Chapter

1

Food Science: An Insight

Food is an integral part of one's life. One cannot live well without food for more than a few days. It supplies energy and gives a feeling of social security. Food is a complex term and comprises a variety of edible substances.

FUNCTIONS OF FOOD

Food has many functions to perform. They are nutritional, social, physiological and psychological.

Nutritional

1. Supplies energy to the body.
2. Supplies fibre to the diet and adds to the bulk, which aids in peristaltic movements and keeps the system clear.
3. Supplies carbohydrates both soluble and insoluble.
4. Supplies proteins to the body for tissue build-up and repair.
5. Supplies the body with fats and essential fatty acids.
6. Supplies the body with various vitamins and minerals.
7. Supplies water to the diet to maintain the water equilibrium constant.
8. Keeps the body free of the multitude of nutrient deficiencies and ensures the proper functioning of the various vital processes of the body.

Social

1. Feasts are an excuse to have social gatherings.
2. Food has a special significance in various cultures and festivals in the society.
3. Food is an integral part of births, birthdays, weddings, etc. and a reason for people to come together.
4. Gurudwaras have "langars" (community eating) to bring people closer to themselves and God.
5. No get-together is complete without an elaborate meal.
6. Special occasions call for the preparation of special meals and many food recipes are representative of a particular occasion.

Physiological

1. Various food recipes are stopped in many physiological ailments of the body.
2. Food plays an important role in controlling levels of chemicals in the body like fat is

restricted in high cholesterol, protein is restricted in kidney problems, sugar is restricted or stopped in diabetes.
3. Hypertension is caused by greater salt intake so it has to be regulated.
4. Oedema calls for water restriction and sodium restriction.
5. Special care needs to be taken when dealing with inborn errors of metabolism like phenylketonuria or lactose intolerance.

Psychological

1. Food gives a sense of security.
2. People earn and work so that they can feed themselves and their family.
3. Food provides solace in times of happiness as well as misery.
4. Eating disorders are a complex interplay of psychological distress.
5. "Emotional eating" is a well known term that relates to overeating or dieting in relation to the emotional or psychological state of individuals.

Therefore, food science gains importance as it is concerned with all the facets of food. It is a methodical study of various aspects related to food. It involves an understanding of what are the various components of food and how they interact with each other as well as the human system. Food science also investigates the best cooking conditions, environment, media and foodstuffs cooked. The nutrient contained in the foods is also studied and deductions as to their efficacy made. Theories are propounded and validated by practicals to deduce results and devise new analysis.

Food science also explains and decides upon best methods for preparing foods. Flavour, texture, colour and aroma characteristics are decided upon.

Science of food divides food into groups. The components in these groups are closely related from the nutritional point of view, source obtained from and some distinguishing characteristics.

On the basis of the above criteria, they have been classified into five food groups:
1. Cereal grains and products
2. Pulses and legumes
3. Milk and meat products
4. Fruits and vegetables
5. Fats and sugar

A balanced diet is one which has the above food groups in an appropriate quantity and supplies the body with all the nutrients. Energy, carbohydrates, proteins, fats, water and fibre are important constituents supplied by a balanced diet to the body. These food groups given in a balanced proportion contribute to a healthy life.

Many foods are consumed as such in the raw state while some are cooked to make them edible. Even vegetables and fruits are cooked to add variety to the diet and make them easily digestible. Cooking of food is important for the following reasons:
1. Improvement in texture, appearance, taste, flavour, aroma and feel.
2. Improvement in palatability of foods.
3. Improvement in the overall impact made by cooked food *vis-a-vis* raw food.
4. Destruction of microorganisms present on the surface of the food or to some extent within them.
5. Cooking of food converts complex substances into their simpler forms making them easily digestible.

6. Cooking methods used make the same food taste and appear different and therefore adds variety to the diet.
7. Cooked food by way of appearance and taste induces more consumption and thus contributes to increased nutrition to the body.
8. Cooking causes the destruction of toxins and undesirable substances present in pulses, etc. and makes them nutritionally better.
9. Cooking also causes the destruction of factors which bind nutrients making them available to the body. Like avidin in raw egg binds biotin and cooking makes it available.
10. Cooking also causes the concentration of nutrients within the food as moisture is lost and so are the impurities.

There are also some disadvantages of cooking:

1. Water soluble nutrients like vitamins B complex and C may be leached into unused water.
2. Oxidation and heat treatment causes the destruction and reduction of vitamins C, B complex (especially Thiamine) and A.
3. Denaturation of proteins takes place and therefore it reduces the quantity of amino acids as they are destroyed.

