Important (UK) foodborne pathogens, sources, vehicles, growth characteristics, onset periods, duration, symptoms and control measures

Pathogen	Source	Food vehicle	Growth temperature range (°C) (optimum)	Growth pH (range) (optimum)	Incubation/ onset period (duration)	Typical symptoms	Infective dose	Oxygen requirements	*Additional specific controls
Bacillus cereus Toxin in food (Tf) Toxin in intestine (Ti)	Soil, vegetation, dust and a variety of cereals, especially rice, dried foods and spices. Intestinal tract of humans.	Meats, vegetable dishes, milk, cream pastries, soups and puddings, fried, boiled or cooked rice, cornflour, vanilla slices, custards and other starchy foods e.g. potatoes and pasta	5 to 48 (28 to 35)	4.4 to 9.3 (7)	(Tf) 1to 6 hrs (12 to 24 hrs) (Ti) 6 to 24 hrs (1 to 2 days)	V, A, N, D (some) A, D (watery), V (some) F	Medium	Facultative anaerobe Spore former	• Thorough cooking, hot-hold (>63°C) or rapid cooling • Storing at correct temperatures • Avoid rewarming • Avoid cross-contamination
Clostridium botulinum Toxin in food (Tf)	Soil, vegetables, intestinal tracts of fish and mammals	Low-acid processed foods, bottled vegetables, garlic oil, mascarpone cheese, dried milk, meats, smoked/fermented fish and other marine products (especially in vacuum packs)	3 to 50 (20 to 30) (type E)	4.6 to 9.0 (7)	2 hrs to 8 days usually 12 to 36 hrs (several months)	Difficulties in swallowing, talking and breathing, vertigo, double-vision and paralysis of cranial nerves.	Very low (toxin) (fatalities common)	Anaerobic Spore former	• Strict control over processing low-acid canned foods (pH >4.5) • Use of nitrates • Discard blown cans or those with holes or defective seams • Thorough cooking • Strict control over smoking and handling of smoked fish (store in freezer) • Care in gutting and preparing raw fish • Strict attention to the shelf life of vacuum packed food (refrigerate) • Avoid cross-contamination • Temperature control
Clostridium perfringens Toxin in intestine (Ti)	Soil, sediment (widespread), intestinal tracts of humans and animals/sewage, raw meat, dust and insects	Beef (especially rolled joints), turkey, pork, chicken, cooked minced meat and other meat dishes, gravy, soups, stews and sauces	10 to 52 (43 to 47)	5.0 to 8.9 (7)	8 to 22 hrs usually 8 to 12 hrs (12 to 48 hrs)	A, D, V (rare)	Usually high	Anaerobic Spore former	• Eat immediately after cooking, store above 63°C or rapid cooling and refrigeration within 1.5 hours of reaching 63°C. Strict temp control. • Joints should not exceed a size of 2.25kg • Thorough reheating of foods • Separate raw/high-risk foods • Double-wash vegetables
Salmonella spp. *Infection*	Water, sewage, soil, birds, insects, carriers, intestinal tracts of animals, especially poultry and swine, raw meat, eggs, milk, melons, terrapins, rodents and reptiles	Beef, turkey, pork, poultry, eggs and egg products (especially raw or lightly cooked), cheese, salads, shellfish, raw milk, melons, almonds, dried coconut, baked goods, dressings (especially mayonnaise), bean sprouts and chocolate	7 to 47 (37)	3.8 to 9.0 (7)	6 to 72 hrs usually 12 to 36 hrs Up to 10 days in low dose outbreaks (1 to 7 days)	A, D, V, F, N, headache	Medium (low in milk and high fat foods such as chocolate)	Facultative anaerobe	• Sterilization and strict control of animal foodstuff • Slaughterhouse hygiene • Safe sewage disposal and chlorination of water • Screening of carriers or suspects • Avoid products made with raw eggs and not fully cooked. Use pasteurized egg. • Separation of raw/high-risk food • Thorough thawing and cooking of frozen poultry • Avoid raw milk, use heat treated • Temperature control • Vaccination of poultry • Acidification and reduction of a_w

