

Acetic acid bacteria are non-pathogenic, gram-positive bacteria that have lactic acid as a primary metabolic end-product and are traditionally used in the production of yogurt.
 These products are used to prevent, diagnose or treat disease, restore or correct function, or maintain or promote health. **NHPs may be derived from plants, animals or micro-organisms."

FOOD DETERIORATION: Physical (abuse, stress, time, parasites, rodents), **Chem**(rxns, temp), **Biol** (heat, cold, light, oxy, gain or loss of moisture, dryness, food enzyme, **MOs**) **Perishable:** not proc/minimal shelf life less than 60 days (meat, veggies, fruits, milk) **Semi-Perishable:** b/w 2-6 months as a result of preservation methods. (ice cream, cheese, dry snacks) (**Shelf stable:** greater than 6 months (cereal grains, **DH** pasta, some frozen foods, canned, **DH** veggies) **deterioration is called senescence***

Microorganisms: 1) **BACTERIA:** fast growth, vegetative cells (active) or spores (dormant=depends on fav. conditions). 2) **YEAST:** slower growth but more tolerant to low pH & water activity. 3) **MOULDS:** even more tolerant to low pH & water activ.-spores-some used in mould fermented foods. 4) **VIRUSES:** agents of foodborne disease, dont cause food spoilage. ***Microbial Spores**=resist to many conditions-inhibit/cause death of vegetative cell (C.Botulinum) **ENZYMATIC: Polyphenol Oxidase:** enzymatic browning, w/in prod-catalyzes oxidation & prod brown pigments. **Food Preservation Object:** 1) minimize deterioration 2) Elim. potential microbiological harm to consumer 3) maintain quality + nutritional value while producing a safe product. **O2 REOS:** a) Aerobic=need O2 (bact, yeast, mould) b) Anaerobic=no oxygen (bacteria) c) Facultative Anaerobe=w/ or w/out O2 (bacteria, yeast). **TEMP:** Incr T=Incr rate of rxn until optimum achieved then denatures. **"CHILL INJURY"**=change in text/color of fruits and veggies-**REFREEZING**. **FREEZING**=causes emulsions to break & fat to sep. & denaturing protein-coagulates. **"FREEZER BURN"**=due to loss of moisture in solids/liqs-freezer.

Food Science: study chem, microbiology, physical + sensory props of food & their ingr during process + storage. **Nutrition:** effects of food in person who consumes it. **Food Technology:** uses info from food science & applies to approp technologies to ensure quality+safety. **Growth**= Soy Drinks=Drink yogurts=eggs=cereal/fruit bars=sports+energy drinks

CA (controlled atmosphere) slow down resp/ration + ripening proc (dec. senescence), extend storage life-3%CO2(dec), 3%CO2(incr), 94%N2(inert). **Production**=>**Processing**-(thermal, low temp, ferm)->**Consumer market**.

Apples: apple juice=pasteurized/caramelized-sterilized. AJ+yeasy-->Cider (flavs+ethanol)-(bacteria)->acetic acid (vinegar)

EX1: Mayo: water in oil (solid) (whole eggs+yolks) **Low Fat Mayo:** oil in water (liq). Oil is dispersed in vinegar with egg yolk (+ lecithin) as emulsifier. Yolk (high protein) surrounds oil droplets, droplets are immobilized (no flow) therefore water can't flow. **Light-er Mayo:** oil in water (corn starch +egg whites) **EX2:** Homomilk=milk fat in skim milk-Skim Milk=milk proteins (micelles) in water based medium.

Emulsifiers: have affinity for water-oil. amphiphatic (hydrophilic + hydrophobic regions), 2 sided molecule.

MACRO COMPONENTS: (add sweetness index)
CARBOHYDRATES: Organic, main source of E, digestible (4 cal/g), 50% of daily caloric intake, complex CH's better than simple CH's, occur in foods as sugars+ starches. SIMPLE carbs (mono/disaccharides): table sugar, sweetness determined by molecular structure + intxn w/ sensory receptors in tongue. COMPLEX carbs (polysaccharides): starch, fibre. **MONOSACCHARIDES:** Glucose (70-80), fructose (140), galactose (60)(not chemically bonded). **DISACCHARIDES:** split back by enzymes or boiling with dilute acids.

