Egg Quality Issues: Egg Quality and Food Safety

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Eggs



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Biological Purpose of the Egg



Formation of the egg

- The formation of the egg shell proper is preceded by a number of stages
- Egg shell quality can be influenced at a number of steps in the formation of the egg:
  - albumen formation
  - shell membrane formation
  - plumping
  - deposition of:
    - mammillary layer
    - palisade layer
    - surface crystal layer
    - cuticle

Oviduct and Egg Formation

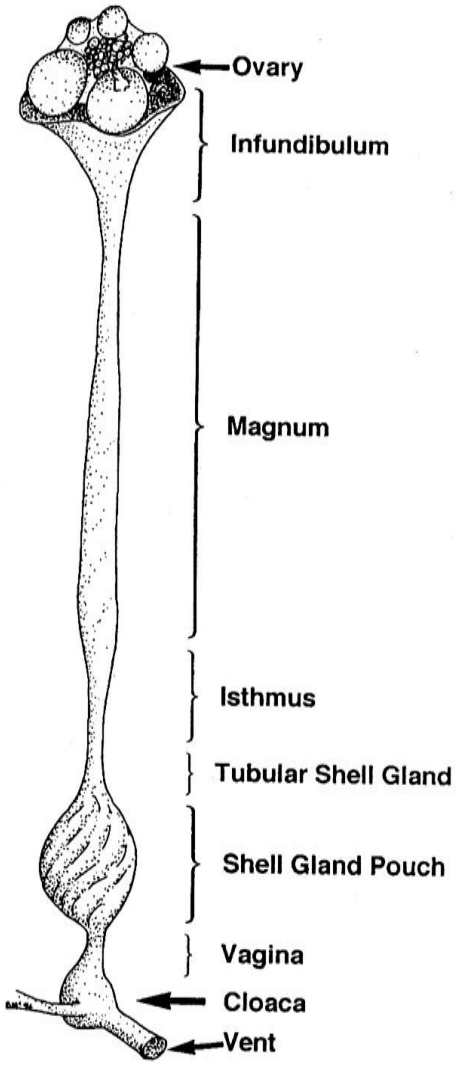
15 min

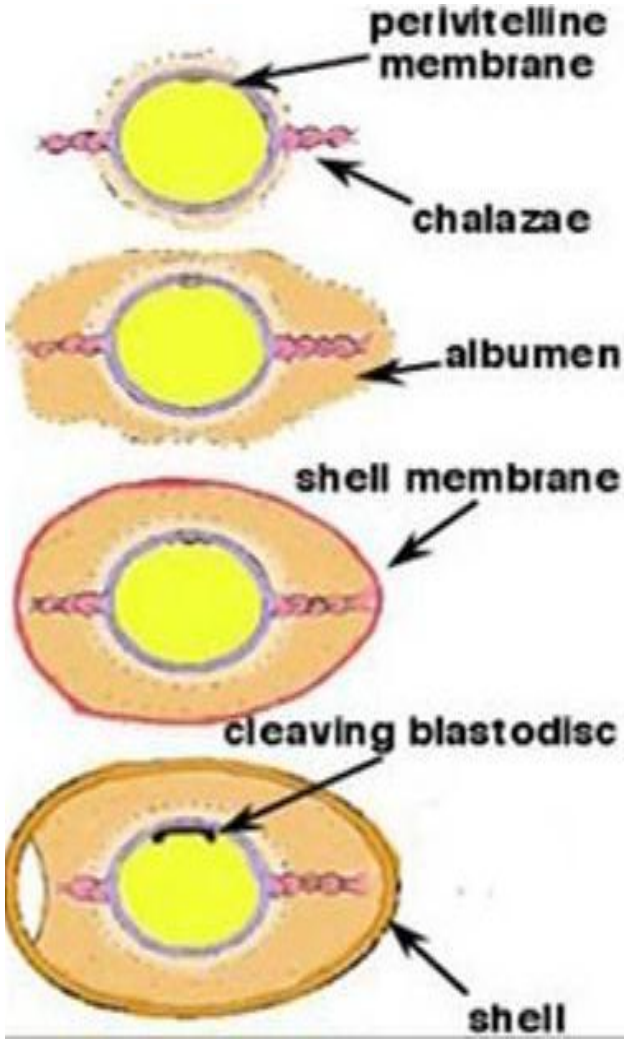
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1 hr

5 hr

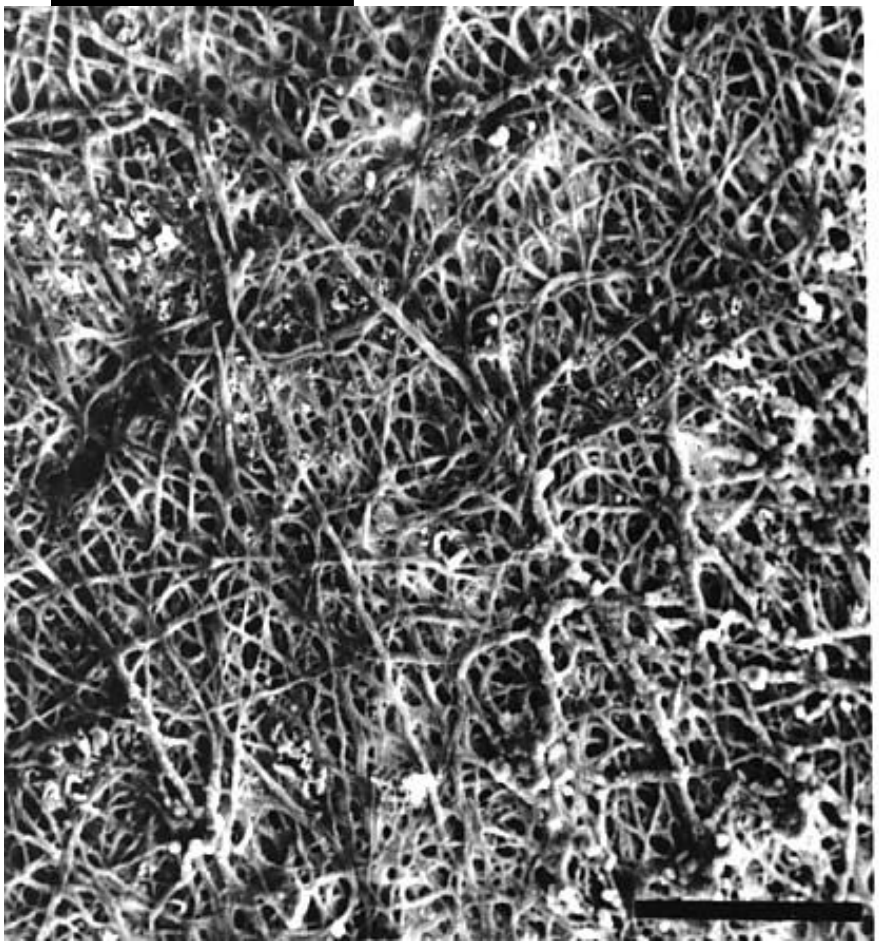
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Shell membranes