Key: V=vomiting A=abdominal pain D=diarrhoea F=fever N=nausea M=malaise * Controls in addition to effective prerequisite programmes and HACCP

Important (UK) foodborne pathogens, sources, vehicles, growth characteristics, onset periods, duration, symptoms and control measures

HANDOUT HO 15 MODULE 4

Pathogen	Source	Food vehicle	Growth temperature range (°C) (optimum)	Growth pH (range) (optimum)	Incubation/ onset period (duration)	Typical symptoms	Infective dose	Oxygen requirements	*Additional specific controls
Staphylococcus aureus *Toxin in food (Ti)*	Hands, throats and noses of humans, boils and cuts, raw milk from cows or goats with mastitis and skin and hides of animals	Ham, turkey, chicken, pork, roast beef, egg products, salads (e.g. egg, chicken, potato, macaroni), bakery products, cream-filled pastries, luncheon meats, milk, dairy products, lasagne and fermented sausage	7 to 48 10 to 45 (for toxin production) (37)	3.8 to 10.0 (7)	1 to 7 hrs usually 2 to 4 hrs (6 to 24 hrs)	A, V (mainly), D (some), N collapse and subnormal temperatures	Medium	Facultative anaerobe	• Avoid handling food, use utensils • Good personal hygiene, especially regarding handwashing • Exclude handlers with respiratory infections involving coughing or sneezing • Cover cuts with waterproof dressings • Exclude persons with boils or septic cuts • Avoid the use of raw milk • Refrigeration of high-risk food • Rapid cooling, precool salad ingrdients
Vibrio parahaemolyticus *Infection*	Estuarine and marine waters and seafoods	Raw, improperly cooked or cooked recontaminated fish or shellfish	5 to 43 (30 to 37) (8 mins at 35°C)	4.5 to 11.0 (8)	2 to 96 hrs usually 12 to 18 hrs (1 to 7 days)	D (blood/mucus), N, A, F V (some)	Medium	Facultative anaerobic	• Cook fish well • Take care to avoid cross-contamination between raw and cooked shellfish and fish • Avoid raw shellfish • Refrigerated storage
Yersinia enterocolitica *Infection*	Soil, water, intestinal tracts of various animals (pigs, birds, dogs and cats), milk and raw pork	Meat and meat products (particularly pork), turkey, vegetables, salads, milk and milk products, shellfish (especially oysters)	0 to 44 (28 to 30)	4.2 to 10.00 (7)	1 to 5 days usually 24 to 36 hrs (1 to 7 days)	A, D, V (rare), F headache	Unknown	Facultative anaerobe	• Thorough cooking • Care with shelf-life of foods stored under refrigeration (psychrotrophic) • Prevent cross-contamination
Bacillary dysentery *Shigella sonnei* *Shigella flexneri*	Infected person/carriers - sewage/manure, water	Contaminated foods, water, milk, salads, parsley, fruits, sandwich fillings, bakery products, e.g. cream filled pastries and shellfish Faecal/oral route	N/A	N/A	1 - 7 days usually 4 days (2 - 16 days)	F, A, N, V, D (may contain blood/mucus)	Very low	N/A	• Exclusion of ill food handlers, or if close contact of case • Ensure safe water supplies • Satisfactory disposal of sewage • Heat treatment of milk • Approved suppliers • Washing/blanching of fruits and salads
Campylobacter jejuni	Soil, sewage, poultry, water, animals, raw meat and raw milk. Cats, dogs, rodents and some wild birds (ducks, geese and seagulls)	Raw milk, handling raw or eating undercooked chicken, other meats, meat products, water, bottled milk pecked by birds	28 to 46 (37 to 43)	4.9 to 9.5 (7)	1 to 11 days usually 2 to 5 days (1 to 7 days)	Headache, F, D (often bloodstained) A (colicky), N V (rare)	Low	Obligate microaerophilic	• Reduce contamination levels of raw meat/poultry (slaughterhouse hygiene) • Hygiene of harvesters • Washing hands after handling raw poultry/meat • Keep animals/pets out of food rooms/businesses • Avoid cross-contamination • Chlorination of water (care with irrigation) • Heat treatment of milk • Thorough cooking

