Zig Zag Education

Food and Nutrition GCSE (9–1) | AQA | 8585

Course Companion

For AQA GCSE (9–1) Food Preparation and Nutrition: Food Science

zigzageducation.co.uk POD 7534

Contents

Teacher's Introduction

This resource is designed to meet the Food Science (3.3) element of the AQA GCSE Food Preparation and Nutrition qualification.

What it covers

The resource comprises two chapters covering the following:

Chapter 1: 3.3.1 Cooking of food and heat transfer		Chapter 2: 3.3.2 Functional and chemical properties of food	
3.3.1.1	Why food is cooked and how heat is transferred to food	**3.3.2.1**	Proteins
3.3.1.2	Selecting appropriate cooking methods	**3.3.2.2**	Carbohydrates
		3.3.2.3	Fat and oils
		3.3.2.4	Fruit and vegetables
		3.3.2.5	Raising agents

How to use this resource

The resource covers all aspects of Food Science and is designed to increase knowledge of the topic and enable learners to test their understanding and skills through a variety of assessment methods.

Learning Outcomes enable the learner to clearly see what they are expected to know at the end of each chapter.

The **Overview** provides a brief summary of what will be covered in the chapter and the **Key Terms** box provides information on key terms within the resource (key terms are emboldened within the chapter text).

Did you know	These boxes contain handy tips.
Things to think about	These boxes provide learners with a chance to develop cognitive skills, do some research (books, Internet, people) and take part in a discussion.
Apply	These boxes provide the learner with the opportunity to further their skills, either through cognitive or practical application.
Qs	Learners' knowledge and understanding is tested through quick Y/N questions.
Skills	Based on the suggested application of skills section of the AQA GCSE Food Preparation specification, these test learners' skills in food safety through practical application.
Exam tip	Useful tips are given to help the learner concentrate on important aspects that may appear in the final assessment.
Check your understanding	Multiple-choice questions and longer open questions, similar to Section A and Section B of the AQA GCSE paper, appear at the end of each section to test knowledge and understanding.
Quiz-ine	There is a crossword-style quiz at the end of each chapter to test learners' understanding of key terms used within the resource. The shaded squares spell out a word associated with the chapter text.
Answers	Answers to questions are provided at the end of the resource.

M Golebiowska, April 2017

Chapter 1: Cooking of Food and H

Overview

In this chapter you will learn why we cook food and what different methods of cooking are, and you will discover how different cooking and preparation methods affect the food and change its features. You will also learn the difference between conduction, convection and radiation, and know where they are applied.

Learning Outcomes

After studying this chapter you should be able to do the fo

- ❑ identify the main reasons behind cooking food
- ❑ identify foods that cannot be eaten raw and reasons
- ❑ learn how cooking affects foods' features such as ap
- ❑ learn how preparation affects foods' features and nu
- ❑ define what conduction, convection and radiation are
- ❑ know how conduction, convection and radiation wor
- ❑ indicate the main processes that take place while co
- ❑ [illegible] appropriate cooking and preparation meth

Key Terms

Conduction	The process of exchanging heat between two objects of different temperature, without the use of any means suc water or air (thus the objects must touch each other); th way of transferring heat
Convection	A process of exchanging heat between two objects throu this is an indirect way of transferring heat
Radiation	A process in which a wave of heat is being sent without t other; this is an indirect way of transferring heat
Food safety	All conditions and actions taken to make food safe to ea
Maillard reaction	A chemical reaction during which proteins react with sug
Microwaves	Type of electromagnetic waves with the frequencies bet used, for example, in microwave ovens
Infrared	Type of invisible radiation emitted by all living organisms

3.3.1.1 Why Food is Cooked

There is no doubt that the discovery of fire gave a huge advantage to the mankind Earth. It gives light, warmth, protects from predators, and – most importantly – a a significant change and probably one of the reasons behind humankind's evoluti

The reasons why food is cooked

Food is cooked not just to taste nice, but to make it safe, change the textures, to extend the life of the food and to provide variety in our diets. Let's discover some of these reasons why food is cooked in a bit more depth.

Large toxic reco vitan liver

To make food safe to eat

One of the greatest advantages of cooking is that it makes our food **safe to eat** by bacteria and destroying harmful substances.

Salmonella is a species of bacteria known to cause gastric p infection include stomach ache, nausea, vomiting, diarrhoea commonly in eggs, poultry and meat, milk, and products tha creams. For this reason it is not advisable to eat these prod Also it is better not to freeze again once food has been defr because it allows bacteria to grow.

Exam tip

Cooking is a way to ensure **food safety**.

Other bacteria found in food include *Escheric* (which usually live in our bowels but are pois when in food), *Shigella* (which causes dysente *Yersinia enterocolitica* (which causes symptor to Salmonella).

One of the most dangerous bacteria found in food is *Clostridium botulinum*, which a toxin that paralyses the nerves and may lead to death (if it paralyses the interco muscles responsible for breathing). Happily, there is a visible sign of its presence the lid of a tuna or meat preserve can is bulging, you definitely should not eat its c

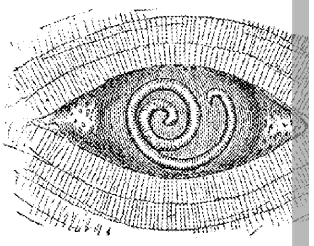
Most bacteria are killed at temperatures over 65 °C. Cooking food in temperature appropriate time ensures that all the bacteria and spores are neutralised.

Other poisonous agents in food include toxins, pesticides, enzymes, mycotoxins a

- Solanine is a green-coloured toxin present in potatoes, green tomatoes and c foods. Eating them raw may cause stomach ache, diarrhoea or fever, so it is to cook them thoroughly to avoid such troubles
- Aflatoxin is a harmful substance produced by moulds. It is often found in pea grains and other products which were stored in improper conditions. They a very toxic and can lead to liver inflam , g e mutations and cancer.

Did you know?

Wild boars are carriers of the *Trichinella spiralis* parasite and therefore their meat cannot be eaten raw!

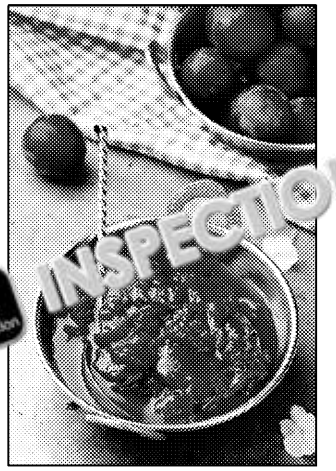


Trichinella spiralis is a parasite living i cells which causes trichinosis if eaten. infection include very high fever, shive pains. To prevent that, all meat is care before it can find its way to shops c

To develop flavours and smells

Cooking allows development of flavours in a number of ways:

- it evaporates water and therefore makes the flavour of its residue more pron
- it causes sugars to caramelise, which is especially advantageous in such produ and even certain vegetables, such as onion or carrot
- during cooking, smelling molecules evaporate and make the smell more inter present in foods are called essential oils (present in large amounts in, for exa
- it allows combination of different ingredients, which leads to developing new



This plum chutney uses both caramelisation and water evaporation to obtain its strong flavour.

Traditional Irish stew is c which allows the fo characteristic texture,

Cooking allows us to create the pronounced flavour of stews, jams, sauces or chut breaking down the structure of cells and freeing the aromatic chemical compound ingredients is also helpful in developing the desired flavour and smells, e.g. by add

To improve texture and aid digestion

You have probably noticed that cooked meat is not only easier to cut, but also to bite and chew. This is because cooking softens and loosens muscle fibres, which makes the meat softer. Also, during cooking, fat melts and penetrates the meat, making it juicy. This is not only important for your taste buds, but also makes it much easier to eat for those who cannot bite or chew, or experience various digestive issues: babies, elderly, and people suffering from Crohn's disease or Irritable Bowel Syndrome (IBS), etc.

Cooking (especially frying, grilling and baking) also makes certain foods crunchy/crispy – which is more desirable by some. This in[illegible]es meats, bread and pastries, chips and crisps.

During cooking some foods chang[illegible] physical state – from liquid to solid (or the other way around[illegible] obtain the desired texture by simply adjusting co[illegible] ti[illegible] four minutes for a soft-boiled egg and 10 minutes for [illegible]-boiled one, or 10 minutes for a thin sauce and 30 minutes for a thicker one.

Things to think about

Identify some foods which are difficult to digest and discuss how mod could aid digestion.

To improve shelf life

Applying high temperatures is a great way of preserving food. This is because mo harmful microorganism species die in temperatures above 65 °C. For that reason, cooking kills most of the bacteria or mould normally present in food and prevents **spoilage**. This way, if correctly stored, food can last longer and maintain all of its nutritional values.

Things to think about

for discussion and tho

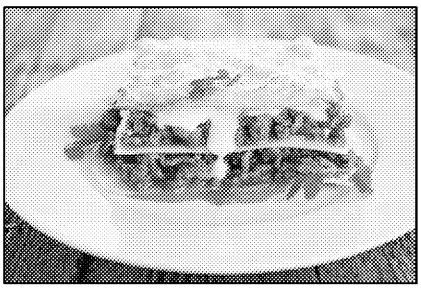
1. Discuss the 'use by' and/or 'best before' dates of various food items that are stored differently. For example, fresh fish, froze fish and tinned fish. Note down w[illegible] e food items are cooked or not and how thi[illegible]on the longevity of the fo
2. Discuss why som[illegible]oods and raw foods have a 'use by date or [illegible]fore' date.

To give food variety

Cooking also allows us to have variety in our diets. This is because of two reasons

- Different cooking techniques allow us to prepare the same product in a numb fried;
- Different combinations of foods, seasoning, herbs and spices make it possible number of different dishes with the use of the same main ingredient.

For example, beef can be used to prepare carpaccio, steaks, burgers, stews, soups as bolognese sauce), and so on.



Lasagne, steak and burger are examples of foods made with the use of beef, but all have uni ways they are prepared and cooked and the combinations of other ingredient

How cooking affects food

Cooking affects food both externally (which makes it look different) and internally (which changes its' features such as texture). Cooking also affects nutritional value of foods. That's because certain micronutrients – such as group B vitamin, vitamin C and vitamin A, are very sensitive to temperature and break down during cooking.

Nutritional value

High temperature, pressure, time of cooking, fragmentation, contact with oxygen in the air – all these factors can affect nutritional value of foods. Most vitamins are damaged by high temperatures; for example, 50% of vitamin B6 and 70% of folate will be damaged during cooking. It is also important to remember that some vitamins are water-soluble. This means that they will dissolve in water during boiling and will be lost if the water is drained.

Appearanc

The look of f changes depending on ingredients and cooking methods used. In meats, protein fibres will shrink and push out water (or jus), so the meat would be Denaturation and coagulation will cause eggs and pastry to set and become solid. Dough and cake will rise – either due to yeast or chemical leavening agents producing carbon dioxide. Rice, pasta and other starchy foods will absorb water and increase in size.

Colour

The colour of the food usually changes due to the Maillard reaction, caramelisation and dextrinisation, which cause the food to become golden or brown. Some vegetables, such as red cabbage or beetroots, would lose their purple colour and become blue or brown if cooked for too long – the colour may then be restored by adding an acid, such as vinegar. Green vegetables, such as spinach or broccoli, may lose their colour and become dull. To avoid this, they should be cooked for a short time only, and preferably in a lidded pan.

