Quality Assurance of Chilled Foods

Kaarin Goodburn MBE
CSci MSc BSc (Hons) FIFST
Chilled Food Association

www.chilledfood.org

University of Leeds
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Summary

- What is Quality and Quality Assurance (QA)?
- Design and Planning for QA of Chilled Foods
- How is QA Implemented and Maintained?
- Brief Overview of Regulations and Other Requirements
- What are Chilled Foods?
- The European Market for Chilled Foods
- Why has the UK been Successful in the Production of Chilled Foods?
- Industry Guidelines for Chilled Foods relating to QA
- Key microbial hazards in relation to Chilled Foods
- Thermal processing
- Predictive modelling
- Physical / Chemical Issues relating to Chilled Food Production
- Auditing QA Systems for Chilled Food Production
- QA on line

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Chilled Foods Quick Facts

- Made in the UK
- >95% (>99%?) retailer own label in the UK
- Multicomponent, prepared
- Hygiene/safety critical
  - Unpreserved apart from chilling
  - HACCP, traceability
- Short shelf life
  - Just In Time (JIT) systems
  - Made on day of despatch to retailer
- Seasonal raw materials
- Year-round supply/production
  - Pan-global sources
  - Specified suppliers meeting UK standards – built-in traceability

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What is Quality?

- All the features and characteristics of a product (or a service) that bears on its ability to satisfy stated or implied needs
  - Fitness for purpose
  - Safety
  - Customer satisfaction

- Related closely to shelf life:
  - The period during which the product maintains its micro safety and sensory qualities at a specific storage temperature

Why Assure Quality?

- **Essential in all Sectors of the Food Industry**
  - Consumer Perceived Quality
  - Safety (Microbiological, Chemical, Physical)
  - Legality
- **Codes of Practice / Good Manufacturing Practice Guidelines**
  - E.g. CFA, IFST
- **Control Systems and Recognised Standards**
  - BRC, IFS, ISO, BSI, SALSA

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What is Quality Assurance?

- **A series of planned actions required to provide the customer with a product they expect**

- **Proactive process**
  - attempts to prevent errors (i.e. right first time)
  - uses HACCP to identify areas of concern
  - correct control points evaluated
  - corrective actions put in place
  - documentation to support all this

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Implementing QA

- **3 main components in the Quality Assurance Process:**
  - The specification (i.e. what has to be done)
  - The documented instruction (i.e. how it is to be done)
  - The recording system (i.e. that it has been done)

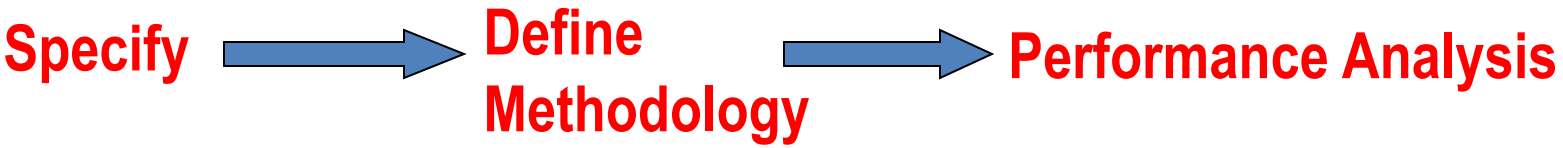
Design and Plan for Quality Assurance

1. Raw Material Specification
2. Ingredients Formulation
3. Processing Equipment and Environment
4. Processing Methods and Conditions
5. Intermediate Specifications
6. Appropriate Labelling Specifications
7. Specifications for Quantity per Pack
8. Specifications for Management and Control Procedures
9. Specified Distribution System and Cycle
10. Appropriate Storage, Handling & Distribution Instructions

Quality Assurance on Line

- Ingredient Specification Checks (Ingredients? Correct percentages? Packaging?)
- Process Checks (hygiene at start up? pH? Temperature?)
- Foreign Body Controls
  - Plastic – blue colour, debox
  - Metal – filters, sieves, metal detection
  - Bone – filters, sieves, X ray
  - Wood – elimination (pallets, boards, utensils)
- Intermediate Product Checks
- Finished Product Attributes (Micro? Chemical? Physical? Size? Weight? Sensory Attributes?)

The QA Process



Define Quality Criteria
ingredients
end product
identify hazards

Documented System for achieving specification

In-built through process.
minimal reliance on end product testing

Performance loop (modification)

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European Regulatory Framework

- **Instruments:**
  - Regulations
    - Come into force in all Member States immediately on publication
  - Decisions
    - Binding on parties e.g. Member States, companies
  - Directives
    - Require implementing into national law via national legislation

General Food Law Principles, EFSA (178/2002)

- General food law & food, feed safety principles:
  - HACCP
  - Farm to table
    - Responsibility of feed manufacturers, farmers, food operators
    - Traceability of feed, food and its ingredients
  - Risk analysis (assessment, management, communication)
  - Application of the precautionary principle, if appropriate
    - if an action or policy has a suspected risk of causing harm to the public or to the environment, in the absence of scientific consensus that the action or policy is harmful, the burden of proof that it is *not* harmful falls on those taking the action
- European Food Safety Authority (EFSA)
  - Risk assessment-based advice and information to the EC
  - Hub for EU/national scientific committees, provide peer review
  - Run Rapid Alert System for Food and Feeds (RASFF)
    - http://ec.europa.eu/food/food/rapidalert/rasff_portal_database_en.htm

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Other Issues

- Labelling
  - 'Use by' dates: Food Labelling Directive (since 1979)
  - 'Fresh': some national rules and guidance
  - Dietary information
  - Weights / volumes
  - Food Information Regulation coming into force
- Microbiological Criteria (Regulation 2073/2005/EC)
  - Role in HACCP – verification monitoring
  - Food Safety and Process Hygiene Criteria
  - *L. monocytogenes* Food Safety Criterion
    - limit 100 cfu/g if evidence to substantiate shelf life
  - Methodology harmonisation
    - Sampling dependent on each criterion
    - Inherent variability – lab procedures & methods (humans), certification issues
    - Unsuitable methods – interference by food components

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Quality Assurance and The Law

- **Food Safety Act 1990 – 'Due Diligence Defence'**
- **Criminal Offence to be found guilty**

'***it is a defence to prove that the person / company took all reasonable precautions and exercised all due diligence to avoid…'***

means that onus lies on the person or company being charged.

The burden of proof is then discharged on a balance of probability. Therefore it is essential to eliminate risks in any food processing operation

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Chilled food:

A prepared food that
for reasons of safety and/or quality
is designed to be stored
at refrigeration temperatures
(at or below 8°C)
throughout its entire life


What Are Chilled Foods?

What are Chilled Foods? UK NPD Chronology

1960s	1970s	1980s	1990s	2000s
sliced meats	dressed salads	recipe dishes	non-dairy desserts	accompaniments
pies	dairy desserts	quiches	dips	speciality breads
		flans	salad dressings	sushi
		sandwiches	sauces	luxury meal kits
		pizzas	stocks	stir fry kits
		ethnic snacks	prepared fruit	
		pastas	prepared veg	
		soups	leafy salads	
			sandwich fillings	

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European Chilled Ready Meals Market

- 2006 Survey by Leatherhead Food International:
  - UK, France, Germany, Italy, Spain, Ireland, Belgium, NL.
  - Ready meal = recipe dishes, flans, pizzas, fresh pasta, sandwiches, breaded products, soup, sauce, chilled pastry
  - Total value 15 billion Euros
  - UK market value was 8 billion Euros (54%)
- UK market 16 billion Euros in 2012
  - 2000% growth 1989-2012

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Basis of UK Industry's Success

- **Massive investment in hygiene & technology**
  - 1970s secure chill chain: UK target 5°C
  - Factory design and layout: area segregation (GMP/LRA, HCA, HRA)
  - Process design and control: 6D heat processes
  - Safety and traceability: 'farm to fork' whole chain approach
  - Generally, short shelf lives: 1-10 days
  - HACCP + best practice: industry (CFA) guidance
  - Quality Systems: Manufacturer/retailer partnerships
  - Systems integration: Forecast/orders/manufacturing/distribution
  - Just in time: Generally, no stock & minimal raw materials held at plants
- **Rapid distribution over short distances**