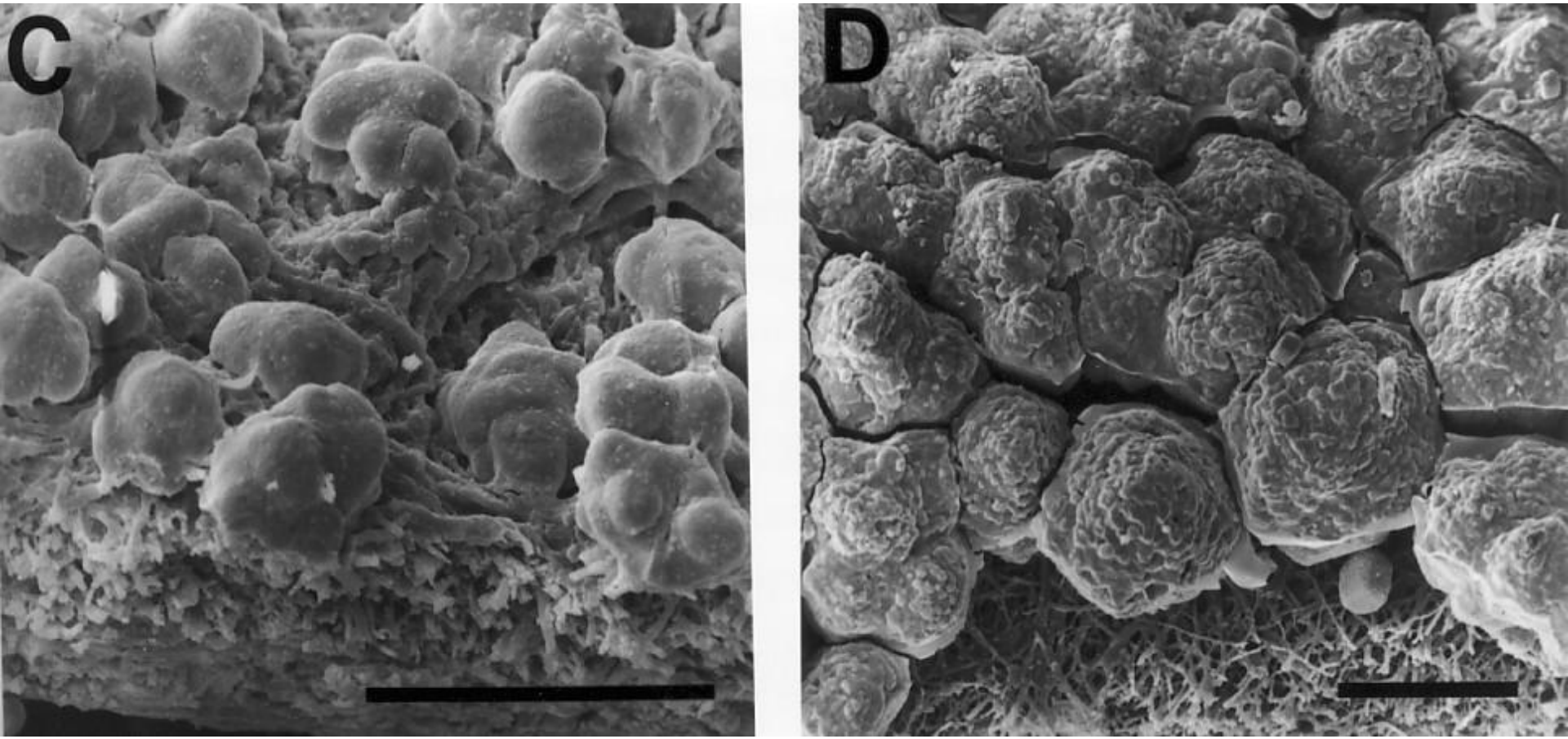


Scale Bar 100 μm



Scale Bar 10 μm

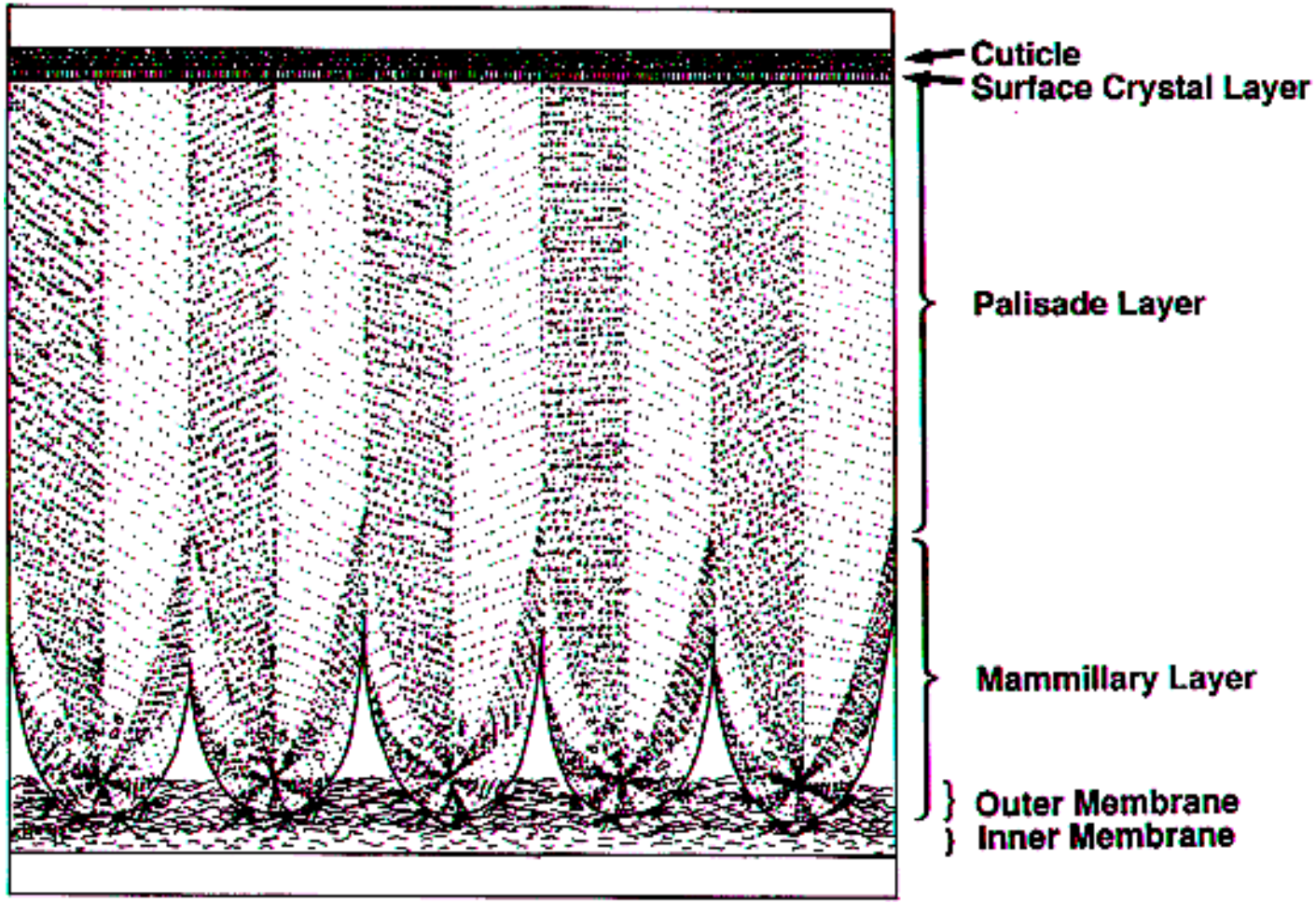
Shell Formation



Scale bar 100 μm

