

PRINCIPLES OF FISH SMOKING

Delivered by Seafish approved senior trainer: Ivan Jaines-White

Co-Delivered by Seafish approved trainer: Gordon Gibb



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PROGRAMME

- Welcome**
 - Aspirations
 - Aims and Objectives
- Introduction to smoking**
 - History
 - Types of smoked products
 - Types of equipment
 - Types of kilns
 - Food Preservation methods
- Raw materials and additives**
 - Fish
 - Salt, sugar and water
 - Additives and flavours
- Curing, salting and brining**
 - Salting
 - The brining operation
 - Managing the brine
 - Hanging
 - Practical considerations
- Smoke generation**
 - Wood types, grades and flavour
 - Smoke production methods
 - Chemical makeup of smoke
 - Reflection
- The smoking process**
 - Preparation is the key
 - Traditional chimney
 - Mechanical horizontal
 - Mechanical vertical
 - The AFOS Micro kiln
 - Controlling the process
 - Practical considerations
 - Operating a Micro Kiln
- Post Smoking Process**
 - Maturation
 - Yield
 - Staged Weighing Process
 - Labelling and packaging
 - Shelf Life
- Food safety issues**
 - General Food Hygiene
 - When does fish start to spoil and why?
 - Bacteria
 - Temperature
 - Bacterial multiplication
 - Listeriosis
 - Summary
 - Allergens
 - Cross contamination
 - Guidance
- Hobbyist or business**
 - Conclusions and discussions
 - Next steps and post course support

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1. WELCOME

- Aspirations
- Video: from early beginnings
- Aims and objectives

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Aspirations



Lynn Noon & brother Keith Gibson proudly showing a range of smoked products they accomplished during a Seafish Smoking course using the AFOS Micro Kiln.

Smoked Salmon sides, Kippers, Haddock fillets, hot & cold smoked Mackerel & smoked Sprats

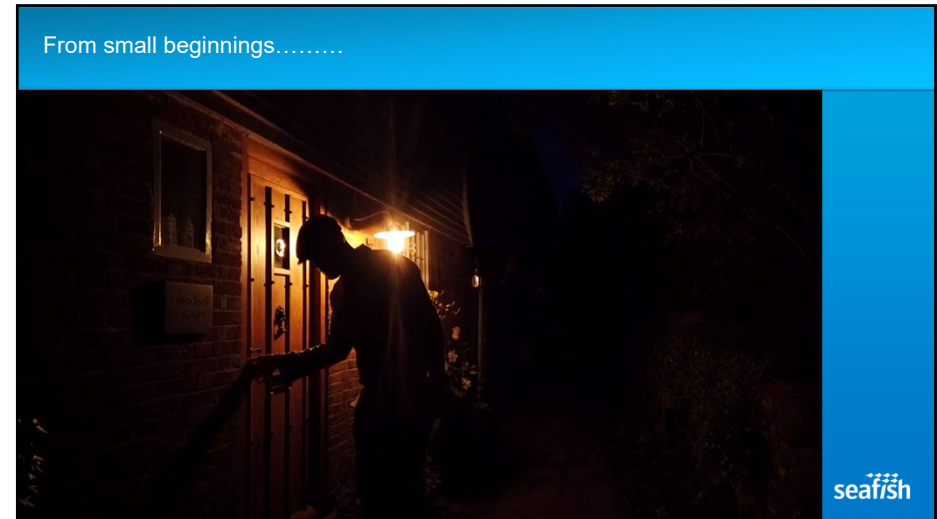
"We thoroughly enjoyed every minute of the smoking course we attended two years ago. Would highly recommend this not only to Trade but anyone in the catering industry or individuals who are looking for new experiences on preparation and preservation of seafood."

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Market/customer perceptions

- A question that is often asked being "is it really smoked or just coloured?"
- Icelandic or Greek style yoghurt
- Smoke flavoured chicken
- Faux caviar
- Smoke flavours

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Aims and Objectives

Aims

- To provide insights into
 - ancient food preserving methods & significance in today's smoking processes.
 - the history, art and science of smoking.
- To provide an introduction to the brining, salting and smoking of fish
- To introduce key concepts, essential practices and useful insights into the production of smoked fish.

