Explanatory notes

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MODULE 2

Bacterial growth

Pass through a number of phases
Lag - no multiplication (bacteria producing necessary enzymes)

The lag phase may be considered as the recovery period for bacteria subjected to unfavourable conditions, for example: too hot, cold, dry

Logarithmic - rapid multiplication

Stationary - numbers remain constant, i.e. number produced is equal to number dying (Factors involved -food, competition and waste)

Decline - numbers decrease, i.e. numbers dying exceed numbers produced

Growth ranges of specific bacteria

Psychrophiles — **Below 20°C (spoilage-refrigerators)**

Mesophiles — **20-50°C (pathogens)**

Thermophiles — **Above 45°C (canning industry-spoilage)**

Psychrotrophs — **Below 20°C but prefer above 20°C**

Binary fission

Reproduction by splitting into two
Speed varies with presence or absence of other requirements (food, moisture, warmth)
In optimum conditions it can be as quickly as every 10 minutes (1000 to 1000,000 in 1 hour 40 minutes) generally accepted as every 20 minutes

Mould

Chlorophyll-free fungi
Produce thread-like filaments (hyphae)
Form branched network of mycelium
Mould may be various colours including:
Black, white, green and pink
Optimum growth temperature 20-30°C
Can grow as low as -10°C
High humidities and fluctuating temperatures assist growth
Affects most foods
Normally mouldy food is "unfit for human consumption"
Stock rotation and "best-before" dates important
Some moulds such as *Aspergillus flavus* can produce mycotoxins
Moulds are usually aerobic

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Obligate aerobe	Grows only in the presence of oxygen e.g. moulds
Facultative anaerobe	Grows either with or without oxygen e.g. *Salmonella spp* and *Staphylococci spp*
Obligate anaerobe	Grows only in the absence of oxygen e.g. *Clostridium perfringens* and *Clostridium botulinum*
pH (acid/alkaline balance)	Most bacteria prefer around 7 (neutral) Below 4.5 most do not multiply Some bacteria can survive pH below 4.5 for some time, (e.g. *E. coli* O157) *Staphylococcus aureus* can survive relatively high salt levels
Protozoa	Single-celled organisms which form the basis of the food chain. Some are harmful (pathogenic) e.g. *cryptosporidium*
Viruses	Multiply in living cells Cannot multiply in food May survive several days outside living cell Mainly airborne and person to person spread (faecal oral route) Only small numbers required (10-100 particles) Onset period 15-60 hours (dose dependent) Norovirus or Norwalk-like virus (NLV) (up to 10% may be foodborne) Some diarrhoea Vomiting (often projectile) Abdominal pain Fever Nausea Fatalities rare Symptoms relatively mild Rotavirus (most common, but unlikely to be foodborne)
Water activity/ available water	Water needed to transport nutrients and waste Pure water a_W 1.00 Bacteria's preferred range 0.99-0.95 Some foods don't have enough "available water" for growth Some bacteria can survive dehydration as spores
Yeasts	Microscopic fungi Reproduce by budding Most are aerobic (obligate and facultative) Majority prefer acid foods (pH 4-4.5) Reasonable level of moisture required Many grow in high concentrations of sugar and salt Growth range 0°C to 47°C (Optimum 25°C to 30°C) Many used in food manufacture Some cause food spoilage