

# EGG QUALITY AND SAFETY

## Dispelling the myth about plastic eggs

### SUMMARY

In recent months, the issue of quality and safety of eggs has been raised several times creating doubts in the minds of consumers and traders alike. In addition, consumers have also shown concern regarding fake or plastic eggs. Plastic eggs or artificial eggs are a myth mainly due to the fact that there is no technology available to produce a plastic/artificial egg that would perfectly resemble a natural egg.

Consumers need to remember that the quality and appearance of the egg mostly depend on the way they are stored and for how long they are stored. Egg quality is best maintained when they are stored in cold temperatures preferably inside refrigerators and consumed within a period of 2 to 3 days. When kept in room temperature, several changes take place in an egg that bring about differences in the smell, texture and appearance of the egg.

This guidance note seeks to bust the myth about fake/plastic eggs and explain to various stakeholders, what to look for when assessing the freshness of eggs and how best to store them to maintain the quality and ensure safety.

### KEY TAKEAWAYS

- Consumers need to know that there are no available techniques to make an egg artificially.
- The way eggs are stored is as important as for how long they are stored. Eggs can lose as much quality in one day at room temperature as in 4 to 5 days in the refrigerator.
- Eggs kept at room temperature can maintain their freshness for up to 10 - 12 days after being laid, but the shelf-life reduces with increase in storage temperatures.
- Consumers should store eggs in refrigerators in designated shelves or inside egg crates.
- In most cases, eggs that are clean, free of visible defects or cracks and maintained under cooler temperatures will remain fresh for 4 to 5 weeks from the time they are laid.
- Retailers/traders should source eggs from credible sources and store them in refrigerators.
- Do not use dirty or cracked eggs. Cracked egg shells are a perfect foil for bacterial infections and the dirty eggs may also contaminate other food stuffs.
- Appropriate temperature and relative humidity (RH) need to be maintained for storing eggs in the cold store, the lack of which can result in mixing up of the yolk and albumin.
- Consumers can make use of this guidance note to check the freshness and quality of eggs easily as home with the help of simple tests.

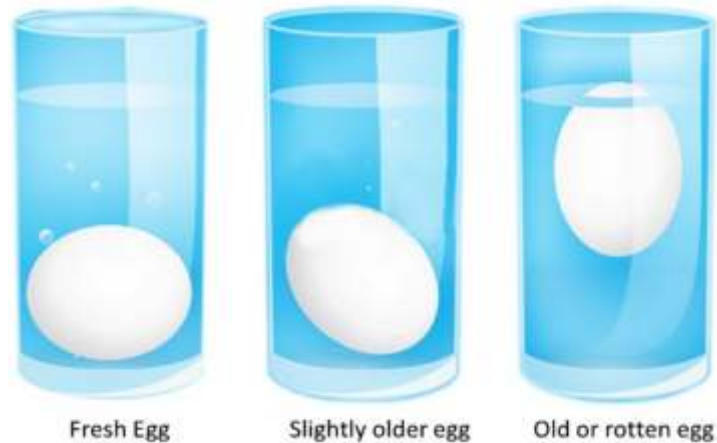
## **I. Maintaining the freshness of eggs**

