The Microbiology of Lightly Cooked Foods

Dr Caroline Willis
Food Water & Environmental Microbiology Laboratory, Porton
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What is ‘lightly cooked’?

Milk pasteurisation (to reduce pathogens to safe levels):
63 – 65°C for 30 minutes or
72°C for 15 seconds

Listericidal cook (Listeria is most resistant vegetative food pathogen):
70°C for 2 minutes

ACMSF (Advisory Committee on the Microbiological Safety of Food):
‘Low temperature cooking’ is any process where max. temperature achieved in slowest heating part of product is <70°C
## Outbreaks Linked With Undercooked Food

<table>
<thead>
<tr>
<th>Food Type</th>
<th>No. outbreaks (2009 – 2012)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken</td>
<td>37</td>
</tr>
<tr>
<td>Beef</td>
<td>12</td>
</tr>
<tr>
<td>Lamb</td>
<td>3</td>
</tr>
<tr>
<td>Pork</td>
<td>7</td>
</tr>
<tr>
<td>Goat</td>
<td>1</td>
</tr>
<tr>
<td>Duck</td>
<td>4</td>
</tr>
<tr>
<td>Venison</td>
<td>1</td>
</tr>
<tr>
<td>Composite meals</td>
<td>2</td>
</tr>
</tbody>
</table>
### Outbreaks Linked With Undercooked Food

<table>
<thead>
<tr>
<th>Organism</th>
<th>No. outbreaks (2009 – 2012)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacillus cereus</td>
<td>2</td>
</tr>
<tr>
<td>Campylobacter</td>
<td>37</td>
</tr>
<tr>
<td>Clostridium perfringens</td>
<td>11</td>
</tr>
<tr>
<td>Salmonella</td>
<td>24</td>
</tr>
<tr>
<td>VTEC O157</td>
<td>4</td>
</tr>
<tr>
<td>Norovirus</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
</tr>
</tbody>
</table>
HPA/LGR Coordinated Study of Lightly Cooked Foods

April to September 2011

357 samples from retail and catering outlets:

- cooked meat (pork, beef, chicken, rabbit, venison, quail…)
- liver (duck, goose, lamb, chicken)
- fish
- egg dishes
Lightly Cooked Foods Study - Results

- Satisfactory (65.2%)
- Borderline (20.5%)
- Unsatisfactory (12.9%)
- Potentially hazardous (1.4%)
Lightly Cooked Foods Study - Results

1.4% (6 samples) unsatisfactory: potentially injurious to health

Duck (3/55; 5%): 1 Salmonella, 2 Campylobacter
Chicken liver (2/102; 2%): 1 Salmonella, 1 C. perfringens
Duck liver (1/14; 7%): 1 Listeria monocytogenes
New trend: Undercooked chicken liver pate!!!

In 2011, 18 outbreaks of Campylobacter infection in England were notified (443 cases reported).

13 outbreaks were linked to chicken or duck liver pate (all catering venues).

The FSA issued updated advice to caterers on the safe handling and cooking of livers twice in 2010, but Campylobacter outbreaks associated with the consumption of chicken liver pate have continued to occur.
Campylobacter outbreaks
Internal contamination of chicken livers

Of 30 chicken liver samples, all positive for Campylobacter on the exterior surfaces

• 9 had surface counts of >1100 /100 grams
• 27 livers had internal contamination
• 2 had internal counts of >1100 /100 grams

Reading College fined after liver pate causes food poisoning

A Berkshire college has been fined £7,000 for food safety offences after a group of elderly people who ate pate prepared by students fell ill.

Reading College admitted breaching food regulations by serving liver pate which had not been cooked to the required temperature.

Principal Lesley Donoghue said the college "deeply regretted" causing food poisoning in 18 people in May 2011.

It was ordered to pay a further £8,000 costs at the town's magistrates' court.

The problems were traced to liver pate prepared by students who were training for catering careers and were overseen by a chef.

'Shocking state'

Trainees had been given the wrong cooking temperature, which was too low to kill Campylobacter bacteria in the raw materials.

Edna Shepherd of the Pine Cones Retirement Club, whose members had eaten at the college restaurant as part of a group outing, said: "Some of the ladies living on their own were in a shocking state."

Lisa Richards of Reading Borough Council it was rare to have a case of food poisoning affecting such a large group of people.
Salmonella in eggs

2003: 0.34% of UK eggs positive

2012: 3/4042 laying flocks positive for S. Enteriditis or S. Typhimurium in UK

BUT Salmonella outbreaks associated with imported eggs

4.2% of laying flocks positive in Europe in 2011

2011: 262 people infected with S. Enteriditis PT14b – linked to eggs imported from Spain

2014: >150 cases of S. Enteriditis PT14b in UK; also in Austria and France – linked to eggs imported from Germany?
Cumulative reports of non-travel associated *Salmonella* Enteritidis PT 14b, 2011-2014
Rare burgers

Increasing trend for rare burgers

- including ‘gourmet’ burgers (thicker than traditional)

Sear and shave approach – reduces surface contamination

BUT: 1) Does not deal with any internal muscle contamination

2) Needs very good hygiene during shaving process

3) VTEC infectious at very low levels

Sous vide cook may retain pink colour but make safe

BUT room for confusion between pink (cooked) and pink (raw) meat

Producer must demonstrate safety
Burger ruling challenged
William Hatchett

Westminster Council may appeal a court ruling which it claims could put diners all over the UK at risk of contracting food poisoning. The ruling has also been questioned by CIEH principal policy officer, Jenny Morris, as contradicting current scientific advice and increasing the possibility of bad practice in the catering trade and UK diners eating burgers contaminated with E. coli.