Sucrose (100SD): glucose+fructose (fruits, grasses, roots) (peaches, mango, white sugar). Sucrose hydrolyzed by enzyme (**INVERTASE**) w/ acid to a 1:1 ratio of glucose and fructose (**INVERT SUGAR**) **INVERT SUGAR:** substitutes part of sucrose in candy making. **Hygroscopic:** Affinity for moisture, prevents chewy candy from drying out. **EX4:** Honey nectar has sucrose, hydrolyzed by **invertase** in bee's saliva to a 40:60 ratio of glucose and fructose. NOT** 1:1, b/c some glucose converted to gluconic acid + hydrogen peroxide (act as preservatives) by glucose oxidase (enzyme in nectar)

Lactose (10-20): Galactose+glucose. Cows milk (4-5%), Human Milk (6-8%)
 Fermented (carbs to alcohols, CO2, organic acids) by lactic acid bacteria (yogurt,cheeses)-->lactic acid (acidulant, preservative).

Maltose (malt sugar)(20): Glucose+glucose. Formed from starch by enzymatic (amylase) or acid hydrolysis.-NOT invert sugar, b/c it starts off with starch.
PROPERTIES OF SIMPLE CH'S: (Hygroscopic)
 Sweetnes 2) Crystallizatio 3)Viscosity/Mouth feel
 4) Fermented by microorganisms 5)Antimicrobial agents
 6)Humectancy (water retention) 7)Reactants in non-enzymatic browning
 8)Caramelization (200) (non-enzymatic):heat sugar (redu+non-red), this produced aroma cmpds +brown pigments...caramelizing sucrose (in cola) 9)Maillard Browning-Reducing sugar(free OH)+ amino acids. Sucrose not reducing sugar, but INVERT SUGAR is. **Products of Maillard:** a) Low molecular weight: intermed. cmpds, aroma/flavours. b) High molecular weight: polymers of low molec weights (melanoidins)-brown-black pigments. [toast, roasted coffee, potato chips, breads, tanning lotions).

POLYSACCHARIDES: Insoluble in water, tasteless=diff than simple sugars.
 High molecular weight polymers or long chains of monosaccharide units. Form part of cellular structure + firmness of tissues. (cellulose,pectins, gums)- Energy reserve in animals + plants (glycogen, starch)
 Source: seaweed, plant exudates, microbial products.

FUNCTIONAL PROPS: 1) Stabilizers/thickeners/viscosity (act as thickening agents by incre. viscosity)
 2) Gelling agents 3) Fat Replacers

Starches: In plant materials as "starch granules" (cereal, tubers), starch molecules=densely packed 2 parts of starch molecules: Amylose (linear)+ Amylopectin (branched) ex: corn starch (1.3-amylose:amylopectin) **Amylose**=contrib. to gel formation, parallel, Hbond together
Amylopectin=give viscosity, bulky shapy, keeps them from bonding together (not gel formation).

GELATINIZATION: when starch is heated in water, the bonds joining amylose+amylopectin are weakened. This allows water molecules to move in and form H-bonds. Eventually, swollen starch.
DEXTRINS: starches can be partially hydrolyzed by acids or enzymes to produce products of intermediate chain length (dextrins)=in foods that provide sensation of fat but low in fat!

AFTER GELAT: linear amylose chains orient back to crystalline zone, alignment of amylose, lost water holding capacity (RETROGRADATION), water squeezes out and staleness. Retrogradation can be avoided w/ Dextrins or modified starches=decre. amylose alignment-accelerated by refrigeration temps, and partially reversed by heating. *Bread stales more quickly in the fridge than freezer bc water molecules frozen

2. FATS+OILS
 -Produce 9 cal/g -No more than 30% of intake. Dietary fats/oils, essential fatty acids needed.
 -FATS are triacylglycerols or triglycerides (glycerol+3 FA) (TG: C-16, C-18).
 -some foods have shorter FA (coconut oil C12), others have longer (fish C20, C22)

SATURATED FATS: no double C-C bonds, no kinks, solids @ room temp (pack together tightly-high mp)
UNSATURATED FATS: double C-C bonds, kinks-prevent bonding=oil
 (pack together tightly-low mp)-double bonds easily oxidized. (PUFA more reactive than MUFA).

