Lecture 2 –

Food supply chain → processes, sales, production
Substantially transformed (minimally processed): e.g. single serve cut up fruit
Elaborately transformed (very processed): e.g. cake

Characteristics of fresh produce
perishable, seasonal, quality variation, fast handling, short delivery time, special storage and packing conditions

Dairy Industry
- 87% water, 3-4% protein, 3-4% lipids, carbohydrates
- 800 mil tonnes milk produced annually (global)
- Milk demand growing → pop growth, income increase, urbanization, western diets
- Australian dairy industry = 3rd largest rural industry, 43,000-100,000 indirect employment

Dairy supply chain
Farm → transport → packaging → transport → distribution depots → transport → consumer

Horticultural produce
Any edible part of a plant. Fruits from ovaries and vegetables from other parts of plant.

Fruit and vege composition
- 80% water, 2-40% carbohydrate, 0.5-7% protein
- rich in vitamins and minerals

Meat Industry
- Recommended 1-3 serves of protein
- Red meat – e.g. beef (slow twitch)
- White meat – e.g. chicken (fast twitch)

Ocean productivity
- linked to nutrient upwelling (cold deep water rises to the surface)
- majority of sea life found near continents
Fisheries: activities involved in catching a species of fish/shellfish, or a group of species that share the same habitat. Can be commercial, subsistence and recreation fisheries.

Benefits of fisheries:
- economy boost
- provide 17% global protein
- provides employment

Problems with fisheries:
- poorly managed
- over fishing

Main reasons consumption of sea food increased
- better health benefits
- ease of prep
- diverse range
- prices

Lecture 3 – Quality of fresh produce

Quality
- different products have different indicators for quality
- suitability of material for a specified purpose → depends on what it is being used for.
- measure objectively against criteria

Food safety → absence from harmful chemical, physical or biological contaminants
Functionality → properties that contribute usefulness

Importance of quality
product consistency, consumer acceptability, nutritional value, reducing processing wastage, trade (high quality attracts premium), consumers regard sensory properties most important

Monitoring quality and food security
Supply chain monitoring → traceability, compliance, inspection data, assessment of physical characteristics, chemicals analysis
- production increases should be achieved without loss of quality

Factors affecting quality
genetics, environment, processing, testing methods

How is quality measured
Objective (set criteria) and subjective (sensory evaluations)
- appearance, taste, flavour
- acceptability is not easy to measure (cultural and genetic differences)
- nutrition

Visual quality attributes
- shape, size, appearance, physical defects (mechanical/pest injury), blemishes (pathogens), flavour and overall acceptability

Importance of visual quality attributes
- appearance =halo effect (perception of overall acceptability)
- consumer associate colour with attributes

Spectral and imaging technologies = detect/reject appearance attributed
Visual quality charts/specifications = dictate limits of acceptability (L*a*b* system)

Textural quality attributes
ISO – combo of mechanical,, geometrical, and surface attributes perceptible by mechanical, tactile, visual and auditory receptors
Texture experiences by: lips, fingers, upper surface of tongue, jaw and teeth

More to mouthfeel than structure
- mastication, mixing with saliva, breakdown and adjusting temperature
- awareness of texture subconscious → expectations not met the reaction is negative
- texture interacts with other quality attributes – appearance, release of taste chemicals

Instrumental assessment of textural quality
Texture tests = compression test, shear tests, cut/break tests, tensile tests, rheological tests.
- texture analysis is complementary to physiochemical

analyses → particle density, porosity, chemical composition, thermodynamic properties

Taste and aroma are combined in flavour perception
Tastants – released during mastication and delivered to taste receptors on the tongue and mouth surfaces
Odorants – sniffed but also released from the food matrix to oral cavity headspace

Taste
bitter, sweet, salty, sour, umami
- detected by taste receptors
- receptors encoded by different genes

Sensory evaluation of flavour quality attributes
- discrimination testing
- preference/acceptance/hedonics testing
- descriptive analysis

Lecture 4 – Analysis of food for safety and quality

Measuring quality and safety
- specified and traced through supply chain from producer to consumer driven by regulation, marketing, consumer demand
- skilled practitioners

Types of samples analysed
- raw materials → determine delivery conforms to standards, assure consistency, evaluate new suppliers
- complaint samples
- competitors samples

Typical analyses
energy value, moisture, protein, fats, carbohydrate, sugar, dietary fibre, salt

Analytical methods
Physical and chemical analyses → measure specific properties or components, well defined, precise, accurate measures, difficult to relate properties of specific constituents
Functional tests → practical and relevant applications, measure collective properties, difficult attribute properties

Sensory methods
→ colour, taste, odour, visual appearance, size, shape, texture, firmness
Some instruments: colour and image analysers, texture analysers, electronic noses
Subjective: surveys determine consumer acceptability

Stages of typical analytical procedure
1. Sampling
2. Sample preparation
3. Measuring
4. Data processing
5. Verifying the procedure
6. Appropriateness of methods

Samples & sampling protocols
- portion of bulk material
- random, stratified, systematic, judgement

Sampling error, sample storage, replication
- Common sampling errors → uneven distribution, lack of randomness
- Changes after sampling due to inappropriate storage → loss of moisture, loss of volatiles, oxidation etc.
- Adequate replication

