



THE UNIVERSITY OF  
MELBOURNE

# FOOD20006

## Food Microbiology & Safety

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Helen Billman-Jacobe





# Sources of microorganisms in food\_Fish

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# Intended learning outcomes

Differentiate between normal flora in plant and animal derived foods, contaminants, spoilage organisms, pathogens and functional organisms

Relate the intrinsic and extrinsic factors of food substances to how microorganism can grow and survive

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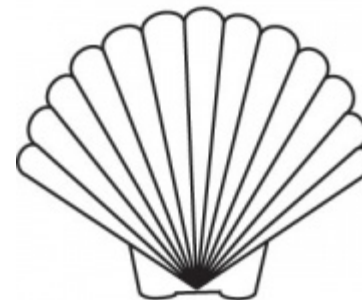
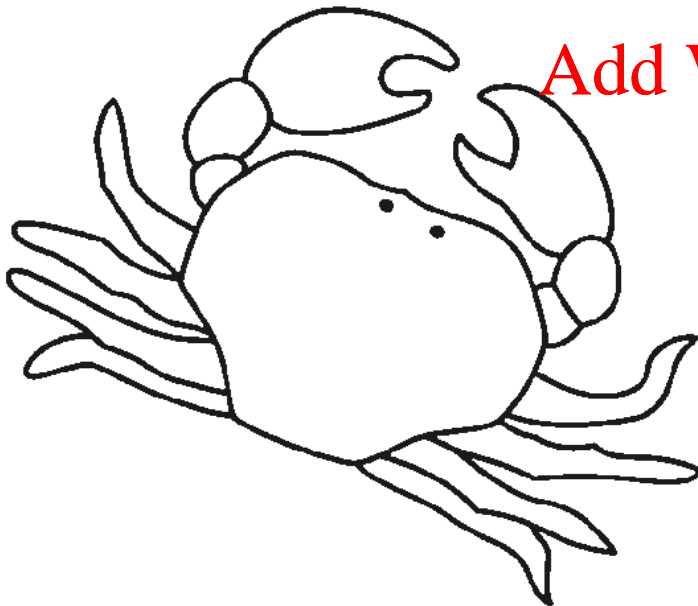
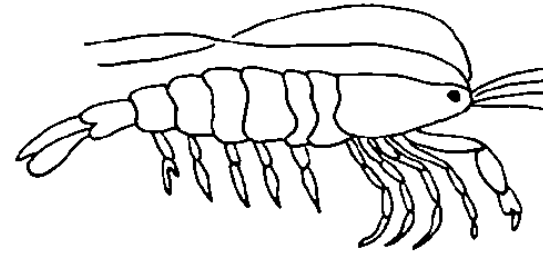
# Fish



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# Intrinsic factors

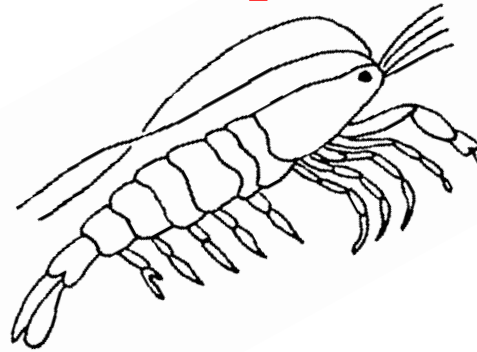
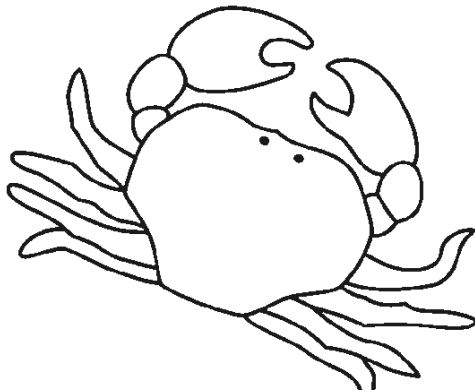
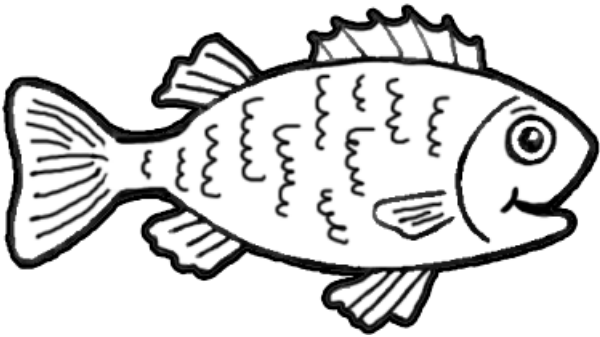
- may be up to 25% lipid
- Low amount of connective tissue
- 15 – 20% protein
- <1% carbohydrate