➔CONTROL as foundation for innovation

Key CFA Guidelines

- **Primary production**
  - Microbiological Guidance for Growers
  - Pesticides Due Diligence
  - Veterinary Residues Management Guidance
- **Factory**
  - Best Practice Guidelines for the Production of Chilled Food
    - Covers all chilled prepared foods: www.tsoshop.co.uk/chilledfoods
    - Basis of European Chilled Food Federation Recommendations
    - Earlier editions drove BRC standards creation => Global Food Safety Initiative
  - Hygienic Design Guidelines
  - Multicultural Hygiene Training
  - Produce washing protocols
- **General**
  - Water Quality Management Guidance
  - Guidance on the use & interpretation of microbiological testing
  - Guidance on the Practical Implementation of the EU Micro Criteria Regulations (FSA-endorsed CFA/BRC)
  - Lm and shelf life guidance (CFA/BRC/FSA)

CFA Guidelines (2006)

- **Full title** ‘CFA Best Practice Guidelines for the Production of Chilled Foods’
- **Coverage**
  - Main Hazards
  - Control measures
  - HACCP systems
  - Shelf life assessment
  - Decision tree for minimum hygiene status
  - Regulatory requirements
  - Traceability
  - Product recall

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CFA Guidelines - Hygiene Areas

Key concern: CROSS CONTAMINATION!

- **Low Risk (or GMP) Area**
  - raw ingredients/components, packed final product
  - Ready to Cook (RTC) foods
- **High Care Area – foods ready to eat or reheat**
  - raw + cooked composite products
  - aim is to minimise contamination
- **High Risk Area – foods ready to eat or reheat**
  - fully cooked ingredients/products only (6D process)
  - aim is to prevent contamination

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HACCP of Chilled Foods

- Essential to understand
  - the microbiology
  - thermal processing and
  - packaging of the product
- Each product will be different
- Need to use CFA Decision Tree to determine hygiene area/s required for manufacture
- Need to keep up to date with technical publications (e.g. legislation, microbiology)
- Need to review processes at each new development

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Know Your (Microbial) Enemies

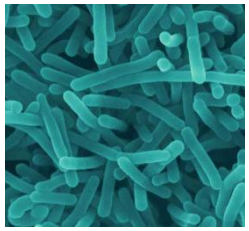
- Key pathogens
- Hurdle technology
- Predictive modelling

Microorganisms to Consider with Chilled Foods

Environmental and zoonotic pathogens, e.g.

• **Prepared Salads**	E.coli, Salmonella spp , L.monocytogenes.
• **Raw Minced Meat**	ACC, Enterobacteriaceae, E.coli, E. coli O157.
• **Smoked Fish (cold smoked)**	ACC, Enterobacteriaceae, E.coli, Salmonella spp, Listeria spp, L. monocytogenes, S.aureus, Clostridia spp.
• **Cooked Meat Product**	ACC, Enterobacteriaceae, E.coli, Clostridia spp.
• **Cooked Meat Product with Rice**	ACC, Enterobacteriaceae, E.coli, Clostridia spp, Bacillus spp
• **Cheese Sandwich**	Enterobacteriaceae, E.coli, S.aureus, Salmonella spp, Listeria spp, L.monocytogenes.
• **Sous Vide Recipe Dish**	ACC, Enterobacteriaceae, E.coli, Clostridia spp.

Listeria monocytogenes



Rod shaped bacteria. Cause infectious food poisoning.
Found in RTE foods, especially dairy (raw milk, blue-veined cheese), RTE fish & meat
Targets pregnant women/unborn babies, elderly, immunocompromised.
High death rates.

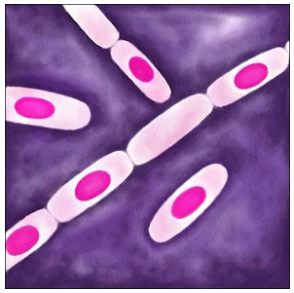
Symptoms	Fever, muscle aches, nausea, diarrhoea, headache, stiff neck, meningitis, convulsions, stillbirth, septicaemia
Onset time	3-70 days
Duration of illness	5-10 days
Destroyed	**70°C for 2 mins (6 logs)**

Clostridium botulinum

Rod-shaped bacteria. Produce most potent toxin known.
Found in foods not heated before eating, low acid foods.
Targets all age groups. High death rates.

Symptoms	Difficulties in breathing, paralysis of the cranial nerves
Onset time	12h-5 days
Illness duration	Months - can lead to death
Destroyed	121°C for 3 mins (12 logs)(proteolytic/mesophilic) **90°C for 10 mins (6 logs) (non-proteolytic/psychrotrophic)**

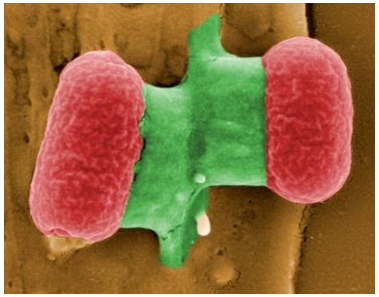
Bacillus cereus



Rod-shaped spore-forming bacteria.
Cause toxic food poisoning.
Found in rice, cereal products and other starchy foods e.g. potatoes, pasta.
Targets all age groups

Symptoms	Abdominal pain, vomiting
Onset time	1-7 hours
Duration of illness	Less than 24hrs
Destroyed	Heating above 126°C for 90 mins
Control	High quality raw materials, rapid cooling

Toxigenic E. coli



Cause infections and toxic food poisoning.
Found in sewage, manure, raw foods e.g. minced beef, fresh produce.
Targets infants and the elderly in particular, depending on strain

Symptoms	Bloody diarrhoea, abdominal pain, nausea, kidney damage
Onset time	12-24 hrs
Duration of illness	1-5 days
Destroyed	70°C for 2 mins

Thermal Processing

The required thermal process depends on:

- The thermal resistance of the microorganisms in the food
- The food's
  - initial microbial loading
  - pH, Aw
  - physical state (e.g. frozen, particle size)
  - desired shelf life

Lm Control: Thermal Processing

- ***Listeria monocytogenes*** **- The most heat-resistant vegetative pathogen of relevance in chill**

- **Destroying Lm destroys all other vegetative pathogens, e.g.**
  - **Salmonella**
  - ***E coli***
  - ***Campylobacter***
  - ***S. aureus***

- **6-log reduction is standard in the EU:**
  - **For short shelf life foods (<10 days)**
  - **Minimum process equivalent to 70°C for 2 mins**

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Sporeformer Control: Thermal Processing

- Sporeformers survive 70°C/2 mins and need to be controlled, e.g.
  - Non-proteolytic *Clostridium botulinum*
  - Psychrotrophic *Bacillus cereus*

- Control through
  - Enhanced thermal process, e.g. 90°C/10 mins equivalent (6 log reduction of non-proteolytic *Cl. botulinum*) or
  - Formulation (pH<5.0 or Aw 0.97 (or combination) throughout the food) or
  - Storage guaranteed at no more than 3°C, or
  - Restricted chilled shelf life (10 days maximum)

  - Rapid post-process chilling (*B. cereus*)

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Thermal Process - Example Quiche

SUSSLEtT 17 8 11 - Microsoft Excel

File | Home | Insert | Page Layout | Formulas | Data | Review | View

Cell C8: Quiche

SUSSLEtT - Effective heating times for thermal processes

A thermal process is defined by a set of time-temperature pairs and is modelled as a set of slopes. Effective processes are evaluated with a linear model for inactivation and a single z-value. Results are effective times for a process at fixed temperature (times are in minutes and temperatures in Celsius).

