THE UNIVERSITY OF MELBOURNE

FOOD20006

Food Microbiology & Safety

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Sources of microorganisms in food

Ray and Bhunia Chapter 3

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

Meat

Coles

MICROBES

Metabolic capacity

optimal growth preferences

Ability to compete with other microbes

Implicit factors

Growth rate

Sensitivity to physical and chemical damage

Factors affecting microbial growth and survival in food

FOOD

pH and buffering

Redox potential

Extrinsic factors

Intrinsic factors

humidity

temperature

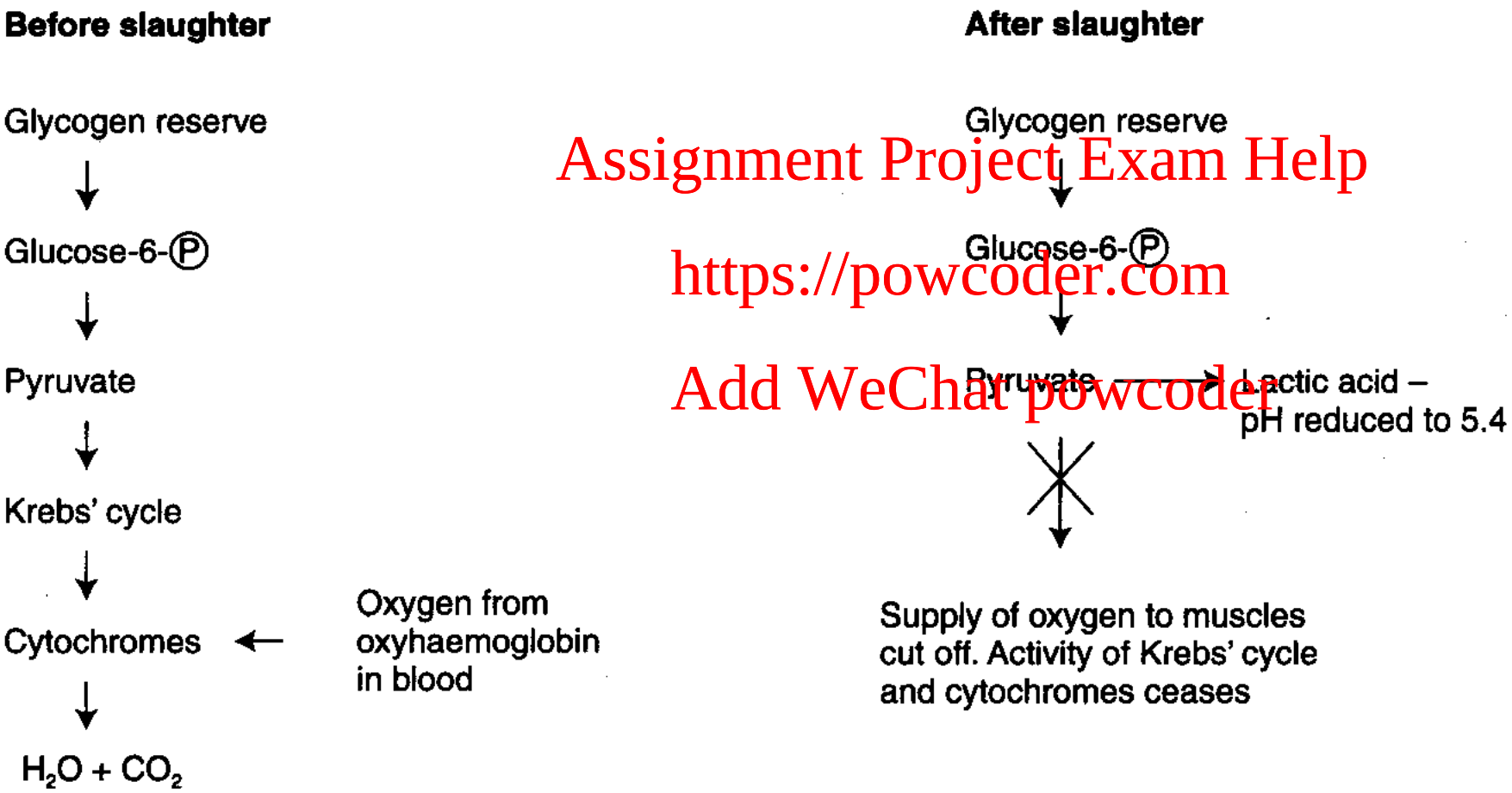
Antimicrobial fa

Gaseous atmosphere

Water activity

Nutrient content

Intrinsic factors: pH changes



Intrinsic factors: nutrients

Table 5.5 *Chemical composition of typical adult mammalian muscle after rigor mortis*