Table 1.1: Changes in nutrients while cooking

Nutrient	*Changes*
Carbohydrates	Starch molecules swell and rupture in an aqueous medium. This increases enzymatic action and improves digestibility Dextrinisation of starch takes place in dry heat and dextrins are formed Sugars are subjected to epimerisation and degradation
Proteins	Proteins get denatured Microbes are destroyed and enzymes inactivated Toxic factors present in food are also destroyed Digestibility of proteins improves Some loss of amino acids Charring and development of off-flavours during cooking
Lipids	Hydrolytic, oxidative, polymeric and other degradation changes altering physical and biological characteristics Rancidity occurs by hydrolytic and oxidative changes Vitamins and minerals are lost due to leaching, oxidation and thermal destruction Colours and pigments can be bleached due to heat and pH changes Effect of metals and oxygen contribute to colour changes

PRELIMINARY PROCESSES

Prior to actual cooking, foods are subjected to a variety of processes and tasks, which aid in the process of cooking. They include cleaning, cutting, sieving, soaking, blanching, marinating, etc.

These processes, although not always necessary, help to make the food appetizing and improve its appearance and acceptability.

I. Cleaning

This refers to the procedure used for making the food product devoid of any undesirable component. It includes washing as well as discarding unwanted components. Washing

with water removes the dirt and pesticide remains from the surface of fruits, vegetables, cereals, pulses and meat products. Dehusking of dhals is also achieved to some extent. Obstinate soil particles clinging to the surface are also removed.

Cleaning also includes the discarding of dried, yellow and withered leaves from greens, spoilt and soggy portions from fruits and vegetables, insect debris and infestation from grains and removal of stones and impurities from cereals and pulses.

Advantages

1. Removal of dirt.
2. Removal of obstinate soil particles along with some microbes.
3. Removal of insecticide, fungicide and spray remains.
4. Removal of impurities from the food surface.
5. Washing with warm water helps in killing germs and worms from cabbage and cauliflower.
6. Removal of repulsing spots of blood, dirt and unwanted parts from meats.
7. Removal of undesirable and repulsing objects from fishes and sea foods.
8. Removal of outer coat from dhals.
9. Removal of husk particles from wheat and rice.
10. Removal of stones from pulses, rice and wheat.

Disadvantages

1. Loss of B-complex vitamins due to leaching in water.
2. Loss of water-soluble nutrients.

II. Peeling

The process of removal of the thin outer layer of the fruits and vegetables to expose the inner soft part. Peeling is done by a peeler which removes a thin outer layer. This helps in exposing the brighter and cleaner portion of food.

Advantages

1. Removal of unwanted portion, i.e. fibrous and non-edible.
2. Obstinate dirt and chemicals which escape the cleaning step can be removed.
3. The appearance improves on peeling as the inner untouched portion is exposed.
4. The fruits and vegetables look brighter and cleaner.

Disadvantages

1. Peeling causes the removal of the nutrients present just below the skin like vitamin C.
2. Peeling can also cause the removal of some edible portion.
3. Peeling can expose the surface of foods more and cause excess loss of nutrients.

III. Cutting

Making the food smaller in size and increasing its surface area. The smaller pieces cook easily and quickly.

Knives, choppers, slicers, grinders and vertical cutters are used for getting desired sizes and shapes.

Table 1.2: Various cutting styles

Term	*Explanation*
Cut	Divide into smaller pieces generally by knife
Chop	Haphazard cutting to divide into very fine sizes
Mince	To almost make a very fine paste
Dice	Cut into uniform cubes
Slice	Cut into thin or thick vertical shapes or slices
Julienne	Cut to 3 × 2.5 mm thin strips
Brunoise	2 mm dice
Jardine	Long batons 2 × 2 × 15 mm
Spiral	Long thin spiral strips
Macedoine	5 mm dice

Advantages

1. Makes cooking quicker and easier.
2. Makes food easily consumable.
3. Gives variety to recipes.
4. Foods can be used for garnishing.
5. Identification and removal of spoilt portions of food.
6. Improvement in food appearance.
7. Uniform blending and cooking of food.

Disadvantage

Cutting makes the food smaller in size which increases the surface area. This results in greater loss of nutrients from food.

Vegetable Spiral Slicer/Cutter Tool

Spiral slicer or cutter is a kitchen tool that cuts vegetables and fruits into long and noodle like strands. This helps in making food decorative, innovative and easily dehydrated in dehydrators.

