Chapter 2
Marketing quality eggs

QUALITY CRITERIA
Quality determines the acceptability of a product to potential customers. The quality of eggs and their stability during storage are largely determined by their physical structure and chemical composition. It is important therefore that those concerned with the handling of eggs are knowledgeable about this information in order to understand why eggs need to be treated in specific ways and to have a rational basis for day-to-day marketing decisions.

Composition and attributes of eggs
An egg consists of shell, membrane, albumen or white and yolk.

The shell. The shell of an egg has a rigid yet porous structure. The porous shell has great resistance to the entry of micro-organisms when kept dry and considerable resistance to the loss of moisture by evaporation. The colour of the shell, which may be white or brown depending on the breed of the laying chicken, does not affect quality, flavour, cooking characteristics, nutritional value or shell thickness.

Shell membrane. Inside the shell there are two membranes (as seen in Figure 6). The outer membrane is attached to the shell, the inner membrane is attached to the albumen or egg white. These two membranes provide a protective barrier against bacterial penetration.

Air space. An air space or air cell is a pocket of air usually found at the large end of the egg interior between the outer membrane and the inner membrane. This air cell is created by the contraction of the inner contents while the egg cools and by the evaporation of moisture after the egg has been laid. The air cell increases in size as time passes.
Figure 6

Egg composition

COMPOSITION

Shell
- Outer covering of egg, composed largely of calcium carbonate.
- May be white or brown depending on breed of chicken.
- Color does not affect egg quality, cooking characteristics, nutritive value or shell thickness.

Yolk
- Yellow portion of egg.
- Color varies with feed of the hen, but doesn’t indicate nutritive content.
- Major source of egg vitamins, minerals, and fat.

Germinal Disc

Vitelline (Yolk) Membrane
- Holds yolk contents.

Chalazae
- Twisted cordlike strands of egg white.
- Anchor yolk in center of egg.
- Prominent chalazae indicated freshness.

Air Cell
- Pocket of air formed at the large end of egg.
- Caused by contraction of the contents during cooling after laying.
- Increases in size as egg ages.

Shell Membranes
- Two membranes – inner and outer shell membranes surround the albumen.
- Provide protective barrier against bacterial penetration.
- Air cell forms between these two membranes.

Thin Albumen (White)
- Nearest to the shell.
- Spreads around thick white of high-quality egg.

Thick Albumen (White)
- Major source of egg riboflavin and protein.
- Stands higher and spreads less in higher-grade eggs.
- Thins and becomes indistinguishable from thin white in lower-grade eggs.

Egg albumen or white. The albumen of the egg is composed of the outer thin albumen and the inner firm or thick albumen. The outer thin albumen spreads around the inner firm albumen. The inner firm albumen in high quality eggs stands higher and spreads less than the outer thin albumen.

White fibrous strips. These are twisted, cord-like strands of egg white, known as chalazae, which hold the yolk in position. Prominent thick chalazae indicate high quality and freshness.

Yolk. The yolk is almost spherical and is surrounded by a colourless membrane. The colour of the yolk varies with the type of feed given to the laying hen. If the laying hen is fed on maize, for example, the yolk will become a bright yellow. The colour of the yolk does not affect the nutritional content.

Egg weight. The weight of eggs varies widely depending on many factors such as the breed, the age of the layer and environmental temperature. In Africa, for example, the egg weight may range from 35 to 65 grams, while in Europe it may range from 45 to 70 grams. As a layer gets older the weight of the eggs increase as can be seen in the following figure.

Figure 7
Egg weight increase according to age of layer

Source: Larbier and Leclecq, 1992
The components of an egg weighing 60 grams are made up as follows:

- yolk (29%) – 17.4 g
- white (61.5%) – 36.9 g
- shell (9.5%) – 5.6 g

**Nutritional value**

Eggs are a good source of high quality protein. They provide important sources of iron, vitamins and phosphorus. As a nutritional source of vitamin D, eggs rank second only to fish liver oils. Eggs are low in calcium, which is discarded in the shell, and contain very little vitamin C.

