Food technology – summary of key points

This HSC Hub resource includes summaries of key points for the units the Australian food industry, contemporary nutrition issues, food manufacture and food product development.

## ****The Australian food industry****

* + 1. Sectors within the Australian food industry
* **Agriculture and fisheries (production)** - Cultivation of land to produce food derived from plants and animals, for example orange farm, tuna farm.
* **Food processing and manufacturing (processing)** - Any form of processing that food undergoes before being sold to the consumer, for example Bulla, Coca-Cola.
* **Food retail (distribution)** - Places where consumers can purchase processed food items, for example Coles, market, bakery.
* **Food service and catering (consumption)** - Preparation and service of food to consumers, such as hospitality industry, for example canteen, restaurant, McDonalds.

#### Investigate an emerging technology in one sector of the Australian food industry

* **Manufacturing and packaging** - advancing technology, with the aim of producing better food products.
* **Biotechnology** - involves using micro-organisms on products in industry, to change human health and the environment, such as gene technology, making of cheese, wine, beer.
* **Genetically modified (GM) foods** - foods that have their original properties changed using gene technology.
* **Technology in food manufacturing and packaging** - technology has been used to extend shelf-life of food, make food safer (UHT kills bacteria) and gives access to better machinery, equipment to produce more, fasters, with less manual labour.
* **Forces behind change in food industry** - advance in science and technology (genetic engineered foods for example seedless tomatoes), concern for food safety (labelling), increase demand for healthy and nutritious foods (removal of fat, salt, sugar), rising community expectations for responsible production (ecological sustainability, organically grown, free range), and world or local issues (drought, economic or political change).

#### The potential risks and benefits of using emerging technologies in food production and manufacture

* **Genetically modified (GM) foods** - foods that have their original properties changed using gene technology.
* **Advantages**
  + produce foods resistant to insects or chemicals to increase yield
  + breed better plants, animals
  + health benefits (nutritionally enhanced)
  + economic benefits (maintain overseas competition)
  + reduce world hunger (higher yield produces more food).
* **Disadvantages**
  + environmentally damaging (unknown effect)
  + health concerns (cause allergies not known before)
  + Australia’s “clean, green” reputation may suffer.
    1. Aspects of the Australian food industry

#### Activities carried out in organisation/s within the food industry

* **Levels of operation and mechanisation** - The scale of production and the sophistication of technology used; there are four levels of operation.
* **Household** - Specialised, niche market, low yield (output), affected by external factors. Production is basic and at minimal quantities; equipment is restricted to home appliances; generally, less than five employees, for example homemade product at local market.
* **Small business** - Flexible, limited opportunities, local customer base. Production is a small scale; equipment not usually industrial; generally, five to twenty employees, for example the local butcher.
* **Large business** - Large profit, continual operation, great influence, removed from customers, likelihood of technical problems. Operate several stores of processing plants; production is a large scale and automated; equipment many processes are mechanised; up to twenty employees or up to one million dollar turnover.
* **Multinational** - Large produce, large profit, quality, continual operations, high employment, adhere to multinational codes, inflexible. Operate in two or more countries; large production output; highly sophisticated technology, for example Coca-Cola.

#### The impact of the operation of an organisation on individuals, society and the environment

* **Environmental impact** - ecological sustainability. Use the least amounts of natural resources to make products, and to replenish the resources for future generations.
* **Waste management**- -in food manufacturing waste is recycled or used to make other products, for example food waste into livestock feed, garden mulch, fertilisers, gelatines, pies, material waste recycled for new products or packaging.
* **Transport** - improved storage, light weight packaging, efficient transportation requires less fuel and deliveries, though products still travel great distance.
* **Food miles** - the distance food travels between production and consumption; aiming to increase localised eating.
* **Research and development** - carried out by individual businesses and the CSIRO. Benefits include increased exports, production of healthier and safer foods, improved profitability.
* **CSIRO**
  + works with farmers, government, research teams to develop innovative agri-food and processing technologies to increase prosperity and sustainability within agribusiness sector.
  + research areas may include biological approaches to farming, livestock health or welfare, pesticide or parricide control, health potential for processed foods, value added processes.
* **Quality assurance**
  + quality assurance – a process of ensuring standards are met; it is needed to ensure consistence in products. The system of HACCP.
  + quality control – the process, by which characteristics are measured, compared, maintained and acted upon if differences are found, for example size, shape, weight, colour, consistency.
* **Consumer influence** - A changing society demands a changing range of food products. Reasons for change include convince, practically, income, ethnicity, health or dietary concerns, technology.
* **Value added food** - a product that has its value or cost price increased by increasing the amount of processing it undergoes, for example tinned whole fruit and tinned sliced fruit. This is done by consumer’s wanting time saving, low skilled products.
* **Economic impact**
  + the food industry is a vital part of the economy, contributing to the standard of living through export earnings and employment and accounting for forty six percent of retailing turnover.
  + the Australian reputation of producing high quality products and being a reliable supplier contributes to export growth, with meat, wheat Australia’s largest export product.
* **Social impact** - food industry allows convenience and variety for society, though has been the cause of social health issues, for example obesity, heart disease, polluting our environment.
* **Lifestyle changes** - consumer behaviour that influence manufacturing: personal independence, increase focus on health and nutrition, increase acceptance of disorder and change, lack of food preparation skills.