Dataset A: Quiche

Dataset B: No selection

Temperature (C): 70

z-value (C): 8

Add Dataset

Remove Dataset A

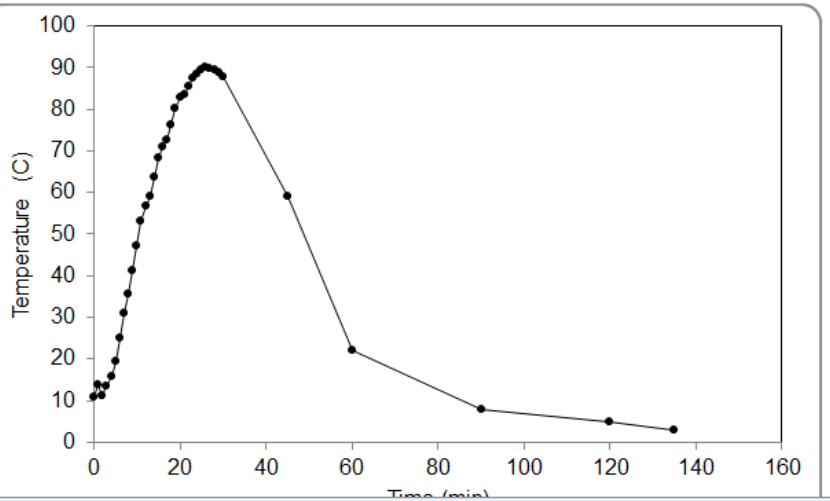
About SUSSLEtT

Exit

Dataset A		Dataset B	
Time	Temp	Time	Temp
0	10.9		
1	13.9		
2	11.2		
3	13.6		
4	15.9		
5	19.4		
6	25.2		
7	30.9		
8	35.6		
9	41.2		
10	47.2		
11	53.3		
12	56.7		
13	59.1		
14	63.8		
15	68.3		
16	70.9		
17	72.6		
18	76.4		
19	80.3		
20	83		
21	83.6		
22	85.6		
23	87.4		
24	88.6		
25	89.6		

Equivalent process for Dataset A	**2343.66 min at 70.0C** Npts = 36, Max(T) = 90.1C
Equivalent process has range	1807.61 - 4877.49 min at 70.0C
Estimated hold for Dataset A	5.0 min at 89.4C (Interval 25.0 - 30.0 min)
Estimated hold (pre, post)fraction	56.8% (30.0, 13.3) of full process

No data selected



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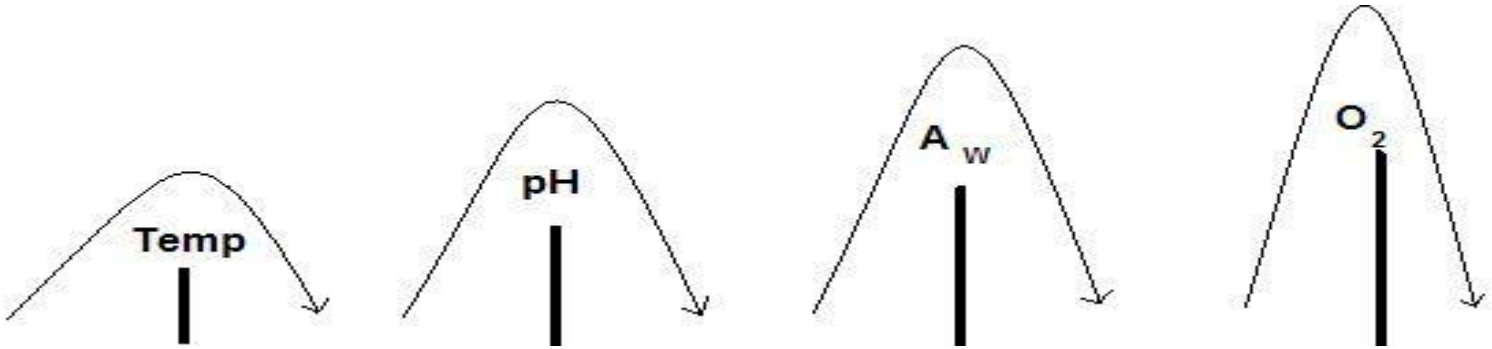
Item collected.

Hurdle Technology

- Understanding microbial growth/growth limits can be used to preserve food without using severe processes



- Each hurdle "costs" the microbe energy
- Combined hurdles, e.g. low pH, low Aw, low temperature can heighten the overall effect of one hurdle, e.g.
  - Sodium nitrite + salt to preserve cooked meats
  - MAP + chill

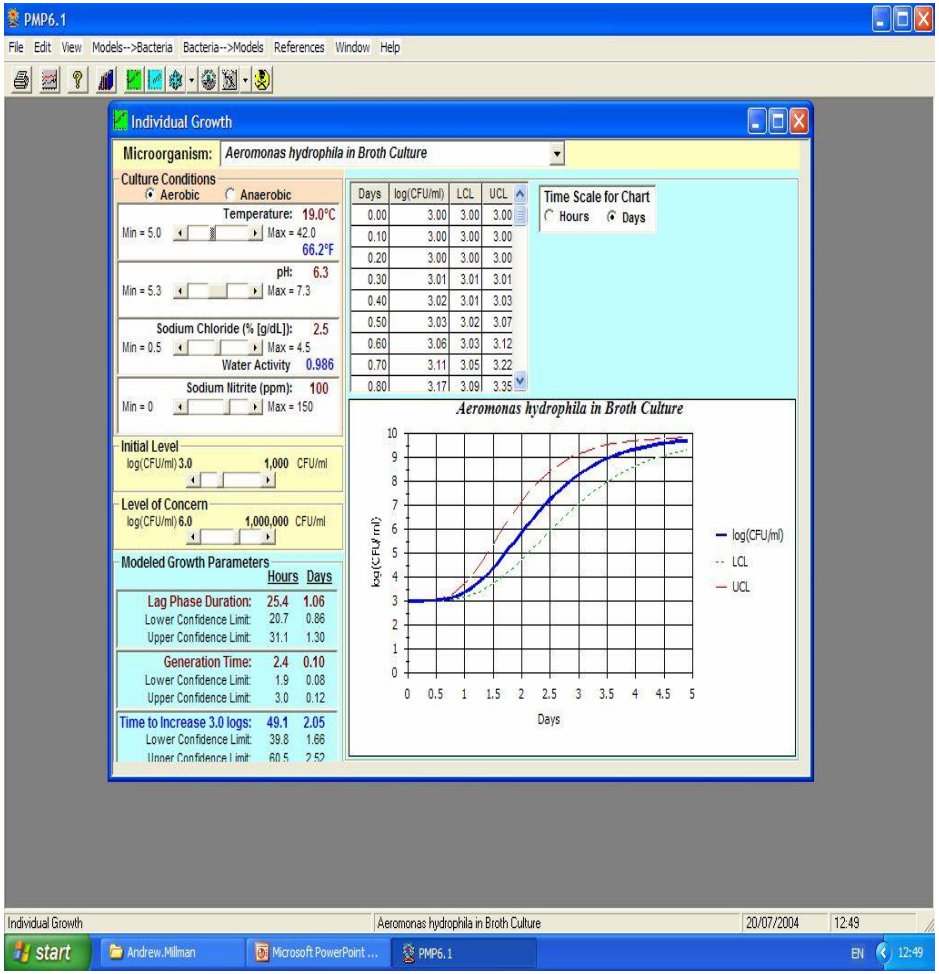
Pathogen Growth Boundaries

Microorganism	Min temp (°C)	Min pH	Min Aw	Aerobic / anaerobic
L. monocytogenes	**-0.4[1]**	**4.3**	**0.92**	**Facultative**
B. cereus	4	4.5	0.93[1]	Facultative
Campylobacter jejuni	32	4.9	0.99	Microaerophilic
Cl. botulinum Mesophilic/proteolytic	10-12[1]	4.6	0.93	Anaerobic
Cl. botulinum Psychrotrophic/non-proteolytic	**3.3**	**5.0**	**0.97 (5% NaCl)**	**Anaerobic**
Cl. perfringens	12[1]	5.5-5.8[1]	0.935[1]	Anaerobic
E. coli O157:H7	6.5	4.5	0.95	Facultative
Salmonella	6	4.0	0.94	Facultative
Staphylococcus aureus	5.2	4.5	0.86	Facultative
V. parahaemolyticus	5	4.8	0.94	Facultative
Y. enterocolitica	-1.3[1]	4.2	0.96	Facultative

[1] *Microorganisms in Foods. Vol. 5. Microbiological Specifications of Food Pathogens*. (1995), ICMSF, Blackie Academic & Professional *ACMSF Report on Verocytoxin-Producing* E coli (1995), HMSO, London, ISBN 0-11-321909-1.

