

# Predictive microbiology in the food industry

Pernilla Arinder

par@sik.se

# An industrial research institute with the task of reinforcing client company competitiveness

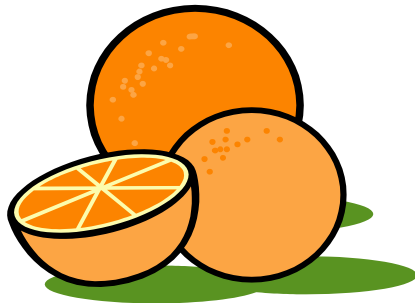
[www.sik.se](http://www.sik.se)



*THE SWEDISH INSTITUTE FOR FOOD AND BIOTECHNOLOGY*

# When could predictive microbiology be used?

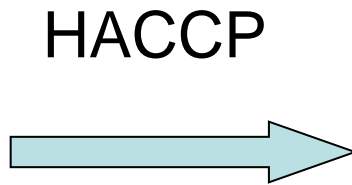
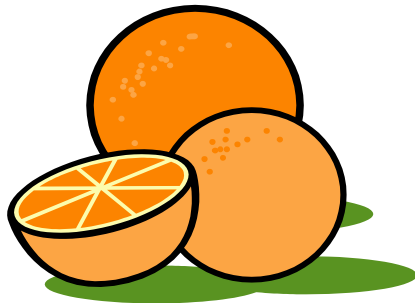
- Predict growth/no growth
- Predict growth rate
- Predict survival



ill?