Texture

High temperature causes food ingredients to change their chemical structure. Du (meat, vegetables, fruit, rice or pasta), while others will become crispy and crunch Starch gelatinisation and water evaporation will cause sauces to thicken. Coagula proteins will cause eggs to set and change from liquid to solid. Dough and cakes v due to carbon dioxide, air or steam action. Sugar will caramelise and create a cru

Smell

The smell of hot foods is usually m pronounced than cold foods. That is becau foods are evaporating and filling the air, which makes them easier to smell. You c baking a cake or sim ering a stew.

Flavour

The flavour of food may change due to changes in chemical structure or due to ad flavourings. During cooking, starch will dextrinise giving a slight sweet taste, while to a deeper, buttery or nutty taste. A complex chemical reaction called the 'Maill numerous chemical compounds which change the flavour of coffee or cocoa to sli

Palatability

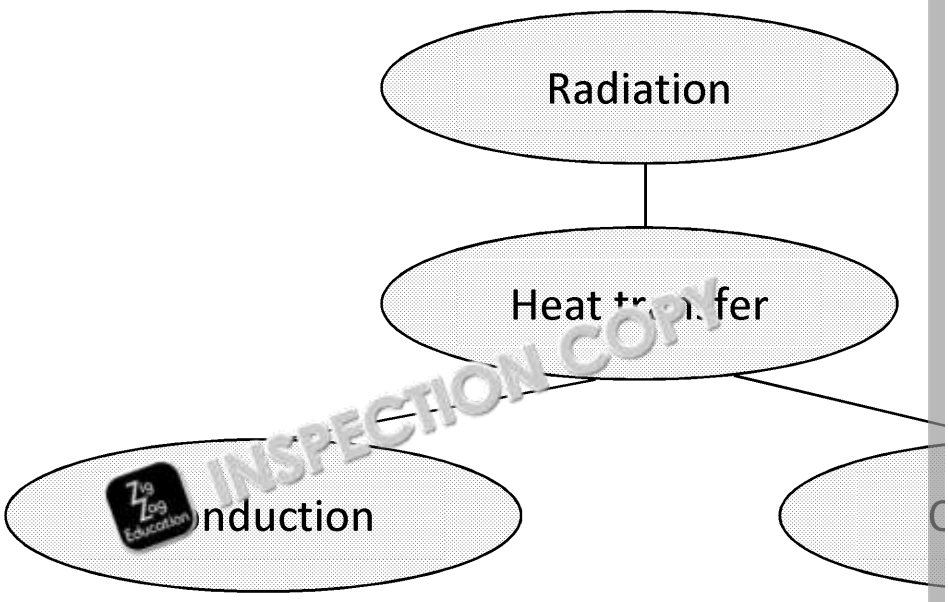
Various chemical reactions which take place during cooking affect all of the food p that a food is pleasurable is called palatability. It could be described by such term crispiness and usually will make food appetising and desirable to the consumer.

Raw onion is white and crispy.

During cooking, sugar in onion caramelises, which causes the onion to change colour and taste (fried onion is sweet). Some of the sulfur-based compounds present in the onion are broken so the smell will be sweeter and more gentle. The onion also becomes softer – that's because some of the fibres in its cell walls are broken down. Cooked onion will have less vitamin C than raw onion.

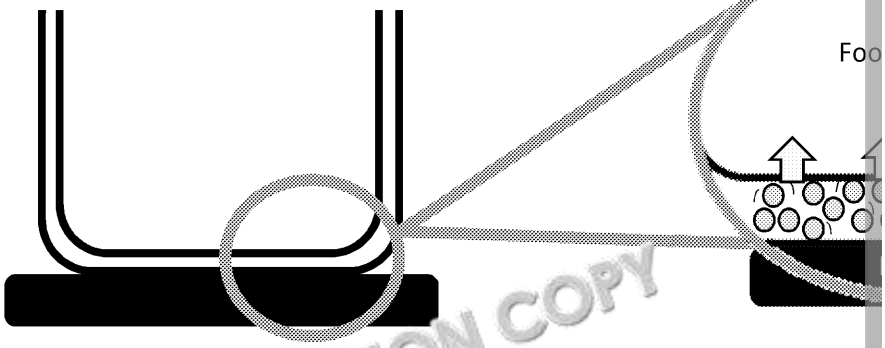
Different methods of heat transfer

There are three ways in which heat is transferred to food. These are conduction,

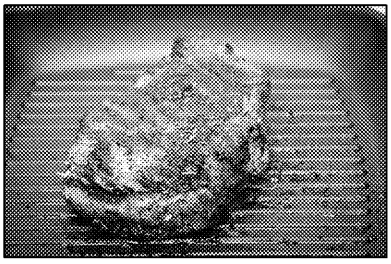


Conduction

The hotter the substance is, the faster its molecules move. That rule is applied in conduction cooking. Heat from the hob is transferred directly to a pan or pot you're cooking in. The molecules of the metal vibrate, and give their energy to surrounding molecules – in this case, molecules of food in the pan. The heat (energy) is transmitted directly, which means that the two objects (the pan and the food) have to touch each other.



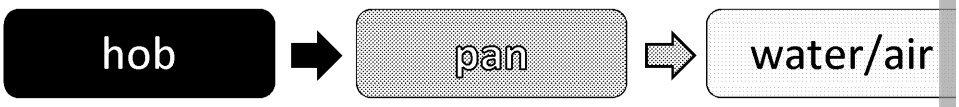
Heat causes metal particles ... the saucepan and causes food molecules to vib... energy and heats the food.

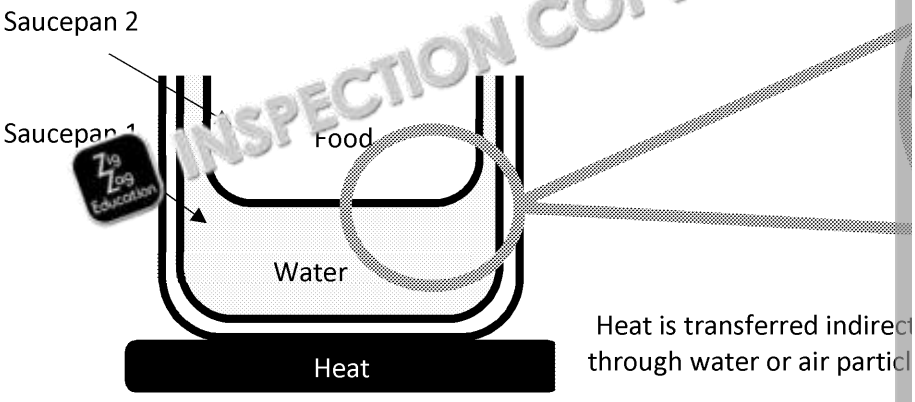


Simmering a stew, frying a steak or cooking a curry in a pan are using conduction

Convection

Convection is a way of transferring heat through migration of water or air particle
heated, water or air particles move up, and when chilled, they move down. These
convection currents, have found their use in ovens, during baking, boiling, poachi
heat is transferred indirectly through the use of water or air.



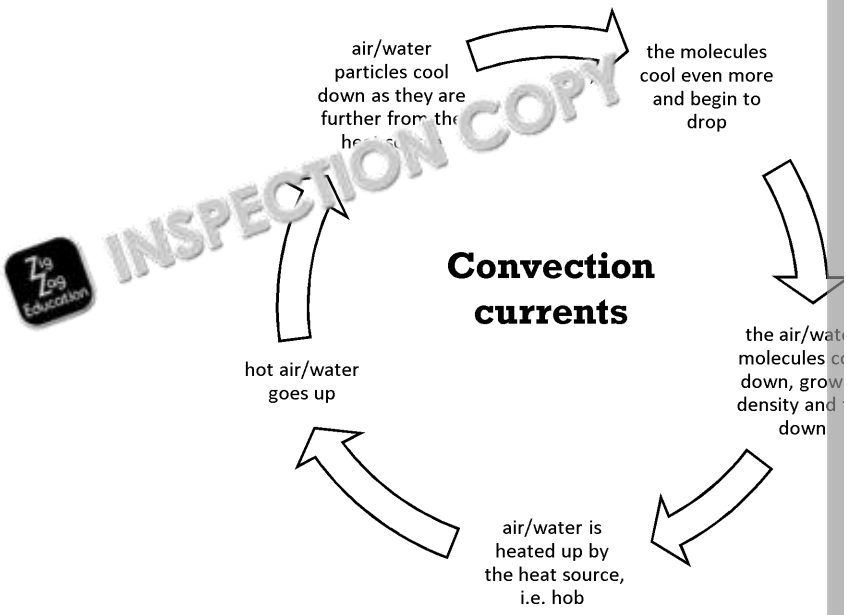


Heat is transferred indirect
through water or air particl

Steaming is an example of convective heat transfer, through the use of vapour.

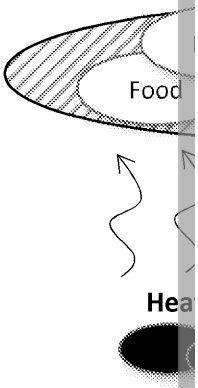
Apply

1) Prepare a chosen sauce
2) Explain how conduction
during the process.
3) Explain why it is necessa
mixture.



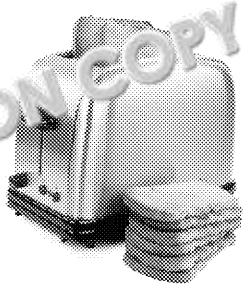
Radiation

Radiation is a technique that involves waves of heat being sent to the food – it mi
the heater and the food do not need to touch each other.
Radiation involves two kinds of waves – infrared and microwaves.



Infrared is a kind of electromagnetic radiation, which involves the use of light waves which are invisible to the eye. In cooking, infrared radiation is used in stoves, ovens and grills, where heat goes from the source to food.

Grilling/barbecuing is a classic way of using infrared for cooking as the black matt coal is effective in emitting infrared rays.



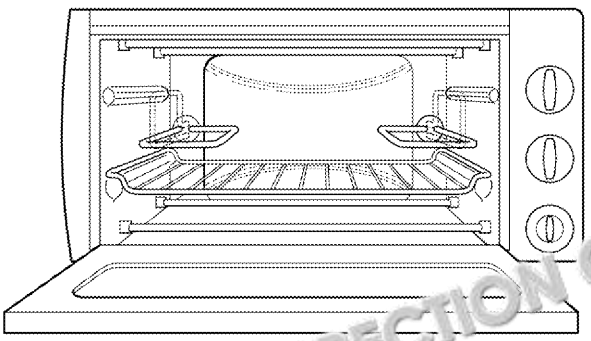
Infrared radiation is also used in toasters.

Apply

List coo
use dur
nutritio
radiatio

Microwaves are also a kind of electromagnetic radiation, but they are longer than infrared waves. They are, most obviously, used in microwave ovens. The waves are sent to the food and heat up particles of water, which (as you already know) move faster and faster, transferring the heat to all other surrounding particles. Th that, the meal can be warmed up quite effectively, but the use of microwave over foods which contain a high proportion of water.

It is also important to remember that microwaves can bounce back from shiny sur for example, aluminium foil or plates decorated with shiny golden-like materials i



How a mic

1. Transformer change high power electrici
2. Magnetron creates
3. Microwaves are sen an antenna.
4. Microwaves heat up
5. Water molecules vib

Apply

1) Prepare a vegetable stew using the recipe at *http://www.goodtoknow.co.u vegetable-stew*
2) Discuss what methods of heat transfer are used at each stage of prepar

Heat transfer summary:

Heat transfer method	Conditions	
Conduction	The objects have to touch each other	
Convection	The objects don't have to touch each other	
Radiation	The objects do not touch each other but waves of heat are being sent	

Apply

Identify the processes that take place when:

1) grilling tomatoes
2) baking a pie
3) cooking a soup
4) roasting chicken
5) boiling potatoes
6) frying fish
7) preparing cottage pie
8) preparing a curry
9) cooking a béchamel sauce
10) poaching eggs

Got time? Give them a go at home or in your class.