Objectives

- To give you more confidence and understanding of how to safely produce smoked products.

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2. INTRODUCTION TO SMOKING

- History
- Types of smoked products
- Types of kilns
- Food Preservation methods

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Origins of smoking

- Examples of early Curing and Smoking Methods

Curing (salting) Drying, Smoking. The origins of these methods of preservation are lost in the sands of time but each of those preserving methods have endured to this day, individually or combined.

- The enduring principles of the Smoking Process

Centuries ago although not understanding the science people would use salt curing and drying to remove moisture, one of the essentials for bacteria to survive. Salt is also a hostile environment for bacterial growth. Fish originally was heavily smoked for long periods to remove moisture.



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Types of smoked products

- Hot
- Cold
- Intermediate
- Salted
- Brined
- Flavoured
- Whole
- Species
- Method

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Types of Kilns

- Traditional chimney
- Mechanical horizontal
- Mechanical vertical
- The AFOS Micro kiln
- Homebuilt

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Food preservation methods

- Temperature reduction: Long term - freezing and short term - chilling
- Water activity methods: Curing, smoking, salting, drying
 - Fermentation often relies on Aw reduction
- Heat treatment: Enclosed: cans, jars etc
- pH: Pickling and marinating

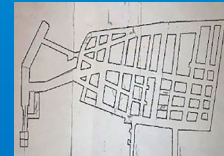
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Temperature reduction



Gustav Backmann & Siberian ice tunnels.
Credit Siberian Times



Freezing is frequently thought of as a recent technology.

There is no doubt advances in rapid freezing have advanced considerably in the last 50 years but it has been used as a food preservative for 1,000s of years in different parts of the world using the regional permafrost. The practice continues today but is being affected by climate change with ice cellars on the same parallels as Siberian permafrost experiencing rising temperatures.

Good quality frozen product can be used for smoking & subsequent storage. As an example the vast majority of mackerel used for hot smoking is frozen within a few months of the year when the fat content is at the required level. The same is true of Herring used for smoking.

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Water activity methods & moisture reduction

Curing, brining, smoking, salting and drying

- Each of the above methods will preserve fish & meat protein as individual applications or a combination of each as in the smoking process.
- Removing moisture & imparting salt deprives bacteria of one of the essentials for growth.
- Products will have shelf lives of a few days to several years.

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Examples of smoked products

- Schillerlocken
- Salmon, Trout
- Sea Bream steaks
- Greenland Halibut steaks
- Kippers, Bloaters, buckling
- Mackerel, Sprats, Sardines
- Cod, Haddock, Coley & Pangasius
- Eels, Arbroath Smokies
- Smoked Roe
- Oysters, Mussels
- Other non seafood products



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Protected geographical food and drink names

- Arbroath smokies
- Traditional Grimsby smoked fish
- Cheddar cheese
- What others?



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Non seafood smoked products

- | | | |
|--------------|---------------|-----------|
| • Salt | • Pheasant | • Venison |
| • Spices | • Partridge | • Boar |
| • Cheese | • Duck | • Skippy |
| • What else? | • Goose | • Brisket |
| • Water | • Guinea Fowl | • Chicken |
| • Oils | • Turkey | • Sausage |
| • Beer | • Ostrich | • Hams |
| | | • Bacon |



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3. RAW MATERIALS AND ADDITIVES

- Fish types and characteristics
- Salt, sugar and water
- Additives and flavours



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Fish types and characteristics

- Whitefish (Demersal) Cod, Haddock, Coley, Whiting
- Oily Fish (Pelagic) Salmon, Tuna, Mackerel, Herring, Sardines, Pilchard, Sprats, Anchovy
- Oily Fish (Other) Greenland (Mock) Halibut, Eels, Red Bream
- Shellfish Oysters, Mussels, Scallops, Clams

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Salt, Sugar and Water

- Food grade salt
- Sugar – white or brown
- Potable water

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Additives and flavours

- Flavours – how many can you name?
- Pre or post smoking?
- Colours

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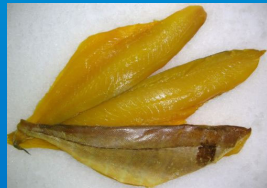
Can you name some flavours ?

