Sensory evaluation

is carried out with the use of the five senses

Smell

Olfactory system responds to aroma stimuli and sends information to the brain, helping a person to decide whether a food smells nice or not

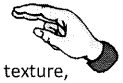
Olfactory system

is built of smell receptors located in the nasal cavity
Aroma is just as important in assessing the flavour of food as the taste, so having a blocked nose will make tasting impossible!

Hot dishes smell more because aroma compounds fill the air faster (evaporate) and the nose receptors can detect them better!

Touch

Helpful in judging the texture, consistency and **mouthfeel** of the food, as well as its temperature and spiciness



The hotness of chilli is recognised as pain and, therefore, spiciness is not one of the tastes!

Eyesight

Important when presenting food, which has to be **appetising**, colourful, neat and decorated

Taste

Taste buds located on the tongue help to taste the five **tastes**: sweet, sour, salty, bitter and umami

Flavour

is the combination of taste, aroma and mouthfeel of food.

Umami

Savoury, meaty taste found in meats, tomatoes, cheese, soy sauce and many other products.

Hearing

Crunchiness and crispiness of a food usually indicates its **freshness**

Taste panel – group of tests performed to assess the organoleptic qualities of a food product
Taste panel should be conducted under **controlled conditions**.

Room conditions:

- Remove potential distractions, e.g. noises, strange smells, other tasters, to help the tasters focus on the task
- Lighting should be adjusted so that differences in the look of food samples aren't visible
- Individual boxes or rooms for each taster should be provided, so that they are separated from each other and cannot communicate

Tasters:

- Instructions should be given to the tasters so that they know how to proceed, e.g. rinse your mouth after trying each sample
- Charts should be given to the tasters so that the results can be compared and summarised
- Water should be provided to rinse the mouth between trying different samples of food

Food samples:

- Food samples should be coded randomly, so that only the person who is setting the panel knows what's in each sample; this also helps to ensure that the taster's opinion isn't based on the number of the sample
- Samples should be of the same size and temperature
- Samples should be served on white or black plates to avoid distraction
- If a food carrier is used, it has to be neutral in taste so that it cannot alter the taste of the tested food sample
- The temperature of food samples has to be controlled, as some foods have to be served cold (e.g. ice cream), and some have to be served hot (e.g. soup) – this supports a fair assessment of the texture, mouthfeel and taste

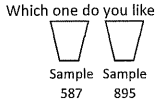
Sensory analysis tests

Often used in the industry, especially when new products are launched, to predict their popularity in the market.
One sample of food can be assessed with the use of various tests.

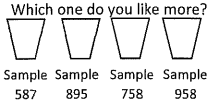
Preference tests

Used to discover if a food is acceptable for consumers

Paired preference test – to indicate a preferred sample out of two



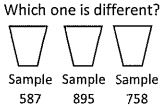
Hedonic test – to indicate a preferred sample out of a few



Discrimination tests

Used to find out differences between samples

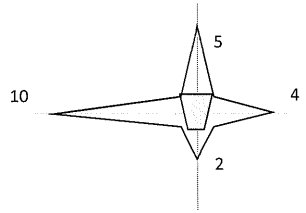
Triangle test – to indicate the different sample out of three, two of which are identical; i.e. the 'odd one out'



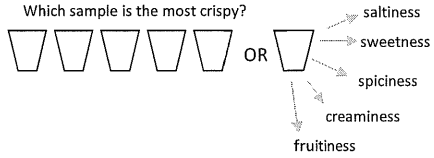
Grading tests

Used to rank, rate or profile food samples, which are then ranked in order of preference or strength of a given factor, e.g. saltiness

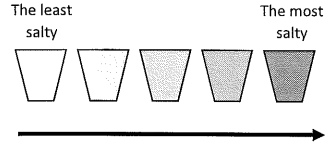
Profiling test – chosen features of a food are rated from 1 to 10 and then the result is plotted in the shape of a star to show the detailed information



Rating test – measures the acceptability of a given feature in a number of samples OR a number of features in one food product; foods are rated on a scale from 1 to 5 or from 1 to 9



Ranking test – measures the strength of a specific food feature and ranks the samples in order



Food sources

Where and how food is made depends on many factors, such as:

- → Climate
- → Soil quality
- → Availability of water and other resources
- → Availability of land suitable for growing plants and pastures
- → The size of a population and how much food needs to be produced.