Eggs provide a unique and well-balanced source of nutrients for persons of all ages. Hard-cooked egg yolks are of great nutritional value as a major supplementary source of iron for infants. When children reach one year of age they may also be given egg whites. Eggs contain significant nutritional value, which is essential during rapid body growth, and therefore are excellent food for young children and teenagers.

Low caloric value, ease of digestibility and high nutrient content make eggs valuable in many therapeutic diets for adults. During convalescence, when bland diets may be required, eggs provide a good nutritious diet. For older people, whose caloric needs are lower, eggs are an easy, inexpensive and nutritious food to prepare and eat.

Availability, modest cost, ease of preparation, popular taste appeal and low caloric value give eggs a primary advantage for human nutritional needs.

**Shell quality: texture, colour, shape and condition**

The ideal shape of an egg as established by tradition and by practical considerations can be seen in Photograph 6.

Shell quality characteristics that must be considered are as follows:

- cleanliness
- soundness (unbroken)
- smoothness
- shape
The two most desirable shell qualities, cleanliness and soundness, are largely controlled by the production and handling of eggs. Eggs with shell defects should be removed from eggs destined to the retail trade. Clearly, consumers have adverse reactions to cracked or dirty eggs. Even if the cracks in an egg are only visible when candling, the micro-cracks may have serious consequences on quality. These eggs may be sold locally and possibly only a few hours after lay.

When the membrane is broken as well as the shell, the contents of the eggs can leak, and therefore the only practicable market outlet is sale as egg pulp. If the eggs are dirty, for example, with blood or faeces, consumers will react unfavourably to them.

Although shell colour is no indication of quality, consumers in some markets may prefer white eggs or brown eggs. In such circumstances, it is advisable to sort eggs by shell colour.

**Yolk and albumen quality**

In quality eggs the yolk should be round, firm and stand up well, and be yellow in colour.

There is often prejudice against very pale or deeply coloured yolks, however, there are some exceptions. In some Italian markets, for example, red yolks are a strong selling point. The yolk should have a pleasant, mild egg odour and flavour and should be surrounded by a large amount of upstanding thick white with only a small amount of thin white. The egg white should have the normal slightly green-yellow colour, though it may be slightly cloudy in appearance.

Consumers are generally very critical of any abnormal conditions in the egg yolk and white. Factors that may cause loss of quality are as follows:

- natural factors
- temperature
- humidity
- time
- handling
- storage
- tainting
Natural factors, for example, can be blood spots, which may range from small specks to a square centimetre in size. They may vary in colour from light grey to bright red and may be found in the yolk or in the egg white. “Blood eggs”, with blood diffused throughout the white or spread around the yolk, are not commonly found and are generally rejected by the consumer. Photograph 7 shows the various degrees of spotting and blood diffusion.

**Deterioration**

The changes that occur in eggs stored for a week to ten days at a temperature between 27° and 29° C are comparable to those that occur in similar eggs in cold storage for several months at a temperature of – 1° C. The effect of temperature and storage on eggs can be seen in Photograph 8. The typical appearance of eggs stored up to 13 weeks at temperatures varying from 10° to 46° C can also be seen in this photograph. In advanced stages of deterioration, the thick white may disappear entirely and the yolk may enlarge to the point where its membranes are so weakened that it breaks when the egg is opened. Changes in odour and flavour take three or four weeks at a temperature of 21° C, or six to seven weeks at a temperature of 10° C to become noticeable to the ordinary consumer.

Temperature, humidity, air movement and storage time can all have adverse effects on interior quality. These factors, if not controlled, can cause loss of moisture in eggs. Loss of water through the porous shell will mean loss of weight. A loss of weight of two to three percent is common in marketing eggs and is hardly noticeable to consumers. However, enlarged air cells and a decreased size of egg contents become noticeable when losses exceed this extent.