- Eggs maintain their freshness for up to 10 - 12 days, after they are laid, at room temperature of about ( $28\pm 2^{\circ}\text{C}$ ), but the shelf life will be shorter at higher temperatures. The important factor in maintaining egg freshness is mainly temperature while humidity also affects the same to some extent. Storing the eggs, in refrigerator, in designated shelves or egg cases is the best way to maintain their freshness.
- To maintain egg freshness and performance, buy the eggs from stores that keep the eggs at cooler temperatures (air-conditioned stores or supermarkets) or stores that keep the eggs in well ventilated covered places and maintain ambient temperature.
- In most cases, eggs that are clean, free of visible defects or cracks and bought from a place that stores eggs under cooler temperatures will remain fresh for 4 to 5 weeks from the time they are laid provided that the eggs are stored in their carton in refrigerators. Beyond this period, the egg quality starts to deteriorate.
- Consumers should strictly avoid handling eggs roughly and leaving them in hot vehicles or places where temperatures are very high. Refrigerate the eggs once you reach home.
- Do not use dirty or cracked eggs. Cracked egg shells are a perfect foil for bacterial infections and the dirty eggs may also contaminate other food stuffs. Dirty eggs may be contaminated but may not still smell bad. Avoid washing dirty eggs, as they would become more porous when wet, thus making an easy entry for bacteria inside eggs.
- If an egg is cracked or too dirty, dispose it off.
- Always wash your hands thoroughly with soap and water after handling eggs.
- Feed quality is also an important factor affecting the overall quality of eggs. Eggs produced by farmers who used castor seed cakes as source of protein were reported to have rubbery textures. Therefore, poultry feed used in poultry farms should be approved by concerned regulatory bodies like BIS, etc.

## **II. Testing eggs for freshness**

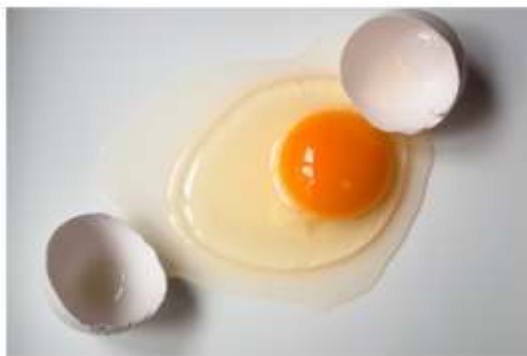
- Fresh egg, when held against a very bright light in a dark room, will display a small air gap usually at the broader (blunt) end of the egg. As the egg ages, the air cell expands in volume. Upon hard boiling a fresh egg, you can clearly see the indentation left behind at the top of the egg once the shell is peeled off.
- In case of fresh eggs, the yolk normally stays in the centre and is not very mobile because of the chalaza (the strings of tissue) that hold it in place. These strings break down as the egg ages (during storage or transportation). When hard boiled eggs are cut length wise, one can see that the yolk has moved off the centre.

- A quick test to check the freshness of an egg is to immerse it in a mug or basin of water. Fresh eggs would remain at the bottom width wise, older eggs would remain at the bottom on one end while the stale/rotten ones would float because of the larger air cell. It is to be noted that sometimes weak shell and fine cracks can also cause the egg to float.



- When broken out of the shell, good quality, fresh eggs display certain characteristics as mentioned below:

The yolk (yellow portion) would be rounded, small and stands high in a thick and gel like egg white. The gel like mass of egg white does not spread over a wide area but tends to stay compact. As the egg ages (with storage and temperature associated with storage), the egg white becomes thin and runny and finally egg yolk and white dissolve into each other in older or rotten eggs (or the alleged plastic/fake eggs). The older eggs may also develop rotten odour and would have lost the typical egg odour.