### Policy and legislation

#### Career opportunities and working conditions

* As the food industry becomes more highly automated the need for unskilled workers will decline. Remuneration (wage) depends on skill level. Specialised equipment, environments.
* Shift work – casual or part time work.
* Characteristic employment in each sector
* Agriculture and fisheries (seasonal, long hours, casual work for example fruit picking, mechanisation has led to decrease employment), food processing and manufacturing (24-hour operations, shift work, office and factory workers), food retail and food service and catering (casual, youth workers).

#### Government policies and legislation and the impact upon the Australian food industry

* Policies and legislation
  + policies and legislations are enforced by business groups (for example Australian Dairy Corporation), advisory groups (for example CSIRO, National Heart Foundation), independent body (for example FSANZ) or government agencies (for example AQIS).
  + policies – to provide the overall philosophy of the government on an issue related to the food industry.
  + legislation – a law passed by governments at local, state or federal levels that can be amended or repealed but the law must first be put to parliament.
* Advisory groups
  + Food Standards Australia New Zealand (FSANZ) - an independent statutory agency that sets standards for food safety and sale. Responsible for development or review of food standards code, development of risk assessment policies, surveillance of food availability, monitoring and control of food safety, food product recall and research into food standards.
* Food Standards Code ensures food products abide by rigorous standards; collection divided into four chapters:
  + **Chapter 1:** general food standards (labelling, additives, used-by date, nutritional content).
  + **Chapter 2:** food product standards (quality, edibility).
  + **Chapter 3:** food safety standards (premises, equipment).
  + **Chapter 4:** primary production standards (production, manufacture).
* Australian Quarantine Inspection Service (AQIS) - part of Department of Agriculture, Fisheries and Forestry, working to protect Australian agriculture from contamination. Responsible for protecting from exotic pests, inspecting imported products, ensuring quarantine status of travellers, certifying agricultural exports and negotiating national or international trade agreements.
* Food labelling
  + Food labelling control
  + Food labelling regulations focuses on statements or words that must (requirements), must not or may appear on labels.
  + Food labelling requirements - name or description of food, product recall information (name, address of manufacturer and batch number), country of origin, ingredients, information for allergy sufferers, nutrition panel, date marking (shelf life), quantity, storage information, legibility (legible, prominent, in English), truthfulness (no false, misleading or deceptive representations).
  + No labelling - when directly from the supplier, food does not need a label.
    - 1. Government policies and legislation
* Local government
  + responsible for appointing an environmental health officer (EHO), inspecting food or food premises and building requirements (construction and alteration of food premises).
  + EHO’s under the Food Act inspect food premises; responsible for investigating complaints, educating those in the industry, inspecting a registered food business, checking the supplier of goods, issuing improvement notices or orders, ensure goods sold meet labelling and other legal requirements.
* State government
  + Food Act 2003 – ensure food is safe and suitable for consumption, prevent misleading conduct in connection with food sale.
  + WHS Act 2011 – protect the health, safety and welfare of employees in the workplace, by reducing work related accidents and eliminating risks.
  + Fair Trading Act 1987 – covers fair and honest business practises protecting consumer and traders.
* Federal government
  + FSANZ Act 1991 – ensure quality and safety in food, provide regulatory framework for industry, provide information to consumers about food, and establish rules for trade.
  + Trade Practises Act 1974 – ensure fair trading and protect the consumer. Addressing restrictive trade practice, unconscionable conduct, consumer protection, liability of manufacturer and importers.
  + National Health and Nutrition Policy – raise awareness to educate Australian, making responsible for their eating patterns and habits.
  + Trade Policy – ensure better trade conditions for Australia.
  + Competition and Consumer Act 2010 - covers most areas of the market: the relationships between suppliers, wholesalers, retailers, and consumers. Its purpose is to enhance the welfare of Australians by promoting fair trading and competition, and through the provision of consumer protections.
  + WHS Act 2011- provides a framework to protect the health, safety and welfare of all workers at work. It also protects the health and safety of all other people who might be affected by the work. All workers are protected by the WHS Act.
  + Food Act 2003- an act to regulate the handling of food for sale and the sale of food and examinations and testing of food.
  + Smoke free dining act- bans smoking in all outdoor eating and drinking areas apart from outdoor smoking areas of up to 50% of licensed premises. Patrons are permitted to take meals into outdoor smoking areas.
  + Protection of the Environment Operations (Clean Air) Regulation 2010- standards for certain groups of plant and premises to regulate industry's air impurity emissions and requirements on the control, storage and transport of volatile organic liquids.

## Contemporary nutrition issues

### Summary of key points

The decisions people make have social, economic, health and environmental consequences. Raising, investigating and debating contemporary nutrition issues enable individuals to make informed decisions and respond appropriately.

### Outcomes

* **H2.1** evaluates the relationship between food, its production, consumption, promotion and health
* **H3.2** independently investigates contemporary nutrition issues
* **H5.1** develops, realises and evaluates solutions for a range of food situations.