- The intrinsic factors on species and rearing environment

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# Microbes in fish

Muscle essentially sterile

Skin, gills and gut carry large numbers of microbes

Fish are cold blooded and the microbes that live on them reflect the normal body temperature of the fish

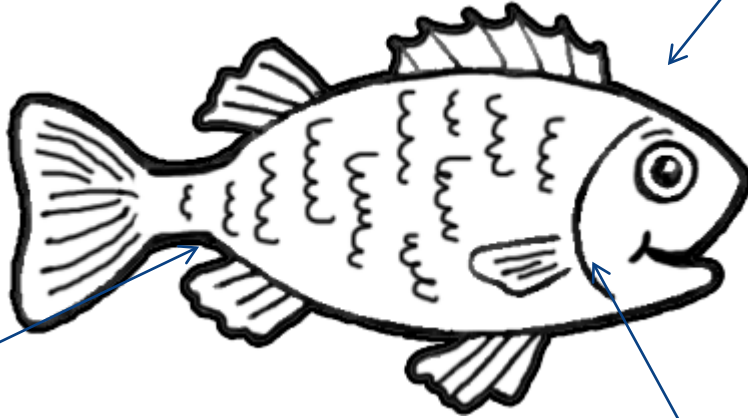
- Temperate waters -2 – 12°C

Bacteria associated with marine fish are likely to be salt tolerant: ~ 2-3% salt

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Skin  $\sim 10^2 - 10^7$  cfu/ml

Alimentary canal  $10^3 - 10^9$  cfu/ml

Gills  $10^3 - 10^9$  cfu/ml



# Farmed vs wild



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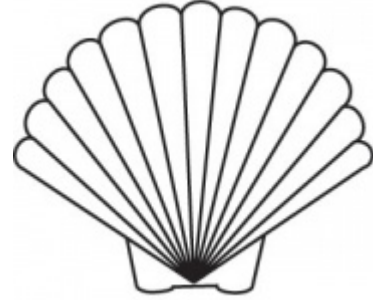
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# Molluscs



The flesh of molluscs differs from vertebrate fish and crustaceans

- It may contain up to 3% carbohydrate in the form of glycogen
- Molluscs are filter-feeders
- They filter small particles from large volumes of water
- They can concentrate microbes including viruses

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# Oyster farming

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# FSANZ Microbiological limits

n=number of samples, m=acceptable microbiological limit

Column 1	Column 2 (n)	Column 3 (c)	Column 4 (m)	Column 5 (M)
<b>Cooked crustacea</b>				
Coagulase-positive staphylococci	5	2	$10^2$ /g	$10^3$ /g
<i>Salmonella</i>	5	0	not detected in 25 g	
SPC	5	2	$10^5$ /g	$10^6$ /g
<b>Raw crustacea</b>				
Coagulase-positive staphylococci	5	2	$10^2$ /g	$10^3$ /g
<i>Salmonella</i>	5	0	not detected in 25 g	
SPC	5	2	$5 \times 10^5$ /g	$5 \times 10^6$ /g
<b>Bivalve molluscs, other than scallops</b>				
<i>Escherichia coli</i>	5	1	2.3/g	7/g



# Spoilage

Non-microbial spoilage: Fatty fish containing large amounts of polyunsaturated fats may go rancid

Most spoilage is of microbial origin

Very little carbohydrate in fish has 2 consequences

- there is little chance of acidification of the muscle  $\sim$ pH6.5
- Bacteria on the fish have to use nitrogenous compounds as an energy source → off odors

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# TMAO

Trimethylamine oxide is an osmoregulator in fish

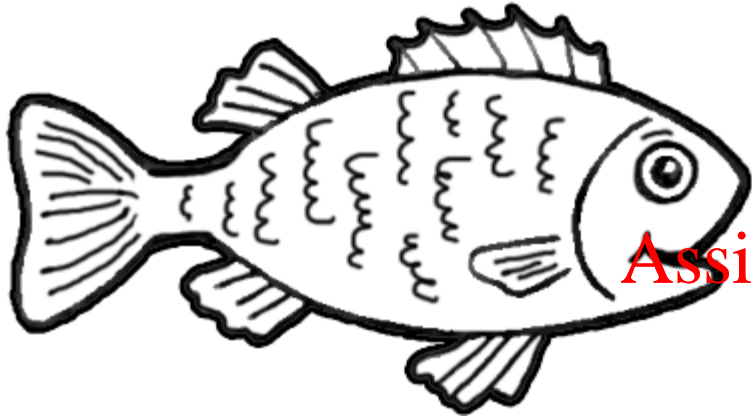
TMAO can be used by some bacteria i.e *Shewanella putrifaciens* under microaerophiic and anaerobic conditions