Fresh egg



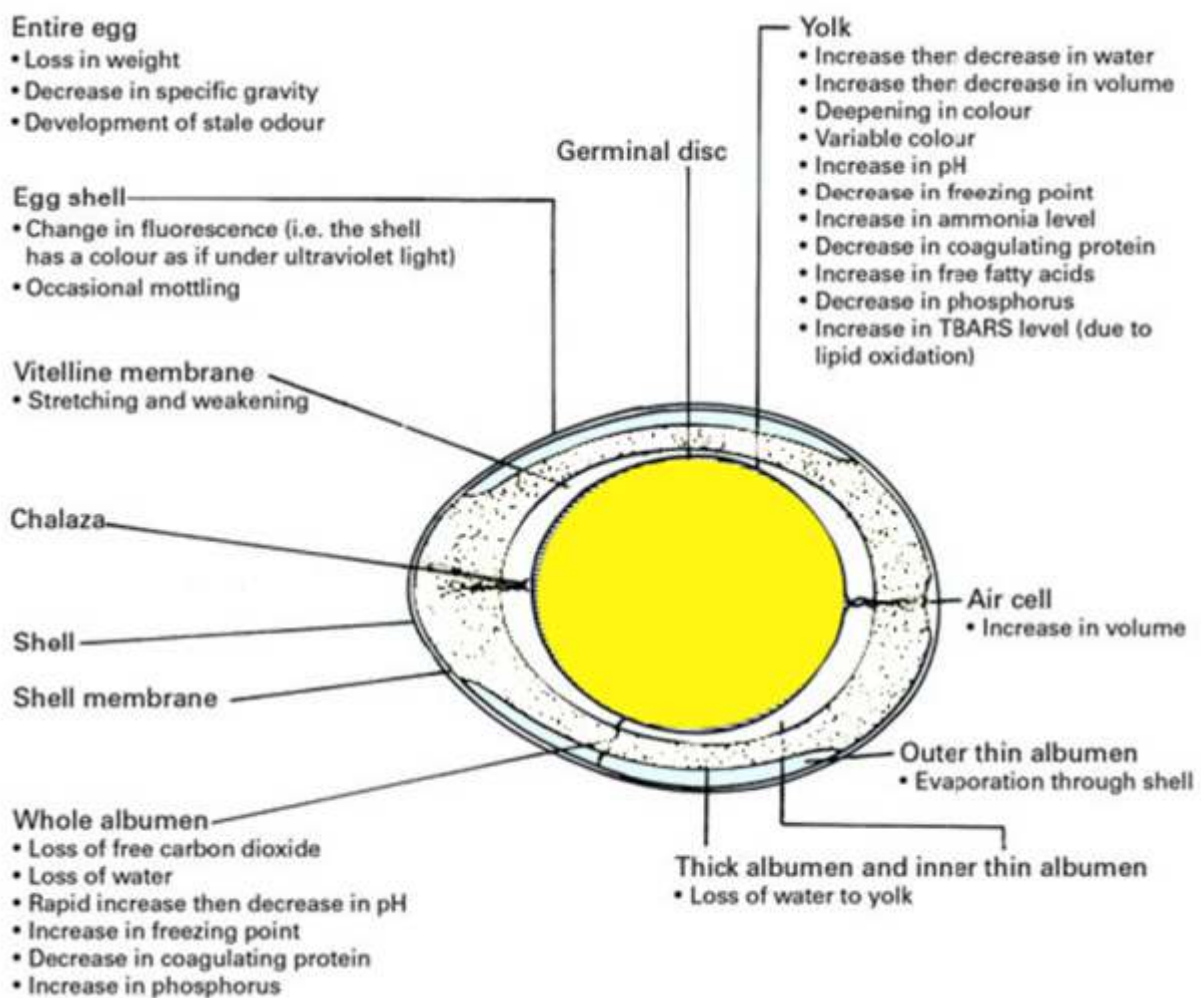
Older or rotten egg

With the aging of egg and the white becoming thinner, one can clearly notice that it will take a longer time to whip into foam, and when whipped the foam is less stable or collapses faster. However, it is also important to note that very fresh eggs also do not foam well and take longer time; but, once beaten the foam is very stable as compared to older eggs. The maximum and better foam volume/stability can be obtained from three or four day old eggs.

### III. If not stored properly, eggs become plastic-like

The way eggs are stored is as important as for how long they are stored. Eggs can lose as much quality in one day at outside high temperature as in 4 to 5 days in the refrigerator. Eggs kept at room temperature can maintain their freshness for up to 10 - 12 days after being laid, but the shelf-life reduces with increase in storage temperatures.

The following changes happen in an egg as a function of storage. These changes in egg quality as the egg ages are summarised in the figure below. To slow down these changes, freshly laid eggs should be put in cold storage, and/or the shells can be covered with a thin layer of an approved oil, particularly over the air cells.