Davy’s – which runs 26 restaurants across London – had appealed against an improvement notice served by Westminster Council EHOs last year, requiring it to put adequate safety controls in place for the production of undercooked burgers. Westminster EHOs have suggested two methods of achieving this: ‘sear and shave’ whole cuts of beef before mincing it to make burgers or ‘challenge testing’ where burger patties are inoculated with E. coli in a scientific study to determine a
Sous Vide

‘Under vacuum’

Food items are vacuum sealed in a bag and immersed in a water bath for cooking.

Originally described by Sir Benjamin Thompson (co-founder of the Royal Institute of Great Britain) in 1799.

Re-discovered by American and French engineers in the mid-1960s as an industrial food preservation method.

Found to give better consistency and moisture retention.
The Sous-Vide process

A staged process with the potential for microbial contamination and/or growth at each stage.
The Sous-Vide Process

Portioning and weighing

**Hazard** here is microbial contamination

- Quality of the raw product
- Contamination during handling
- Portion size / standardisation
The Sous-Vide process

Vacuum packing

Hazard here is microbial contamination

- Contamination from the packing machine
- Contamination from the packaging material
- Contamination due to integrity of the seal
The Sous-Vide process

Cooking

Hazard here is survival / growth of micro-organisms due to inappropriate temp/time regime.

FSA guidance on cooking temp/times for sous-vide:

A time/temperature combination as measured at the centre (slowest heating point) of a product equivalent to 70°C for 2 min.

This should achieve an approx. 6 log reduction of vegetative pathogens (e.g. Listeria, Salmonella, E. coli O157).

A 6 log reduction means the population has been reduced by 99.9999%
Cooking temp/time equivalents

D value
- the time required at a defined temperature to reduce the viable numbers of particular species or groups of species of microorganisms by 1 log value (90% “kill”)

Z value
- the temperature required to obtain a one log change in D value
e.g. If an organism had a D value of 3 minutes at 60°C, and the z value was 7°C, then at 67°C the D value would be 0.3 minutes.
Conversely – if the temperature was reduced by 7°C the D value would be 30 minutes
Low-Temperature Cooking

<table>
<thead>
<tr>
<th>Core temp (°C)</th>
<th>Cooking time (mins) for z=7.5°C (used for Listeria and Salmonella)</th>
<th>Cooking time (mins) for z=6°C (used for VTEC O157)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>43.5</td>
<td>93</td>
</tr>
<tr>
<td>65</td>
<td>9.3</td>
<td>13.6</td>
</tr>
<tr>
<td>70</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>75</td>
<td>0.43</td>
<td>0.3</td>
</tr>
<tr>
<td>80</td>
<td>0.09</td>
<td>0.05</td>
</tr>
</tbody>
</table>
Cooking Temperature

Target temperature **must** be achieved in slowest heating part of product

Consider:

- Portion size and thickness
- Number of portions in the cooking device at one time
- Temperature of portions before they are put in device (warm / frozen?)
- Properties of food affecting heat transfer (homogeneous?, high fat content?)
- Adequate vacuum achieved in packaging?
Cooking at Less Than 60°C

Research data is limited for reliable z-values in this range
- depends on bacterial strain, nature of food etc.

Other potential risks introduced – growth of thermotolerant bacteria
*Clostridium perfringens* grows at 52°C
The Sous-Vide process

Cooling

**Hazard** here is the opportunity for growth of surviving spore formers

- **RAPID** e.g. Ice bath to achieve core temp of 0 - 3C within 90 minutes

Also stops the cooking process (organoleptic)
The Sous-Vide process

Storage

**Hazard** here is cross-contamination and growth of surviving micro-organisms

- Clean equipment
- Good hygiene practices
- Personal hygiene
- Integrity of packaging
- Temperature control and monitoring
- Stock rotation
The Sous-Vide process

Re-heating and serving

Hazard here is survival and growth of micro-organisms

• Re-generation temperature
• Holding time (remember come up time)
• Any further processing e.g. pan frying
Hepatitis E and Pork

- In the UK, between 1996 and 2003, 17 (9%) of 186 serologically confirmed cases of Hepatitis E were acquired in the UK.
- Non-foreign travel associated cases were older men infected with the genotype 3 (porcine) strain.
- Since 2010 numbers of cases have increased substantially and, in 2012 the total of laboratory confirmed cases was 579 (non-travel cases accounted for the majority (64%) of cases in 2011/12 compared with an average of 43% of cases between 2004 and 2011.
- Over 60% of the non-travel cases were in men over 50 years of age.
- PHE case-control study
  - Infection with locally-acquired hepatitis E in England and Wales was associated with the consumption of processed (raw and ready-to-eat) pork products (Said et al, 2013).
ACMSF Review of Hepatitis E in Food

Advice includes:

- Further work is undertaken on heat inactivation of HEV in naturally contaminated raw, rare and ready to eat pork products and these studies should relate to industry practice.
- Further work is undertaken on the effect of curing and/or fermentation of pork products (e.g. salamis and dry cured meats) on HEV infectivity.
- Work towards development of an ISO standard method for detection of HEV in foodstuffs (including pork products) should be encouraged.
- A structured survey of HEV contamination in pork products across the retail sector is conducted.

Studies suggest that it may take 20 minutes of cooking to inactivate virus – not very realistic in practice?
Conclusions

Some light cooking processes are increasing in popularity (rare burgers, pink duck, pink liver, sous vide)

Heating is a very good critical control measure for removing/reducing microbiological contamination. Reduction in temperature of processing must be carefully controlled and validated to ensure safety.

Food businesses must demonstrate equivalent efficacy to 70°C for 2 minutes

Novel risk factors such as Hepatitis E still not fully understood in terms of minimal cooking processes
Any Questions?