Beetroot cured	Roasted Salmon with Honey Glaze
Gin, Juniper, Grapefruit & Lime	Hot Smoked Mackerel with Cracked
Rum, Lime & Ginger	Black Pepper
Whisky and Orange	Dill
Whisky and Maple Syrup	Garlic
Lavender and Citrus	Lime
Raspberry Vodka and Blueberries	Piri Piri
Tequila, Coriander, Chilli and Lime	Chilli
Fennel and Pernod	Coriander
Gin and Orange	Crushed Nuts
Chilli Smoked Salmon	Honey Glazed
Cracked Black Pepper	
Honey and Bourbon	

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Colours and other additives



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Food dyes in Fish Smoking

- Main dyes used are natural in origin
- Annatto - Seed
- Turmeric - Rhizome
- Curcumin - Turmeric
- Do you know of any other forms of dye?

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15 minute comfort break

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Reflection on course so far

- Observations
- General comments
-
- Questions

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4. CURING, SALTING AND BRINING

- Salting
- The brining operation
- Managing the brine
- Hanging
- Practical considerations

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Cold smoking salmon video

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Programme 3.

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Salting

Reflecting on the hand and machine salting in the video, are there any observations or questions at this time?

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Salting and salt/sugar variations

Salt

- Breaks down protein
- Helps to preserve
- Removes water
- Improves flavour

Sugar

- The sugar can be a variation to the smoked salmon process.
- It can be added to the salting (or brining) process
- Sugar improves the storage quality of foods. A high concentration of sugar inhibits the growth of bacteria

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The brining operation

Essential measures

- Brine strength
- Time in brine
- Pellicle formation
- Temperature

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Managing the brine

Essentials in making up brine

- Salt to water or water to salt?
- Brine strength?
- How long in the brine?
- Ensuring consistency
- Adding colour

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Small scale measuring equipment

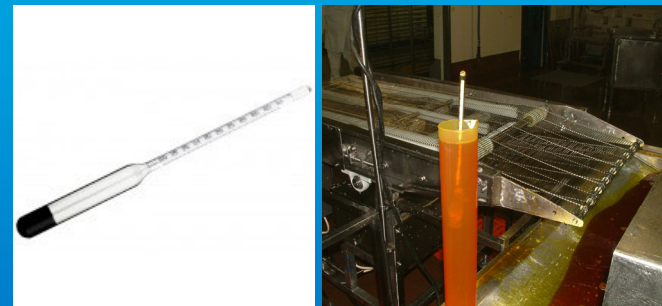
- Brinometer
- Thermometer
- Weigh scales & measuring jugs
- Timer



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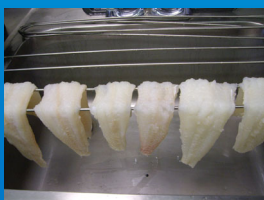
Measuring brine strength



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Hanging & traying to allow essential draining & setting of pellicle



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Practical considerations

- Where – raw material, brine container?
- How – where will product be placed after brining?
- How long before smoking?

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5. SMOKE GENERATION

- Wood types grades and flavours
- Smoke production methods
- Chemical makeup of smoke
- Practical considerations

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Wood types, grades and flavour



Different woods, wood blends and size will affect the smoking process and product in a number of ways.

Softwoods: Juniper and Pine will add colour to the product.

Hardwoods: Oak, Manuka, Hickory, Chestnut, Walnut, Ash, Apple, Cherry, Beech, Alder and Mesquite will add flavour.

Blends are used to combine those features and can be an effective marketing aid.

Food grade wood products free of contaminants are essential.