Coating eggs with oil and other substances and storing them at low temperatures and high humidity may control moisture loss. The best conditions for storage are at a temperature of about – 1° C and relative humidity between 80 and 85 percent. At a temperature of 10° C, lower relative humidity is needed, between 75 and 80 percent. At all temperatures there is the risk of mould spoilage where the relative humidity is too high. Packaging materials that are too dry or are excessively moist and absorbent will also accentuate evaporation losses.
The contents of eggs when just laid are usually sterile and contain few organisms capable of causing spoilage even when the shells are slightly dirty or stained. The main cause of spoilage by bacteria is the washing of dirty eggs before marketing. When the egg is washed, organisms from water – usually bacteria – can penetrate the shell. Once inside they multiply and eventually spoil the egg, causing green, black and red rots. Even when eggs become wet without any cleaning process, for example, by condensation after removal from refrigerated storage into a warm temperature, conditions may be favourable for the penetration of micro-organisms and rotting may follow. When eggs are kept dry, no such way is provided for bacteria to penetrate the shell.

Mould spores normally present on eggshells may, if sufficient time elapses, germinate and grow, penetrating the shell and causing spoilage. Generally this occurs only when eggs are in cold storage for several months or more under conditions of high humidity (above 85 percent). It can occur, however, at any temperature if the humidity is sufficiently high and the holding time long enough.

Eggs can easily be tainted by strong odours from kerosene, gasoline, diesel oil, paint and varnish, and by such fruit and vegetables as apples, onions and potatoes. Special care must therefore be taken in storage, packaging materials and transport facilities used.

**QUALITY MAINTENANCE**

Maintaining fresh egg quality from producer to consumer is one of the major problems facing those engaged in marketing eggs. Proper attention to production, distribution and point-of-sale phases are of vital importance in maintaining egg quality.

**Production factors**

The factors that affect egg production are discussed in Chapter 1. The main production factors that affect quality maintenance are the following:

- breed
- age
- feed
• management
• disease control
• handling/collecting eggs
• housing

Breed. The breed of the laying hen affects shell colour; for example, Leghorns produce white eggs, while Rhode Island Reds produce brown eggs. The following egg quality factors are partly inherited: shell texture and thickness, the incidence of blood spots and the upstanding quality and relative amount of thick albumen. Though it may not always be possible, a consistent policy of selection for breeds by egg producers can bring noticeable improvements to quality.

Age. Birds typically begin producing eggs in their twentieth or twenty-first week and continue for slightly over a year. This is the best laying period and eggs tend to increase in size until the end of the egg production cycle. Birds lay fewer eggs as they near the moulting period. In the second year of lay, eggs tend to be of lower quality.

Feed. Egg quality and composition derive primarily from what a layer is fed. In terms of taste, for example, eggs laid by hens fed on fishmeal will have a “fishy” taste. The type of feed will also influence the shell of an egg and the colour of the yolk. Layers must be kept away from certain plant foods if egg colour defects are to be avoided. These may include cottonseed meal and the foliage of the sterculiaceae and malvaceae such as mallow weed.

Regular access to fresh or high-quality dehydrated green feed helps birds to produce eggs with a uniform yellow yolk. Yellow maize, alfalfa meal, and fresh grass provide good pigment sources for a normal yellowish-orange yolk colour.

Management. Good general management of the laying flock can improve egg quality. If birds are treated correctly and not put under conditions of stress they will produce properly.
**Disease control.** Diseases have an effect on egg quality. Infectious bronchitis and Newcastle disease, for example, will cause birds to lay eggs with poor quality shells and with extremely poor quality albumen. Many of the birds continue to lay poor quality eggs even after recovery. Effective vaccines should be administered.

**Handling/collection eggs.** Frequent collection is essential each day in order to limit the number of dirty and damaged eggs and also to prevent the hens from eating the eggs. Careful handling is necessary in order to avoid breakage.

**Laying house.** The number of dirty eggs produced can be reduced significantly by providing good housing and clean nests for the layers. Cleaning and hygiene operations should be carried out frequently.