TMAO has a high redox potential

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# Off odors and flavours



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- TMA
- Products of protein decomposition
  - hydrogen sulphide
  - Methyl mercaptan
  - Dimethyl sulphide
  - Skatole (from tryptophan)

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TMAO and near neutral pH means that MAP does not improve keeping quality

Gaseous atmosphere

Extrinsic factors

humidity

temperature

Catch, gut then chill asap



Intrinsic factors

Water activity

High aw

Antimicrobial factors

Nutrient content

Fish protein rich  
Shellfish carbohydrate rich

Moderate  
pH 6.5

pH and buffering

High due to TMAO

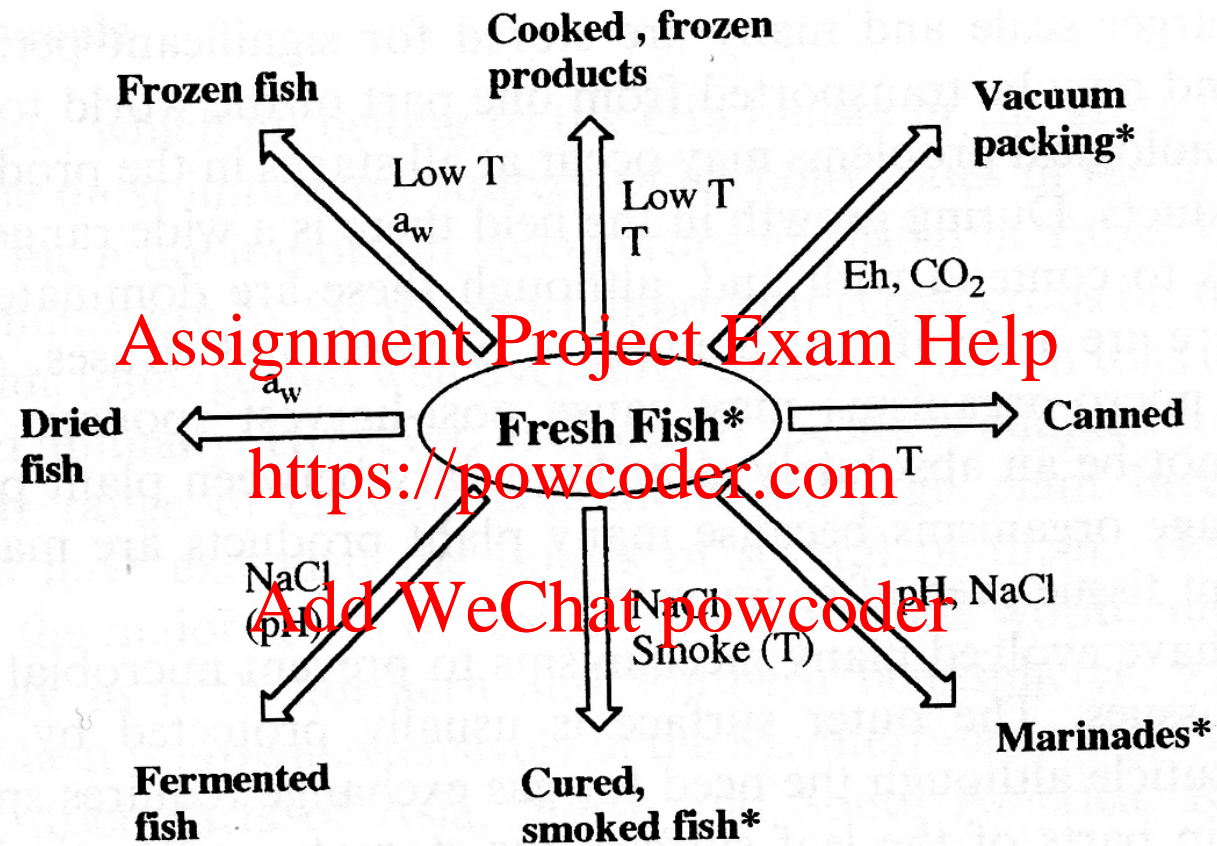
Redox potential

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**Figure 5.7** Fish and fish products. T indicates elevated temperature;  $E_h$  low redox potential; pH, reduced pH;  $a_w$ , reduced  $a_w$ , and \* stored at chill temperatures





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