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FOOD20006 Assignment Project Exam Help

Food Microbiology & Safety

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Factors influencing microbial growth in food : Intrinsic factors contd

Ray and Bhunia Ch 6

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Intended learning outcomes

Distinguish between intrinsic, extrinsic and implicit factors

List the categories of intrinsic factors in food that affect microbial growth

Describe the intrinsic factors of samples of food

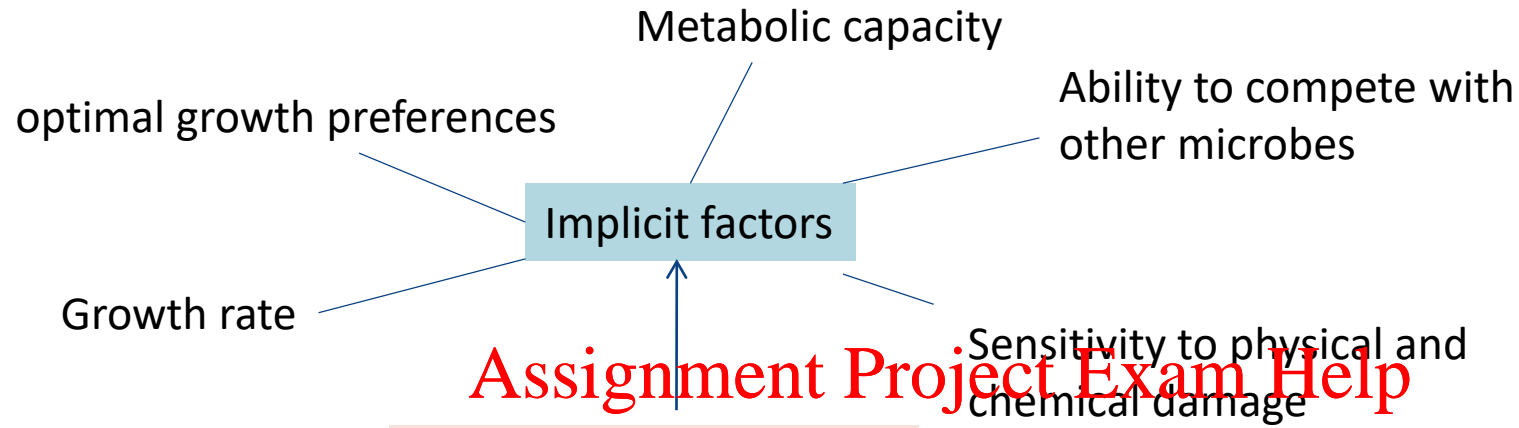
Explain how intrinsic factors affect the growth and survival of microorganisms in food