Apply

Use a microwave and an oven to prepare frozen pizza. How long does it take

3.3.1.1 Check your understa

1. Cooking food is the best way to… (*1 mark*)

   a. increase the amount of vitamins ☐ b. increase the am
   c. kill harmful bacteria ☐ d. activate enzyme

2. Water is necessary when… *(1 mark)*

   a. baking ☐ b. boiling
   c. frying ☐ d. grilling

3. The flavour of food ma[illegible]ged by… *(1 mark)*

   a. coagulat[illegible] ☐ b. caramelisation
   c. [illegible]xt[illegible]tion ☐ d. both b and c

4. During cooking, rice will… *(1 mark)*

   a. increase its size and absorb water ☐ b. decrease its size
   c. increase its size and lose water ☐ d. decrease its size

5. Sauces thicken during cooking because of… *(1 mark)*

   a. water evaporation and caramelisation ☐
   b. water absorption and caramelisation ☐
   c. water evaporation and starch gelatinisation ☐
   d. water absorption and starch gelatinisation ☐

6. List three processes that take place during baking a lasagne. (*3 marks*)

   .....

   .....

   .....

7. List three foods and three ways of preparing and cooking them to show variety. *(3 marks)*

   .....

   .....

   .....

   .....

   .....

   .....

   .....

3.3.1.2 Selecting Appropriate Cookin

How we treat our foods and what we do to them determines the final effect. A pr
cooking methods helps obtain the desired effect, maintain nutritional value of foo
tasty and appetising.

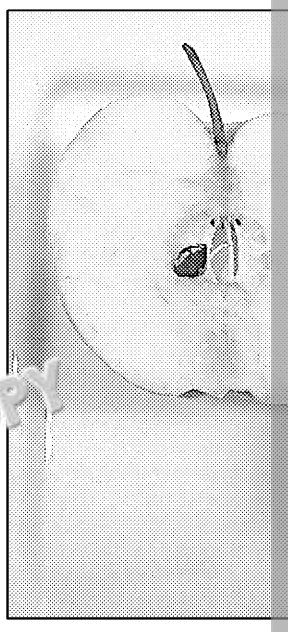
Preparation methods

Before cooking, it is sometimes necessary to properly prepare food to either make
Preparation methods involve:

- washing and cleaning – to remove dirt, dust and microorganisms
- sorting – choosing the good foods and throwing a[illegible]h bad (mouldy or rot
- peeling and removing unnecessary/i[illegible]e p[illegible]s (such as seeds from apples
- blanching
- cutting [illegible]ing [illegible]ding, etc.
- mixing [illegible]ding
- marinating
- macerating
- shaping (e.g. bread rolls, pasties, cookies, etc.)

Peeling and cutting deprive fruits and vegetables of their protective layer of skin.
to such factors as oxygen, light and temperature, which damage vitamins in food.
fruits damages their cell walls, which leads to cell breaking and leakage of enzyme
damage their surroundings, causing the fruit or vegetable to brown. This is called
Chapter 3.3.2.4 Fruit and Vegetables.)

Freshly cut apple



The same

Cutting, grating, shredding, blending and other methods of diminution change th
be advantageous in some cases; for example, when making an apple purée. It is a
who prefer softer, less crunchy foods – such as people with dental problems, or b

Blanching is a process in which a product is put into hot water for a few minutes (the time varies with the food) and instantly chilled. This process is used to de-skin tomatoes. It also helps reduce vitamin loss (because of oxygen in the air) by inactivating the enzymes in fruit and vegetables' cells.

Marinating is a process of conserving foods by putting them into a marinade. Marinades contain acid (either from vinegar, balsamic vinegar, lemon juice, buttermilk or other), which denatures proteins in meats and therefore softens/tenderizes them. Marinating also shortens the time of cooking and changes the flavour of foods making it more desirable.

Maceration is a process in which dry foods (such as raisins and other dried fruits) absorb water. This is used to make them easier to bite or process further, e.g. ble anything from water, through lemon juice, to cocktails. Alcohol-macerated fruits a example, Christmas pudding.

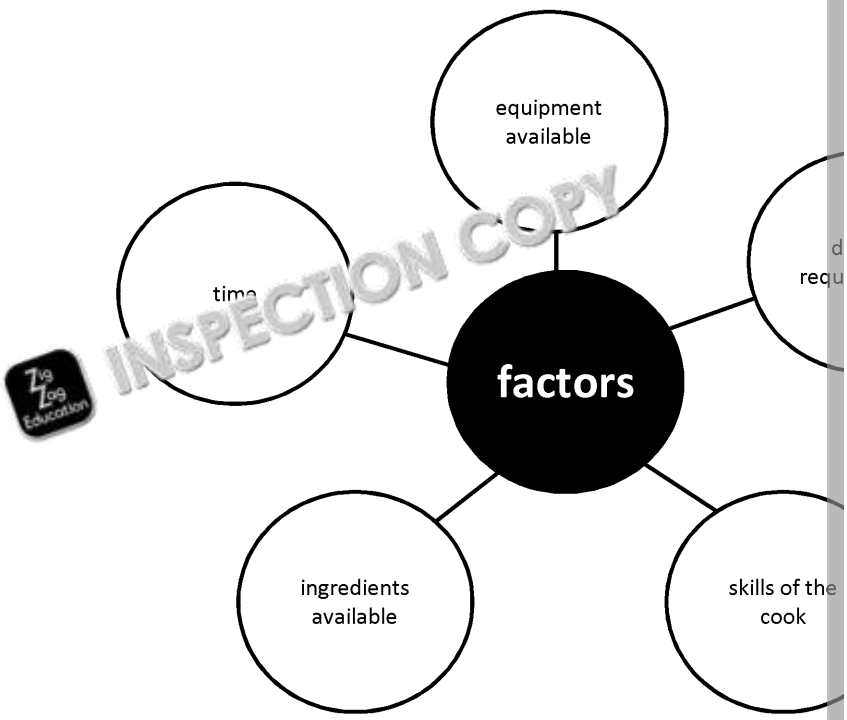
Apply

Prepare pieces of chosen meat (beef, chicken or pork). Marinate one of together. What do you observe? How has the marinade affected the *appeara* and *palatability* of the meat?

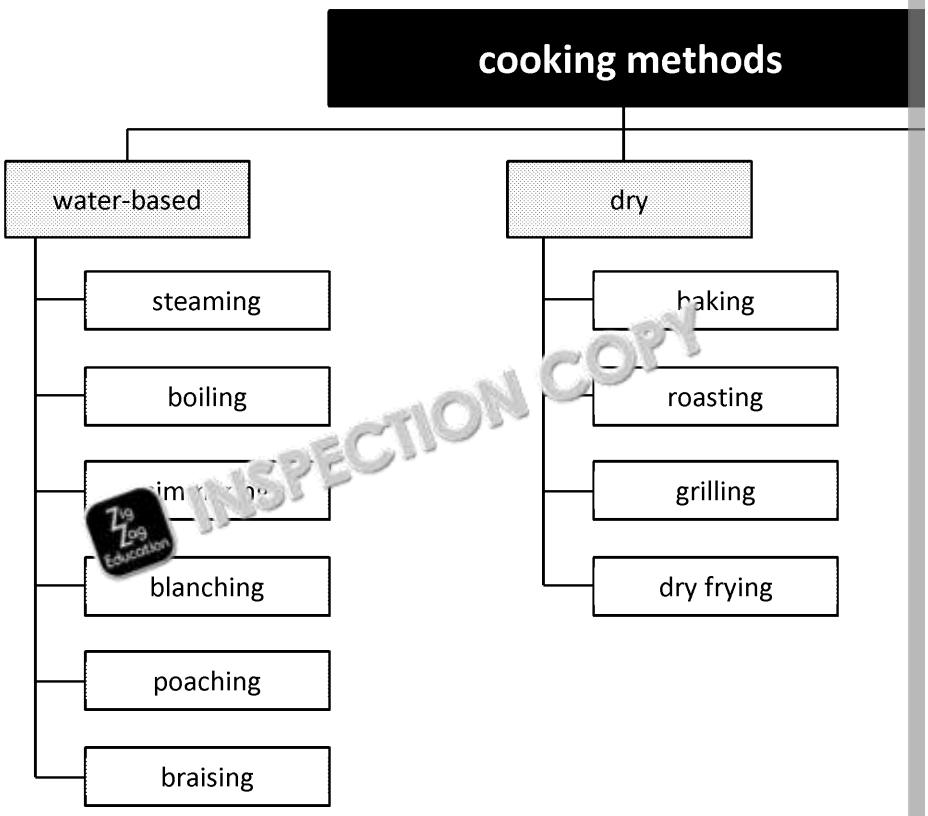
Cooking methods

There is a wide selection of cooking methods, which involve water-based, fat-base choice depends on various factors, such as skills of the cook or requirements of th person who doesn't own an oven will not be able to make a lasagne, and a person not be able to poach an egg. Likewise, it won't be possible to cook a three-course won't be possible to cook spaghetti without water (frying isn't a good example as not recommended to offer triple fried chips to someone suffering from cardiovas

Therefore, the choice of a cooking method depends on such factors as equipment the cook, time for cooking, available ingredients and requirements of a customer



Different cooking methods are often combined together to obtain the desired me
water-based, fat-based and dry methods.



Water-based cooking methods

Water-based cooking methods use water and other liquids to transfer heat – eith
indirectly (as in steaming). Their use is beneficial for a number of reasons:

- addition of fat is usually not required, making the dishes low in calories
- they help to soften proteins which makes them more digestible
- they are safe for fat-soluble vitamins as they will not dissolve in water or bec
- they help to soften the starch and make it more digestible for people
- the time of cooking may be easily adjusted – it's enough to probe the cooked whether it's already done.

Steaming is a technique which requires the use of a steamer (or simply a strainer steamer, a small amount of water is placed in the bottom pan, and food is placed cooking, water evaporates and cooks the food above. This method is advantageo (they do not dissolve in water because they simply have n[illegible]ntact with it). Food healthy, nutritious and low-fat.

Boiling is one of the most popu[illegible] methods, in which food is cooked in a l heat. An example of tha[illegible] that method is boiling potatoes, cabbage or eggs.

Simmering [illegible]hnique in which food is cooked with a significant amount of liquid, but on low heat and for a long time. An example of the use of that method is simmering a stew. The foods cooked this way will become soft and tender, but the long time of cooking will decrease the nutritional value of them.

Poaching is a technique in which small amounts of water (or other liquid, such as
applied to food to prevent it breaking apart. It is used to cook delicate products s
a good idea to save the liquid and use it to prepare a sauce to prevent vitamin los

Braising is a cooking method which, technically, combines frying and simmering.
the surface, and then simmered for a long time. This way the food remains juicy a
tender. The long time necessary and the high temperatures applied will unfortun
of a food.

Apply

Boil, fry and roast potatoes. Measure the time they need to cook properly.
benefits of different cooking methods versus the ti[illegible] people may have to p

Dry methods

Dry method[illegible] cooking techniques which do not require the use of wa
roasting, gr[illegible]d dry frying. Since these methods produce high temperatures,
special probe to check the readiness of the cooked food (because the surface is us

Baking and roasting are techniques that, basically, require the use of an oven.