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### Diet and health in Australia

* **Malnutrition**
  + Occurs when nutrients are not supplied to the body in correct amounts; can cause over-nutrition (excess intake) or undernutrition (inadequate intake).
  + Health costs: health care is highest national expense (disease of affluence), loss of productivity increase price of goods.
  + Social service cost: income support paid to those unfit to work; ultimately a cost to taxpayers.
* **Over-nutrition**

Diet related disorders: obesity (caused by hormones, heredity or activity levels; result in excess adipose tissue and health problems), hypertension (result in heart failure, reduced blood flow, aneurisms), dental caries (caused by tooth decay; result in loss of teeth).

* **Undernutrition**

Diet related disorders: nutrition deficiencies (inadequate fibre, iron, calcium), eating disorders (anorexia, bulimia).

### Nutritional considerations for specific groups

Specific groups have particular nutritional needs depending on their: physical state, age, health status, level of exercise, nationality.

* **Aboriginal and Torres Strait Islanders**

Indigenous people have significant health disadvantages; low life expectancy (18 years less than non-indigenous person), alcoholism and obesity is experienced. Poor education, increasing poverty, inadequate access to health services and food supply (geographic isolation) all attributes to cardiovascular disease and type 2 diabetes.

Strategies to promote optimum health of indigenous people: health, hygiene and nutrition education programs (bush food, encourage physical activity, maintain cultural values), aboriginal health service officers (ensure health service is used), early intervention programs, improving supply, affordability of health foods in remote community.

* + 1. Nutritionally modified foods

Function foods – food that have been nutritionally modified to meet consumer demand (nutritionally beneficial); improve consumers health with fat replacements, artificial sweeteners, added micro-nutrients (enriched/fortified), added fibre.

* **Function foods**

Fortified foods: contain nutrients not originally in the product (for example orange juice with added calcium).

Enriched foods: contain nutrients added to replace those lost during processing.

Nutritionally modified foods: altered to improve nutritional characteristics (add/remove components).

* **Supplements**
  + Role of supplements

**Vitamin supplements**: vitamin deficiencies are rare in Australia (exceptions; pregnancy); excess intake of water soluble gets flushed out, fat soluble stores as fat.

**Minerals supplements**: intolerances (dairy sees lack in calcium), deficiencies in iron, calcium, iodine has seen increase of fortified foods.

**Protein supplements**: growth and repair cells, formation of enzymes and hormones, secondary energy source; excess intake can store as adipose tissue (weight gain).

* **Value of supplements**
  + Half the population self-prescribes on regular basis; seen as a nutritional insurance, to: safeguard against inadequate diets or illness, treat stress or illness, and enhance performance.
    1. Roles in promoting health
* Government role

**State and federal:** development of health and nutrition policy (National Health and Nutrition Policy), nutrition and health education (Dietary Guidelines), health care systems.

**Local:** inspection and licensing of food premises, provision of sport facilities, community programs (Meals on Wheels).

* **Food industry sectors role**
  + Agriculture and fishery: organic farming.
  + Food processing/manufacture: production of health foods (wholemeal, low fat, low salt, pro-biotic foods)
  + Food retail: promotion of health value and organic products.
  + Food service and catering: health options (vegetarian, gluten free).

**Private agency role**

Health programs (Weight Watchers, gyms), medical personnel.

**Community role**

Promote information (Nutrition Australia’s healthy eating pyramid), endorsement programs (Heart Foundation Tick), Healthy Canteen program in schools.

**Individual role**

Be well informed, educated, demand for quality and information.

* + 1. Active non-nutrients
* **Non-nutrients**– not essential but can enhance bodily functions.

Anti-oxidants: found in plant foods (vitamin A, C, E); control blood cholesterol levels and neutralise the action of free radicals in the body which reduces cancer. Phytochemicals are non-nutrient anti-oxidant (colour compounds: flavonoids, carotenoids), (bacteria: phyto-oestrogens).

* **Dietary fibre:** found in plant foods; absorb moisture in gut allowing faeces to pass easily, acting as fuel for beneficial bacteria; either soluble or insoluble.

Omega-3 fatty acids: found in fish and plant sources; strengthen heart and bloodstream/vessel, brain development.

* **Probiotics:** beneficial gut flora (bacteria); reduce gastrointestinal problems, improves digestion, maintains immune system; “Yakult”, “Inner Health Plus”.

Influences on nutritional status

* + 1. Health and diet
* **Obesity**

Leading preventable cause of death worldwide (65% Aus adults obese, with it increasing as age does); caused by excess kilojoule intake, lack of physical activity; leads to reduced life expectancy, health problems (heart disease, type 2 diabetes, sleep apnoea, cancers, osteoarthritis); diet and exercise most effective treatment.

* **Diabetes**

Body unable to control level of glucose in blood released from carbohydrates, normally controlled by insulin released from the pancreas; diet helps manage diabetes; foods with low glycaemic index (GI) don’t cause dramatic change in blood glucose level as they release glucose slowly in the blood.

* + Type 2 diabetes (maturity onset diabetes or non-insulin dependent diabetes mellitus) the pancreas does not produce enough insulin for normal control of blood glucose level, caused by insulin resistance from excess adipose tissue.
  + Type 1 diabetes is not diet related; caused by a condition where pancreases cells are damaged and cannot make insulin; low blood glucose levels (hypoglycaemia) cause dizziness, shakiness, fainting as body’s cells lose energy; high blood glucose levels (hyperglycaemia) can cause coma.
* **Cardiovascular disease (CVD)**

Cholesterol is an insoluble lipid transported through the body by lipoproteins (high density lipoproteins (HDL) take cholesterol out of the body, low density lipoproteins (LDL) deposited cholesterol on blood vessel walls, preventing blood flow).