Other factors, such as religion and ethical beliefs of local communities, also play an important role in deciding what foods will be made in the nearest area.

For example, more and more free-range eggs are produced in the UK nowadays due to popular belief that free-range hens are happier and produce better-quality eggs, but also to ensure animal welfare standards are kept.

Food source type	Where	Example	What for?
Grown 	Orchards	Apples, plums, avocados, cherries, nuts	Fruit, nuts, animal feed
	Fields	Root vegetables, grains, seeds, legumes	Food, animal feed, fertilisers, bioenergy
	Polytunnels	Lettuce, radish, strawberries	To ensure availability all year long
Reared 	Sheds, barns	Cattle, pigs, horses, poultry	Meat, milk, leather, feathers, eggs, work, bioenergy
	Fish farms	Fish, seafood	Food, animal feed
Gathered 	In forests, near the roads	Wild berries, mushrooms, herbs	Medicines, beverages, herbal teas, spirits and liquors, pickles
Caught 	Open spaces and forests	Wild animals, game and venison	Food, enjoyment
	Oceans and seas	Wild fish, seafood	Food

Farming

A farm is an agriculture establishment in which crops are grown and livestock is reared for profit. The two main ways of farming include:

Organic farming

- ✓ No chemicals
- ✓ Little or no use of pesticides
- ✓ No artificial fertilisers
- ✓ No herbicides
- ✓ No GM feed or seeds
- ✓ Antibiotics are only used when necessary
- ✓ Crop rotation may be applied to preserve soil quality
- ✓ Animal welfare standards are kept

Intensive farming

- ➢ Chemicals such as pesticides, herbicides and artificial fertilisers are used to prevent crop failure
- ➢ Antibiotics are used to prevent diseases in livestock, not to cure them
- ➢ GM feed and seeds are used to obtain high-yield crops
- ➢ Animal welfare standards are often violated

Sustainable fishing

Rearing fish and seafood in fish farms for meat, caviar, pearls, animal feed or other reasons. Sustainable fishing means that fishing in natural fisheries is allowed only for certain periods of time so that the shoal of fish has the chance to reproduce and restore itself.

Advantages of fish farms:

- ✓ Protect natural ecosystems
- ✓ Prevent overexploitation of fisheries
- ✓ Keep animal welfare standards
- ✓ Protect wild species diversity
- ✓ Prevent by-catch

By-catch: accidental catch of a sea organism which wasn't the primary goal of the fishing.

Disadvantages of fish farms:

- ✕ The fish tanks are often overcrowded
- ✕ Fish might be fed low-quality feed which affects their flavour and nutritional value
- ✕ Fish might be fed antibiotics, increasing the risk of antibiotic resistance

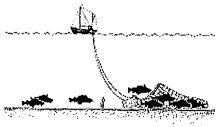
Sustainable fishing policy is set by the Marine Stewardship Council.

Methods of fishing:

Purse seining: fishing with the use of a large net in which fish and other sea organisms are trapped

Longlining: fishing with the use of a longline to which other lines are attached, each of which ends with a hook

Bottom trawling: pulling a large net along the sea bottom, used to catch shrimp and bottom-dwelling fish



Food production

The way food is made affects its quality, safety and yield. Modern technologies help to obtain high amounts of food while ensuring it's safe to eat and nutritious.

Egg production

Symbol	Name	Conditions
0	organic	Birds are fed only organic feed, animal welfare standards are applied
1	free-range	Hens are let outside the barn during the day to enjoy the most natural conditions possible
2	barn	Birds can move freely around the barn, but may have trimmed beaks to reduce injury caused by fighting among themselves
3	cage	Hens are kept in tight cages, without being able to move

Red Lion Scheme is a quality mark which ensures that all hens have been vaccinated against salmonella so the eggs are safe to eat.

Local and seasonal foods

Characteristic of countries or regions, as well as certain seasons of the year.

- fresher
- more nutritious
- tastier
- empowers local farmers
- supports local communities
- may be cheaper than imported foods
- supports biodiversity of species

- limited offer / small variety of foods offered
- limited availability /short time for purchase
- depends on weather conditions and local climate
- may be more expensive than imported foods

Genetically modified foods

Come from GM animals or plants, or GM microorganisms are used during production.

