Egg Quality Identification and Measurement
Industrial Uses of Egg – I

I. Foodstuff Industries
   A. Bakery product
   B. Ice Cream
   C. Macaroni and Noodles
   D. Mayonnaise and Salad dressing
   E. Others: pudding, custard, infant food, confectionary, jams, sausage, maple syrup, beverage..
   F. Egg Substitute
   G. Animal feeds
II. Medicine and Medical Research

A. Therapeutic uses and pharmaceutical preparations
B. Culture media
C. Serology
D. Artificial Insemination
E. Use of the developing chicken embryo for medical research:
   a. study of pathological organisms and tumors; b. diagnosis; c. vaccines; d. testing germicides; e. testing milk
III. Manufacturing
   A. The leather industry
   B. Artist’s materials
   C. Dyes
   D. Photography
   E. Cosmetics
   F. Synthetic products: rubber; resins; cork compositions; imitation horn, shell, & ivory; glue and lubricating powders, artificial fiber
   G. Fertilizers
Industrial Uses of Egg – IV

VI. Traditional Uses
   A. Popular Arts
      1. Eggshell mosaics
      2. Easter eggs
      3. Other art forms
FIGURE 5.--Ideal egg shape, usually found in AA or A quality.

FIGURE 6.--Practically normal shape which may be found in AA or A quality.

FIGURE 7.--Slightly abnormal shape, showing definite ridges and rough shell permitted in B quality.

FIGURE 8.--Abnormal shape having pronounced ridges permitted in C quality.
The Parts of An Egg

ALBUMEN
Outer thin
Firm
Inner thin
Chalaziferous
Chalazae

YOLK
Germinal disc (Blasdoderm)
Latebra
Light yolk layer
Dark yolk layer
Yolk (Vitelline) membrane

SHELL
Cuticle
Spongy (Calcaneous) layer
Mammillary layer

MEMBRANE
Air cell
Outer shell membrane
Inner shell membrane

THE PARTS OF AN EGG

FIGURE 3.--The parts of an egg.
Egg Grading

- Sorting of products according to quality, size, weight, and other factors.

- Involves inspection of:
  - Shell – Soundness, cleanliness, apparent strength, and shape.
  - Interior – candling.

- Sorting into sizes on the basis of weight.
Crackless egg system in candling process
Measuring of Shell Quality

1. Shell thickness – at least 0.33 mm.
2. Specific gravity.
3. Crushing strength.
4. Piercing strength.

No relationship between shell color and interior quality.

Belling: detection of “blind (hair like) checks”
Measuring Air Cell Depth

Point from which to measure air cell depth

OFFICIAL EGG AIR CELL GAUGE

AA QUALITY
1/8 inch

A QUALITY
3/16 inch

B QUALITY
3/8 inch

FIGURE 13.--Gauge for measuring depth of air cell.
Measuring of Albumen Quality

* Haugh Unit:

\[
\begin{align*}
AA & > 72 \\
A & 60-72 \\
B & 31-60 \\
C & =< 30
\end{align*}
\]

* Albumen Index = Height of the thick albumen/width of thick albumen
Measuring of Yolk Quality

1. Color: Roche color fan.
   NEPA – potassium dichromate solution.
   Beta-carotene.

2. Spherical condition.


4. Yolk Index.
Egg Grades


TABLE 2.—SUMMARY OF UNITED STATES STANDARDS FOR QUALITY OF INDIVIDUAL SHELL EGGS

Specifications for Each Quality Factor

<table>
<thead>
<tr>
<th>Quality Factor</th>
<th>AA Quality</th>
<th>A Quality</th>
<th>B Quality</th>
<th>C Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Cell</td>
<td>1/8 inch or less in depth. Practically regular.</td>
<td>3/16 inch or less in depth. Practically regular.</td>
<td>3/8 inch or less in depth. May be free or bubbly.</td>
<td>May be over 3/8 inch in depth. May be free or bubbly.</td>
</tr>
<tr>
<td>White</td>
<td>Clear. Firm. (72 Haugh units or higher.)</td>
<td>Clear. May be reasonably firm. (60 to 72 Haugh units.)</td>
<td>Clear. May be slightly weak. (31 to 60 Haugh units.)</td>
<td>May be weak and watery. Small blood clots or spots may be present.* (Less than 31 Haugh units.)</td>
</tr>
<tr>
<td>Yolk</td>
<td>Outline slightly defined. Practically free from defects.</td>
<td>Outline may be fairly well defined. Practically free from defects.</td>
<td>Outline may be well defined. May be slightly enlarged and flattened. May show definitely but not serious defects.</td>
<td>Outline may be plainly visible. May be enlarged and flattened. May show clearly visible germ development but no blood. May show other serious defects.</td>
</tr>
</tbody>
</table>