- Microbial risk assessment
- HACCP



# HACCP

**Conduct a hazard analysis**

**Identify critical control points**

**Establish critical limits for each critical control point**

**Establish critical control point monitoring requirements**

**Establish corrective actions**

**Establish record keeping procedures**

**Establish procedures for ensuring the HACCP system is working as intended**

## Proces

## Effect on microbial hazard

Raw material

Contamination



Wash

Contamination



Unshell/press

Contamination



Storage  
Mixing

Contamination  
Growth



Pasteurisation

Inactivation



Storage  
Pour into bottles

Contamination  
Growth

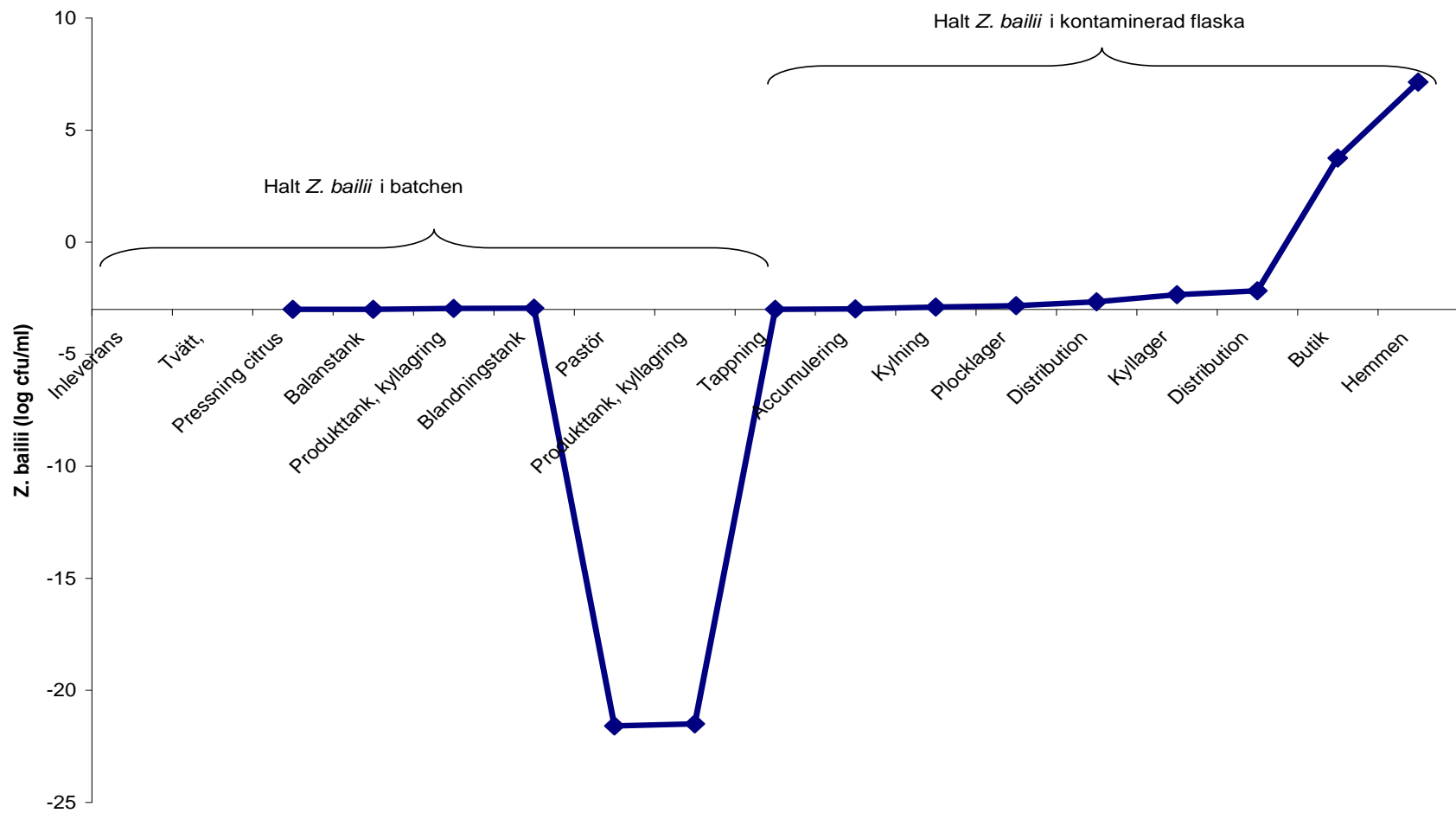


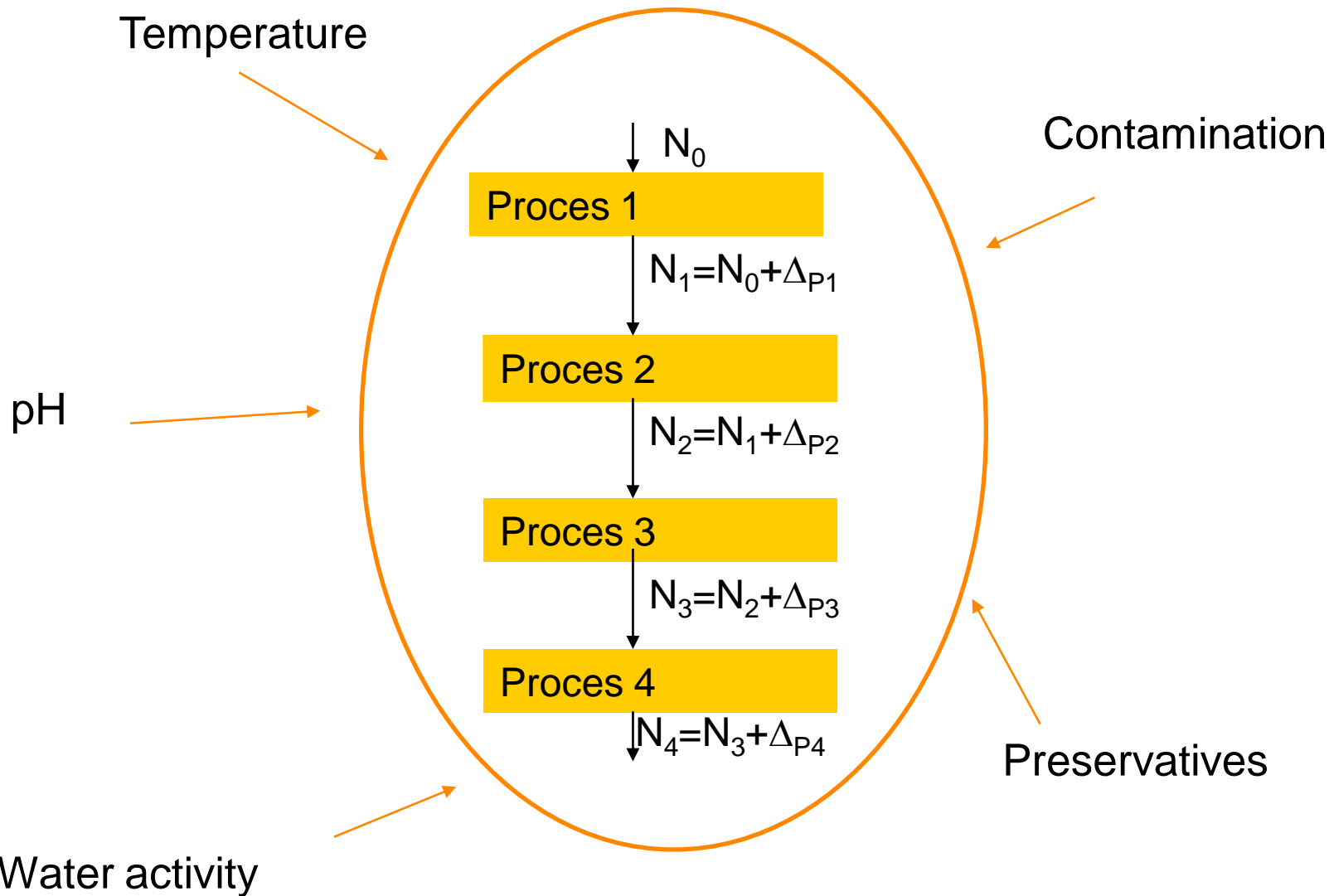
Storage, distributions  
Storage in homes

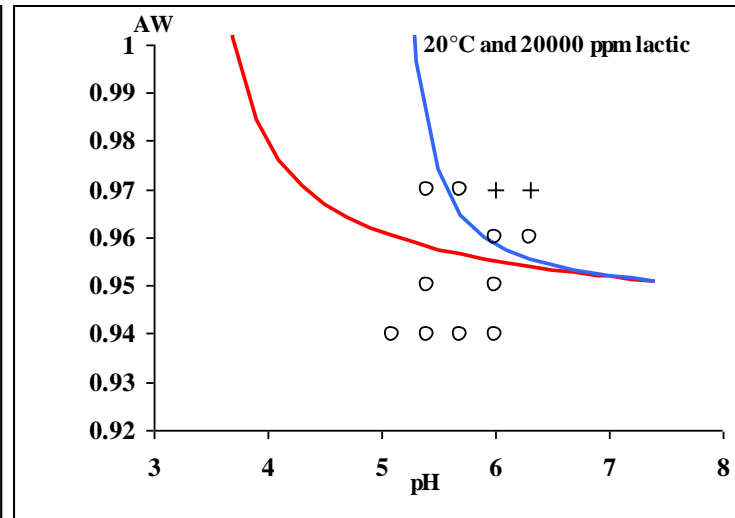
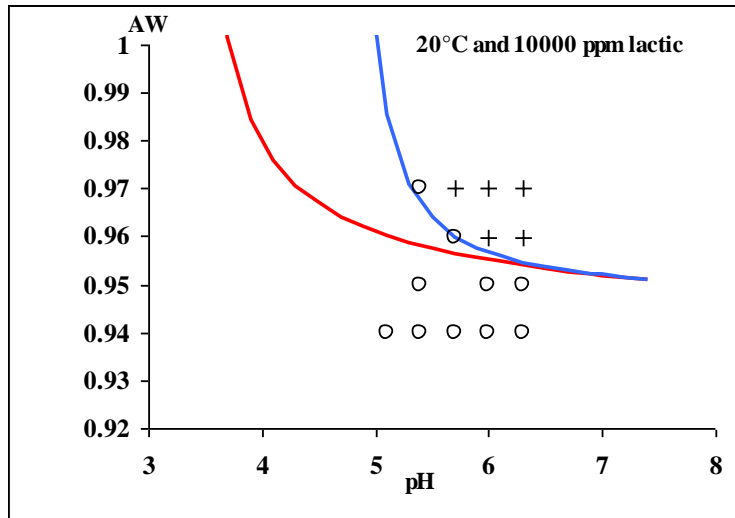
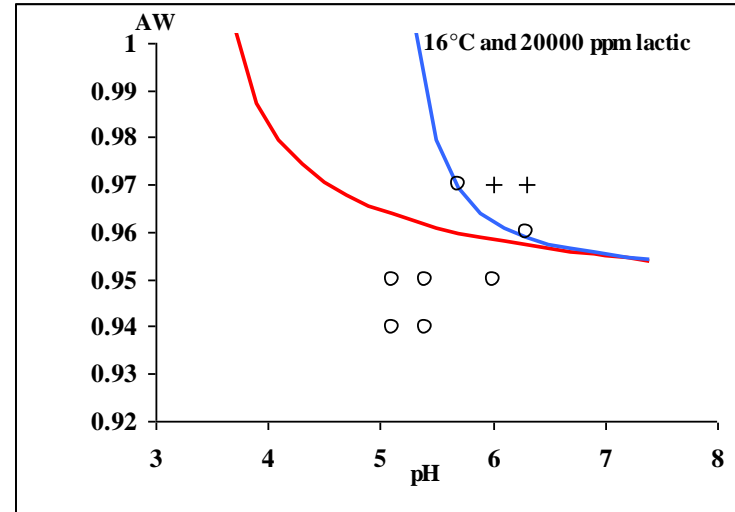
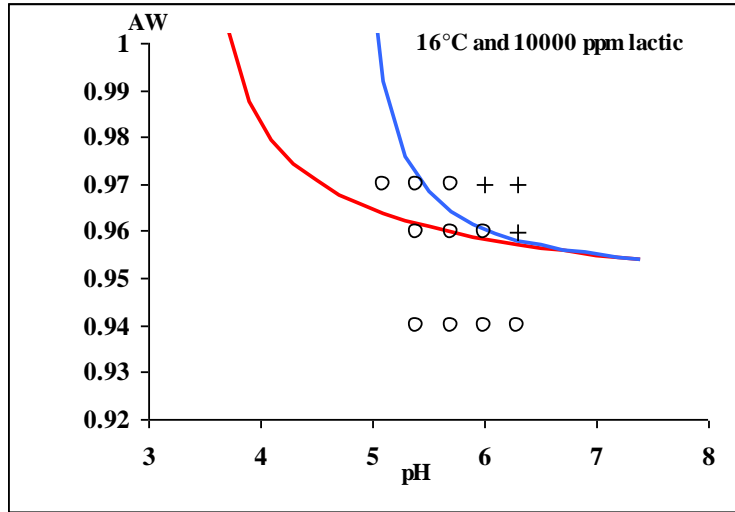
Growth and or inactivation