PROPERTIES: 1) **Oxidative Rancidity** (improper storage, repeated expos. to high temp): double bonds + oxygen--> products (off flavs, carcinogenic cmpds)

PUFA/PUFA+heat: light, oxygen-->hydrogen peroxides->OHs, ketones, aldehydes.
Reduce Oxidative Ranc:
 a) proper storage pkgng (away from light, oxygen, warm temp) b) limit repeat exposure to high temp c) addition of antioxidants (natural+synthetic) d) Hydrogenation
Hydrolytic/Lipolytic Rancidity: cleavage of bond linking FA to glycerol-->release free FAs. Lipase enzymes.Triglyceride+lipase-->short chain (free) FAs+glycerol. **Partial Hydrogenation:** Used by food industry to harden liquid oils into semi-solid fats (margarine)-P.Hydrogenation of UFAs=Trans fats.
 -Hydrogen atoms are forced into the unsaturated double bonds in UFAs=-raises fats MP.
 -Cis UFA=mp=19 -Trans UFA=mp=43 (less prone to oxidize).
 -**Trans FA** lose kink, pack closer together, but not healthy!-behave like saturated fat, raise LDL cholesterol-Coronary Heart Disease, labellin required
FUNCTIONS OF FATS IN FOODS: Lubricant, Texturizing, Aeration, Aroma consti, High temp heating. Soften when heated, keep emulsification stable-sometimes emulsifiers. (**Stabilizers not same as emulsifiers:** they increase viscosity (keep droplets suspended or dispersed)(polysac). Homogenization: formation of a stable emulsion to prevent seperation, such as that in unhomogenized milk.

3. PROTEINS
 4 cal/g (0.8g per kg), excess into E or stored as fat. AA=amino group+carboxylic group
 20 AA's, and 9 essentials (in food)-Isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, valine, histadine (infants). 3-D Structure determines functional property+ nutritive value.
 -protein quality of animal protein higher than plant proteins
 -Plant Proteins: less digestible, less favorable ratio + quantity of one or more essential amino acids.

FUNCTIONAL PROPERTIES OF PROTEINS:
 1) Emulsifiers: amphiphatic-egg yolk proteins in mayo, mustard proteins.
 2) Foams: proteins coagulate to form fine film around air. Trap air bubbles & form rigid 3-D structure when heated or cooled. Solid Foams=when heated, protein denatures=rigid. (meringues, breads, ice cream)
 3) Gels: collagens, form 3d structure that traps water (gelatin gels, yogurt (milk protein when acidified), cheese, frankfurters(heating of meat proteins)
 4) Allergies: milk, eggs, fish, crustaceans, wheat, tree nuts**, peanuts**, soybeans, sesame seeds, sulphites.
 5) Enzymes:Promote chem rxn that's not spont., inherent in food or added in processing, ripening, heat

process=inactive enzymes +microbial organisms=longer shelf life.

CHEESE:Proteases=enzymes used for milk coagulation during cheese making
Isomerase=HFCS Pectinase=clarifies apple juice

4. WATER
 -Free water: available for all chemical, enzymatic rxns & for microbial growth.
 -Bound water: adsorbed on macromolecules +small molecules (sugars-salt*) not available for chemical, enzymatic or microbial activity.

-Water Activity (Aw)=measures available free water in foods for chemical, enzymatic, and microbial growth. (add solute--decrease vap press)
 Aw controlled by: 1) addition of solutes (bind water-salts, sugars), Physically remove free water (freezing, dehydration).
 -**Water Content**-total (measured), not related to water activity.