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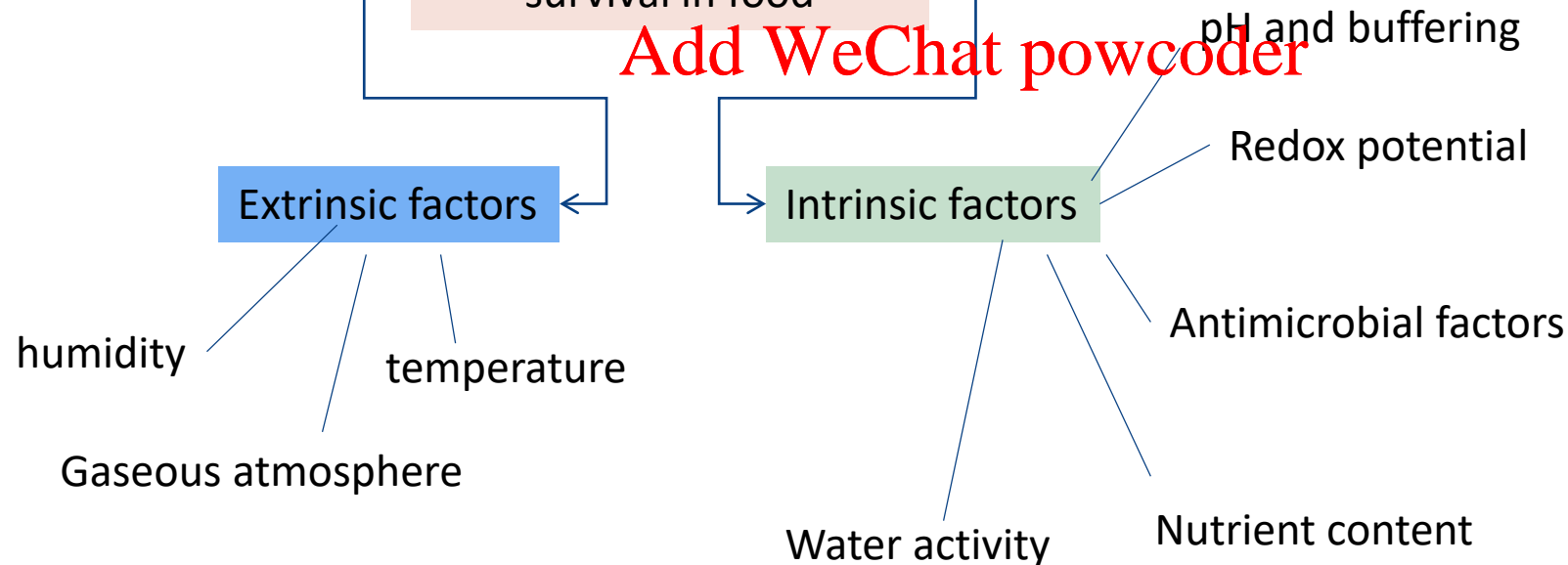
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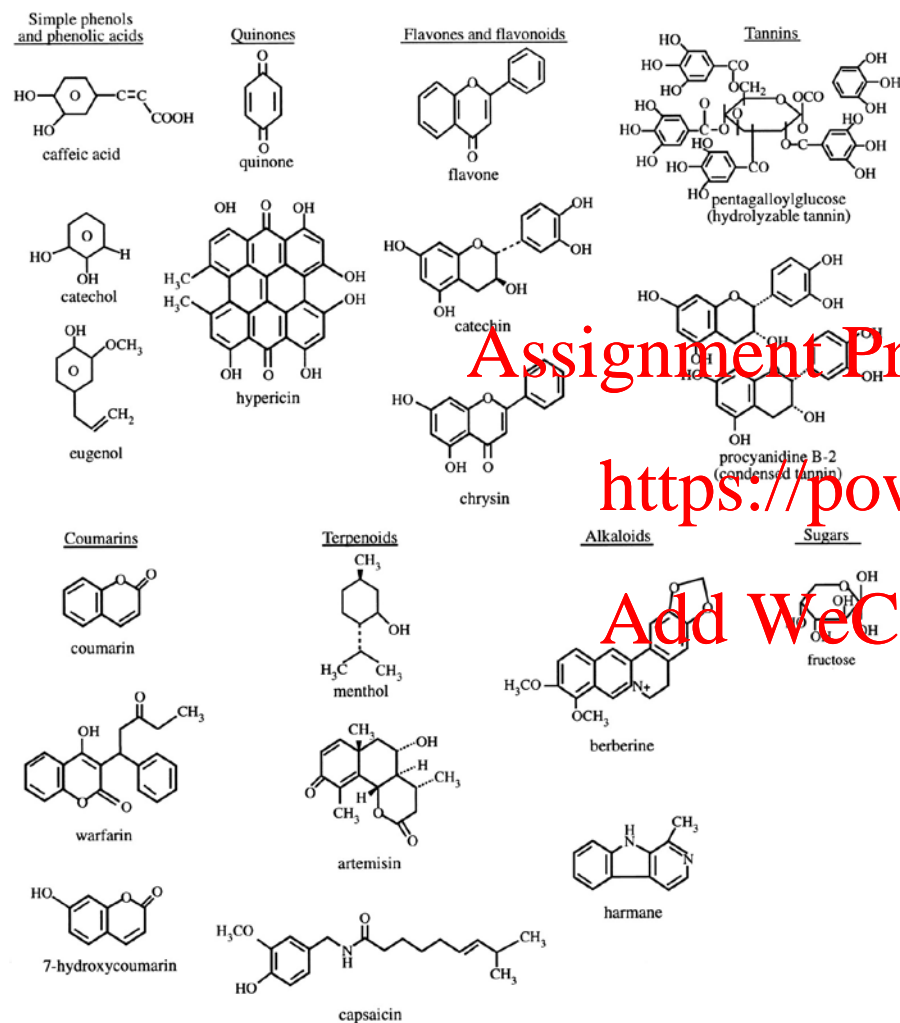
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Common antimicrobial plant chemicals



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Intrinsic factors: $\text{pH} = -\log[\text{H}^+]$

Profound effect on microbial growth!