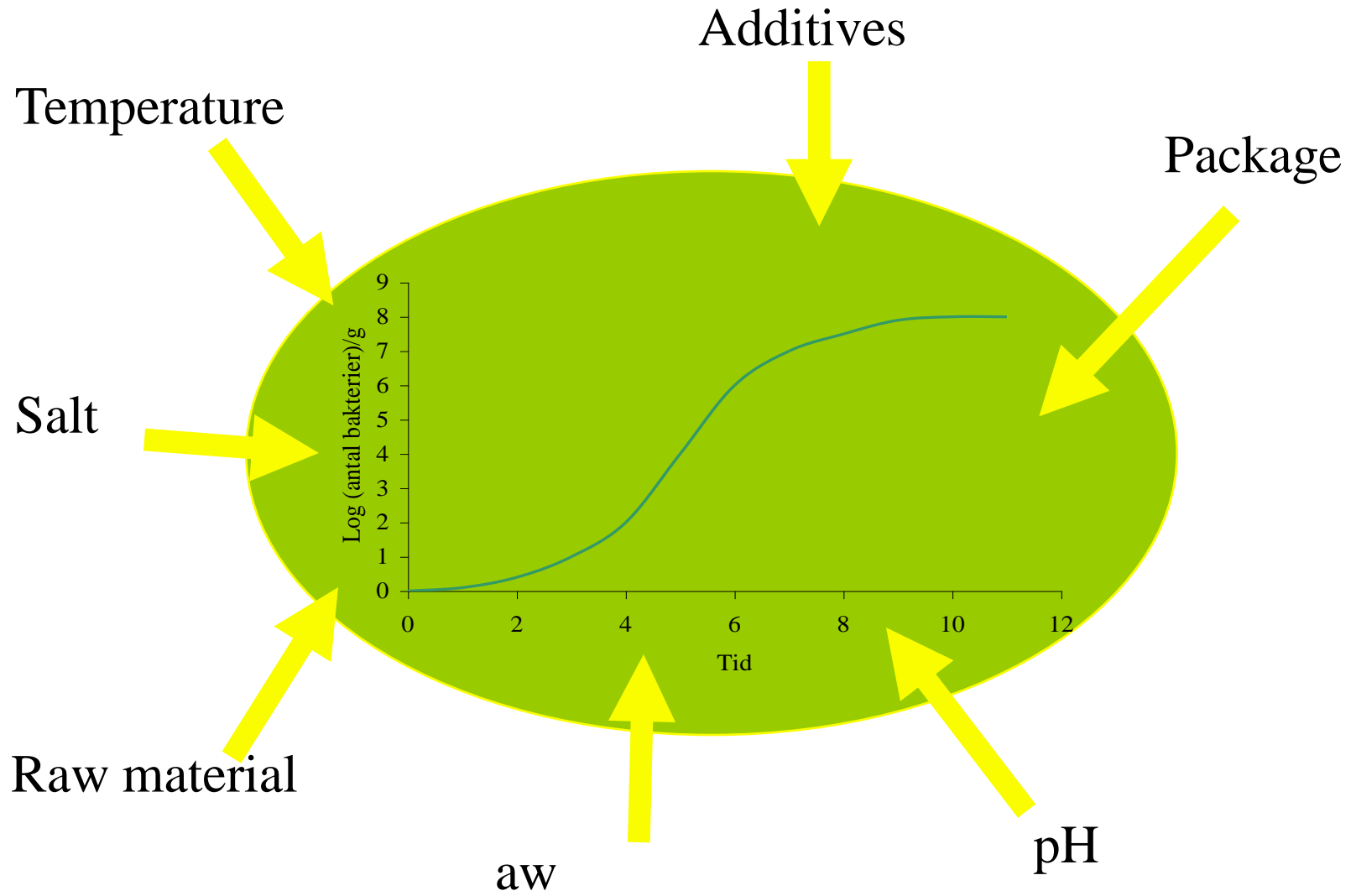






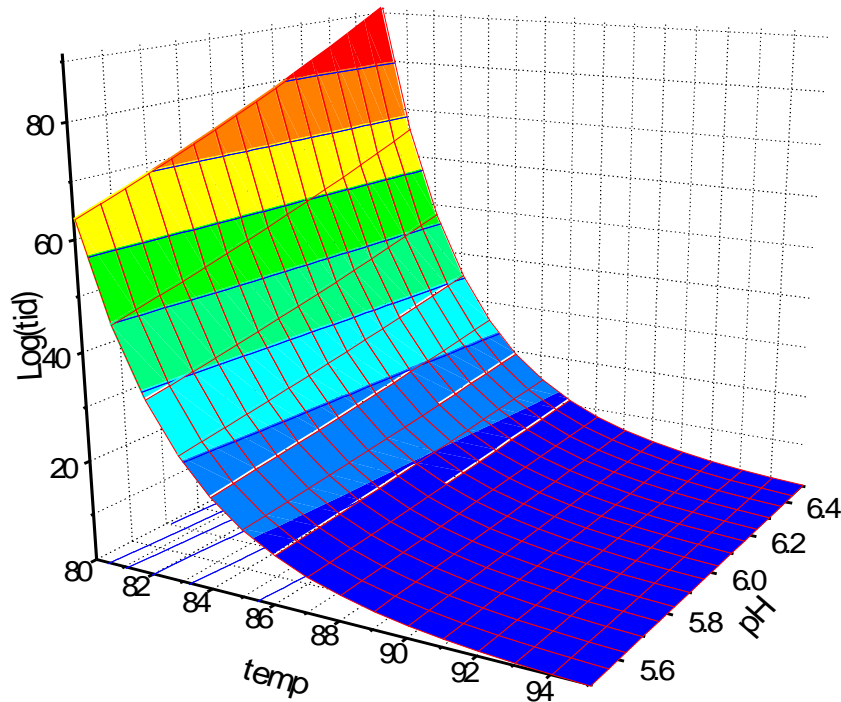






# Reduction of *B. cereus* in broth

sa = 20.000

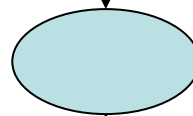
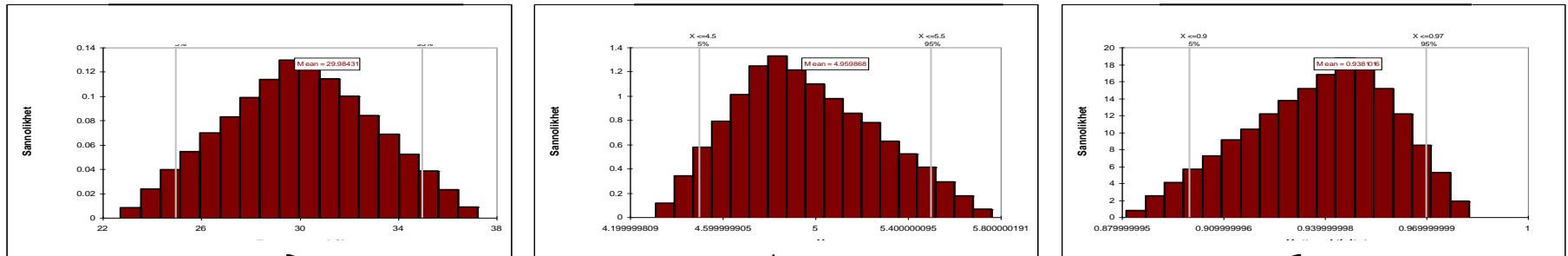


The spores were easier to reduce when:

