Current and Potential Processing Technologies and Egg Safety

Ahmed Yousef
Department of Food Science and Technology
The Ohio State University
Yousef.1@osu.edu

Egg Processing and Safety

Product	Microorganisms of concern	Processing
Shell Eggs	*Salmonella* *Mycoplasma* Others? *Pseudomonas* *Proteus* Molds	Washing Pasteurization Alternatives Ozone Pulsed light
Liquid Whole Egg	*Salmonella* *Listeria* Gram-negatives Spore formers	Pasteurization Alternatives Additives HPP PEF Radiation

Transmission of *Salmonella* Enteritidis to Eggs

Trans-Ovarian (Vertical)
Infected ovary
Pathogen in yolk

Trans-shell (Horizontal)
Fecal contamination
Improper washing
Pathogen in shell
Migration is possible

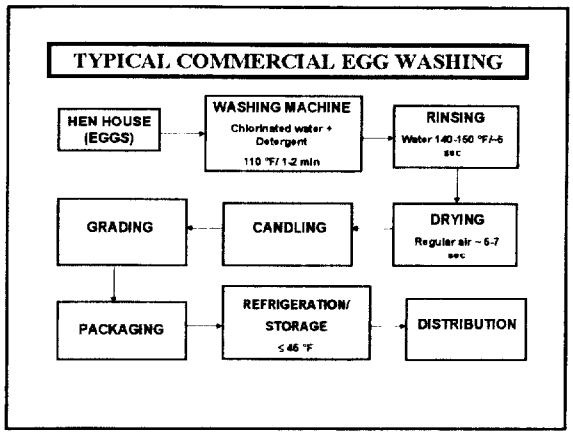
Egg-Breaking
Contaminated shell
Pathogen in liquid egg

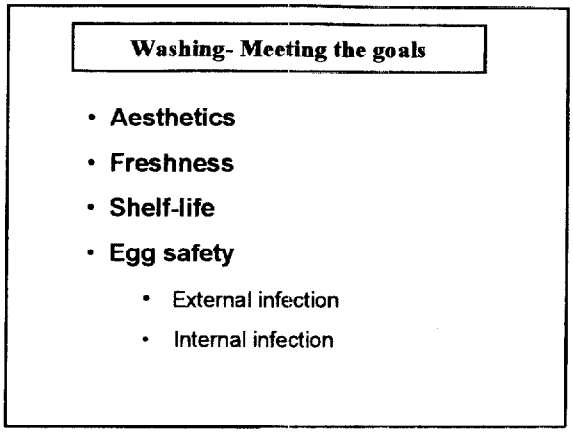
Processing Shell Eggs

Shell Eggs Processing Goals

- Aesthetics
- Freshness
- Shelf-life
- Egg safety
  - External infection
  - Internal infection

1. Washing





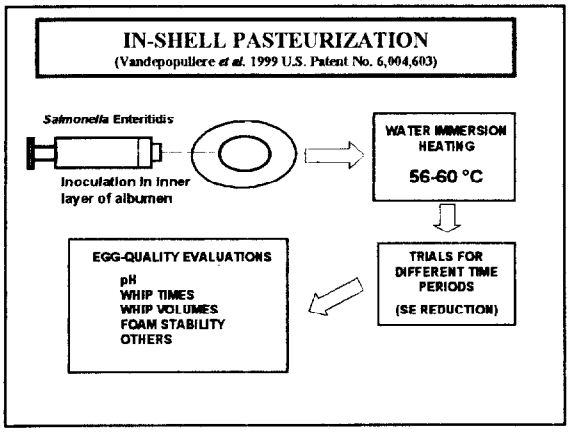
2. In-shell Pasteurization

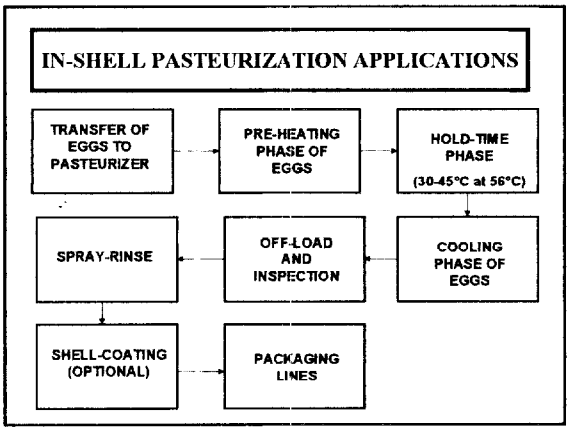
IN-SHELL PASTEURIZATION

DEFINITION

"PRECISELY-CONTROLLED CONDUCTION THERMAL PROCESSES DESIGNED TO EFFECTIVELY ADDRESS *Salmonella* EGG SAFETY CONCERNS (D-VALUE = ≥ 5 log CYCLES), WHILE MANTAINING THE APPEREANCE, TEXTURE AND FUNCTIONAL CHARACTERISTICS OF A FRESH, HIGH-QUALITY SHELL EGG"