- resistance to pests and unfavourable weather condtions
- more nutrients, e.g. beta-carotene in Golden Rice
- fewer pesticides and herbicides are used
- higher yield of crops = more food
- stay fresh for longer, shelf life is improved

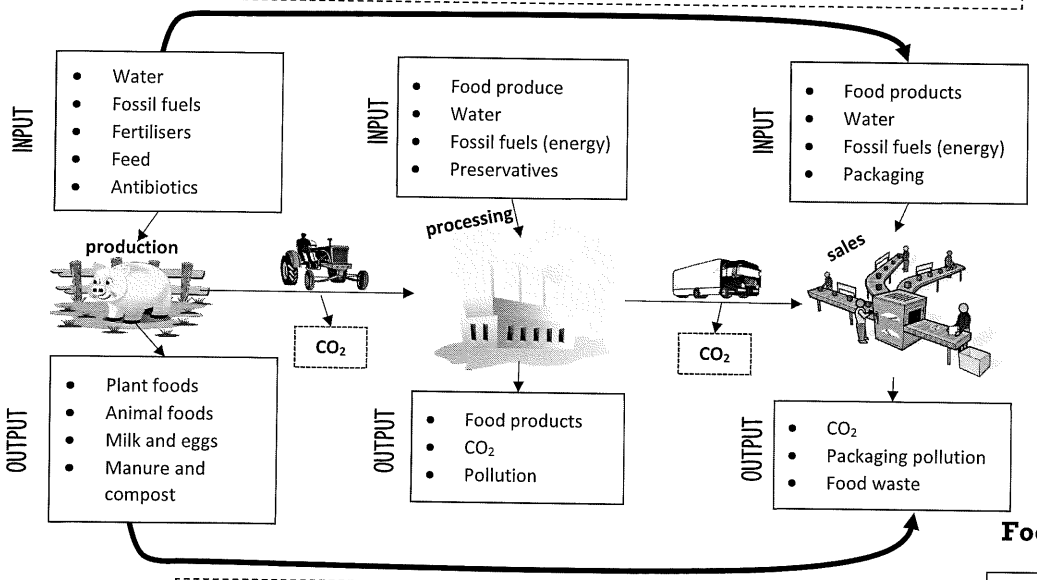
- no known long-term health effects
- use of viruses and bacteria may pose risk of spreading new diseases
- GM seeds can contaminate natural habitats and decrease species variety
- pests, bacteria and viruses may develop resistance and pose new risks

Food and the environment, and sustainability of food

Why is carbon dioxide so dangerous?

Food production, at each of its stages, emits large amounts of carbon dioxide. Carbon dioxide creates an impermeable layer around Earth. When warmth is reflected from the Earth's surface, it is caught by that layer and bounces back. As a result, the average temperature on Earth rises, and that affects plant and animal species.

Carbon footprint
The amount of carbon dioxide and other greenhouse gases emitted into the environment during production and transportation of a product

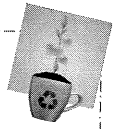


Food miles
The distance from the field to the plate of the consumer – importing food products from distant countries increases the food miles

How food production affects the environment and communities

Food production has a direct and an indirect effect on the environment by creating various pollutants or by causing deforestation. The way we produce and transport food is also meaningful to those who produce it: farmers, farm workers, and even people working in your local shop.

Packaging



→ Fossil fuels are used to produce many types of packaging
→ Tonnes of used packaging are thrown away every day
→ Unrecycled packaging creates pollution
→ Animals, birds and fish swallow the debris and die
→ Some materials used for packaging NEVER decompose!

Fairtrade

A foundation and ethical movement focused on supporting farmers and sustainability of food.

Advantages of Fairtrade:
✓ Ensures fair wages and prices
✓ Improves working conditions
✓ Empowers local communities, farmers and workers
✓ Supports education and growth in developing countries
✓ Helps to protect the environment

FAIRTRADE FOUNDATION

Each step of food production has a huge impact on the environment. Overexploitation of natural resources, such as water, soil and fossil fuels, together with transportation and packaging of food, contribute significantly to climate change.

Climate change

... the effect of this process is known as global warming. Global warming means that climate conditions change and plants cannot grow anymore, because they are not used to the new conditions. Also, as it is warmer, oceans evaporate faster, and this leads to severe hurricanes and massive rainfall, **which damage even more crops by causing flooding**.