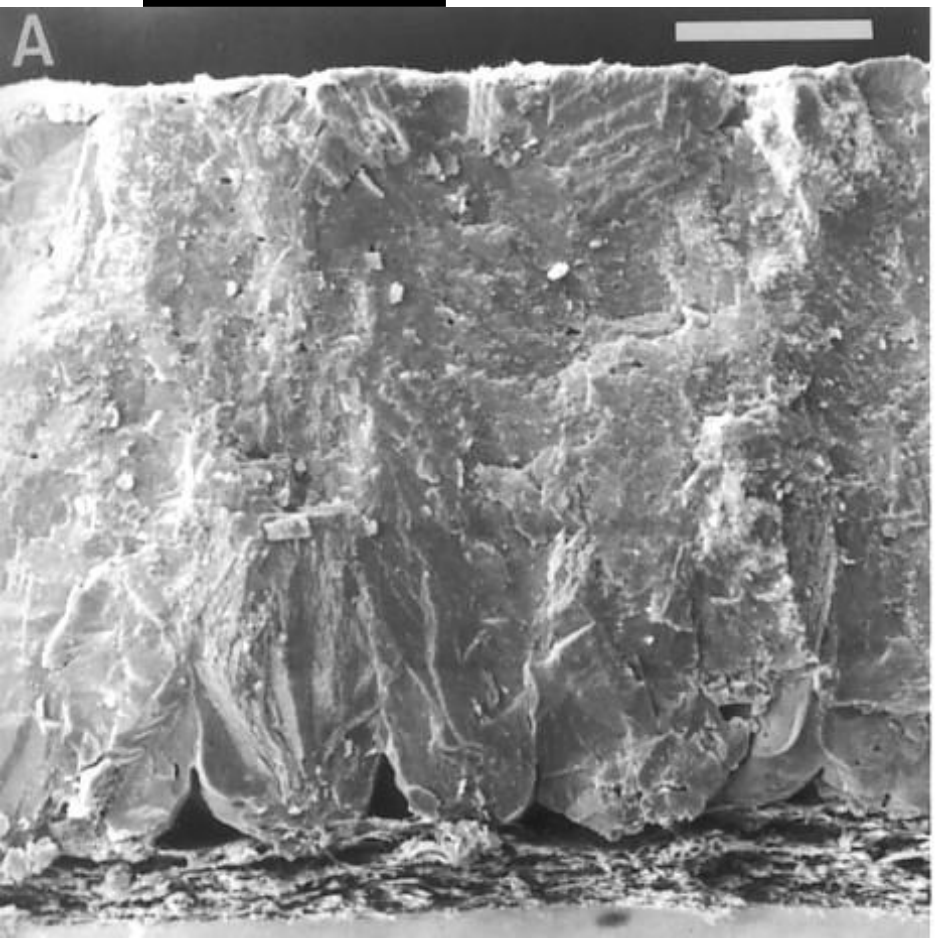
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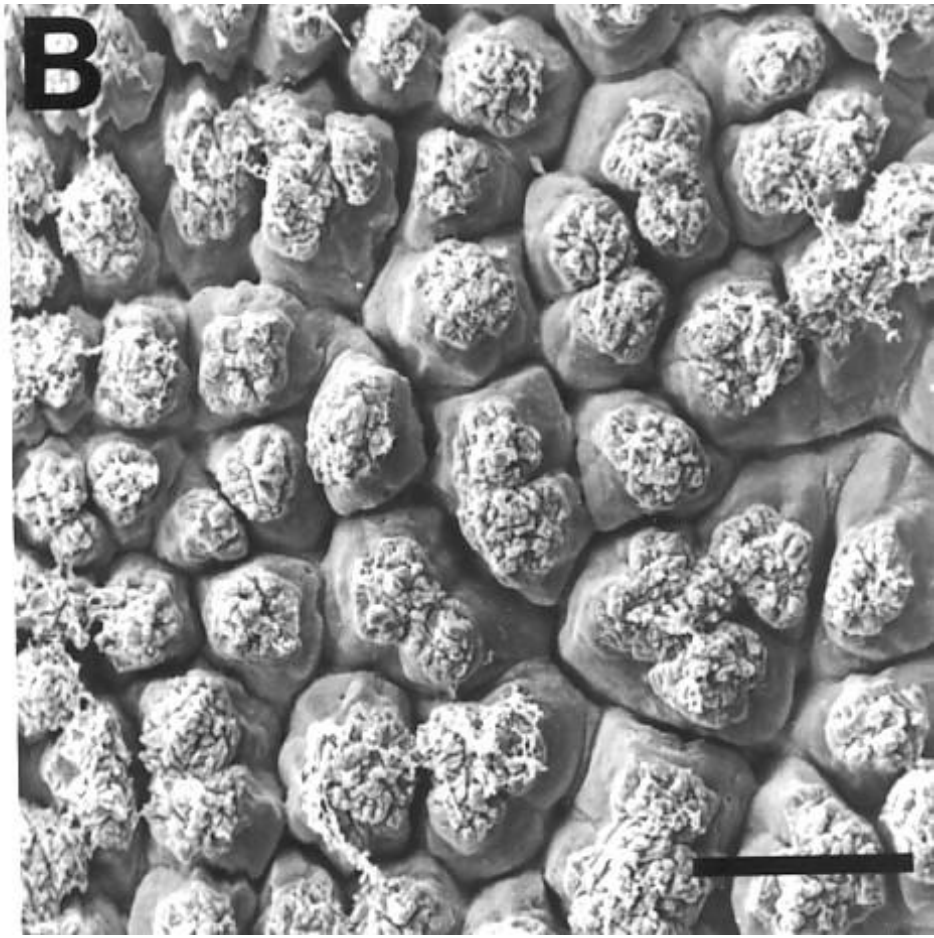
TS of egg shell