Baking is applied to foods that do not have a stable structure, but will obtain it after processing. This includes such foods as muffins, sponge cake or fish pie. Before baking, it is advisable to cover the form with fat and/or breadcrumbs, to prevent the mass from sticking. Baking helps obtain soft foods with crispy surface – such as on top of bread. Sugar will caramelise in high temperatures and add flavour to the foods. Starch will break down and become more easily digestible, which may be important for people with digestive tract diseases.

Roasting is applied to foods that are already solid, such as turkey or parsnips. During roasting, it is advisable to sprinkle the surface of the roast with fat or juice that's leaking out of it to create a crispy, shiny skin.

Grilling is a technique which uses infrared waves to heat up the food. Grilling allo
out, which makes it more appropriate for some people, e.g. those on a low-fat die
grill foods, because harmful, carcinogenic substances may be produced as a result

Dry frying is frying in a dry pan – without the use of fat. It usually requires the use
(Teflon, stainless steel or ceramic). During dry-frying fat will melt and leak out of
acceptable for people who cannot consume a lot of fat. [illegible]me of cooking is im
food is cooked, the more vitamins will be lost due to [illegible]gh temperatures applie

All dry methods of cooking are [illegible]ded for health reasons to people who w
on fats.

Apply

Research (using books or the Internet) a recipe for a casserole or tagine and
of how to prepare them. What cooking methods will you use?

Fat-based cooking methods

Fat-based cooking methods include shallow frying, deep frying and stir frying. Frying usually produces high temperatures (around 200 °C and more) and therefo damages vitamins in foods. Depending on the quality and quantity of the fat usec fried foods are more or less appropriate for different people. For example, frying general is inappropriate for an obese person with hypertension, but shouldn't be harmful for a healthy one.

Fat-based cooking methods use different fats, such as vegetable oils, butter, lard goose fat, and even margarines.

Shallow frying requires only a small amount of fat. The fat in shallow frying:

- seals the surface and closes juices inside the f (e.g. meats)
- creates a crispy skin/surface
- gives the food the desired ta
- prevents food stick in pan

These deep

Shallow fry damage some of vitamin C and vitamin B2 due to heat, but will add more fat-soluble vitamins to the food.

Deep frying uses large amounts of fat – this is often used to fry chips or breaded treats such as Scotch eggs. During deep frying, the whole product is being sunk in fat, allowing it to cook evenly. Unfortunately, during deep frying a lot of fat is being absorbed by the food, making it fatty and not suitable for many people. Also the heat will lower the vitamin content in the food.

Exam tip

Stir frying, steaming, grilling, dry frying and poaching are ways of conserving foods' nutritional value.

Stir frying is a variation of shallow frying, in w moved constantly in the pan. The technique i (especially Chinese). The dish in which food is Stir frying is a method which takes a short tim preserve its nutritional value and colour.

Things to think about

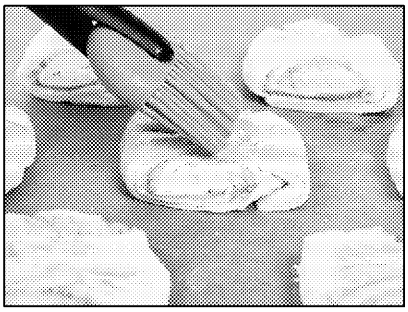
Discuss advantages and disadvantages of all of the cooking methods (w fat-based). Discuss how the use of each of th ethods could affect how this can influence the food choic at individual would need

Finishing methods

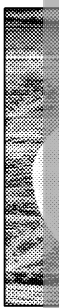
The food we eat not only needs to be healthy and tasty, it is also recommended t
This means that the food has to look pleasant and encourage people to eat it – in
Different methods of finishing the food include:

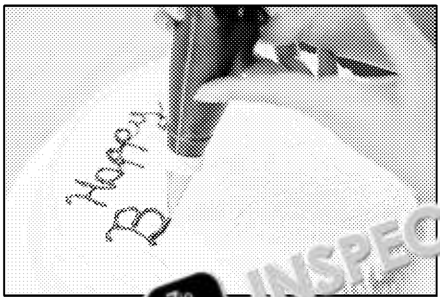
1. Glazing – applying a glossy coating to foods; glaze is applied to food by dippi substances used for glazing include icing sugar, jam and water solution, or ed
2. Egg-wash glazing – smearing a raw dough or pastry before baking to make it technique usually uses beaten egg white or whole egg, or milk – this is becau and proteins react together in a Maillard reaction, creating a brown colour
3. Decorating – e.g. piping; applying precise patterns to food's surface by pres
4. Garnishing – adding a contrasting colour of vegetable, fruit or herb to make f sometimes to contrast the main flavour; most popular garnishes include basi coriander, spring onions, … and carrot, pumpkin and sesame seeds, and e
5. Adding … o… – usually a crunchy top on foods, or fried onion, e.g. on
6. Icing – …, a sweet mass made of icing sugar with various additives (such egg white), which adds a pleasing flavour, texture and appearance to sweet
7. Dusting – with icing sugar or cocoa powder
8. Filling – with fruit, cream or whipped cream, e.g. profiteroles

Icing makes the food more appetising and appealing to the consumer.

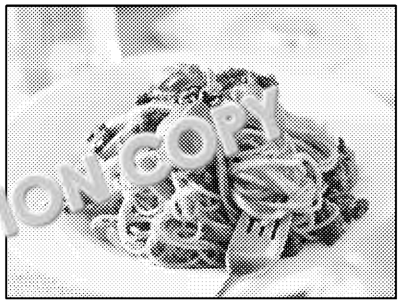


Egg-wash glazing allows pastries to obtain a golden shiny surface after baking.

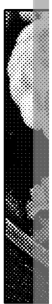




Piping also e… writing on cakes.



Basil leaves are often used for garnishing.



Apply

Prepare two vegetable pasties. Glaze the surface of one of them and bake both. What do you observe?

3.3.1.2 Check your understa

1. Blanching is used to… (*1 mark*)

   a. prevent fruit from browning ☐ b. prevent meat fr
   c. increase the amount of vitamins ☐ d. decrease the a

2. Roasting is used to cook… *(1 mark)*

   a. eggs ☐ b. bread
   c. carrots ☐ d. muffins

3. The change of colour of [illegible] cut is caused by… *(1 mark)*

   a. enzyma[illegible]ng ☐ b. enzymatic brow
   c. [illegible] greening ☐ d. reduction

4. Stir frying is a way of… *(1 mark)*

   a. conserving nutritional values in food ☐ b. conserving fat i
   c. preventing enzymatic browning ☐ d. decorating fooc

5. Water-based methods of cooking are better for your health than fat-bas

   a. they decrease the amount of fat in food ☐
   b. they increase the amount of vitamins in food ☐
   c. they increase the amount of fat in food ☐
   d. they decrease the amount of vitamins in food ☐

6. Explain why enzymatic browning takes place. (*2 marks*)

   .....

   .....

7. List three processes that take place when cutting, boiling and finishing v

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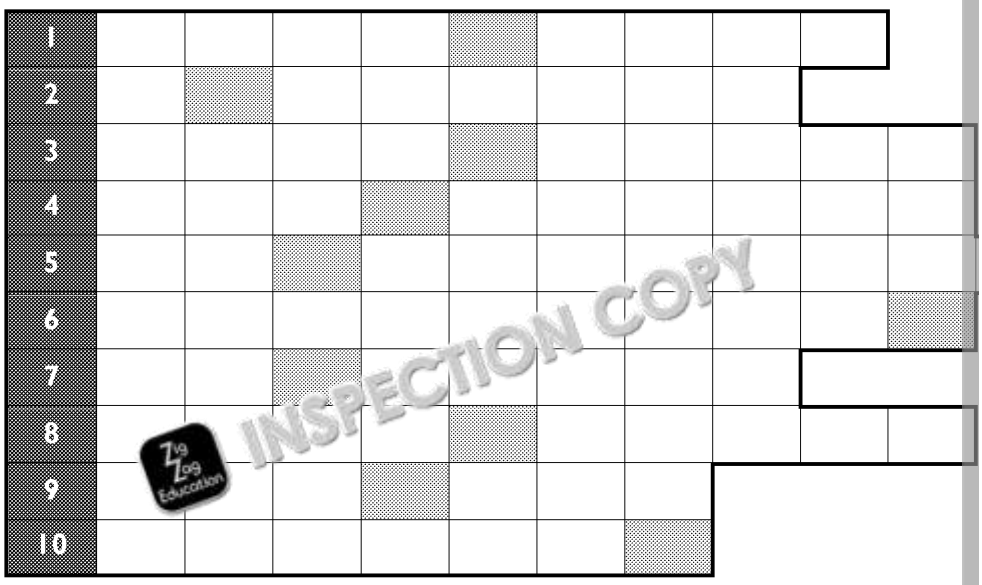
3.3.1 Quiz-ine

Fill in the answers to the questions below to reveal a phrase relevant to food safe



1. The amount of time for which a food can be safely stored (9)
2. Cooking method used to prepare vegetables and meats (8)
3. Electromagnetic waves used for radios and in cooking (10)
4. Method of direct heat transfer (10)
5. Smelling agents in food (13)
6. Bacteria found in eggs and poultry (10)
7. A type of radiation that involves the use of light waves that are visible to the
8. Method of cooking which requires the use of water or air (10)
9. Consistency of food (7)
10. Method of cooking with the use of a wok (7)

The shaded squares reveal this phrase:

Chapter 2: Functional and Ch
Properties of Food

Overview

This chapter is about the role of different ingredients in cooking. Here you will learn what proteins, carbohydrates and fats are used for, what their function is in cooking and how they react to heat. You will also discover the difference between enzymatic browning and oxidation of fruit and vegetables and learn which of them are the most susceptible to the processes. You will also discover how to choose a suitable various raising agents, depending on the ingredients you are working with.

Learning Outcomes

After studying this chapter you should be able to do

- ❑ identify the main chemical processes that take and preparing food
- ❑ understand the need for the use of certain tec
- ❑ list different ways to use proteins, carbohydra
- ❑ understand the main processes that affect veg
- ❑ [illegible] different raising agents
- ❑ explain how raising agents work
- ❑ choose the right cooking and preparation meth
- ❑ know most popular finishing methods

Key Terms

Protein denaturation	The process of damaging proteins' chemical structu irreversible
Protein coagulation	The process of changing proteins from liquid to gel
Gluten formation	The process of creating a strong, elastic, net-like str with water
Foam formation	The process of trapping air bubbles between protei it lighter and more susceptible to growth
Gelatinisation	The process of breaking down the chemical bonds i presence of water and heat
Dextrinisation	The process of breaking down long starch chains int
Caramelisation	The process of browning sugars in the presence of h
Shortening	The process in which fat particles surround flour pa formation impossible
Aeration	The process of incorporating air between fat particl mass lighter
Plasticity	Elasticity; abili[illegible]o easily change shape or physical s
Emulsification	The process of combining water and oil together to
Enzymatic brown[illegible]	The process of enzymatic denaturing due to plant c of enzymes
Oxidation	The process of denaturing substances (such as vitan exposure

3.3.2.1 Proteins

The choice of ingredients and their amount in a dish is a matter of the 'to be or no
properties of foods, the way they react to heat, air and mechanical actions are the
meal. Knowing how ingredients are combined is then important in order to under
certain dishes and what their role is in them.

The chemical structure of proteins

Proteins are large biomolecules built of hundreds of amino acids. Amino acids bo
chains of peptides, and peptides bond together to form longer chains of polypepti

amino acids → peptides → polyp

Proteins can form different spatial structures, usually to save room and fit more into a cell. Amino acids may react with each other, creating new chemical bonds.