- pH scale is –ve log, so factors of 10 between every unit
- neutral = 7, acid is lower than 7, and alkaline is higher

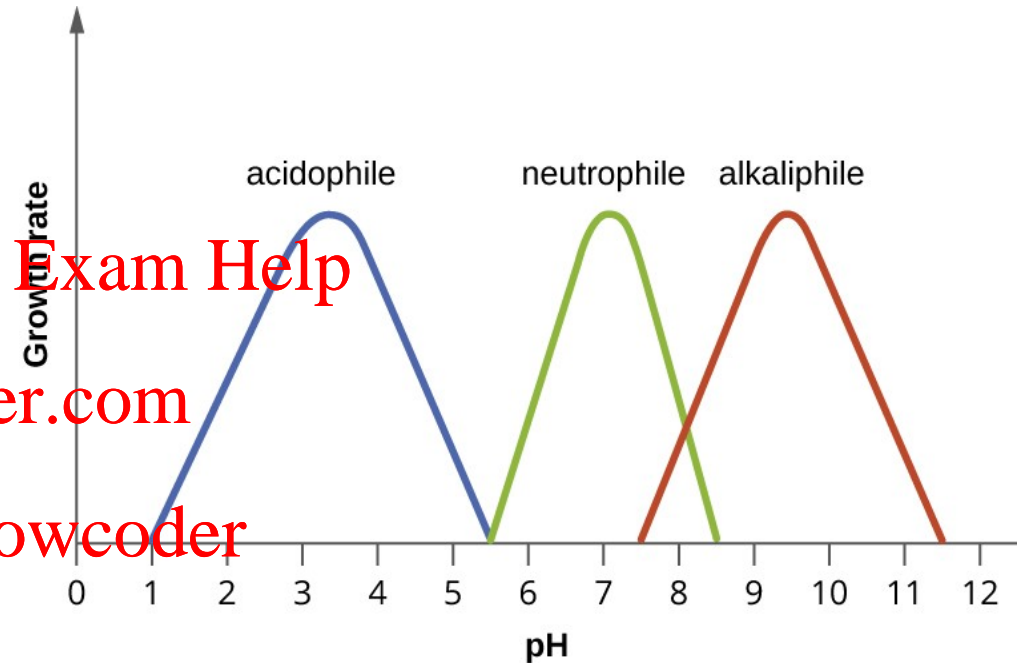
Preferred growth pH ranges of:

- Bacteria
- Yeasts
- Filamentous fungi

pH 6.0 – 8.0

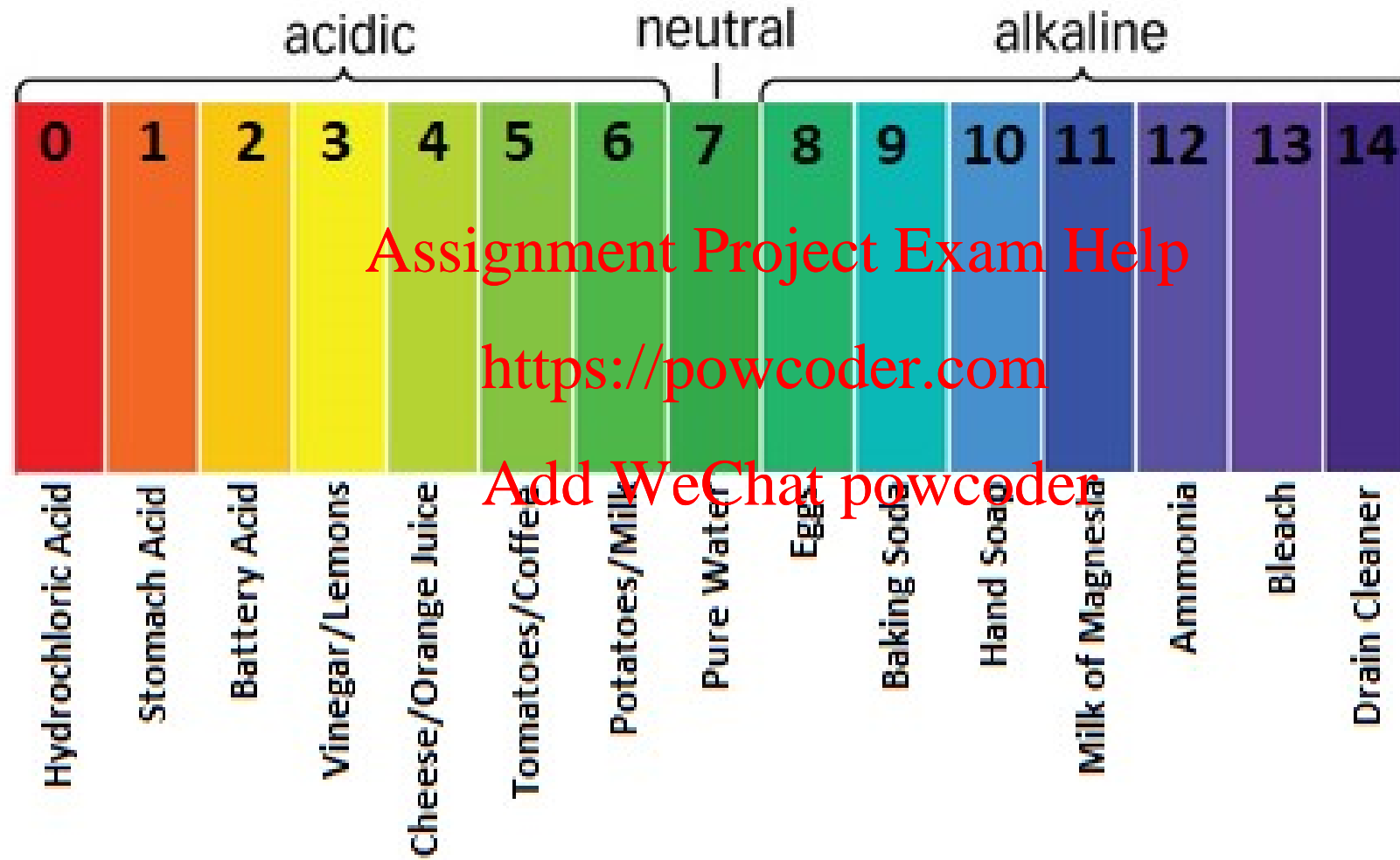
pH 4.5 – 6.0

pH 3.5 – 4.0



*microbial growth can alter pH, e.g. fermented foods

Food pH scale



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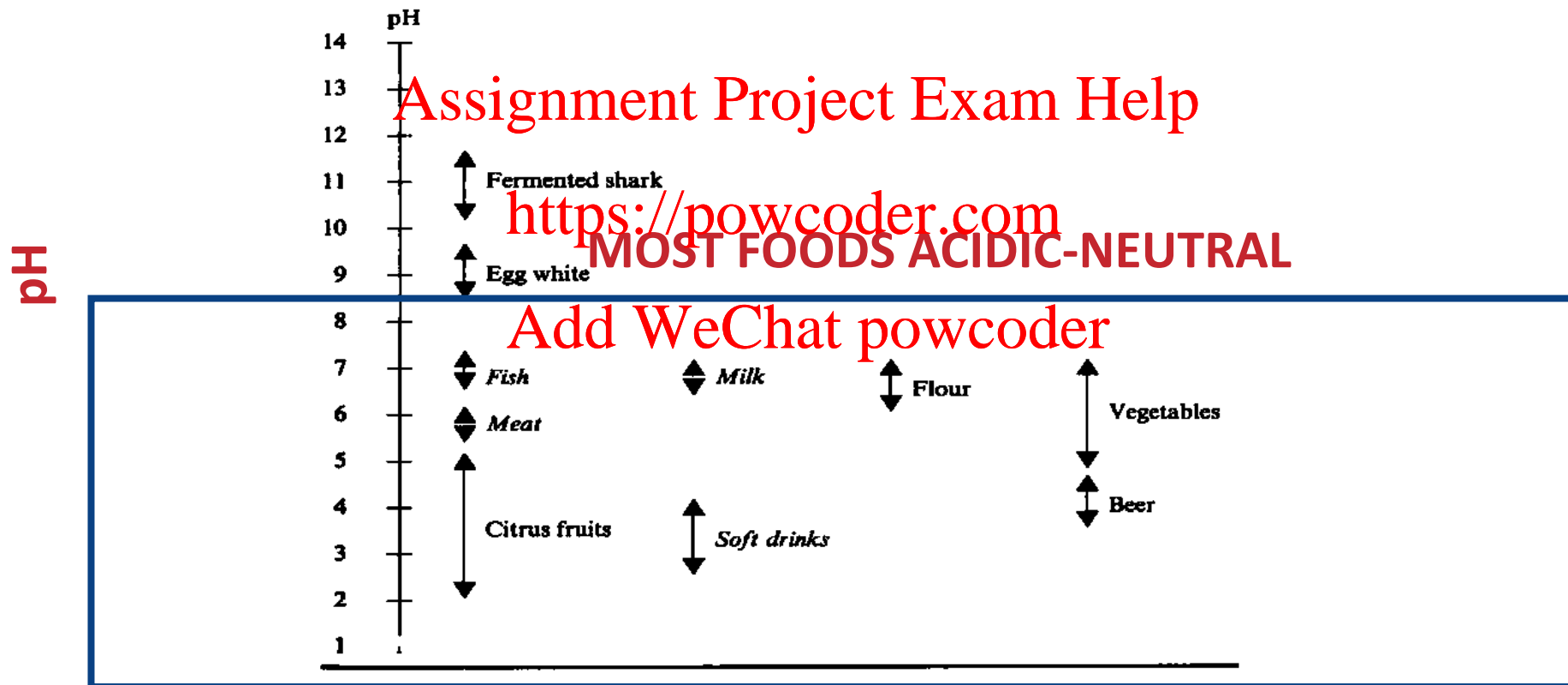
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Foods vary in pH

Chapter 3

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Table 3.2 *Approximate pH ranges of some common food commodities*



source: modified from p25, Adams & Moss 3rd Edn.