Modelling Hurdle Technology - ComBase

- Develop combinations of hurdles through trial and error or using modelling programs
- Inputs:
  - Food characteristics (pH, Aw)
  - Food storage temperature
  - Organisms of concern
- Outputs:
  - Growth curve
  - Lag phase
  - Generation (doubling) time
  - Time to increase to x logs
- www.combase.cc



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Modelling Hurdle Technology

- Predicts organism growth under the defined conditions
- Adjust parameters to limit growth and extend shelf life
- Allows “safe” decisions to be made about food and a new process
- Cost effective – no costly plant trials to complete

- REQUIRES TRAINING TO INTERPRET

- MUST USE VALID (REAL) STORAGE TEMPERATURES

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Let’s Do Some Modelling!

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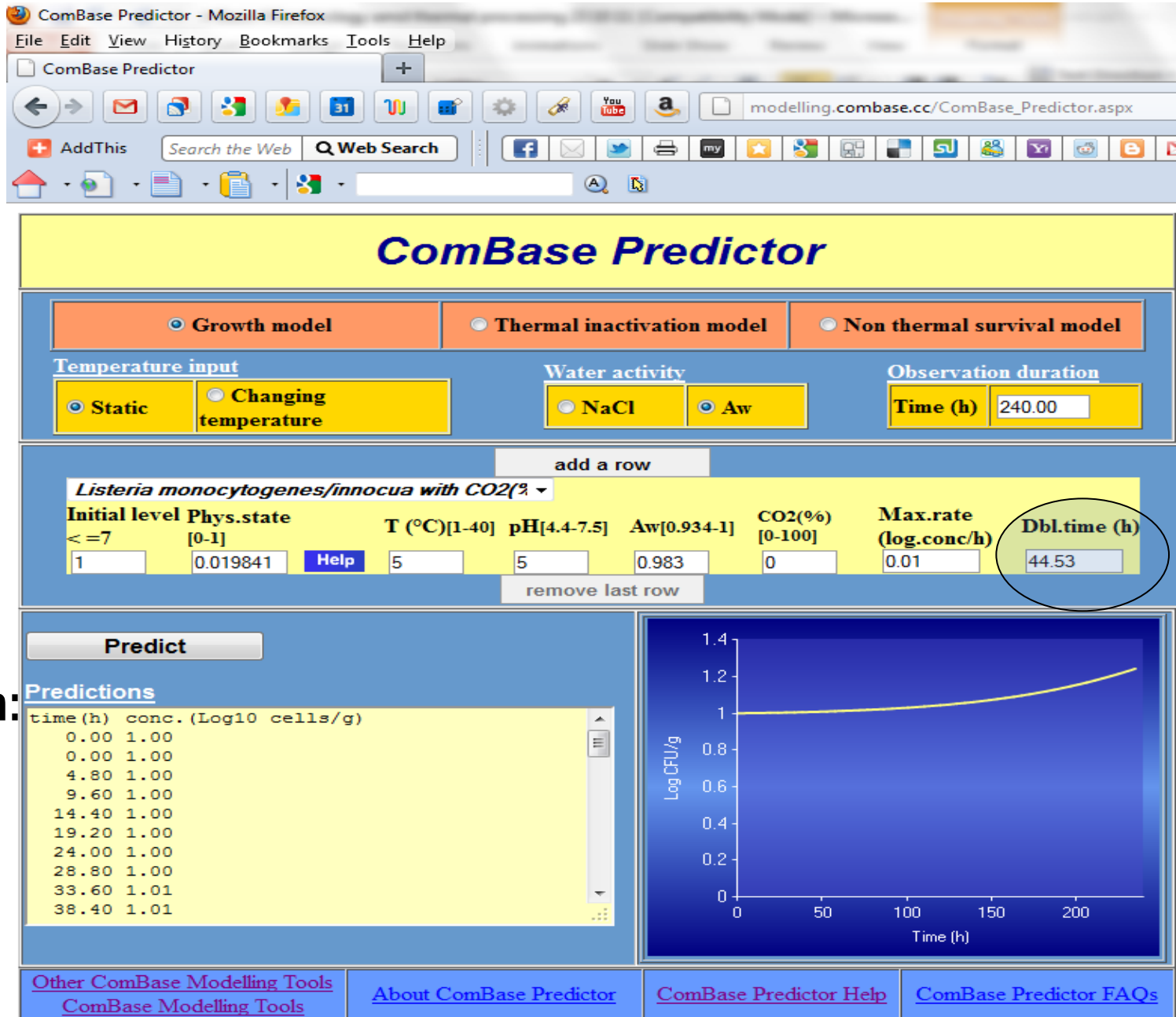
Predictive Modelling Examples

- *Listeria monocytogenes* growth
- Three real foods:
  - pH 5.0, Aw 0.983
  - pH 5.8, Aw 0.990
  - pH 6.6, Aw 0.985
- Stored at a constant:
  - 5°C
  - 8°C