**Measures to prevent deterioration during marketing**

**Temperature.** By far the most effective method of minimizing deterioration of quality in eggs is to keep them at temperatures below 13° C. Eggs should never be left standing in the sun or in a room that gets very hot at some point in the day, but should be moved into shaded, well-ventilated rooms and underground cellars as quickly as possible. Various methods to prevent deterioration by temperature are shown below.

1. A simple method is covering eggs with green leaves, so as to reduce temperature.

2. A method commonly used is that of putting eggs in a porous pot where the outside of the pot is kept damp. Great care should be taken, however, to avoid the excess use of water, which could trickle down to the bottom of the pot damaging the eggs at the bottom.

3. Eggs can be kept in a wide-mouthed earthen pot that is buried in the ground up to half of its height. The inside of the pot is lined with a thin layer of grass to prevent the eggs being spoiled by excess moisture. Eggs are placed in the pot as soon as they are collected and the top covered with a thin
cloth to facilitate the exchange of air. A layer of sand and earth is spread around the earthen pot and water is sprinkled on it frequently during the day. The eggs are turned once a day to prevent the internal yolk of the egg from sticking to one side of the eggshell. Such a system may reduce the egg temperature by 8° C below the temperature outside the pot.

4. Another method that can be used which is ideal for dry climates makes use of the cooling effect of evaporation. Baskets of eggs are stored in a small wooden or wire-frame cupboard. A water tray is kept on top of the box and pieces of sacking are placed in the tray and arranged so that they hang on all sides of the box. More elaborate versions with arrangements for a steady dripping of water on to the sacking can be developed. This can be seen in Figure 8. In humid areas such devices would be less useful. The maintenance of egg quality in wet tropical areas is extremely difficult without refrigeration.

5. Refrigerated storerooms can be used if electricity is available. An example of a refrigerated storeroom is shown below. If refrigerated storehouses are not economically viable, the use of electric fans may be appropriate.
Figure 8
Evaporation cooling in dry climates

The cooler should be shaded from direct sunlight. It is most efficient when air circulates freely round it and does not give good results in a closed room. The cooling effect can be intensified by blowing air through damp sacking with an electric fan.
Producers, wholesalers and retailers should move eggs to consumers as quickly as possible to minimize the risk of spoilage. The importance of avoiding delays at all stages in the distribution channel cannot be overemphasized and should be the primary consideration determining marketing arrangements.

*Treatment of dirty eggs.* Some eggs will inevitably have dirty shells. For the purpose of appearance, washing is the most effective and simplest method of removing dirt and stains from the shell surface. The water, however, may contain bacteria that could penetrate the porous eggshell causing it to decay. Odourless detergent-sanitizing substances should be used in the water to wash eggs, but these may be difficult to obtain.

Eggs can be submerged in clean hot water (water temperature should be around 38° C); however, this may cause thermal cracks in the eggshell and internal expansion of the egg content. It is better to avoid washing eggs altogether. Using dry abrasives for scraping and brushing may be the optimal solution. In using this method, care should be taken to avoid removing excessive shell material, which will weaken the shell and increase the rate of evaporation.

*Shell oiling.* Coating eggs with a thin film of oil greatly reduces losses by evaporation, especially where eggs are in cold storage for several months or are held at temperatures above 21° C. Special odourless, colourless, low-viscosity mineral oils should be used. Where eggs must withstand high temperatures, they should be oiled from four to six hours after lay. If eggs are to be stored at a temperature of 0° C, they should be oiled 18 to 24 hours after lay. Eggs can be oiled by hand dipping wire baskets or by machine. The temperature of the oil should be at least 11° C above that of the eggs. Before the oil is reused it should be heated to a temperature of 116° C to prevent bacteria survival and then be filtered. The oil reservoirs should be cleaned properly. In terms of appearance oiled eggs differ from other eggs only in the slight shine left on the eggshells by the more viscous oils.

**Inducements for quality maintenance**
Provision of effective incentives for the adoption of quality maintenance procedures is the function of the marketing system. It must provide some
means whereby egg quality can be appraised and a system of purchasing premiums and deductions applied accordingly. Methods of assessing quality of eggs are discussed below.