*If they are small (aggregating not more than 1/8 inch in diameter)
Interior Quality Defects – I

1. Blood spot – most common.
   
   Caused by worming cpd, gossypol, Nicarbazin, high storage temp., and aging.
Interior Quality Defects - II

4. Double-yolked eggs.
5. Yolkless eggs.
6. Egg within an egg (reversal of oviduct direction).
7. Soft-shelled eggs (premature laying).
8. Thin-shelled eggs (dietary deficiencies, heredity or disease).
10. Off-colored yolks (from feed ingredient).
11. Off-flavored eggs (due to disease or feed flavor).
Some Official Grading Terms Used by the USDA - I

Check – broken or crack in the shell but with its shell membranes intact and its contents do not leak.

Leaker – egg contents are exuding.

Loss – An egg that is inedible, smashed or broken.

Stuck yolk – yolk membrane becomes attached to the shell membrane.

Mixed rot (addled egg) – yolk mixes with the white.
Some Official Grading Terms Used by the USDA – II

Sour egg – murky shadow around off-center swollen yolk.

Green whites – caused by Pseudomonas bacteria, fluoresce under UV.

White rots – threadlike shadows in the thin white, fishy odor.

Musty eggs – caused by absorption of odors, molds, and bacteria.

Moldy eggs; black rots; cooked eggs; blood rings; no grade eggs; off-flavored eggs...
# Weight Classes for Consumer Grades for Shell Eggs

<table>
<thead>
<tr>
<th>Size or Wt. Class</th>
<th>Min. Wt/doz (oz/doz)</th>
<th>Min. net wt lb/30doz</th>
<th>Min. wt/egg oz/doz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jumbo</td>
<td>30</td>
<td>56</td>
<td>29</td>
</tr>
<tr>
<td>Extra large</td>
<td>27</td>
<td>50.5</td>
<td>26</td>
</tr>
<tr>
<td>Large</td>
<td>24</td>
<td>45</td>
<td>23</td>
</tr>
<tr>
<td>Medium</td>
<td>21</td>
<td>39.5</td>
<td>20</td>
</tr>
<tr>
<td>Small</td>
<td>18</td>
<td>34</td>
<td>17</td>
</tr>
<tr>
<td>Peewee</td>
<td>15</td>
<td>28</td>
<td>--</td>
</tr>
</tbody>
</table>
Egg Quality Maintenance
Physical-Chemical Breakdown of Egg Quality - I

1. As egg cools, contents contract and air cell formed.
2. Cuticle or bloom begin to dry.
3. Size of the pores increase.
4. Albumen gives off carbon dioxide, and carbonic acid breaks down.
5. The white changes from almost neutral (pH 7.6) to alkaline (pH 9.7).
6. The mucin fibers becomes watery.
Physical-Chemical Breakdown of Egg Quality - II

7. Yolk absorbs water from albumen, swells and become a round flabby mass.
8. The egg becomes an inedible product when the yolk settles to shell and becomes attached (stuck yolk).
9. Vitelline membrane brakes (mixed rot)
EGG QUALITY DECLINE

NORMAL NEW-LAIRED EGG

QUALITY

Highest

High

Intermediate

Low

TIME

AA QUALITY (1)

A QUALITY (2)

B QUALITY (3)

C QUALITY (4)

LOSS

X

U.S. DEPARTMENT OF AGRICULTURE

NEG. C&M-56-65 (6) CONSUMER AND MARKETING SERVICE
Fresh egg
Yolk dome shaped

Layers of white clearly seen
- thin and gelatinous

Stale egg
Yolk flattened

White thinning and spreading out
Retarding the Decline in Quality

1. Low temperature preservation – most important.
3. Thermostabilization.
5. Controlled humidity.
7. Combination of above methods.

Ideal condition: 50–60°F and 70% RH.
USDA Recommendations on Egg Cleaning

1. Washing promptly.
2. Do not clean excessively dirty eggs.
3. Water with iron content of less than 2 ppm.
4. Do not reuse wash water except in a continuous washer.
5. Wash water should be 90F or higher or 20-40F warmer than the eggs.
Egg Cleaning Steps

1. Receiving – cooler with 50°F and 70% RH.
2. 1st stage washing – 105°F water with detergent.
3. 2nd stage washing – 130-140°F water.
4. Air dry.
5. Spray with mineral oil.
6. Inspection.
7. Packaging.
Egg Cleaning

Loader/Washer
Egg Packing Operation Breakage

From hen nest to carton – 2.32 to 11.76%.