* **Food sensitivity (allergies/intolerances)**
  + Allergy: occur when the body’s immune system responds to a specific food protein (allergen) an incorrectly identifies it as a dangerous foreign protein; the reaction between the antibodies produced to destroy the food protein and the allergen cause the symptoms of the allergy; skin prick testing is used to identify allergies; nuts, egg, milk, seafood, sesame, wheat, soy are common allergens. Coeliac disease is a condition where gluten (protein from wheat, barley, rye) damages the lining of the small intestine, with risk of bowel cancer developing.
  + Intolerance: a response to a specific chemical found in food; does not involve the immune system as the body is not responding to an individual protein. Lactose intolerance results when an individual has a difficulty in digesting lactose (main carbohydrate in milk); the lactose cannot be broken down or absorbed by the body so sits in the colon as a watery stood, producing gas and abdominal pain.
* **Lifestyle, cultural and social practises**
  + Lifestyle and physical activity

Modern lifestyles are largely sedentary, providing little need for sustained activity (increase working, increase car ownership, passive leisure and technology reduce activity).

* + Cultural beliefs

Food taboos – certain foods forbidden or unacceptable by social or religious customs, especially religious taboos, e.g. uncommon practise to eat dog in Aus, consumption of pig forbidden in Islam and Judaism, Lent festivals.

* + Social practices

Smoking: has become less socially acceptable as links with disease have become established; contributes to cancer and cardiovascular disease as free radicals which are present in tobacco damage body cells by destroying anti-oxidants in the blood.

Alcohol: consumption is accepted in moderation even encouraged (anti-oxidants in red wine neutralise free radicals); overconsumption is detrimental to health, contributing to malabsorption of nutrients, memory loss, liver damage.

* + 1. Media and ethical issues (advertising)
* **Ethical issues and responsible advertising**

Unethical for advertisers to lie, which is why they focus on positive points and avoid negative; advertisement bombards susceptible children (bright colours, fun characters), especially that of junk food, contributing to obesity; Advertising Standards Board (org. to monitor Australian advertising) band advertising of free toy with unhealthy food.

* **Promotion of health foods**

Increase in dietary disorders and health awareness increases advertising for healthy choice food and healthy body image; producing function foods to appeal to customers’ desire for health and wellbeing; use of words “healthy” and “nutritious” influence purchasing behaviours and improve product sales.

* **Promotion of fast foods**

Average Australians eat 4 meals a week prepared outside the home; duel families with busy lifestyles are targeted with fast, convenient food; Subway and McDonald’s “Healthy Choice” meals are targeting public trends toward health.

## Food manufacture

### Summary of key points

Developments in food manufacture have an impact on society and the environment. A knowledge and understanding of food manufacturing processes informs choices and encourages responsible patterns of consumption.

### Outcomes

* **H1.1** explains manufacturing processes and technologies used in the production of food products
* **H4.2** applies principles of food preservation to extend the life of food and maintain safety.

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* + 1. Production and processing of food
* **Unit operations**

Specific processes food undergoes during production.

* **Separation**

Passing liquid through a filter to removed solid particles, either physically (sieving: thorough mesh, filtration: through filter, centrifuge: rotating bowel e.g. salad spinner) or chemically.

* **Grinding/milling (size reduction)**

Reducing materials size (easy to handle, for final product, for a new product).

* **Mixing**

Distributing ingredients through a product batch.

* **Heating**

Increasing temperature of a product, either conduction: heat by direct contact, convection: heat by liquid or gas, radiation: heated by airborne particles.

* **Evaporation**

Increasing solid content of a product; liquid changed to vapour.

* **Dehydration**

Reducing moisture content of a product.

* **Cooling**

Reducing temperature of a product.

* **Freezing**

Changing water into ice.

* **Flow process charts**

Representation of production process; five basic symbols used individually or in combination (one on top of the other).

 Operation (material is changed in some way).

 Inspection (characteristics examined e.g. quality).

 Transport (material moved from one place to another).

 Delay (temporary stoppage preventing next process).

 Storage (material or complete product kept in storage).

* **Quality and quality control of raw materials**

Food manufacture – conversion of raw materials into a final product using physical and chemical processes.

* + Quality control of raw materials

Raw materials must: be free from contaminants, meet specific criteria characteristics for manufacturing (size, colour, moisture content, nutrition).

* + Raw material specifications
  + Description of material (moisture content, physical, sensory, chemical, microbiological characteristics). Sampling method for material (number of samples for quality assurance). Test for specific characteristics. Action after test (accept if meets criteria, reject if doesn’t meet criteria).
  + Quality management

**quality assurance** – a process of ensuring standards are achieved and maintained.

**quality management** – planning and managing to ensure the product meets expectations.

* **Hazard analysis critical control points (HACCP)**

System which identifies hazards within production, and methods for dealing with them; 7 Steps: conduct hazard analysis, identify CCP (critical control points), establish critical limits, monitor CCP’s, corrective actions, verification (assessment), documentation.