Carbon dioxide and other greenhouse gases create a layer around Earth

The heat cannot escape into space and the temperature of the atmosphere rises

Glaciers melt and sea levels rise, while oceans evaporate faster due to higher temperatures

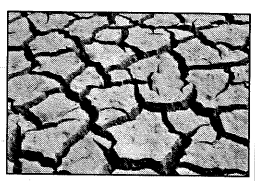
Fierce hurricanes, rainfall and tornadoes devastate the land

Crop failure due to floods and droughts

Food shortages, famine, wars and death

Greenhouse gases
Vapour, CO_2, nitrous oxide, methane, ozone, CFCs absorb infrared radiation and trap heat

Global warming
Rise in average temperature on Earth due to extravagant release of greenhouse gases



Food availability

Climate change affects food availability. Droughts caused by faster evaporation of waters, and floods caused by massive rainfall are causes of crop failure around the world. Crop failure means that there are no plants to eat, and no food for animals.

Food security – when all people, at any time, have access to nutritious, healthy food in sufficient amount

Food availability may be increased by:
✓ The use of GM seeds and organisms to produce more food
✓ Modern technologies to store food for longer
✓ Transportation of food around the world, e.g. to those who affected by famine

Food availability may be decreased by:
✗ Climate change and the effects of global warming
✗ Insufficient land for growing food
✗ Growing world population which requires more food
✗ Overexploitation of soil and fisheries
✗ Limited resources such as water and fossil fuels

Seasonal foods

Food products which are characteristic of a given season, because this is when they are ripe and are harvested

Spring: sprouts, kale, lettuce, spring onion, radish
Summer: peas, berries, courgettes, cucumbers, apricots, cherries
Autumn: apples, pears, plums, aubergine, pumpkin, celery
Winter: potatoes, carrots, parsnips, beetroots, Brussel sprouts, onions

Advantages of seasonal foods:
✓ Are often produced locally, so reduce food miles and carbon footprint
✓ Are cheaper in season
✓ Are higher in nutrients and tastier than off season

Food waste

Reasons:
→ Buy and cook too much
→ Don't eat the food before it goes off

Effects:
→ Waste of money, pollution, carbon footprint increase

Methods of prevention:
→ Plan shopping, don't go shopping when hungry
→ Only cook as much food as needed
→ Eat everything on the plate or store leftovers for later
→ Reuse food products to make new meals
→ Store food correctly to avoid spoilage
→ Use peelings and scraps to make compost

Food production

Various methods of food production and processing help to obtain a variety of food products, but can also affect the nutritional value of food.

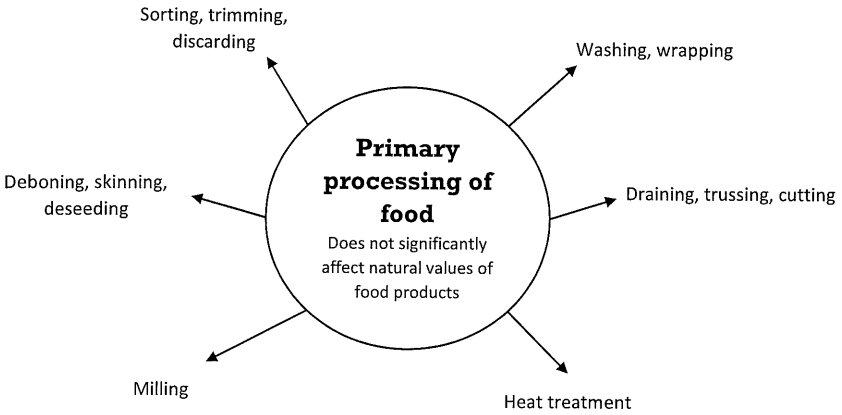
Primary sources of food

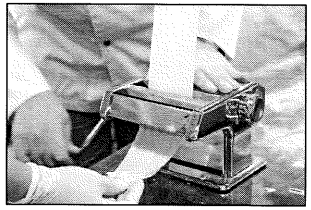
Foods in their natural, raw state, e.g. milk, wheat grains, apples