Types

There are various types of spiral slicers/cutters available. Some of the common ones are discussed below:

- **Joyce Chen Saladacco Spiral Slicer:** This helps in cutting ultrathin noodle like spirals and ribbon from firm vegetables by using a blade set in horizontal platform. Foods wider or longer than 3½ inches are difficult to cut. It requires a bit of skill to operate well.
- **GEFU Spirelli Spiral Cutter:** This small sleek device resembles an hourglass and is a simple handheld slicer that operates like a pencil sharpener. It has a single spike found inside the cover that works freely and independently while twisting the food and keeping it in its place.

- **Spiral Vegetable Slicer, Handheld with Cleaning Brush:** The slicer produces two varieties like linguini and spaghetti. This is very easy to operate, useful and affordable. This is very easy to operate and safe for any kind of dishwasher or top rack.

IV. Sieving

Sieving refers to the process of passing food through a mesh with holes of specified size to separate the impurities and dirt particles from it. It also helps in proper blending of food.

Advantages

1. Dirt, stones, insects and coarse fibres are removed from the grains and pulses.
2. Contaminants removed, the shelf life of product increases.
3. The product is mixed uniformly.
4. Separation of different sizes of food product can be done.

Disadvantages

1. Undigestible component of food, fibre is lost.
2. Bran of cereal flour is lost.
3. Proteins, vitamins B and fibre present in the bran is lost.
4. It is time-consuming.

V. Soaking

This refers to the process of immersing food into water and leaving it as such for some time. This results in endosmosis and swelling up of the cereals and pulses. Water used can either be plain or salted with sodium carbonate or chloride to increase flavour and make food tender.

Advantages

1. Husks or outer hard covering can be easily removed.
2. Cooking takes less time when food has been soaked previously.
3. The food softens and attains a smooth texture.
4. Grinding becomes easier and more uniform.
5. Extraction becomes easier than when dry ingredients are used such as tamarind and coconut.
6. Helps in reducing the flatulence causing power of pulses.
7. Helps in reduction of pungency of vegetables from allium family like onion and garlic.
8. Soaking is a pre-process for fermentation to occur.
9. Helps in separating impurities as they are light and start floating on the water surface.

Disadvantages

1. Water-soluble nutrients are leached and discarded with the water.
2. Soaking is time-consuming and therefore has to be planned. Instant preparations are not possible.

Preparatory methods: Apart from these preliminary processes before the actual cooking procedures, there are many methods, which are followed to get food ready for cooking. These include the processes, which are necessary before the food is subjected to heat for cooking.

VI. Processing Methods

These methods are used to make food ready for the actual process of cooking and help in enhancing the final product. These include mixing of ingredients, blending, beating, whipping, folding, mashing and stuffing. All these processes, although not part of the actual cooking, are done to get the desired recipe and form of food product.

Advantages

1. Help in reducing the cooking time.
2. Help in enhancing the overall impact and flavour of the food product.
3. Beating and whipping incorporate air in the food and make it fluffy and light.
4. Binding and kneading of flour makes it elastic and helps in making various shapes out of it.
5. Mashing reduces the size and helps in uniform mixing of the product.

Disadvantages

1. The food becomes more prone to infection as it is exposed to air for a longer time.
2. Special care has to be taken about the preparation area.

a. Coating

It refers to the process of covering the food with an additional layer of crumbs, egg, flour or any other substance before cooking it. This makes the food crisp and gives it a shiny appearance. Coating can be done in a variety of ways.

b. Dredging

Food is coated with dry ingredients like flour, bread crumbs or powdered nuts, etc. This gives a rough and uneven coating which adds crispy feel to the product.

c. Breading

Another way of coating in which three substances are used. The food is first coated (dredged) with a layer of flour. Then it is dipped in an egg mixture, which binds the flour layer to the food and gives a smooth feel. Lastly, the food is coated with bread crumbs. This lends a characteristic texture to the food.

d. Battering

This coating method is commonly used. Pakoras and bondas are made this way. The food is coated with a layer of semi liquid batter. It is a paste with a flowy consistency. Bengal gram flour, rice flour and refined wheat flour are used for this purpose. Vegetarians do not use egg in it while non-vegetarians use an egg mixture thickened with flour for the preparations. Egg has the quality of lending a shine to the food.

Advantages

1. Imparts variety to the diet.
2. Adds colour and flavour to the product.
3. Coating lends a rough and crispy feel to the product.
4. There is less fat absorption in product coated with a substance.
5. Heat transmission is more effective when food has been breaded.
6. Food substances, which otherwise splutter when fried, are bound together and do not separate in the pan.
7. Foods retain the inherent moisture as it is not able to escape from the surface.
8. Coating can be done in a variety of ways and with numerous substances, providing innovative ways to enhance nutritive quality as well.