Lm Growth Modelling #1, 5°C

- pH 5.0
- Aw 0.983

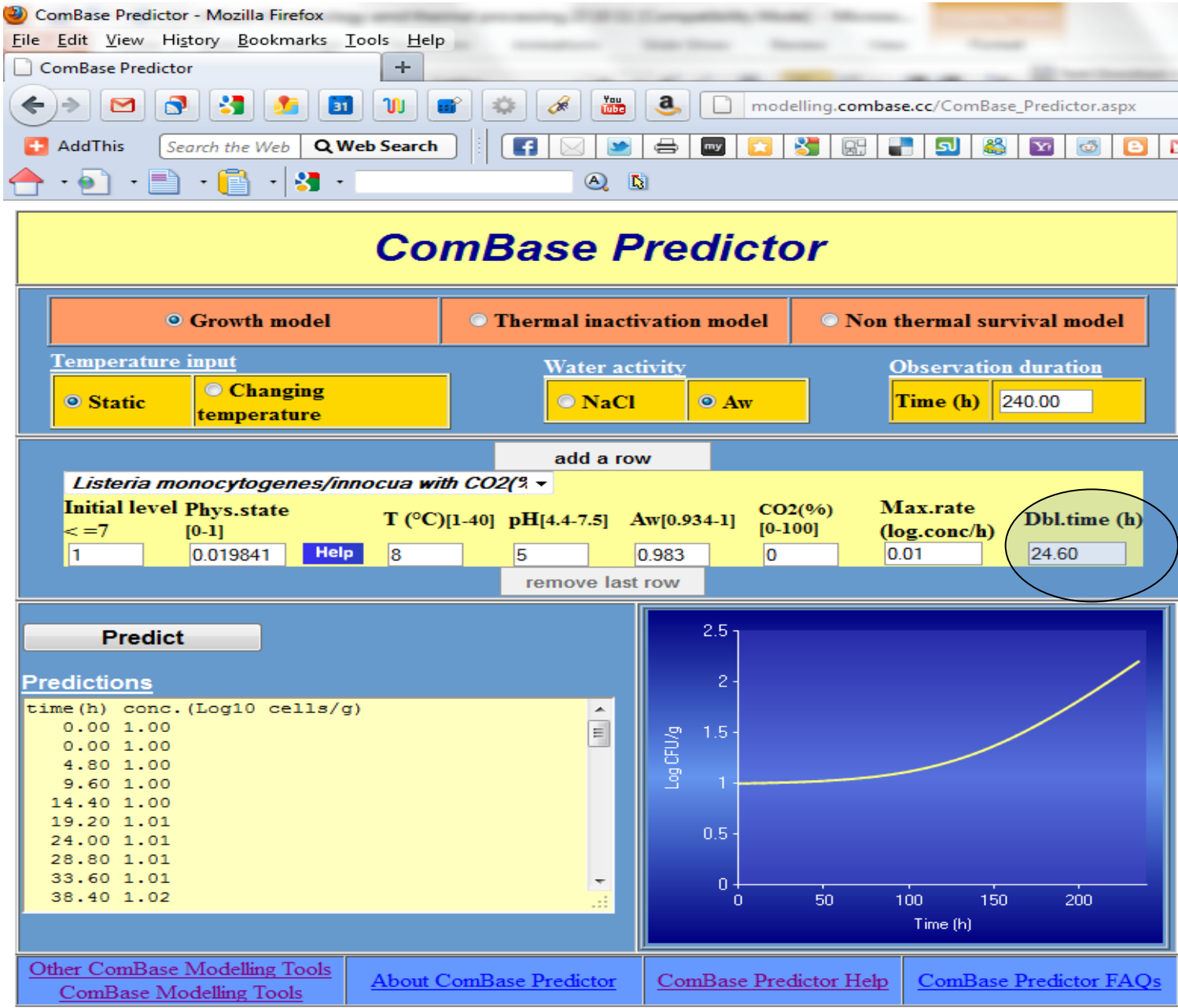


1-log increase in:
>240h/>10d

But must consider spores!

Lm Growth Modelling #1, 8°C

- pH 5.0
- Aw 0.983

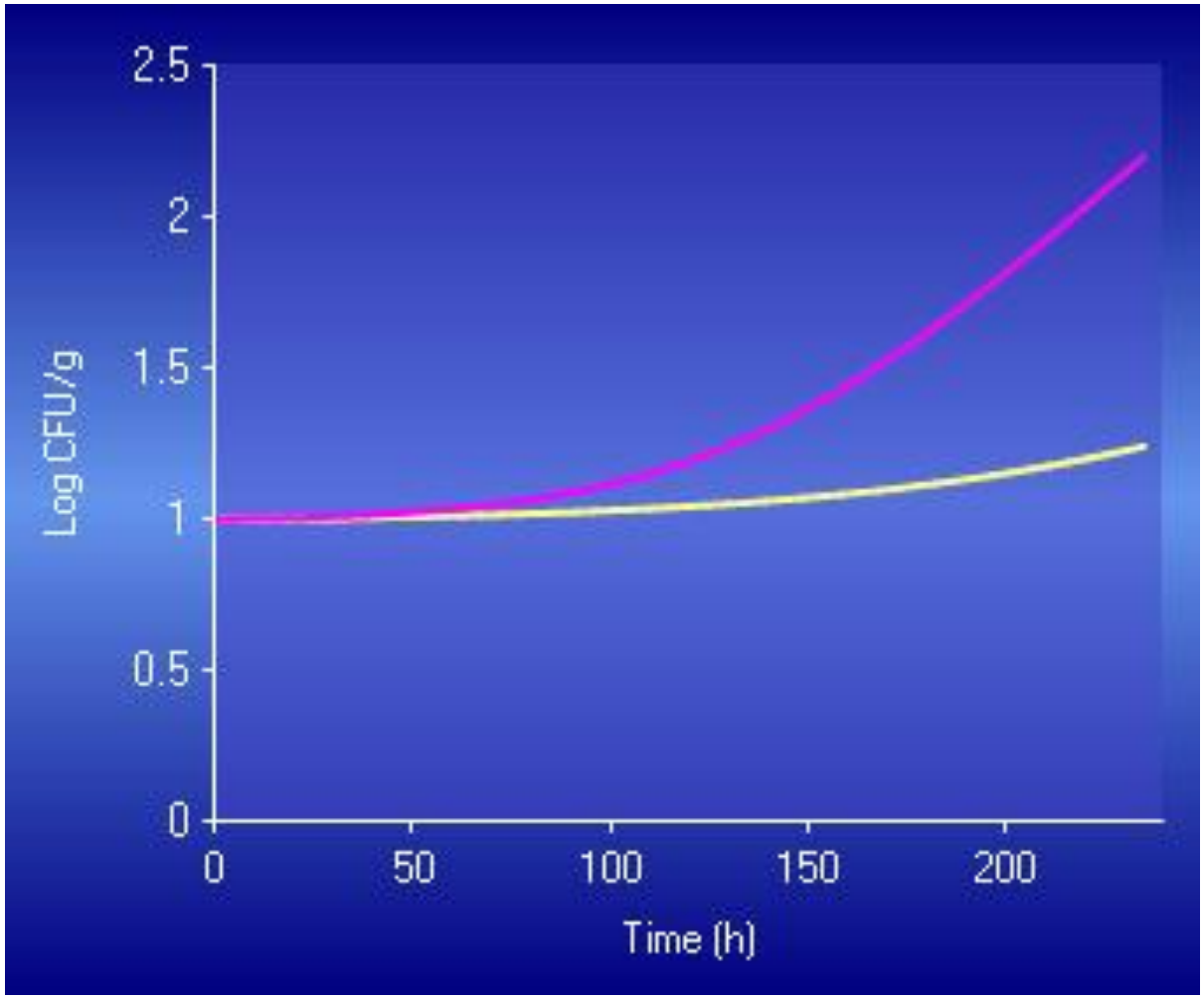


1-log increase in:

~110h/4.5d

Lm Growth Modelling #1

- pH 5.0, Aw 0.983



8°C
Doubling time 24.6h

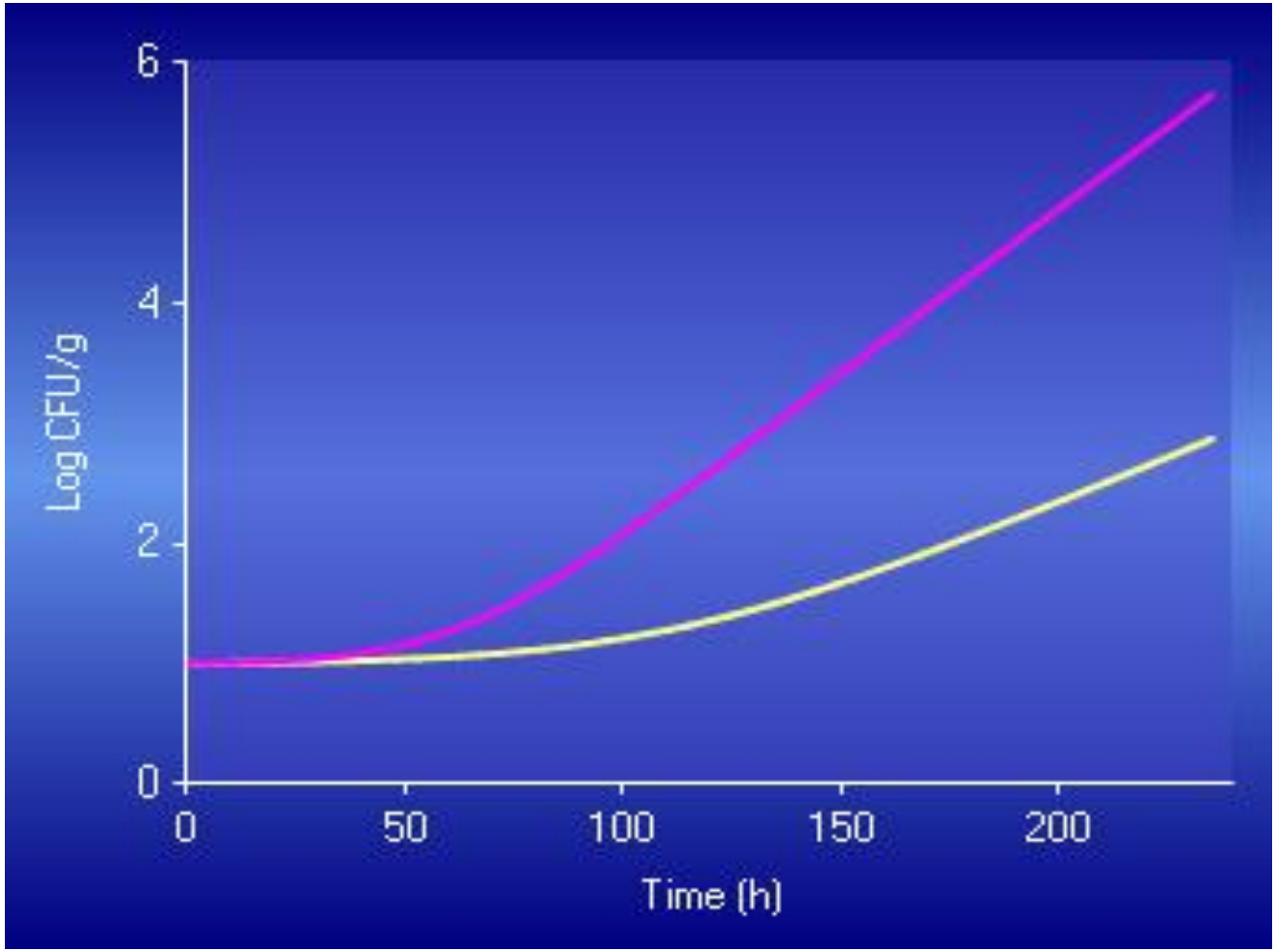
5°C
Doubling time 44.5h

1-log increase:
5°C: >240h/ >10d
8°C: ~110h/ 4.5d

But must consider spores!

Lm Growth Modelling #2

- pH 5.8, Aw 0.990



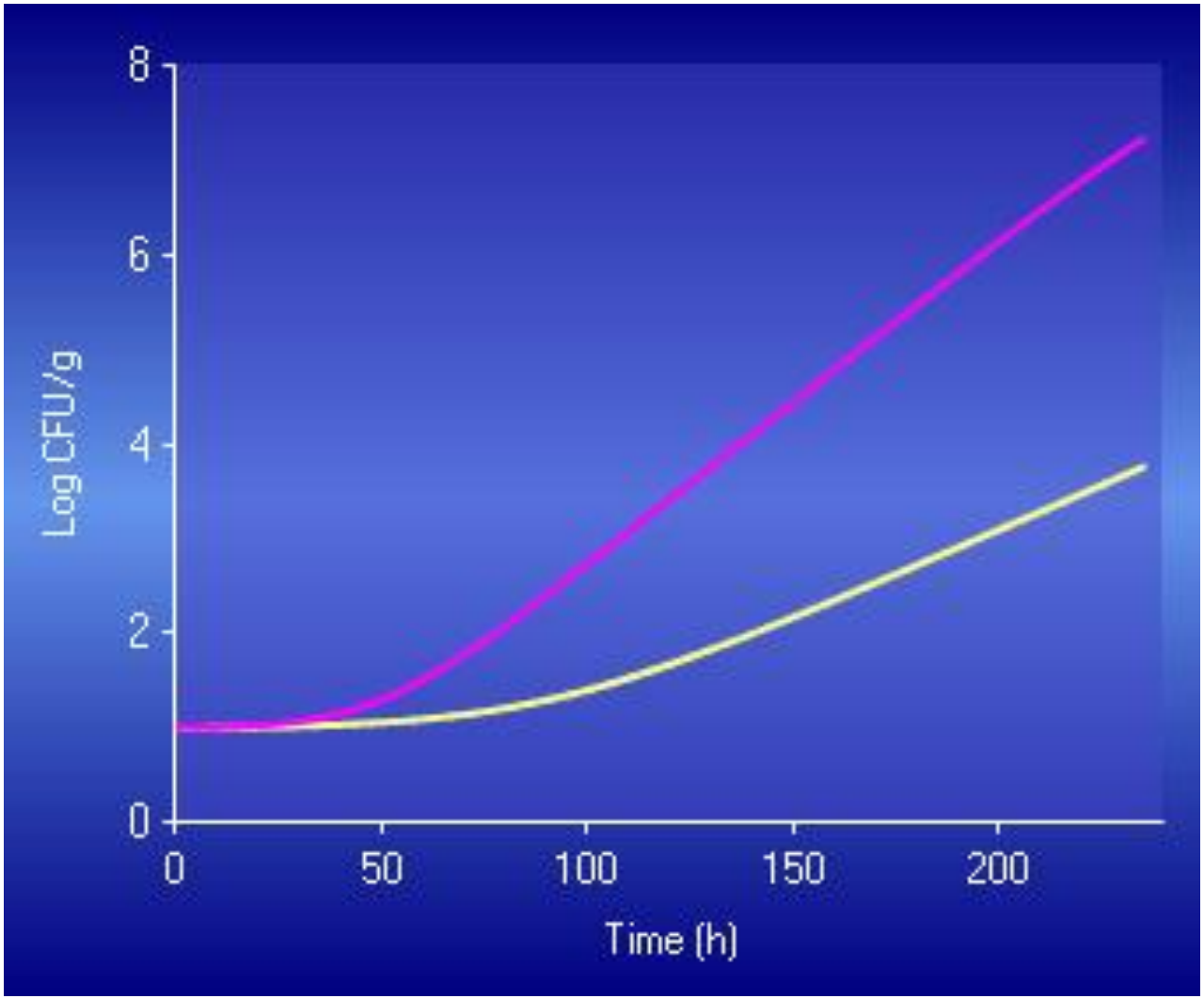
8°C
Doubling time 11h

5°C
Doubling time 19.9h

1-log increase in:
5°C: ~180h/ 7.5d
8°C: ~95h/ 4d

Lm Growth Modelling #3

- pH 6.6, Aw 0.985



8°C
Doubling time 8.8h

5°C
Doubling time 15.9h

1-log increase in:
5°C: ~160h / 6.5 d
8°C: ~60h / 2.5d

Key Terms: RTE, RTC, RTRH

Key Terms: RTE, RTC, RTRH

- **Ready to Eat (RTE)**

  Intended by the producer or the manufacturer for direct human consumption without the need for cooking or other processing effective to reduce to an acceptable level or eliminate microorganisms of concern. (cold-eating) Manufactured in a High Care or High Risk Area

- **Ready to Cook (RTC)**

  Designed to be given a heat process delivering a 6-log kill with respect to vegetative pathogens (a minimum process equivalent to 70°C/2 mins) throughout all components. Manufactured in a Low Risk/GMP Area

- **Ready to Reheat (RTRH)**

  Designed to be reheated by the final consumer. Manufactured in a High Care or High Risk Area

CFA Decision Tree – Hygiene Areas

- CFA decision tree determines the standard
  - thermal process used
  - Terminology reflects risk presented by the manufacturing environment to the product

- 3 areas:
  - Low Risk
  - High Care
  - High Risk

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Manufacturing Hygiene Areas

- **Low Risk (or GMP) Area**
  - Raw material intake
  - Ready to cook foods
  - Packaged product

  - Separate equipment, utensils, staff and changing areas

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Manufacturing Hygiene Areas

- **High Care Area**
  - RTE and RTRH food production
  - Includes RTE/RTRH ingredients not thermally processed (minimum 70°C/2") but having been decontaminated (validated) and grown/produced to RTE standards
  - Separate equipment, utensils, staff and changing areas
  - Filtered air at positive pressure

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Manufacturing Hygiene Areas

- **High Risk Area**
  - RTE and RTRH food production
  - Only thermally processed foods (minimum 70°C/2” equivalent)
  - Separate equipment, utensils, staff and changing areas
  - Filtered air

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CFA Decision Tree

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Equivalent thermal process		Micro effect of thermal process	Post-process contam risk?	Remaining hazards to be eliminated or controlled		Min hygiene level reqd
All components ≥ 70°C/2" equiv?	YES →	Vegetative pathogens (e.g. *Listeria* spp.) destroyed. *C. botulinum* & *B. cereus* potential hazard	→ YES →	Strict hygiene. Hurdles *v. C. botulinum* must be used to achieve >10d	→	**HRA**
			→ NO →	*C. botulinum* & *B. cereus* potential hazard. Hurdles *v. C. botulinum* must be used to achieve >10d	→	**LRA**
↓NO			**Cook before consuming?**			
Not all components ≥ 70°C/2" equiv?	YES →	All types of pathogens remain a hazard	→ NO → (RTE, RTRH)	Pathogens may remain from original components or recontamination. Limit further contamination by using HCA. Shelf life may need to be short unless sufficient hurdles used	→	**HCA**
			→ YES → (RTC)	Pathogens may remain from original components or recontamination. Cooking instructions must be validated. Shelf life may need to be short unless sufficient hurdles used	→	**LRA**

How should the decision tree be used?