1. **Primary structure** – when the protein has a form of a simple chain of amino acids bound together.

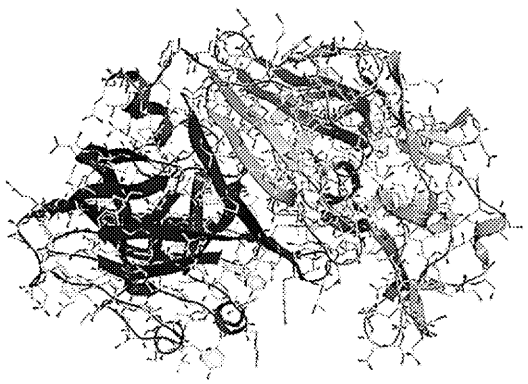
2. **Secondary structure** – when the chain starts to form a spiral (helix) or harmonica (sheet); here the amino acids come closer together, creating hydrogen bonds between them, which gives them one of the shapes (shown right).

3. **Tertiary structure** – when the spiral/harmonica clumps tighter to form a ball or other 3D shape (usually to save room). In the tertiary structure the protein is still built of one chain of amino acids, which now form three different types of chemical bonds (peptide bonds, hydrogen bonds and disulfide bridges).

4. **Quaternary structure** – when different chains of proteins form a 'lump' made of different tertiary-structured proteins, to form a fully functioning biological unit such as an enzyme or hormone.

Now you have a better understanding of how proteins are structured, we can begin to look at how different methods of preparation and cooking can change the structure and chemical properties of a protein.

The quaternary structure, different chains of proteins join together to form a functioning unit, such as an enzyme.



The use of proteins in cooking

Protein denaturation

Denaturation is a process in which chemical bonds in the proteins are being broke
their structure. This happens in certain conditions:

1. When heat is applied to a protein, e.g. during baking a soufflé or boiling an e
2. When acid is applied to a protein, e.g. when lemon juice is added to meringu
3. Due to mechanical actions, such as whisking egg white (see foam formation).

Different proteins denature at various temperatures. For most of the proteins in
denaturation is around 65 °C and more. This is why eggs set, meats and fish beco
spongy when cooked.

Acid is also capable of damaging bonds in protein. This is used when adding lem
foam (e.g. whipped egg white for meringue from collapsing or when marinating

Foam formation

Mechanical actions, such as whisking, also lead to the damage of protein structure
be partially denatured – you can notice how whipped egg white will turn into liquid
During whisking, protein molecules stretch and tiny air bubbles are being forced i
forming a foam. Foams are used to lighten the texture of food, to make it more p
during cooking. Foam formation is used to prepare sponge cakes, soufflés, ice cre
other foods.

Notice that if beaten for too long, the proteins will shrink and push out water – th

Apply

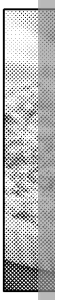
1) Prepare an egg white. Beat it to obtain a white foam.
2) Divide the foam into three bowls.
3) Add a teaspoon of lemon juice to the second bowl. Continue beating t
4) Write down your observations.

Apply

1) Marinate a piece of pork and a piece of fish. Compare the structure of marinated pieces.
2) Roast all of the products. Compare the structure. What do you notice
3) Learn at *http://www.bonappetit.com/test-kitchen/cooking-tips/article/stupid-easy-or-less* how to make various marinades

Coagulation

Coagulation is a process in which large particles of proteins agregate and form lumps. This is because they are being deprived of their electric charge. You can observe it by adding salt to an egg white. This process is usually reversible. Coagulation is used, for example, in salted fish – to undo it, you need to soak it in water in order to wash out the salt. Coagulation often takes place simultaneously with dentauration, so it might be difficult to differentiate them; for example, when frying eggs, the proteins both denature and coagulate, leading to the final change of texture. Coagulation may also be caused by enzymes, such as rennin used in cheese production, and heat, for example when boiling eggs.



In qu
in re

Apply

1) Prepare five eggs and boil the[illegible] fferent time: three, five, seven, 10
the shells with a pen [illegible] kn[illegible]when to remove which egg from the wat
2) Peel the eggs [illegible] them in half and note down the differences you ob

Gluten gives the dough plasticity and traps air bubbles, allowing it to rise.

Gluten formation

Gluten is the protein found in certain grains (such as wheat, rye, barley and oats). Gluten is formed from two kinds of proteins: glutenin and gliadin. When mixed with water, they join together and form a net-like structure. Gluten fibres are elastic and can be easily stretched, which gives the dough a sponge-like structure. This feature is called **plasticity**. This is why wheat bread is soft and elastic, and gluten-free bread is rather tender and brittle.

During bread making, yeast produces carbon dioxide (CO_2). The gluten net is useful because it traps the carbon dioxide bubbles and allows the dough to rise.

Oats are n
Unfortuna
process us
the same f
process wh
oats very c
with gluter
packaging
certified as
steps were
contamina
products c
coeliacs, a
cause harm
all resourc

Apply

1) In groups, prepare three kinds of [illegible]pas[illegible]dough with the use of differe
flour, plain flour and co[illegible]ch [illegible]ou can use the recipe at
http://www.food[illegible]rl.com/recipes/fresh-pasta-dough.html
2) Write do[illegible]y[illegible] observations.

3.3.2.1 Check your understa

1. Which process occurs during kneading a bread dough? (*1 mark*)

   a. foam formation ☐ b. denaturation
   c. coagulation ☐ d. gluten formatio

2. Denaturation can NOT be caused by… *(1 mark)*

   a. adding lemon juice ☐ b. adding kitchen
   c. adding balsamic vinegar ☐ d. adding spirit vin

3. A marinade tenderises [illegible] because… *(1 mark)*

   a. it contai[illegible] ☐ b. it contains oil
   c. co[illegible] acid ☐ d. it contains pepp

4. Denaturation is a process which damages… *(1 mark)*

   a. the amino acids ☐ b. the chemical bo
   c. the structure of sugars ☐ d. the structure o

5. Coagulation takes place during… *(1 mark)*

   a. baking a shortbread pastry ☐ b. baking a quiche
   c. toasting bread ☐ d. cooking pasta

6. Explain how the use of high-gluten flour helps produce a dough. (2 *mar*

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7. Explain how protein coagulation and denaturation allow one to produc

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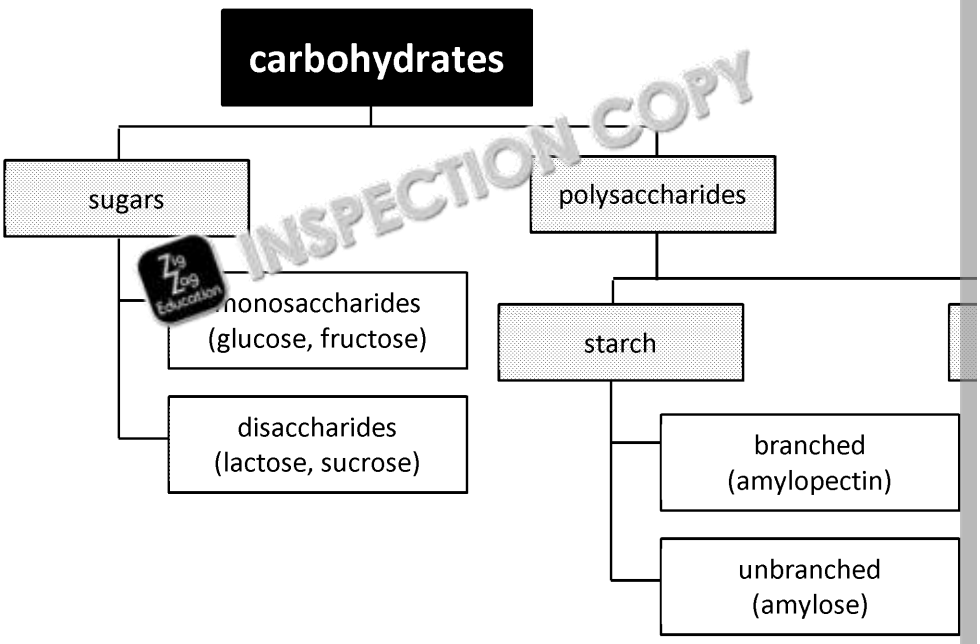
3.3.2.2 Carbohydrates

Carbohydrates include sugars, starches and dietary fibre. They are present in mar
vegetables and fruit to pure sugar. Carbohydrates are the main source of energy
necessary to build DNA strands and conduct all live processes in every living cell.

The chemical structure of carbohydrates

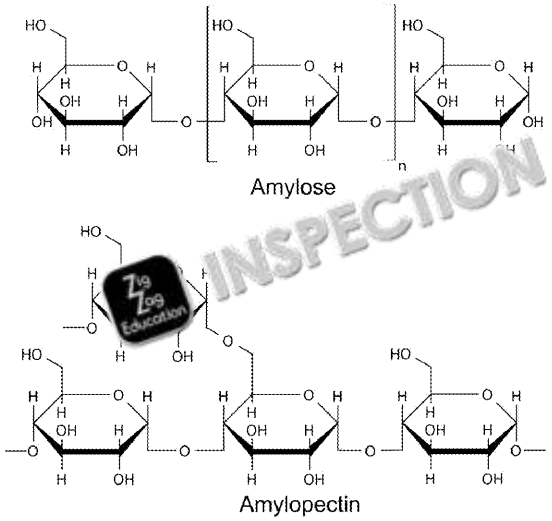
Carbohydrates are all structured differently and can be split into the following gro



Sugars include monosaccharides (single molecules) and disaccharides (built of two molecules of single sugars). They are found in table sugar, honey, syrups, etc. They dissolve easily in water. When cooked, sugars **caramelise**.

Starches and fibre are long chains of monosaccharides bound together.

Starch is the main compound of flour. It is built from many monosaccharides bound together into long chains, which can be either branched or unbranched (this may be important when dissolving starch – the branched one should dissolve more easily). Starch doesn't dissolve in cold water, but instead fo[illegible]suspensions. The su[illegible]ension is a mixture of starch particles floating in water, and eventually, forming a residue at the botto During cooking starch can eith

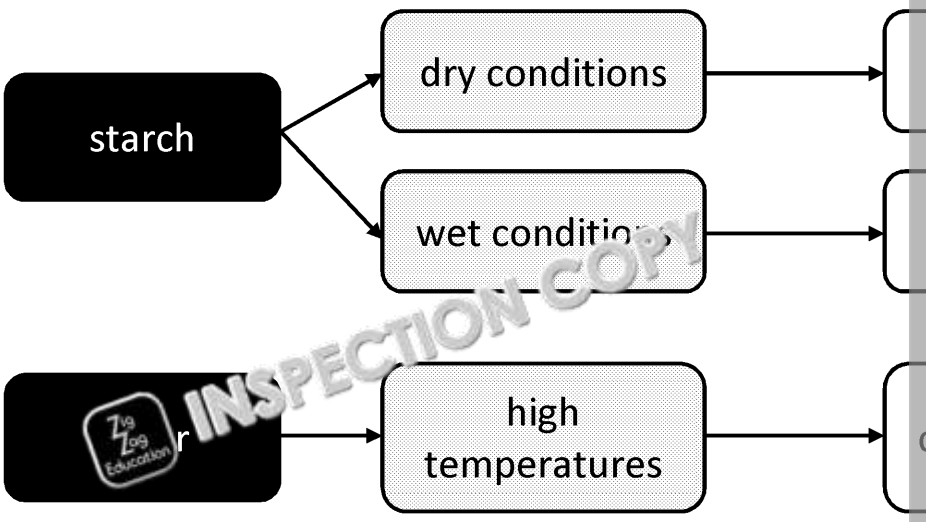


Amylose is an example of an unbranched starch, while amylopectin is branched. They are both built from thousands of glucose molecules.