Disadvantages

1. The product becomes mushy and soggy if held for a long time.
2. Sometimes, when not applied properly the bread crumbs can break during frying.
3. Breading may not stick to the substance.

VII. Blanching

A widely used procedure in the canning and preservation industry. It is also practised at home level. The process is used to inactivate the enzymes in food which might be the cause of potential spoilage. Blanching refers to the immersion of foods (particularly fruits and vegetables) in boiling water and then sudden dipping in cold water. The process uses the principle that enzymes are denatured at high temperatures and are inactived at low temperatures. Therefore, the use of hot and cold water ensures that the denatured enzymes do not have the conditions of renaturation.

Advantages

1. Inactivation of enzymes that can cause spoilage.
2. Destruction of surface microbes.
3. Easy removal of peels.
4. Less loss of nutrients present below the skin vis-a-vis peeling.
5. Better expression of the pigments and brighter appearance of vegetables and fruits.
6. It is the preliminary process for canning and preservation.
7. Softens the food product.

Disadvantages

1. Water-soluble nutrients are leached out in the water. Therefore, the water used for blanching should be utilized.
2. Blanching, if done for a long time, makes the product excessively soft and soggy.

VIII. Marination

The process of dipping foods in a paste called marinade made from flavouring agents, curd, oil, ginger–garlic–onion paste, spices and salt so that these infuse into the food. This gives rise to foods with good aroma and flavour. The marinade makes foods rich in taste and are largely used for meat products. Some vegetables like potatoes, tomatoes, chillies,

bitter gourd and brinjals are also marinated. Tenderizing of food also takes place while marination.

Advantages

1. Adds flavour to the food.
2. Adds aroma and enhances taste of food.
3. Prevents the browning reactions in food as the marinade acts as a barrier between oxygen and the food.
4. Food texture on cooking is improved on marination.
5. Marinades add variety and introduce different flavours to the same food.

Disadvantages

1. Water-soluble nutrients may leach into the marinade and be lost to some extent.
2. The foods may become strongly flavoured and not appreciated by some people.

IX. Grinding

Dividing the food particles into small fragments or into a paste is termed grinding. The fragmentation of food into small components for use in specific recipes is grinding. It can be both wet grinding as well as dry grinding. Wet grinding, as the name suggests, uses liquids, preferably water, to make a fine paste of food, like in making idli batters or chutney preparation. Dry grinding involves absolutely no use of water and just fragmentation of particles into smaller ones. Dry spice powders, garam masala, flours of wheat, bengal gram, rice and pulses are examples of dry grinding.

Advantages

1. Grinding facilitates easy and uniform mixing of ingredients.
2. Fermentation is easier in ground rice and pulse pastes than other forms.
3. Taste and flavour of foods is improved and enhanced.
4. Lump formation is difficult and gravies made are uniform.
5. Powdered form are better blended and have better flavour enhancing capability.
6. Extraction of flavouring compounds is better like in ground coffee.

Disadvantages

1. There is fast loss of flavour since the surface area is increased.
2. Infestation by insects and physical changes is more than in whole or unground foods.
3. Loss of vitamin C by oxidation is increased.

X. Drying

Removing water or moisture from foods is drying or dehydration. The removal of hydrates from foods for the enhancement of shelf life is drying. Mango, gongura, cauliflower, carrots are commonly dried vegetables. The storage conditions for dried products are also not too rigid. Absence of moisture helps in retarding microbial growth.

Advantages

1. Shelf life is improved and prolonged.

2. Grinding of foods that have low moisture content is easier than others.
3. Vegetables when dried can be stored for long periods and used when they are not available in the market in off seasons.
4. Some vegetables like ladies' finger if dried do not exhibit sticky nature.

Disadvantages

1. Heat labile nutrients may be lost during the process of dehydration.
2. Some taste alterations may take place.

Freeze drying is a dehydration process that first freezes material and then reduces the surrounding pressure to allow the frozen water in the material to sublimate directly from the solid phase to the gas phase. It is also known as lyophilisation, lyophilization or cryodesiccation.

Most commercial freezing is done either by blast freezing, which is in cold air kept in motion by fans or by contact freezing which is placing the foodstuffs in packages or metal trays on refrigerated surfaces.

Advantages

1. Ease of transportation.
2. Ease of storage.
3. Increased shelf life.
4. Use in crisis and conflict as emergency food aid.
5. Use in camping sites or for people stationed in difficult filed assignments.

Disadvantage

Taste not as good as fresh produce.