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Ashwood – smoking chips



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Smoke production methods



- Smoke pit
- Smoke box
- Electrical/hotplate methods
- Friction wheels
- Others
 - Smoke guns
 - Smoke pans



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Chemical makeup of smoke

- Wood smoke is a very complex collection of (more than 300) chemicals.
- The chemical makeup varies depending on wood type and temperature of burning.
 - Low temperatures promote “aldehydes” production
 - Higher temperatures promote “phenol” production
- Aldehydes impart a desirable smoked flavour
- Phenols impart a less desirable disinfectant flavour
- PAHs – Polycyclic Aromatic Hydrocarbons (see [guidance](#))

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Reflection on wood types

Sawdust, Chips, Hardwoods, Softwoods

- What quality must each of the above have?
- Name some of the types of wood used?
- What do each add to the smoking process?
- Can they be mixed/blended?
- What are the implications of using composites such as plywood, sterling board, MDF?

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6. THE SMOKING PROCESS

- Preparation is the key
- Traditional chimney
- Mechanical horizontal
- Mechanical vertical
- The AFOS Micro kiln
- Controlling the process
- Operating a Micro Kiln

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Preparation is the key

- Good raw material
- Recognising product variations
- Standard operating procedures
- Brine consistency-measuring
- Brine immersion
- Salt content

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Which fish is a King Salmon ?



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40 minute lunch break

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Types of Kilns

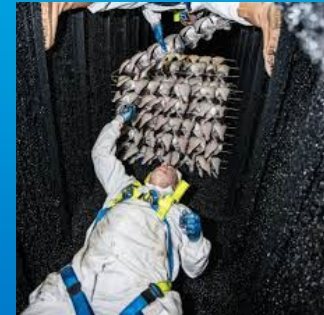
- Traditional chimney



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Traditional chimneys



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Traditional cold smoking video

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Observations - questions

Reflecting on the video, what observations or questions at this time do you have in respect of:

- Type of business
- Quantity of fish in brine
- Salting
- Product
- Environment?

This video was made some years ago before the change in ownership

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Mechanical kilns - vertical smoke flow

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Factory scale equipment - Whitefish mechanical video

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Observations - questions

Reflecting on the video, what observations or questions at this time do you have in respect of:

- Type of business
- Quantity of fish in brine
- Product
- Environment?

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Mechanical kilns – vertical smoke flow



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Operating a Micro Kiln

- History of the kiln
- Capabilities and limitations
- The controls
- Micro kilns in action

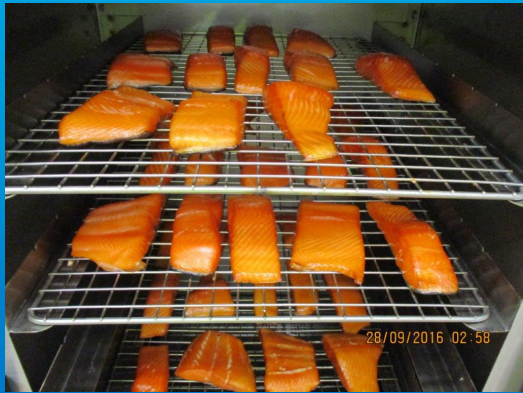
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Micro Kiln controls

- Time
- Temperature
- Smoke density
- Airflow
- Humidity

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Domestic to small scale commercial applications



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7. POST SMOKING PROCESSES

- Maturation
- Yield
- Staged weighing processes
- Labelling and packaging
- Shelf life

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Maturation

- Maturation is a process during which the smoke flavours penetrate the product over time.
- It will continue during chilling, overnight in a chillroom and will continue during transport.
- Chilling smoked fish is an essential part of the process before it is packed. If not chilled bacteria will form and the quality will be affected to the point of it being wasted.
- Maturation is a relatively short process over, for example, 24 hours compared to 28 day matured meats.

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Yield - what is it ?

- In simple terms, yield is the actual output from a given quantity of materials after undergoing a process.
- Yield can be good, bad or in line with expectations.
- Yield can be assessed at various stages.
- What is a general perception of post smoked yield from a cold smoking process such as skin on Haddock fillets compared to a post hot smoking process of skin on Mackerel fillets?

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Staged weighing processes

Weighing the product is important at a number of critical points during the process. Why is that?