**GRADING AND STANDARDIZATION**

Grading and standardization consist of arranging produce into a number of uniform categories according to physical and quality characteristics of economic importance. It is a process of identification, classification and separation.

The advantages of grading and standardization are as follows.

- Different grade eggs may be sold to different customers. Customers willing to pay more for high quality eggs will be served. On the other hand, eggs with micro-cracks or small blood spots may be sold to bakeries.
- Setting and maintaining a reliable standard creates consumer confidence in the product and a favourable reputation. This will enable buyers (wholesalers, retailers, exporters, consumers) to purchase a reliable product that they recognize and may well avoid inspection and disputes.
- The ability to furnish an accurate description of eggs in storage may help in obtaining credit.

**Grade specifications**

The value factors most generally appreciated in eggs are internal quality, appearance and soundness of shell, size and colour.

Most egg marketing systems find it advantageous to adopt grading practices that:

- eliminate inedible and defective eggs;
- separate eggs into high and lower acceptable categories; and
- establish uniform weight classifications.

For example, the grading system used in the United States of America, as recommended by the United States Department of Agriculture (USDA), is summarized in Table 7.
Table 7
Summary of United States grade standards for individual shell eggs

<table>
<thead>
<tr>
<th>Quality Factor</th>
<th>AA Quality</th>
<th>A Quality</th>
<th>B Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shell</strong></td>
<td>Clean.</td>
<td>Clean.</td>
<td>Clean to slightly stained.*</td>
</tr>
<tr>
<td><strong>Air Cell</strong></td>
<td>1/8 inch or less in depth.</td>
<td>3/16 inch or less in depth.</td>
<td>over 3/16 inch in depth.</td>
</tr>
<tr>
<td></td>
<td>Unlimited movement and free or bubbly.</td>
<td>Unlimited movement and free or bubbly.</td>
<td>Unlimited movement and free or bubbly.</td>
</tr>
<tr>
<td><strong>White</strong></td>
<td>Clear.</td>
<td>Clear.</td>
<td>Weak and watery.</td>
</tr>
<tr>
<td></td>
<td>Firm.</td>
<td>Reasonably firm.</td>
<td>Small blood and meat spots present.**</td>
</tr>
<tr>
<td><strong>Yolk</strong></td>
<td>Outline slightly defined.</td>
<td>Outline fairly well defined.</td>
<td>Outline plainly visible.</td>
</tr>
<tr>
<td></td>
<td>Practically free from defects.</td>
<td>Practically free from defects.</td>
<td>Enlarged and flattened.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Clearly visible germ development but not blood.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Other serious defects.</td>
</tr>
</tbody>
</table>

For eggs with dirty or broken shells, the standards of quality provide two additional qualities.

<table>
<thead>
<tr>
<th>Dirty</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unbroken. Adhering dirt or foreign material, prominent stains, moderately stained areas in excess of B quality.</td>
<td>Broken or cracked shell, but membranes intact, not leaking.***</td>
</tr>
</tbody>
</table>

* Moderately stained areas permitted (1/32 of surface if localized, or 1/16 if scattered).
** If they are small (aggregating not more than 1/8 inch in diameter).
*** Leaker has broken or cracked shell membranes, and contents leaking or free to leak.

Note: Measurements in inches: 1/8 inch = 3 mm, 3/16 inch = 6 mm.
Source: United States Department of Agriculture
The various egg sizes according to weight used in the United States are as follows:

- Jumbo = 70 g and above
- Extra large = 65-70 g
- Large = 56-65 g
- Medium = 49-56 g
- Small = 42-49 g
- Peewee = 35-42 g

Of course different size specifications and quality factors vary from country to country; for example, the various sizes according to weight used in Africa are as follows:

- Large = 65 g and above
- Medium = 55-65 g
- Small = 45-55 g

**Quality specifications development**

A simple set of quality specifications might be set up as follows.