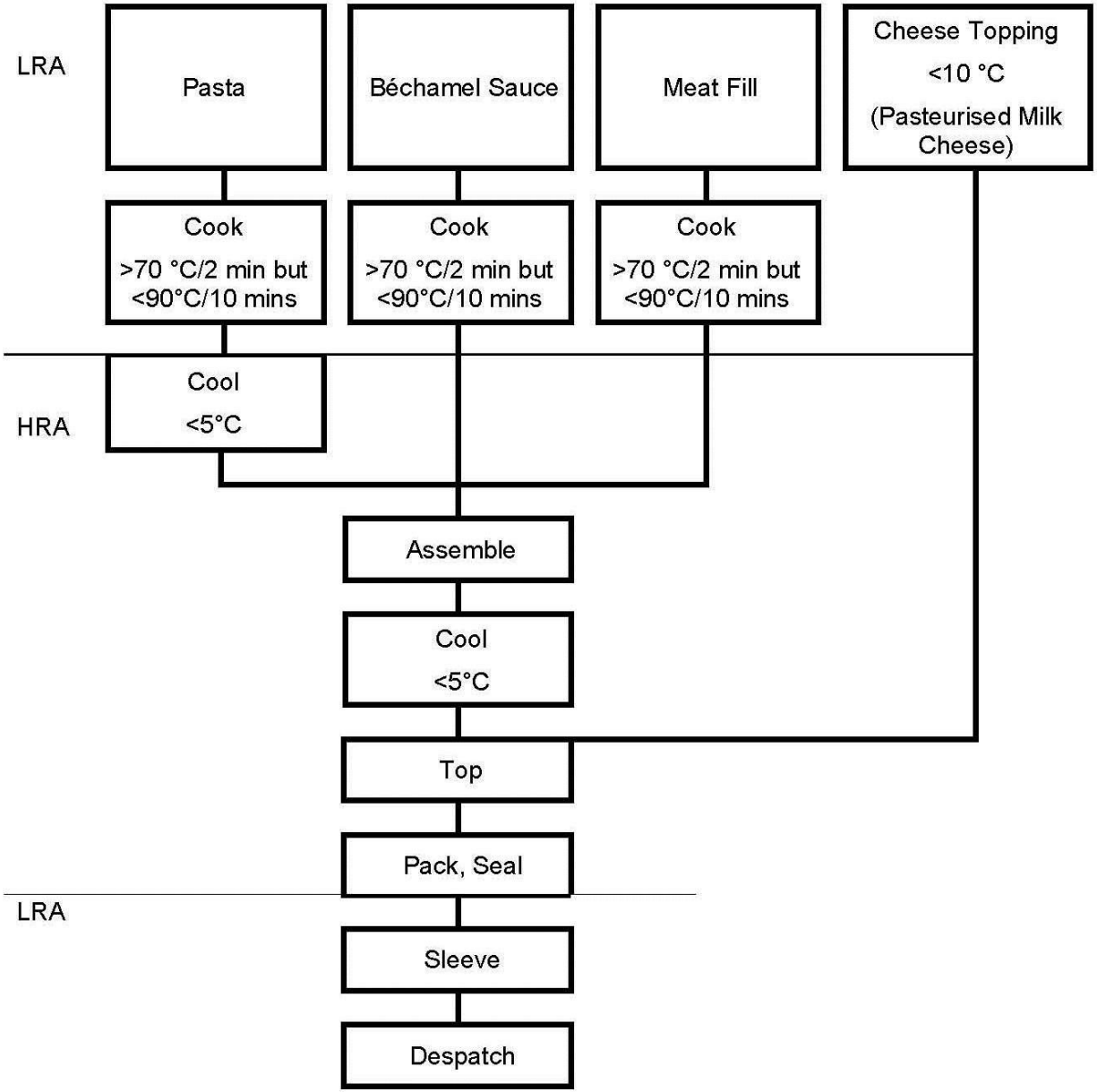
CHILLED FOOD ASSOCIATION

Fully Cooked RTE/RTRH Food
e.g. RTRH Lasagne

Equivalent thermal process		Micro effect of thermal process	Post-process contam risk?	Remaining hazards to be eliminated or controlled	Min hygiene level required
All components ≥ 70°C/2" equiv?	YES ➔	Vegetative pathogens (e.g. *Listeria* spp.) destroyed. *C. botulinum* & *B. cereus* remain a hazard	➔ YES ➔	Control recontamination by strict hygiene. Hurdles against *C. botulinum* must be used to achieve shelf life >10d	➔ **HRA**