		% weight
Water		75.0
Protein		19.0
Myofibrillar	11.5	
Sarcoplasmic	5.5	
Connective	2.0	
Lipid		2.5
Carbohydrate		1.2
Lactic acid	0.9	
Glycogen	0.1	
Glucose and glycolytic intermediates	0.2	
Soluble non-protein nitrogen		1.65
Creatine	0.55	
Inosine monophosphate	0.30	
NAD/NADP	0.30	
Nucleotides	0.10	
Amino acids	0.35	
Carnosine, anserine	0.35	
Inorganic		0.65
Total soluble phosphorus	0.20	
Potassium	0.35	
Sodium	0.05	
Magnesium	0.02	
Other metals	0.23	
Vitamins		

After R.A. Lawrie, 'Meat Science', 3rd edn., Pergamon Press, Oxford, 1979

Intrinsic factors: Aw

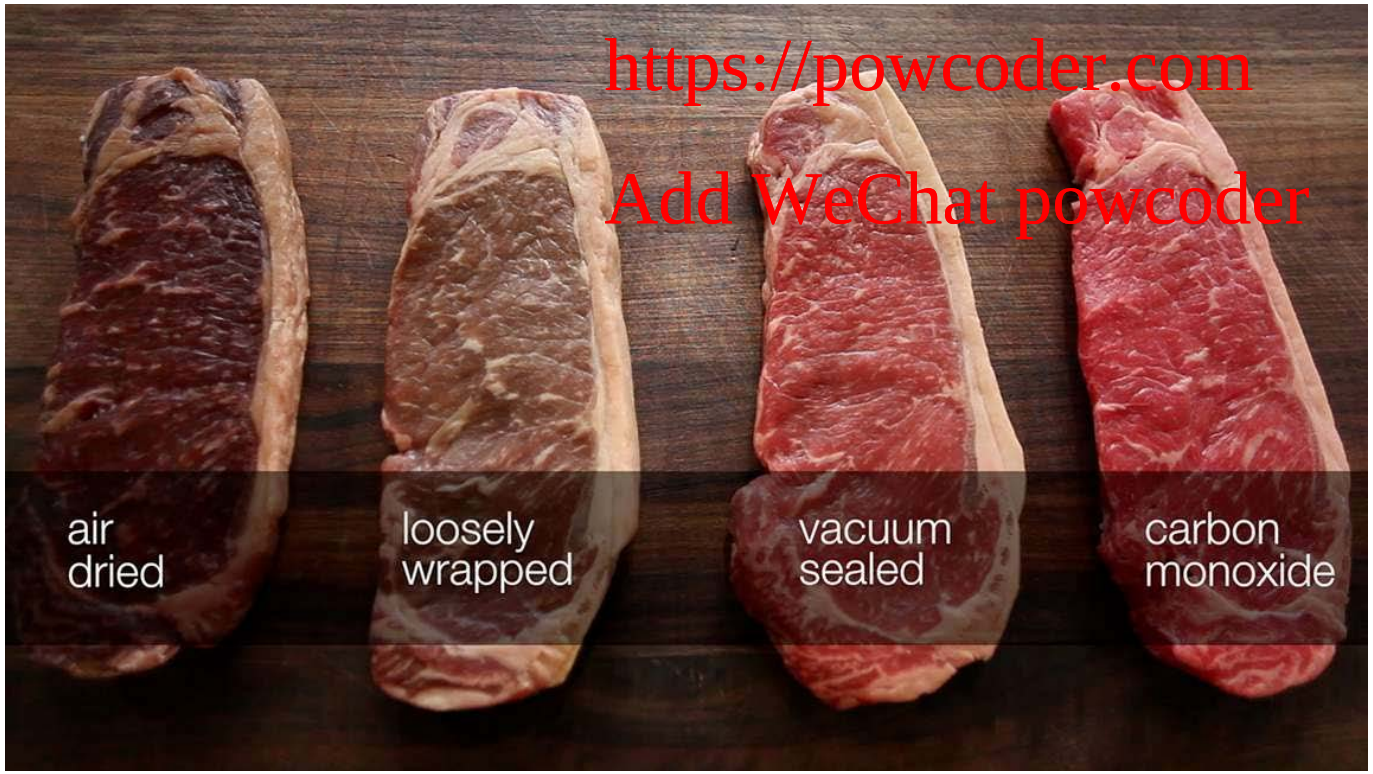
Nutrient content: water, protein and amino acids, minerals, fats and fatty acids, vitamins and other bioactive components, and small quantities of carbohydrates