**First Grade.** The shell must be clean, unbroken and practically normal in shape and texture. The air cell must not exceed 9.5 mm in depth and may move freely, but not be broken and bubbly. The yolk may appear off-centre, but only slightly enlarged, and may show only slight embryonic development. No foreign objects may be present.

**Second Grade.** The shell must be unbroken, but may be somewhat abnormal in shape and texture. Only slight stains and marks are permitted. The yolk may appear dark and enlarged and may show embryonic development, but not at the blood vessel stage and beyond. Blood spots less than 6mm in diameter are permitted.
**Third grade.** Other edible eggs are permitted, that is, those that are not rotted, mouldy or musty. Also, those eggs that are not incubated to blood vessel stage, and those not containing insects, worms or blood spots 6mm in diameter, are permitted.

**Interior quality**
The most accurate test of interior quality is the break-out method – open the egg on to a flat glass surface and compare the appearance of the yolk and white with that shown for various quality levels as shown in Figure 9.

A more simple side-view comparison of egg quality can be seen in Figure 10.

In marketing, however, the above method can only be used on a sample basis. A method that does not require egg breaking is more appropriate.

**Candling**
Candling is the only method of testing eggs for quality, internally and externally, without breaking them. It consists of inspecting an egg with a beam of light that makes the interior quality visible. A very simple form of candling is placing a candle in a dark room and positioning an egg in front of the flame and looking at the interior quality. A simple candling device can be seen below.

![Candling box](source: Kekeocha, 1985)
Figure 9

Interior quality of eggs by United States standards
Figure 9, continued

Source: USDA
If electricity is available, a light bulb can be placed in the box, otherwise a paraffin lamp or candle can be enclosed in a casing. The hole in the box should be about 3 cm in diameter, sufficient for egg sizes ranging from 40 to 70 grams. The light will shine out of the hole making the interior egg quality visible.

**Candling method.** Pick four eggs to be candled and put two in each hand. Place the first egg near the candling box hole with the large end of the egg held against the light, and with the axis at a 45° angle so that the egg has light shining through it. Twirl the egg so as to observe defects which otherwise might not be observed. If first egg candled is free of defects, roll the first egg back in to the palm of the hand. Meanwhile, the second egg in the other hand should be brought to the light and examined. While the second egg is up against the light, the third egg in the other hand should be brought into candling position. Photograph 9 shows how to hold eggs while candling.

Although the beginner will soon learn to detect such things as cracked shells and bloodspots, considerable training is needed before internal quality can be estimated with reasonable accuracy. Photograph 10 shows the appearance of eggs of various quality in candling.

The main interior quality points to be observed in candling can be summarized as follows:
**Yolk.** The judgement of internal quality is based mainly on the visibility, ease of movement and shape of yolk. Common yolk faults are the following:

- *Sided* – displaced to an appreciable extent from its normal central position.
- *Stuck* – on twirling the egg, it may be found that the yolk is stuck to the inner shell membrane.
- *Patchy* – uneven in colour, including defects sometimes described as “heat spots.”
- *Abnormal in shape* – flattened or irregular and in extreme cases may be broken and dispersed in the white.
- *Discoloured* – of a dark or greyish appearance often with a very distinct outline.
- *Embryonic development* – first shows as a dark halo round the germ cell near the centre of the yolk and later as thin blood vessels and a bright blood ring.

**White.** In practice, the quality of egg white is judged by the degree of movement of the yolk and by the definition of its outline. Common faults in egg white are as follows:

- *Discoloured* – definitely tinted grey, yellow, green or brown.
- *Cloudy* – muddy or streaky. Usually this condition indicates potential rot, but washing an egg in very hot water can cause a similar appearance.

**Air cell.** The depth of the air cell is a rough indication of the age of the egg and there is often a relation between this depth and the internal quality. Hence, the depth of the air cell is taken into account in candling, but other indications of quality are given equal weight. The air cell may be:

- *Large* – exceeding 6 mm in depth.
- *Running* – if the air cell is broken, one or more air bubbles will be found in the white. If the air cell has forced its way between the two shell membranes, bubbles will move around the shell when the egg is candled.
A running air cell, however, may be caused by rough handling and should not exclude the egg from a high-grade class.