CATEGORY OF FOOD: READY-TO-REHEAT CHILLED COOKED FOOD

PART 1
EXAMPLE PROCESS FLOW DIAGRAM

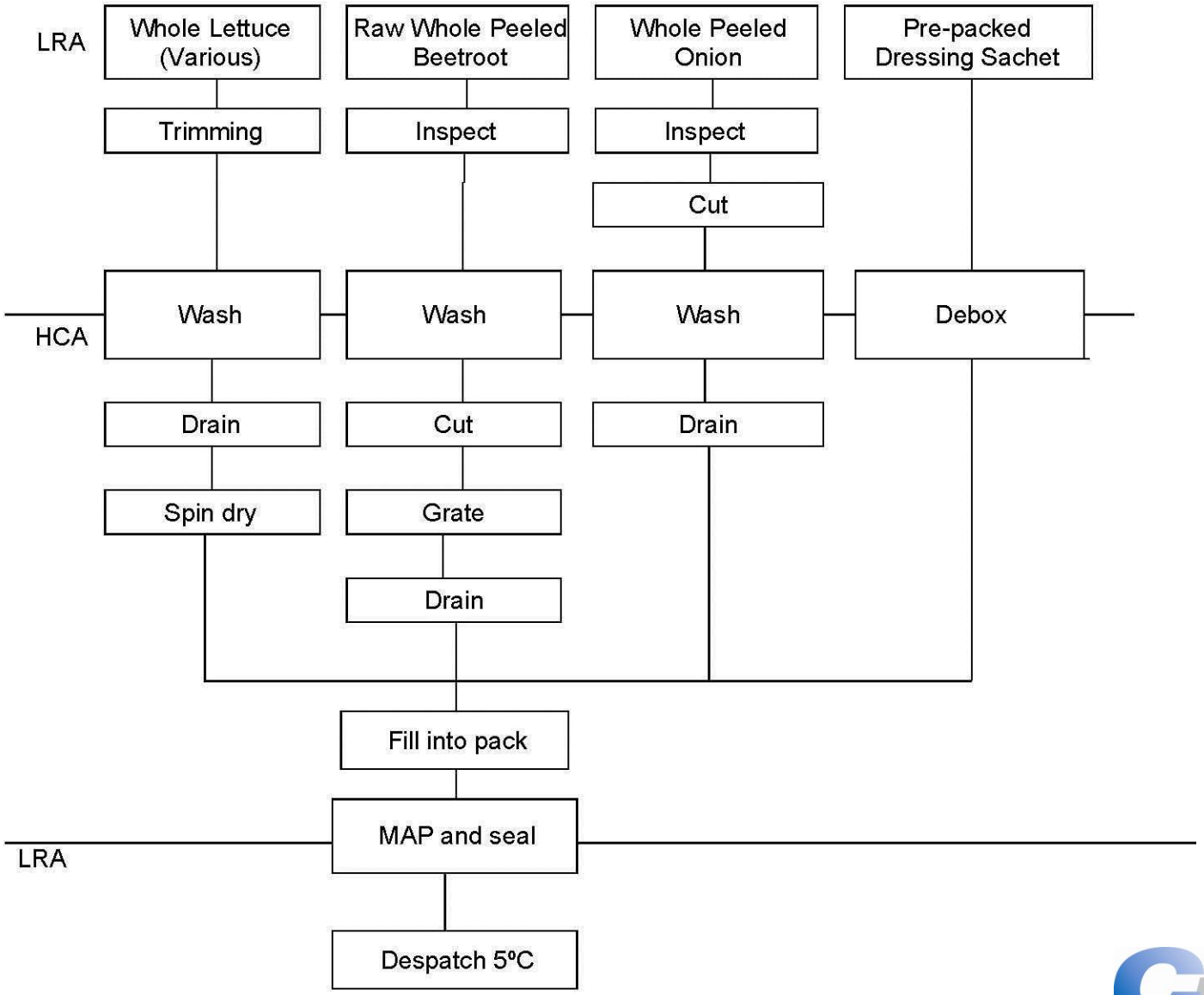


Raw RTE Food, e.g. Leafy Salad

Equivalent thermal process		Micro effect of thermal process	Cook before consuming?	Remaining hazards to be eliminated or controlled		Min hygiene level required
All components ≥ 70°C/2 min equivalent?						
↓NO						
Not all components ≥ 70°C/2 min equivalent?	YES →	All types of pathogens remain a hazard	→ NO → (RTE)	Pathogens may remain from original components or recontamination. Limit further contamination by using HCA. Shelf life may need to be short unless sufficient hurdles used	→	**HCA**

CATEGORY OF FOOD: RAW PREPARED READY-TO-EAT PRODUCT

PART 1
EXAMPLE PROCESS FLOW DIAGRAM

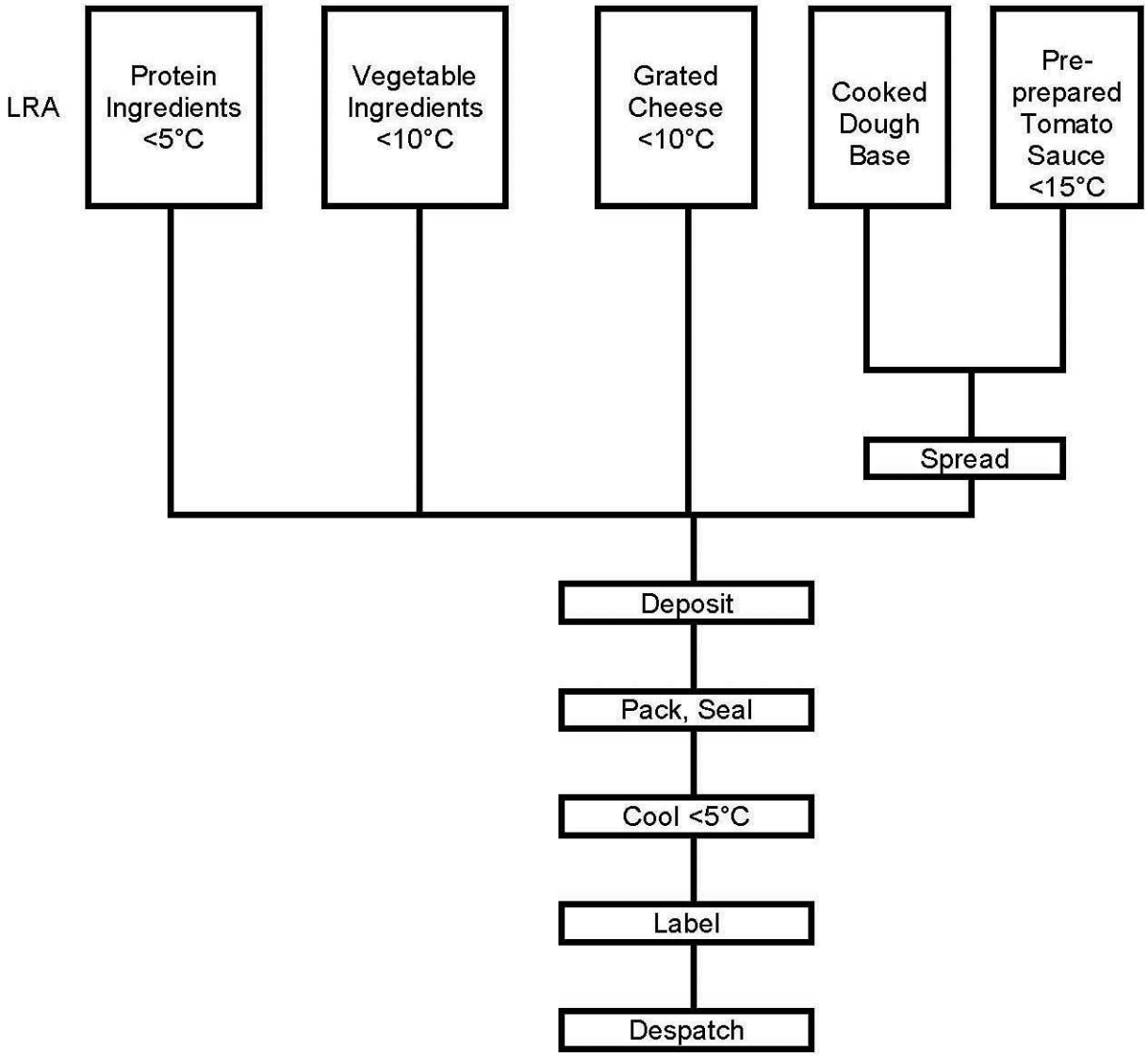


RTC Food, e.g. Pizza

Equivalent thermal process		Micro effect of thermal process	Cook before consuming?	Remaining hazards to be eliminated or controlled	Min hygiene level required
All components ≥ 70°C/2 min equivalent?					
↓NO					
Not all components ≥ 70°C/2" equiv?	YES →	All types of pathogens remain a hazard	→ YES → (RTC)	Pathogens may remain from original components or recontamination. Cooking instructions must be validated. Shelf life may need to be short unless sufficient hurdles used	→ **LRA**

CATEGORY OF FOOD: PREPARED FOOD (INCLUDING COOKED AND RAW INGREDIENTS) TO BE COOKED BY THE CONSUMER BEFORE EATING

PART 1
EXAMPLE PROCESS FLOW DIAGRAM



Physical / Chemical Issues

• Prepared Salads	snails, caterpillars, grit/soil
• Raw Mince Meat	plastic, metal, bone, gristle
• Smoked Fish (hot or cold smoked)	bones (if fillet), metal, correct species
• Cooked Meat Product	plastic, metal, correct species
• Cooked Meat Product with Rice	plastic, metal, correct species
• Cheese Sandwich	correct cheese, plastic, metal, plasters
• Ready Meal/Recipe Dish	metal, correct species (if protein),plastic, bones

Auditing Quality Assurance Systems

- Internal Audits and Checks
  - Processes, stocks, records, products (eg micro)
- External (3rd Party) Auditors
- Verification of HACCP
- Local Authority checks
- Challenge Testing
- Updating

  - EC Regulations, Statutory Instruments, GMP, FSA

Conclusions / Recap

- Definition of Quality and Quality Assurance (QA)
- Design and Planning for QA of Chilled Foods
- Implementation and Maintenance of Quality Assurance Systems
- Brief Overview of Regulations and Other Requirements
- Definition and Types of Chilled Foods
- The European Market for Chilled Foods
- Industry Guidelines for Chilled Foods relating to QA
- Key microbial hazards in relation to Chilled Foods
- Thermal Processing
- Predictive Modelling
- Physical/Chemical Issues relating to Chilled Food Production
- Hygiene Areas and the CFA Decision Tree
- Auditing QA Systems for Chilled Food Production
- QA on line

CFA CHILLED FOOD ASSOCIATION

Questions

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CHILLED FOOD ASSOCIATION

The centre of excellence for the chilled food industry

www.chilledfood.org

cfa@chilledfood.org