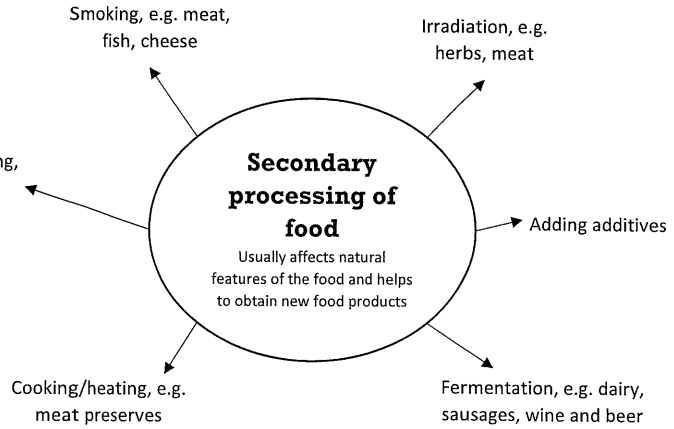
Secondary sources of food

Foods that have been changed, e.g. yoghurt, flour, jam

Water-soluble vitamins are especially fragile to such factors as light and temperature. Heating can lead to a loss of approximately 70% of folates, 55% of thiamine and 50% of vitamins C, B6 and B12.



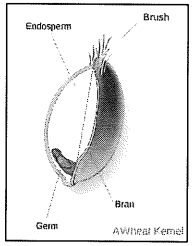




The making of flour

1. Harvesting and transport to the factory/mill
2. Separating from dirt, stones, pieces of metal and other pollution
3. Washing and drying to easily separate the bran
4. Milling
5. Sieving to separate the bran

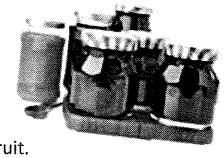
Bran: the outer layer of a grain



The making of pasta

1. Harvesting the cereals and transportation to the mill
2. Milling and transportation to the factory
3. Mixing flour with warm water
4. Kneading and gluten formation
5. Adding flavourings and colourants
6. Rolling and pressing
7. Pasteurisation with steam
8. Cutting the pasta into chosen shape
9. Drying
10. Packaging

The making of jam



1. Harvesting the fruit
2. Washing and crushing/cutting
3. Adding water and sugar
4. Simmering
5. Pouring into jars

Pectin: natural gelling agent present in fruit. It is released from fruit in the presence of heat and acid.
Acid: may be naturally occurring in fruit or may be added to the mixture to help release the pectin.

Heat treatment of milk

Pasteurisation: warming up the milk to 72 °C for 15 seconds to kill most of the pathogenic bacteria
Ultra-heat treatment: heating up the milk to 135 °C for 1–2 seconds to kill all bacteria and spores
Microfiltration: pushing the milk through very fine membranes to remove bacteria and other pollutants
Homogenisation: pushing the milk under pressure through very fine membranes to reduce the size of fat droplets and prevent the formation of cream
Sterilisation: heating up the milk to over 110 °C for 30 minutes to kill bacteria and spores.
Sterilisation of milk leads to a change in colour, flavour and nutritional value of milk. During the process, milk proteins react with lactose, creating brown pigments which also affect the flavour of milk. High temperature decreases the amount of vitamins in the milk, especially vitamins B1 and B12.
Drying: process in which milk is first condensed, and then dried. The temperatures used during the process may lead to a fall in the levels of vitamin B1 and vitamin B12 in the powdered milk.

The making of yoghurt

1. Milking cows and transporting the milk to the factory
2. Pasteurisation and homogenisation
3. Warming up to 42 °C
4. Adding starter cultures
5. Fermentation (ripening)
6. Cooling
7. Adding flavourings
8. Packaging

Starter cultures: probiotic bacteria added to milk during yogurt and cheese production to begin the process of fermentation
Fermentation: changing lactose into lactic acid by adding bacteria. This changes the pH of milk and leads to protein coagulation/denaturation and thickening of the mixture.

The making of cheese

1. Milking cows and transporting the milk to the factory
2. Pasteurisation and homogenisation
3. Adding starter cultures
4. Fermentation (ripening)
5. Adding rennet
6. Cutting the curd and separating it from the whey
7. Pressing (stacking curds on top of each other)
8. Adding salt
9. Pressing into cheese hoops
10. Ageing

Rennet: enzyme which coagulates milk and increases curdling
Whey: liquid by-product of cheese production

Technological developments associated with better health and food production

Modern technologies not only help to obtain high-yield crops, but also help to better preserve and improve nutritional value of food to support healthy living.

Supporting health

What we eat has a huge impact on our health. Eating too little may lead to deficiency of a given nutrient. This is important since processing of food often leads to a decrease in its nutritional value – higher calorie content, but lower vitamin and mineral amount, etc.

Governments and producers strive to make food safe and healthy for consumers by adding substances which are beneficial for health.