XI. Filtering

This process is generally undertaken to remove suspended impurities. Unwanted particles, dirt and mud are removed by this process. Sometimes it is done to separate two substances that have to be used separately. Whey water from cottage cheese is separated this way through a muslin cloth. Coffee, tea, juices, soups are filtered this way.

Advantages

1. Unwanted particles and dirt can be easily removed from food.
2. It is an easy process and generally does not take very long.
3. Extraction of flavours and extractives can be done by using a filter.
4. Filter coffee is prepared easily this way and has a characteristic flavour.
5. Taste of food is improved and so is the flavour.

Disadvantages

1. Nutrients may be lost by the process of filtration like while making whey water and rice konji. This loss can be compensated by using these liquids for some other purposes.
2. It is not feasible to filter large amounts of food as this will require large vessels and will be time-consuming.

COOKING METHODS

Once the arrangements and preparations have been made the actual cooking of the food begins. Generally, foods are cooked by heat but cold treatments like while making cold salads and desserts can also be used. Heat as a medium of cooking can be used by three ways:

1. **Conduction:** Transfer of heat by contact.
2. **Convection:** Transfer of heat by flow of liquid or gas from a hotter to the less hot part.
3. **Radiation:** Emission of heat in the form of waves from hot objects.

A newer technology is cooking by microwaves in a microwave oven. Here food is cooked by microwaves, which are electromagnetic waves similar to radio, TV, etc. Cooking is accomplished by a medium in which food is cooked. The various media used in cooking are air, water, steam or fat either individually or in combination. Generally, moist heat methods use water or steam as a media while dry heat methods use air or fat. Microwave cooking is accomplished by heat and energy derived from microwaves.

A. MOIST HEAT METHOD

1. Boiling
2. Simmering
3. Poaching
4. Stewing
5. Blanching
6. Steaming
7. Pressure cooking

B. DRY HEAT METHODS

1. Grilling
2. Toasting
3. Roasting
4. Baking
5. Sautéing
6. Frying

C. COMBINED METHOD

Braising

A. MOIST HEAT METHODS

1. Boiling

Heat is provided to food by a combination of conduction and convection currents. Heat from the utensil is passed on to the liquid which then transfers it to food. The foods are cooked by placing them in boiling water at 100°C and maintaining this temperature till desired stage of cooking has been reached. Water is the most common liquid used in boiling. The boiling point of liquids is altered by addition of impurities and at high altitudes.

Eggs, pulses, cereals, vegetables and meat are cooked this way.

Advantages

1. Simplest method of cookery not requiring any special skills or equipment.
2. Boiling of food brings about a uniform cooking of food as water surrounds food from all directions.
3. Soluble starches get removed and rice grains separate when boiling is used.
4. At high temperatures protein content of foods gets denatured and embedded in food.
5. Starch gets gelatinized and collagen gets hydrolysed.
6. Boiling food aids in proper digestion of food.

Disadvantages

1. The process of boiling takes time and utilizes more fuel. Therefore, is not always economical.
2. When excess water is used the water soluble nutrients are lost. To reduce the loss, the water used for boiling should be utilised in the recipe or in any other form. Variety of soups, gravies, rasam and dhal can be made out of this water.
3. Loss of minerals is also a big disadvantage with boiling. Even this can be replenished if the water is used and not discarded.
4. Boiling of food brings about its decolouration. Bleaching of pigments takes place and makes the food less acceptable. Beet roots if cooked with skin have better colour retention.
5. Generally, food when boiled develops a bland taste. This happens as flavour compounds leach into the water. To avoid this seasonings and spices have to be added to food.
6. If boiling is done for long periods of time the foods become over soft, soggy and mushy.
7. Foods may get scorched or burnt if water evaporates due to excess boiling.
8. Food may tend to break when boiling is done at constant high temperature and not turned down. It is advisable to bring food to a vigorous boil and then turn the heat down for further cooking.

2. Simmering

Simmering is the process when foods are cooked in water at a temperature below the boiling point (82–99°C) on low flame. The pan is covered at all times with a well fitted lid. This retains the steam formed within as well.

Advantages

1. Foods get thoroughly cooked and develop a uniform tenderness.
2. Scorching is prevented as evaporation of water outside the pan is prevented.
3. Since the water is utilized while cooking, loss of water soluble nutrients that leach is minimum.
4. Foods get an infused flavour and aroma.

Disadvantages

1. Long durations of cooking results in loss of heat sensitive nutrients.
2. Takes more time as food is cooked over low temperatures and in a slow process.
3. There is more consumption of fuel.