MINOR COMPONENTS:
 1) **Organic Acids:** flavour+tartness, used as antimicrobial agents, adjust pH or acidity of food ex: Malic acid (apples), citric acid (citrus fruits, tomatoes, strawberry), tartaric acid (grapes), lactic acid (yogurt, cheese, olives, saurkraut)
 pH=quantifies H concentration (ACTIVE ACIDITY)
 pH of 4.6=borderline low Acid+Low Acid.
 pH<4.6=strong juices, apple juice, strawberry, apples-will not support growth of disease causing microorganisms
 Low acid foods (pH>4.6)=meat, fish=use high temp for preserv.

Total acidity=TITRATABLE ACIDITY=measures the total acid content.

2) Colours+Pigments 1) Carotenoids: a) Carotenes-red in tomatoes (lycopene), orange in carrots (beta carotene). b) Xanthophylls-yellow(pineapple), orange (peaches, salmon)
 2) Chlorophyll: green pigments=apples, lettuce, celery, broccoli. Chloro a-blue-green hue (brocc), Chloro b-yellow-green hue (brocc stem)
 3) Anthocyanins & Anthocyanins (anthocyanidin+ sugars): blueberries, cherries, cranberry, plums, red cabbage. anthocyanins sensitive to pH change, color lost at high pH's.

3) Aroma+Taste Compounds:
 Aroma (volatile cmpds-low []'s) & taste (non-volatile) profiles of foods=FLAVOUR (present as part of food matrix-strawberries or modified during process/heating (cooked strawberries)).
4) Vitamins + Minerals No effect on flav, color, texture-low nat in diet.
Water Soluble=Vit C, B complex, Folic acid

Fat Soluble=Vitamins A, D, E, K...*If part of water ingredient=not additive=minor comp (for nutrition)...*If act as preservative=food additive -Vit C (ascorbic acid)=bleaching agent/preserv=stops oxidation/aging, antioxidants (slows rancidity/browning rxns). Vit E (tocopherols)=preserv=antioxidant. **Minerals:** chemical preoperites + textural character. (Ca, Mg, K, Na, Fe, Zn) **Natural Health Products (NHP)**=not food or drugs="medicinal ingredient"****Codex Alimentarius Commission: 1962-WHO+FAO International food standards (160 countries) FOOD ADDITIVE:** any substance, the use of which results or may reasonably be expected to result in it or its by-products becoming a part of or affecting the characteristics of a food. a) Maintain nutritional quality b) enhance stability/shelf life c) Make the food attractive without deception d) essential aid to food processing *Doesn't include: nutritive materials, vitamins, a.a, minerals, spices, seasoning, flavoring Food pkg. drugs administered to animals consumed as foods, agricultural chemical residues (CONTAMINANTS) **ADI=acceptable daily intake**-dose which over an entire lifetime appears to be without appreciable risk **PDI=probably daily intake**-based on food consumption estimated...PDI<ADI=then approved.

Polysaccharide	Characteristics and Functional Properties
pectine	<ul style="list-style-type: none"> are structural polymers in plants form the cementing material between individual plant cells pectin affects texture of plant tissues used in jams and jellies as gelling agents in the presence of sufficient acid contribute to viscosity of tomato paste and ketchup contribute to the mouth feel and maintenance of particles in suspension (e.g. orange juice, unclarified apple juice)
agar	<ul style="list-style-type: none"> extracted from seaweed (kelp) used as a thickening agent
alginates	<ul style="list-style-type: none"> extracted from certain types of seaweed used as gelling agents keep solids and liquids in suspension in food juices
gum arabic or gum acacia	<ul style="list-style-type: none"> is a plant exudate from the bark of the acacia trees used as thickener and stabilizer in products like beer, soft drinks, ice cream
carrageenan	<ul style="list-style-type: none"> extracted from certain types of seaweed (red algae) used as a suspending agent to keep cocoa particles in suspension in chocolate milk
xanthan gum	<ul style="list-style-type: none"> produced by bacteria first isolated from rotting cabbage, now cultured in large fermentation tanks and purified. used in salad dressings as a thickening agent, which enables the dressing to cling to the salad components used as a suspending agent to maintain pieces of onion, red pepper, spices in a stable suspension.
cellulose and hemicellulose	<ul style="list-style-type: none"> are present in many plant tissues as supporting structures (e.g. the fibre in celery) are polymers of glucose that are indigestible along with pectin and the other carbohydrate gums form the indigestible portion of our carbohydrate intake that is known as dietary fibre
starch	<ul style="list-style-type: none"> are polymers of glucose digestible when cooked (e.g. rice, potatoes, etc.) used as thickening, suspending and gelling agents (read text below for more information on starch)