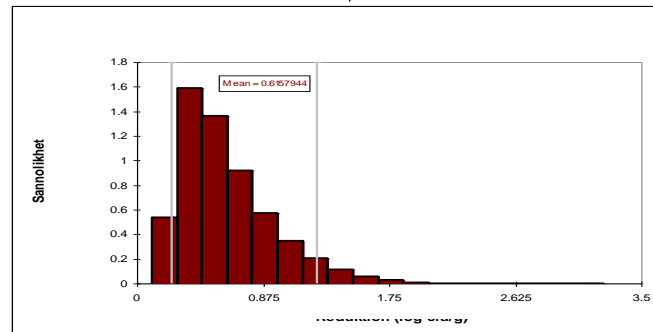
- ↓ pH decreased
- ↓ the salt level decreased

# Probability simulation with @-Risk i Excel

Variations in product/process parameters



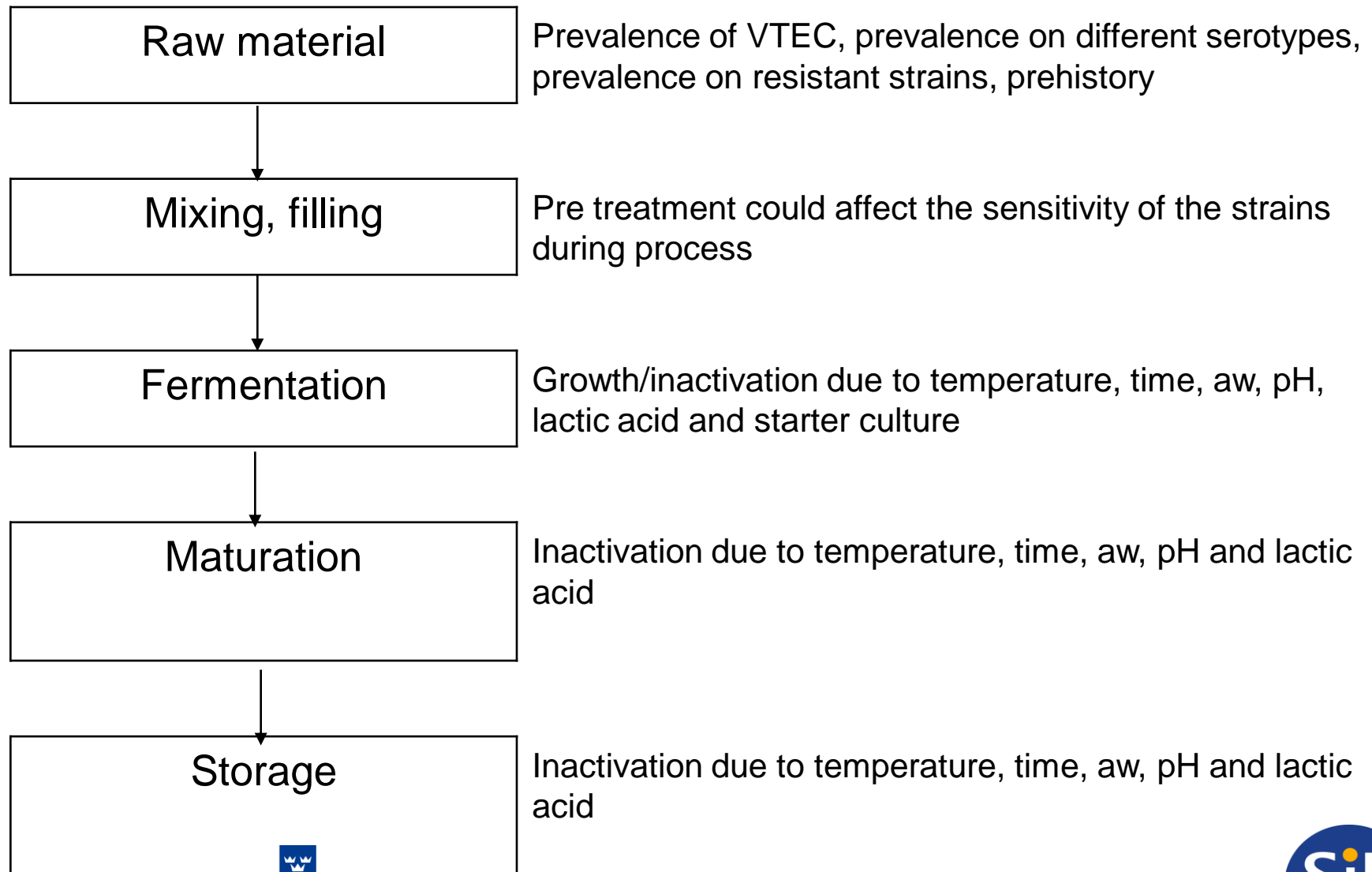
Variations in the final product



# VTEC in fermented sausage



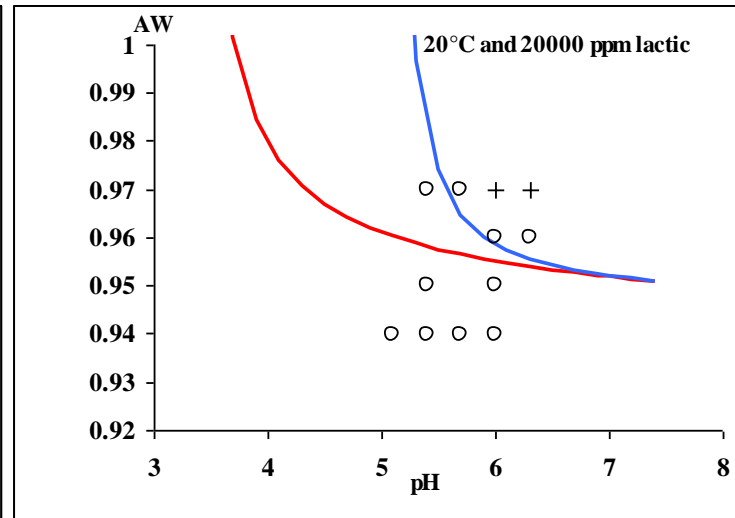
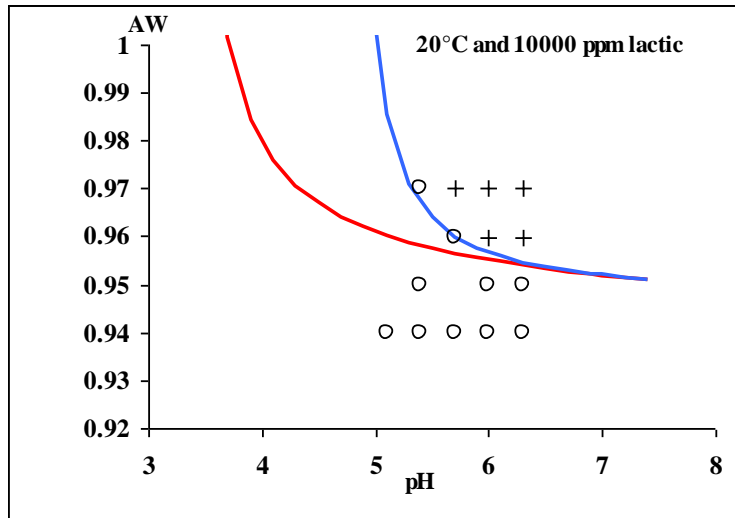
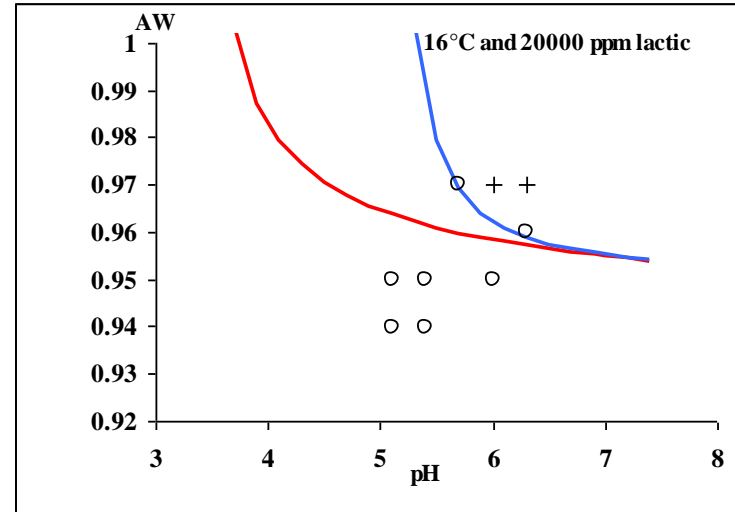
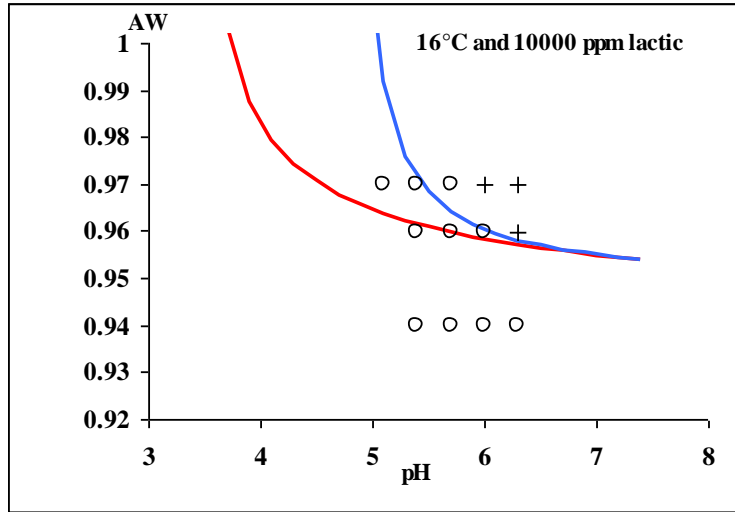
# Process exposure assessment