- To ensure that the weight of raw material when received is not below the purchase weight
 - Pre brining weight after skinning or trimming
 - Pre smoking weight after brining
 - Post smoking weight
 - Post smoking trimmed weight
 - Packed weight

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Labelling and packaging

- Accurately labelled products and ensuring consumers are aware of ingredients are essential to avoid allergen related illnesses and wellbeing issues
- Guidance on [labelling](#) from Seafish
- Guidance on [allergens](#) from Seafish

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Shelf life

- Who are the people most likely to be interested in shelf life apart from the consumer?
- Quality - using good quality raw material
- Keeping it that way
Process – Storage – Distribution – Retail display
- Moisture reduction
- Shelf life validation
- Laboratory testing
- Environmental Health Officer (EHO)

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8. FOOD SAFETY ISSUES

- General food hygiene
- When does fish start to spoil and why?
- Bacteria
- Temperature
- Bacterial multiplication
- Summary
- Allergens
- Cross contamination
- Guidance

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General food hygiene

- A scientific review by the Food Standards Agency (FSA) estimating that around 2.4 million cases of foodborne illness occur every year in the UK.

2.4 million

- This is up from the 2009 estimate of approximately one million.

Top five culprits

Campylobacter,
Clostridium perfringens,
Listeria monocytogenes,
Salmonella and norovirus

are responsible for 98 percent of the 180 deaths but it is not possible to rank the five pathogens. Total deaths could be as low as 113 or as high as 359.

The UK recorded 57 deaths due to Salmonella in both 2017 and 2018, according to data compiled by the European Centre for Disease Prevention and Control (ECDC).

Source FSA 2020

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When does fish start to spoil and why ?

- From the moment it dies
- Bacteria cause fish to spoil
- The more bacteria on the fish the quicker it will spoil.
- Bacterial growth will be slowed considerably between 0 and 5 degrees c.

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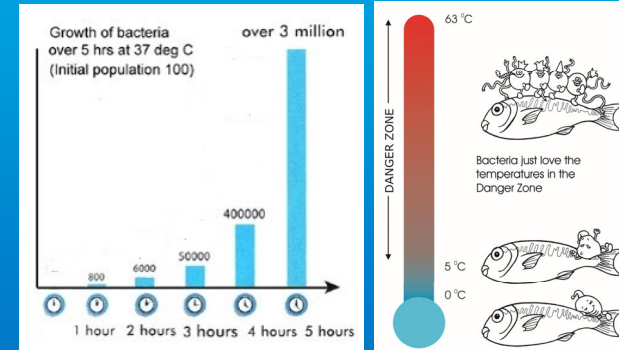
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Bacteria

- What are they?
- What do they do?
- Where are they?
- How do they live?
- What do they need?
- How do we control them?

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Temperature and bacterial multiplication



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Implementing a sampling programme to evidence that the finished product is absent of *L.monocytogenes* in 25g before it leaves the control of the business.

Carry out sufficient shelf life testing to evidence that the finished product will reach the end of its shelf life without exceeding the 100cfu/g limit as specified by Council Regulation (EC) No. 2073/2005. Once an appropriate shelf life has been determined, the finished product should periodically be submitted for laboratory analysis to ensure that the shelf life remains compliant.

Reduce the shelf life of the product to 5 days or less. This complies with Foods Standards Agency guidance that *L.monocytogenes* should not grow to levels exceeding 100cfu/g within 5 days.

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<https://www.gov.uk/government/news/fsa-and-ukhsa-warn-of-listeria-risk-with-baronet-soft-cheeses>

<https://www.gov.uk/government/publications/listeria-monocytogenes-surveillance-reports/listeriosis-in-england-and-wales-summary-for-2020>

<https://www.foodsafetynews.com/2022/12/recall-for-fish-linked-to-deadly-uk-listeria-outbreak/>

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Summary



- Bacteria are everywhere
- Pests and vermin must be excluded



- Cats are not approved pest controllers



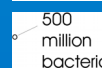
- Food handlers must meet minimum standards



- Smoking process does require sufficient space to function



- Bacteria require almost no space to function



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Allergens

The 14 allergens are:

celery, cereals containing gluten (such as barley and oats), **crustaceans** (such as prawns, crabs and lobsters),

eggs, fish, lupin, milk, molluscs (such as mussels and oysters),

mustard, peanuts, sesame, soybeans, sulphur dioxide and sulphites (if they are at a concentration of more than ten parts per million) and

tree nuts (such as almonds, hazelnuts, walnuts, brazil nuts, cashews, pecans, pistachios and macadamia nuts).