3. Poaching

This method is generally used for eggs. Poached eggs is a preparation liked by most people. It involves cooking in minimum water at temperature below boiling point. Eggs are broken and put in water at this temperature and the proteins get coagulated and cooked. Fishes and fruits are also poached. Salt may be added to the water to impart taste to foods. Other spices and seasonings can also be used.

Advantages

1. Cooks food quickly as direct immersion in hot water takes place.
2. There is no addition of fat, so no extra calories in food.
3. The foods that are poached are better digested.

Disadvantages

1. Water-soluble nutrients leach into the water used for poaching.
2. The foods are generally bland in taste, unless seasonings are added.

4. Stewing

This method combines water and steam as media for cooking. Food is put in a pan with water just covering half of the food. A tight fitting lid is put above the pan at all times. Water is first brought to a boil and then simmered to bring to a temperature of 98°C. Food above the level of water is cooked by steam. The method is a slow cooking method and requires a minimum of 2–4 hours. Cheaper cuts of meat along with vegetables and legumes are cooked this way and the recipe is called stew. Pork and mutton stews are popular.

Stewed apples are also made by this method.

Advantages

1. Loss of water-soluble nutrients does not take place as the nutrients that leach into the water are utilized.
2. There is greater infusion of flavour and slow cooking facilitates in better development of aroma.
3. Meat fibres become tender and soft due to slow and prolonged cooking.

Disadvantages

1. Lot of time is consumed in this process.
2. Fuel efficiency is not very good.

Note: Blanching: Explained on page 8.

5. Steaming

As the name suggests, this method uses steam as the medium of cooking. Food does not come in contact with water but is surrounded by steam and is cooked by the heat supplied by steam. Water is boiled and the steam generated by it is used for cooking food. Cooking takes place at temperatures of 100°C and heat is higher than that supplied by water at this temperature due to latent heat in steam.

Types of Steaming

Dry steaming: Use of double boiler is advocated for dry steaming. Double boiler consists of a pan with the food placed over a pan with water. The steam generated from this pan is used for cooking food. Sauces, custards and soufflés are made by using a double boiler.

Wet steaming: Steam comes in direct contact with the food and cooks it. Dhokla and idli are made this way.

Waterless steaming: In this form of steaming outside water is not added. Water present within the food is used as a medium for steam generation. When food is wrapped in aluminium foil, banana leaf or papaya leaf and cooked, it is waterless steaming. It has an added advantage of sealing flavours inside the food and blockage of any external flavour to come inside the food.

Advantages

1. Constant vigil and stirring is not required.
2. Nutritive value of foods remain intact as leaching does not take place.
3. Cooking time is less.
4. No external fat is added which makes the food easily digestible and light.
5. Due to the indirect form of cooking, scorching and burning is avoided.
6. The food develops a fluffy and light texture.
7. The flavour of steamed food is good.
8. Use of double boilers has an advantage of controlling the temperature and overflowing of milk.

Disadvantages

1. Dhokla cookers and idli makers are required.
2. Special vessels are essential for steaming foods.
3. Limitations of the type of foods that can be cooked by this method, e.g. rice cannot be cooked this way.

6. Pressure Cooking

Table 1.3: Relationship of temperature with cooking time

Cooking time	*Temperature*
1 hour	100°C
½ hour	110°C
15 minutes	120°C

A newer method of cooking, discovered by working on the principle that a relatively small increase in temperature can drastically reduce the cooking time. Steam under pressure and raised temperature is used for cooking food. Steam is trapped in the cooker and kept under pressure so that the temperature of water and steam is above 100°C, this reduces cooking time.

Therefore, there is an inverse relation between time and temperature.

Temperature is generally not raised above 120°C as pressure increases enormously and special pressure valves are required to control it.

Pressure cookers are an efficient gadget for cooking at high altitudes where the boiling point of water decreases and food is not cooked properly. But by using pressure cookers pressure is artificially increased and food cooks easily and quickly. Pressure cookers are made of heavy gauge aluminium or steel and have a pressure outlet which is capped by weights. Copper based pressure cookers are also available in the market. For safety reasons

a safety valve is fitted at all times to control and release pressure above safe levels. It is advisable to release air in steam form and then put the weights as air will interfere with proper heat transfer.

Advantages

1. Reduces cooking time.
2. Fuel efficiency is increased.
3. Constant monitoring is not necessary.
4. Nutrient loss is less.
5. The flavour and aroma of food are trapped inside the cooker and not lost.
6. Food is cooked properly and made tender.
7. One can identify the cooking process being completed by counting the number of whistles.
8. Food is normally not scorched or burnt.
9. A number of foods can be pressure-cooked at the same time.