Fat Substitute	Description	Examples
Protein Based-Stabilize texture food	protein partially coagulated by heat, creates emulsion; microcapsulation; spheres of protein & water small "hydrophilic protein" which encase "oil"	Simplesse soy, milk (milk) or egg white protein; Cheesecake dust; wheyproteins & richness of fat; LA-Calc; soy lecithin; cream, yogurt, cheese cream, salad dressings; margarine; coffee creamer; soups, sauces.
Carbohydrate Based-somewhat less stable milk	sources: corn, potato, wheat, lupulina, cauliflower, starch, gum (maltodextrin & fibre)	Maltin; D-glucose; Car; D; others from non-gelatin to partially digest to D-xylich; Inulin; Isomaltose; no. frozen desserts, frosting, preservatives
Fat Based	Soybean Protein (4% FA allowed in yogurt must add ultramar A, B, C, E, K); not digest; compromised charge	Highly not approved in Canada, can without high temp, rich taste & creamy texture of fat; made of fat. Enzymes that normally breakdown fat can break it down (0-3%)

TARTERS: (BERRY: "MINT") (diacetic, some FAA's) (glycine, peptides-aspartates), synthetic sweeteners (saccharin, cyclamate), citroflavon, lead acetate.	ZSALTY: only sodium chloride+KCl=Salt substitute rarely; 3-5% weight; 5% salt; slightly salty (CaCl2=Very bitter); 0.5% Citric+Zinc=Sweet
INSULIN: promoted (H) organic; aromatic amino-acid; (aromatic, acidic, oleic, stearic, myristic, lauric, palmitic, phosphoric acids).	SIBITRIL: analysis (refine) in coffee, theobromine in chocolate; some acids (Nutsalts, CaCl2, a.v. xanthines; liquid sweetener, sharpness)
SILAMIN: (glycinate) "savoury" (hydrophilic/thermo entropic); polystyrene; no flavour on one, but (microencapsulate) intensity or quality of taste of another substance (INSB=monocyclic glucose-aldehyde may +sugar flavours; Malt-high carb; beads, level)	SOthers: (WATER)propyl-galactone (black tea=non-meltable); polyhydroxy-high mw; hydroxy-sugar alcohols; sucrose; cyclamate; sugar alcohols, xylitol, sorbitol, mannitol; gum

Classification	Growth temperatures (°C)	Characteristics
Psychrophilic	0 to 18	Psychrophilic grow well in cold temperatures, while Psychrotolerant have ability to grow and multiply in cold temperatures. Psychrotolerant are the major cause of spoilage in refrigerated foods.
Psychrotrophic	-10 to 35	Psychrotrophic grow well in moderate temperatures, being responsible for most food spoilage at room temperatures of 37°C. Psychrotrophic are also associated with spoilage in meat products.
Mesophilic	10 to 45	Mesophilic grow best at high temperatures. Most thermophilic organisms are spore-forming.
Thermophilic	50 to >100	Thermophilic grow best at high temperatures. Most thermophilic organisms are spore-forming.

Dispersed phase

Continuous phase

Name of Dispersion

Examples

solid liquid oil

liquid liquid gel

liquid liquid foam

gas liquid foam

gas liquid solid foam

liquid liquid emulsion

liquid solid emulsion

starches, proteins, some salt precipitates in water
 starch paste, pectin, proteins (jams, jellies, tofus, gelatin)
 whipped egg white, water frostings
 meringue, ice cream, bread
 milk, mayonnaise, salad dressing, butter, margarine