Source: Food Standards Agency

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Key facts about allergens

- In the UK, about ten people die every year from food-induced anaphylaxis.
- For those at greatest risk, the tiniest trace of food allergen can trigger severe symptoms and, in some cases, cause fatal or near-fatal symptoms.
- People suffering severe reactions need emergency expert help from a trained paramedic, usually with injectable adrenaline.
- Those who are aware of the risk can find the day-to-day unpredictability of living with food allergy risks stressful.
- Teenagers and young adults seem to be at particular risk of severe reactions.

Seafish guidance [available here](#)

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Cross contamination - ensuring a safer product

There are a number of actions you can take to prevent cross-contamination with allergens. These include:

- **cleaning utensils before each usage**, especially if they were used to prepare meals containing allergens;
- **washing hands thoroughly** between preparing dishes with and without certain allergens;
- **storing** ingredients and prepared foods separately in closed and labelled containers;
- **keeping ingredients** that contain allergens separate from other ingredients.

Source: Food Standards Agency

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What do I need to smoke fish?

- **Sawdust/wood chips** Should be commercial food grade, virgin wood or uncontaminated whisky barrels for example. Hardwoods versus Softwoods – effects
- **Salt** Pure Vacuum Dried (PVD) salt is good all round salt but rock salt used in some applications
- **Brine Tank** Container of appropriate size for scale of operation for mixing brine and immersing fish
- **Brinometer** Practical low cost instrument for measuring brine strengths
- **Smoker** Several models available ranging from home use, small high street business, farm shop to the high volume factory models. However the basic principles remain the same.
- The smoker seen in this course is the AFOS Micro Kiln, with a vertical smoke flow similar to a traditional chimney.

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9. HOBBYIST OR BUSINESS

- Practical considerations when setting up a small-scale commercial business, adding to an existing facility or just a hobby.
- Where will it be done?
- Qualifications – what do I need?
- How do I achieve a food safe environment, HACCP policy?
- What will be the process flow to avoid cross contamination?
- What are the regulations on hot & cold smoked product regarding process flow, product storage pre and post smoking, equipment use?
- Allergen controls – will allergens be used?
- What form of packaging will be used?
- Prosecution and penalties are imposed on businesses found to be guilty of negligence & malpractice in respect of food safety
- The hobbyist is not immune from prosecution under common law if a product is gifted to someone who then suffers from salmonella or other forms of food poisoning or suffers anaphylactic shock from an undisclosed allergen presence.

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Next steps and post course support

- Courses and support
- Coaching and consultancy
- Other training
 - food hygiene and HACCP

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Courses and support

- OTHER SMOKING COURSES
 - Introductory, Basic and Basic+

– SUPPORT MATERIALS

- Post course guidance and notes available to trainees on [this webpage](https://seafoodacademy.org/pfs-resources.php)
(<https://seafoodacademy.org/pfs-resources.php>)

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Other training

- FOOD HYGIENE
 - Elementary Food Hygiene
 - Intermediate Food Hygiene
- HACCP
 - Introduction
 - Elementary
 - Intermediate
- HEALTH & SAFETY

Seafish resources [available here](#)

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CONCLUSIONS AND DISCUSSIONS



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Coaching and consultancy

Coaching and consultancy is available ranging from on line to on site presence.

Details can be obtained from todays trainers

Ivan Jaines-White

email: ivan.jaines-white@outlook.com

mobile 077 88 598661

Gordon Gibb

email: gordon-gibb@outlook.com

mobile 07739 591228



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