# Egg Processing

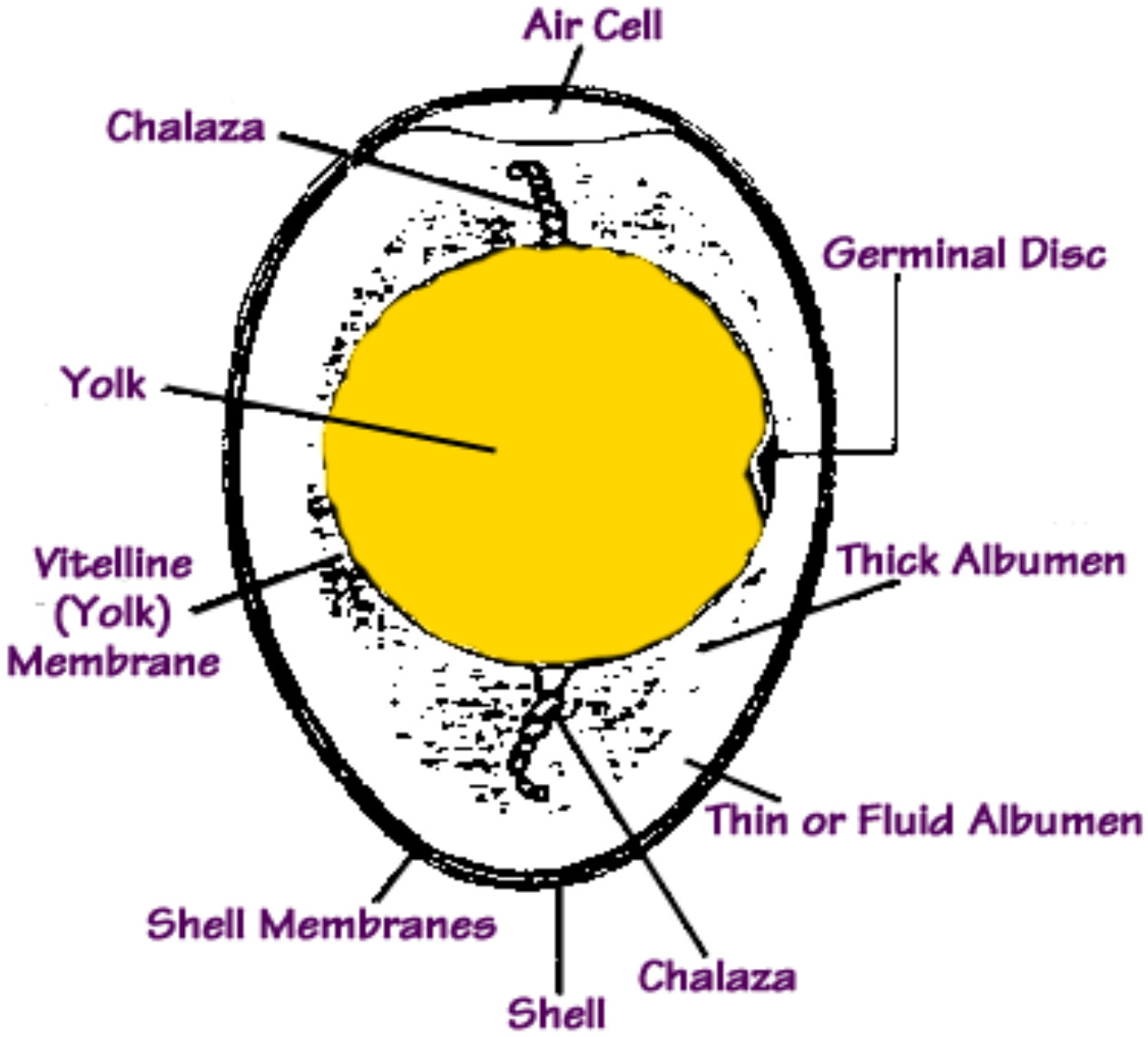
# Topics

- Egg
- Classification of Egg
- Composition and nutritional value of  eggs
- Processing of poultry egg
- Byproducts and their utilization

# What Is Egg?

- Egg are an **oval or round** object **laid by** a **female** bird, reptile, fish, or invertebrate, usually containing a **developing embryo** and many of these have been **eaten by** humans for thousands of years.
- The eggs of birds are enclosed in a chalky shell, while those of reptiles are in a leathery membrane.
- An embryo is an early stage of development of a multicellular organism.