- **Ringed** – the air cell is very large, sharply defined and with grey or brown edges.

Other common defects of internal quality that may be found are listed here:

- **Blood spots** – clots or streaks of blood in the white or adhering to the yolk.
- **Blood egg** – blood is diffused throughout the white or spread around the yolk.
- **Meat spots** – fatty material, fleshy or liver-like that may be found floating freely in the white, embedded in the chalazae or attached to the yolk.
- **Staleness** – in most cases the air cell is abnormally large, clearly defined and often ringed. As a rule the yolk is sided and its outline clearly defined.
- **Mould growth** – usually grey or black in colour, but can occasionally be pinkish, found on the outside and inside of the shell or shell membranes.
- **Rot** – usually violet, green, red or blue in colour. The early stages of a rot are less easy to detect, but any egg with a streaky, turbid white should be rejected. The egg may have an unpleasant smell even if unbroken.
- **Taint** – the egg has an abnormal odour.

Photographs 11 through 14 show examples of various egg quality deficiencies that can be seen when candling.

**Shell condition.** Weak, rough, mouldy, cracked and deformed shells may be detected as eggs are picked up for candling. But with candling small or micro-cracks on the eggshell can be seen. A typical deformed eggshell can be seen in Photograph 15.

Another method of verifying shell soundness is that of gently hitting two eggs together (belling). A dull sound instead of clear clinking indicates a cracked egg.
Developing a standardized system
Any system used to grade the quality and weight of eggs is only effective if it ensures that consumers obtain eggs of the quality and kind they want. This requires that three conditions be met.

1. The initial classification must be correct.
2. There should be no appreciable deterioration between time of grading and time of sale.
3. The consumers should have a clear guide to the quality of produce they are purchasing.

In developing a grading system, the following preparations are vital.

- Study thoroughly the pattern of production, consumption and trade.
- Work out grade specifications in close consultation with those traders who would be likely to take advantage of them.
- Qualified inspectors are needed to ensure that conformity with the grades indicated is upheld. Producers and packers who accept their inspection can be authorized to apply approved grade stamps.
- Legislation should be enacted to prevent the possibility of misleading labelling. Certain standards may be made obligatory, for example, minimum standards to protect consumers from unwholesome and dangerous foods.
- Finally, if consumers are to take full advantage of a grading system, the grade indications should be clear and easily understood.

It is important that eggs are not allowed to deteriorate below the grade indicated before they reach the consumer. Under conditions of high humidity with temperatures of 32° C and above, eggs being distributed may undergo considerable deterioration in only a few days. Under such circumstances, the inspection of eggs held for more than three or four days must be clearly and responsibly assigned.


**Equipment and candling layout**

In order to grade and pack eggs with consistent accuracy, speed and economy, it is essential that adequate facilities be provided. These include a semi-darkened room, without stray illumination, that is well equipped with bench and shelf space and with good facilities for handling of eggs and recording results. The candling device, if possible, should be adjustable and mounted at such a height that the beam of light when emerging horizontally from the device arrives at about the height of the operator’s elbow. The lamp or light bulb in the candling box should be kept clean. An operator should use the same candling apparatus every day to help minimize errors. Each operator must have enough room to move freely and handle packing materials and boxes. Efficiency can be increased by installing partitions between candling benches, arranging supplies of packing materials conveniently and by providing for the easy disposal of damaged materials. Floors and walls should have smooth, hard non-reflecting surfaces and be rounded at intersections. Thorough cleanliness is essential to prevent bad odours. Good ventilation should be provided.

The candling bench should be designed to particular needs. Where there are only a few candling benches, operators themselves can obtain eggs and supplies from nearby stocks and carry away completed egg cases. As the volume handled increases, however, it usually becomes more efficient to assign a special worker to service the candlers.