pH growth ranges of microbes

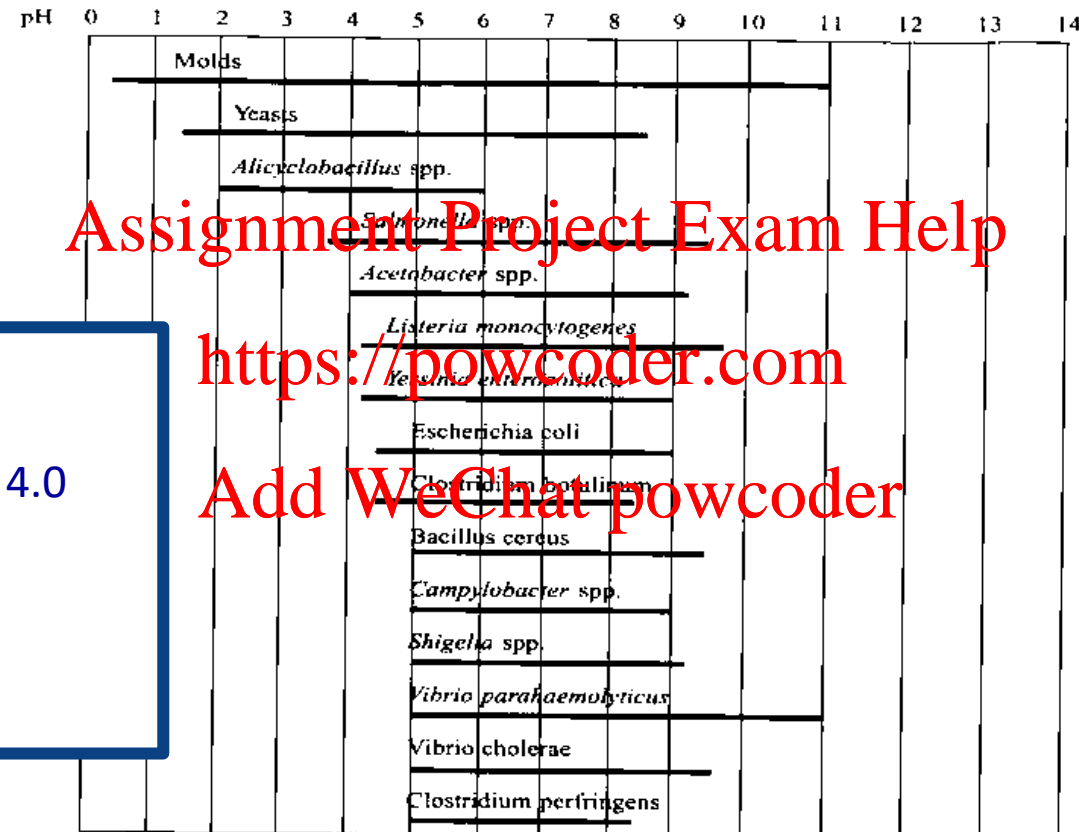


Figure 3-1 Approximate pH growth ranges for some foodborne organisms.

Optimum Growth ranges

- Filamentous fungi, pH 3.5 – 4.0
- Yeasts pH 4.5 – 6.0
- Bacteria pH 6.0 – 8.0

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pH effects on food

•1. <u>Flavour</u>	pH can provide sour, tart or acidic tastes in food. Eg. Citric acid
•2. <u>Texture</u>	pH can affect the water holding capacity of some foods, impacting texture. pH can also have an impact on the hard or softness of items such as cheese.
•3. <u>Appearance</u>	The pH level plays a part in changes in pigmentation as well as the development of haze in some products. Eg Anthocyanins in some fruits change colour depending on pH.
•4. <u>Shelf Stability</u>	pH works to prevent spoilage by inhibiting bacterial growth. Lower pH can inhibit microbial growth. <u>Most</u> bacteria will not grow at levels below pH 4.6
•5. <u>Fermentation</u>	pH can affect bacteria used in the production of fermented food E.g. For Yoghurt the required pH for this is ≤ 4.5 (FSANZ).
•6. <u>Safety</u>	Acidic pH levels can be used to control foodborne pathogens



Intrinsic factors: Water Activity

A_w = measure of available water for biological functions

i.e. water in its free (unbound) form

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- Ions and polymers (carbohydrates) can **bind water**, so making it difficult for microbes to use it for growth

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A_w of foods varies from 0.1 to a maximum of 1.0

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Moisture content and Water activity

Moisture content (%)

Amount of **bound** water + **free** water

Quantitative measure of the amount of water in a sample

Water activity (A_w)