# Anatomy of An Egg

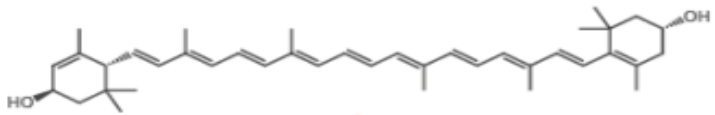



Chalaza: Twisted membranous strips joining the yolk to the ends of the shell.

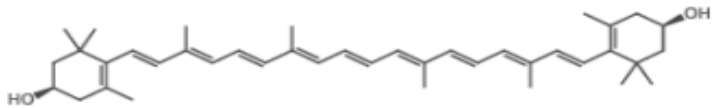
# THE CHEMISTRY OF EGGS & EGG SHELLS

Eggs are one of the most versatile kitchen ingredients; there are numerous ways of cooking them on their own, and they can also be used to help create a range of other foods. Here, we take a look at what they're made of, and how they change during cooking.

## EGG COLOUR & COMPOSITION




LUTEIN




ZEAXANTHIN

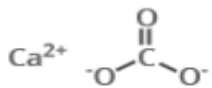
The yellow colour of egg yolks is due to the presence of the carotenoid pigments lutein and zeaxanthin. Artificial additives aren't permitted, but additives such as beta-carotene and marigold petals can be added to chicken feed to influence the yolk's colour.

EGG WHITE PROTEINS

| OVALBUMIN | CONALBUMIN | OVOMUCIN | OTHERS |
|---|---|---|---|
| 54% | 12% | 2% | 32% |

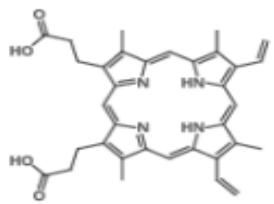
About 90% of the egg white is water; the rest of its mass is mostly protein. Ovalbumin's purpose is thought to be nutrition for the developing chick; Ovomucin helps thicken the egg white; and conalbumin binds iron & guards against infection.

## EGG SHELL COMPOSITION




CALCIUM CARBONATE

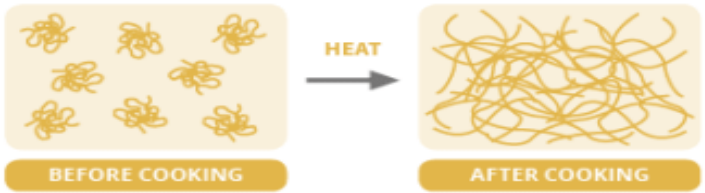
Calcium carbonate is the main component of eggshells. Nanoparticles of calcium carbonate are arranged into ordered crystals by proteins, forming a calcite shell. The colour of the eggshell comes from porphyrin pigments on the shell's surface.



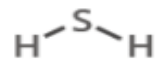

PROTOPORPHYRIN IX

*Brown pigment; the presence of the pigment oocyanin causes eggs to have a blue or green colouration.*

## COOKING EGGS




Egg proteins begin in the raw egg as folded chains, but as they are heated they begin to denature and unfold. Interactions between the unfolded proteins create a three-dimensional network, trapping the water and causing the egg to solidify.




HYDROGEN SULFIDE

FeS

IRON (II) SULFIDE

Hydrogen sulfide, formed by the reaction of sulfur-containing proteins in the albumen, is the compound that gives cooked eggs their characteristic smell. When eggs are cooked for a long time it can react with iron in the yolk, forming iron sulfide, and giving a green hue to the yolk surface.

7.6 ALBUMEN pH OF FRESHLY LAID EGG

9.2 pH AFTER SEVERAL DAYS OF STORAGE

Albumen pH increases as $CO_2$ diffuses out through the shell. Albumen adheres more strongly to the shell at lower pH, making it harder to peel boiled eggs.