Aw: high Aw. Drying meat is a common way of preserving it

Intrinsic: Eh

Eh: oxidative deterioration of meat leads to off-flavor development.

Oxidation of ferrous-oxymyoglobin (Fe^{2+}) to ferric-metmyoglobin (Fe^{3+}) occurs in the presence of some reactive species and produces discoloration of meat



Chefsteps

Meat: Spoilage organisms

Cause organoleptic changes in products

- Off odor
- Off flavour
- Bad taste
- Change in colour

Spoilage occurs at a bacterial density of ~10^7 cfu/g

One product is skatole made from tryptophan. It is foul smelling. The amino acid arginine can be degraded anaerobically to generate the amine putrescine

Amines such as putrescine and cadaverine formed by decarboxylation of amino acids are good chemical indicators of meat spoilage

Decarboxylation reactions of several other amino acids yield amines such as tyramine and histamine

Anaerobic degradation of sulphur containing amino acid yields H_2S

Intrinsic: Eh

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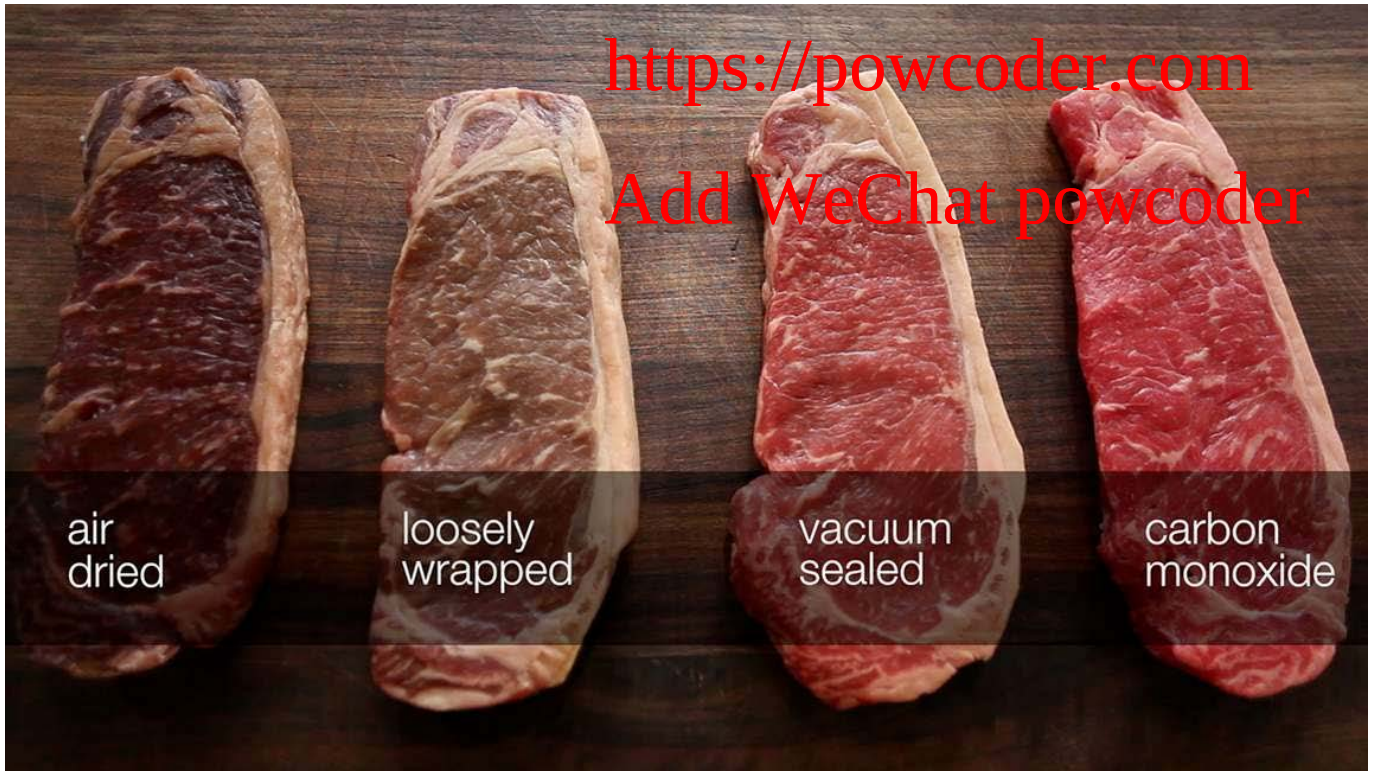