[Figure sourced from <http://www.thepoultrysite.com>]

While transporting and storing eggs undergo different temperatures. Due to this, the air cell in the egg increases in volume, loses water content (through more than 20000 pores in the egg shell) from the yolk and albumen due to evaporation through (more than 20000 pores) the shell. The chalaza, a funnel shaped proteinaceous matter connecting the yolk and albumen starts disappearing and finally the egg loses its weight (a normal fresh egg weighs around 50-65 g, while older or rotting eggs would lose about 15-20 g of their weight). The increase in air cell volume can be easily detected by piercing the broader end of the egg with a pin. A normal (fresh) egg does not give away easily while an older egg simply gives in due to increased air cell.

As a consequence of water loss in eggs, the egg white and yolk portions shrink followed by mixing of these two portions. Both these portions dissolve into each other, and when such an egg is broken it does not give a separate egg yolk or white giving the impression of a fake (or plastic) egg. Further, the smell of mixed yolk will not have the typical odour one associates with a fresh egg. Moreover, the shell membrane in a normal (fresh) egg is slimy and appears smooth. With the loss of moisture this membrane becomes dry and has a paper like appearance and texture. This again creates the impression that the egg could be plastic or fake. One should note that the membrane of a fresh egg would take time to burn when held against a flame, while the membrane of the older (fake or plastic) egg would burn quickly due to its dryness; but, both would produce the same kind of ash without a hint of smell that is normally associated with burning plastic.

Consumers can find out if the egg is genuine by simply dipping the shell pieces of suspected fake (or plastic) egg in strong acids (like 2N hydrochloric acid). Calcium carbonate, being the major component of egg shells, will dissolve the shells in the acid. Alternatively, egg or eggshells when placed in vinegar (~which has 3-4 percent of acetic acid) will dissolve the shells slowly but will start giving out bubbles (and sometimes make the eggshells float, in case of pieces). The membrane of such acid treated shells will have no adhesion to the shells but will almost have the texture of a paper or thin plastic.

#### **IV. Plastic eggs - a myth**

Before addressing the issue of fake eggs or plastic eggs, one should understand the economics of egg production and sales. The total egg production in our country during 2016-17 was reported at 88.1 billion and the growth in production has been >12 percent compared to the previous year. Such increase in egg production is due to the fact that they are sold at wafer thin margins. As against this, consider the fact that there are no techniques available to make an egg that resembles a natural egg perfectly. It is also important to note that there are techniques to make artificial eggs using chemical ingredients like calcium chloride, alginate and/or gelatin apart from dyes/colours. This technique is usually employed for encapsulating several ingredients, molecules or nutrients. One of the best example could be the soft encapsulation of fish oils. This technology is widely used to mimic roes (fish eggs are called roes) and more so to mimic caviar (eggs of sturgeon fish). Such roes are mainly made to serve vegetarian sushi, especially for people who cannot eat fish eggs. The process of making such eggs is labour intensive, apart from being expensive. Fish eggs are normally 50-100 times smaller than chicken eggs.

But, in any case, it is difficult and almost impossible to make an egg that smells and tastes like fish or chicken eggs. Now, consider the scenario where the retail cost of an egg is around ₹ 5. Even if the retailer buys it at ₹ 4 and makes a profit of ₹ 1 per egg, they would prefer to purchase an artificial egg only if it is available at cost lesser than ₹ 4. One of the reports states that printing a 3D print of an egg costs ₹ 5000, if it is printed in excess of 100 pieces. Would someone go to the extent of selling a product worth ₹ 5000 for ₹ 5? Taking into consideration, the cost of ingredients and labour intensiveness of the process, it is hard to believe that one can produce a fake egg at almost 4-5 times the price of a natural egg. Making a fake egg is not anybody's cup of tea as it would require professional skills to handle the encapsulators that would make fake eggs. It is simply say that the motivation to create a fake product (egg in this case) for sale is that fakes can be produced at a fraction of the cost of the genuine product, in order to generate more profit. In this case it seems unlikely.