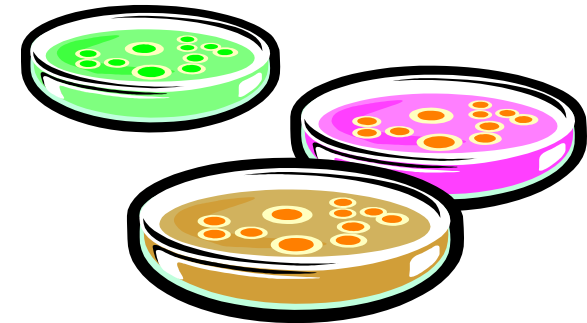
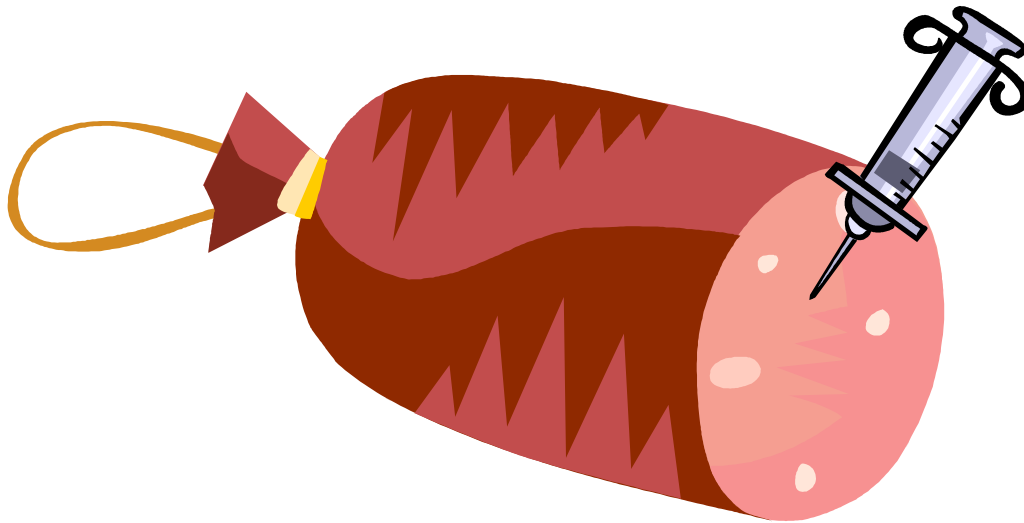