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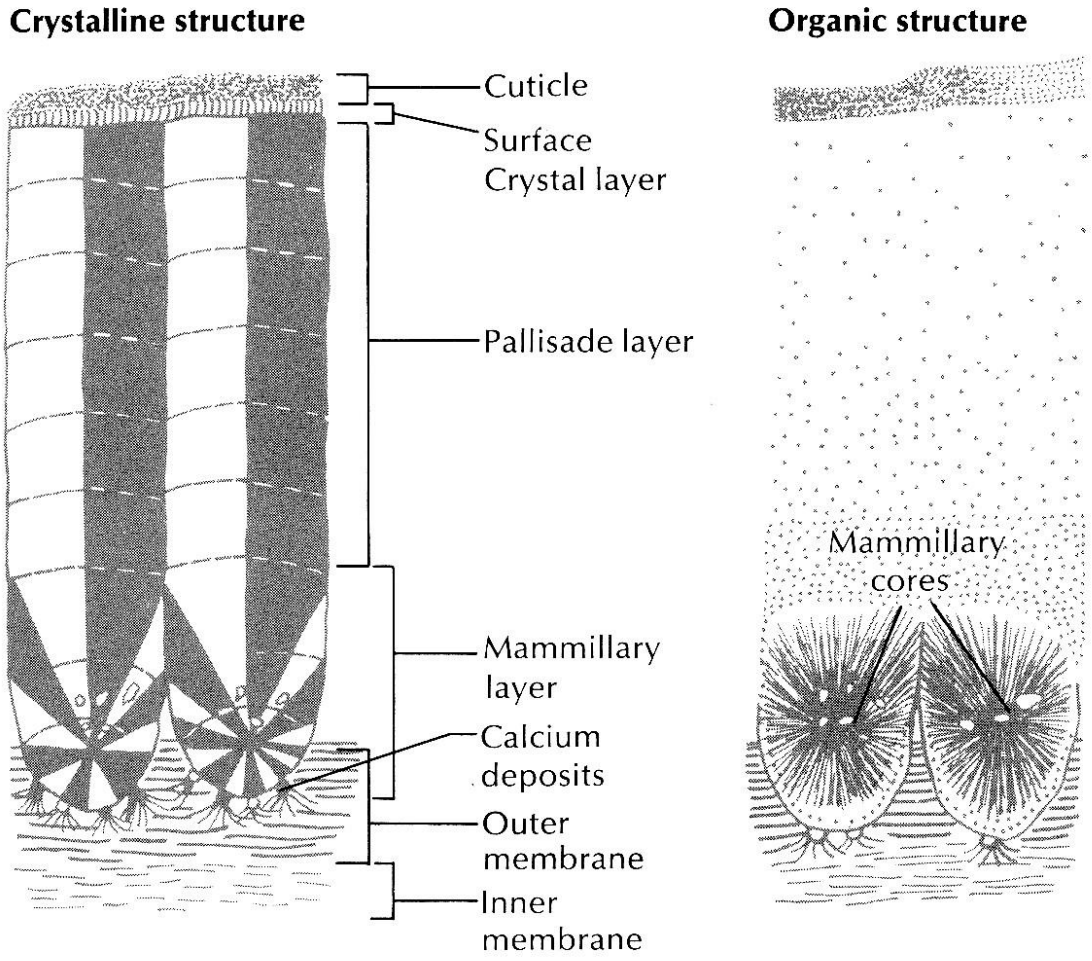
Shell ultrastructure





Scale Bar 100 μm

TS showing organic matrix



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Cuticle and pores



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Cuticle and pores



Scale bar = 100μm

Egg shell Cuticle:
Konica Minolta Spectrophotometer



De Reu 2010



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Why is egg quality important?

- Egg shell quality
  - Visual appearance of the egg
  - Integrity of the egg until used by consumer
  - Microbiological safety of the egg
  - Hatchability of the egg
- Egg internal quality
  - Consumer preference for yolk colour
  - Consumer preference for particular range of viscosity of egg albumen
  - Known association between albumen viscosity and egg freshness
  - Microbiological safety of egg contents

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Measurement of egg quality: external appearance









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Egg Quality Laboratory UNE



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Egg shell quality measurements





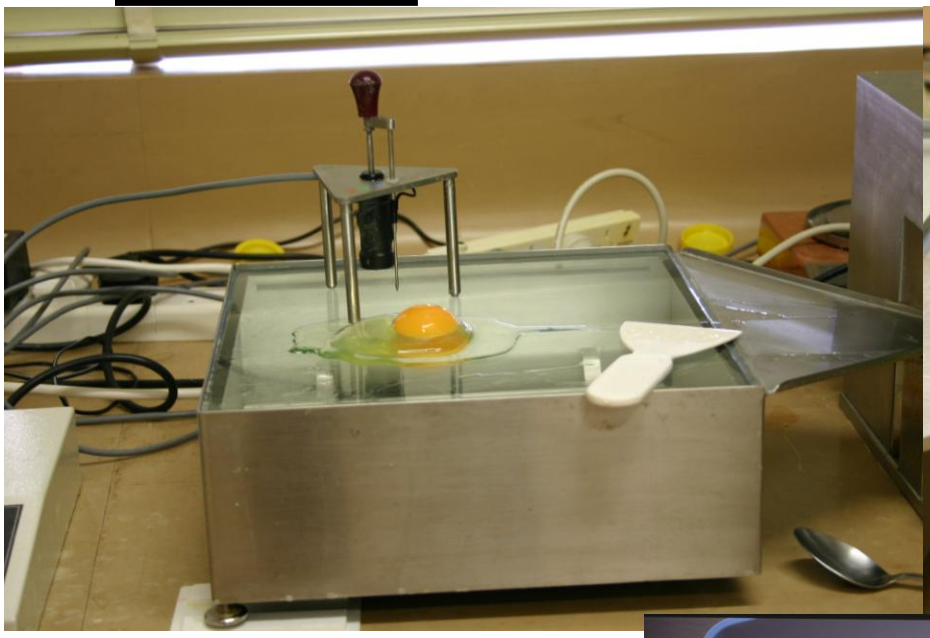




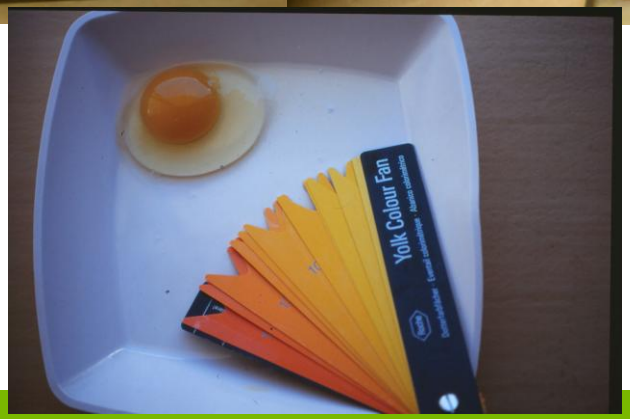


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Egg internal quality







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Commercial QA Setup





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Egg Quality & Food Safety

Main organisms of concern

- Salmonella enterica
- Motile serotypes are often referred to as paratyphoid (PT) salmonellae and include:
  - S. enterica serotype Enteriditis (usually abbreviated as S. enteritidis)
  - S. enterica serotype Typhimurium (usually abbreviated as S. typhimurium)