# Chemistry of Egg And Egg Shell

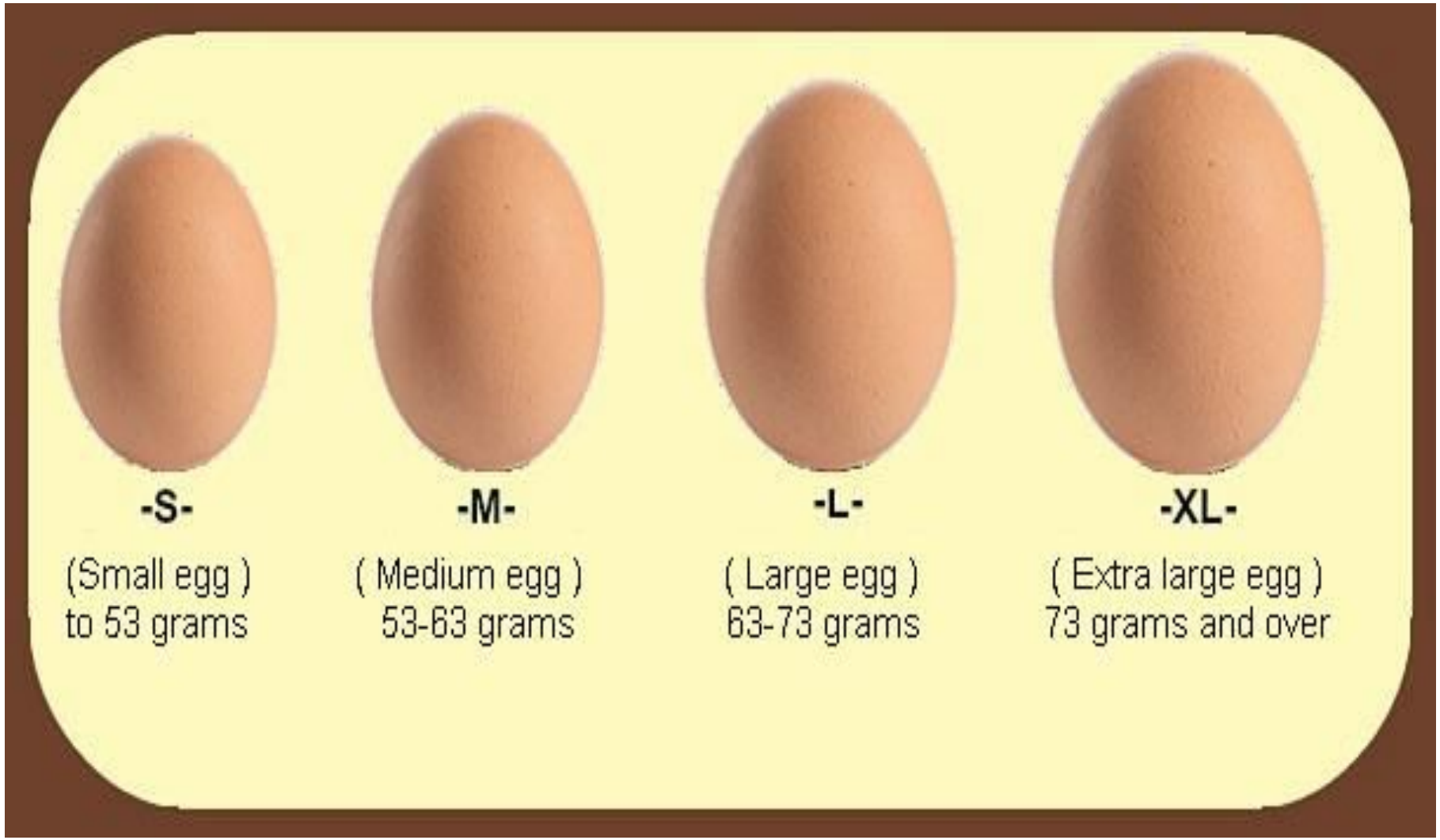
- The **yellow color** of the egg yolk is due to the presence of **carotenoid** pigments **lutein and zeaxanthin**.
- About **90% egg white** is water and rest of the mass is protein.
- **Calcium carbonate** is the main component of egg shell.
- The color of the egg **shell comes from porphyrin pigments** on the shell surface.
- **Hydrogen sulfide** formed by the reaction of sulfur containing protein in the albumin that gives **characteristics smell after cooking**.