Chefsteps

Spoilage organisms

Packaging influences what can grow

- Aerobic
  - *Pseudomonas*
- Vacuum packed
  - *Lactobacillus*
  - *Brochothrix thermophatica*
- Modified atmosphere packaging (MAP)
  - *Lactobacillus*
  - *Brochothrix thermophatica*

Pseudomonas

- Predominant bacteria that are often associated with spoiled meat are *Pseudomonas,* which are motile, Gram –negative, rod shaped, aerobic bacteria.
- Digest proteins in meats into amino acids and foul-smelling compounds such as ammonia, amines, and hydrogen sulfide
- *Pseudomonas fragi* growing on meat surface uses compounds such as glucose, free amino acids, and lactate.
- Prefer sugars and metabolise amino acids when sugars are depleted glucose>lactate>citrate>glutamate>creatine-creatinine

Brochothrix thermosphacta

Gram-positive, non-spore forming, non-motile, catalase-positive, facultatively anaerobic, regular rod shaped bacteria. The optimal temperature for growth is 20-25º C.

Can grow at at temperatures a low as 0°C and under conditions of low oxygen concentration and high $C0_2$ concentration

Brochothrix thermosphacta can grow aerobically in the presence of 210 mM L-lactate

It can grow anaerobically at pH values down to at least 5.5 provided there is no lactate

B. thermosphacta is sensitive to undissociated lactic acid

Postrigor meat usually contains sufficient lactic acid to select against the anaerobic growth of *B. thermosphacta*.

Clostridium sp

Anaerobes
Spore formers
Toxins
Gas production
Psychrophiles

C. estertheticum - blown pack spoilage- H_2 and CO_2 gas

C. perfringens is commonly found on raw meat and poultry. It prefers to grow in conditions with very little or no oxygen, and under ideal conditions can multiply very rapidly. Some strains of *C. perfringens* produce a toxin in the intestine that causes illness.