* **Workplace health and safety (WHS)**
  + Promoting and maintaining the physical, mental and social wellbeing of workers.
  + Equipment

Equipment needs to be: strong (operate continuously with large quantities), durable (reliable so production is not held up by breakages), hygienic (easily cleaned, scratch resistant), efficient (transport conveyers from one process to another).

* + Food additives

Substances added to food, during processing, that are not normally consumed by themselves.

* + Acids

Control acidity level. Anti-caking agents: ensure free flow. Anti-oxidants: prevent lipids turning rancid (300). Colours: restore or improve appearance (100). Emulsifiers: prevent oil and water mixtures separating (400). Flavours: restore or improve taste (600). Gums: improve texture (400). Humectants: prevent from drying out. Mineral salt: improve physical stability. Minerals: replace or add nutritious value. Preservatives: retard micro-organism growth (200). Propellants: expel food in spray. Stabilisers: disperse substances in mixture (400). Sweeteners: restore or improve taste (900). Thickeners: improve viscosity (1000). Vitamins: replace or add nutritious value.

* + Use of food additives

Improve stability and keep quality, restore or improve taste or appearance, provide foods for dietary needs, extend shelf life.

* + Production Systems – ways in which the processing of food production is organised and applied.
* Classified as: small scale (domestic level operation), large scale (large production line based operations), manual (physically handling material for example. bakery), automatic (machines carry out repetitive actions from one process to another), computerised (monitoring and controlling production process using microprocessors; known as computer-aided manufacturing).
* The type of production system depends on: nature of product, scale of production, economic considerations, consumer acceptance.
  + 1. Preservation
* **Reasons for preserving food**
  + Promote safety, keep foods acceptable for consumption, retain nutritious value, allow availability all year round, remain economically viable (profit rather than wastage).
  + It is cheaper to produce large amounts rather than small amounts (economies of scale).
* **Preservation process**
  + Canning/ bottling

Convention canning combines control of temperature and exclusion of air, with the can filled with the food product and a liquid is added to force air out of the package. The filled cans are then heated to kill microbes. Aseptic canning is another method, where the can and food product are separately heated then packed. Bothe processes use a retort to heat cans. The can should be concave, indicating the vacuum inside.

* + Pasteurisation

Involves control of temperature, with a heat treatment process that kills or reduces microbes to an acceptable level, e.g. holder process 65˚/30 min, UHT (ultra high temperature) 72˚/15 sec, HTST (high temperature short time) 140˚/4 sec.

* + Fermentation

Involves control of pH. Occurs when carbohydrates are converted into acids or alcohol, for example. beer brewing, bread production. The sour condition is unfavourable to microbes.

* + Dehydration (drying)

Involves restriction of moisture via the control of temperature. Any method that decreases water in a food is a form of drying, for example. salting, candying, freeze drying (sublimation/solid to gas) e.g. dried tea, herbs.

* + Chilling/freezing

Involves control of temperature. Chilling slows microbial growth. Freezing (-18˚) stops microbes growth, for example. frozen vegetables.

* **Principles behind food preservation**
  + Exclusion of air:

Aerobic – living only in the presence of oxygen.

Anaerobic – living in the absence of oxygen, i.e. some microbes don’t need oxygen to survive.

* + By removing air from food, microbes become dormant, for example. vacuum packing.
  + Restriction of moisture

Removal of water from foods for example. dehydration, evaporation.

* + Control of pH (chemical preservation)

Dissolving substances in water for example. salt, sugar, that chemically alters the water, for example. smoking, acid adding.

* + Control of temperature

Heating and or cooling of a food.

* + Causes of Food Spoilage (MR PEE)

Microbial activity: bacteria, fungi (yeasts, moulds).

Rodent activity: infestation of bugs or other animals.

* + Physical damage: the state of food is altered in some way e.g. bruising of food, denting of can, wilting of food.
  + Environmental factors: oxygen, light, water.
  + Enzymatic activity: ripening of fruit and vegetables, and decomposition of meat.
  + Growth of Micro-organisms

Pathogenic – causing disease.

* + Lag phase: micro-organism adjusts to environment. Logarithmic (growth) phase: micro-organism cells grow and multiply. Stationary phase: the number of cells being formed is constant to the number that die. Death phase: micro-organism dies from poor conditions for example. no food, low temperature.
  + • Condition for growth of micro-organisms

Warmth, water, oxygen, suitable pH, food source.

* + 1. Packaging, storage and distribution
* **Types of packaging**
  + Cans

Either aluminium or steel. Must used packaging in Australia. Cheap, unbreakable, stackable, recyclable, inert, easy to handle.

* + Glass
  + Inert, aseptic, odourless, recyclable, easy to open and reseal, heat resistant, non-porous, transparent, comes in variety of shapes, colours, sizes, provides long-term storage.
  + Paper/Cardboard

Paper bags e.g. flour, paper sacks e.g. bulk flour, moulded fibreboard cartons for example. eggs, paperboard e.g. milk, composite containers (more than 1) for examples. pringles.

Versatile, cost effective, light weight, recyclable, print over packaging, fragile, inert (grease-proof).