Choice of many methods for measuring stage
- high volume data collection (accuracy)
- traditional methods (spectrometric, chromatographic, enzymatic)

Near infra-red reflectance (NIR) spectroscopy
- each molecule vibrates in unique way
- vibrations interact with IR light (create unique spectrum)
- collects light

Error
- Systematic error (inaccuracy of observation)
- Random error (measurable values being inconsistent when repeated)

Accuracy and precision
- Accuracy = how close a measured analytical result is to the real answer (in centre)
- Precision = how close replicate results from the same sample (close together)

Systematic risk management protocols
- internationally recognised protocols for managing safety risk
- HACCP, establish max and min limits, critical control point monitoring, corrective action, documentation, validation

International standards organisation (ISO)
- provides assurance about an organizations quality management systems
- 150+ members, 16,000 standard protocols
- plan, implement, operate, maintain and update a food safety management system
- demonstrate compliance with statutory and regulatory food safety requirements
- evaluate and assess customer requirements and demonstrate conformity with those requirements that relate to food safety
- communicate food safety issues to their suppliers, customers and relevant interested parties in the food chain
- ensure that the organization conforms to its stated food safety policy

Lecture 5 – Biochemistry and physiology of fruit and vegetables

Fruit and vegetable
- diverse
- essential contribution to balanced diet
- Australian horticultural industry supplies 95% domestic demand
- Quality attributes in F&V influenced by range of biological characteristics
- trying to increase exports by 40% by 2020

Plant metabolism
Metabolism: chemical reactions that continually occur inside living tissues
Anabolism: synthetic metabolic reactions
Catabolism: degradative (destructive reactions)
Balance between anabolic and catabolic processes determines intrinsic shelf-life and storability of fruit and vegetables

Products of photosynthesis
- veg high in starch (>30%)
- water insoluble allows high cellular conc.
- Stored in large quantities in roots, stems, bulbs, seeds
→ polysaccharides (cellulose, pectin, hemicellulose)
- hemicellulose play role in texture and viscosity
- pectin breaks down during ripening and softening
- Fruit store carbohydrates as sugar
- % of soluble solids test maturity
- Sugar is major contributor in fruit and vege

Catabolic processes: respiration
- Carbohydrates are main substrates
- degradation of sugars release energy

Processes in Respiration
- aerobic or anaerobic
- In presence of oxygen, pyruvate enters Krebs cycle
- absence of O2, ethanol or lactic acid produced

TCA cycle
- most important energy liberating system
- source of organic acids in fruit and vegetables
- organic acids are stored in the vacuole where pH is lower than in the cytoplasm
- tonoplast damaged = leakage of acids damages cell

Respiration Rate and Shelf-life

Role of metabolism in produce quality
- Anabolic processes e.g. photosynthesis.
→ type of storage influences shelf life
- Catabolic processes
→ drives cellular biochemistry, include production of key metabolites and organic acids, loss of dry matter
Respiration rate is indicative of overall metabolism (measured by amount of O2 consumed and CO2 produced)

What affects respiration rate?
- age of tissue
- temperature
- O2 and CO2 concentration
- wounding

What affects post harvest and respiration rate?
Ripening → ethylene is a plant hormone synthesised by all cells. It is produced during fruit ripening. Fruit is classified as climacteric and non-climacteric

Climacteric and non-climacteric
Climacteric: give off a lot of ethylene e.g. banana
Non-climacteric: don't give off a lot of ethylene e.g. blueberry

Postharvest handling and storage
Precooling:
- removal of field heat (hydro-cooling, vacuum cooling, forced air cooling)
Cold chain:
- refrigerated transport and storage (e.g. refrigerated loading areas, avoiding delays, monitoring product temperature, quick transfer)
→ optimal temp 0 degrees, freezing point is -3 – 0.5 degrees
→ chilling sensitive
Storage before threshold causes discolouration, pitting, ripening disorders, off flavour and odour

Ethylene is suppressed by:
- low temperature (0 degrees depending on fruit)
- high temperature (35 degrees)
→ deliberately administered to induce ripening

Postharvest handling and storage
Ethylene – can be controlled in non-climacteric as well as non-climacteric fruit. It increases respiration rate and reduces shelf-life. Can have detrimental effect on produce shelf-life and quality
Ethylene inhibitors:
- 1-MCP → blocks ethylene receptors
- AVG → inhibits ACC synthase and applied pre-harvest

Lecture 6 – Postharvest physiology and biochemistry of fruit and vegetables → factors affecting quality

Quality attributes of horticultural produce
- genetics
- crop nutrition
- agronomy
- pollination
- pest and disease
- colour change → loss of colour caused by degradation of pigments

- enzymatic oxidative browning → caused by release of phenolic oxidizing enzymes from breakdown of cell membranes or mechanically damaged tissues
- Physical damage due to handling
- Pressure or compression damage
- Vibration damage

- firmness and texture are most closely associated with cell wall structure and composition. Primary cell walls comprise of rigid cellulose microfibrils held together by network of hemicellulose and pectins
- Storage – tendency for water to move from produce to atmosphere
- Greater the SA:V = faster the rate of water loss

- Genetics, environment, cultural practice and nutrition impact flavour through effects on plant development.
- Harvest at optimal maturity is critical to achieve maximum flavour quality
- longer time between harvest between eating = loss in aroma