Dietary fibre is built of thousa bound together into long chai although it is available in purif indigestible for humans, but h Soluble fibre absorbs water w like substance, which turns th fibre will break down and soft plant foods to become soft.

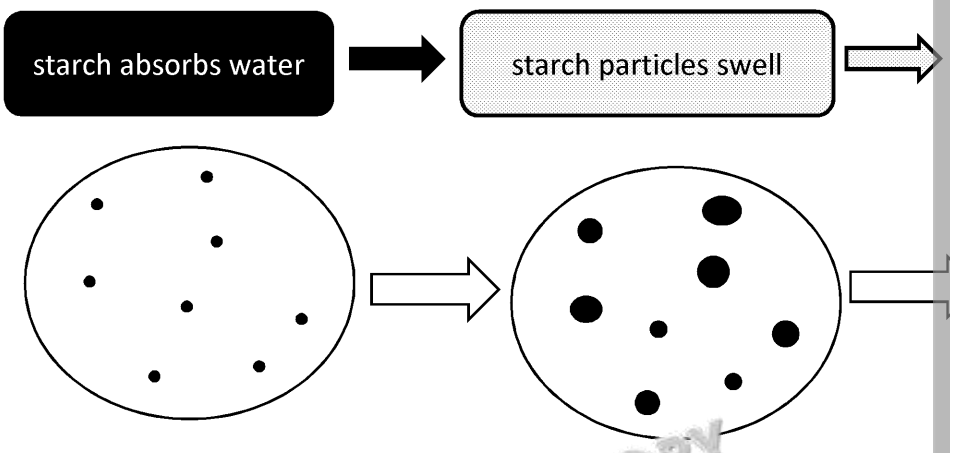
Preparing and cooking with carbohydrates

Food preparation and cooking involves many and various techniques which differ
food and the chemicals it's made of. Various times of cooking, temperature and t
lack will cause visibly different effects on carbohydrate-rich food products.



Gelatinisation of starch

Starch particles do not dissolve in water. Instead, they absorb it and swell, turnin
process happens when the mixture of water and starch is heated and is called gela
cooking since it helps thicken sauces and other mixtures, such as puddings. The m
constantly to prevent lump formation. In cold water, starch granules will first for
to the bottom of the vessel.



Starch granules in cold water

ch granules absorb water when heated.

Apply

1) Prepare three samples of béchamel sauce: use plain flour for sample1, p
and again plain flour for sample 3 but do not stir the mixture. What to
2) Explain how convection and conduction are applied during sauce-maki

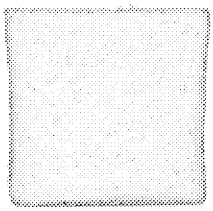
Dextrinisation of starch

Shorter chains of polysaccharides are also called dextrin. When polysaccharides, s
conditions, their long chains break down into shorter ones – this is called dextrinis
while baking bread (and other starchy foods) and is responsible for the sweet-ish
crispiness of the crust.

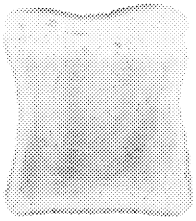
Apply

Place a piece of bre
chew for 60 second
changes from savou
long chains of polys
down by the enzym
sweet short chains
molecules of sugar.
when bread is being
enzymes, but heat.

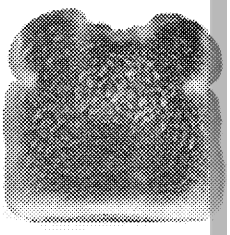
While making roux for a sauce, flour dextrinises. Different stages of dextrinisation
lead to a final variation of colour and taste.



Fresh bread has long chains of polysaccharides.



Lightly toasted bread will have some of the polysaccharides broken down into dextrins, so its colour and flavour will change.



Too long time and to
high temperature o
toasting will cause th
bread to burn. The
starch in it will be
dextrinised, but
evaporation of wate
will cause it to taste
bitter.

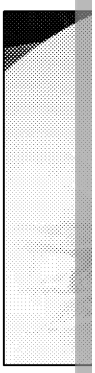
Apply

Toast bread on different settings in a toaster (1, 2, 3, 4 and 5) or for differen
(e.g. two, five, 10, 15 and 20 minutes). Compare the colour of the bread slice
changed both the appearance and the taste of the bread.

Caramelisation of sugars

Sugars include molecules of monosaccharides and disaccharides. At high temperature, sugar crystals break and melt into syrup and change colour from light yellow through golden to brown. This is because oxygen and hydrogen are being evaporated and only black molecules of carbon are being left. Depending on the temperature and time of cooking, all foods containing sugars will caramelise.

Caramelisation is used in cooking to either change the flavour or affect the colour of the food to make it more appealing. This process is used when making fudge or burning the surface of *crème brûlée* to create the golden crunchy top. Caramel is also used in manufacturing cola-like beverages and is responsible for their dark brown colour.



Caram
sweet to

Apply

1) Group, prepare roasted carrots and onions.
   - Group A: roast for 30 minutes in 200 °C
   - Group B: roast for 30 minutes in 160 °C
   - Group C: roast for 60 minutes in 160 °C
   - Group D: roast for 60 minutes in 100 °C

2) Make notes on how cooking time and temperature affects the colour a

Did you know?

Maillard reaction takes place when proteins and carbohydrates are cooked by dry methods. Amino acids from proteins and sugar from carbohydrates react with each other, which results in creation of so-called *amadori compounds*. These agents change the smell, flavour and colour of the food (it becomes brown). The Maillard reaction is used to obtain the desired smell and flavour of bread and pastry, beer and coffee beans.

3.3.2.2 Check your understa

1. Dextrinisation takes place when… (*1 mark*)

   a. simmering a tomato sauce ☐ b. making a roux
   c. cooling jelly ☐ d. boiling pasta

2. Caramelisation is NOT used to prepare… *(1 mark)*

   a. vanilla fudge ☐ b. boiled vegetable
   c. roasted vegetables ☐ d. toffee sauce

3. The process of absorbing water and thickening mixtures with the use o

   a. dextrinisation ☐ b. caramelisation
   c. gelatinisation ☐ d. gelation

4. During cooking, pasta… *(1 mark)*

   a. will push out water and dextrinise ☐ b. will swell and ca
   c. will absorb water and dextrinise ☐ d. will absorb wat

5. Explain how starch affects viscosity (stickiness) of sauces and soups. (3

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3.3.2.3 Fats and Oils

Fats and oils are built of a glycerol 'head' to which three chains of fatty acids are attac
fatty acids are bound together by either single or double bonds. This decides whethe
temperature – generally, saturated fats (which have only single bonds) are solid at ro
fats (in which double bonds are present) are liquid and are therefore called oils. The
important because it determines its consistency, melting temperature and, therefore,

Three chains of fatty acids

Workin haracteristics of fats and oils

The structure of fats has an important role when choosing cooking ingredients. S
preparing shortcrust, while oils will be better for frying or preparing a dressing. C
help to obtain the desired effect.

Plasticity

Plasticity of fats means their ability to be reshaped and to melt at different temperatures (they have different melting points). A good example is butter and lard. They are solid while in the fridge, become soft and greasy at room temperature and melt to an oil during cooking.

There are certain types of margarines which are spreadable in low temperatures – you can say that they have good plasticity.

Shortening

When mixed with starch (like flour), fats create a layer around starch particles, an therefore prevent gluten from forming long chains. This is called **shortening** and obtain crunchy, crumbly pastries, as in biscuits. It is noticeable that only solid fats shorten the mixture – oils will rather turn it into a lump. For this reason, it is bette cold butter/lard and cold water, and then let the pastry rest in a fridge to obtain a melt-in-the-mouth pastry.

Apply

Prepare a shortbread pastry using butter or h n L tt e and half oil. Bake the b the difference in texture and taste

Aeration

Similar to fo mation, aeration is the trapping of air bubbles in the fat mixtur leads to the c eation of creams, which can be observed when whisking butter wit or when whipping cream. Aeration is also used to obtain the cloud-like texture of creams.

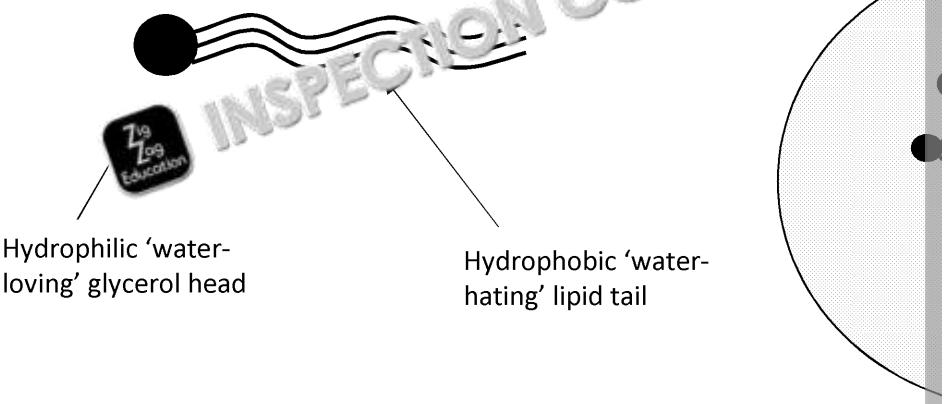
Apply

1) Pour three different kinds of cream into a bowl: single cream, whipping c
2) In groups, whisk each cream to measure the time needed and observe th
3) Compare how much fat each of the creams contains and how this affects to change in volume.

Emulsification

Emulsion is a mixture of oil and water. Depending on the amount of ingredients u
can distinguish water-in-oil emulsions and oil-in-water emulsions. An example of
emulsion is milk: usually fat molecules are spread evenly in the liquid, but when b
will form a coat on top. An example of water-in-oil emulsion is butter (notice how
when taken out of the fridge).

Since fat is hydrophobic, the particles of fat and water will repel each other, leadi
dissection of the emulsion into layers. To prevent that and make the mixture mor
emulsifiers are used. One of the most popular emulsifiers is lecithin, present in eg
Emulsions are used not only in cooking, but also in the cosmetic industry.



When put in water, fat particles will turn their hydrophilic heads towards it, creati

Emulsifiers will attach to oil droplets keeping them dispersed and making the mixt

Did you know?

Mayonnaise is also an emulsion, made of vegetable oil, egg yolk, vinegar and fla

- liquid phase – vinegar (sometimes milk is also used)
- oil phase – vegetable oil, such as sunflower oil; various types of mayonnais
  other kinds of oil, such as olive oil, to improve their nutritional value
- emulsifier – egg yolk. It is a natural source of lecithin which will suspend o
  the mixture and prevent layering.

Large factories may also use homogenisers – special m[illegible]hes which pump the
and make oil droplets smaller, making it easier [illegible] nd in the mixture.

Rese[illegible]cl

Read th[illegible] of a mayonnaise jar/bottle and try to define whether it's an oil-
water-in-oil emulsion. Justify your answer.