* + •Plastic

Either rigid or flexible. Polyethylene Terephthalate (PET) for example. plastic bottle, High Density Polyethylene (HDPE) e.g. bottle cap. Cheap, light weight yet strong, flexible, easy to store, resistant to breakage, comes in variety of shapes, colours, sizes.

* + Aluminium foil/Laminations

Light weight, heat resistant, usually combined with other packaging in lamination.

* + Combination packages

Consists of two or more separate packaging materials that function independently of each other, for example. cereal packaged in HDPE bag to protect against humidity and oxidation, and paperboard box to protect product.

* + Primary: packaging in which food is sold to consumers. Secondary: multiple primary packs, e.g. juice packs. Tertiary: secure multiples of secondary packaging for bulk handling and distribution.
* **Functions of packaging (PPCIC)**
  + Protects: protect the product from physical and mechanical damage (vertical/horizontal impact (where force comes from), compression).
  + Preserves: hampering the spoilage of food products (prevent moisture, prevent loss of moisture, prevent contamination of micro-organisms, allow breath for example. fruit, prevent rancidity, prevent light sensitive products from UV light). Contains: put in some sort of container for easy storage and distribution. Informs: contact between consumer and manufacturer (identify the product and brand, display quantity and price, explain features, provides direction for use, provide health and consumer protection information for example. use-by-date, nutritional information). Convenience: save effort in preparation e.g. whipped cream in can, use directly from package for example. microwaveable packaging, use anywhere for example. ring pull can.
* **Choosing packaging**
  + Inert – non-reactive chemical or biological properties.

Considerations must be given when determine the best package for the job: characteristics of food, cause of spoilage or quality loss, shelf-life requirements, intended usage, company image, cost, production facilities, legal requirements, ethical consideration, consumer wants.

* + Storage and Distribution

Storage – the holding of goods; taking place: after material arrives to factory, when product is held during manufacturing process, after product has been packaged for distribution. Storage environments: cold storage (0–5˚), freezer storage (-18–-30˚), dry storage (24˚).

* + Handling – transport and packaging of goods.
  + Distribution – movement of goods once the product has undergone processes; from manufacturer to consumer, through wholesalers and/or retailers.
* **Developments in packaging**
  + Developments in packaging can be linked to increase in: technology, availability of food year round, urbanisation, affluence, environmental issues, age of population, demand for tamperproof packaging, legislation on food labelling.
  + Cans

Ring pull lids, altered shapes for storage and handling, plastic cans.

* + Active packaging

Use of materials designed to interact with air in package, creating an atmosphere that results in food products lasting longer. Either sachets or films to add or remove gasses to package headspace.

* + Modified Atmosphere Packaging (MAP)

Airspace around food is altered so ideal mix of gasses maximise shelf life of food. Either gas flushing (add gas) or vacuum packing/ cryovacing (remove air).

* + Sous vide

Process where food is “under vacuum”; cooked in airtight bag.

* **Packaging innovations**
  + Biodegradable packaging

Made from substances that will decay relatively quickly, e.g. bioplastic trays from wheat starch.

* **Intelligent packaging**
  + Packaging able to respond to changing conditions, for example. smart labelling that changes as fruit ripens from changing gas.
  + Packaging providing greater convenience

Innovative designs for convenience: self heating, self chilling, easy opening, flexibility, strength.

## Food product development

### Summary of key points

This unit is part of the HSC course and is in one section which investigates the processes involved in food product development, considering market, technological and environmental impact of food product development.

### Outcomes

* **H1.3** justifies processes of food product development and manufacture in terms of market, technological and environmental considerations
* **H4.1** develops, prepares and presents food using product development processes.

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* + 1. External factors impacting food product development- macro environment

**Economic environment**

* **Inflation rates:** change equipment and ingredients cost, wage and processing; pass cost to consumers.
* **Interest rates:** interest rate change on borrowed money; pass cost to consumers.
* **Exchange rates:** changes cost on imports.
* **Tax rates:** changes affect company profit margin; pass cost to consumers.
* **Tariffs**: affect retail price of food.
* **Wage and salary levels:** high wage=high priced food, though consumer have more to spend.
* **Unemployment:** unemployment place strain on government=high taxes.
* **Natural disasters**: drought, flood disrupts production and affects availability and prices.

**Level of economic activity (economic cycle)**

* **Recession:** Downturn in economy; less disposable income, low capacity to pay for goods and services, unemployment, consumers spend less, interest rates rise, inflation increases, consumers less willing to try new food. Business cost increase, profit decline, new product development declines.
* **Expansion:** Economic growth in terms of production, employment, opportunities and introduction of new products. Prosperity increase, more items become available to consumers. Economic climate improves with unemployment, interest rates and inflation decreases. Consumers spend more because they are more financially secure.
* **Boom:** Fast economic growth; consumers spend more, companies expand operations and product range, new businesses appear, low unemployment. Interest rate rise to control economy may cause company to decrease product expansion.
* **Contraction:** Similar to, but less severe than recession; disposable income, consumer spending, business activity and new product development is affected.