# Chemical Composition of A Single Egg

| Nutrients (unit) | Amount (s) |
|---|---|
| Weight (g) | 50 |
| Water (g) | 37.3 |
| Energy (Kcal) | 77 |
| Protein (g) | 6.3 |
| Fat (g) | 5.3 |
| Cholesterol (mg) | 186 |
| Carbohydrate (g) | 0.56 |
| Fiber (g) | 0 |
| Calcium (mg) | 25 |
| Iron (mg) | 0.6 |
| Vitamin A (IU) | 260 |
| Vitamin E (mg) | 0.5 |
| Vitamin D (IU) | 43.5 |

Source: U.S. Department of Agriculture

# Classification Of Egg According To Weight



I am more nutritious than you.

=

I am more nutritious than you.

Which one is better for me?

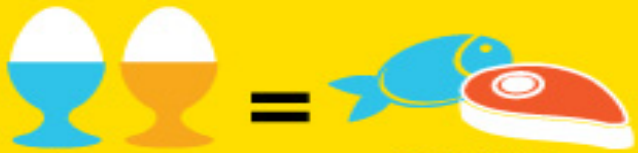
# The Power of Eggs

## CANADIAN EGGS

Canadian eggs are fresh, local and high quality.

## ACCORDING TO

Canada's Food Guide



2 eggs = 1 serving (From the Meats and Alternatives food group)

1 large egg =

5 grams of fat

70 calories

A large egg provides **6 grams** of high-quality **protein**, which helps build antibodies and repair muscles.

**50%** of your daily requirement of vitamin B12, which helps protect against heart disease.

Eggs provide 14 important nutrients such as **vitamins A, D** and **E, folate, iron, zinc** and **choline**—eating eggs is good for your **bones, teeth, skin** and **eyes.**

**DON'T SKIP THE YOLK!**

Most of the egg's nutrition is in the yolk, including half the protein.

White and brown eggs have the **SAME NUTRITIONAL VALUE**

**Want to know more about egg nutrition?**

**aneggadayisok.ca**

**Eggs. Natural Goodness.**

# Nutritional Value of Egg

**Yolk (yellow)**

- 33% of the liquid weight of an egg
- Contains **all the fat** (5-6 gm)
- **Little less** than **half the protein** (2.5gm)
- With the **exception of riboflavin and niacin** the yolk contains a higher proportion of the those vitamins than the white
- Also contains more phosphorus, manganese, iron, iodine, copper and calcium.

**White**

- **More than half the protein** (4gm),
- Also contain niacin, riboflavin, chlorine, magnesium, potassium, sodium, sulphur.

# Processing of Egg

- The moment an egg is laid **physical and chemical changes** begin to reduce freshness.
- In most production facilities **automated** gathering belts gather and refrigerate eggs frequently.
- Gathered eggs are moved into **refrigerated** holding rooms where the temperature is maintained between **40 - 45ºF**.
- Humidity is relatively **high** to minimize moisture loss.

# B- Egg quality

- **Egg quality standards are based on:**
- Shell cleanliness.
- Shell soundness.
- Shell texture.
- Shell shape.

**External**

- Relative viscosity of albumen.
- Freedom from foreign matter in albumen.
- Shape and firmness of yolk.
- Freedom from yolk defects.

**Internal**

# Factors affect on Grading Eggs

## 1. Exterior Grading Factors

- Most important factors is **shell thickness.** by checking the quality of the shell, egg may classified different groups.
- The ideal eggshell is **clean, smooth and oval** in shape with **one end** slightly bigger than the other.
- Eggs with **cracked or broken** shells should be discarded.
- If you are selling the eggs, remove any with **unusual shapes**, textures or thin spots on the shell.

# FACTORS AFFECT ON GRADING EGGS

**2. Interior Grading Factors**

- Grading the interior of the egg is performed by a method called **candling.** Using an egg candler will allow you to examine the air cell, the egg white, spots and cracks.