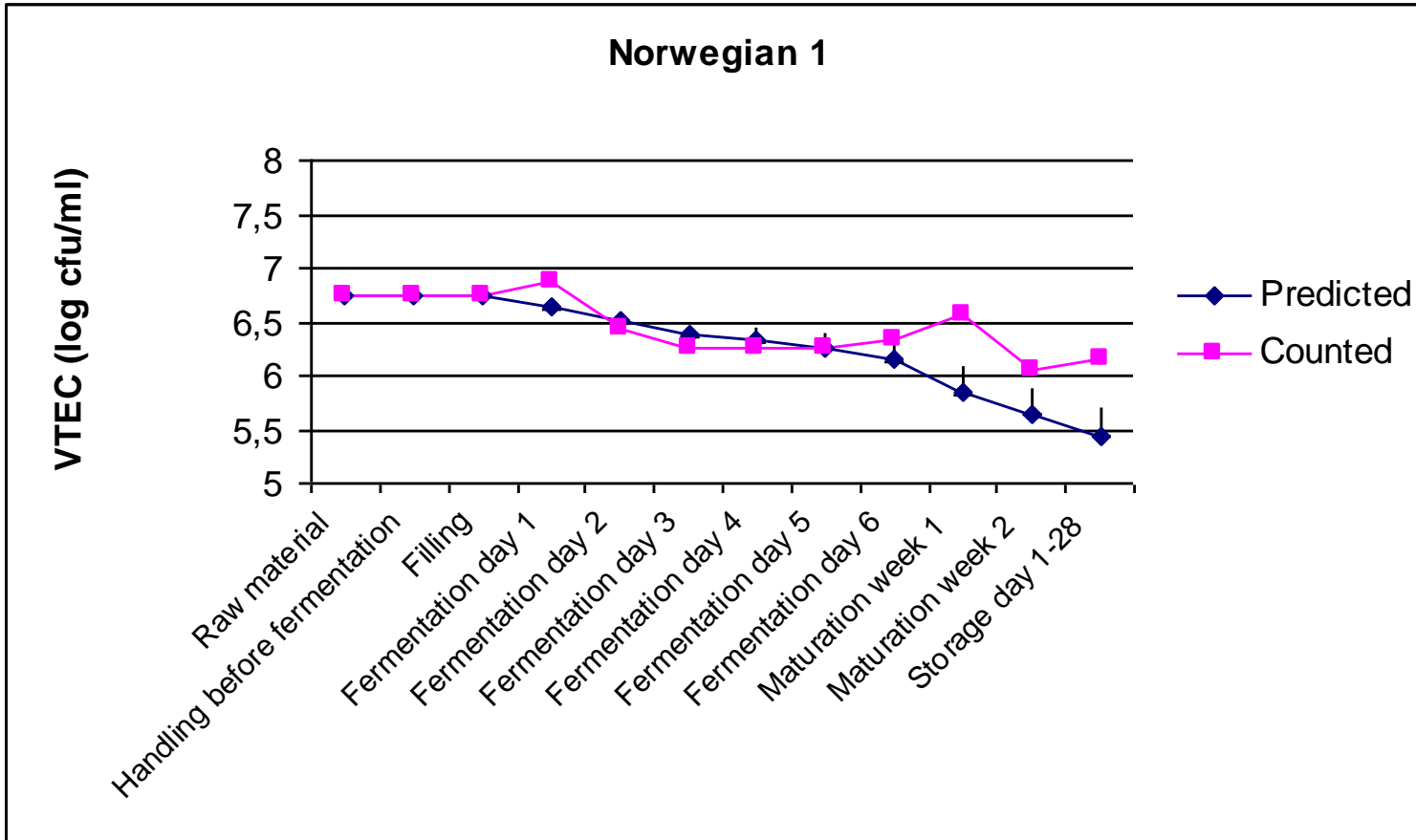
# Models

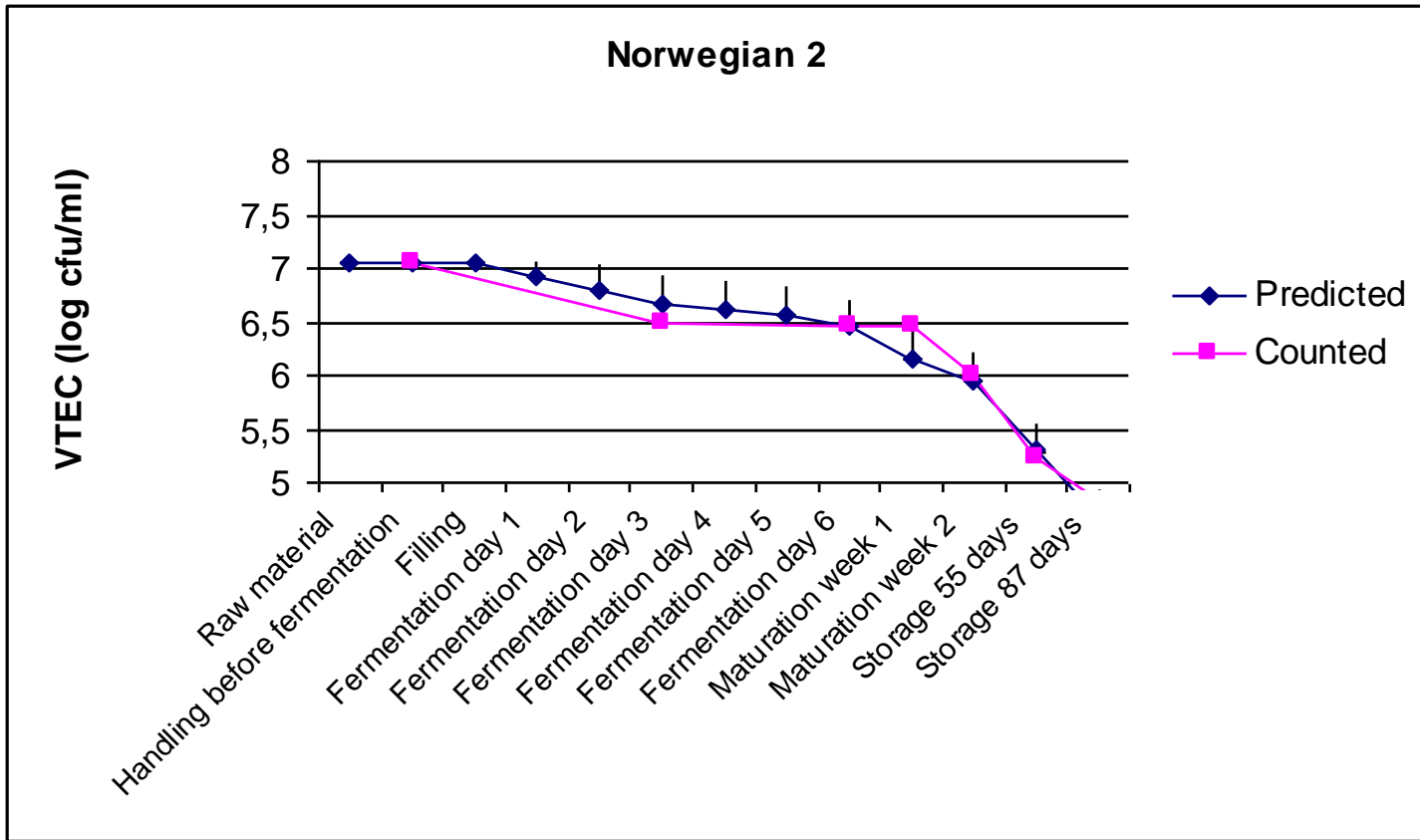
- Probability of growth no growth
  - Temperature
  - pH
  - Lactic acid
  - Water activity
- Growth
  - Temperature
  - pH
  - Lactic acid
  - Water activity
- Inactivation
  - Temperature
  - Lactic acid
  - (pH)