**Political Environment**

* **Policies or incentives**: tax concessions, grants or subsidies help gain access to export markets or research and development.
* **Tariffs on imports:** affect cost of imported machinery.
* **Legislation:** Australian Food Standards Code and Trade Practices Act 1974 limits procedures.
* **Quality management and food hygiene regulations:** HACCP limits procedures.
* **Competition and consumer laws:** Trade Practices Act 1974 and code of conduct limits claims of products.

**Ecological environment**

* **Ecology** – relationship between living things and environment.
* **Ecological considerations for a new food product**
* **Raw materials:** use of crops, livestock, land, water, fertilisers, pesticides, energy. **Packaging materials:** resources used and effects of pollution.
* **Effect of transport and fuel sources.**
* **Energy source and water use.**
* **Waste products of production (solid, liquid, gas.**
* **Transport and fuel use for distribution to customer.**
* **Post consumer:** disposal and degradability of packaging.

**Technological Environment**

* Extrusion (processing) techniques, UHT processes, new packaging technology (for example. MAP), mechanical processing, automated equipment, improved distribution systems, genetic engineering (for example. GM foods).
* New equipment, processes or packaging, may lead to development of new or improved products.
* Technology improves product efficiency, expands product range, and lowers costs and labour requirements.
  + 1. Internal factors impacting food product development- micro environment

**Personnel expertise**

* Personnel employed by a food company include: production staff, financial staff, marketing and sales staff, product development staff, quality assurance staff, maintenance staff.
* Highly skilled and flexible workforce is needed to compete internationally, with education and training vital.
* Technical expertise and knowledge is vital, though leadership, planning and organisational, decision making and communication skills are also necessary.
* Technology is also essential today so employeesmust gain higher qualifications to work with new technologies.

**Production Facilities**

* Production – mechanism whereby raw materials are converted into final products.

**Level of production**

* **One-off production:** In-house custom made, high price products, for single or few items (for example. birthday cake).
* **Batch production:** Single production run, general purpose use, with low production volume and efficiency, and high costs (for example. Tim-Tam, ice-cream).
* **Mass production:** Simple technology and assembly, few highly trained staff, automated (for example. Coke).
* **Continuous production:** High-technology equipment, few staff, consistent quality maintained by automation.

**Financial position**

* Food product development will only occur if company is in a good financial position.

Financial position of company includes: value of assets (cash, property, equity in other companies, stock), cash flow, profit and loss balance, value of shares (for public company), amount of borrowings or loans, market share.

**Company image**

* Food product has two aspects that influence consumer: tangible aspects (size, texture) and intangible aspects (brand name and image).
* Company image influenced by: quality, familiarity, reputation, price, packaging, availability, sponsorship, promotions.
* Strengths Weaknesses Opportunities Threats (SWAT)
* **SWAT analysis** – looks at businesses strengths and weaknesses in relation to its competitors and identifies opportunities and threats arising from the external environment.

Reasons for food product development

**Consumer trends**

* **Trend** – swing in community attitude which defines current styles of preference.
* **Market segment** – categorising consumers into different groups according to demographics (for example age, gender, occupation, education) or psychological preferences (such as. lifestyle, taste, media exposure).

**Market concerns**

* Health
* Products that are nutritionally advantageous (functional foods), which promote aspects of health (for example high fibre, low fat, low salt, low sugar, cholesterol free, nutrient enriched products).
* Dietary considerations
* Increase awareness and concern for diet related health issues has consumers seeking products that help prevent illness or disease (e.g. reduced fat and sugar, high fibre, fortified foods). Target niche market with intolerances.
* Environment
* Increase awareness and concern for the environment has consumers seeking organic products and recyclable packaging. Increase in sustainable development.
* Consumer demands
* Demand – measure of how many consumer buy a product.
* High demand characteristics

**Convenience**

* Ready meals, portion sized, tamper evident, easy opening, resealable, easy storage, convenient.

**Cost**

* Budget restraint.
* Societal changes

**Aging population**

* Australians are living longer and the aged population is growing (baby boomers). Digestion issues, small single serves, convenient packaging.

**Change in household structures**

* Marrying later in life and increase separation and divorce cause demand for small single serves, heat and eat meals. Women joining workforce cause demand for meal kits, value added products and readymade meal solutions.

**Longer working hours**

* Changing world of work results in less time at home; more take away, eat on the go.

**Technological developments**

* New food ingredients (such as bush food) and packaging materials (for example MAP), advances in processing equipment and techniques (UHT) allow for new product.
* Allow for price reductions, improved quality, greater convenience or greater efficiency.

**Company profitability**

* Profitability, advancing financial gain, survival in the marketplace, competition within the market sector, increase market share and entering into new and non-traditional markets such as Asia.

**Types of food product development**

* **Me too -** direct copies, or with minor modifications, of existing products, making up 20% of new products (for example generic products, Pepsi is me too of Coca-Cola). Exploiting successful product with an established market by competing head on.
* **New to world** - completely new and different to pre-existing products that have not been on the market before, which arise from new technologies and new ingredients, making up 10% of new products. Most likely to be successful on the basis of their novelty.
* **Line extensions -** relatively minor changes to extend the product range of a company’s existing products by incorporating features such as new flavours, colours, health and diet related variations, new forms of packaging and different serving sizes (for example Tim Tam flavours); making up 70% of new products.
* Increase market share. Respond to marketplace trends. Respond to consumer demands. Identify new market segments. Emergence of new processing technology or packaging. Availability of new flavours, health related additives. Value adding strategies for existing products.
  + 1. Steps in Food Product Development

**Design Brief**

* Document drafting out the concept of a new product, determining aspects of end product and what is to be achieved from it.
* Mission statement sets corporate goals, policies, and provides guidance for new product.