Schuman, 2000





In-shell Pasteurization- Meeting the Goals

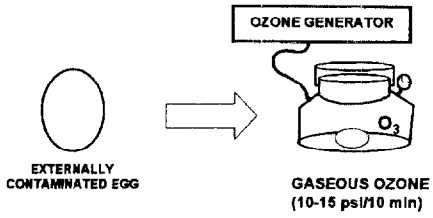
- Aesthetics
- Freshness
- Shelf-life
- Safety
  - External infection
  - Internal infection

3. Alternative Technologies

- Ozone
- Pulsed light
- Irradiation
- High Pressure?
- Combinations

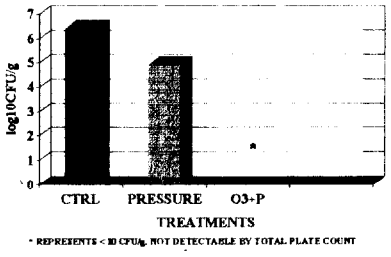
3.1. Ozone and Cold Sanitization of Shell Eggs

GASEOUS OZONE AT PRESSURE

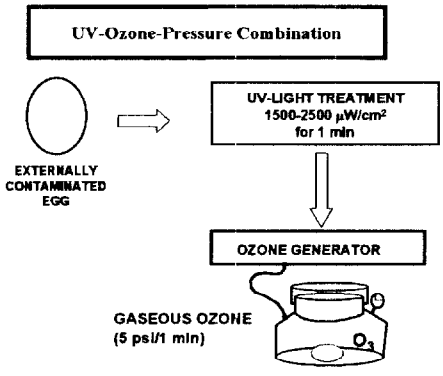


COLD SANITIZATION TREATMENT

(Rodriguez-Romo & Yousef, 2000)

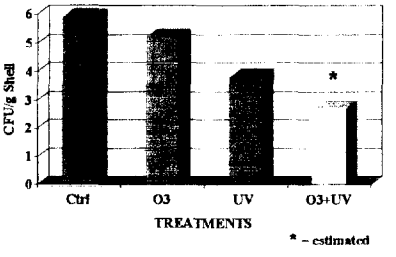


UV-Ozone-Pressure Combination



UV-Ozone-Pressure Combination

(Rodriguez-Romo & Yousef, 2000)



* – estimated

SUMMARY OF RESULTS

(Rodriguez-Romo & Yousef, 2000)

Treatments				*Effect on Salmonella Enteritidis*
Mode of Infection	Conditions	Ozone delivery method	Time (min)	Total $\log_{10}$ reduction
External	No pressure	Gaseous	3-8	1.2 1.9
	*Pressure (10-15 psi)		10-20	> 5.0
	No pressure	Aqueous (20-25 ppm)	10-20	1.5

* = COLD SANITIZATION

SUMMARY OF RESULTS (Cont'd)

(Rodriguez-Romo & Yousef, 2000)

Treatments				*Effect on Salmonella Enteritidis*
Mode of Infection	Conditions	Ozone delivery method	Time (min)	Total $\log_{10}$ reduction
External	UV-LIGHT 1500-2500 $\mu W/cm^2$	Gaseous	2	4.3
	Pressure (5 psi)			

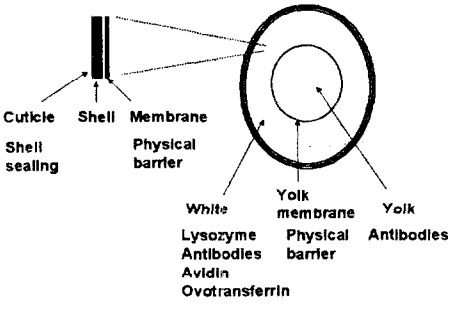
Cold Sanitization- Meeting the Goals

- Aesthetics
- Freshness
- Shelf-life
- Safety
  - External infection
  - Internal infection

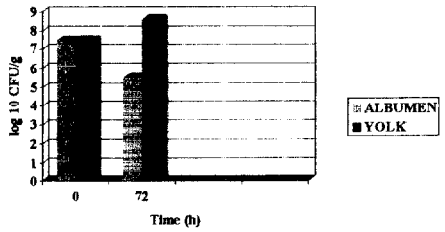
Shell Eggs Safety Research- Challenges

- Validation Methodology
  - Facility
  - Naturally vs. artificially-contaminated eggs
  - Artificial contamination
    - Media for cells suspension
    - In the yolk or by the yolk
- Disrupting natural defenses-implications

Egg Components and Natural Defenses



Behavior of *Salmonella* Enteritidis in the the White and Yolk of Shell Eggs Incubated at 37°C for 72 hours



Shell Eggs Safety Research-Challenges

- **Continuous washing**
  - Reminiscent of reworking
  - Potential problems
- **Repackaging**
  - Should be studied

CONCLUSIONS

Current practices and new processing technologies for shell eggs

- **Evaluation against clear goals**
- **Ability to maintain or benefit from natural defenses in eggs**
- **Benefit from new developments in microbiology (e.g., stress adaptive response, staining and visualization techniques)**
- **Facility for running egg safety research with similarity to real world.**