Non-Caloric Sweetener (made to replace sweetening agent)	Non-Nutritive Low-Calorie
1) Acesulfame Potassium (K)-SWEETIT, SWEETENE 200x sweeter than sucrose Heat stable, no calories, not metabolized (0 cal/g) based goods, gum, candies	1) Aspartame: 2 x (phenylalanine, aspartic acid)-180-200x sweeter than sucrose Degrades at high temp-time+cal; no effect on blood insulin/glucose levels DND (diabetes) does not metabolize aspartame degrades, PKU (phenylketonuria) cannot metabolize phenylalanine.
2) Saccharin (Santalol)-saturated molecule, 300 groups replaced with Cl, 500x sweeter as sucrose. Not metabolized, no increase in blood glucose/insulin levels.	2) Sugar Alcohols: Sorbitol, Mannitol, Xylitol, Glycyl, (Sorbit) as well as sucrose. Cooling/Dossett promotes both decay by increases in gluc/insul. Slow absorption=slower effect (0.5-0.5g/yr). Partially glycol. (1:1 S-C=2g)
ALLOWED IN CANADA: Acesulfame, Acesulfame K, Saccharin, Steviolone (low calorie 7000-13000x), Cyclamate, Saccharin (only in pharmaceuticals, in presp. as food additive).	SENSORY PERCEPTION OF FOODS: 1) APPEARANCE: Birefringent, special lighting 2) TEXTURE: Cutting (papal), Compression (squeezed) so it remains in one piece (bread), Tensile Strength (Teardrop/gelatin) apart-mulder), Shearing (none of food slides past another-gum).

Food & Drugs Act of Canada (Health products & Food Branch)	Consumer Packaging and Labelling Act (CPA)	Canadian Agricultural Products Act (CPA)-Meat Inspection Act.
<ul style="list-style-type: none"> food and drug regulations standards of identity and composition for health products food additives food safety regulations regulatory aspects of food safety grade standards for agricultural produce, meats, dairy products, eggs, fish and seafood meat, poultry, fish processing plant inspection fruit and vegetable processing plant inspection advertising regulations 	<ul style="list-style-type: none"> Consumer Protection Laws: avoid deceptive/unconscionable/unfair (sub) for human consumption if advertising commitment for diseases (2002) Consumer name of food country of origin Net weight & address Declaration of total calories, amt of fat, total sodium, fat, cholesterol, protein, vitamins, iron, high protein, sodium, iron, vitamins A, K, etc. for meat, eggs, fish, seafood nutritions (90 days or less) Use-by date Flavour: maintain info Product claimed/labelled 	<ul style="list-style-type: none"> Inspected fresh & veggie: Canadian Pork and Canada Standard same nutrient value. Meat & Poultry: multiple level, numbering (number covering that is media or slightly higher than AA-A-B-C-D)
<ul style="list-style-type: none"> weights and measures regulations public health inspection of retail stores and food service establishments inspection of provincially inspected meat processing plants and dairy processing plants 	<ul style="list-style-type: none"> Standards of Identity: what food is, defines food/ingredient Composition: Standards for spoiled meats of mandatory and optional foods (28 Divisions-Dr-16/food additive) 	<ul style="list-style-type: none"> Eggs: weight, cleanliness, soundness and shape of shell (stage and position), size of an egg (small -extra, abnormality egg blood spots)-A-B-C-Canada meet req.
<ul style="list-style-type: none"> public health inspection of retail stores and food service establishments 	<ul style="list-style-type: none"> Claims Allowed: 1) Not low in fat... +trans fat 2) Reduced fat: reduced fat content 3) Zero fat: no added fat 4) Light: reduced caloric content 5) No cholesterol: no cholesterol added 6) No sugar: no added sugar 7) No sodium: no added sodium 8) No fat: no added fat 9) No preservatives: no preservatives added 	<ul style="list-style-type: none"> 3) Eggs: weight, cleanliness, soundness and shape of shell (stage and position), size of an egg (small -extra, abnormality egg blood spots)-A-B-C-Canada meet req.

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UNSATURATED FATS: double C-C bonds, kinks-prevent bonding=oil
 (pack together tightly-low mp)-double bonds easily oxidized. (PUFA more reactive than MUFA).

PROPERTIES: 1) **Oxidative Rancidity** (improper storage, repeated expos. to high temp): double bonds + oxygen--> products (off flavs, carcinogenic cmpds)