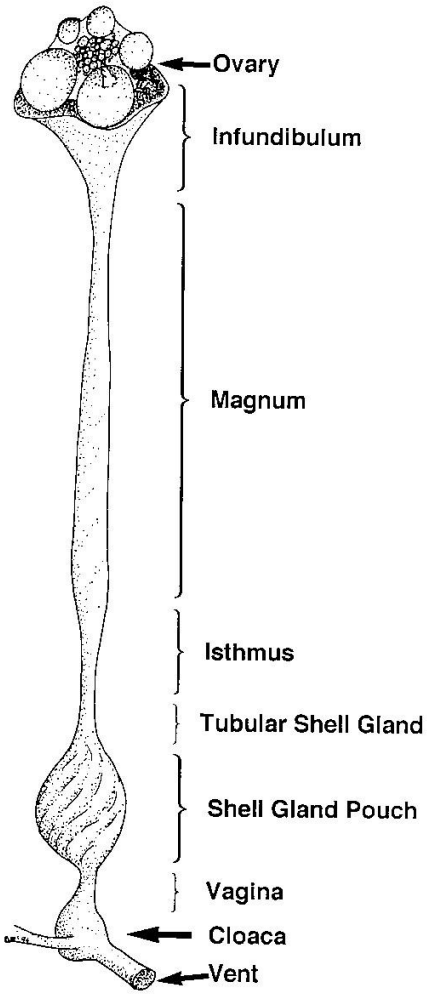
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Routes of Contamination: Transovarian

- Glandular epithelial cells of isthmus & magnum can be experimentally infected with SE
- Sites for adherence of SE on oviduct mucosa
- SE localised from ovary and oviduct of hens producing SE contaminated eggs
- Uncertain to what extent this is the route of transmission of SE to egg
- SE is the only microbe of concern that is transmitted this way

Hen's Ovary and Oviduct





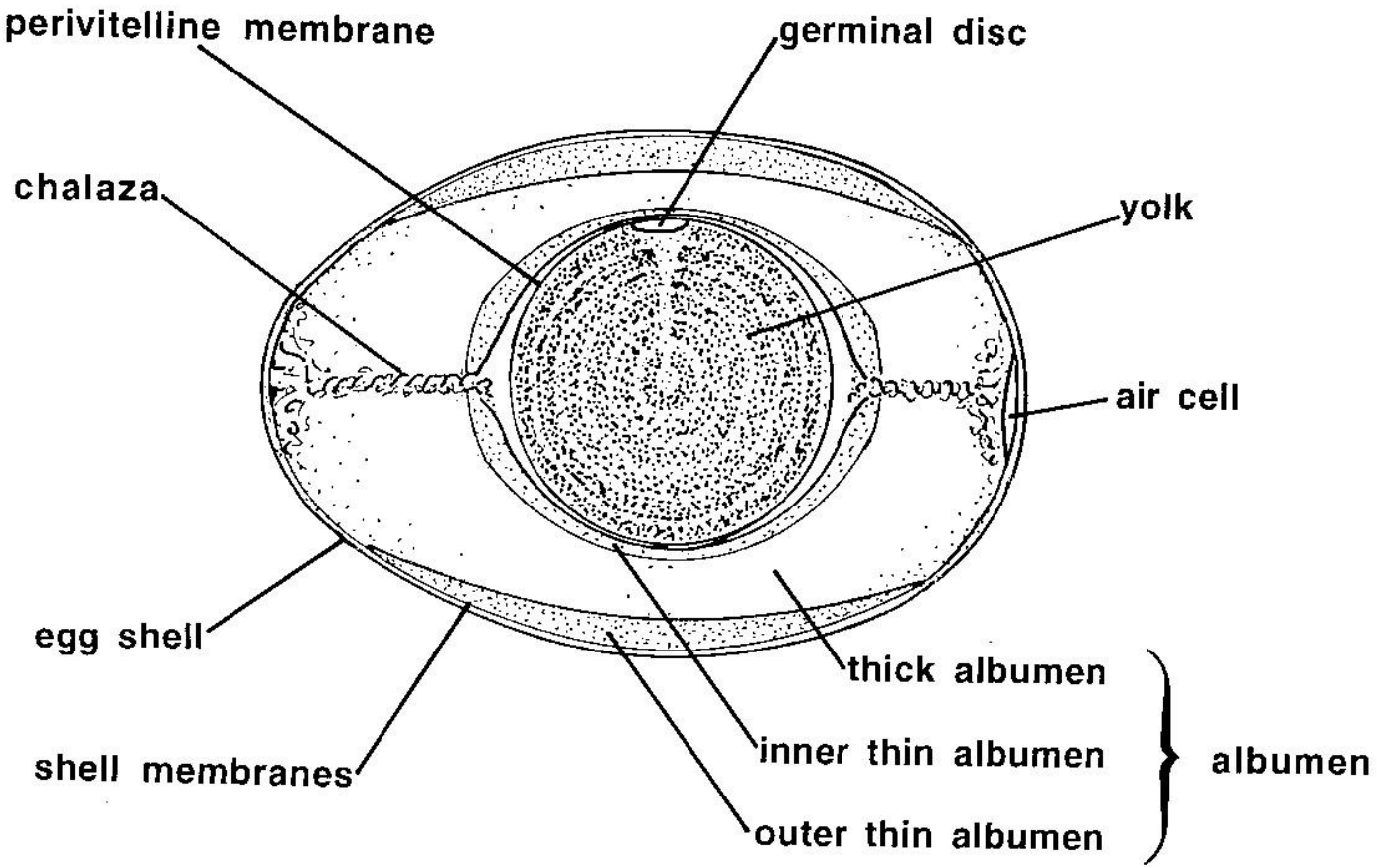
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Routes of Contamination: Through the Egg Shell

- Through any defects in the egg shell
- Through the pores of the egg shell
- Across the egg shell membranes
- Into the albumen
- Across the perivitelline membrane
- Into the yolk