*1.* ***Air Cell Depth*** - The air cell is the **empty space** between the shell and the white usually found at the **bigger end** of the egg. As the **egg ages**, the air cell depth **grows** and the quality of the egg diminishes.

2. ***White or Albumen*** - The white of the egg is called the **albumen**. The **quality** is based on its clarity and thickness. Look for a clear color without discolorations or floating foreign matter. **Thick albumen** allows limited movement of the yolk and indicates a **higher quality egg**.

3. ***Yolk*** - The quality of the yolk is determined by the **distinctness** of its outline and other features like size, shape and **absence** of any blemishes or blood spots. It should be surrounded by a dense layer of albumen.

4. ***Spots*** - Candling can help reveal **foreign matter** like blood spots or meat spots. Eggs with interior spots should not be sold.

# Egg Quality

| | Grade AA | Grade A | Grade B |
|---|---|---|---|
| Break Out Appearance | Covers a small area | Covers a moderate area | Covers a wide area |
| Albumen Appearance | White is thick and stands high; chalazae prominent | White is reasonably thick, stands fairly high, chalazae prominent | Small amount of thick white, chalazae small or absent. Appears weak and watery |
| Yolk Appearance | Yolk is firm, round and high | Yolk is firm and stands fairly high | Yolk is somewhat flattened and enlarged |
| Shell Appearance | Approximates usual shape; generally clean,* unbroken; ridges/rough spots that do not affect the shell strength permitted | | Abnormal shape; some slight stained areas permitted; unbroken; pronounced ridges/thin spots permitted |
| Usage | Ideal for any use, but are especially desirable for poaching, frying, and cooking in shell | | Good for scrambling, baking, and use as an ingredient in other foods |

*An egg may be considered clean if it has only very small specks, stains or cage marks. Source: USDA

# Grading Of Egg

- Classification is determined by interior and exterior quality
- Designated by the **letters AA, A, B**.

# Grading Process

- Eggs are examined for both **interior and exterior** quality
- Sorted **according to weight (size)**
- No difference in nutritive value exists between different grades
- However almost **no grade B eggs** find their way to the retail supermarket, they go to egg users such as **bakeries or food service** operations and to egg breakers for use in egg products

# GRADE AA

- **Any kind of cracked** onto the surface of a grade AA egg is not permitted.
- **Yolk must be firm**
- Large proportion of **thick white to thin white** exists
- The shell approximates the **usual shape** for an egg
- Generally **clean and unbroken**
- **Ridges/rough spots** that do not affect the shell strength are permitted

# GRADE A

- When cracked covers a r**elatively small area.**
- Yolk is round and upstanding
- **Thick white is large in proportion** to the thin white and stands fairly well around the yolk
- Shell **approximates the usual shape** for an egg
- Generally clean and unbroken
- **Ridges/rough spots** that do **not affect the shell** strength are permitted

# Grade B

- When **cracked**, spreads out more
- Yolk is **flattened**.
- About as much (or more) thin white as thick white
- Shell has an **abnormal shape**.
- Some **slightly stained** eggs are permitted
- **Unbroken**
- Pronounced **ridges/thin spots** are permitted.
- **No grade B eggs** find to the retail supermarket, they go to egg users such as **bakeries or food service** operations

# Egg Spoilage

- **Freshly laid eggs** are generally **sterile**, but soon become contaminated by:

1. Fecal matter of hen
2. Cage or nest
3. Wash water if eggs are washed
4. Handling
5. Material in which the eggs are packed.

# Changes Not Caused By Microorganisms

- Untreated eggs lose moisture during storage and hence lose weight.
- Shrinkage shown by the size of the airspace or air cell of the egg.
- Changes in the physical state of the contents of the egg seen by candling or breaking.
- As the egg ages, egg white becomes thinner and more watery and yolk membrane weakens.
- The poorer the egg, more movement of the yolk.
- Normal pH of egg-7.6 to 9.5, storage increases the alkalinity of the egg white.