Amount of **free** water

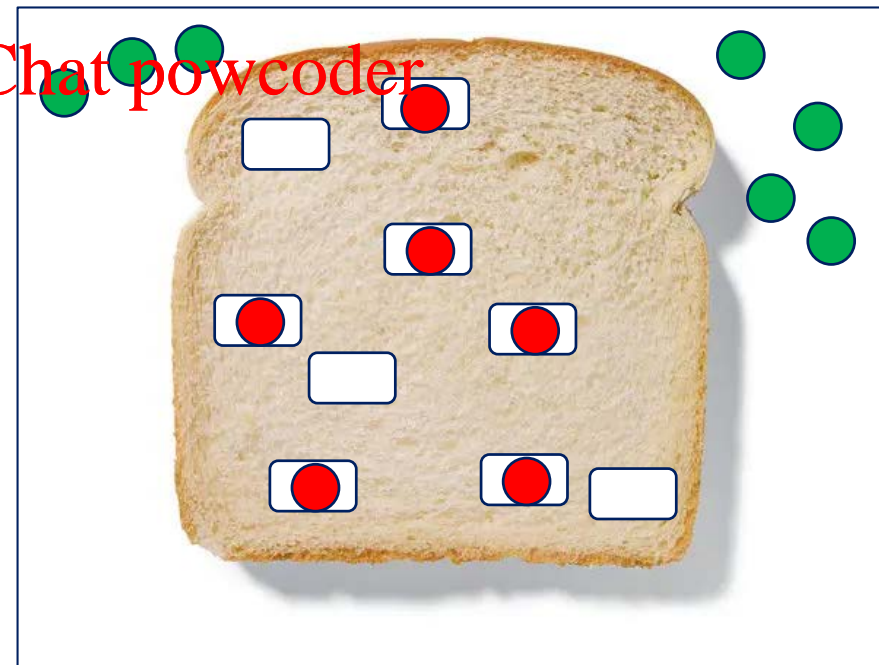
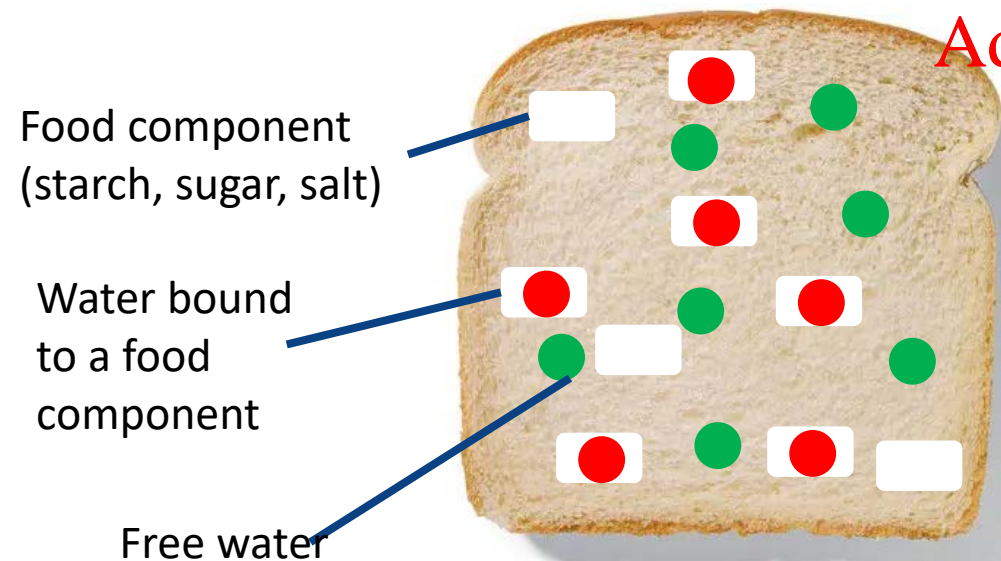
Qualitative measurement of the status of the water in a system

Microbes can use the free water

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Water activity (A_w)

- **Water activity** can be measured by placing a sample in a sealed measuring container.
- The vapor pressure of the **water** in the substance and the **water** in the air is allowed to equilibrium over time.
- The relative humidity of the air surrounding the sample is equal to the **water activity** of the sample
- The humidity can be measured using a device called a water activity meter





Intrinsic factors: Water Activity

A_w = measure of available water for biological functions

i.e. water in its free (unbound) form

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Most microbes can not grow below $A_w \sim 0.6$

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Most bacteria cannot grow below $A_w \sim 0.9$

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So this is a powerful means of preventing microbial growth



Intrinsic factors: Water Activity



Microbial groups able to grow at low A_w :

- **Osmotolerant** – can grow in the presence of **high concentration** of un-ionised organic compounds (e.g. sugary foods)
- **Xerotolerant** – can grow on **dry** foods (e.g. grains)
- **Halotolerant or Halophilic** – grow in the presence of high concentration of **salts** (e.g. NaCl, such as soy sauce)

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Limit below which microbes do not grow, $a_w \sim 0.6$

But if A_w increases again – then can allow dormant microbes to grow





Intrinsic factors: Redox Potential (Oxidation-Reduction Potential)

REDOX POTENTIAL: *the tendency of a medium to accept or donate electrons*, as measured against a reference electrode

The redox potential is designated by E_h and is measured in millivolts (mV)

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It is equivalent to the ability to oxidize or reduce

- A positive value, means it is oxidising (accepts e^-)
- A negative value, means it is reducing (donates e^-)
- E_h affected by pH and O_2

Redox potential of some foods



Water activity & pH

Potato

Apple

tea

Sweet biscuits

jam

Barley and split peas

rice

honey

pasta

crisp savoury biscuits



Lemon

honey

sultanas

toffees

sugar

tomato paste

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Intrinsic factors

nutrients

inhibitors

water activity

pH

Redox potential

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