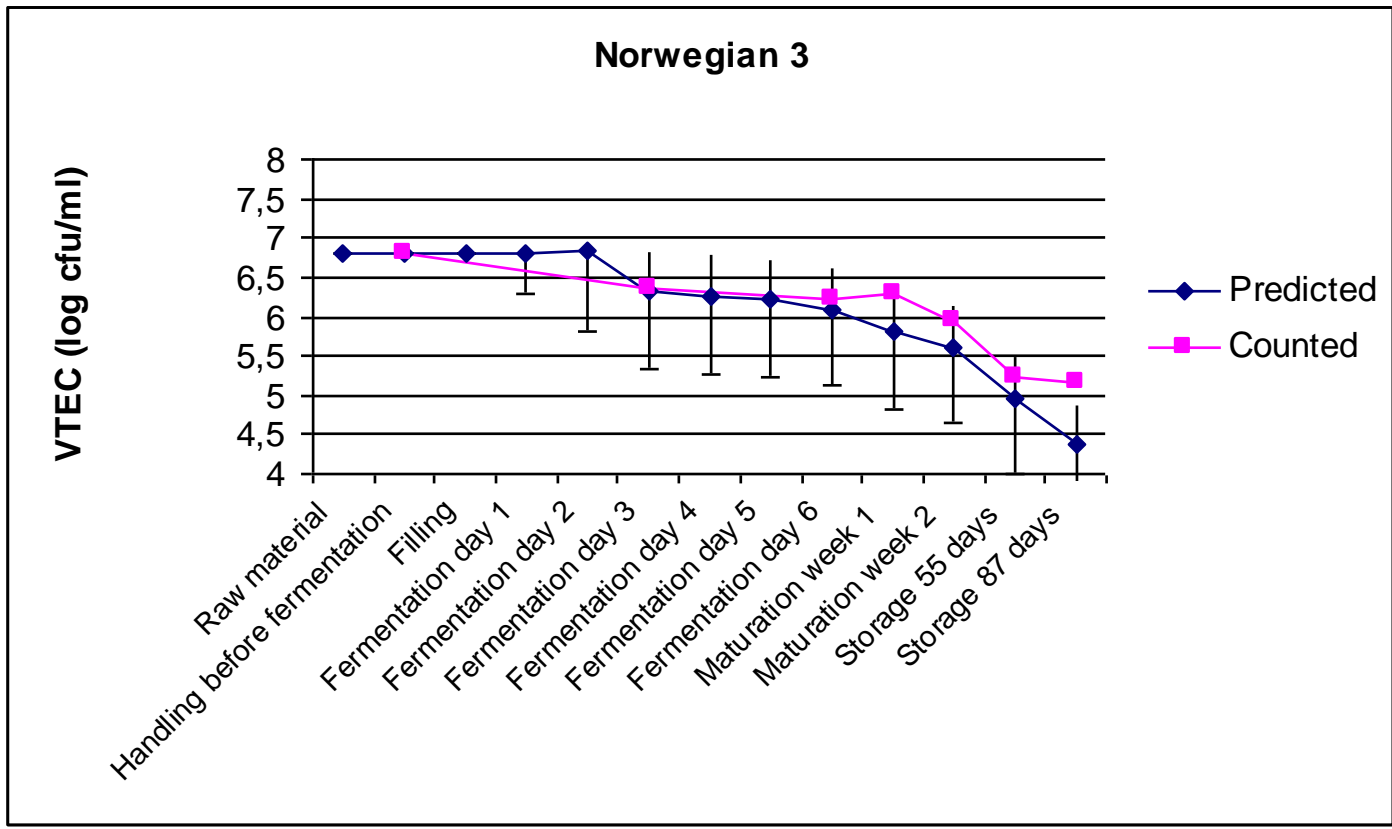


# Challenge test

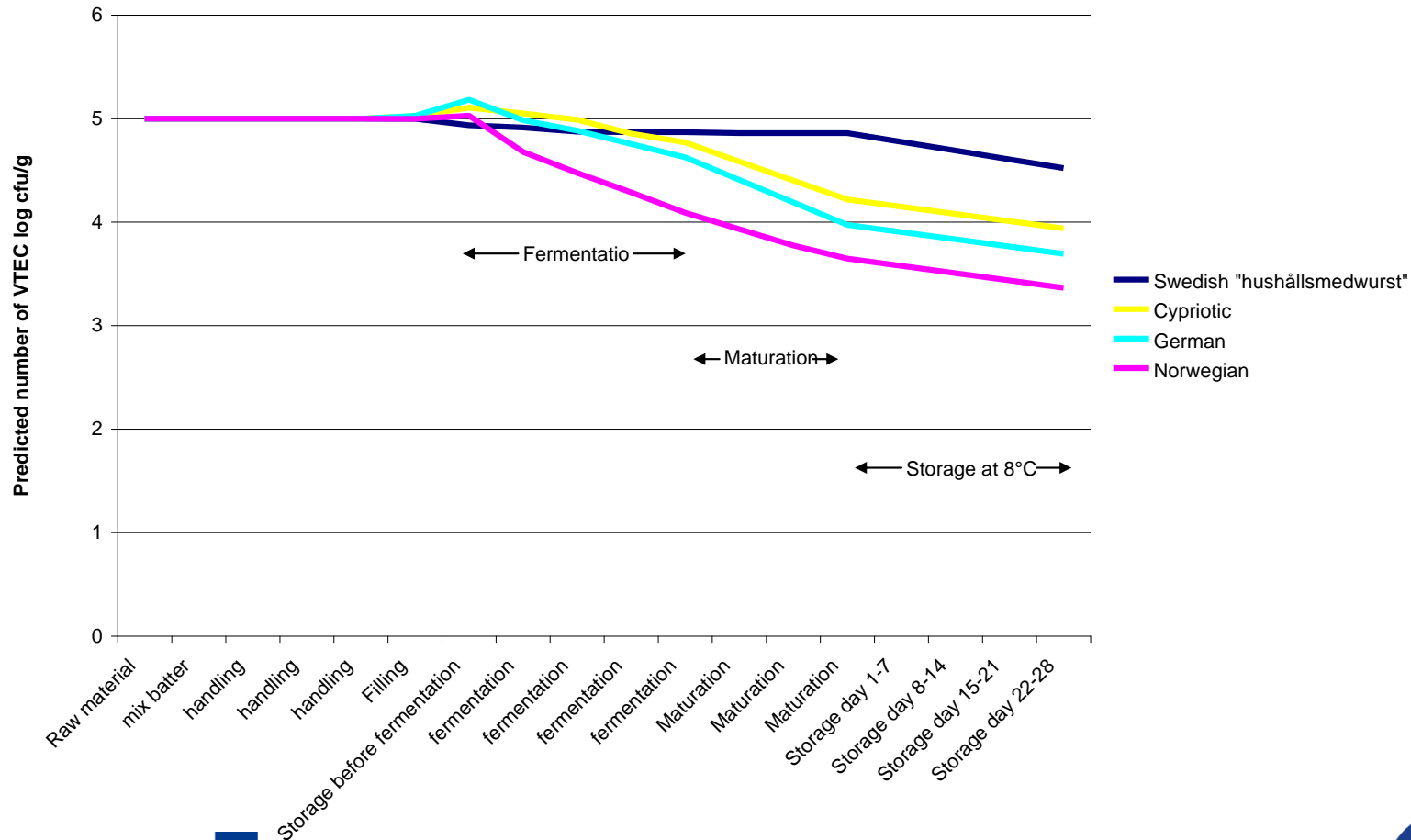








# Predicted number of VTEC along the process chain for 4 type of sausages



# HACCP

- VTEC survives the production of the sausage and are a hazard to control.
- Prevalence of VTEC in raw material important.
- Temperature, water activity, pH, and lactic acid are important factors to control that VTEC does not grow.
- Temperature and process time are important factors to control that VTEC is inactivated.