Disadvantages

1. Long hours of pressure cooking make foods soggy and too soft.
2. Flavours of foods may mix and individuality be lost.
3. Accidents may happen if the equipment is not handled properly.

B. DRY HEAT METHODS

The medium of cooking is not water but either air or fat.

The methods of grilling/broiling, pan broiling/roasting and baking use air as the medium of cooking.

Shallow fat frying, deep fat frying and sautéing use fat as the cooking media.

1. Grilling

It is the process of browning foods by placing them above, below or in between red hot surfaces. A grill is the specific equipment used for grilling. Barbecuing is also a grilling method. Grilling can be done as such or with a coating of oil and spices.

The grilling of food can be done by three ways:

1. **Food placed below the hot surface:** This way the food cooks by radiation and so heat is slowly conducted to the inner surfaces of food. This method browns the food faster. Food is reversed for even cooking.
2. **Food placed above the hot surface:** This way food is cooked by convection currents and radiation energy. This is a more efficient method of grilling and food cooks faster.
3. **Food placed in between grills or hot surfaces:** This way there is no need for reversing the food as it is cooked on both sides by the hot surface. Efficient browning and cooking takes place giving rise to delicious food.

Advantages

1. The food is cooked with no or very little amount of fat.

2. Cooking is accomplished quickly.
3. The flavour of grilled food is improved.
4. The food becomes crisp and crunchy.

Disadvantages

1. A constant vigil is required to cook foods till the desired stage and prevent burning.
2. Often foods get charred and become unacceptable.
3. Grilling is mostly done for non-vegetarian cuisine, although lately lot of vegetarian dishes are grilled.

2. Toasting

Generally applied for bread slices which are browned from both sides by keeping them between two grills. This way they are browned from both sides evenly and become more crunchy. Toasters are based on the same principle where bread slices are placed between two heating elements.

3. Pan Broiling or Roasting

This is the process of cooking food by placing it in an uncovered pan and supplying heat to it. No or little fat can be used. Cashewnuts, groundnuts, almonds, pistachios, lotus seeds and sesame are cooked this way. Roasting imparts a crunchy taste to the food. Chapatis are also cooked this way.

Advantages

1. Improves colour, flavour and texture of food.
2. Roasted seeds are easy to grind.
3. Roasting reduces the amount of moisture of foods.
4. Roasting improves the keeping quality of food and prolongs the shelf life.
5. Roasting quickens the speed of cooking.

Disadvantages

1. A continuous vigil is required to prevent scorching and burning.
2. Amino acids are lost while roasting and when foods become brown.

4. Baking

The medium of cooking here is hot air. A dry method of cooking, it combines steam, which is generated while food is cooked. A characteristic feature of baked foods is a brown and crisp exterior and a soft and porous interior. Cakes, custards, baked vegetables, breads, biscuits, pizzas and au gratin are all baked foods.

Ovens are special instruments, which bring about baking of foods. The air inside the oven is heated by means of either electricity or gas. A tandoor heats air by way of fuel like coal or wood. The ovens are insulated to prevent the outside air from interfering with internal temperature and inside air escaping outside. This way, fluctuations within the oven are avoided.

The food is cooked by the following way:

$$\text{Sources of heat} \xrightarrow[\text{Convention}]{\text{Radiation}} \text{walls of oven base} \xrightarrow[\text{Convection}]{\text{Conduction}} \text{other}$$

$$\text{Walls of oven} \longrightarrow \text{heated air current} \longrightarrow \text{food}$$

Temperatures maintained in an oven depend upon the food to be cooked but normally 120°C to 260°C are advised.

Advantages

1. The texture and flavour of foods are improved.
2. Baking gives rise to a variety of combinations and dishes.
3. Foods can be baked in an oven in bulk.
4. Foods are cooked uniformly in an oven.

Disadvantages

1. An oven is required for baking.
2. Special skills are necessary for baking efficiently in an oven.
3. Over cooking results in burning and scorching of food.

FAT AS COOKING MEDIA

5. Sautéing

Onions, garlic and some dishes are cooked this way. Cooking in just enough oil to cover the base of the pan is sautéing. The base of the pan is greased with oil and food cooked in this oil. Food is rotated and tossed occasionally for uniform cooking. A lid is often put over the pan so that the steam generated cooks the food and becomes tender. The food cooked this way obtains a tender and moist feel. No external liquid or gravy is added. Conduction is the process by which heat is transferred to the food.