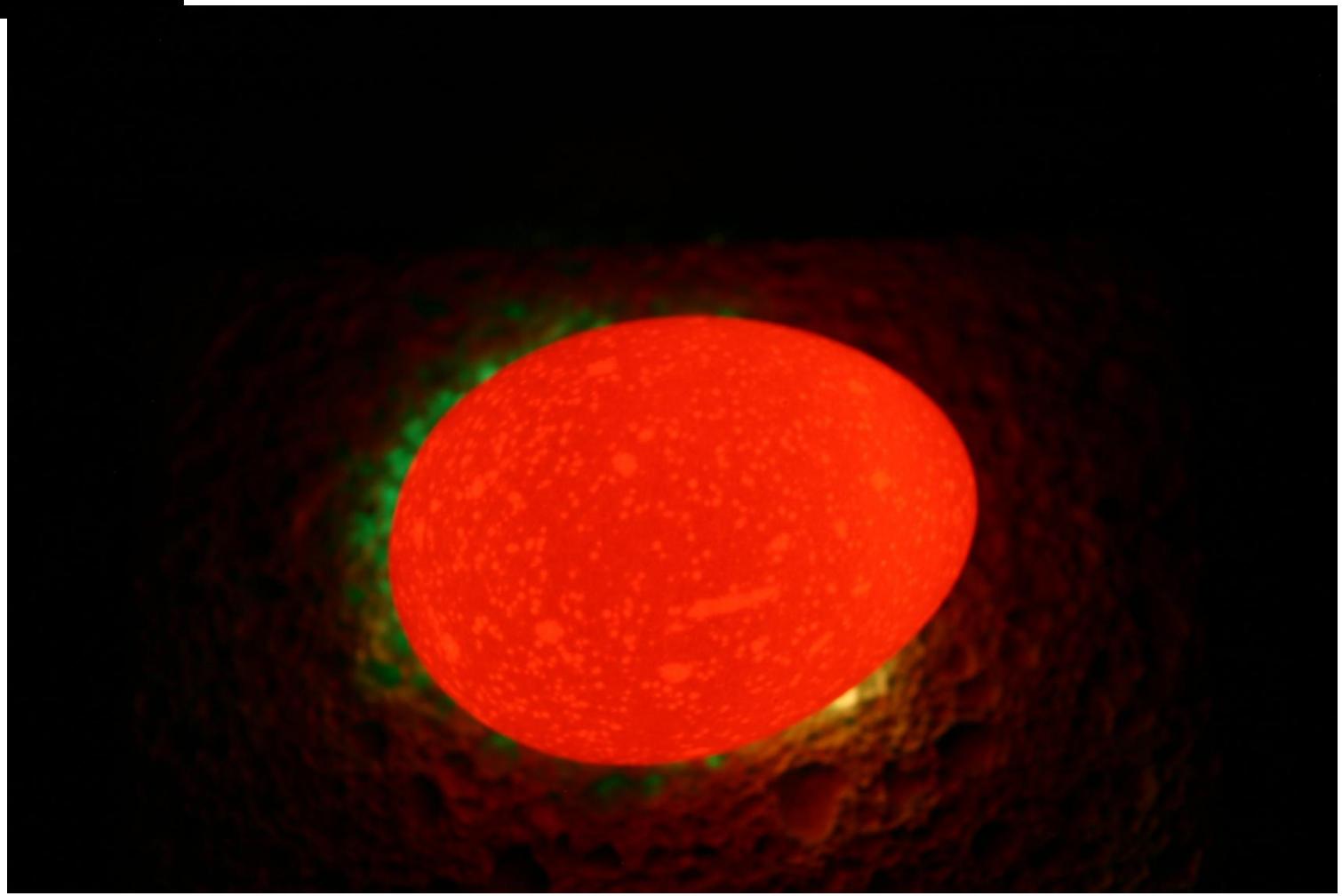
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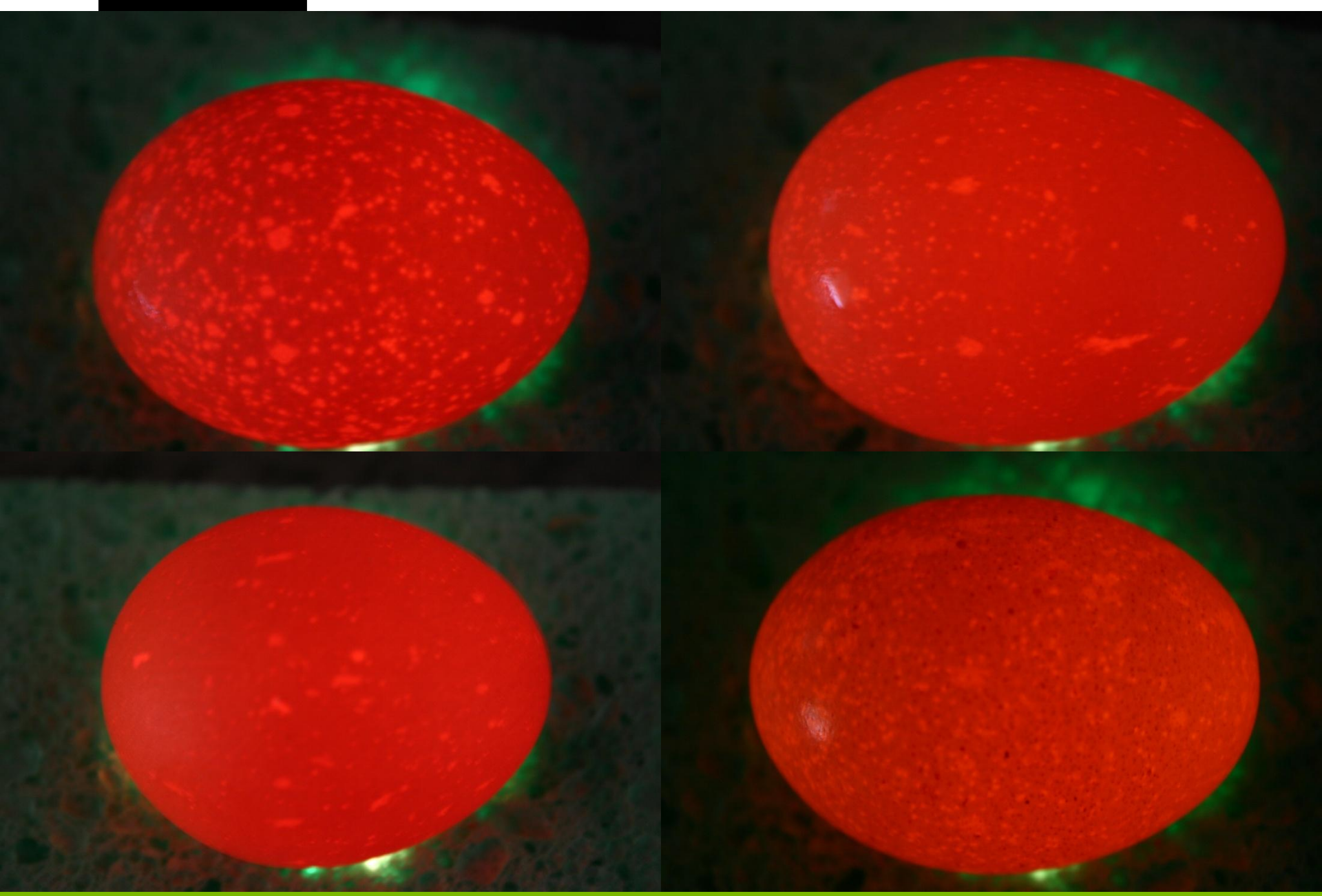
Egg Components