Research

Check what substances are used as emulsifiers in foods on *http://www.eufic.org*
emulsifiers-food/

3.3.2.3 Check your understa

1. Shortening means that… *(1 mark)*

   a. fatty acids become shorter ☐ b. gluten fibres be
   c. sugar chains become shorter ☐ d. carbohydrate c

2. Aeration is used to produce… *(1 mark)*

   a. bread dough ☐ b. whisked egg wh
   c. whisked egg yolks ☐ d. whipped cream

3. Plasticity means that… *(1 mark)*

   a. fat is so[illegible] temperature
   b. [illegible] is liquid at room temperature
   c. [illegible] is easily spreadable at room temperature
   d. different fats melt at the same temperature

4. Which statement about fat molecules is FALSE? *(1 mark)*
   a. fat molecules contain three chains of fatty acids
   b. fat molecules are hydrophobic
   c. fat molecules are hydrophilic
   d. fatty acid chains can have both single and double bonds

5. Which statements about fats is TRUE? *(1 mark)*
   a. fats dissolve vitamin B
   b. fats with water create emulsions
   c. fats with acid create emulsions
   d. all fats have the same melting temperature

6. Explain the need to use emulsifiers. (2 *marks*)

   .....

   .....

7. Explain how shortening helps obtain a crumbly pastry. *(4 marks)*

   .....

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Various cooking and preparation methods affect the nutritional value of fruit and
important source of fibre, vitamins and minerals. Special care should be taken of
damaging influence of external factors, such as oxygen or light. To prevent the lo
fruit and vegetables and maintain their appearance, texture and taste as much as
when preparing and cooking, such as:

- not exposing them to air or light unnecessarily to prevent such processes as e
  oxidation from happening
- consuming the liquid in which they were cooked
- microwaving, steaming, roasting or grilling vegeta les ra her than boiling the
- shortening the time of cooking whenev r po. sib e
- scrubbing instead of peeling

Enzyma bi wning

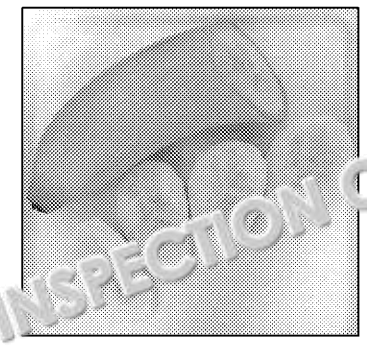
When you're peeling or cutting vegetables, you destroy the structure of plant cell
contents to spill out. The enzyme in the cells' juices, called *polyphenol oxidase*, re
damages substances in plant tissues, causing them to brown. This is negative to t
on the other hand, helps obtain the desired flavour of tea, coffee or chocolate. Th
number of vegetables and fruit, such as:

- avocados, bananas, peaches, pears, apples, mangos, apricots, plums, grapes
- aubergines, mushrooms, potatoes, lettuce

Enzymatic browning can be slowed down or stopped by either:

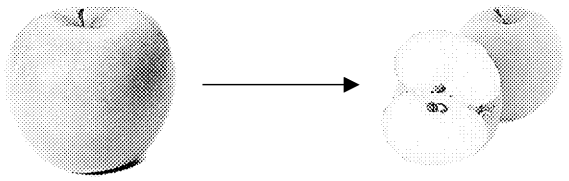
- lowering temperature, i.e. putting the cut vegetables into the fridge
- inactivating enzymes by blanching
- adding acid, such as lemon juice or vinegar to foods
- removing oxygen – this is applied in salad factories and manufacturers, where
  oxygen conditions.

Enzymatic browning will accelerate in the presence of iron or copper – for this rea
plastic containers to store the food.



Freshly cut banana.

The same banana
minutes.

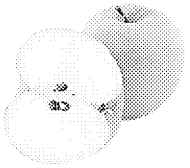


The polyphenol oxidase enzyme is activated by oxyge molecules from the air.

When the fruit is cut, the cells are damaged, which causes the enzymes inside it to have contact with oxygen.

Plant cells are full of various substances, e.g. enzymes. The enzyme called polyphenol oxidase is usually inactive and waits for the cell to send it a signal to start working.

lem juice / blanching



Acid or heat wi enzyme so the its c

Research

Explore in more detail why enzymatic browning takes place at *https://www.youtube.*

Oxidation

Oxygen is necessary to live – it is produced by plants from carbon dioxide and used by animals for breathing. However, oxygen has a destructive effect on most foods, causing substances in them to oxidise. During oxidation, food particles lose electrons, which are being caught (or, more often, stolen) by oxygen molecules. This leads to food spoilage and loss of nutritional value, leading to development of an unpleasant flavour and smell.
Natural antioxidants are present in foods (such as vitamins A, C and E), but it is best not to expose the food to air if possible. Oxidation may be stopped or slowed down by:

- protecting food from oxygen, e.g. by covering it or packing in oxygen-free conditions
- use of antioxidants, either natural of artificial, such as lemon juice, lime juice,
- use of barrier substances such as salad dressing which covers the surface of f

Apply

- Take three apples of different kin (e.g. Golden Delicious, Gala and Jo
- Cut or grate them and lea e for 30 minutes.
- After that tim you should observe different stages of oxidation – this i different amounts of vitamins protecting them from the process.
- the experiment, but add lemon juice to each sample. What do

Research

Explore the variety of English apples and pears on *http://www.englishapplesandpe* the amount of antioxidants in them and assess which apple varieties are less pr

3.3.2.4 Check your understa

1. Oxidation is undesirable because… *(1 mark)*

   a. it increases the amount of vitamins to dangerous levels
   b. it leads to vitamin loss
   c. it prevents food spoilage

2. Antioxidants include… *(1 mark)*

   a. vitamin A, C and K
   b. vitamin A, C an
   c. vitamin C, E and K
   d. vitamin A, E an

3. Enzymatic brow… …s mostly… *(1 mark)*

   a. …iry
   b. nuts
   c. …at
   d. fruit and vegeta

4. Oxidation leads to… *(1 mark)*

   a. bad smell and flavour development
   b. loss of nutritional value
   c. unappetising appearance of the food
   d. all of the above

5. Enzymatic browning will happen more quickly in… *(1 mark)*

   a. fruit which are high in vitamin C
   b. grated potatoes kept in a metal bowl at room temperature
   c. vegetables which are cooked whole
   d. fruit kept in a covered bowl in a fridge

6. Explain the difference between enzymatic browning and oxidation in fr…

   .....

   .....

7. List three ways of preventing enzymatic browning… *(3 marks)*

   .....

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3.3.2.5 Raising Agents

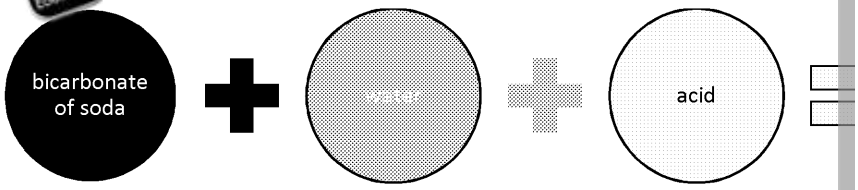
Raising agents are used in cooking to lighten the texture of certain foods and mak
consumers. They introduce gas to a mixture, which is then trapped in it, helping a

Chemical raising agents

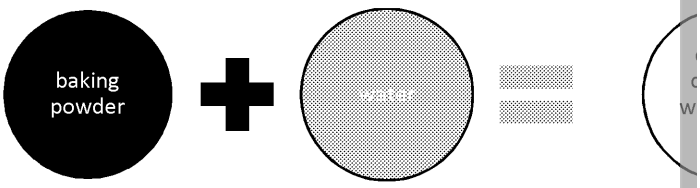
Chemical raising agents include bicarbonate of soda and baking powder.

Bicarbonate of soda ($NaHCO_3$) is a white powder added to baked goods for leaver
properly and avoid a soapy aftertaste.

In the presence of water, acid and heat, it turns into carbon dioxide (CO_2) – a gas,
mixture. The reaction also produces small amounts of water (vapour) and salt, wh
During baking, the carbon dioxide turns into air bubbles. As these expand and rise
Sodium bicarbonate is used in heavy doughs and cakes which contain an acidic ing
lemon juice.

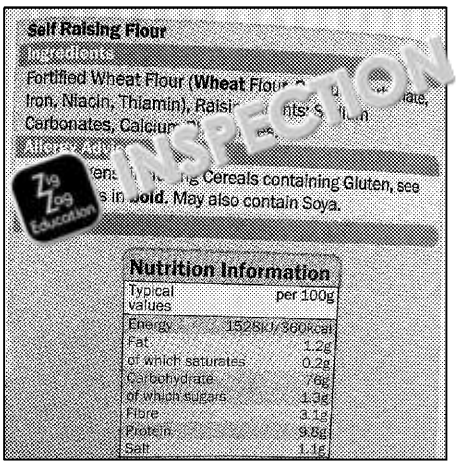


Baking powder is a white powder which contains bicarbonate of soda and a weak
phosphate or sodium sulphate. In contact with water, it will go through many che
end will produce carbon dioxide. During baking the gas will expand and cause the
is used in many recipes, such as sponge cake or pancakes.

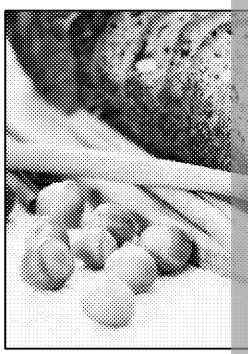


Self-raising flours already contain raising agents (usually baking powder) in correc
good choice if you don't know how much to use.

Too much of chemical raising agents can cause a soap-like, bitter flavour, and for t
only as much as indicated in a recipe.



Self-raising flour already contains raising agents. Note that it's also fortified with calcium, iron, niacin and thiamine.



Sodium bicarbonate is use carrot cake or soda brea tex

Mechanical ways of raising

Mechanical ways of raising include mechanical actions that help incorporate air in
There are many mechanical methods to be aware of:

Method	How does it work and wh
Whisking	Whisking helps introduce a lot of air into the mixture liquid and creating a foam. A metal or plastic whisk egg whites into a foam to produce, for example, mer
Beating	Beating with a wooden spoon helps produce batters, heavy for a whisk. Batters are used to prepare panc or tempura for prawns.
Sieving	Sieving flour traps ai bb between flour granule sponge cak
Creaming	Cre ps air bubbles in a mixture of fat and su ixture, the lighter colour it will have. Helpful w whipping cream.
Folding	Folding traps air between layers of food, e.g. in Fren
Rubbing in and kneading	Kneading introduces air into the dough. Used in mo bread dough, doughnuts, scones, etc.

Steam as a leavening agent

Steam can be used as a leavening agent when a mixture has a high proportion of l
and is cooked at high temperature. When the food is exposed to heat, the water
reaches its boiling point and turns into steam. During cooking the steam rises
and expands, pushing the food mixture upwards. Steam is used to produce puff
pastry, choux and Yorkshire pudding – that's why their texture is layered.

Apply

1) Prepare a basic soufflé. You can use a recipe from *http://allrecipes.co.uk/recipe/23840/cheese-souffles.aspx?o_is=Hub_TopRecipe_1*
2) What raising methods will you use and why?

S1, S11

Biological raising agents (yeast)

In the presence of food, water and warmth **yeast** breaks down sugars and produces carbon dioxide and alcohol, which leads to a rapid growth of the mixture. This is found its use in the food industry.

Yeas
fung

Apply

1) Prepare a batter for a savoury roulade using eggs, flour, milk, butter an
2) What raising method will you use? Why?

Yeasts are used in the production of wine, beer, kefir (fermented milk beverage) a

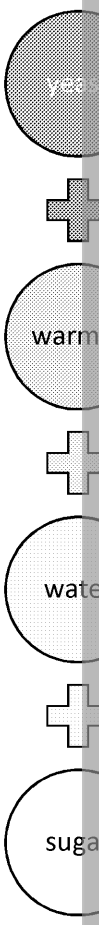
During the fermentation of yeast, sugar is transformed into carbon dioxide and alcohol, which dictates the final flavour of a given product. During baking, the carbon dioxide produced turns into air bubbles. As these expand, the mixture rises.