**Idea generation**

* Identifying possible solutions to design brief, brainstorming.

**Screening**

* Selecting best idea and checking whether it fits into company constraints (financial, processing, products, marketing, company, ethical and legislative limits).

**Market research**

* Asking consumers what they want and need, and whether they would accept the new product. Done through surveys, focus groups or field observations. Once the research is conducted the data must be analysed.
* Primary research: gathering original data (e.g. surveys).
* Secondary research: investigation what others found in their primary research.

**Sampling methods**

* Non-probability sampling: includes convenience sampling, volunteer sampling, judgmental sampling (deliberate) and quota sampling.
* Probability sampling: picking via numbers and chance; includes simple random sampling and stratified random sampling.

**Product specifications**

* Description of characteristics of new product, including:
  + products description (form and style)
  + features and attributes (flavour, texture, nutritive value, packaging, shelf life)
  + raw materials (and supplier)

**Target market, consumer benefits** (benefit in nutrition, cost, convenience, quality), pricing strategy.

**Pricing strategy**

* Selling price of product, depending on: price of competing products, target market ability to pay, company image, product benefits.

**Feasibility study**

* Determine whether costs of production and sales forecast will achieve a breakeven point (financial feasibility), and ability of the company to make the new product using existing resources (for example availability of ingredients, new processes, costs of ingredients, microbiological safety tests) (technical feasibility).

**Product process development**

* Involves converting factory to accommodate new product; line extension products only need small changes. If product is new then equipment and factory layout needs to be altered.
* Involves coordination of raw materials, tasks, equipment, processing, quality management, packaging, labelling and storage.

**Prototype development**

* **Prototype** – trial product.
  + Extensive product and market research carried out to ensure ingredients perform satisfactorily. Prototype recipe converted into commercial batch size to allow for widespread testing.
  + Packaging must withstand the rigours of processing but be able to fit on the production line as well as provide protection for the product.
* **Prototype testing**
  + New food product needs to be tested to see if it satisfies Australian Food Standards or approved by AQIS. After prototype undergoes testing, commercialisation (full scale production and manufacturing) takes place; product launch.

**Quality testing**

* Check effectiveness of quality management and hygiene standards.

**Sensory evaluation**

* Test market appeal based on texture, flavour, aroma, colour.

**Consumer testing**

* Opinions sought from consumer; whether to by product.

**Packaging tests**

* Tests conducted to determine effectiveness (handling, storage), durability, interaction effects of packaging.

**Storage trials**

* Simulate distribution, retail and home storage conditions; test safety and quality after storage, and establish shelf life.
  + 1. Marketing mix

**Marketing Plans**

* Translate company’s objectives into marketing terms that that maximises sales, maintains or increases customer satisfaction and improves consumer choice and quality of life.

**Product**

* Product variables for success: appeal to target market, name, brand name, attributes or features, benefits, packaging and labelling, image and positioning, size.
  + **Product life-cycle** (product growth over time/sales history)
  + **Introduction**: Intense and costly marketing and promotional strategies.
  + **Growth:** Marketing strategies more focused on brand name rather than product to counteract action of other manufacturers.
  + **Maturity**: Market strategies relate to brand name, company image, pricing and emotive aspects.
  + **Post maturity**: Less marketing effort is expanded and distribution and promotional efforts decrease.

**Promotion**

* Any form of communication between seller and buyer with aim of increasing product sale.
* To select type of activities to promote product, company has to consider budget, market and stage of product life cycle.
* **Advertising - i**nforms consumers about product and persuades them to buy. Print, electronic, outdoor advertisement.
* **Personal selling - s**ales person promoting product and answering questions.
* **Publicity and public relations** - unpaid use of media to broaden public knowledge and recognition of product; public image.
* **Sale promotions and demonstrations -** give buyer incentive to buy or try product.

**Price and pricing strategies**

* **Penetration pricing:** Price is below competitor for long enough to gain foothold in market; used when entering market.
* **Price skimming:** Sold at high price at first then price falls over time; used when new to the world or long life expectancy.
* **Competitive pricing:** Price set to match competitor, though used with other promotions.
* **Psychological pricing:** Influence customer perception (such as $2.99, “low price”, “special”).

**Place and distribution**

* **Place** – where product is sold.
* **Distribution** – movement of product from producer to point of sale.
* **Type of distribution**
* **Intensive distribution:** High volume sales to mass market, available at every outlet (for example - chocolate bar).
* **Selective distribution:** Select target market, specialised retail outlets (for example. deli items).
* **Exclusive distribution:** Small premium target, limited supply sold at few retail outlets due to expense (such as handmade chocolate); elite image.
* **Distribution channels -** system by which product flows from producer to consumer; direct or indirect (through retail outlet) selling to consumer.
* **Distribution system -** longer distribution is less effective. Involves warehousing, materials handling (move from storage to shipping), inventory control (quality control), order processing, transportation.