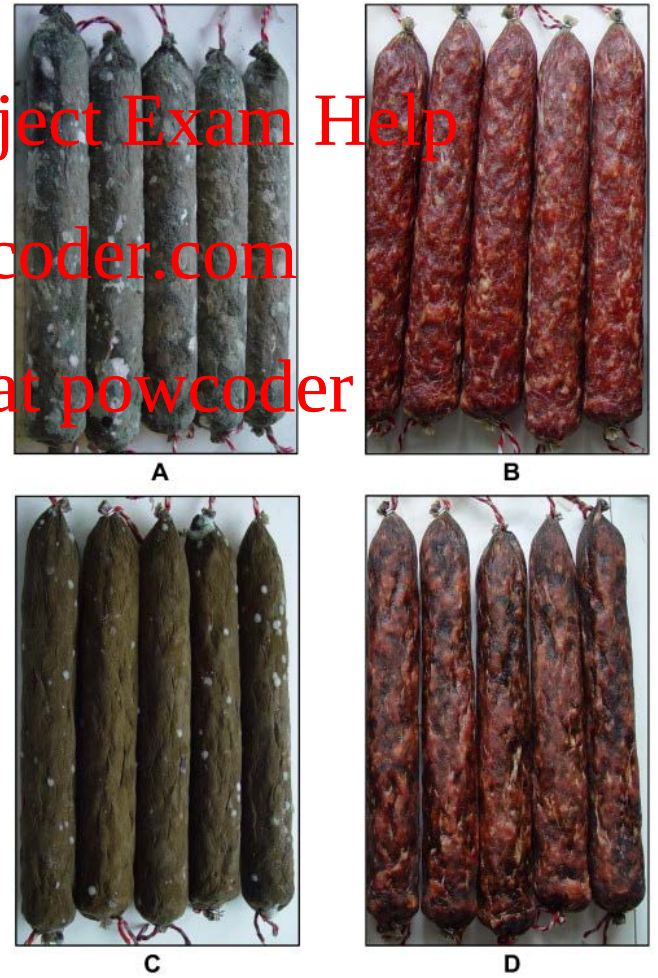
Yeasts and molds

Cladosporium (black spot) -dark mycelia which may be brown to blackish-brown or gray-green in color.

Pencillium corylophillum (blue green mold)

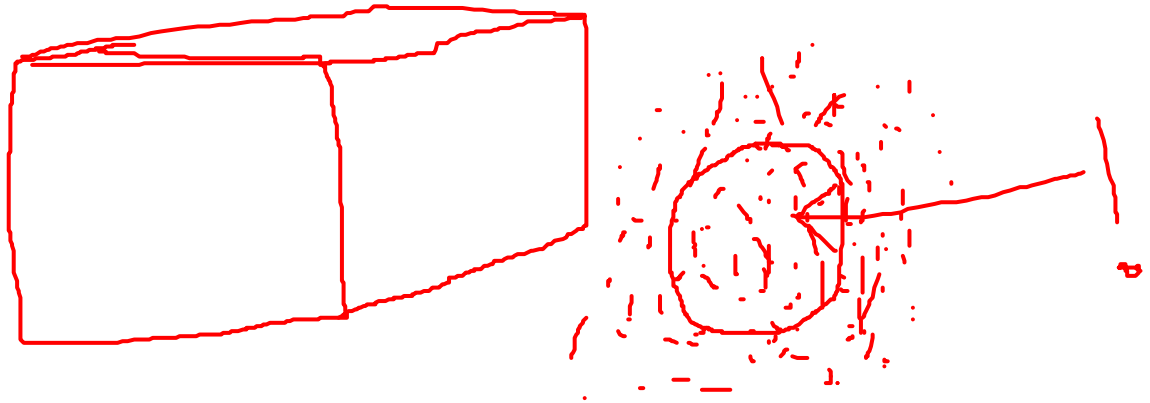
Thamnidium elegans (whiskers)

Spoilage. Rarely cause disease



https://doi.org/10.1016/j.meatsci.2014.10.003

Food Safety News



Most alarming to FSA officials was that respondents seemed to believe all red meats, whether ground or not, are equally safe. Nearly a third of them (32 percent) "incorrectly believe that eating a rare burger is the same as a rare steak when it comes to food poisoning risk."

"It's important that people realize that burgers are not like steak," said Steve Wearne, FSA's policy director. "Harmful bacteria can be carried on the surface of cuts of meat. When a rare steak is seared these bacteria are killed, but burger meat is minced so bacteria from the surface of the raw meat gets mixed all the way through the burger. These bacteria can remain alive on the inside, unless the burger is fully cooked through, no matter how good quality and expensive the meat."

http://www.foodsafetynews.com/2016/08/fsa-finds-brits-not-up-to-the-mark-on-best-burger-practices/#.W1vTWtIzY2w

Try the same exercise with this scenario

We are making a chicken casserole. Chicken was bought from the supermarket and then cut into pieces and coated with flour and seasoning (salt-and-pepper). The next step is to fry the flour-coated chicken in oil to brown it. The browned chicken will be added to a casserole with vegetables, herbs and stock and cooked in an oven at 180°C for 45 min .

Identify the sources of microbial contaminants of each of the ingredients used in this meal

Ingredients = chicken, flour, vegetables, herbs, salt-and-pepper, stock