What determines the risk of growth of *Salmonella* after recontamination of ready to eat heat-treated egg products

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Introduction

• Salmonella cause most of food-borne outbreaks in Europe (EFSA)

• Eggs and egg products cause most of them.

How??

• Raw eggs used in ice cream, mayonaise, eaten undercooked.

• Solution – pasteurization!!
Pasteurized egg products
However...

It is very dangerous to assume something is safe.

Prevalence:

- 0.3% pasteurized egg products were positive for *Salmonella* in 2011 in USA (FSIS). No outbreaks though.

- 1.7% in Japan (Hara-Kudo & Takatory, 2009)

Outbreaks in Europe:

- 2007, from pasteurized egg white and yolk used for chocolate mousse, pasteurized egg white for desert and salmon mousse.

- 2012m from pasteurized egg white (ready to drink)
How *Salmonella* appears in heat-treated products

- Products can be re-contaminated

- *Salmonella* can survive pasteurization (resistance or failure)
Factors to be considered

- Product type (natural composition)
- Temperature (before pasteurization and after)
- Salt
- Preservatives
- Inoculum level
- Serovars
Product type (natural composition) I

20°C

Survival of *Salmonella* in egg white

- S. Enteritidis
- S. Tennessee
- S. Typhimurium

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Product type (natural composition) II

Survival of *Salmonella* in egg white

- **S. Enteritidis**
- **S. Tennessee**
- **S. Typhimurium**

Graph showing survival of *Salmonella* at 20°C and 30°C, with pasteurization indicated.

Adapted from McQuestin et al., 2010, *Food Microbiology*

Adapted from Baron et al., 1999, *J. of Food Protection*
Product type (natural composition) III

pasteurization

Growth of Salmonella in light pasteurized whole egg

- S. Tennessee
- S. Enteritidis
- S. Typhimurium
Temperature (before)

Adapted from Singh 2011. *J. of Food Science.*

Adapted from Sakha & Fujikawa, 2013. *Biocontrol Science.*
Temperature (after)

Adapted from McQuestin et al., 2010, Food Microbiology

Salt

S. Typhimurium Pasteurized salted (10%) yolks, 30°C

Adapted from Musgrove et al. 2009, J. of Food Protection
Preservatives

Survival of *Salmonella* in pasteurized egg yolk

- S. Tennessee
- S. Enteritidis
- S. Typhimurium

Time, h
Inoculum size

S. Enteritidis Pasteurized liquid egg. 24°C

Serovar

Growth of *Salmonella* in light pasteurized whole egg

- **S. Tennessee**
- **S. Enteritidis**
- **S. Typhimurium**

![Graph showing growth of different serovars of *Salmonella* over time](image-url)
Conclusions / Recommendations

- Avoid abused temperatures before pasteurization
- Control pasteurization temperatures
- Avoid cross contamination from raw material and equipment
- Cool products immediately after pasteurization
- Salt or other preservatives can be used to prolong shelf life
Thanks for your attention