Yeasts are available in many forms:

- **Fresh** – a beige, soft block, with a gentle smell of mushrooms; it is necessary to grow it first in a bowl with warm water and sugar before adding to a batch
- **Dried** – small granules that have to be restored before use (dissolved in water or other warm liquid);
- **Easy-blend** – powder added directly to the batch

Yeast is usually used in production of heavy, sugar-rich and low-fat products such as bread, bread rolls, pizza or doughnuts.

Fresh yeast.



Apply

1) Prepare a bread dough with the use of bicarbonate of soda, and one using yeast. Compare the time needed to prepare and bake the doughs.
2) Compare the taste of both breads.
3) Assess the nutritional value of both breads.

S1, S4, S10, S11

3.3.2.5 Check your understa

1. Which of the following statements is TRUE about mechanical raising ag

   a. they incorporate air into the food
   b. they incorporate carbon dioxide into the food
   c. they produce alcohol
   d. they produce carbon dioxide

2. Sieving is a mechanical raising agent because… *(1 mark)*

   a. it traps air between fat particles
   b. it traps carbon dioxide be… fat particles
   c. it traps air betwee… …ticles
   d. it traps ca… …e between starch particles

3. Y… NOT used to produce… *(1 mark)*

   a. beer ☐ b. wine
   c. kefir ☐ d. buttermilk

4. What gas is produced by the use of baking powder? *(1 mark)*

   a. carbon oxide ☐ b. oxide
   c. hydrogen ☐ d. carbon dioxide

5. During fermentation of yeast, what substances are produced? *(1 mark)*

   a. carbon dioxide and alcohol ☐ b. water and alcoh
   c. carbon dioxide and water ☐ d. carbon oxide a

6. Give three examples of mechanical raising agents and explain how they

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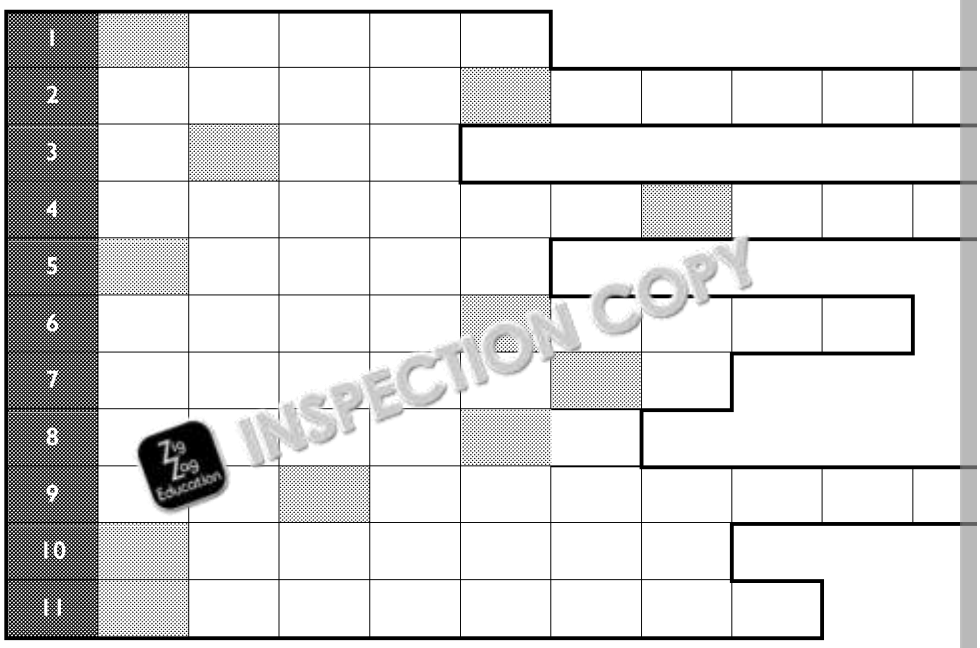
3.3.2 Quiz-ine

Fill in the answers to the questions below to reveal a phrase relevant to food safe



1) The unbreakable polysaccharide (5)
2) They prevent oxidation (12)
3) What you obtain when whisking egg white (4)
4) The gas produced by yeasts (13)
5) Produced when water boils (5)
6) Process in which food is briefly put into hot water (9)
7) Short chain of carbohydrates (7)
8) The protein in flour (6)
9) Process in which the structure of protein is damaged (12)
10) Substance created when sugar is heated (7)
11) A mixture of water and oil (8)

The shaded squares reveal this phrase:

Answers

Chapter 1

3.3.1.1

Things to think about (p. 4):
Examples could include deep-fried foods, such as chips, which are high in fats. To digest th
be produced in the gall bladder, and that puts extra strain on the liver. Modifications coul
that the surface of the food is sealed and the food doesn't soak up as much fat.
Also, raw vegetables might be difficult to digest for some people due to high insoluble fibr
steam or boil them to break down some fibre and improve digesti .

Things to think about (p. 5):
1. Students should notice that foods w h ar frozen usually have longer date marks th
raw fish and fish salad. Stud nt sho ld also notice that highly processed, sterilised o
with a 'best before' date mar rather than a 'use by' mark.
2. Studen ld r w a conclusion that a 'use by' date mark is used on fresh, easily s
process d products, while a 'best before' date mark is used on foods which are
way that protects them from the external factors and significantly extends their shel

Check your understanding
Q1: C, **Q2:** B, **Q3:** D, **Q4:** A, **Q5:** C
Q6: Any three from:
- convection
- conduction
- radiation
- starch gelatinisation
- water absorption
- caramelisation

Q7: Various answers are possible – student is to indicate three products and at least t
them.

For example, any three from:
- pork – chops / stew / baked / fried / boiled / in a soup / sausage / paté / co
- carrots – boiled / steamed / baked / fried / in a stew / in a soup / pureed (m
- potatoes – boiled / steamed / baked / fried / stuffed / chips / crisps / salad
- eggs – hard boiled / soft boiled / fried / stuffed / salad / paste / poached / s

3.3.1.2

Things to think about (p. 17):
Examples could include:

	Advantages	
Boiling	• Low-calorie • No added fat • Quick	• Vitamins diss when drainin • Loss of vitam • Loss of colou
Steaming	• Prese e itional value of food • Food becomes tender Hard to overcook	• Can't be used pork, as it wo
Simmering	• Develops the flavours • Helps to obtain a desirable texture • Helps to cook the food evenly throughout • Helps to obtain the desired texture, e.g. by evaporating water the food becomes thicker	• Time-consum • Can cause vit
Blanching	• Helps to preserve the nutritional value and colour of the food • Quick	• The food doe hard/tough

	Advantages	
Poaching	• Good for preparing delicate ingredients • Helps to preserve the texture of the food • Food remains juicy	• Can't be used they would ta • Vitamins can then drained
Braising	• Seals the surface so the food remains juicy • Improves the texture of the food	• Time-consum • Causes vitam and long- coo
Baking	• Creates an attractive crust • Develops flavours through dextrinisation and caramelisation • Improves palatability of food	• Time-consum • Food may eas high or the ti • The long cool temperature
Roasting	• Creates an appetising crust/surface • Helps to lower the calorific value of food as fat [illegible] and leaks out of it	• Causes vitam and long cool • Time-consum • Can increase fat is added t
Grilling	• Usually quick • Usually low-fat • Helps to preserve the nutritional value of food	• May create h the very high
Dry frying	• Very quick • Helps to prevent the nutritional value of food • Helps to lower the calorific value of food	• Very high ten burn very qui
Shallow frying	• Creates a crunchy crust • Helps to obtain an appetising colour • Seals the surface so the food remains juicy	• Increases cal • High tempera
Stir frying	• Very quick • Helps to prevent the nutritional value of food • Low-fat • The food remains crunchy • The colour of food (e.g. broccoli) is usually preserved	• Can't be used pork as they

Check your understanding

Q1: a, **Q2:** c, **Q3:** b, **Q4:** a, **Q5:** a

Q6: Two marks for:

- cutting damages cell walls
- cell juices spill out and cause enzymes to work on the surrounding cells

Q7: Any three from:

- enzymatic browning
- loss of vitamins
- changing texture
- altering texture
- garnishing
- glazing
- altering nutritional value

Quiz-ine:

1. Shelf life
2. Roasting
3. Microwaves
4. Conduction
5. Essential oils
6. Salmonella
7. Infrared
8. Convection
9. Texture
10. Stir fry

Hidden phrase: food safety

Chapter 2

3.3.2.1

Check your understanding
Q1: d, **Q2:** b, **Q3:** c, **Q4:** d, **Q5:** b
Q6: Any two from:
- Yeast ferments and produces carbon dioxide.
- Gluten forms a net, which traps air bubbles / carbon dioxide.
- Gluten fibres are elastic and can be stretched.
- This allows dough to rise.

Q7: Any four from:
- Proteins denature when heated.
- Proteins coagulate in the presence of salt or mild acids.
- In quiche Lorraine eggs are beaten and poured over top.
- During baking, the proteins in the egg mixture denature and coagulate thanl thick/stable.

3.3.2.2

Check your understanding
Q1: b, **Q2:** b, **Q3:** , **Q4:** d
Q5: Three points for:
- Starch undergoes gelatinisation in the presence of water and heat.
- Starch molecules absorb water and swell.
- Absorption of water leads to thickening of a given mixture, e.g. a soup or sau

3.3.2.3

Check your understanding
Q1: b, **Q2:** d, **Q3:** c, **Q4:** c, **Q5:** b
Q6: Two points for:
- Fats are hydrophobic and repel water molecules, leading to layering.
- Emulsifiers prevent the mixture from layering.

Q7: Four points for:
- In shortening, fat molecules create a hydrophobic layer around starch molec
- This prevents gluten in starch from accessing the water.
- Gluten cannot form long fibres without water.
- Therefore the pastry is crumbly/crunchy/brittle, rather than spongy and ela

3.3.2.4

Check your understanding
Q1: b, **Q2:** b, **Q3:** d, **Q4:** d, **Q5:** d
Q6: Two marks for:
- Enzymatic browning is primarily caused by an enzyme (oxygen accelerates
- while oxidation is primarily caused by oxygen

Q7: Any three from:
- protection from oxygen by covering food, e.g. with cling film
- protection from oxygen by packing food in oxygen-free conditions
- using proper tools which do not contain copper or iron
- use of acid such as lemon juice or vinegar
- lowering temperature by putting food into the fridge
- blanching the food to deactivate enzymes

Check your understanding
Q1: a, **Q2:** c, **Q3:** d, **Q4:** d, **Q5:** a
Q6: Six points – any three for a mechanical raising agent and any three for the mecha

Whisking	Eggs are whisked with sugar to make meringue or sponge cake; which air bubbles are trapped.
Beating	Liquids are beaten to make a batter; air bubbles are trapped in
Folding	Air is being trapped between layers, e.g. in flaky pastry.
Sieving	Air is being trapped between starch particles (but also icing sug
Creaming	Air is trapped between fat and sugar particles in the mixture.
Rubbing in	Rubbing the fat into flour traps the air in the mixture.

Quiz-ine:

1. fibre
2. antioxidants
3. foam
4. carbon dioxide
5. steam
6. blanchi
7. dextrin
8. gluten
9. e[illegible]ulsification
10. caramel
11. emulsion

Hidden phra[illegible] food science