# VTEC och *Z. bailii* i juice



## Proces

## Effect on microbial hazard

Raw material

Contamination 


Wash

Contamination 

Unshell/press

Contamination 


Storage  
Mixing

Contamination   
Growth



Pasteurisation

Inactivation 

Storage  
Pour into bottles

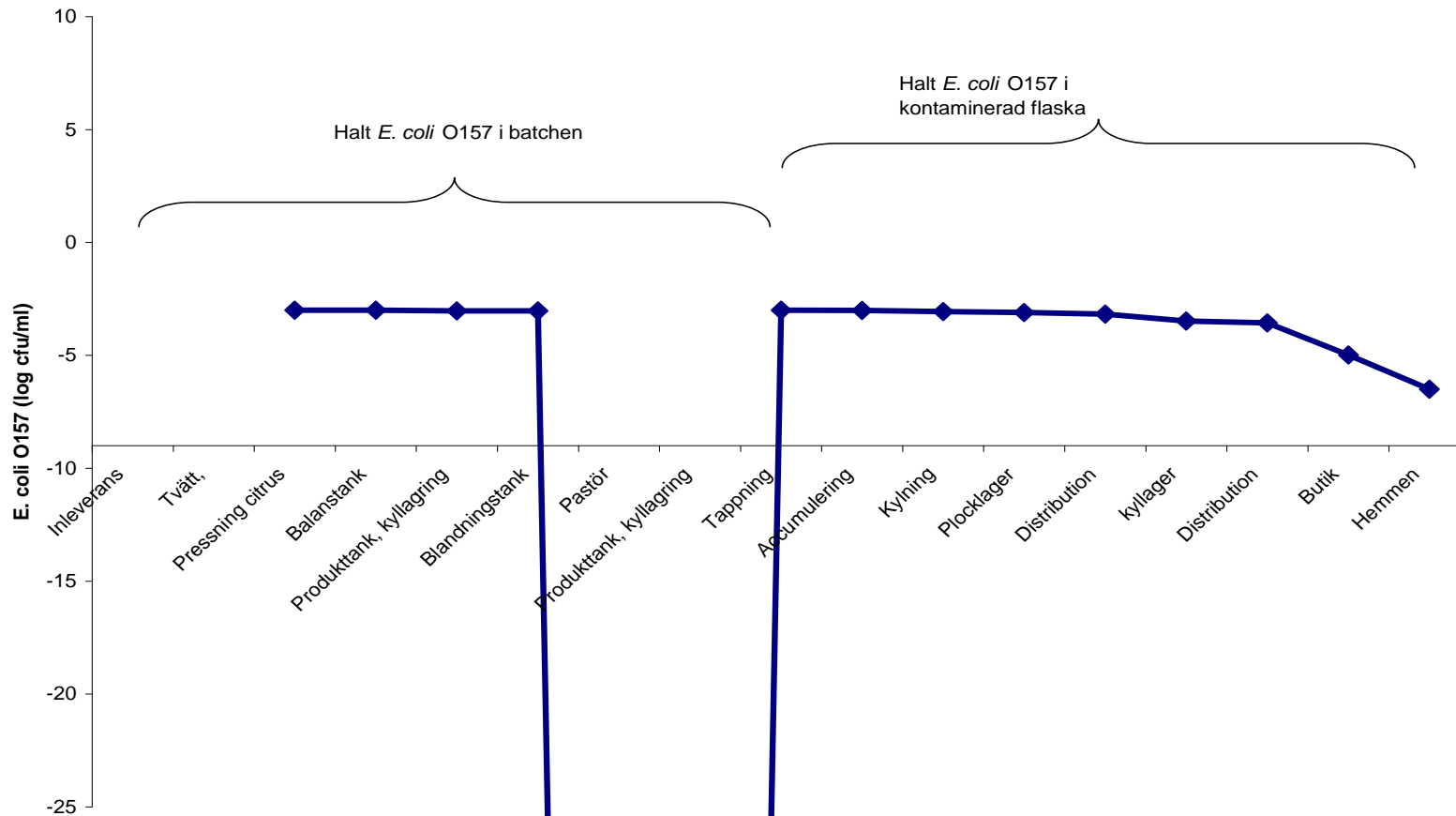
Contamination   
Growth

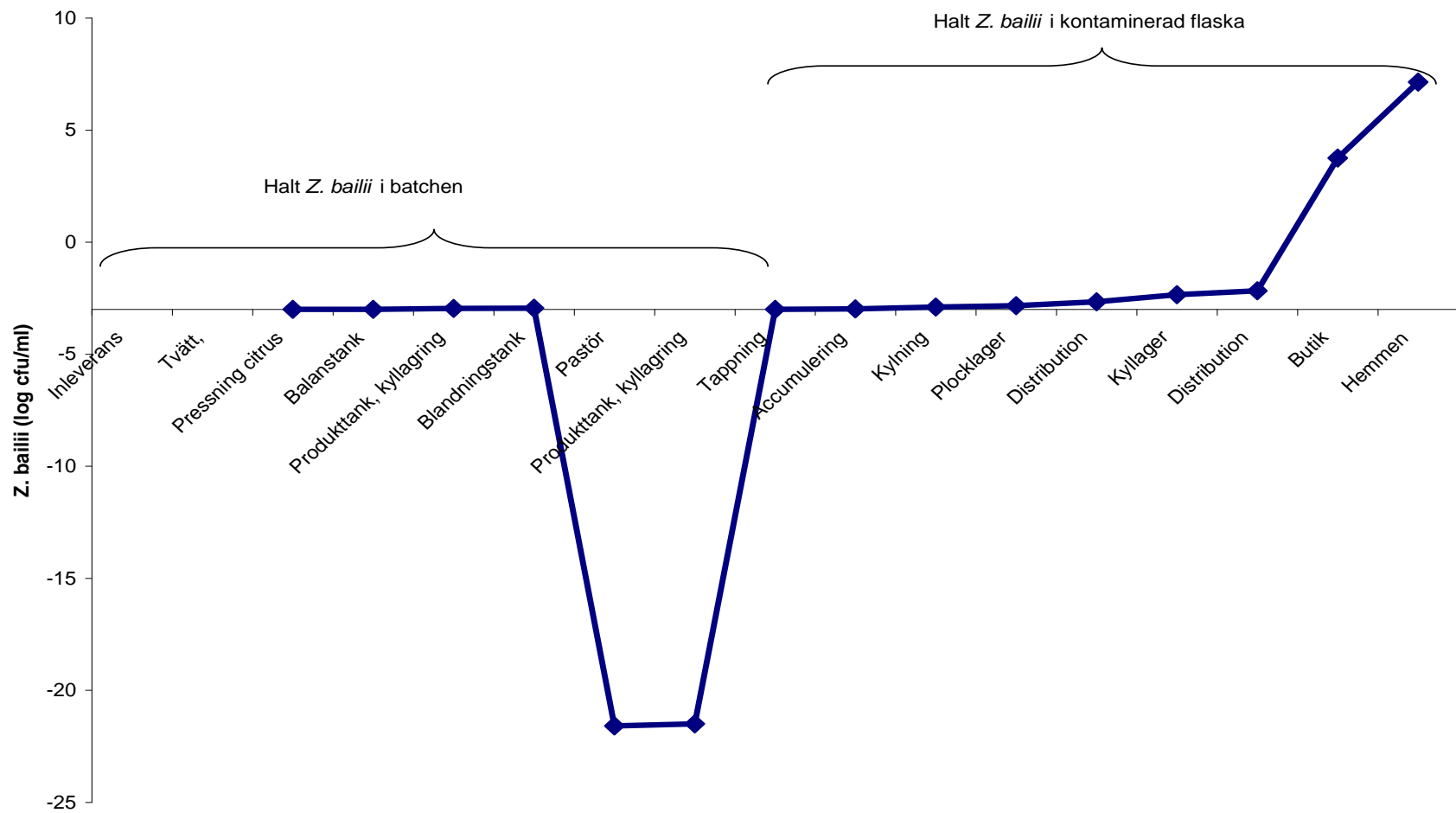
Storage, distributions  
Storage in homes

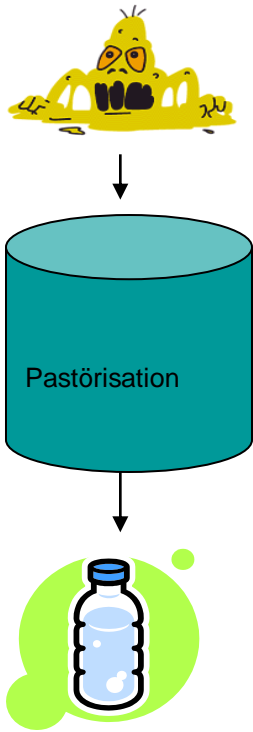
Growth and or inactivation  

# Modeller

- Survival of *E. coli*
  - PMP
- Growth of *Z. bailii*
  - Braun & Sutherland 2004
- Probability of growth of *Z. bailii*
  - Cole et al. 1987
- Heat inactivation
  - Predicting using D-value and z-value







Heat



All bottles  
contaminated

1% of the  
bottles are  
contaminated

$<1/10^{12}$  of the  
bottles are  
contaminated

# Why use predictive microbiology?

- Efficient way to study the effect of a change in one or more parameters. Saves many challenge tests.
- Fast and cost efficient in product development and risk assessment.

## But

- A model is only a model and gives indications, there is variations in microbiological flora, food etc.
- Models are often developed from data origin from a simplified system and the reality is more complex.

# Thank you!

The studies referred to has been funded by SAFEFOODERA  
and VINNOVA