Moreover, eggs being riskier product are always subjected to testing in accredited laboratories in case of imports at the point of entry. Therefore, it is highly unlikely that fake eggs (which are expensive to make) would find their way into our country and be available for sale at cheaper rates.

## V. Other myths about egg quality

- **Plastic or fake eggs are for real**

No. The plastic or fake eggs are a myth mainly due to (a) economics involved in preparing a plastic or fake egg, and (b) inability for anybody to make a composition similar to natural egg.

- **Bad or rotten eggs always smell bad**

Eggs can smell and taste fine and still have Salmonella. Also, bacteria on the shell can get inside if the eggs are cracked; and, can also find their way into other foods if kept in contact. However, if an egg does smell bad, never use it.

- **Dirt or chicken shit on eggs indicates that eggs are organic and natural.**

Certainly, the dirt is an organic material but it is neither safe nor good for health. Chicken shit may contain harmful bacteria, mainly Salmonella. It is advisable that such dirty eggs be discarded.

- **If eggs are dirty, wash them to remove the dirt**

No. Eggs become porous when washed, hence never wash eggs. Washing normal or dirty eggs may allow the harmful bacteria (from the dirt or from the water) to enter into the eggs.

- **Eggs remain fresh if stored at room temperature and need not be refrigerated**

Refrigerating eggs keeps them fresh for longer duration as compared to storing them at room temperature and also minimises the risk of any bacterial growth.

- **Egg is a better source of protein, minerals and vitamins than milk; and, hence providing raw egg to someone sick will provide them protein and minerals**

No. Never give raw eggs to anyone including pregnant woman, infants or older people as eating raw eggs enhances the risk of Salmonella infection. It should never be given in raw form to those who are seriously ill, especially when they are sick. It is preferably better to consume cooked eggs in which egg white is firm and yolk is completely thickened.

- **Uncooked (raw) eggs are a better source of proteins and nutrients**

No. Drinking eggs in their raw form or in the form of milkshakes with raw egg whites is the riskier way of consuming eggs. Cooking eggs does not reduce the protein content or nutrients present in them to an unavailable form.

- **The egg float test can clearly differentiate good and bad eggs**

The float test can differentiate fresh and older eggs. But, it never differentiates the goodness of the egg in terms Salmonella contamination.

## **VI. For traders and retailers**

- Source eggs from credible sources only.
- Traders and retailers can minimise the decline in egg quality by observing the following basic guidelines:
  - Have adequate and cool holding places to store eggs (preferably refrigerated)
  - Avoid storing eggs close to strong smelling food or food products
  - Store or display eggs away from sunlight
  - Strictly rotate the egg stocks on FiFo (First in First out) basis i.e. keep older stock in front of fresh stocks so that all eggs sold are as fresh as possible
  - Avoid transporting eggs in hot vehicles or hotter temperatures
  - Advise the consumers to store the eggs in cooler temperatures or refrigerators
  - Immediately discard any cracked or dirty egg
  - Do not sell dirty eggs to consumers

## **VII. For regulatory staff and laboratories**

- **Sample condition:** Egg samples collected for analysis should preferably be transported under cooler temperatures without subjecting them to higher temperatures. It is advisable to transport the eggs in cartons or egg cases if being sent for analysis.
- **Screening and confirmation:** Screen any suspected fake egg samples for true protein by Biuret's/Lowry's as well as Kjeldahl methods. Natural chicken eggs (whole egg), would generally have a protein content between 11.5 to 12.5 percent, lipid content of 11.5 – 12 percent and almost no carbohydrate (<0.5 percent, if any). Since egg is known to have the most desirable amino acid composition, next only to milk; amino acid composition will also help distinguish the normal eggs from allegedly fake eggs.