a pure white shell, on a scale over an approximate range of 1 to 100.

Hy-Line brown eggs are being selected for a darker shell, with a genetic improvement of about one unit per generation. Among our white egg lines, any hens with tinting in their shell are removed, to ensure that the commercial continues to have a pure white shell.

In conclusion, breeders have to recognise the unique egg quality needs of each of their worldwide markets. To some extent this is accomplished through the development of special varieties for certain niche markets.

In general, the principal genetic varieties are sold throughout most of the world, with management adjustments to provide eggs for customer requirements that vary from the norm. ■

Left, the height of the thick white is measured and recorded automatically as a probe is lowered into the albumen. Right, shell colour is measured for both white and brown shelled eggs.