# Changes Caused By Microorganisms

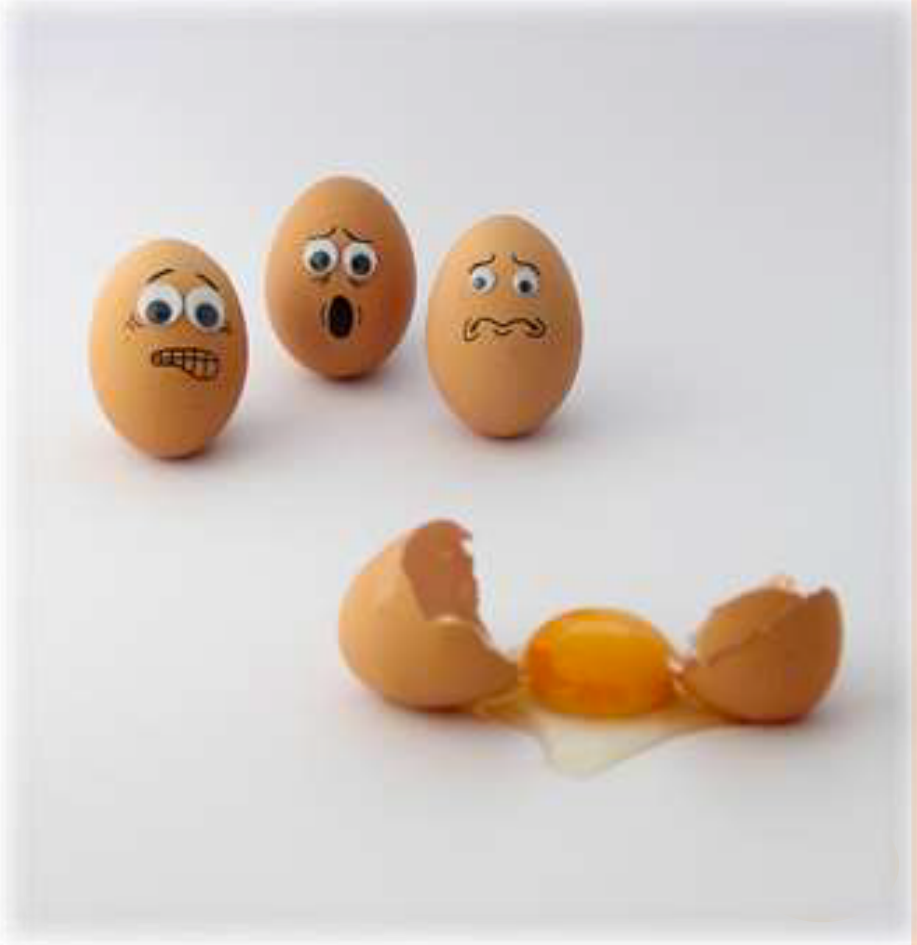
- Contaminate the shell
- Penetrate the pores of the shell to membranes (shell must be moist)
- Grow through shell membranes to reach white
- Grow in egg white to reach egg yolk
- Time taken to penetrate varies with organism & temperature
- In general, more spoilage is caused by bacteria than by molds.
- Eventually, these microorganisms will **penetrate the eggshell** and spoilage will occur.
- **Pseudomonads** are common spoilage agents, but molds like ***Penicillium*** and ***Cladosporium*** sometimes grow in the air sac and spoil the egg.

# Changes Caused By Microorganisms

- Bacteria need to overcome the antibacterial properties of albumen to cause spoilage of eggs.
- Also, they use the protein complexes as a source of nitrogen for growth.
- Bacterial spoilage is called as rots.
- Three chief ones are green rots, colorless rots & black rots.
- The other two are pink rots & red rots.


# Egg Losses

- Poor egg shell quality is a huge hidden cost to egg producers.
- More than 10% of eggs produced in the hen house are uncollectible or broken before intended use.



# Egg Losses

- The first 2-5%, they are lost simply due to form which may be:

– Shell less

– Cracked or broken to the extent that they are not suitable for collection.