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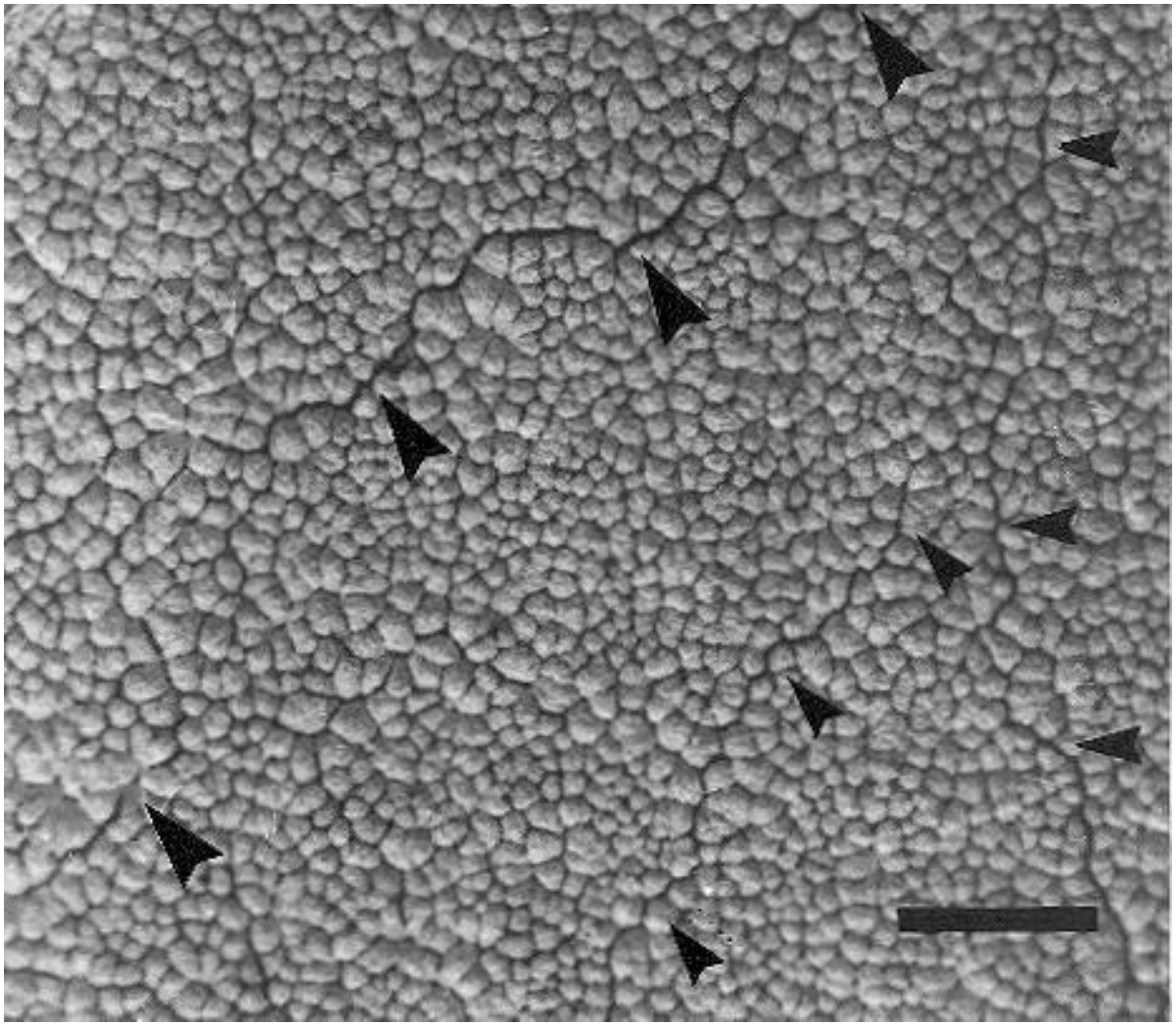
Translucent Egg Shells





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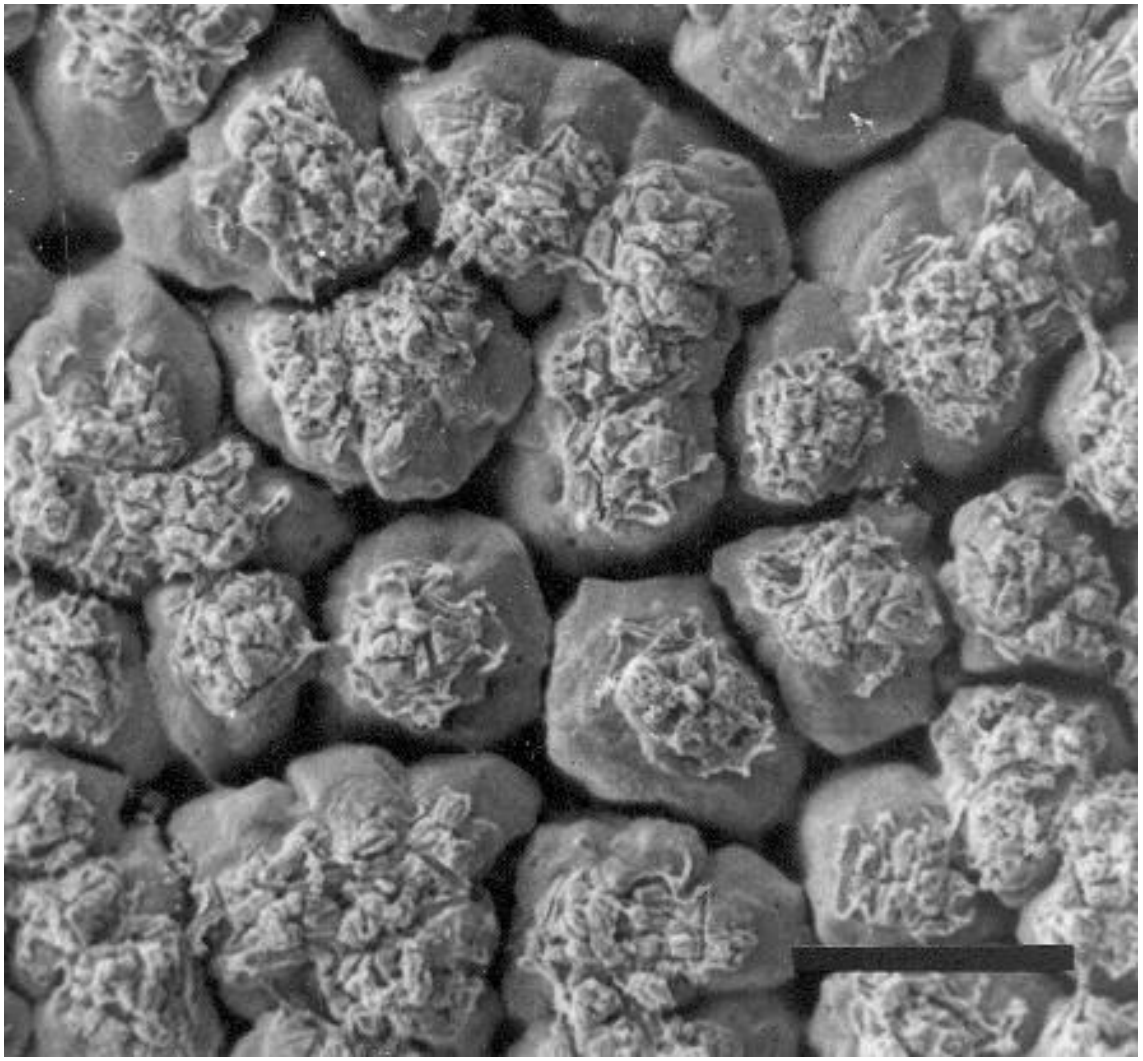
Alignment