71% between nest to packing plant.
29% between grading and packaging
  13% during machine-loading, washing & drying.
  16% during weighing and packing.
Factors Affecting Quality During Production

Drug and supplements (unintentional additives).
Egg size: strain, age, drug.
Egg shape: breed, strains, disease.
Shell texture: hereditary, rough shells from Newcastle disease.
Shell color: nicarbazin, aureomycin.
Pink albumen: cottonseed and soybean meal.
Blood spot: breed.
Mottling: nicarbazin, tannic acid, gallic acid.
Off flavor: fish meal, garlic, rancid fat from feed.
Cooking: green yolk ring. Rusty albumen...
Physical, Chemical, Nutritional, and Functional Characteristics of Eggs
Per Capita Egg Consumption in US

- 1950 -- 389
- 1960 -- 335
- 1970 -- 315
- 1980 -- 273 (Shell+Processed)
- 1990 -- 246 = (204 + 42)
- 2000 -- 258.7 = (180.8 + 77.9)
## Chemical Composition of Egg

<table>
<thead>
<tr>
<th></th>
<th>%</th>
<th>Water</th>
<th>Protein</th>
<th>Fat</th>
<th>Ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole</td>
<td>100</td>
<td>65.6</td>
<td>11.8</td>
<td>11.00</td>
<td>11.7</td>
</tr>
<tr>
<td>White</td>
<td>58</td>
<td>88.0</td>
<td>11.0</td>
<td>0.2</td>
<td>0.8</td>
</tr>
<tr>
<td>Yolk</td>
<td>31</td>
<td>48.0</td>
<td>17.5</td>
<td>32.5</td>
<td>2.0</td>
</tr>
</tbody>
</table>
Factors Affect the Chemical Composition of Egg

1. Breed, strain, and age of hen.
2. Environment, 30°C smaller egg.
4. Storage and processing – lost vitamin A.
5. Cooking – scramble affect riboflavin.
Nutrient Composition of An Egg

* Protein – 6-7 g, highest quality.
* Fat – 5-6 g, readily digestible.
* Carbohydrate – low in calories.
* Vitamins – generous quantities except Vitamin C.
* Yolk is high in cholesterol – for blood, nerve, tissues.
Protein Quality

- Egg – 100
- Milk – 80
- Beef – 79
- Fish – 66–88
Proteins in Albumen - 1

Ovalbumin - predominant, 4 -SH and 1 -SS- /molecule.

Conalbumen - Chelate Fe+++ (red color), Cu++ (Yellow color), and Zn.

Ovomucoid - act as a trypsin inhibitor, heat resistant.
Proteins in Albumen - 2

Ovomucin – Contribute to the gel-like structure.

Lysozyme – Lyse the cell walls of some bacteria.

Ovoglobulin – excellent foaming agent.
Proteins in Albumen - 3

Ovoinhibitor – a proteolytic enzyme inhibitor.

Ovoglycoprotein – 1% only.

Ovoflavoprotein – bound riboflavin in a 1:1 ratio.

Avidin – 1 mole combine with 3 moles of biotin.
Functional Properties of Egg --

1. Leavening – baked goods.
2. Binding.
3. Thickening – custards, puddings, and cream filling.
4. Retard crystallization and prevent a gritty texture – cake icings and candies.
5. Natural emulsifiers – lecithin.
7. Coating – cakes, rolls, cookies, breads and other bakery foods.
8. Add color and richness to foods.
Misconceptions About Nutritive Value of Eggs

1. Pay more with the desired shell color for nutrient.
2. Deep yellow yolk are higher in nutritive value.
3. Fertile eggs are more nutritive than non-fertile eggs.
4. Organic eggs are safer and more nutritious.
5. Raw eggs are more digestible than cooked.
Meringues and Copper Bowls

Meringues – egg foam. Contains only egg white, sugar and traces of acid and salt.

When the pH >6, all the transferrins (conalbumin) can bind a number of different di- and tri-valent metal ions, including iron, zinc, manganese and copper. This would make the mass of egg white harder to denature to the point of overcoagulation and curdling, and so more tolerant of overbeating.