- Another 3-8% is lost during:
  - Collection
  - Moving through the belts
  - Cleaning
  - Packing
  - Transportation to the end user

# Egg By-products

- Most eggs are sold to the consumer as shell eggs.
- The only part of the egg that is not used is the **shell.**
- If eggs are further processed at an **egg breaking plant, tons of shells** accumulate.
- Most of the remaining shell is **mineral,** similar in composition to **limestone**.
- A **small proportion** of the remaining shell is protein that comes from shell membranes and the residual egg white.
- Another by-product is inedible eggs.
- A small number of eggs are also **discarded as inedible** because of the inclusion of blood or meat spots. These eggs have sometimes been used in **pet foods**.

# Egg Shell Structure

- Weight: 5-6 gm
- 10% of total egg weight
- Thickness: 300-350 micrometes.
- Breaking strength >30N

# Functions Of Egg shell

- Protecting the contents of the egg from the microbial and physical environment.
- Controlling the exchange of water and gases.

# Eggshell Composition

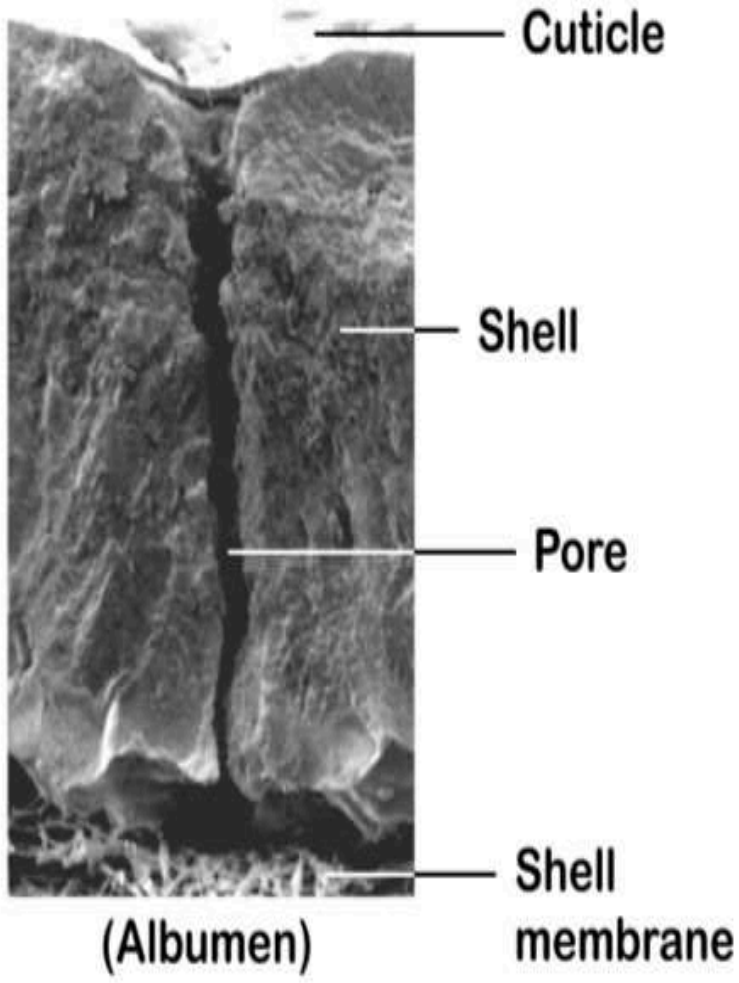
1. Calcium carbonate: 94-97%

– The calcium content of the eggshell is approximately 1.7-2.5g