Cholesterol-lowering spreads

Cholesterol: fatty substance necessary for correctly transporting fats around the body. It is found in many animal-derived foods, such as meat, cheese and eggs. Cholesterol does not occur in plant-derived foods.

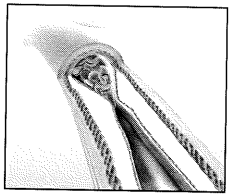
→ LDL is 'bad' because it increases cholesterol amount in blood where it can be used to build plaque in blood vessels

→ HDL is 'good' because it transports cholesterol to the liver, which can remove its excess from the body

Health outcomes of increased cholesterol levels and excessive fat consumption:

→ In excess, cholesterol may be deposited in the blood vessels, creating atherosclerotic plaque

→ This increases the risk of hypertension, CHD, heart failure and stroke.



Some fat spreads are enriched with **plant sterols** and **plant stanols**. These substances have proven to be effective in lowering blood cholesterol level and preventing atherosclerosis.

Food fortification

During processing, many food products lose their nutritional value.

The function of food fortification is to:

→ Restore the nutritional value of foods

→ Improve the nutritional value of foods

→ Make food more suitable for certain groups of consumers

→ Prevent diseases caused by malnutrition

Some foods are fortified **by law**:

Wheat flour and bread	Thiamine	To prevent beriberi disease, help release energy from food
	Niacin	To prevent pellagra, help release energy from food
	Calcium	To prevent rickets and osteoporosis
	Iron	To prevent iron deficiency anaemia
Vegetable fat spreads	Vitamin A	To prevent growth and eyesight issues, such as night blindness
	Vitamin D	To prevent rickets and osteoporosis
Semi-skimmed and skimmed milk	Vitamin A	To prevent growth and eyesight issues, such as night blindness

Other foods, such as cereals and fruit juices, may be fortified **voluntarily**.

60% Wholegrain Rolled **Oats**, 38% Wholegrain **Oat** Flour, Calcium, Niacin, Iron, Riboflavin B2, Vitamin B6, Thiamin B1, Folic Acid, Vitamin D, Vitamin B12.

Genetic modifications

Each cell of a plant or animal has a nucleus, which contains its DNA. DNA is built of tiny fragments called genes, which encode all information about the organism.

Cell → nucleus → chromosome → DNA → gene

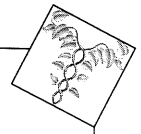
Modern technologies have allowed people to manipulate and change the DNA code. It is possible to:

→ Cut out unwanted genes to avoid diseases or eliminate bad features

→ Modify the sequence of genes to change the information they carry

→ Paste new genes to a DNA strand to give the organisms new features

If a plant or an animal's DNA has been changed, we say the organism has been called genetically modified.



Advantages of GM foods

✓ Resistant to weather conditions
✓ Resistant to pests
✓ Need fewer nutrients to grow
✓ Less need for fertilisers and herbicides
✓ Animals produce more muscle tissue and milk
✓ Produce high-yield crops necessary to feed the growing population
✓ May have more nutrients than the natural species (e.g. Golden Rice)
✓ May have more intense flavour or colour

Disadvantages of GM foods

× GM seeds contaminate fields and lower biodiversity of plant species
× No proof that they are safe to eat
× May increase the risk of allergies and cancer
× May contribute to the growing rates of obesity in the world
× The use of bacteria and viruses in production can cause the creation of new diseases
× May lead to antibiotic resistance and the spreading of diseases which are difficult to fight off
× Pests may develop resistance and the use of pesticides may increase drastically when this happens

Food additives

All food additives must be carefully tested before they can be used in food products. They are listed on the food label along with their E number and their function.

	Advantages	Disadvantages
Colourings	• Improve the look of food • Make food more appetising	• May be used to hide poor quality of food • May cause hyperactivity in children
Emulsifiers and stabilisers	• Prevent the ingredients from separating • Maintain the texture of food	• Flatulence and bloating • May be used to hide poor quality of ingredients used
Flavourings	• Improve the taste and smell of food • Make food more appetising	• May be used to hide poor quality of ingredients used • Increase appetite and make people eat more than they need
Preservatives	• Enhance shelf life of food • Prevent oxidation and spoilage	• May cause allergy response and anaphylactic shock • Nitrates may contribute to cancer development

Food additives may be natural (e.g. beetroot extract used as a colouring agent) or synthetic (e.g. citric acid).