Scale Bar = 500 μm

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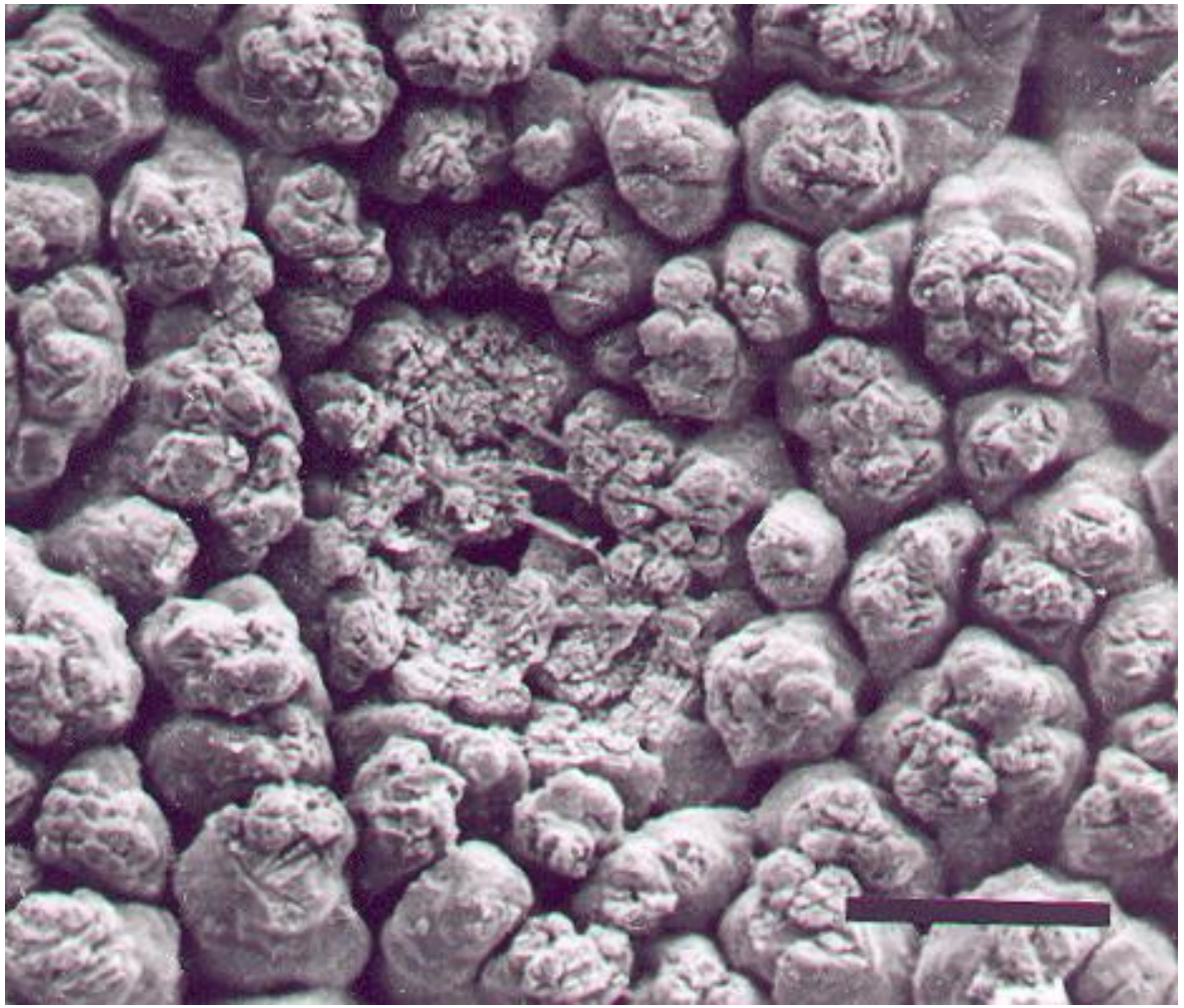
Late Fusion



Scale Bar = 100 μm

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Pitting/Depression



Scale Bar = 100 μm

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Egg Defence Mechanisms

- Lactobacillus flora in cloaca and vagina have an inhibitory effect on SE
- Eggs with intact cuticle blocking pores are less likely to be contaminated
- Egg shell matrix contains antibacterial proteins – only weak action on SE
- Shell membranes contain bacteriolytic enzymes

Egg Defence Mechanisms (cont)

- Albumen contains antibacterial substances
  - Lysozyme
  - Ovoinhibitor
  - Cystatin
  - Ovotransferrin (binds iron)
- Perivitelline membrane acts as a barrier

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Condensation on eggs

- Concern about condensation on eggs moved from refrigeration to room temperature
- Concerns that moisture increases the ability of bacteria to enter the egg
- No evidence that this actually occurs in intact eggs
- Some evidence from experimental studies with agar filled eggs
- Benefits of refrigeration of eggs outweigh this *potential* negative

Future Studies (Poultry CRC Project)

- Egg shell translucency, shell strength and product safety
- Egg shell translucency and the occurrence of microcracks in the eggs of commercial laying hens.
- Egg shell translucency, microcracks, shell cuticle and egg shell thickness on the ability of bacteria such as Salmonella and E. coli to penetrate the egg shell

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Future Studies (continued)

- Strain of hen, stage of lay and bacterial load on the eggshell surface and in the egg contents
- Sampling flocks for the presence of food-borne pathogens, where problems are identified in eggs from these flocks
- Effect of egg washing by different methods using different detergents and sanitisers (with SARDI)

Acknowledgements

- University of New England
- Australian Egg Corporation Limited (AECL) and predecessor organisations
- Poultry CRC
- Students
- Colleagues

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Thank you for your attention