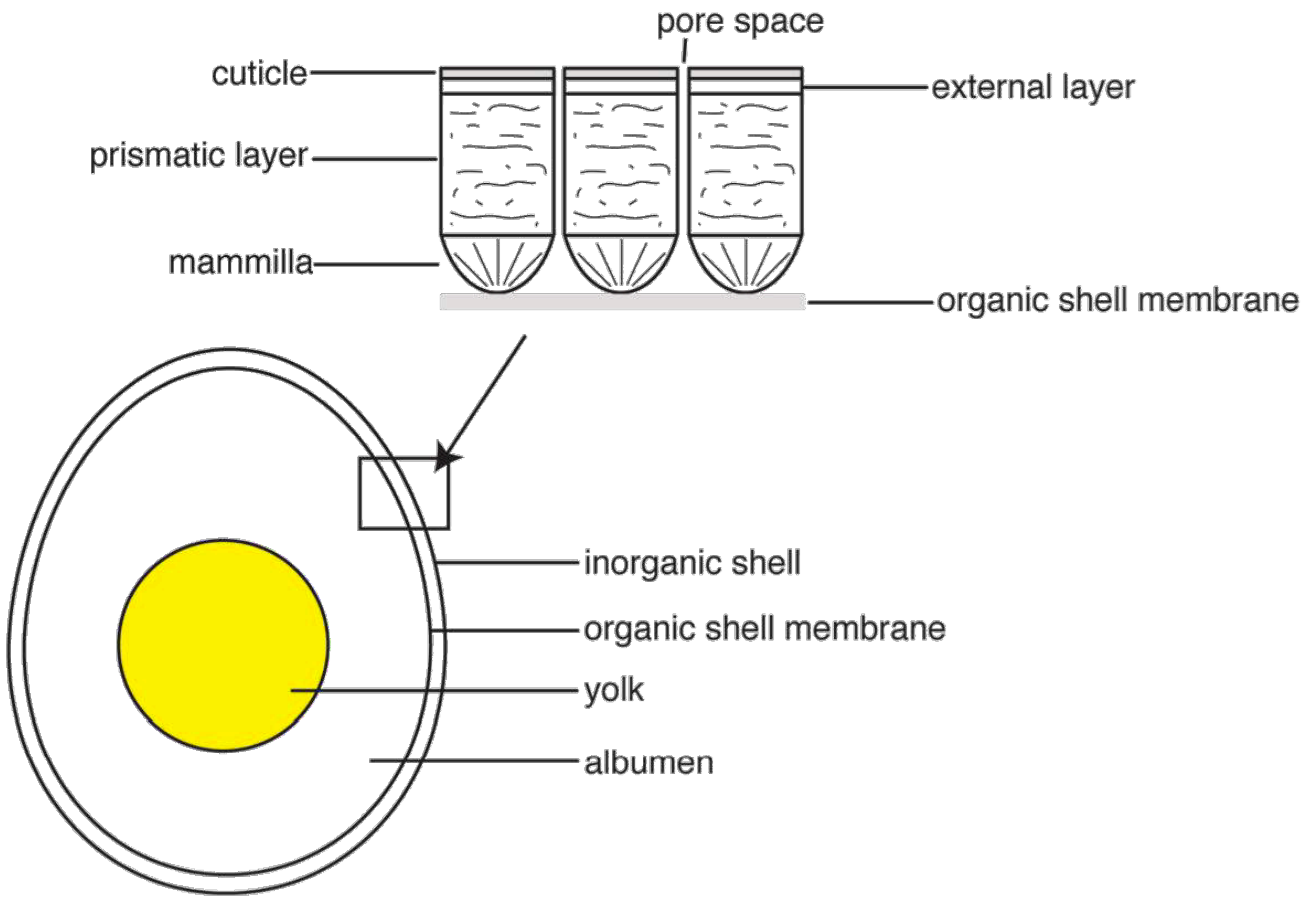
2. Phosphorus: 0.3%
3. Magnesium: 0.2%
4. Sodium, Potassium, Manganese, Iron and Copper: traces
5. Organic matter: < 2%, it is consisted of:
    1. Matrix proteins
    • They are mixture of proteins and polysaccharides rich in sulphated molecules.
    • They are critically important in determining the egg shell structure and serves as foundation for the deposition of calcium carbonate.
    2. Shell pigment.

# EGGSHELL COMPOSITION

- There are about 8000 microscopic pores on the shell.
- The outer surface of the shell itself consists of a mucous coating (cuticle) which is deposited on the egg just prior to the lay.
- This proteinous covering helps to protect the interior content of the egg from bacterial penetration through the shell.



# Eggshell Composition



# Uses Of Egg Shell

- Eggshell membrane mainly consists of protein in the form of **COLLAGEN**. It also contains small amounts of chondroitin sulfate, glucosamine and other nutrients. The trace amounts of these beneficial compounds in eggshell membrane are unlikely to have any significant effects on your health. some studies and research show that regular intake of eggshell may benefit our bone joints.