6. Shallow Fat Frying

The amount of fat used is more than that for sautéing and less than that for deep frying. Oil does not wholly cover the food but is supplied as and when required. Conduction and convection currents transfer heat to the food.

Tikki, kebabs, paranthas are cooked by this method.

Deep frying: Even here the medium of cooking is oil. The difference is that food is covered from all sides by hot oil. Food to be cooked is dropped in hot oil and immersed in it. The cooking by this method utilises less oil and is uniform. The temperature of oil used is 180 to 220°C and cooking is rapid. There is sudden and rapid drying out of the surface of food and this results in a crisp product. The surface browns in colour.

Generally, there is 10% oil absorption by the product. It may be more depending on how often oils are used and the type of oils used.

When oils reach their smoking point there is decomposition into fatty acids and glycerol. Thereafter glycerol decomposes to acrolein, this compound is responsible for the irritation in the eyes.

Advantages

1. There is improvement in the taste of the food.
2. The texture of food also improves and becomes appetizing.
3. There is an increase in the calorific value of foods.
4. Deep fat frying is the quickest method of cooking.
5. The amount of fat used can be controlled in shallow frying.

Disadvantages

1. Food may become soggy and mushy when excess oil is used.
2. The method is accident prone and requires constant attention.
3. Use of oil adds cost to the food and they become expensive.
4. Due to addition of oil it becomes difficult to digest these foods.
5. Repeated use of the same oil causes the development of harmful substances.

C. COMBINED METHOD

Braising

It is a combined method of cooking food. Here stewing and roasting are combined into a single operation. The utensil used is a pan with a tight fitting lid. Generally, meats are cooked this way, firstly meat is sealed on all sides by browning followed by placing on a lightly fried layer of root vegetables. Stock or gravy is then added covering 2/3rd of the meat portion. Spices and salt with flavour compounds are added for taste. Thereafter cooking is done.

The above-mentioned methods are used singly but often a combination of these methods are used to make a recipe.

Microwave cooking: A comparatively newer technology and cooking method, microwaves are fast gaining ground in many kitchens. The method of cooking by microwaves was first accepted in the late 1940s and is now a very much accepted form of cooking. The primary reason for its popularity is the speed at which it cooks food and the convenience factor.

The microwave ovens do not require any medium for cooking nor any medium for heat transfer. They are based on the principle of utilising microwaves as the energy source. Microwaves are generated by a magnetron and have the frequency of 2,450 million/per second.

Food is cooked by excitation of water molecules present in food by the incident microwaves, which are electromagnetic radiations. These waves pass through paper, bone china, glass and some plastics while metals reflect these. Therefore, metals are not used for microwave cooking. Utensils, which do not absorb or reflect microwaves are ideal for use in microwave ovens. The incident electrical energy by microwaves is converted to heat energy inside the food and water molecules are excited which cooks the food. There is uniform heating of food and microwaves penetrate food to a depth of 2.5 to 7.5 cm. Therefore, if larger depths of food are cooked, the greater depths of food cook by conduction, which follows cooking by radiation.

Advantages

1. Cooking becomes faster and saves a lot of time and botheration.
2. Fuel efficiency is maintained and there is no wastage of fuel.
3. Reheating of foods becomes very convenient and saves the trouble of washing obstinate dirt from utensils.
4. Loss of nutrients is reduced to the minimum.
5. There is no colour change in the foods and they appear as bright as fresh.
6. Defrosting of frozen meats and food products becomes very easy. Thawing becomes a piece of cake.
7. The oven does not heat up and so do the utensils. There is only heating and cooking of the food. This saves a lot of burning accidents.
8. There is no alteration in the texture and flavour of food.
9. Chances of scorching and burning are reduced.
10. Less of fat and oil are used.

Disadvantages

1. Skill and practice is required to operate the oven efficiently.
2. There is no browning of food and so it is difficult to make out whether food has been cooked or not.
3. Cooking time is so short that sometimes flavours do not blend properly.
4. Cakes and pastries do not brown on the surface and so do not have that appeal. Browning has to be done separately or done without it.
5. Bulky and deep foods are sometimes not cooked properly as some portions escape radiation and have to be cooked by slower conduction.
6. Deep fat frying cannot be accomplished in microwaves. One cannot make puris, kachoris, cutlets, etc.
7. Eggs cannot be boiled in the oven or any shelled products cooked in it.
8. There is burning of the taste buds since the liquids do not boil over and it is difficult to gauge how hot they may be.
9. An idea has to be made by trial and error as to when the foods cook. Sometimes they may be uncooked while at others they might get over cooked.