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Important (UK) foodborne pathogens, sources, vehicles, growth characteristics, onset periods, duration, symptoms and control measures

HANDOUT
HO 15
MODULE 4

Pathogen	Source	Food vehicle	Growth temperature range (°C) (optimum)	Growth pH (range) (optimum)	Incubation/ onset period (duration)	Typical symptoms	Infective dose	Oxygen requirements	*Additional specific controls
Escherichia coli O157	Intestinal tracts of humans and animals, sewage, animal carcases and water	Raw or rare meats and poultry, raw milk and milk products, unprocessed cheese, salads, fruit, undercooked burgers/mince, cooked meats, buffets, fruit juice and seafoods.	3 to 46 (37)	4.4 to 9.5 (7)	1 to 8 days usually 3 to 4 days (2 weeks or longer)	D (watery/bloody) A, N Up to 30% develop haemolytic uraemic syndrome	Very low (fatalities especially young and elderly)	Facultative anaerobe	• Reduce contamination levels of raw meat especially at slaughterhouses • Effective separation of raw meat and ready-to-eat food (avoid cross-contamination) • Thorough cooking of meat especially burgers and mince • Double-washing salad vegetables and ready-to-eat fruit • Heat treatment of milk/apple juice • Hygiene of harvesters
Hepatitis A (viral)	Carriers, faeces, blood, urine and water	Water, shellfish, milk, icing/pastry glazes, fruit, salad, vegetables and fruit juices Faecal/oral route	N/A	N/A	15 - 50 days (1 week or longer)	F, M, N, A Jaundice		N/A	• Exclusion of ill food handlers • Ensure safe water supplies • Satisfactory disposal of sewage • Heat treatment of milk • Approved suppliers • Washing/blanching of fruits and salads
Listeria monocytogenes	Soil, sewage/effluent, water, vegetation and other environmental sources, carriers, birds and mammals	Raw milk, soft cheese, coleslaw, ice cream, raw vegetables, raw and cooked meat, raw and undercooked poultry, raw and smoked fish, pâté, jellied pork tongue, fermented sausages, salads and cook-chill products.	–1.5 to 42 (30 to 37)	4.4 to 9.5 (7)	1 day to 3 months (48 to 72 hrs)	Flu-like symptoms N, V, M, F, D, septicaemia, meningitis and abortion in pregnant women	Probably low for immuno-compromised	Anaerobic (microaerophilic)	• Strict stock rotation of refrigerated food and use within date code • Pregnant women to avoid risk foods, especially soft cheese and pâté • Thorough reheating of cook-chill foods • Avoid cross-contamination, especially in factories • Washing of ready-to-eat salads etc. • Safe sewage disposal/care with irrigation • Use of clean vehicles/crates for transport of raw vegetables
Norovirus	Infected person, environmental contamination (airborne spread) sewage/water	Ice, desserts, cold meats, salads, some fruit, shellfish. Faecal/oral route	N/A	N/A	10 - 50 hrs 12 - 60 hrs	V (often projectile) D (some) A, F, N	Very low	N/A	• Exclusion of ill food handlers • Approved suppliers • Washing/blanching of fruits and salads • Environmental decontamination of public areas
Typhoid (Salmonella Typhi) **Paratyphoid - salmonella paratyphi*	Carriers, sewage/manure, water	Water, milk, cooked meat, dairy products, coconut, salad dressings, salads, some fruit and vegetables (manure) Faecal/oral route	N/A	N/A	3 days to 1 month usually 8 to 14 days (Paratyphoid usually shorter) (1 to 8 weeks)	F, N, M, headache. Rose spots on trunk. Slow pulse. Anorexia, Spleen enlargement. Constipation or sometimes D (severe)	Low (some fatalities)	N/A	• Exclusion of ill food handlers • Ensure safe water supplies • Satisfactory disposal of sewage • Heat treatment of milk • Approved suppliers • Exclude carriers • Washing/blanching of fruits and salads • Hygiene of harvesters

**** Paratyphoid is less severe and symptoms may be similar to salmonella food poisoning.**

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